Partial immersion cooling solution for lithium-ion battery thermal management

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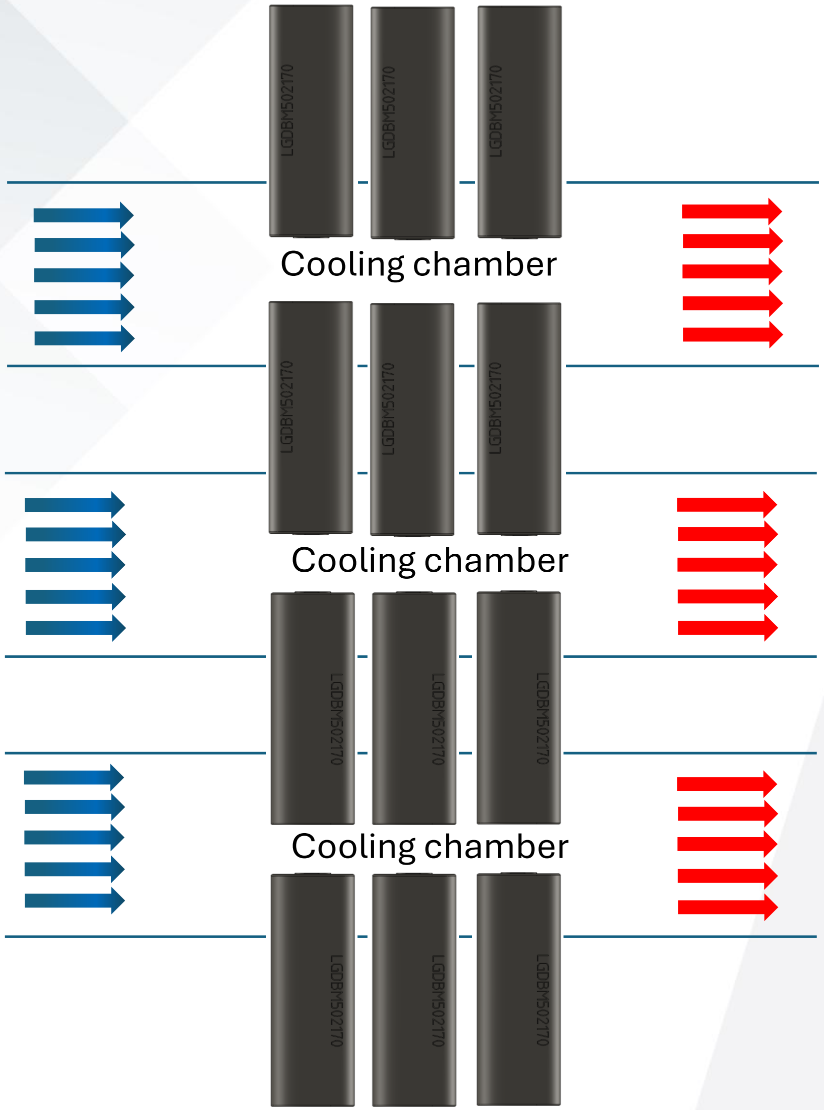
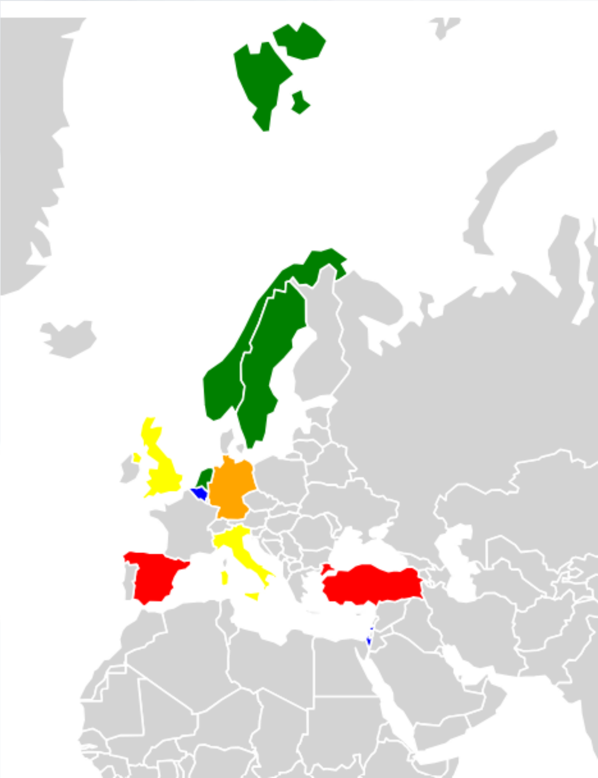


Introduction

Advanced Light-weight Battery systems Optimized for fast charging, Safety, and Second-life applications



- 25% charging time reduction down to 30 minutes (40 minutes currently, 20-80%) using 150kW charger
- Peak Energy Density of >200Wh/kg for i3, an improvement of 50% against the current 152Wh/kg
- 20% weight reduction of the battery system equating to 56kg weight reduction for i3 battery system to 222kg (currently 278kg)

ALBATROSS

Thermal management challenges

Figure 1 BMW i3 electric car [1]

Figure 2 Cylindrical lithium battery module [2]

Figure 3 Cylindrical battery cell [3]

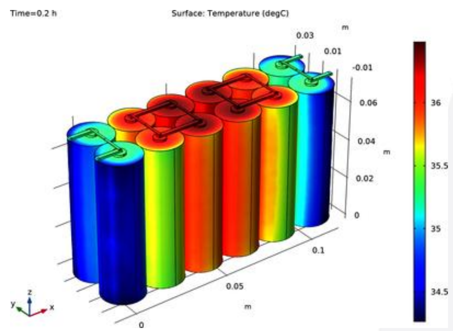


Figure 4 Thermal distribution of battery [4]

Limitation:
1. Range
2. Charge time

Solution:
1. Increase cells
2. Increase charge current

Problem:
Heating

[1] https://www.sgcarmart.com/articles/news/updated-bmw-i3-gets-new-battery-for-extra-range-21699
[2] https://accupowerus.com/service/cylindrical-lfp-module/
[3] https://battery101.co.uk/products/samsung-50e-21700-lithium-ion-battery
[4] https://www.comsol.com/model/thermal-distribution-in-a-pack-of-cylindrical-batteries-76291

Immersion cooling

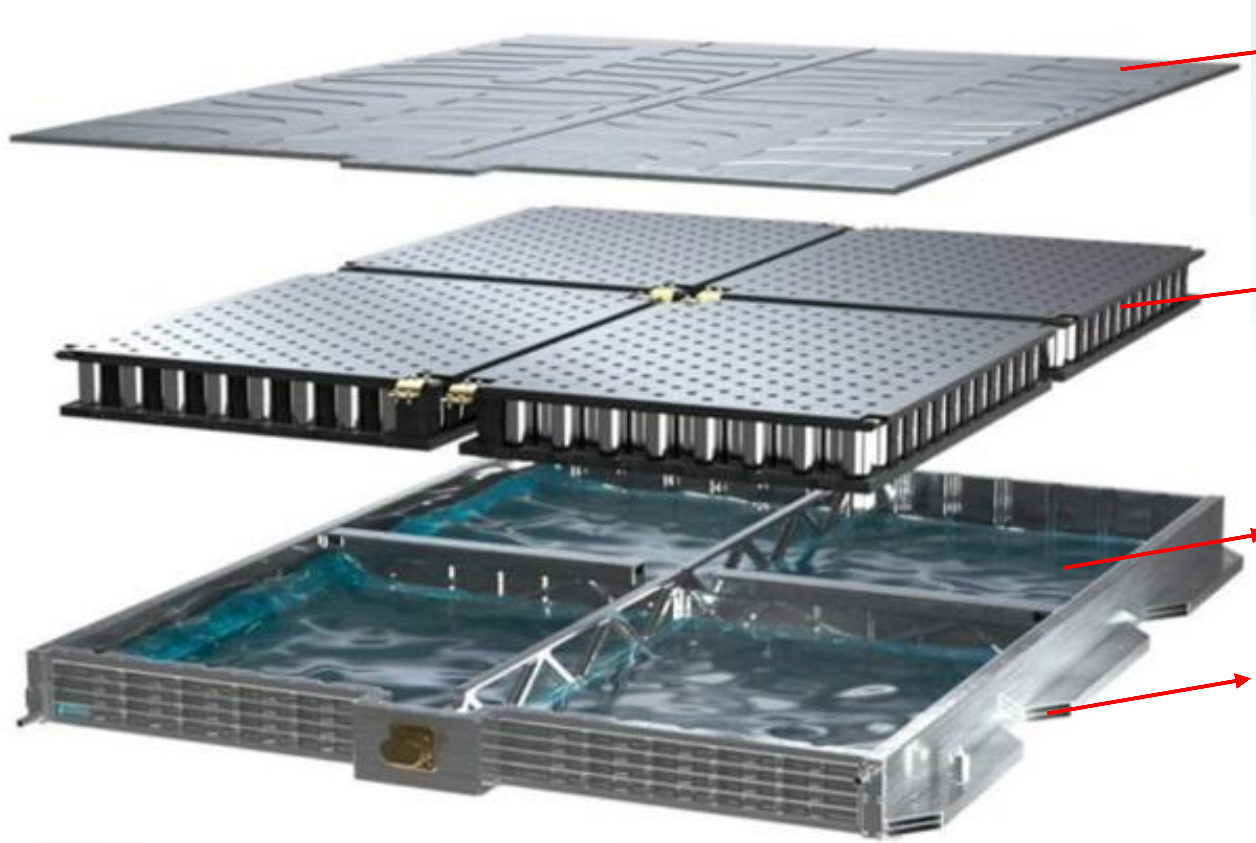


Figure 7 Battery pack with immersion cooling [5]

Advantages of immersion cooling

1. High cooling efficiency
2. Lower charge time

Main challenge

Increased Weight and space

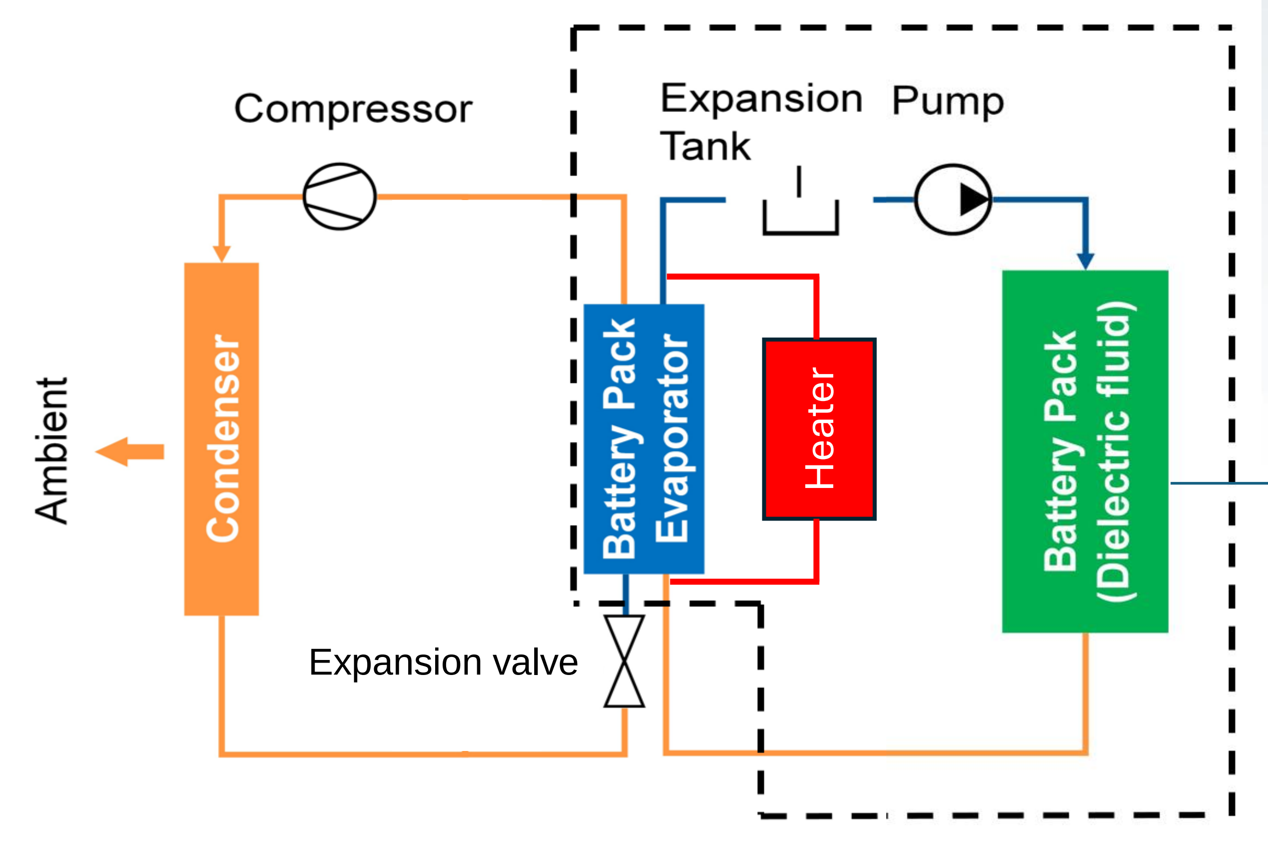
Using partial immersion cooling to reduce the weight

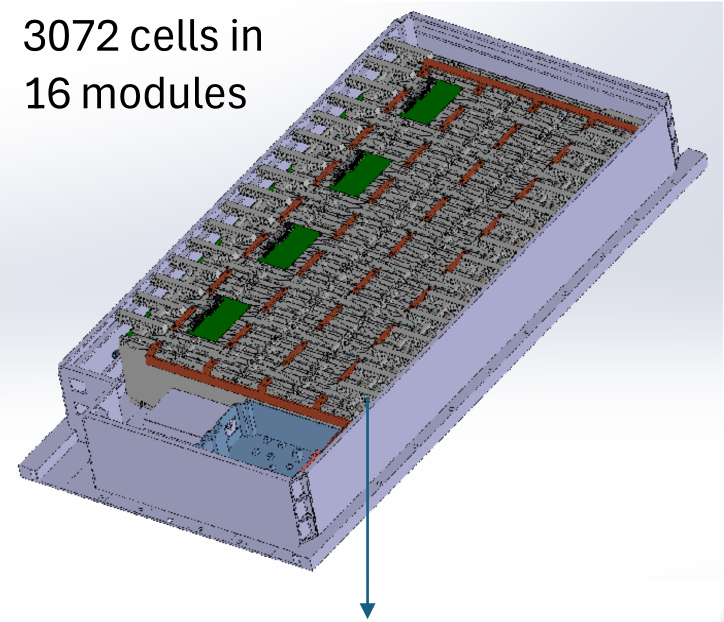
[5] https://www.aftermarketnews.com/xing-mobility-debuts-immersion-cooling-battery-ces/

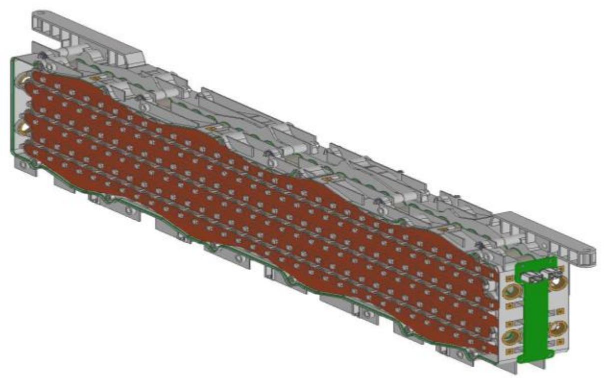
Objectives in Albatross project

Specification	Before ALBATROSS	After ALBATROSS	Improvements
Cell Energy Density	174 Wh/kg	250 Wh/kg	43% increase in energy density for bette performance and energy storage.
Battery Weight	278 kg	222 kg	20% weight reduction improves vehicle efficiency and driving range.
Total Battery Capacity	42.2 kWh	55 kWh	30% increase in capacity extends driving range.
Charging Time (20%-80%)	40 min	30 min	25% reduction in charging time for faster turnarounds.
Driving Range	285-310 km	Up to 480 km	Up to 60% increase in driving range improves practicality and efficiency.
Sustainability	Not emphasized	Designed for dismantling and recyclable materials	Eco-friendly design with 15-20% lifecycle improvement.

Methodology



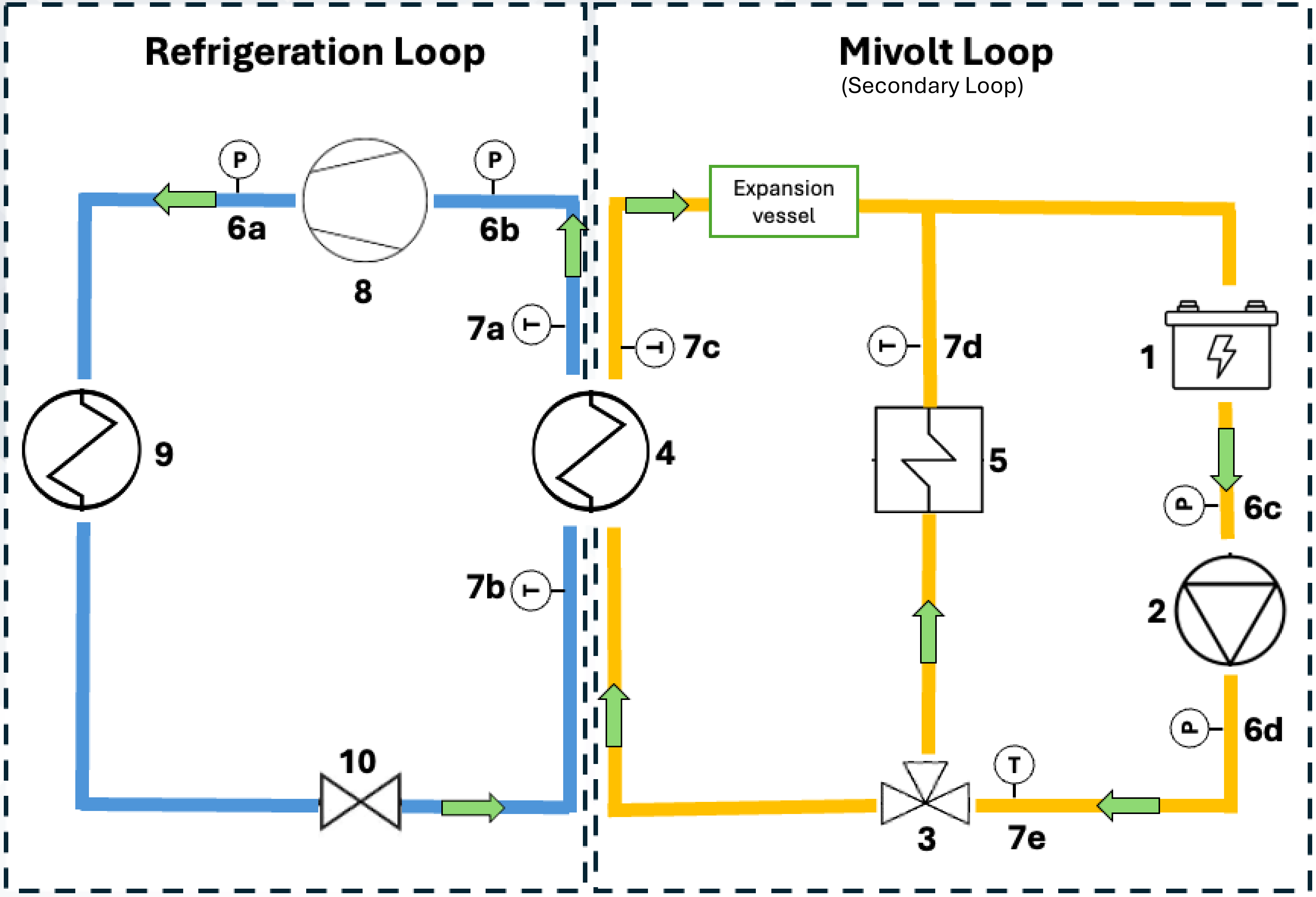




MIVOLT DF7 PROPERTIES

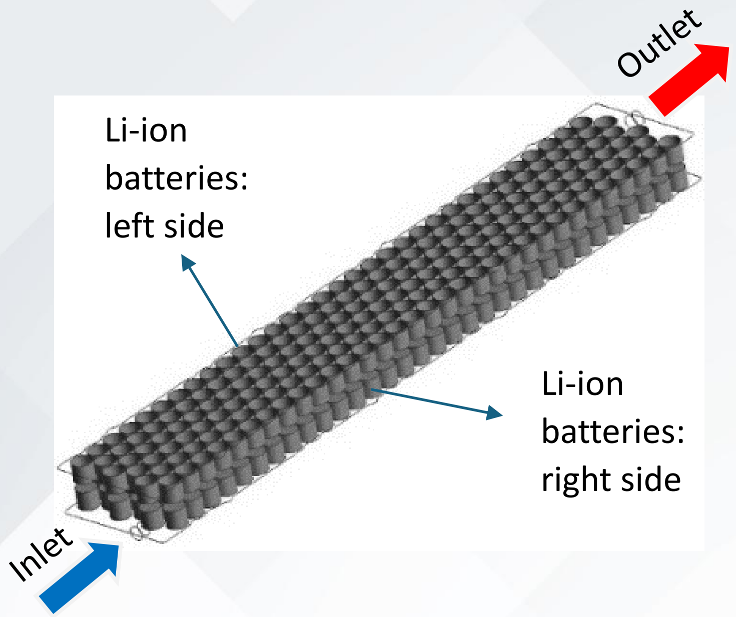
Thermal Properties	Units	MIVOLT DF7
Density at 20°C	kg/m³	916
Specific Heat at 20°C	J/kg-K	1907
Kinematic Viscosity at 20°C	mm²/s	16.4
Thermal Conductivity at 20°C	W/m-K	0.129
Coefficient of Expansion at 20°C	1/K	0.00080
Cold Behaviour		
Kinematic Viscosity at -10°C	mm²/s	87.4
Kinematic Viscosity at -30°C	mm²/s	534
Pour Point	°C	-75

