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LIBERTY NEWS

this issue

LIBERTY Newsletter

LIBERTY focusses on the areas of lifetime, increased range, battery safety and sustainability. The project aims to develop a battery pack that will have the same useful life as those of current combustion engines, i.e. up to 20 years or 300,000 km.

The LIBERTY project started in January 2021. This newsletter briefly presents the achievements and main results from the LIBERTY workpackages until now. Furthermore the conferences where LIBERTY project was presented are highlighted in the black box on the left side and news from the COLLABAT cluster as well as LIBERTY's open access publications and a project outlook can be found in this 4th Newsletter.

Enjoy reading!

Insight in LIBERTY's technical work

What we aim for:

LIBERTY's overall target is **substantially improving BEV battery performance, safety and lifetime from a lifecycle and sustainability point of view.**

The **key objectives** of LIBERTY are:

- **Objective 1: To achieve a range of 500 km on a fully charged battery pack;**
- **Objective 2: To achieve a short charging time below 20 minutes;**
- **Objective 3: To achieve an ultimately safe battery system;**
- **Objective 4: To achieve a long battery lifetime of 300.000 km;**
- **Objective 5: To achieve sustainability over the battery pack's entire life cycle, reducing its environmental impact by 20 %.**

LIBERTY project develops a complete battery back starting from current innovations at TRL (Technology Readiness Level) 4. The final result of LIBERTY will be a TRL 7 battery system (demonstrator in operational environment).

Please find below a description of the excellent work done in the workpackages to reach these objectives.

Presenting LIBERTY - Maybe you have met us @

LIBERTY project presented @eMobility Expo World Congress

21-23 March 2023, Valencia, Spain

Yolanda Bravo Rodríguez, (Valeo), presented the innovations from Valeo at the eMobility Expo World Congress, **in the area of improving the performance, safety and lifetime of BEV batteries from a lifecycle and sustainability perspective.**

A focus was on the innovations from Valeo: the Battery Thermal Management System and Battery casing. Some impressions of the well-attended session can be found on the picture below.

Maybe you have met us @

COLLABAT cluster presented @TRA 2024

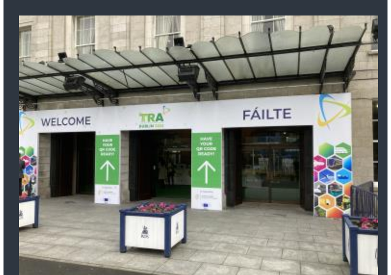
15-18 April 2024, Dublin, Ireland

LIBERTY coordinator Eduardo Miguel (Ikerlan) represented LIBERTY in the COLLABAT Cluster booth at the Transport Research Arena (TRA).

In the special Session **"Joining Forces to Support Uptake of Sustainable Green Mobility",** an overview on how COLLABAT Cluster research projects support to overcome some of the challenges associated with the future of the electric vehicles.

Short presentations by Tomas Jezdinsky, Corneliu Barbu, Rafael M. Afonso and Eduardo Miguel highlighted innovative solutions that will contribute to make the uptake of green e-mobility happen in the EU.

The event was introduced by Edel Sheridan from (BEPA - Batteries European Partnership Association), providing an invaluable insight into European battery value chains.



LIBERTY Consortium Meeting, July 2024, FM premises in Lommel, Belgium

FM in Lommel hosted the LIBERTY consortium meeting and its General Assembly after 3,5-year project runtime, with a lot of interesting points and a lab tour on the agenda.

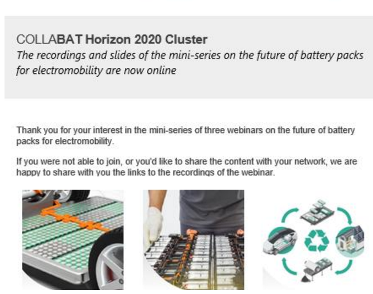
COLLABAT Cluster

EU funded -– ALBATROSS, HELIOS, LIBERTY, MARBEL - H2020 Battery projects join forces towards sustainable future battery packs

COLLABAT showed results to the public in webinars and other dissemination major events like Transport and Research Arena (TRA), Road Transport Research (RTR), and the Battery 2030+ Annual Conference.

