AZL Aachen GmbH
Excellence in Lightweight Production

In cooperation with:

Aachen Center for Integrative Lightweight Production | RWTH AACHEN UNIVERSITY

AZL Joint Partner Cost Sharing Project:
Concept Study & Development of Cell-to-Pack Battery Casings

Background Information

Background Information

Previous AZL study on Battery pack designs

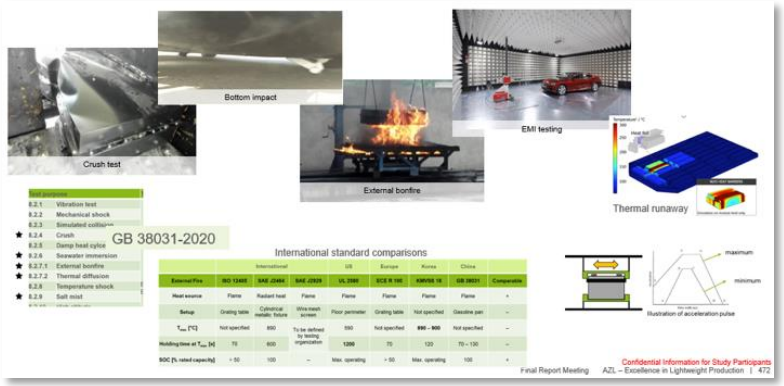
Summary points previous AZL consortium study:

- 44 reference designs and concepts analysed. Today mostly metal, fastest solution for OEM, but also relatively heavy.
- 20 different multi-material pack structure designs made by AZL. Yielded 5 patents. Fully CAE analysed and optimised to all relevant load cases.
- Many composite dominant design concepts are up to 20% cheaper and up to 36% lighter than the reference aluminium design.

46 partners in the consortium

44 Reference parts and concepts analysed

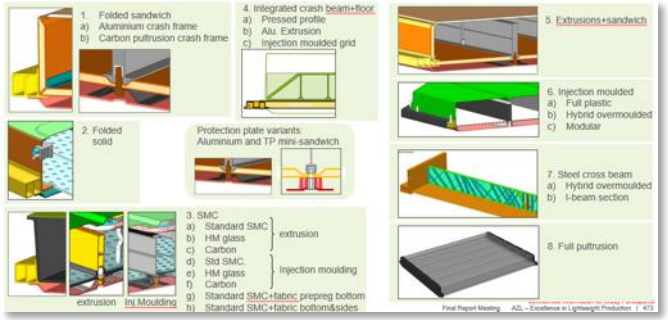
Overview and analysis of all relevant international standards and requirements



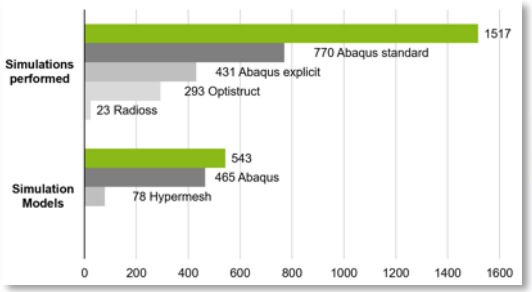
Background Information

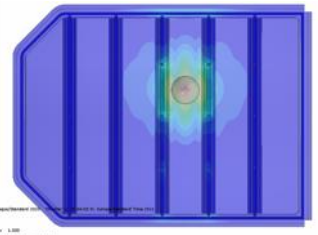
Previous AZL study on Battery pack designs