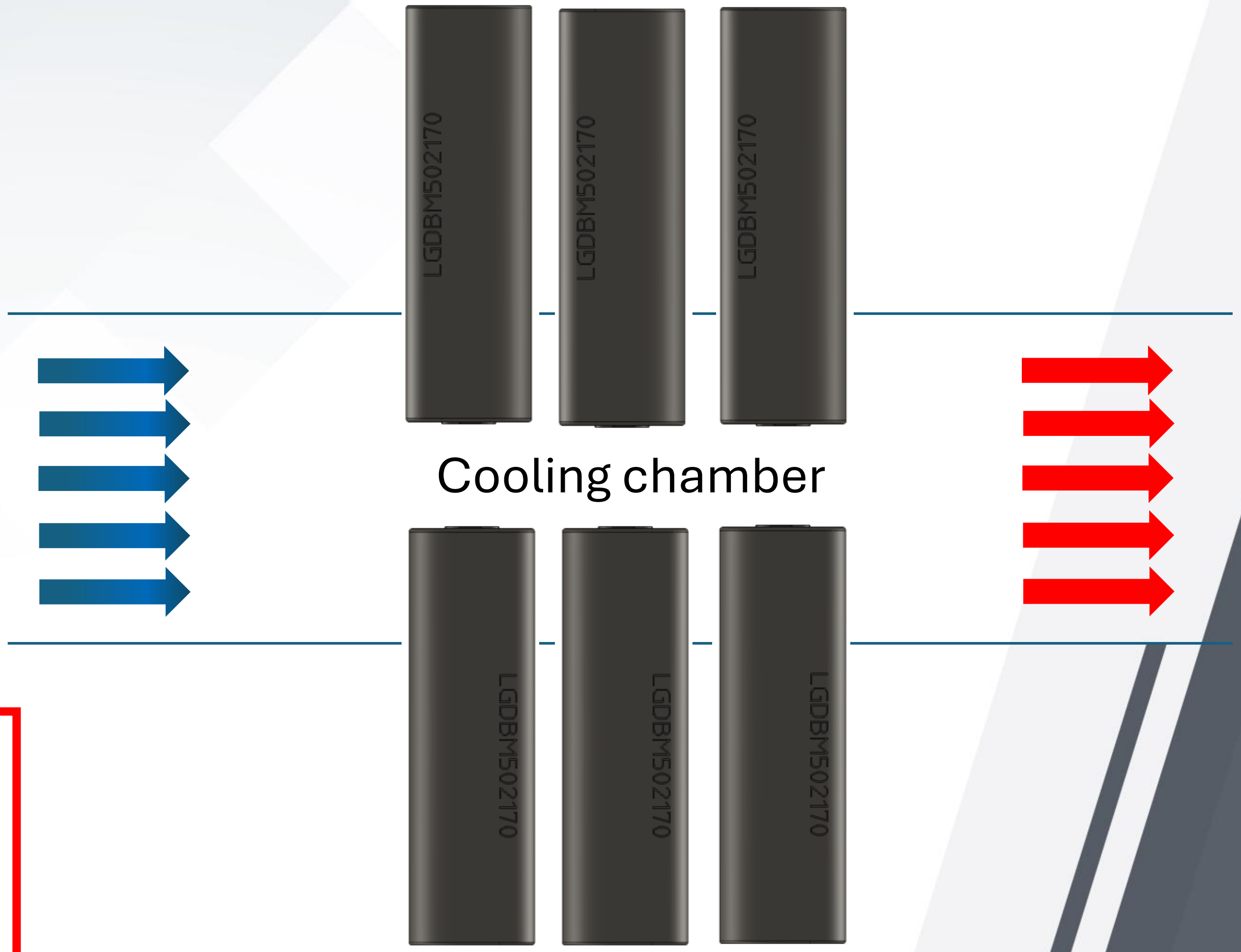
Thermal Management System – layout

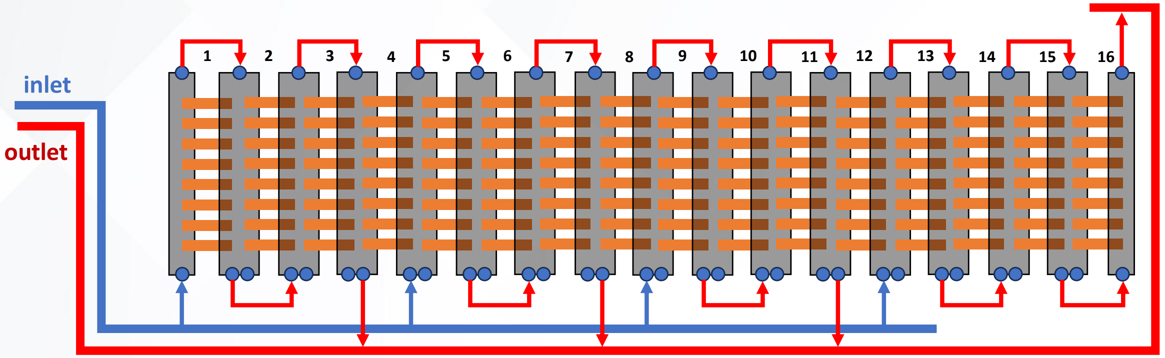


	Component	Source	Spec
1	Battery Pack		
2	Pump		Confirmed
3	3-way Valve		TBD
4	Heat Exchanger		TBD
5	Heater	ZEM	
6	Pressure sensors (x4)		TBD
7	Temp sensors (x5)		TBD
8	Compressor	OE	In discussion with Mahle
9	Condenser	OE	In discussion with Mahle
10	Expansion Valve	OE /	In discussion with Mahle

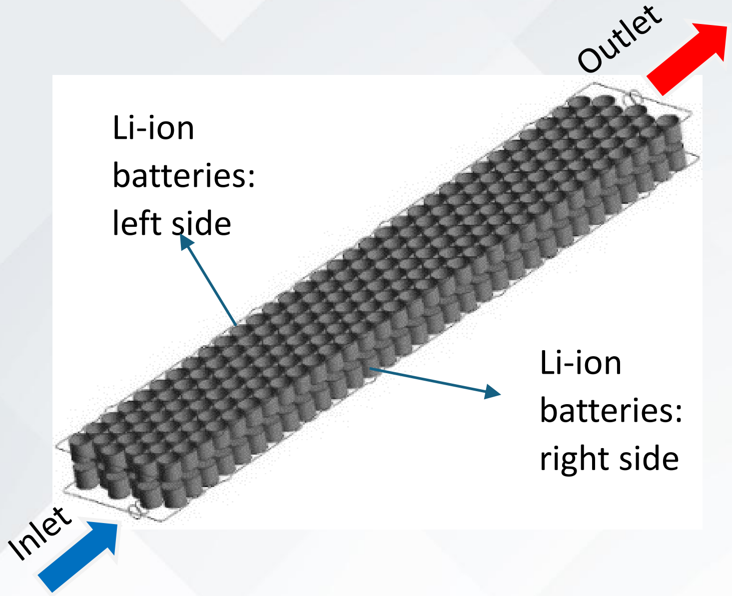
Partial immersion cooling concept



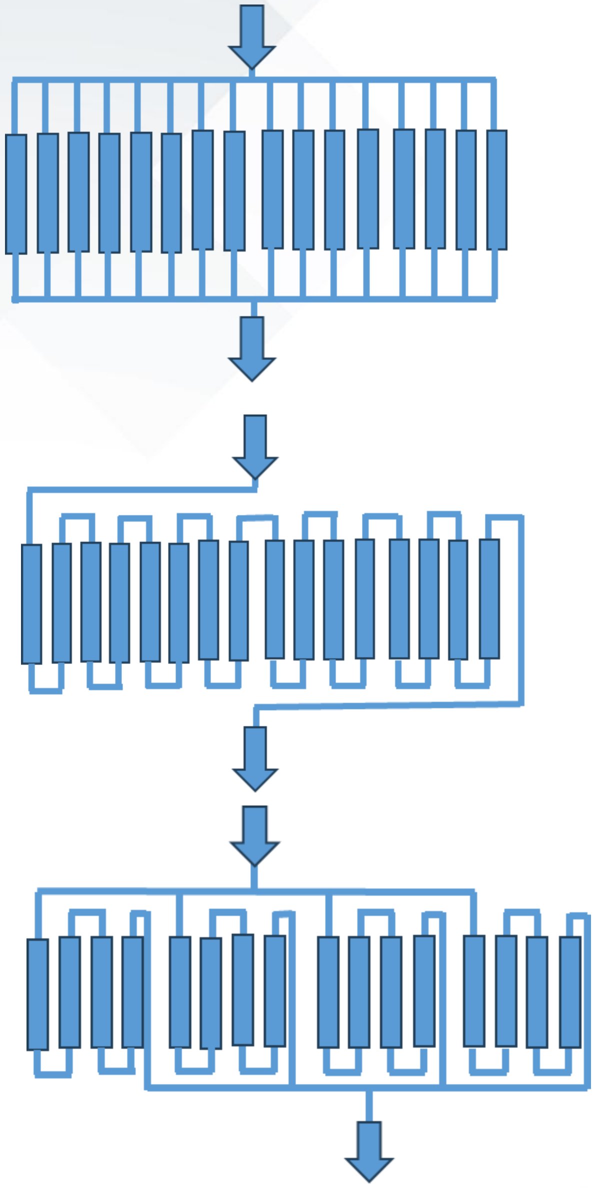


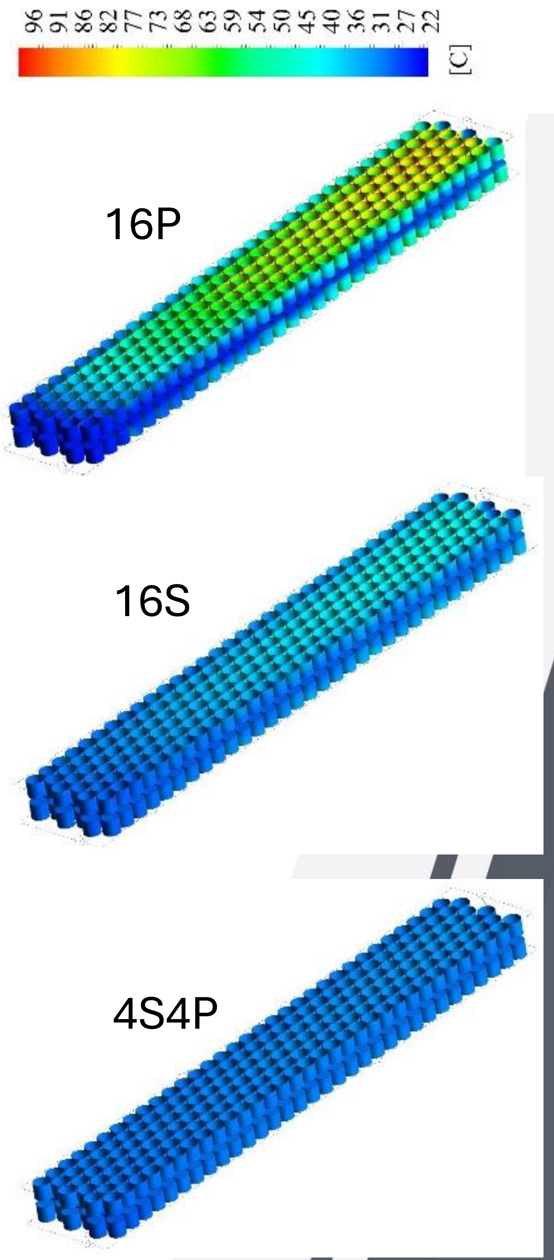


Module arrangement study



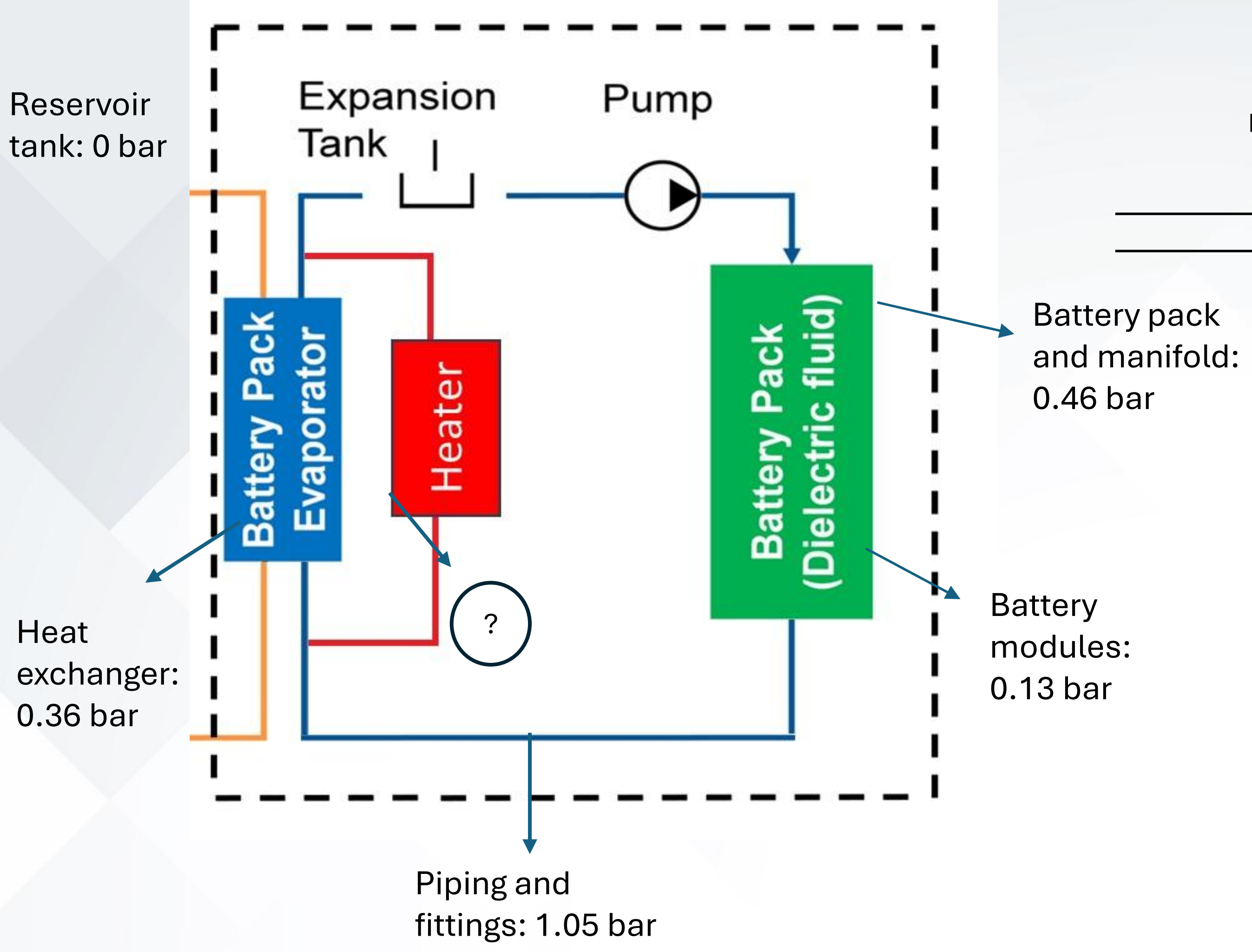
Case	Flow rate at each module (lpm)	Pressure drops in the pack (kPa)	Average Battery Temperature (℃)	Maximum Battery Temperature (℃)
16 P	5.4	0.45	43.2	98
8P-2S	10.7	2.78	36.6	68.7
4P-4S	21.5	18.48	33.1	51
2P-8S	42.9	130.4	31.4	40.4
16S	85.8	960.64	30.7	34.6