In addition, COLLABAT Cluster is preparing a public event to demostrate the projects results in Barcelona (Spain) on November 27.

Find out about the highlights from the subclusters in the recoridngs from the sublicster webinars:


COLLABAT Horizon 2020 Cluster

The recordings and slides of the mini-series on the future of battery packs for electromobility are now online

Thank you for your interest in the mini-series of three webinars on the future of battery packs for electromobility.

If you were not able to join, or you'd like to share the content with your network, we are happy to share with you the links to the recordings of the webinar.

Access recordings and slides

- Battery Management Systems (BMS): New Developments for Next-Gen EV Batteries
- Methodologies for testing and validation of Electric Vehicles' batteries
- The Priceless Value of LCA in the Circular Economy and its Influence in the Battery Industry

We hope you enjoy watching the recordings. If you have any questions or feedback, please do not hesitate to contact us.

Highlights from the WPs

Progress towards objectives

- Reduce 20% battery weight while still meeting sound crashworthiness requirements and an optimal TCO (Achieved)
- Allow fast charging up to 350kW considering the battery system voltage level increase from 400 to 800V (Achieved)
- Includes safety solutions to guarantee high insulation while limiting the potential thermal runaway (Achieved)
- Allow for optimal cell cycle life. (on track. Tests are ongoing in WP6)

Highlights / Main results

- MS3 achieved: Conceptual design of battery system and overview of technical progress.
- MS4 achieved: Draft battery system design I.
- MS5 achieved: Draft battery system design II.
- MS6 achieved: Final battery design.

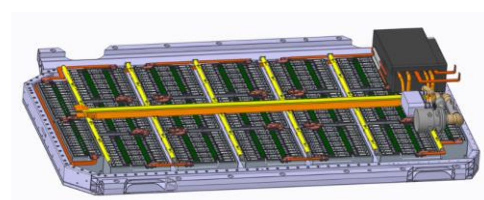


Figure 1: Battery system including electrical and thermal subassemblies

Battery system hardware component development (VAL)

The main output of WP3 is the production of the hardware to be assembled in the battery pack. Previous work had been already finished to guarantee functional specifications fulfilment and integration. Thus enabling to meet project requirements.

Summary of status and achievements

During the first semester of 2024, the remaining components have been manufactured and sent for assembling, maintaining a close cooperation with the work carried out in WP6.

Highlights / Main results

- Final settlement of battery main switch integration. Assistance for installation and connection (Infineon and Fraunhofer).

Figure 2: Semiconductor based battery main switch coompared to replaced component

- Delivery of all the set of components for battery thermal management and cooling loop (pump, chiller, filter and valve). In parallel, validation activities have been done to ensure function and safety functions (flow for TR conditions). The suctions at the bottom of the battery pack have been validated. All parts have been succesfully installed.

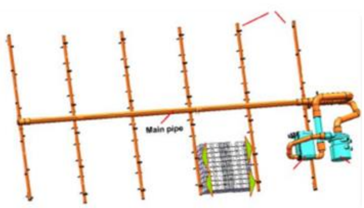


Figure 3: Image of cooling ducts integration in the battery pack.

Figure 4: Image of fluid sprayed over battery cells.

Battery management system and state estimator development (FHG)

Summary of status and achievements

In 2024, the successful integration of the developed Battery Management System (BMS) with all associated components into the battery system was completed. The system integration incorporates two main hardware system parts: i) the control system (Battery-Junction-Box (BJB) including the BMS-Master) and ii) the monitoring system on cell level (BMS-Slave).

After successfully integrating the BMS hardware and software into the battery system, the flawless BMS operation was evaluated and demonstrated on system level. As a key requirement for safety and lifetime, the BMS communication and data acquisition of all related system components could be approved, including: BMS-Master, BMS-Slave units, insulation measurement, novel semiconductor switch, main contactors, current sensor, vehicle-CAN, and the cloud connectivity through an edge-device.

As the successful BMS functionality is crucial for all upcoming performance tests, the validation of all subsystems is mandatory. In Figure 5, the finalized BJB of the battery system including the integrated BMS-Master is depicted.