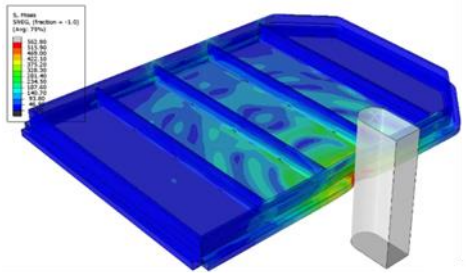
Development of 20 Design concepts

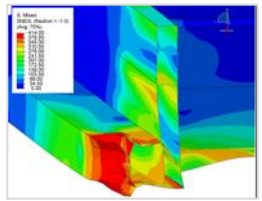


1516 CAE simulations, 543 FEM models



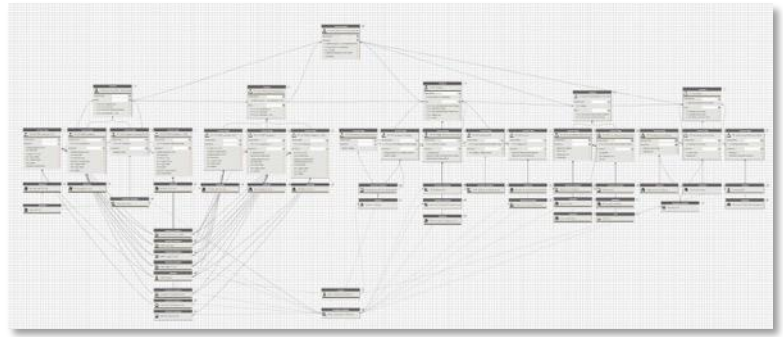






Production layout and cost analysis

- Detailed material, process and assembly analysis by AZL
- Verified with multiple sources
- Process chain modelling and cost calculations



➔ Result

- High potential for cost saving and weight saving by various multi-material solutions incorporating composites in comparison with Aluminium solutions
- Comparison of weight and costs at equal performance and safety level

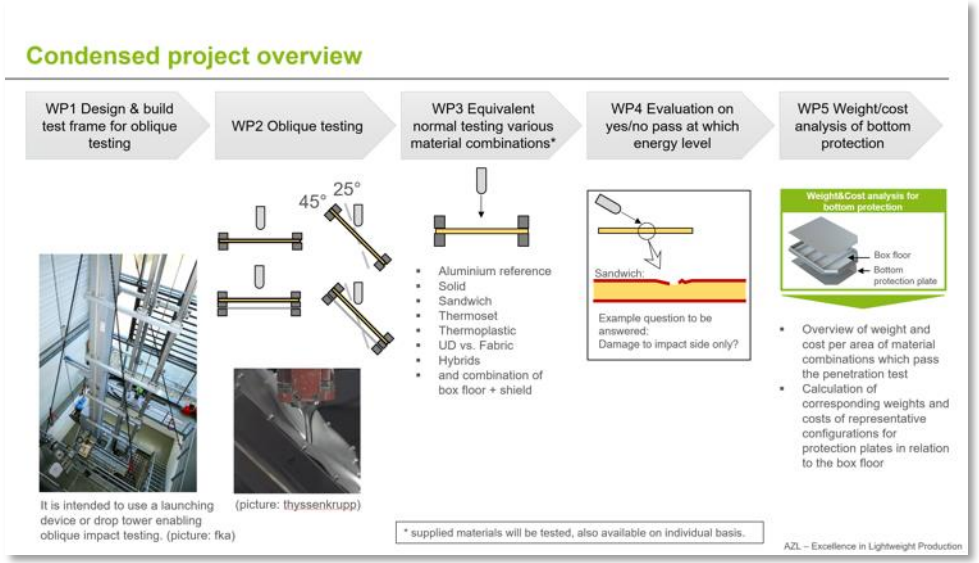
Background Information: Follow-up projects running now

Bottom Impact Protection and Fire Protection

Impact Protection

Application relevant test method and investigation of relative safety performance of different material options for bottom impact protection of battery casings

- Setup of test procedure and test bench
- Test of 20 samples
- Impact on performance, weight and costs

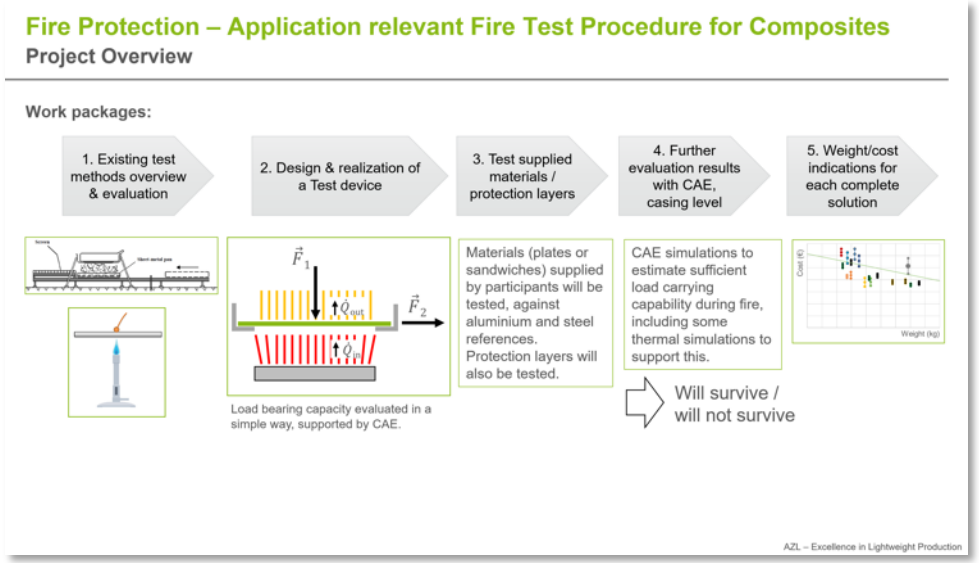


13 partners in the consortium

Fire Protection

Application relevant Fire Test Procedure for Composites

- Setup of test procedure and test bench
- Test of 50 samples
- Impact on performance, weight and costs