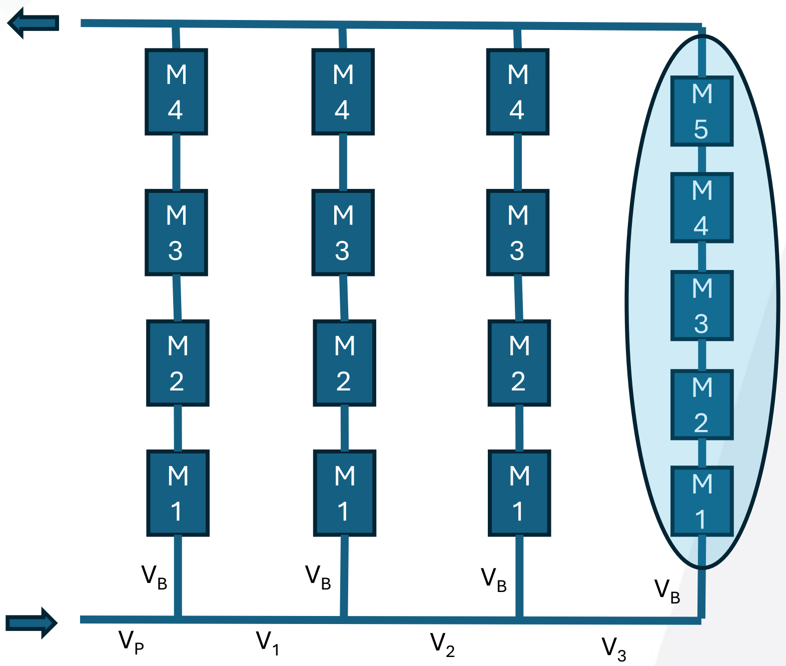


Pressure Drop calculations

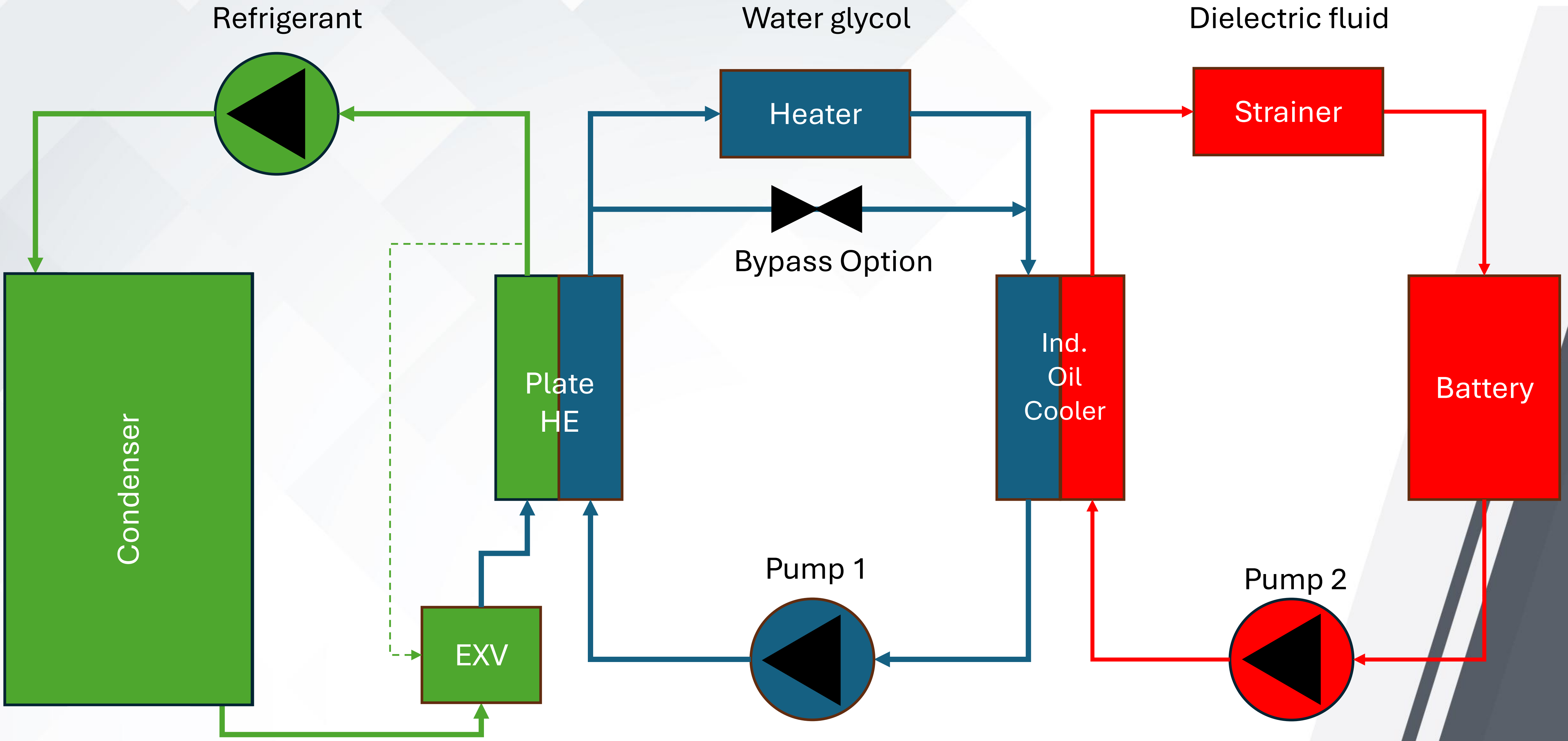
Required pump head: 2 bar



Component	Pressure Drop (kPa)	Method
Battery Pack	13	CFD
Manifold	46	Calculations
Piping	75	Calculations
Heat Exchanger	36	Danfoss solution
Exp. Vessel	0	Assumed
3-way valve	30	Assumed
Sum	200 kPa	



New Thermal Management System – layout



Conclusions

- Partial immersion cooling is capable for the thermal management of the module.
- Average temperature of 33.1°C during fast charging using the flow rate of 85.5 lpm
- High pressure drop using the flow rate of 85.5lpm during fast charging requires precise cooling loop design

HELIOS Project –

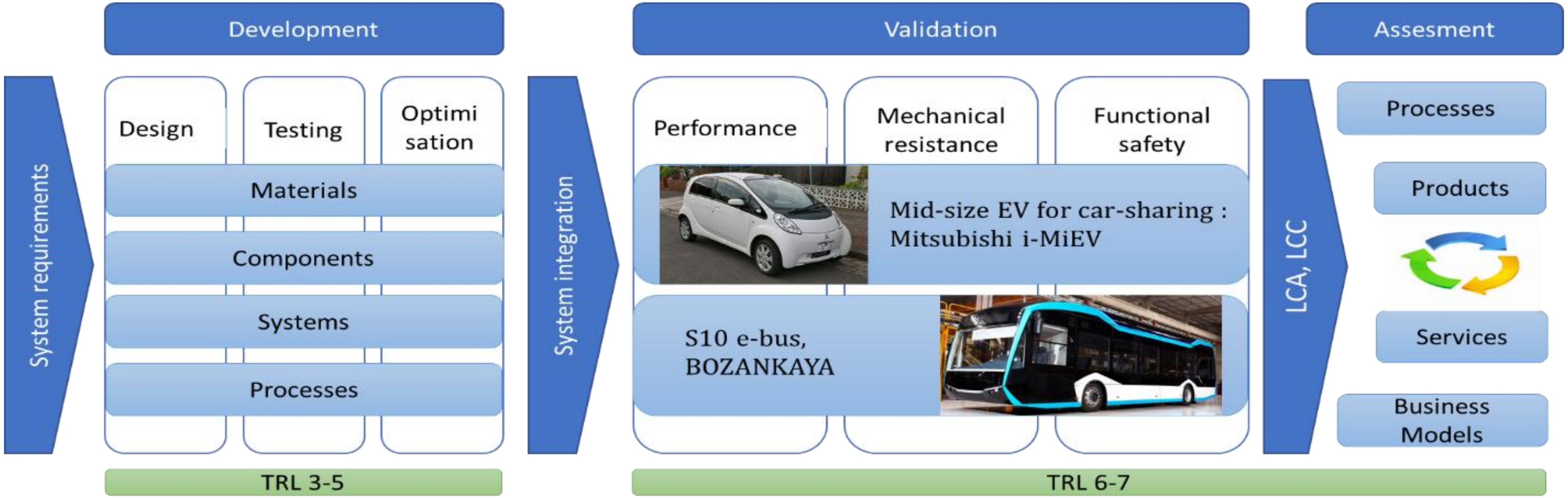
Innovative hybrid modular pack design with HP & HE cells to cope with different driving styles and use cases

Collabat Cluster Workshop, 26th Nov 2024 in Barcelona

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 963646

Helios Project Overview

Methodology followed in Helios project

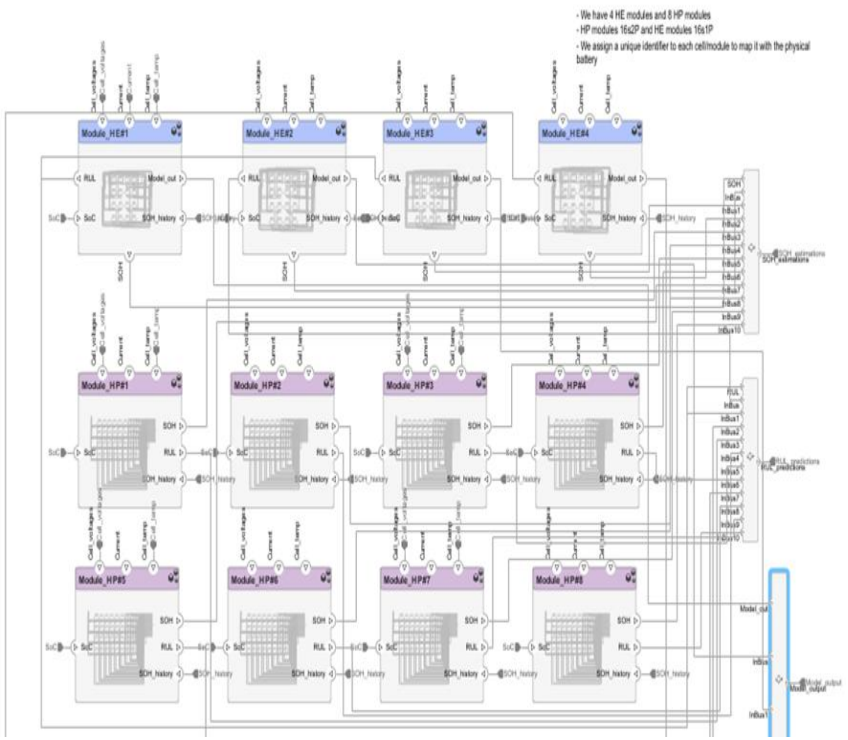


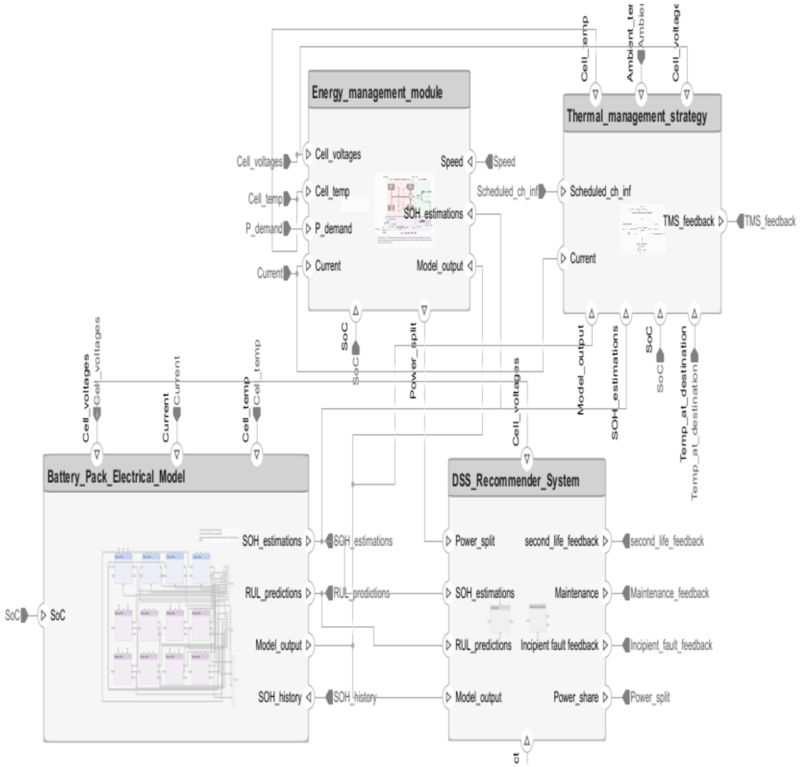
Helios Project Overview

Positioning of the Project

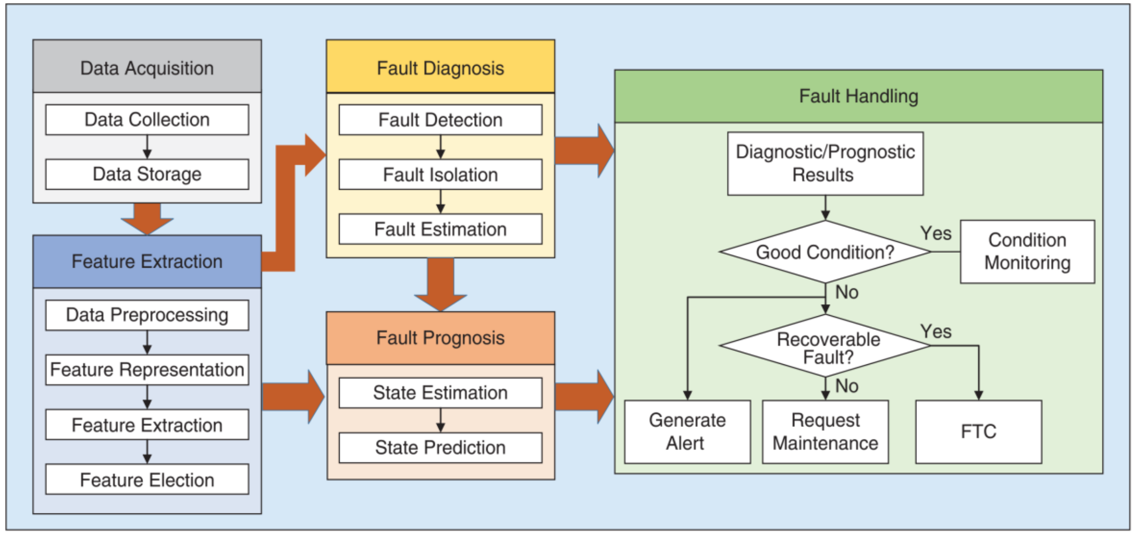
Technologies involved in HELIOS	TRL @M0	TRL @ M48
Hybrid module configuration battery packs, integrating LFP and NMC cells	4	7
Advanced polymers and composite material for structural components, housing and insulation	5	7
Hybrid thermal management system integrating tab and surface cooling with PCMs	4	7
Multilevel converters for the efficient management of energy and power	5	7
Multilevel converters for modularity, scalability and adaptability to the powertrain	4	6
In-vehicle AC-DC converters for ultra-fast charge	5	7
Improved charging protocols and communications	4	7
Improved state estimation methodologies, SOC and SOH	4	6
Improved control and health management strategies	4	6
Development of BMS with enhanced functionalities for state estimation and connectivity	5	7
DC-DC converter for cell balancing	4	7
AI algorithms for improved PHM embedded in the datAssist™ IoT software platform	4	6
Digital twins for performance and process circularity optimisation	4	6
LCCA tool for circular economy of Li-ion battery packs	5	7
V2G communication protocols for 1st and 2nd life battery pack utilisation	5	7
Big data analysis and IoTs applied to the management of performance and carbon footprint of EV fleets	4	6
Multisensing units integrated in the BMS for measurement of multiple parameters	5	7
Gas sensors for early detection of CO, VOCs, etc	3	5

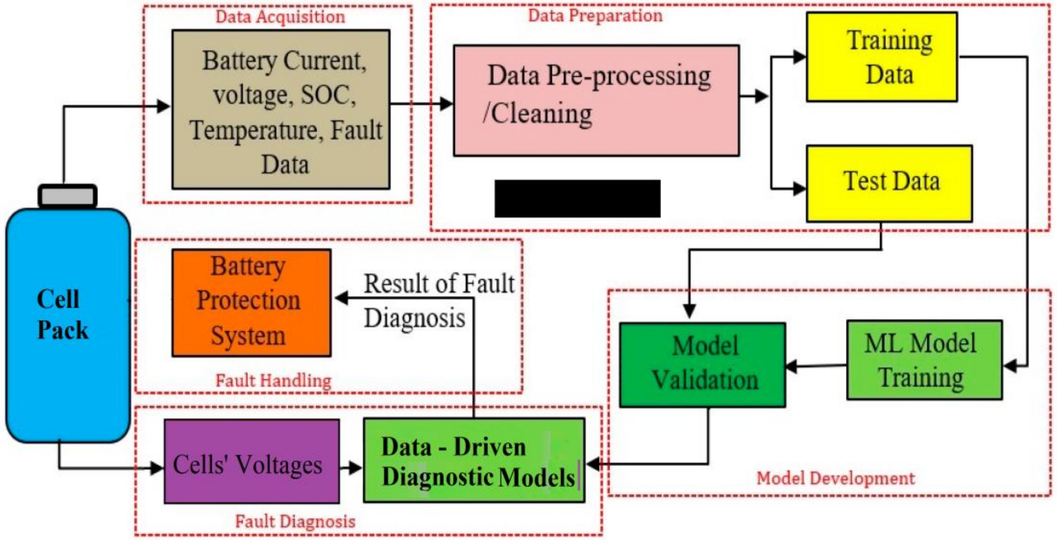
Complete models for DT development



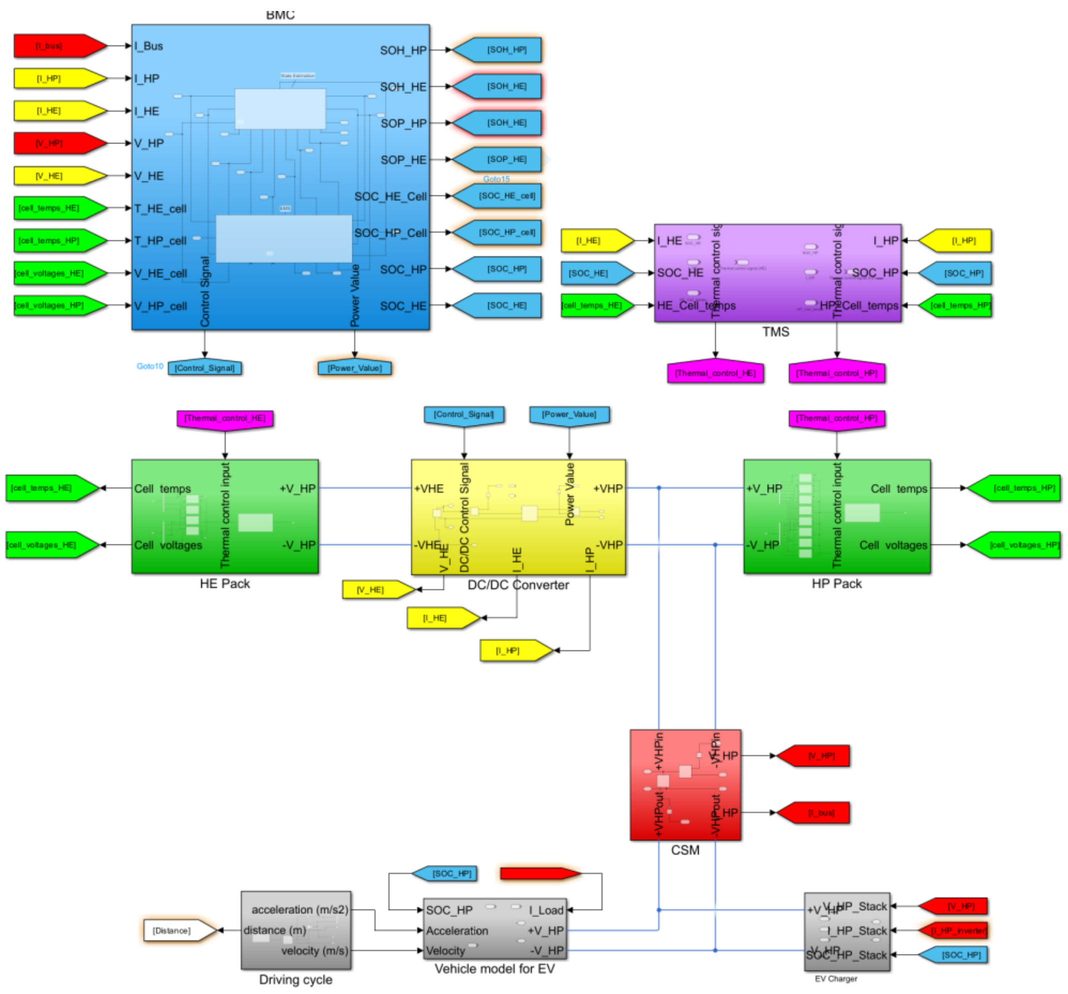


FMEA, data-driven detection and control

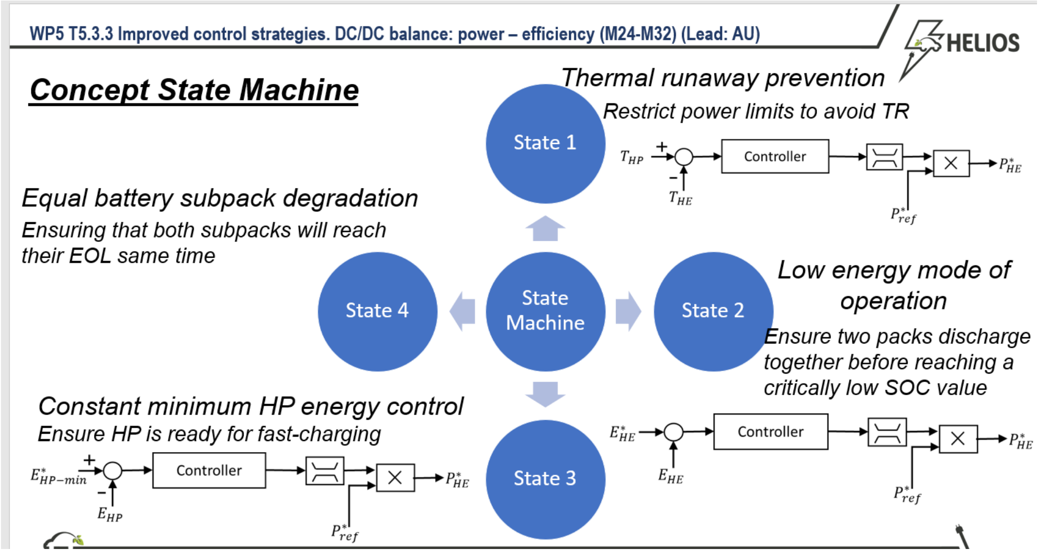




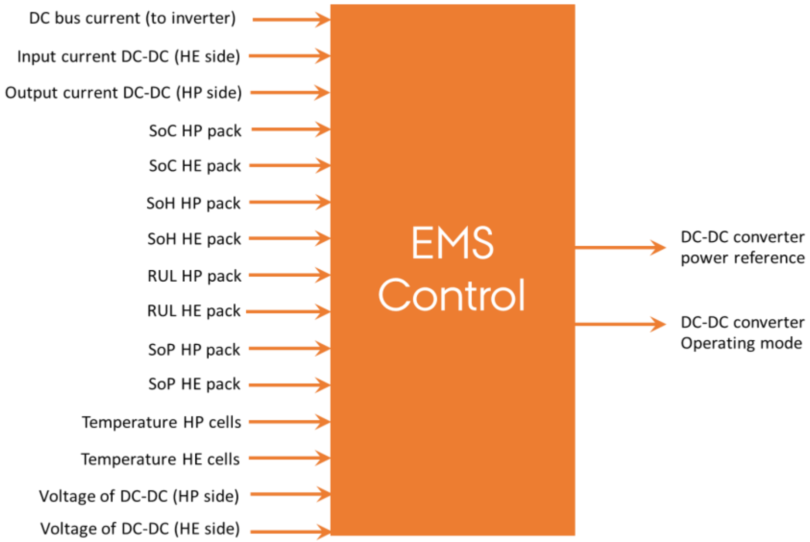
System-level simulation platform



EMS Control



WP5 T5.3.3 Improved control strategies. DC/DC balance: power – efficiency (M24-M32) (Lead: AU)
HELIOS
Concept State Machine
Thermal runaway prevention
Restrict power limits to avoid TR
State 1
Controller
Equal battery subpack degradation
Ensuring that both subpacks will reach their EOL same time
State 4
State Machine
State 2
Low energy mode of operation
Ensure two packs discharge together before reaching a critically low SOC value
Constant minimum HP energy control
Ensure HP is ready for fast-charging
Controller
State 3
Controller



DC bus current (to inverter)
Input current DC-DC (HE side)
Output current DC-DC (HP side)
SoC HP pack
SoC HE pack
SoH HP pack
SoH HE pack
RUL HP pack
RUL HE pack
SoP HP pack
SoP HE pack
Temperature HP cells
Temperature HE cells
Voltage of DC-DC (HP side)
Voltage of DC-DC (HE side)
EMS Control
DC-DC converter power reference
DC-DC converter Operating mode

SENSOR TECHNOLOGY FUSION FOR BATTERY SAFETY

Pressure sensor detects strong exothermal events by pressure peak

- Detects dangerous runaway in battery case
- Robust technology
- Low power consumption
- Park-mode with BMS wake-up functionality
- Variable detection criteria (threshold, slope, ...)

