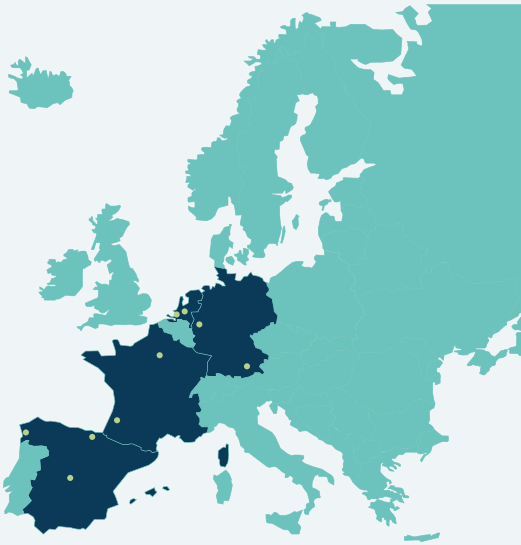
Alma

Advanced Light Materials and Processes for the Eco-Design of Electric Vehicles

Consortium partners:

The ALMA consortium involves a diverse group of 9 partners from 4 different EU countries: France, Germany, the Netherlands and Spain.



ALMA is an EU Commission funded project with a global ambition.

This project has received funding from the EU H2020 funding program for innovation under Grant Agreement No. 101006675

Project Details:

Start date: 1 February 2021
Duration: 3 years
EU contribution: EUR 4.3M

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Project Coordination:

The project is coordinated by **CTAG** – Automotive Technology Centre of Galicia.
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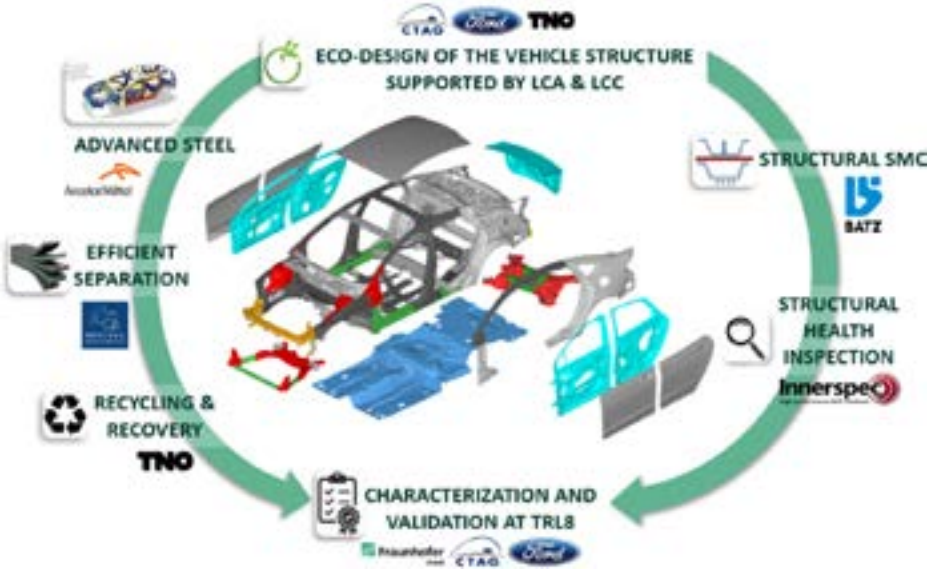
Redesigning the future of e-mobility through new, sustainable & innovative solutions.

Main Results



The body-in-white (BiW) of ALMA's concept car is **160 kg lighter**, representing a **22% weight reduction** compared to the baseline BEV BiW. Over the car's entire service life, the use of other materials and weight reduction contributes to a total reduction of **1850 kg CO2-eq**, a **24% decrease** in emissions.