24 partners in the consortium

Content of the Project

New Project Consortium | 33 Participating Companies

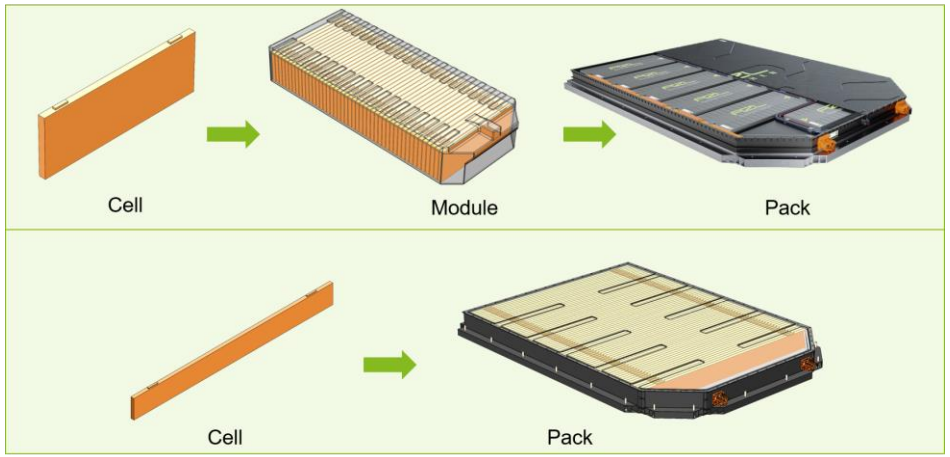
„Cell-to-Pack Battery Casings“ – Concept & Development Study

Concept Study & Development of Cell-to-Pack Battery Casings

What & Why for Cell-to-Pack

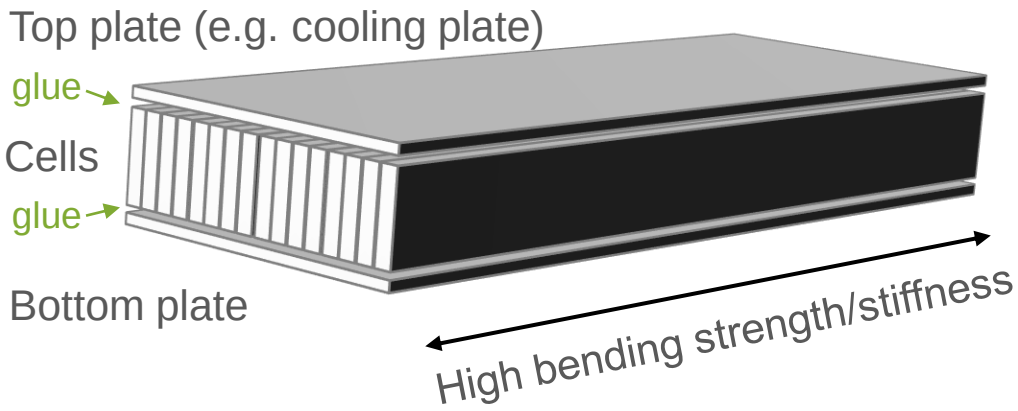
Currently the use of battery modules in a casing structure is the most common form of a battery pack. See below example of an AZL developed multi-material battery box structure, accommodating 11 battery modules.