Humidity sensor for water detection & compensation

- Can detect leakage in cooling system or condensation in battery
- Enables higher gas sensing accuracy
- Enables dew point calculation
- Low power consumption & Low cost

Thermal gas sensor measures H2 level in battery case

- Redundancy to detect runaway, also in case of broken battery case (no pressure built-up possible after accident)
- Detects runaway of NMC/LFP cells or cold venting of aged cells
- Measures H2 from water electrolysis (leakage + HV)
- Significant gas concentration in battery case allows low sampling rate in park-mode (low current draw)
- Shut down of battery in case of explosive gas mixture

Acceleration sensor measures mechanical misuse

- 3-axis MEMS sensor detects acceleration up to 200 g
- Accidents and ground contacts of battery can be detected
- Robust technology with low power consumption

Pressure sensor only **SOP mid 2025**
- Pressure sensor with gradient evaluation
- Low-power mode incl. BMS wake-up
- CAN communication
- QM part

Pressure / gas and humidity sensor **SOP end 2026**
- Pressure + hydrogen sensor with gradient / threshold evaluation
- Low-power mode incl. BMS wake-up
- CAN communication (LIN optional)
- ASIL B rating

SENSOR TECHNOLOGY FUSION FOR BATTERY SAFETY

Integrated Sensors:

- absolute pressure sensor → 60 to 165 kPa
- hydrogen sensor → 0 to 40 %
- relative humidity sensor → 0 to 100 %
- temperature sensor → -40 to 125 °C
- 3D Accelerometer → ±200 g

* housing of final product will be smaller and can be changed to customer needs

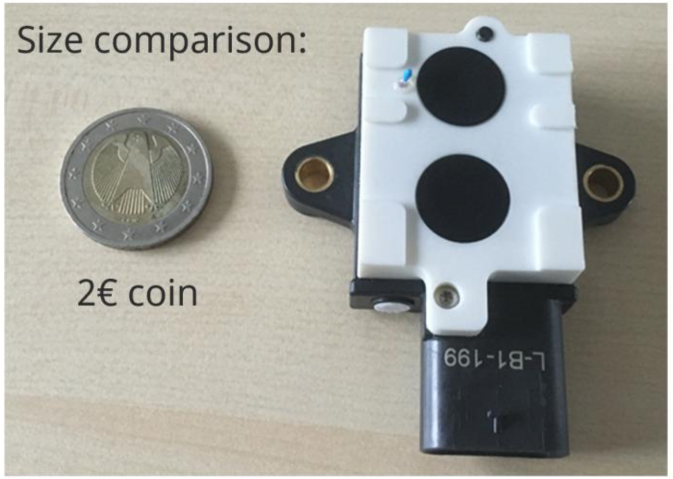
Samples available for testing

Communication:

- CAN-Interface (500kBaud)
- 4 Pins (Ubat, GND, CAN H, CAN L)
- dbc file delivered from VT

Power Supply:

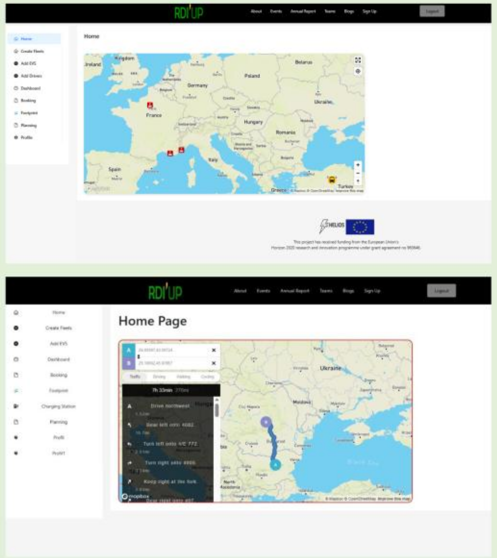
- Sensor Voltage 12V (always on)



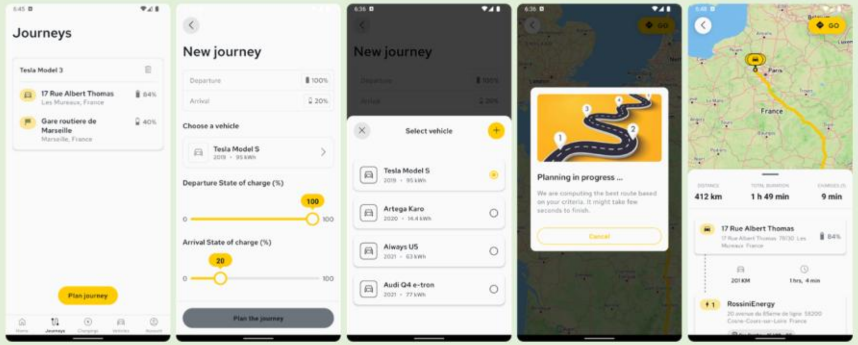
Fleet Management Platform (FMP)

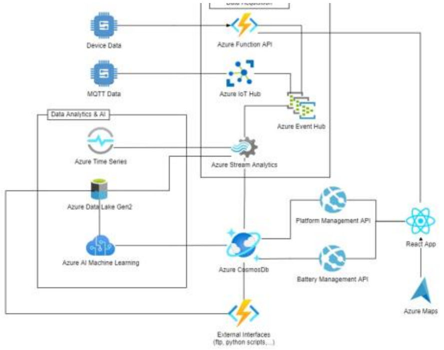
IoT Platform

Fleet Operator Web APP



Driver Mobile APP

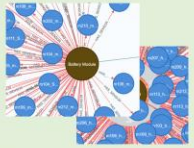


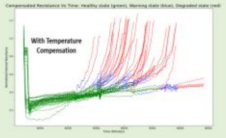


Fault Management DSS

Fault management from battery pack, on-board subsystems, cloud-based SW platforms, and charging stations

Fault reporting and decision making based on knowledge graphs



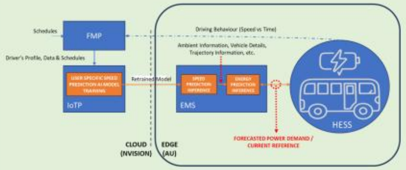


Model for the detection of long-term degradation of battery cells

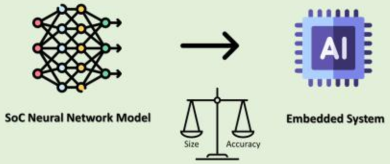
EMS based on Driving Behaviour

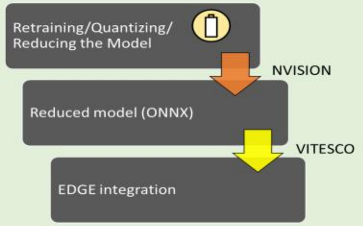
Model predicting driver behaviour (repeating routes data from Bozankaya)

Model training in the cloud, and inferred in the Edge for a better EMS

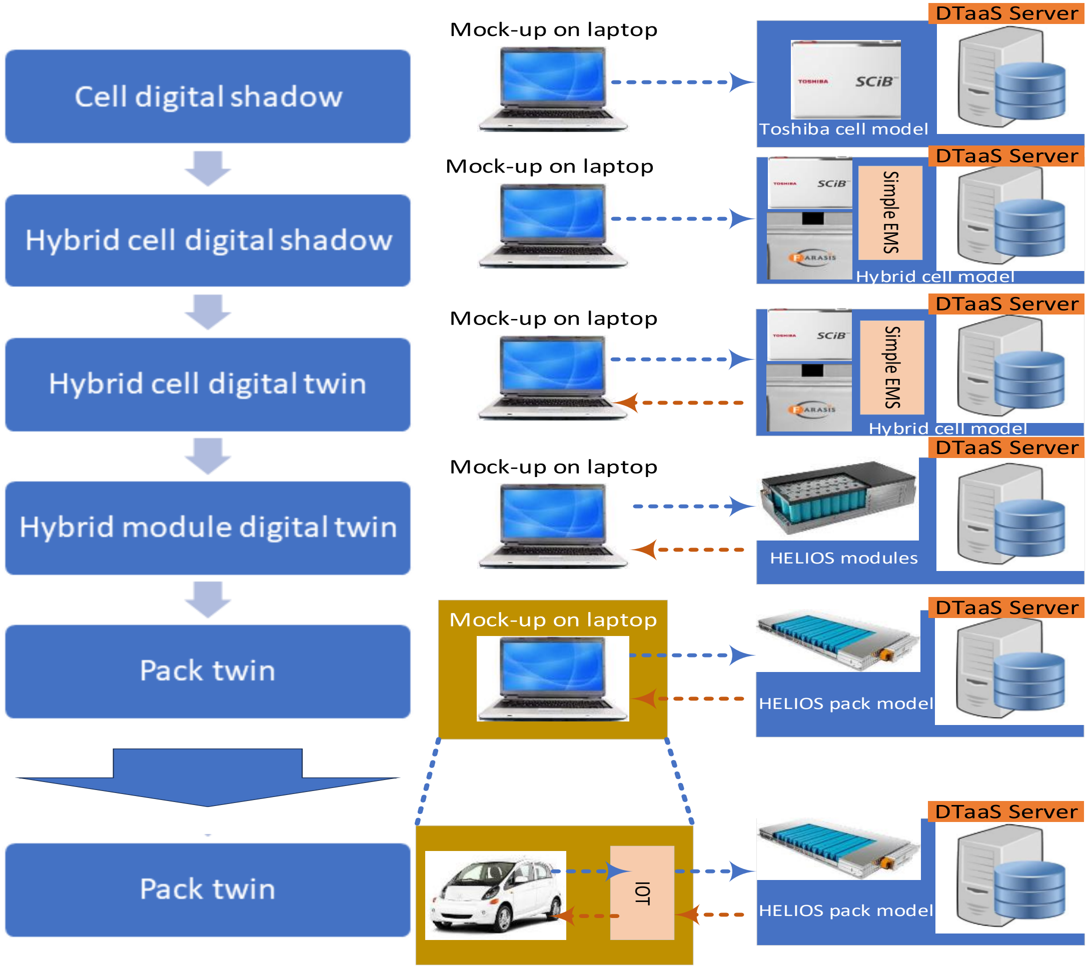


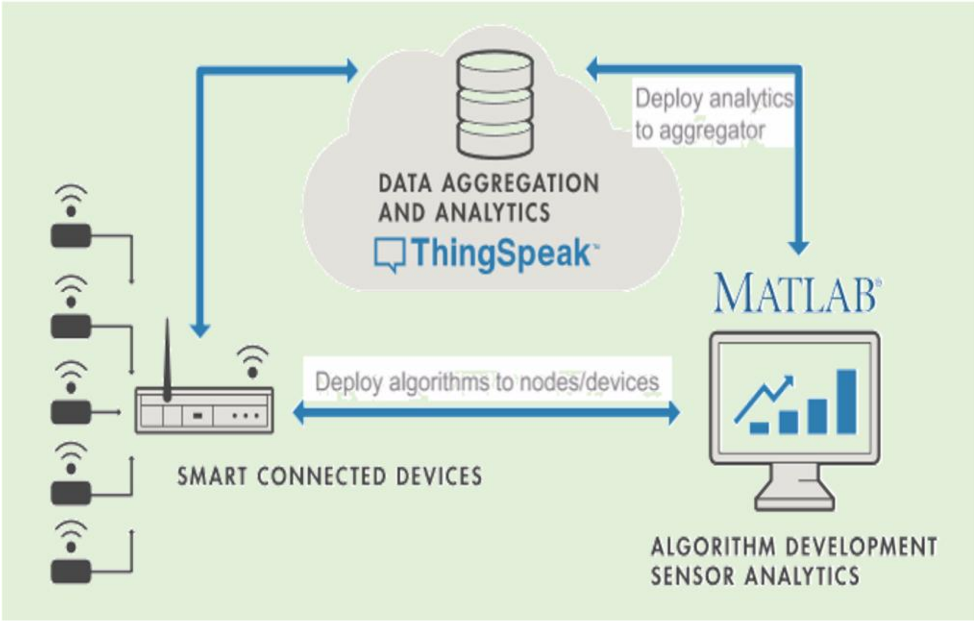
Edge-based SoC Data-driven Model





Digital Twin Platform (DTP)





Outlook

- In the final validation of the Helios hybrid modular battery concept, we will show our results in two use-case towards end of 2024, on the extreme ends of needs and driving styles
- A small EV (Mitsubishi iMiEV) and a fullsize E-Bus from Bozankaya

THANK YOU!

Immersion Cooling System

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Valeo
SMART TECHNOLOGY
FOR SMARTER CARS

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R&I Technical Leader at Valeo
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LIBERTY
LIGHTWEIGHT BATTERY SYSTEM
FOR EXTENDED RANGE AT IMPROVED SAFETY

Lightweight Battery System for Extended Range at Improved Safety

LIBERTY has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 963522.
The document reflects only the author's view, the Agency is not responsible for any use that may be made of the information it contains.

CONTENT

- **Immersion cooling system (INTRODUCTION)**
- **System used in LIBERTY project**
- **Test bench and main results description**

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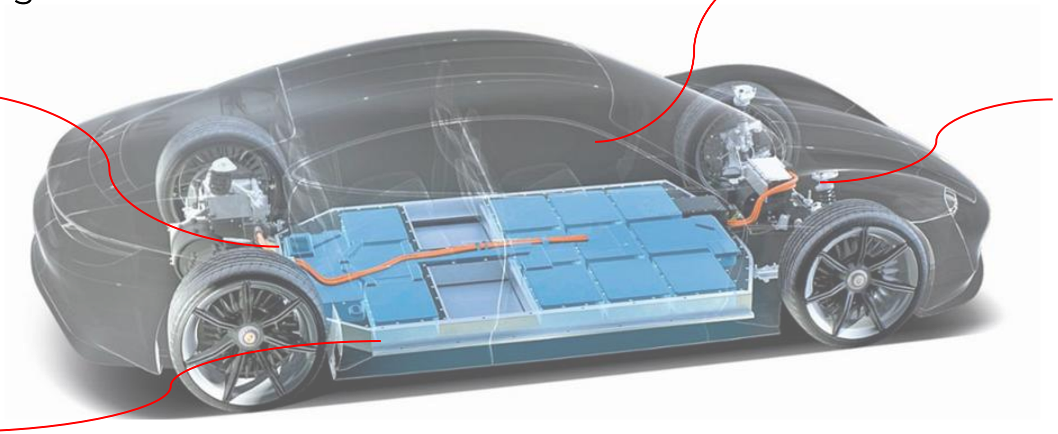
EV Thermal Management System

Valeo
SMART TECHNOLOGY FOR SMARTER CARS

LIBERTY
LIGHTWEIGHT BATTERY SYSTEM

Battery Thermal Management
- Cooling/heating
- Heat recovery for cabin heating
- Pre-heating
- **Quick charging**
- Power availability

Cabin comfort
- Heating & cooling
- Dehumidification
- Welcome comfort

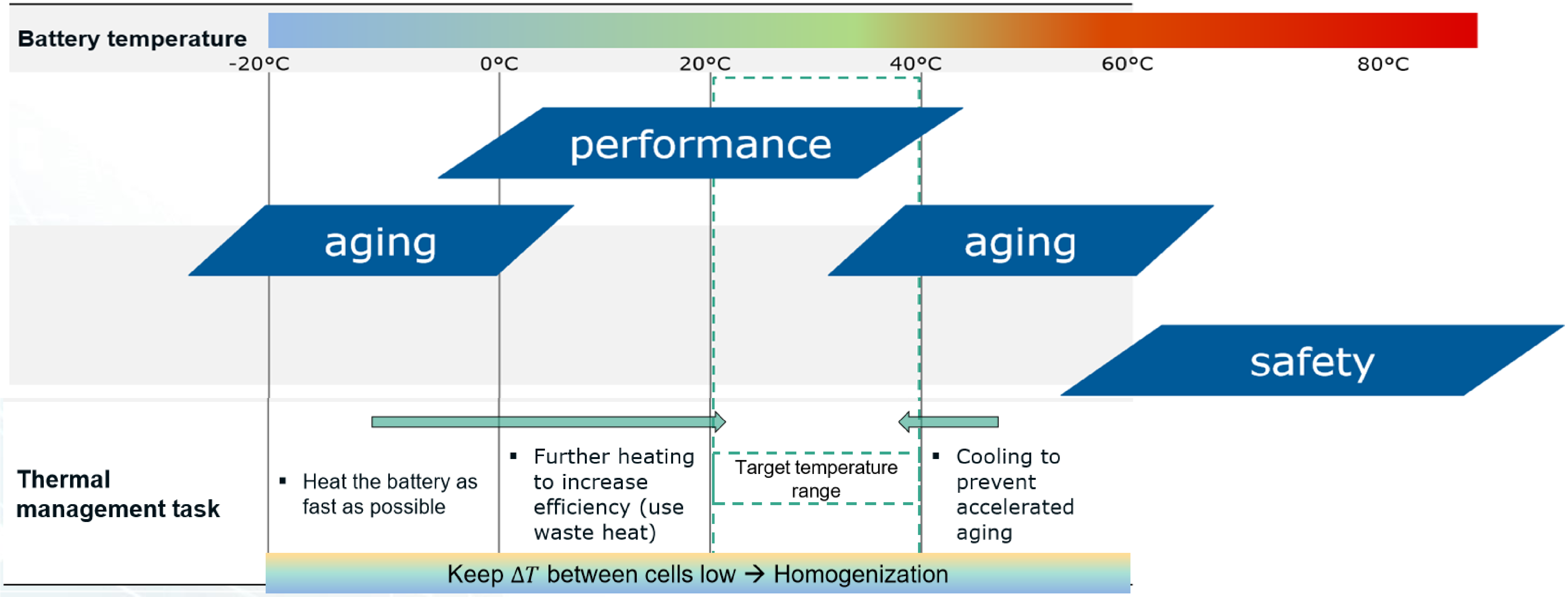


Powertrain & Electronics cooling
- Cooling
- Heat recovery for cabin or battery heating