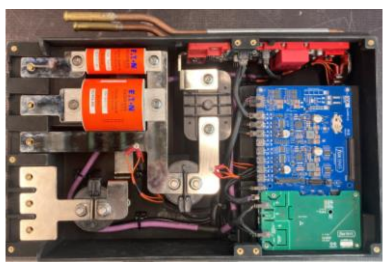


Figure 5: Picture of the finalized BJB

Highlights / Main results

The assembly and system integration of the BMS was finalized and available for performance testing. The functionality and communication on system level was successfully tested. Furthermore, the SOC, SOH and SOS algorithm are developed and tested.

Crash simulation of the LIBERTY Pack and the worst case scenario (VIF)

Summary of status and achievements

For the Simulation of worst case scenario, the load case that was chosen is the Side Pole Euro NCAP Test. In Euro NCAP's test, a car (in our case the battery pack) is propelled sideways at 32 km/h against a rigid, narrow pole (diameter 253 mm). The Battery Pack will also be propelled at a 75° angle (Figure 6).

Load case	Seed of the impact	Angle of the impact	Position of the pole
1st case	32 km/h	75°	Center

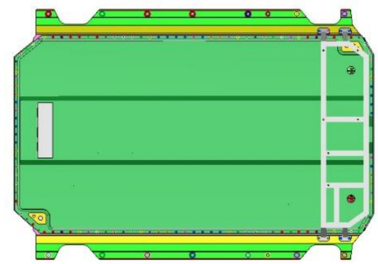


Figure 6: Schematic representation

This sort of simulation will represent the deformation that was done on the singe cell level illustrated on Figure 7.

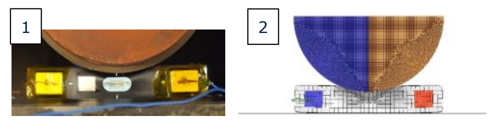


Figure 7: Cell level test

As the loading on the Battery Pack is so localised, deformation can be very high, and the pole can penetrate deeply into the structure. This was the reason for choosing this load case as the worst case scenario. The results of this simulation gave a crash force output as well as an energy level output that was used to better understand the weak points of the structure and to determine the location of highest risk of short circuit.

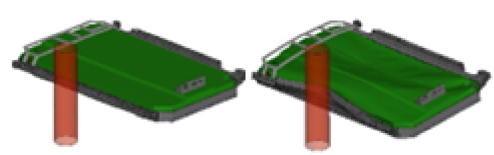


Figure 8: Outer deformation

The left part is representing the start position while the right side is representing the end position.

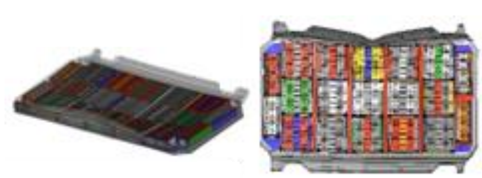


Figure 9: Inner deformation

As stated, the deformation is mostly concentrated on the rib section of the structure, while some deformation is also present at the cell level.

Two more simulations were performed, the Front Side Barrier (Figure 10) and the Side Barrier test (Figure 11), both input data was used form EuroNCAP. This was done to simulate an impact from a different direction (front case) and to extend the area of impact (side case). In both cases the deformation was only present on the outer structure of the assembly and no major deformation was present on battery cells in comparison to the Side Pole test.

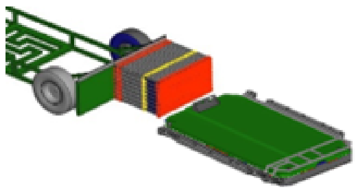


Figure 10: Front barrier impact

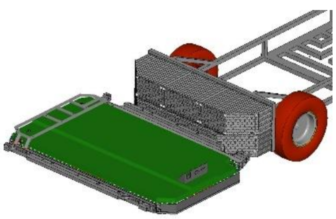


Figure 11: Side barrier impact

Integration, testing and concept validation on cell, cell stack, battery system and EV level (FM)

Summary of status and achievements

Work is performed on following tasks:

- Battery system assembly and functional system testing;
- Ageing, performance and safety testing on cell and cell-stack level;
- Performance and safety testing on battery system level.