Cell-to-Pack is seen by many as a future development:
Skip the module, and directly mount cells into the battery box structure



Previous AZL research on battery packs showed:

- Trend to higher range promotes higher volumetric energy density. → Cell-to-Pack
- Module deletion yields cost saving, less components
- Slightly reduced battery pack height
- Interviews with OEMs confirm the wish to change to cell to pack design in future
- One step further: structural cell-to-pack (with blade cells):



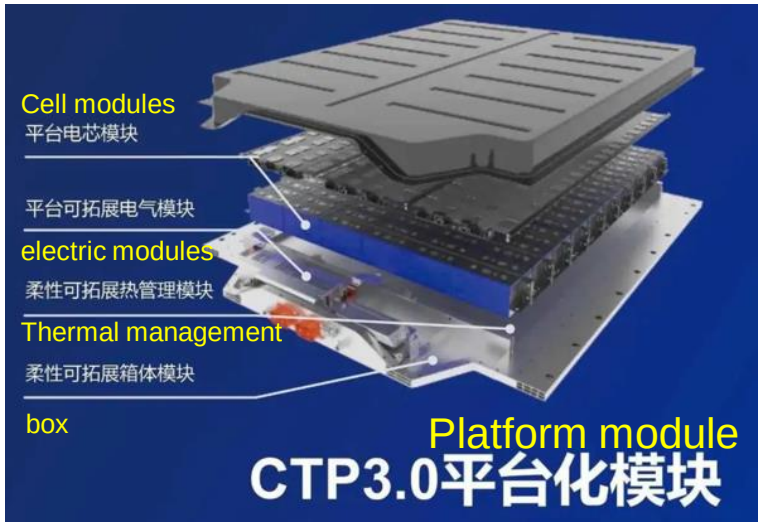
Concept Study & Development of Cell-to-Pack Battery Casings

Cell-to-Pack examples

BYD blade cells, LFP type

BYD Han battery pack

CATL Cell to pack concept, prismatic cells, both LFP and NCM



Telsa model Y, Cylindrical cells

Although marketed as Cell-to-BIW, it could be regarded as Cell-to-Pack, with an integrated passenger compartment floor structure.

Cell-to-Pack state of the art:

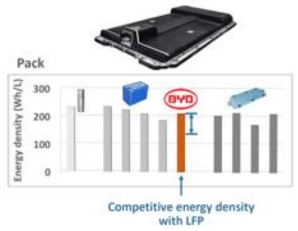
Lots of developments going on, but little is published.

Challenges Cell-to-Pack:

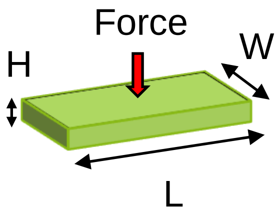
- Sensitivity to bottom impact damage
- Repairability
- Fire protection in case of high energy density, needs suitable design concepts, supported by mechanical analysis

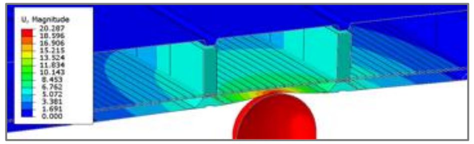
Concept Study & Development of Cell-to-Pack Battery Casings

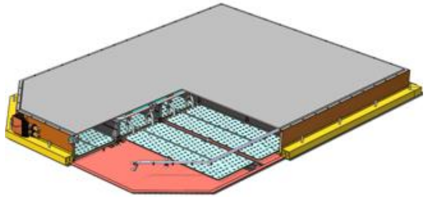
Project Procedure & Scope of Work

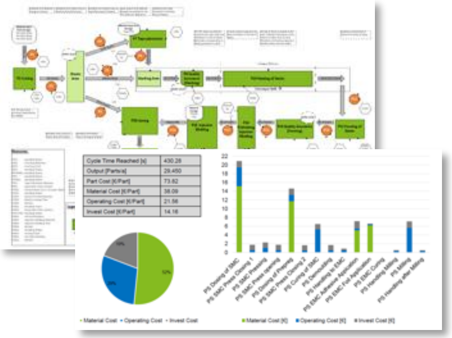


Norm	Type of norm
ISO 12405	ISO
ISO 6469	ISO
IEC 62660	IEC
IEC 60086	IEC
IEC 62281	IEC
UN ECE R100/2	UN ECE
UN ECE R136	UN ECE
UN 38.3	UN
SAE J2464	SAE
SAE J2929	SAE
SAE J2380	SAE
Sand 3123	Andere
UL 2580	UL
UL 2271	UL
GB/T 36276	GB/T
GB/T 34570	GB/T









WP1

Screening of Market and Technology Developments

Questions:
- Which are the major players?
- What is in development today?
- Latest update on requirements
- Benefits and challenges with respect to pack requirements?

Result: Overview on developments, benefits and challenges for cell-to-pack.

WP2

Update on reference Specification Sheet

Results
- An existing AZL aluminium reference enclosure will be updated for the purpose of studying cell-to-pack.
- Requirements will be updated where relevant.