Thermal Runaway
- **Avoid propagation**
- Passengers safety

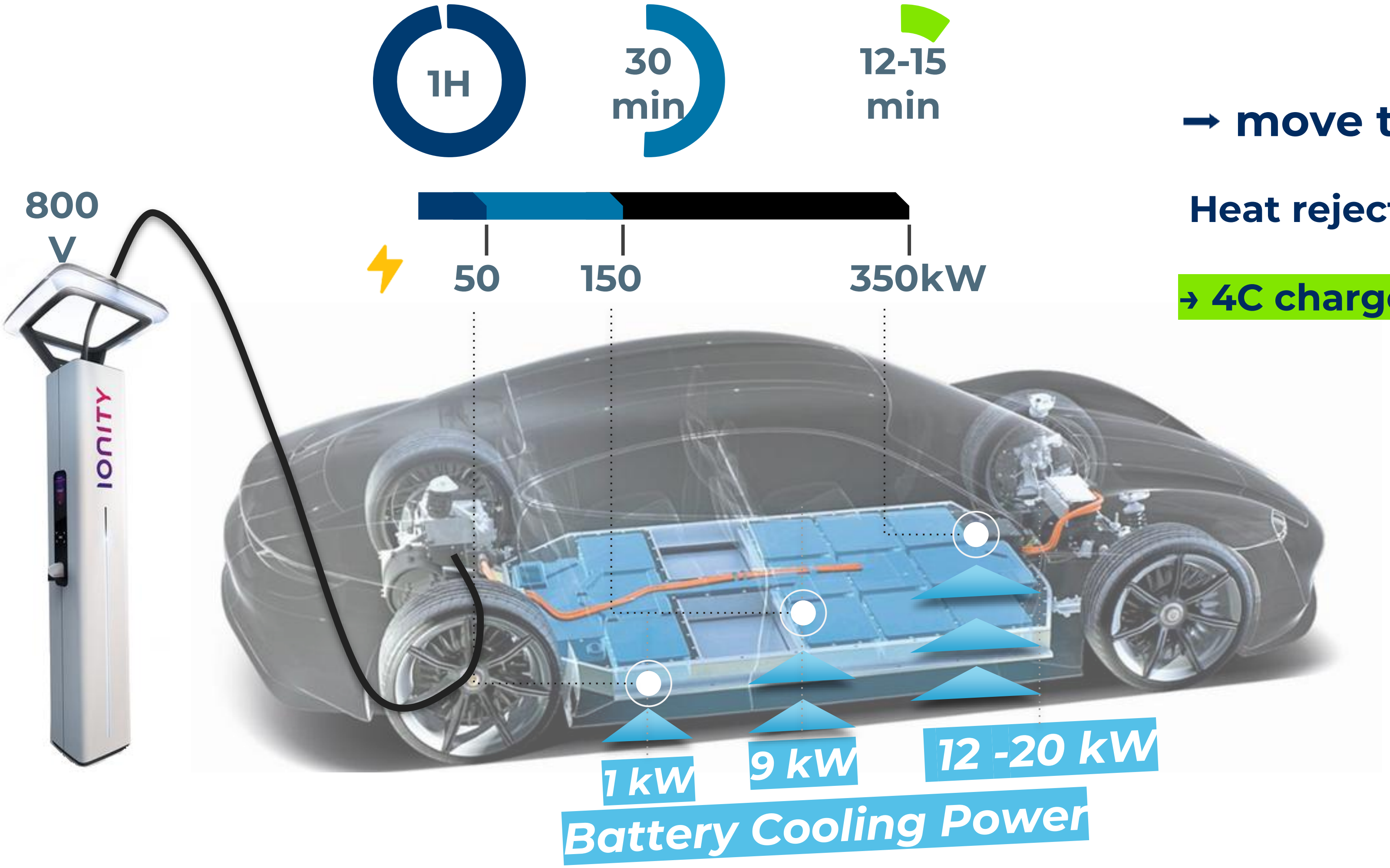
- Battery thermal management is achieved through the **Thermal Management System** (TMS), in conjunction with cabin and powertrain cooling.
- Additionally, battery **safety** has become a key focus.

The battery ideal temperature



Battery thermal management involves a trade-off among **safety**, **performance**, and **durability**

Fast charging requires enhanced cooling



→ **move to 3 & 4C charging**

Heat rejection = Resistance x Current²

→ 4C charge heats 4x more than 2C !

Reducing charging time has become a priority for EVs, necessitating increased battery cooling capacity.

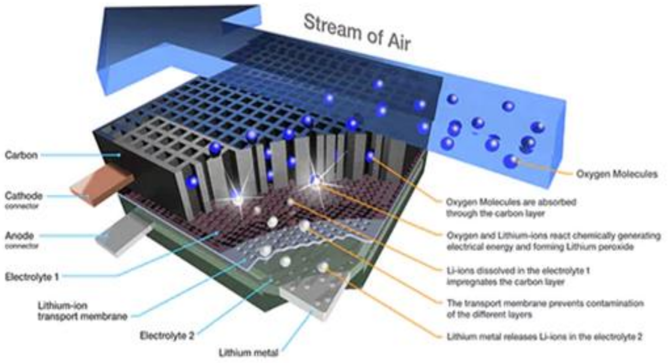
Avoid thermal propagation

- Mechanical Abuse
  - Collision and Crush
  - Penetration
- Electrical Abuse
  - External Short circuit
  - Overcharge
  - Over discharge
- Thermal abuse
  - Internal Short Circuit

Avoiding **thermal propagation** in the event of cell failure has become essential to ensure passenger safety

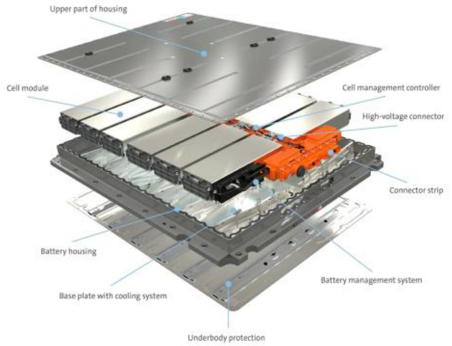
Optimal Thermal Management System

- **Chemistry**



- **Charge / discharge profile**

- **Cell-to-pack or module**

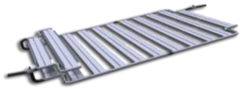


For a given cell **chemistry**, **charge/discharge** profile, and environment, the optimal battery thermal management (BTM) system is a compromise among **cost, weight, and performance.**

A new way to cool the battery

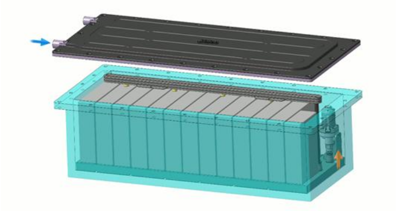
AIR

LIQUID



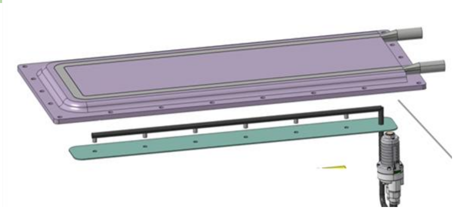
REFRI

Biphasic cooling



Immersive cooling

Spray cooling



SOTA battery cooling

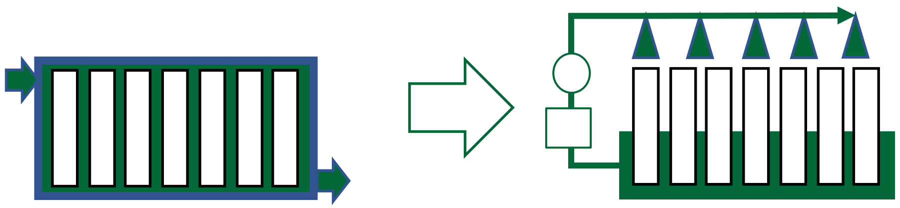
Immersive cooling

Compared to cold plates, **immersive cooling** with dielectric fluid enhances overall heat transfer and improves the durability of the cells.

CONTENT

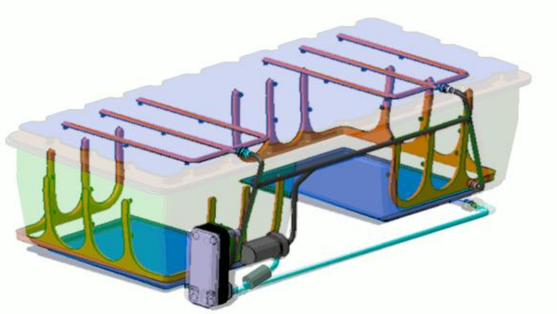
- Immersion cooling system INTRODUCTION
- **System used in LIBERTY project**
- Test bench and main results description

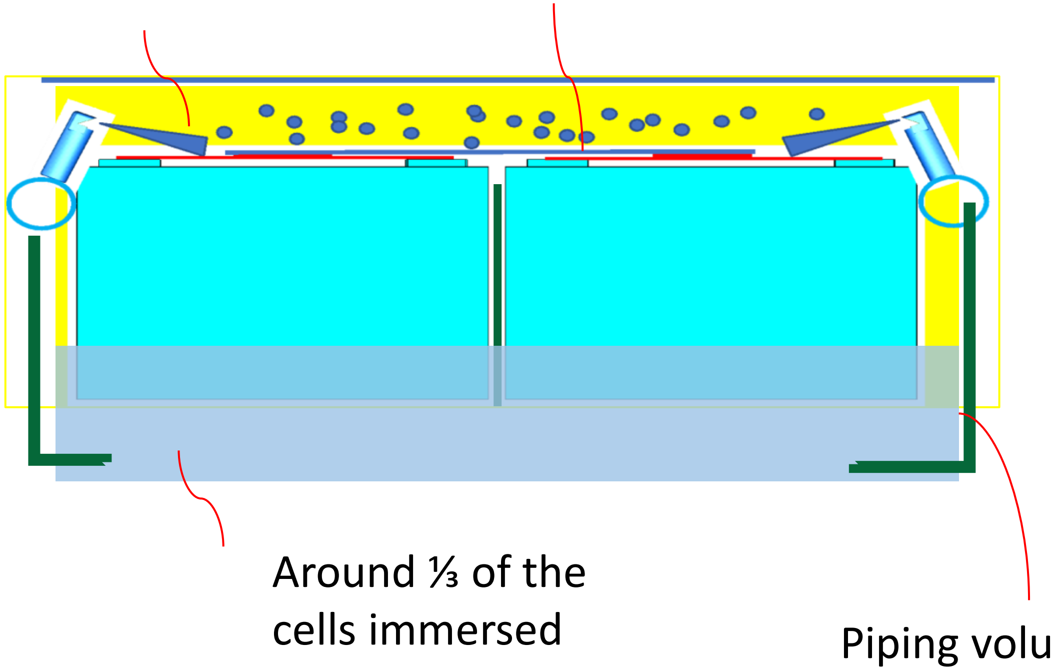
Advantages of Spray Cooling



Immersive cooling

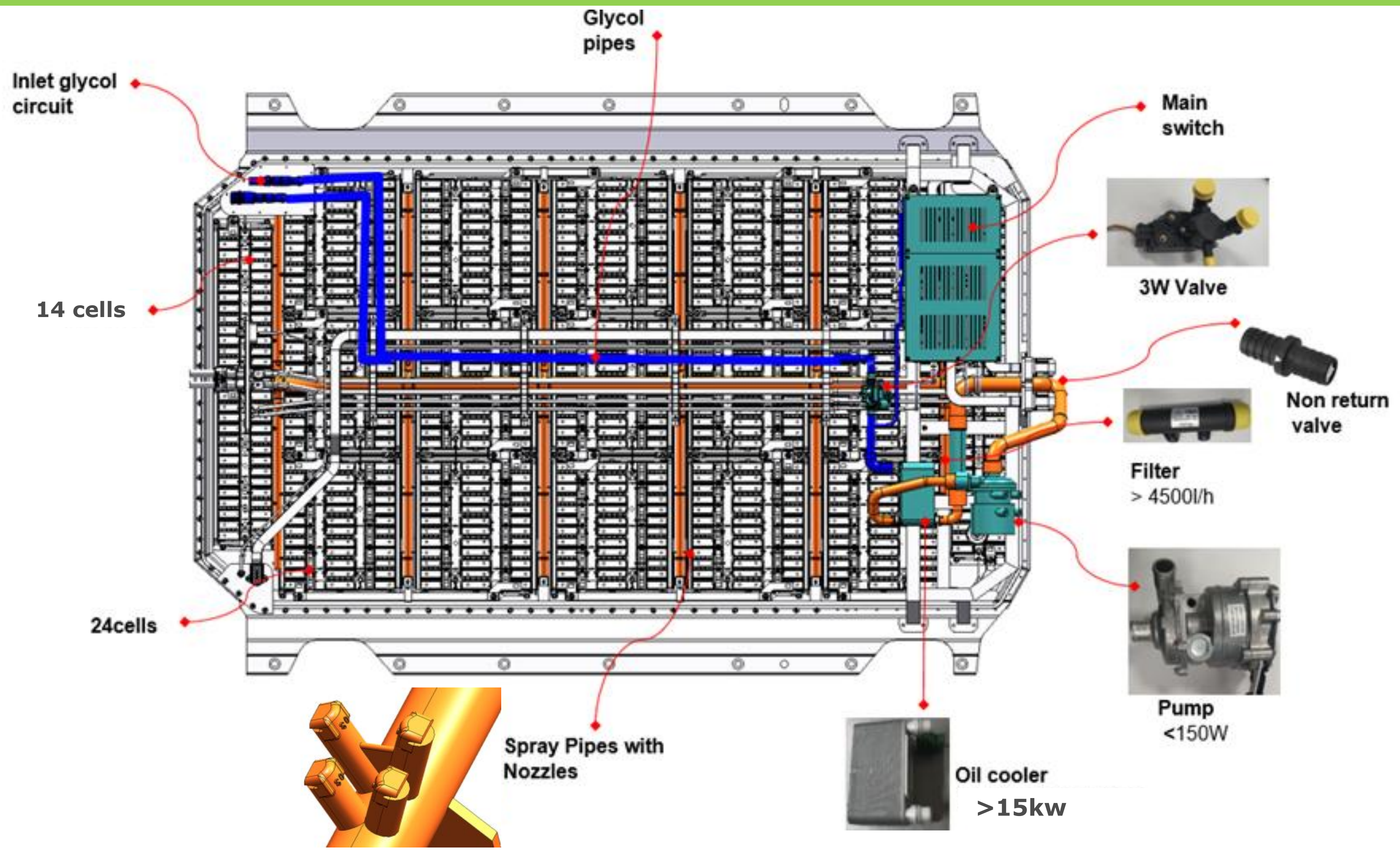
Spray cooling

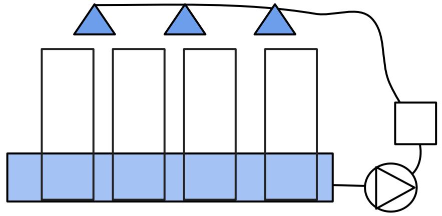




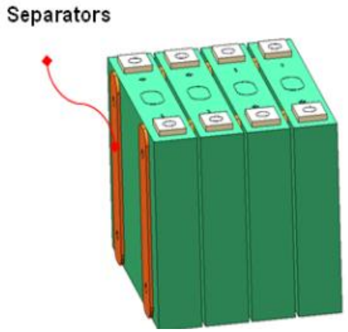
- Spray cooling **reduces** battery **weight** and **cost** by minimizing the required dielectric fluid.
- Additionally, it effectively cools the **busbars** at the top of the cells, enhancing overall thermal performance.

Integration at Liberty battery pack



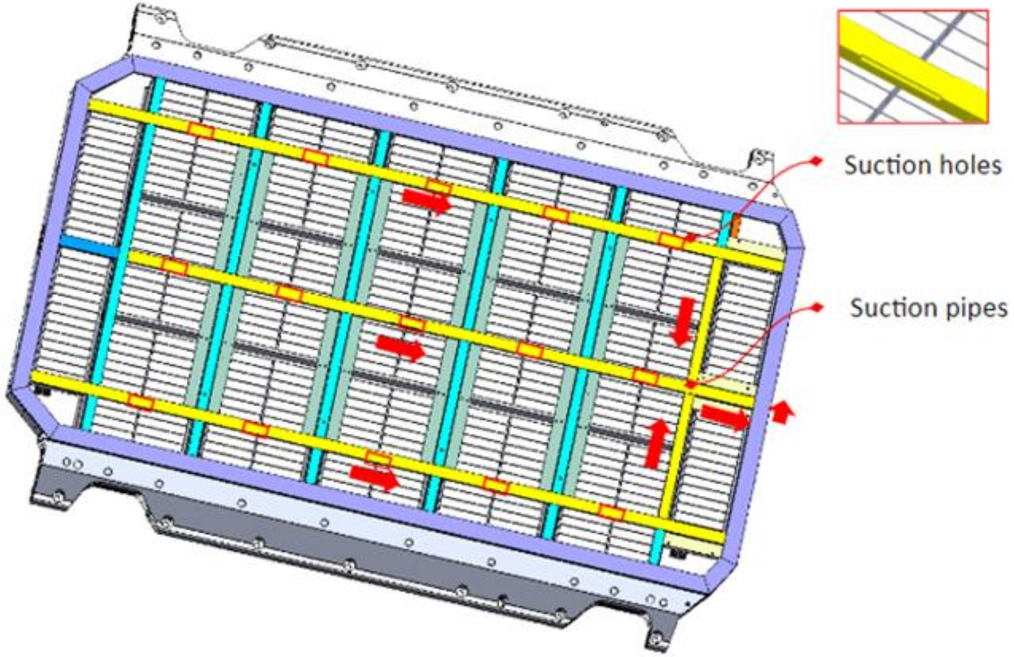


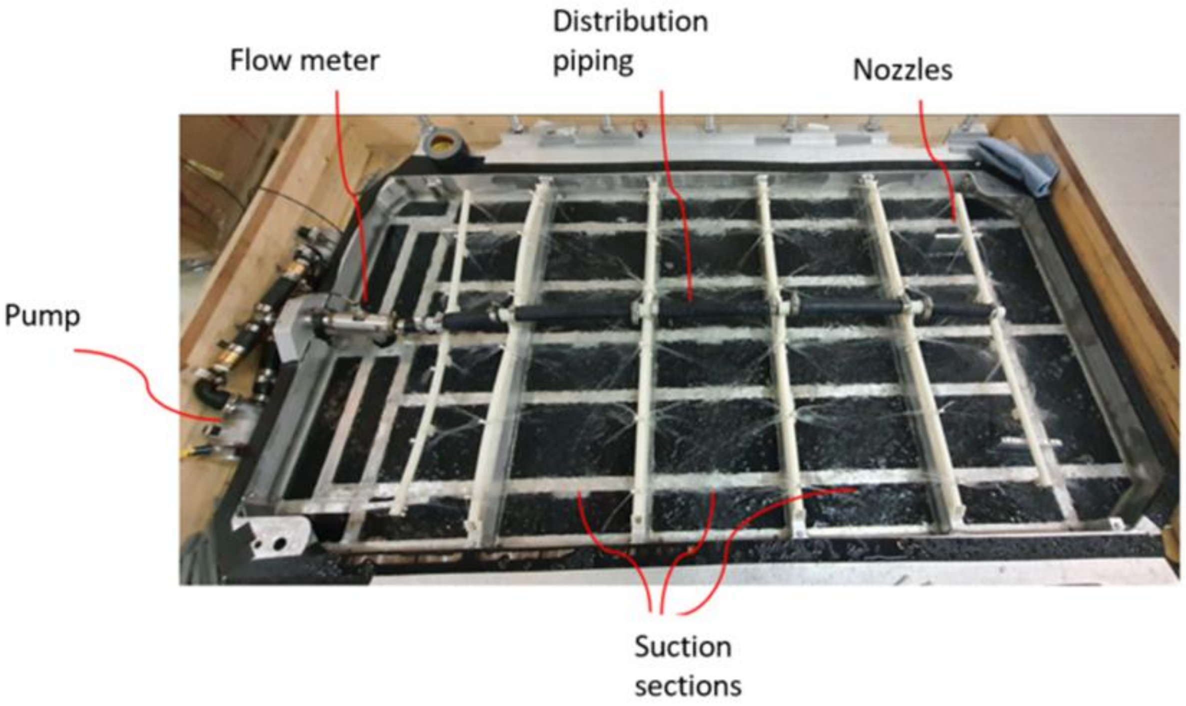
Spray cooling

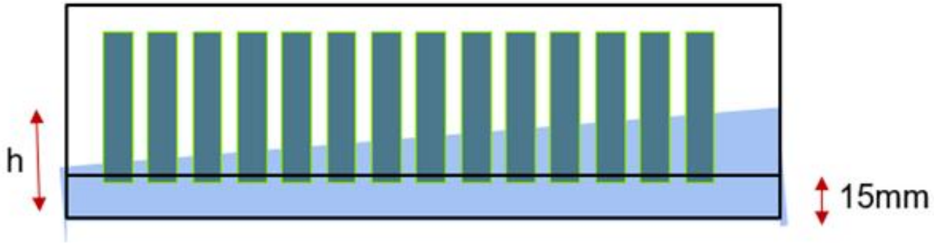


Spray immersive cooling and component integration optimize the available volume of the battery pack **without requiring additional volume or packaging**