Last month, the battery pack was succesfully assembled using the assembly procedure that is developed within the LIBERTY project. The assembly is done in collaboration with all the technical partners. After the assembly the functional tests are succesfully performed to ensure that all functions of the battery pack are working as expected and that the battery pack can safely be tested and validated on the testbench.

Figure 12: Assembled LIBERTY battery pack

With respect to testing activities, the accelerated lifetime tests at cell level are continued. The obtained results are very good and exceeding the project objectives for both performance and lifetime (a lifetime target of 300.000 km is defined in the LIBERTY project). Performance tests at cell-stack level are executed to validate the performance of the thermal management system during fast-charging conditions. Additional safety testing is performed by thermal runaway tests at cell-stack level.

In the upcoming months the battery pack will be tested and validated on the testbench. The validation tests consist of the execution of load profiles (simulating acceleration and regenerative braking events) and drive cycles such as the WLTP. Finally, fast-charging tests will be performed to validate the project objectives, namely a charging power of 350 kW leading to a charging time from 10-80 % SoC of less then 18 minutes. At the same time, a simulation environment is developed to model the safety performance of the battery pack.

Figure 13: Testbench to validate the battery pack

Highlights / Main results

- The battery pack is succesfully assembled and the functional tests are succesfully performed.
- The ageing tests at cell level show very good results that exceed the project objectives for both performance and lifetime .
- The thermal management system is validated by fast-charging tests at cell-stack level.
- In the upcoming months the battery pack will be tested and validated on a testbench.

Overall techno-economic assessment, recycling and LCA (ACC)

Summary of status and achievements

ACC is evaluating the sustainability of the components by identifying the most efficient and environmental downstream process for each components used in the LIBERTY battery pack. The re-use and recycling are optimized to achieve better separation within a semi-automated dismantling. The process for the recovery of lithium is also a target studied.

Highlights / Main results

As for the development of procedures for battery system dismantling and recycling, assessment of reuse, following main results are achieved:

- Semi-automatic dismantling is investigated
- Recovery of lithium with high purity was achieved.“

LIBERTY outlook

- LIBERTY webinar powered by CLEPA on November 13.
- COLLABAT final event at the Battery Innovation Days in Barcelona / Spain on November 27.
- **LIBERTY FINAL EVENT** hosted by Mercedes in Stuttgart / Germany on December 6.

Stay tuned!

How to find out more about LIBERTY project:

The project is evolving quickly. Stay tuned for upcoming news, events, and publications.

Visist us on our website

Follow us on Linkedin

COLLABAT LinkedIn page

LIBERTY Leaflet

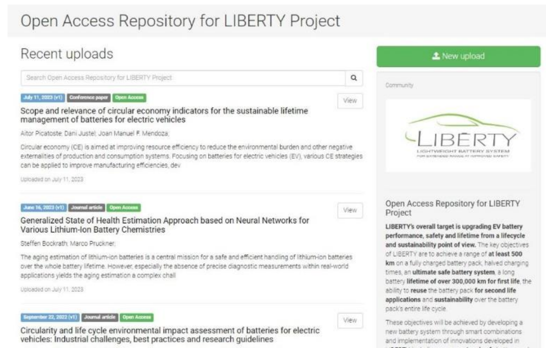
LIBERTY Poster

Articles about LIBERTY published online

LIBERTY publications

LIBERTY presentation

LIBERTY Open Access Repository on Zenodo



LIBERTY project supports the concept of **FAIR** (**F**indability, **A**ccessibility, **I**nteroperability, and **R**euse) data works toward making research data FAIR.

Peer-reviewed publications of LIBERTY project will be open access as soon as the research/publication has been completed and published.

Looking for something to read for the weekend? Interested in specialist literature on batteries for electric vehicles? Then we have the right thing! All publications that have been published within the framework of LIBERTY are **publicly available on our** website and on our Zenodo repository. Enjoy reading!

PROJECT FACTS

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Start: 01 January 2021

Duration: 48 Months

Total investment: 10.8 M€

Participating organisations: 16

Number of countries: 7

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