WP3

Listing of concepts

Sketch design & dimensioning of multiple alternative concepts

Results
- Overview of potential materials and production technologies (metal, plastic and composites)
- Simplified design & (CAE) analysis models for multiple selected concepts, allowing dimensioning against the relevant load cases.

WP4

CAD visualization

Results
- CAD models of selected concepts

WP5

Process Chain Definition & Business Case Analysis

Results
- Weight, Cost and CO_2 analysis (cradle to gate) for multiple concepts
- Analysis of other KPIs, e.g volume utilization
- Benchmarking against cell-to-module-to-pack reference.

Concept Study & Development of Cell-to-Pack Battery Casings

Estimated Time-Planning

OPEN to JOIN!

Duration 10 months

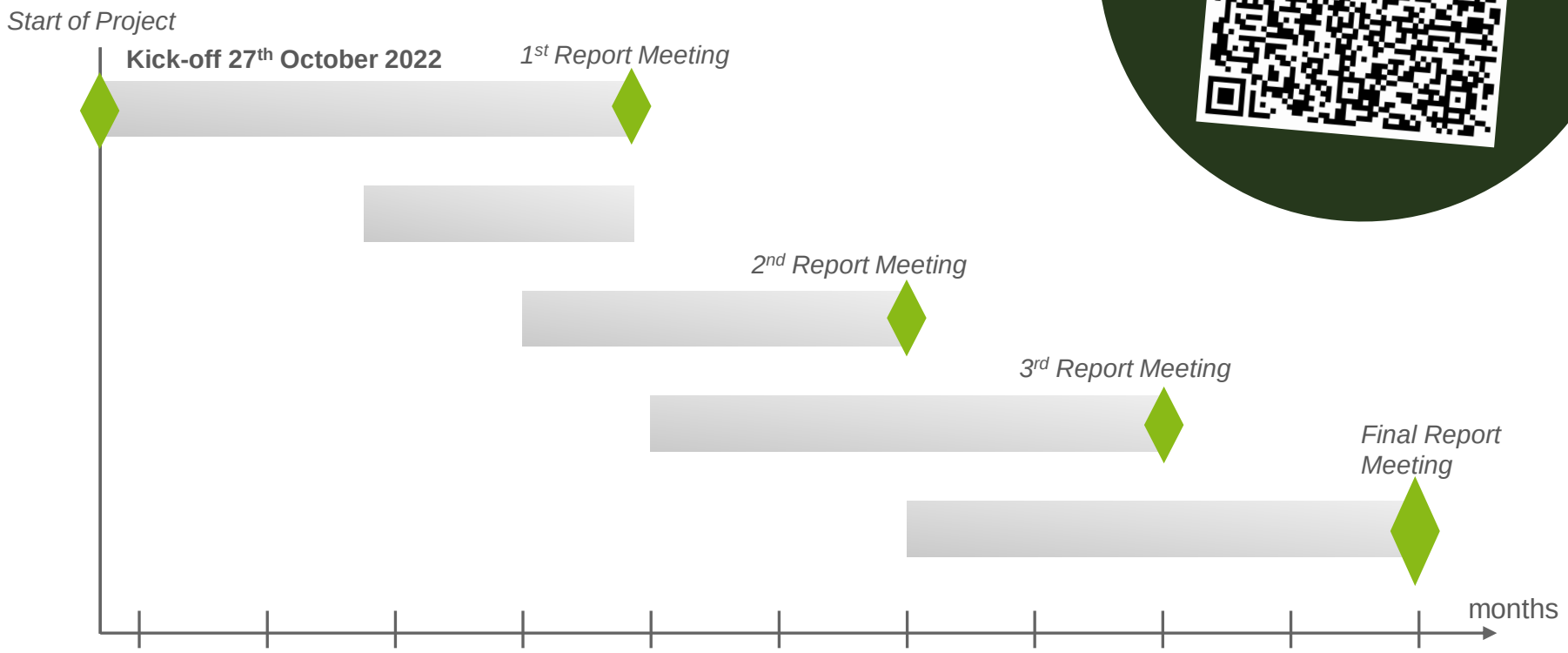
WP1:
Screening of Market and Technology Developments

WP2:
Update on reference specification sheet

WP3:
Listing of concepts | Sketch design & dimensioning of multiple alternative concepts

WP4:
CAD visualization

WP5:
Process Chain Definition & Business Case Analysis



Your Contacts

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