Fluid Balance and Filling Optimization

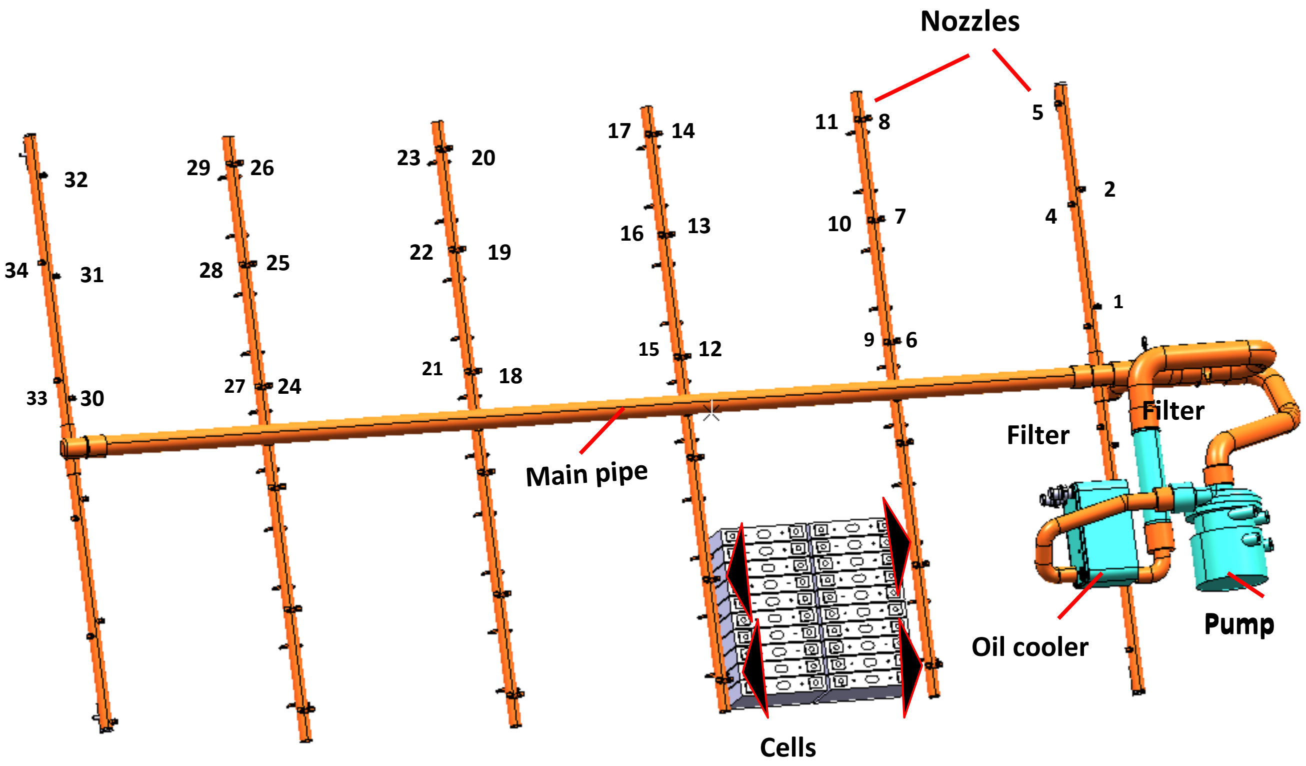


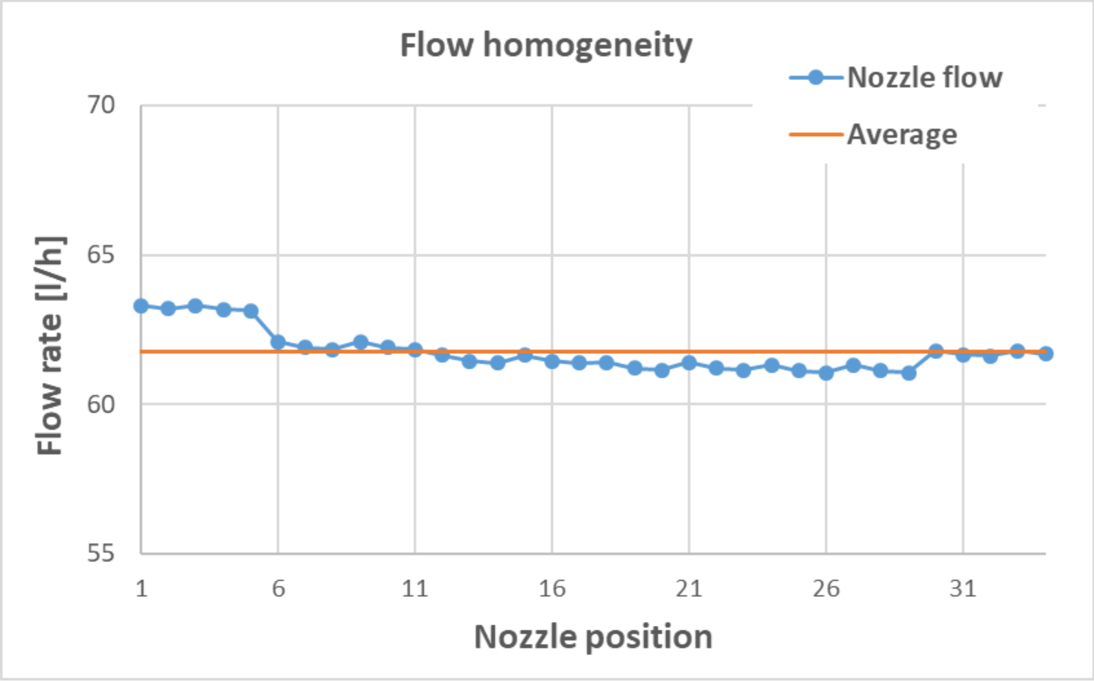




Optimizing suction openings ensures balanced filling across different battery compartments

Flow Distribution at the Nozzles

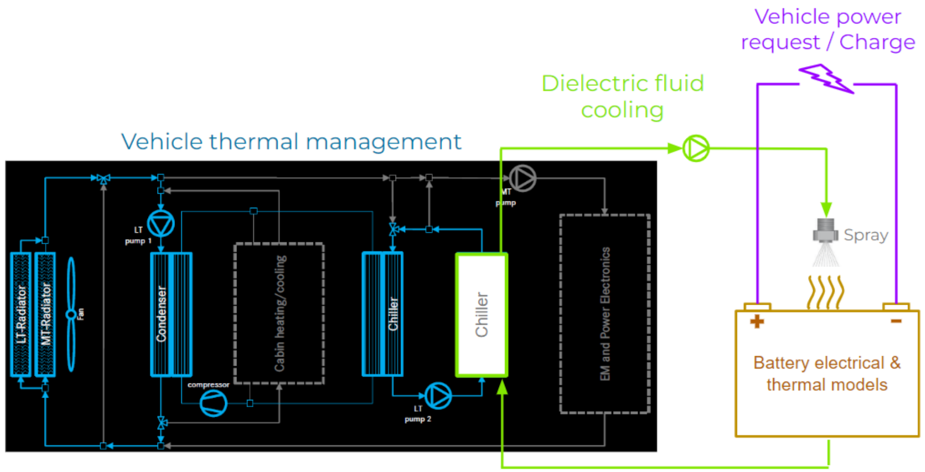


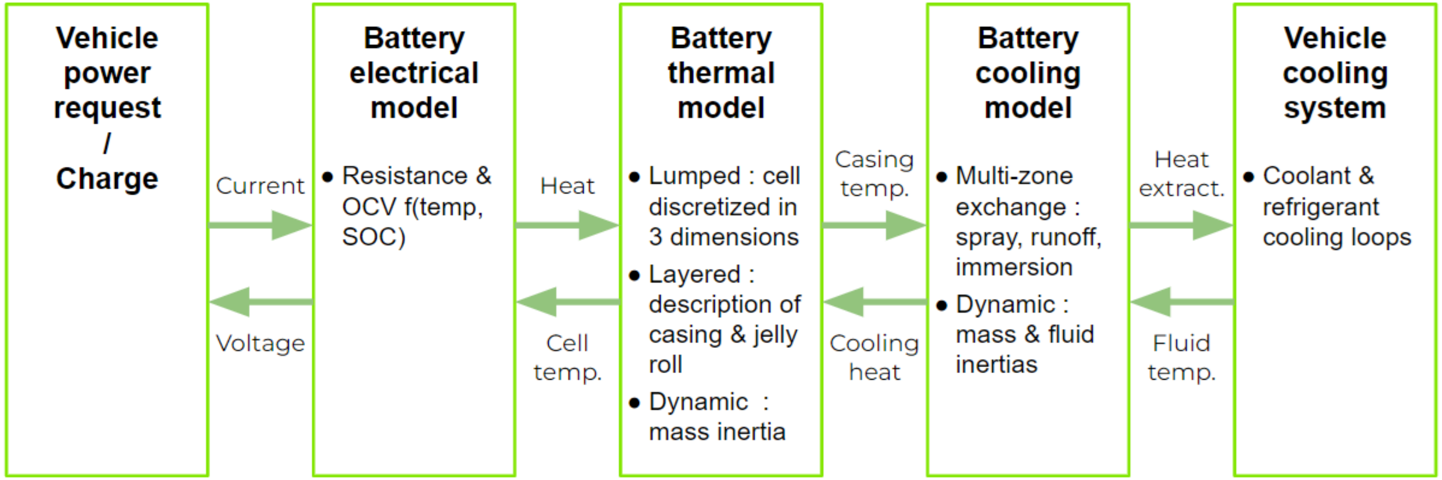


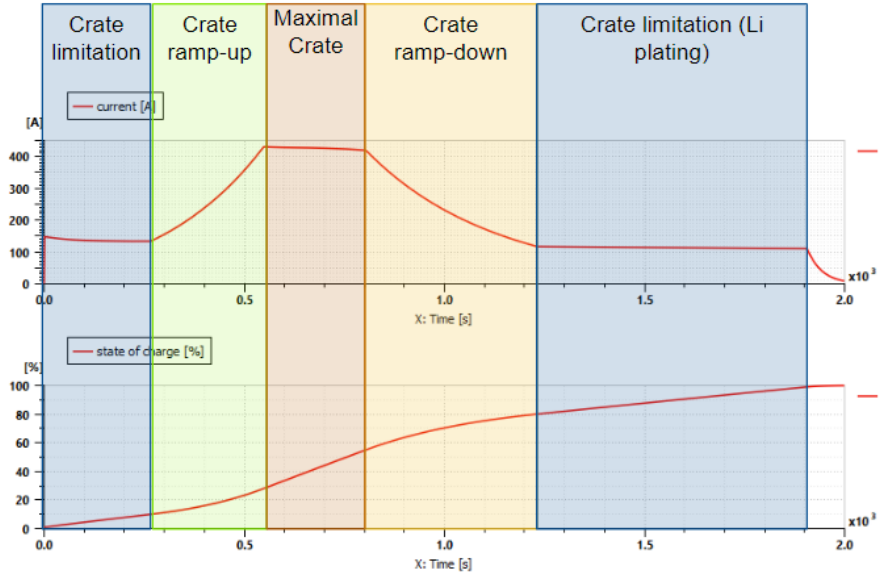
Special attention was given to the distribution and **location of the nozzles**, as well as the **diameter of the pipes**, to ensure **balanced flow** rates of **less than 3 L/min**.

At the Final Battery Pack

Fluid suction and nozzle distribution were verified in the **final battery pack**





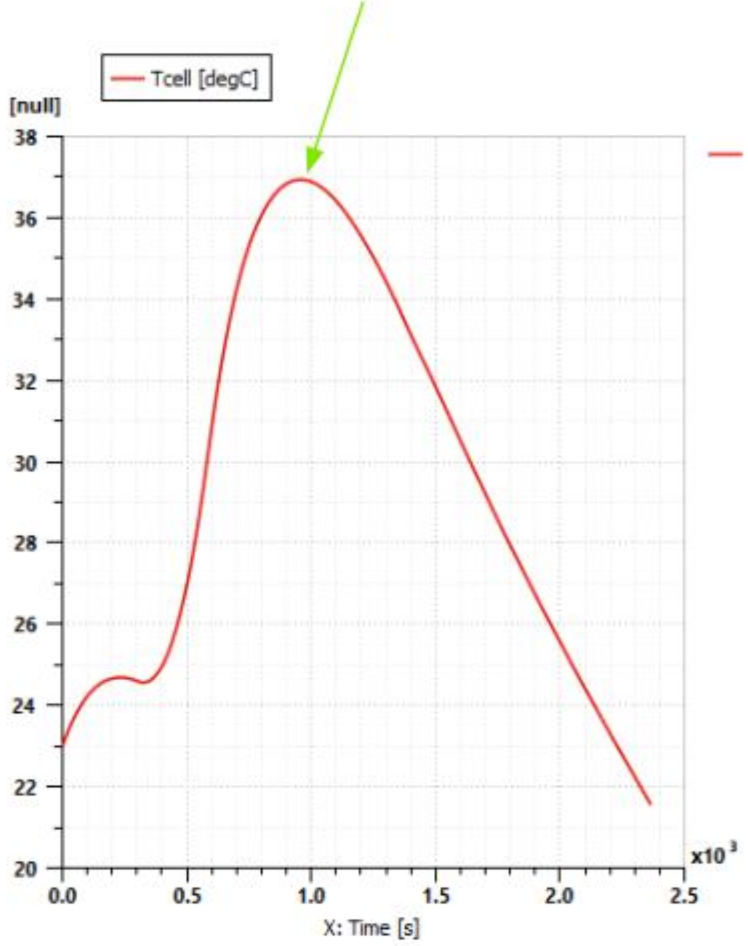


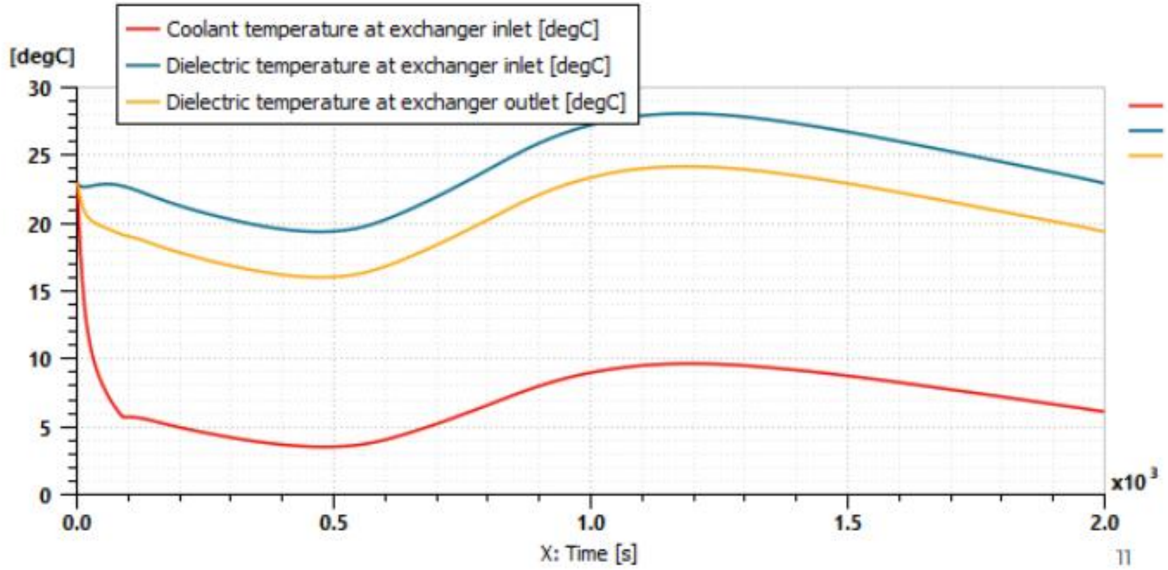
A complete predictive model was developed to include the **entire global car thermal management system.**

Thermal Management Numerical model

With cooling *, cells remain under 40°C

Maximal Crate duration could be extended





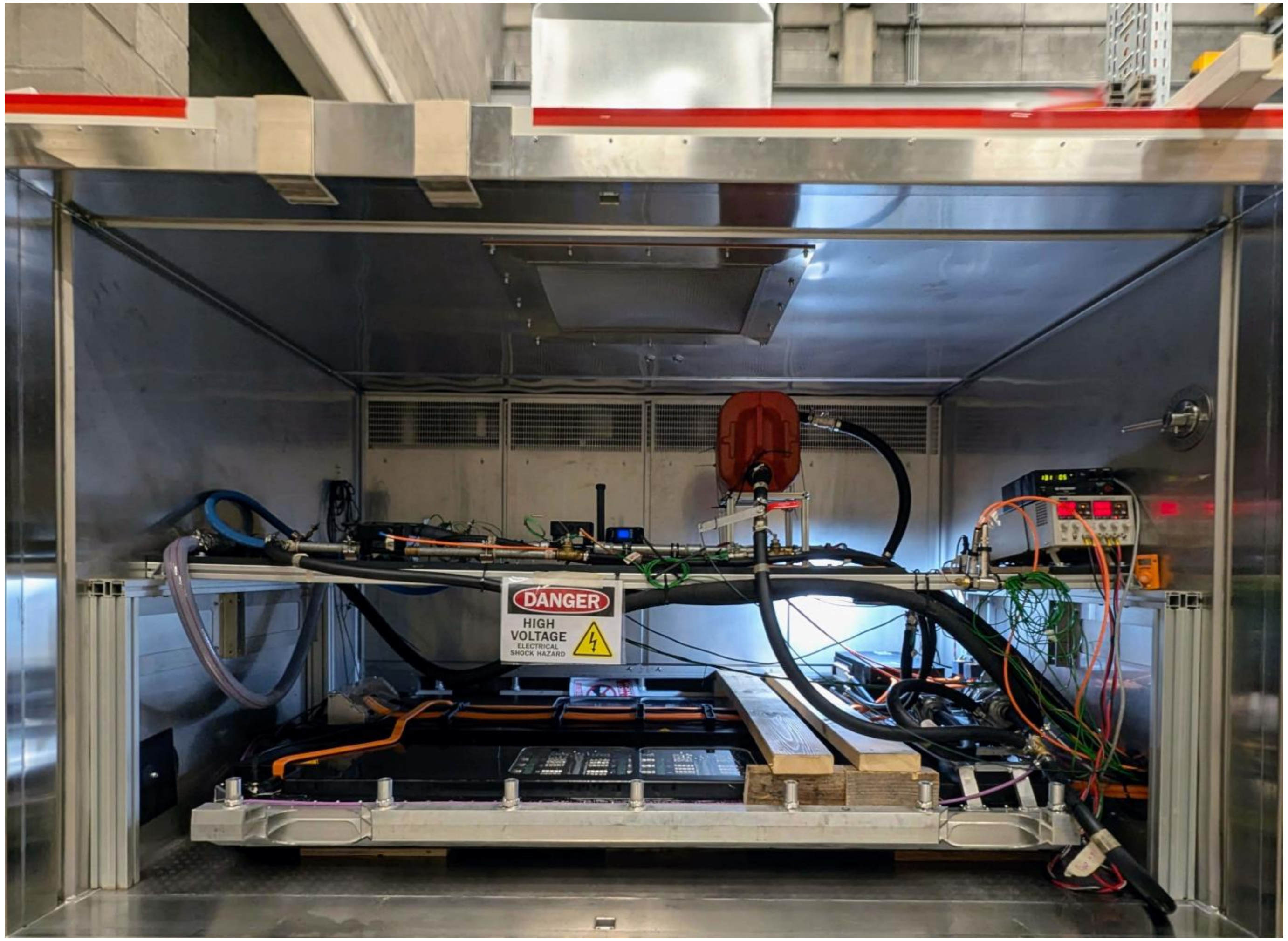
The simulations predict the cells' charging cycles and thermal behavior