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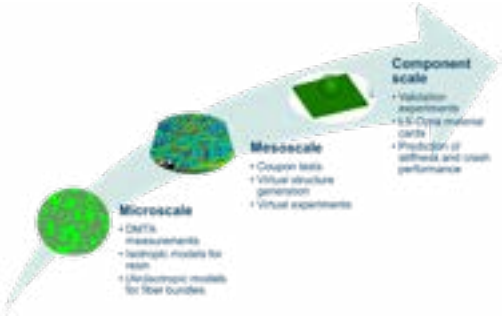
Eco-Design approach with LCA and LCC

We applied an eco-design and circular approach throughout the entire life cycle to create a multimaterial BEV structure, optimising material selection and production processes for efficiency and environmental sustainability. This approach helped achieve a **22% weight reduction** from the baseline BEV BiW, meeting crash requirements, based on CAE analysis. Ford and CTAG validated the innovative BEV structure in multiple crash scenarios, affirming the holistic circular engineering approach in real-world conditions.

TNO's BEVSIM tool evaluated environmental impacts of materials at each stage, allowing us to make informed decisions regarding the "right material for right application" to minimise the environmental footprint while maintaining cost-effectiveness and manufacturability. Among the selection of materials chosen to be designed by either SMC or steel, BEVSIM suggested using SMC for the cowl panel as a drastic reduction of reference was possible, with a huge lightweighting potential. The steel option not only keeps the number of references, but it also has higher CO2 eq. BEVSIM evaluated the comparison of trade-offs between materials that may offer greater sustainability during use phase but pose environmental costs during production and end-of-life phases.

Innovative Materials

Efficient manufacturing processes resulted in fewer references, and ArcelorMittal's integration of high-performance steel grades in steel components contributed to substantial reductions in material usage, thinner profiles, and corresponding vehicle weight savings. ArcelorMittal proposed the Multi-Part Integration concept (MPI) using Laser Welded Blanks (LWB) technology, consolidating around 10 parts into a single, large component through a single stamping operation. Validated concepts include the H-Frame and the Door Ring.
In addition, ArcelorMittal also finetuned advanced steel materials, such as FortiformS1270 (AHHS), Duplex (steel with reduced density) and Ultimate (a sandwich of steel/plastic/steel laminate material) for weight reduction and comparable crash performance.



Fraunhofer ITWM demonstrated that their simulation methods make it possible to experiment with many material models, minimising the need for experimental calibration, thereby saving precious time and resources.
In collaboration with Ford, BATZ and CTAG, Fraunhofer demonstrated that the SMC components, developed by BATZ, meet crash safety requirements, significantly reducing vehicle weight.

BATZ conducted a thorough analysis of the vehicle structure to optimise components and systems, prioritising lightweighting using SMC composites. Key achievements include the Battery Lid, addressing crash protection for the battery, and the Cowl Panel, made of advanced SMC-Tex material ensuring structural integrity during frontal crashes—a global novelty for this vehicle type.

Circularity

RESCOLL's innovative reversible assembly method, utilising debondable adhesives and primers like INDAR, has successfully demonstrated bonding and debonding on the composite part of the battery tray through a robotized program. In case of a faulty battery, debonding could also be used for reparation procedure to ensure the SMC cover can be reused with a new battery tray. This achievement ensures cost-effective and efficient separation at end-of-life, promoting a circular economy in the automotive industry.

Innerspec's structural monitoring system, using acoustic signature analysis, is able to assess wear and potential damages like delaminations and porosity in composites. For steel parts, it can detect cracks and residual stress. While results are promising, the ultimate applicability of an embedded car structural health monitoring system is yet to be fully explored.

ArcelorMittal successfully demonstrated the recyclability of Fortiform S1270 through recycling trials. Additionally, the trials confirmed that Ultimate (laminate) steel sheet does not release plastic fragments during shredding. This reduces the risk of increased waste in shredded vehicle parts reaching landfills.
On the other hand, TNO demonstrated the recycling and recovery of composite materials through pyrolysis and solvolysis processes. The quality of recovered materials showed good potential for re-use, either in new materials or, as in the case of pyrolysis, to fuel the process

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