CONTENT

- Immersion cooling system INTRODUCTION
- System used in LIBERTY project
- **Test bench and main results description**

Test bench for battery pack testing

CTS climate chamber pack



Test bench for battery pack testing

Test performed on the battery pack for validation of immersion cooling system:

- Fast Charge:
  - 300kW
  - 2.33C (18min)

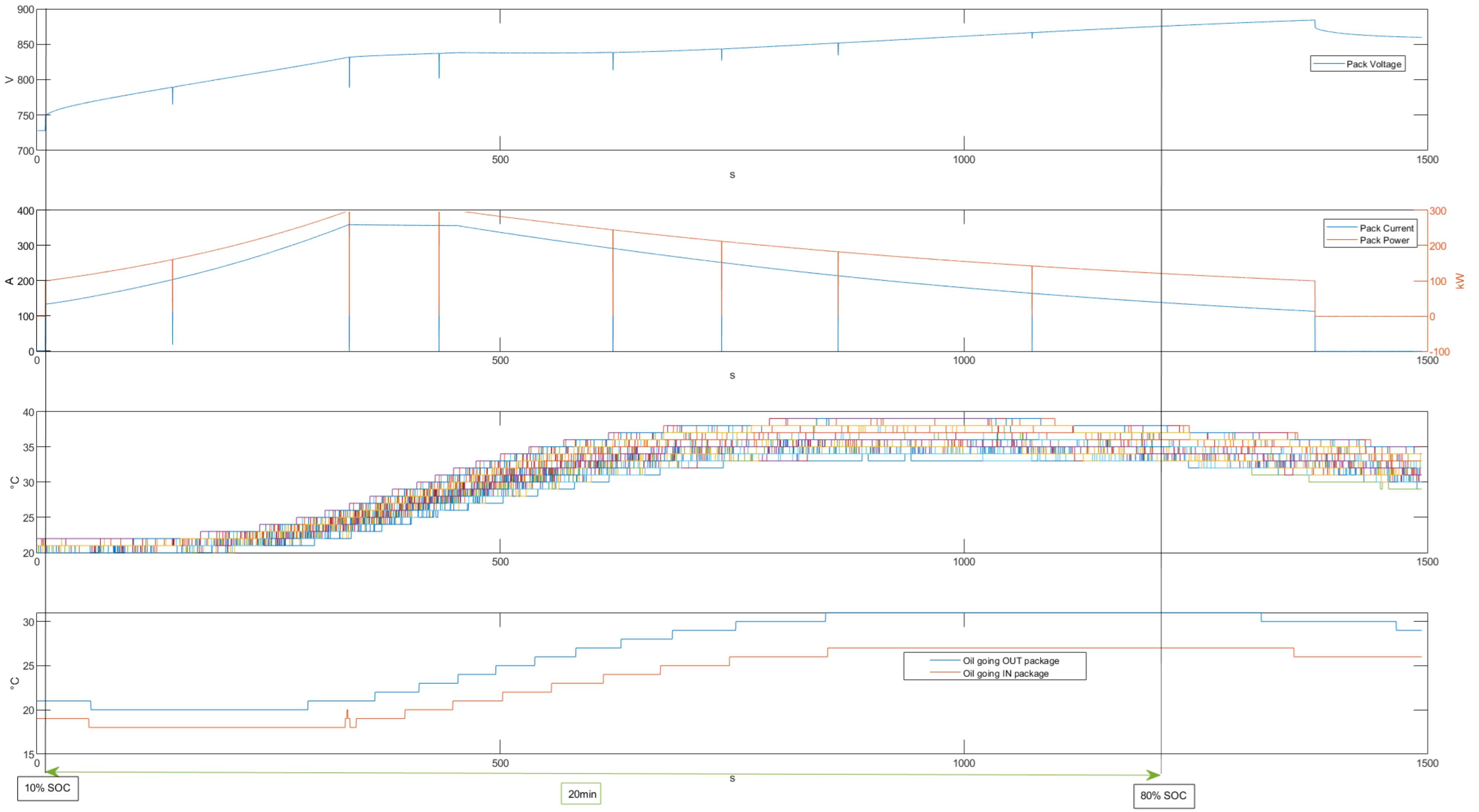
Test bench for battery pack testing

Fast Charge 300kW test:

~20min for 10% → 80% SOC

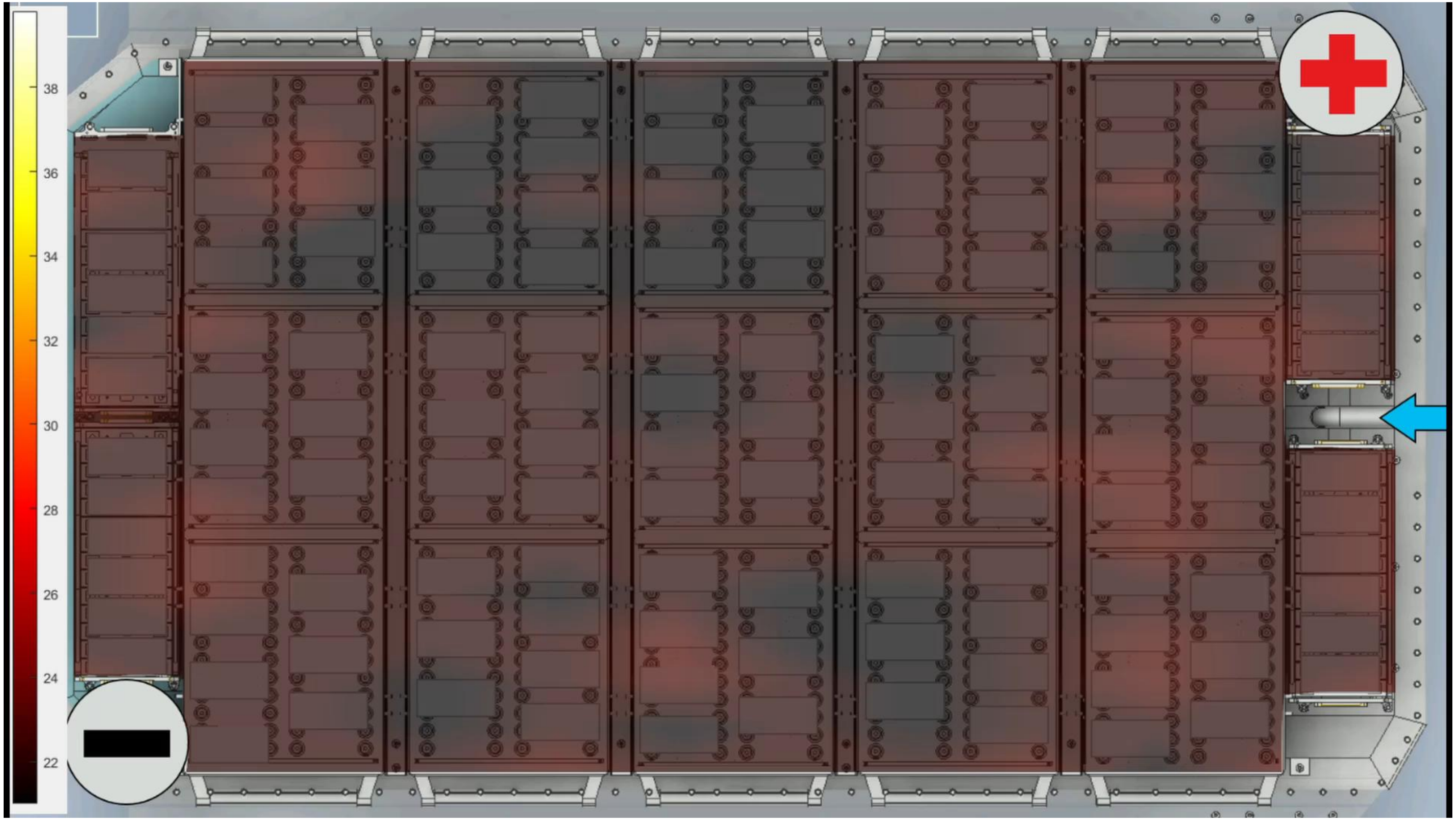
T cells < 40°C
ΔT cells < 6°C

T_{oil} > 20°C



Test bench for battery pack testing

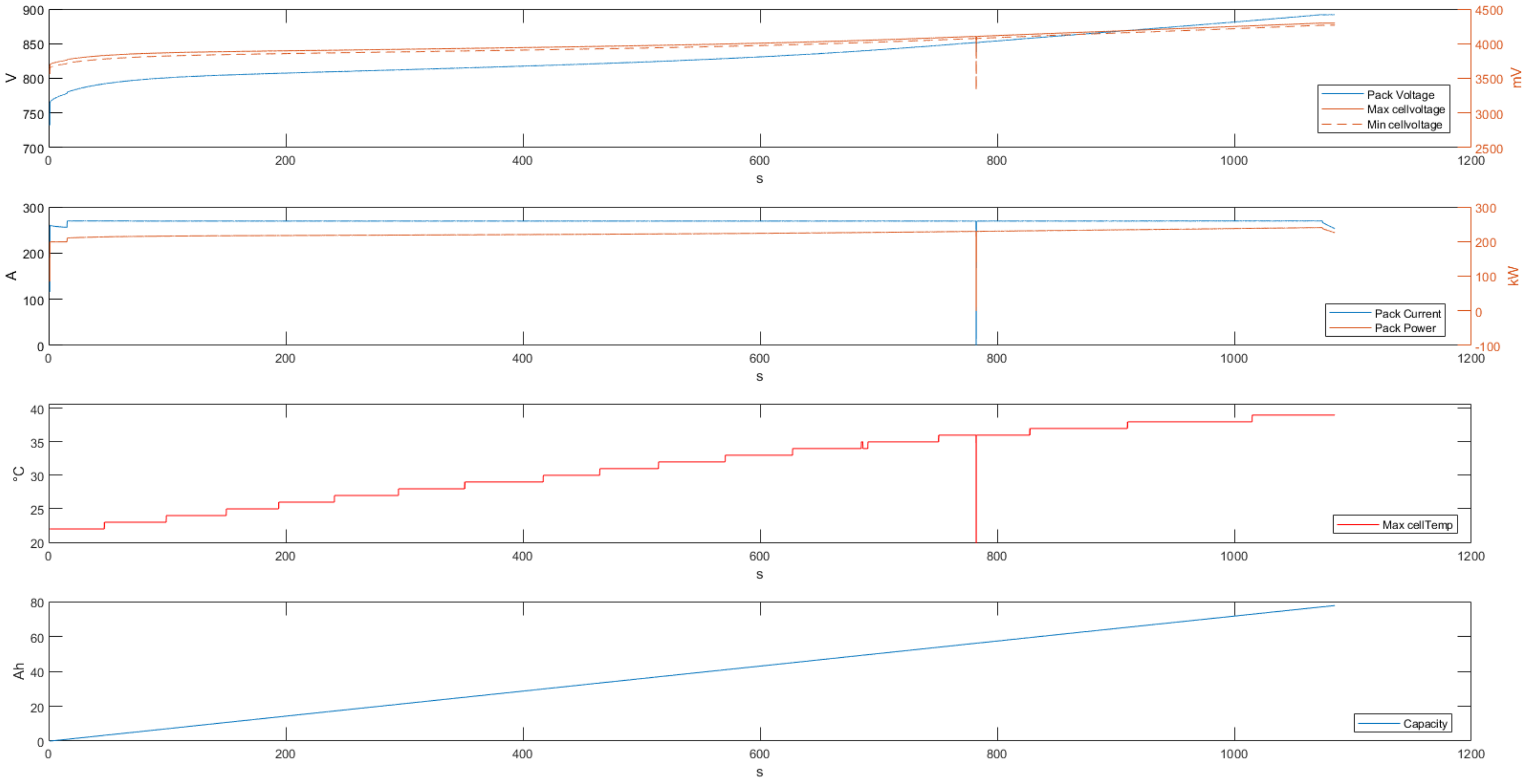
Fast Charge
300kW heat
distribution



Test bench for battery pack testing

Fast Charge
2.33C test:

18min for
10 → 80% SOC



ACTIVE SAFETY (With spray)

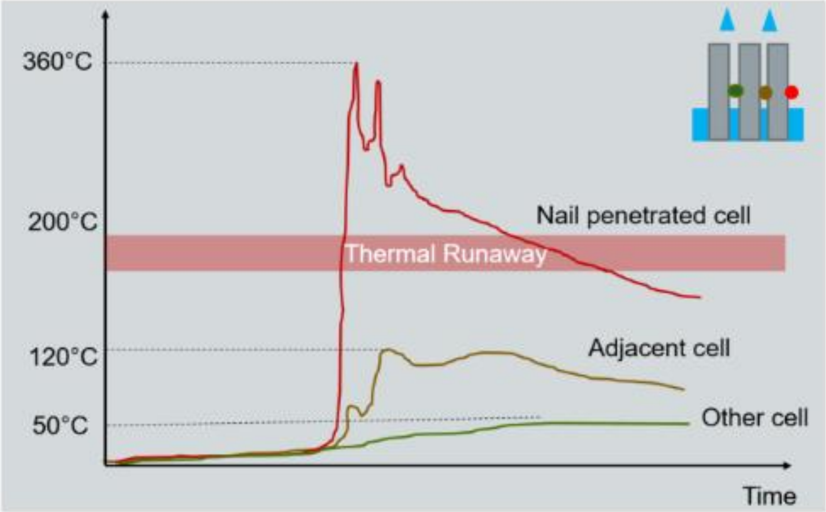
- **Objective** : TR validation with spray cooling

- Test method : nail penetration
- Cells 58Ah (CALB)
- Flow rate ~ 4.5l/min
- T cooling = 25°C
- Test method : nail penetration

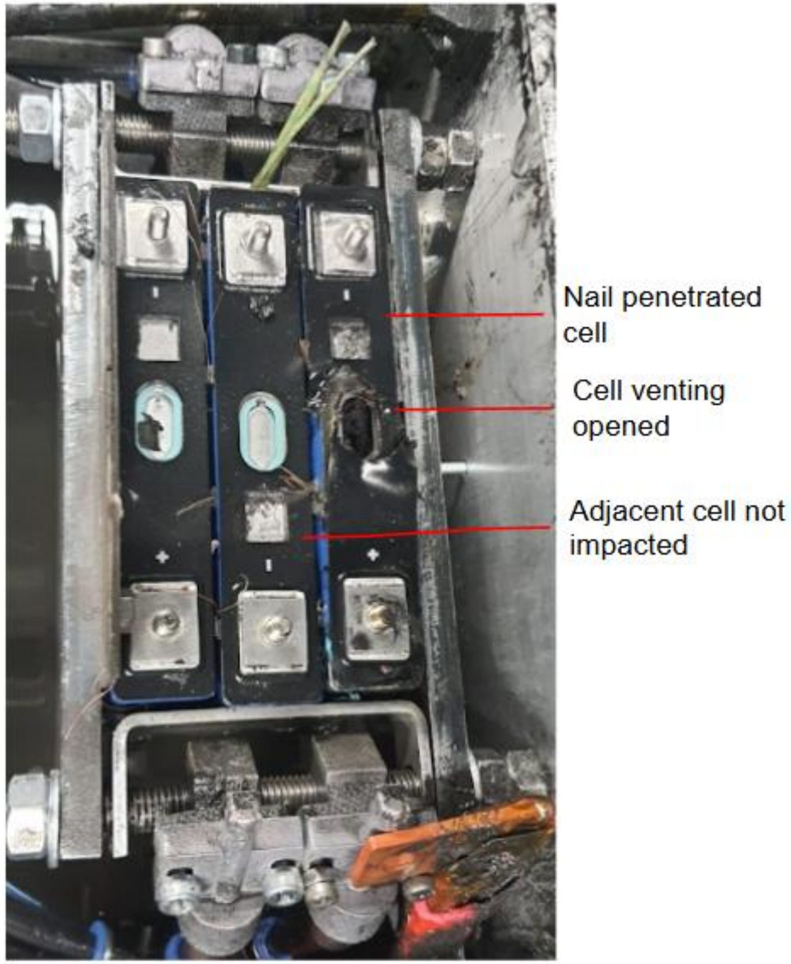
- **Test result:** No TR propagation to the adjacent cells

- Max penetrated cell temperature 365°C
- Max average temperature of the adjacent cell **85°C → no TR propagation**

Spray cooling over the cells



TR results (09/03/2023 at Virtual Vehicle Austria)



Visual of the cells after the TR tests

Thank you

Lightweight Battery System for Extended Range at Improved Safety

LIBERTY has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 963522.
The document reflects only the author's view, the Agency is not responsible for any use that may be made of the information it contains.

MARBEL

Manufacturing and assembly of modular and reusable EV battery for environment-friendly and lightweight mobility

Switchable 400V/800V JBOX for Ultra-Fast Charging

PRESENTER NAME: Alberto Gómez Núñez – FICOSA AUTOMOTIVE S.L.U.
EMAIL: alberto.gomeznunez@ficosa.com

DATE: 26th November 2024

FICOSA GROUP HIGHLIGHTS

Established in **1949** in **Barcelona**

Presence in **17 countries**

8,152 employees

Automotive **Tier 1** supplying all **major OEMs**

Global partners with **Panasonic**

8% sales invested in **R&D**

1,3 bn € sales

MARBEL

FICOSA GLOBAL FOOTPRINT

USA — Detroit (MI)-Cookeville-(TN) Shelbyville (KY)

Mexico — Salinas – Victoria Escobedo

Brazil — Sao Paulo

Spain — Viladecavalls – Barcelona – Soria – Sant Guim

Portugal — Porto

France — Dieuze – Le Neubourg

Morocco — Rabat

Germany — Rüsselsheim – Köln - Wolfenbüttel

Italy — Morcone - Venaria

Poland — Dabrowa Gornicza

Romania — License agreement

Turkey — Bursa / Gemlik

India

China — Taicang

Japan — Tokyo

Korea — **(Joint venture)** Gyeongsangbuk-do

Chart legend

Commercial Office

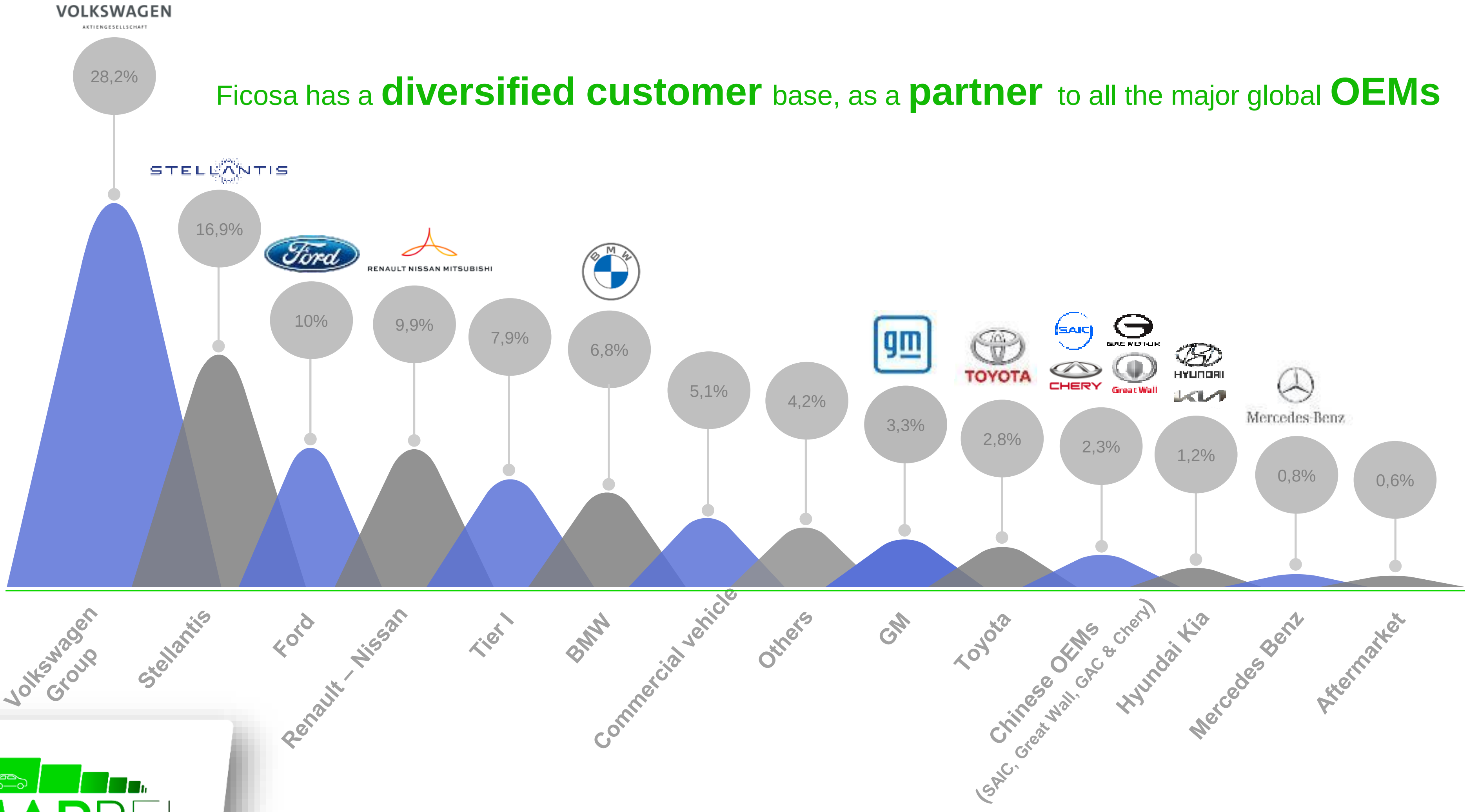
Plant

Technical Center

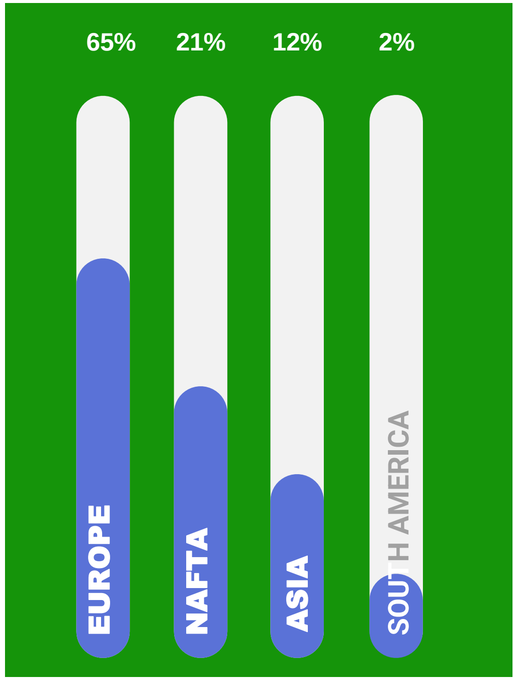
Research

FICOSA CUSTOMER DIVERSIFICATION

Ficosa has a **diversified customer** base, as a **partner** to all the major global **OEMs**



FICOSA
SALES BY REGION



MARBEL

FICOSA BUSINESS UNITS

MECHATRONICS

eMobility

Battery Management System, Junction Boxes, Current Sensors and Charging Systems

Command and Control

Gearbox actuators, Shifter-by-wire, MTX / ATX Gearshift and Styling parts, Electric Lumbar Systems and light cables.

VISION

Rearview Systems

Exterior Mirrors, Interior Mirrors and IRMS (Intelligent Rearview Monitoring System), Sensor Cleaning System

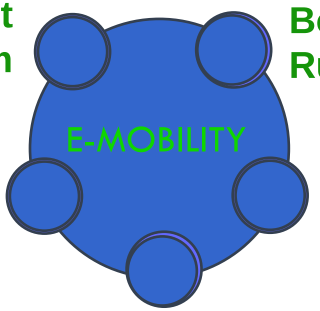
ADAS

Parking Cameras, Camera Monitoring Systems (eMirror), Surround View Systems, Autopark and Object sensing Camera, In-Cabin detection

SAFELY CONTROL OF ENERGY MANAGEMENT AND CHARGING IN BEV, PHEV & FCEV

Battery Management System

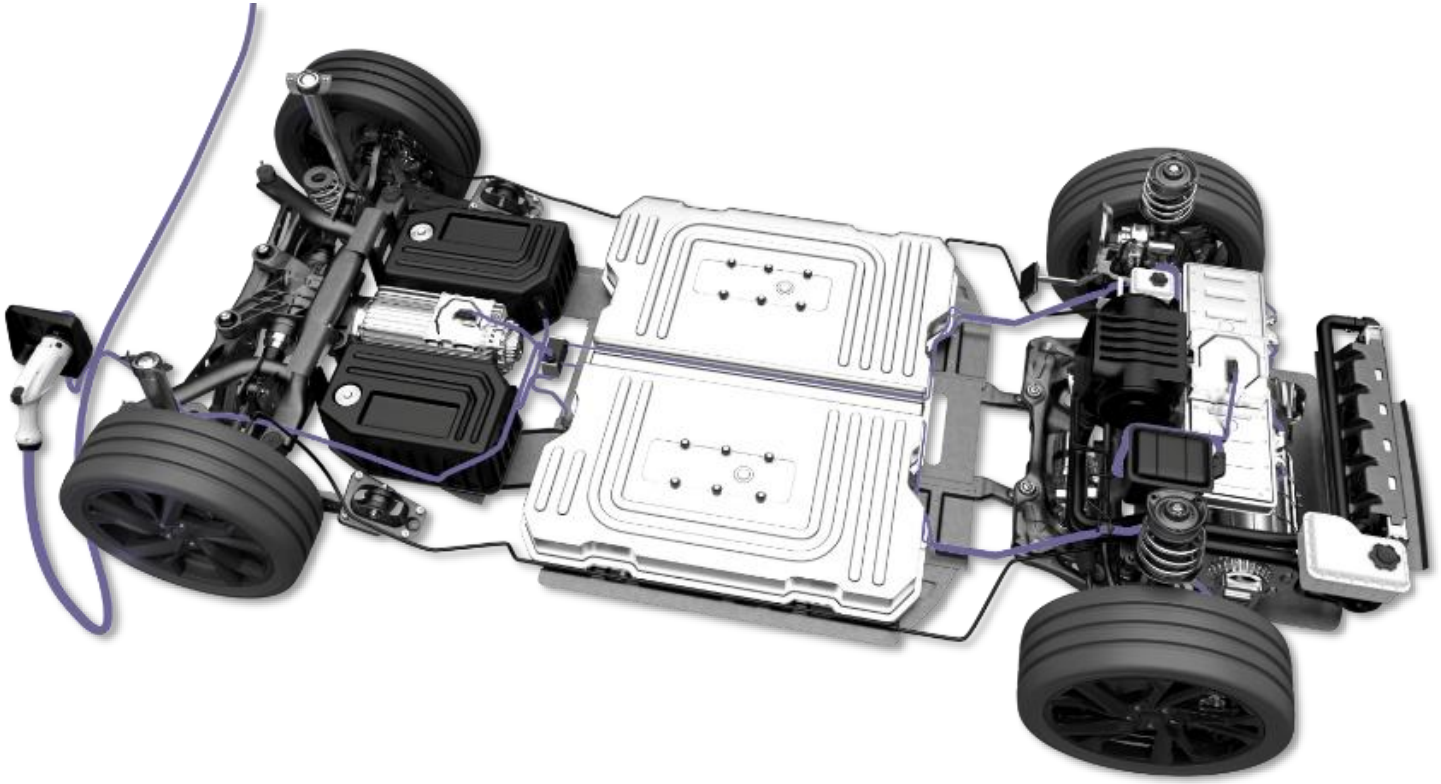
Multi-sensing Box /Thermal Runaway Sensors



Cell Connection Systems

Smart-Battery Junction Box

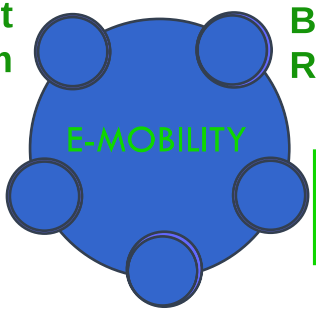
EV Charge Communication Controller



SAFELY CONTROL OF ENERGY MANAGEMENT AND CHARGING IN BEV, PHEV & FCEV

Battery Management System

Multi-sensing Box /Thermal Runaway Sensors



Cell Connection Systems

Smart-Battery Junction Box

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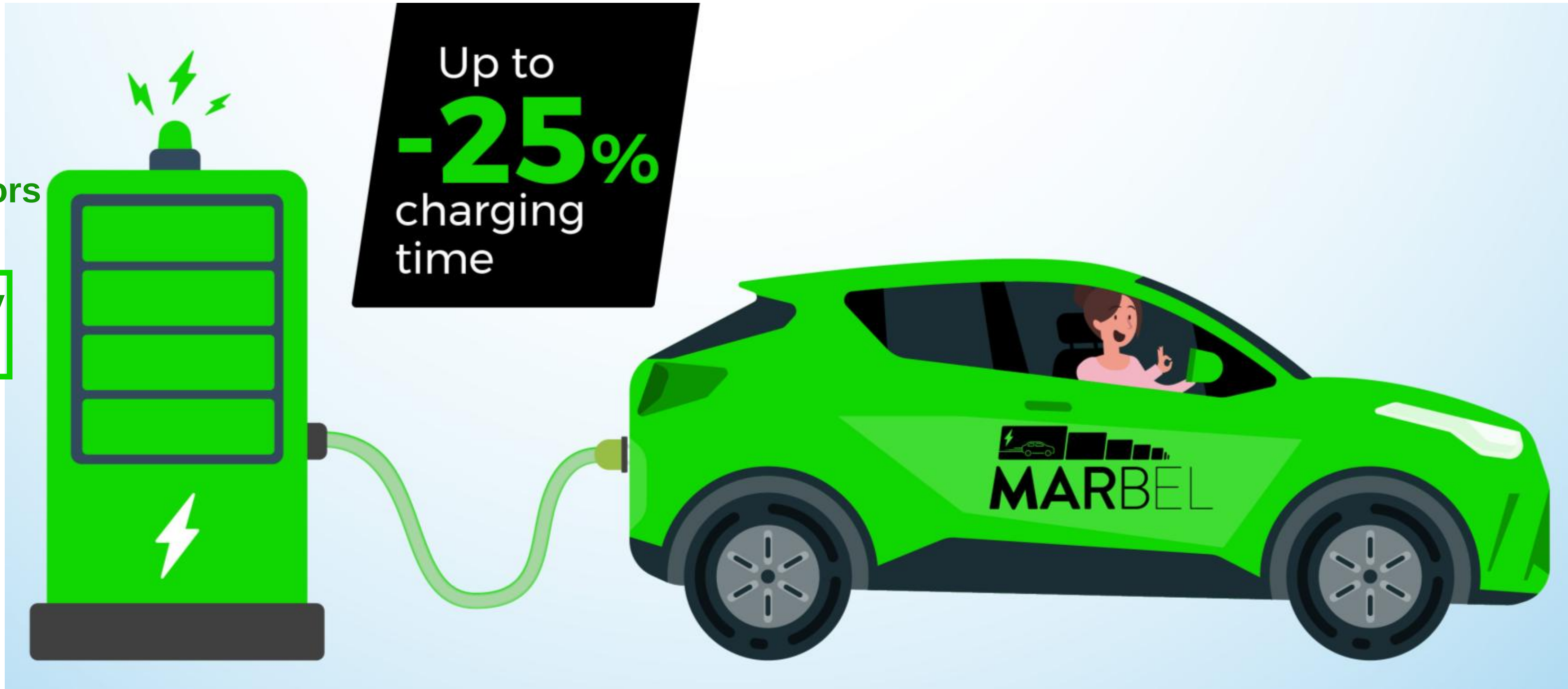
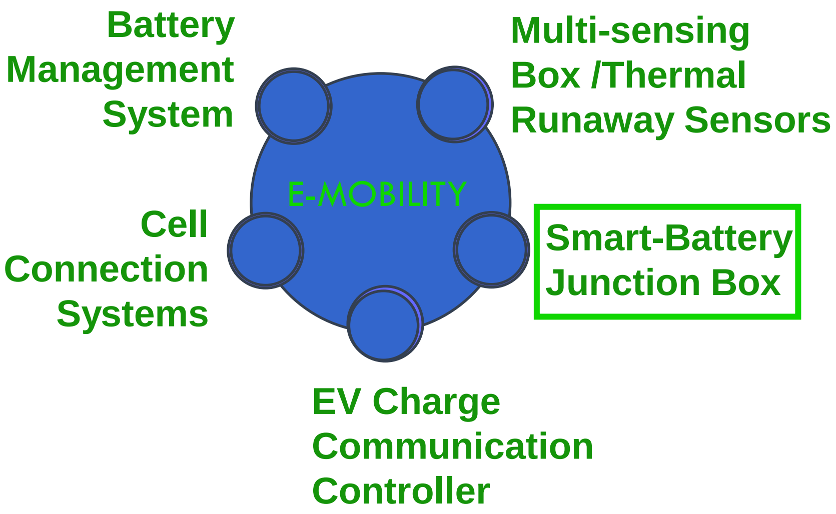
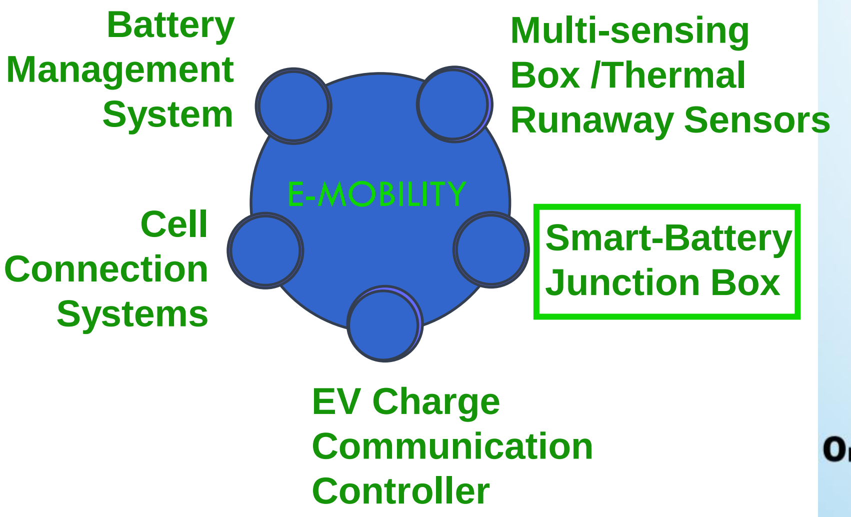


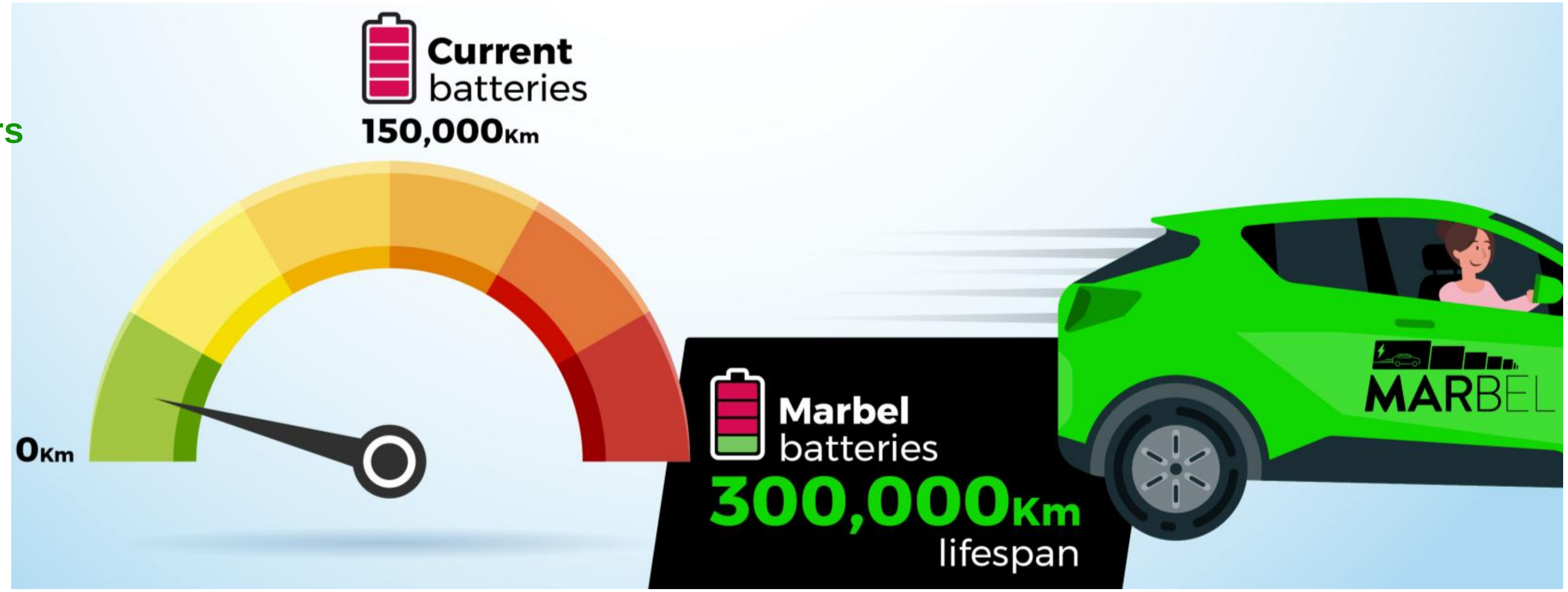
SAFELY CONTROL OF ENERGY MANAGEMENT AND CHARGING IN BEV, PHEV & FCEV



MARBEL

SAFELY CONTROL OF ENERGY MANAGEMENT AND CHARGING IN BEV, PHEV & FCEV

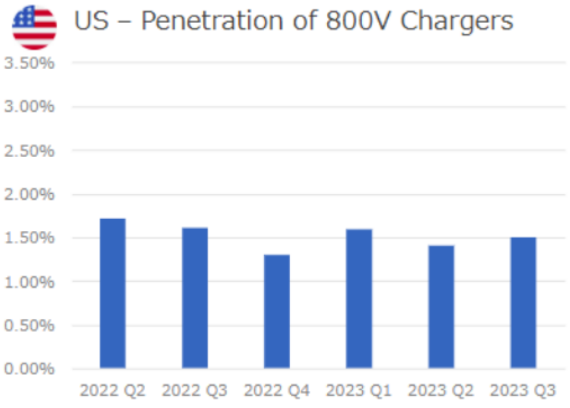


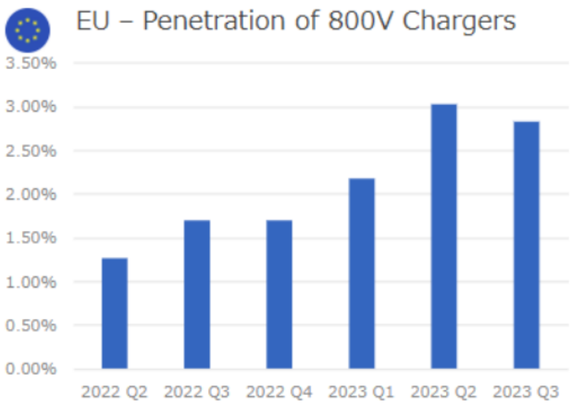


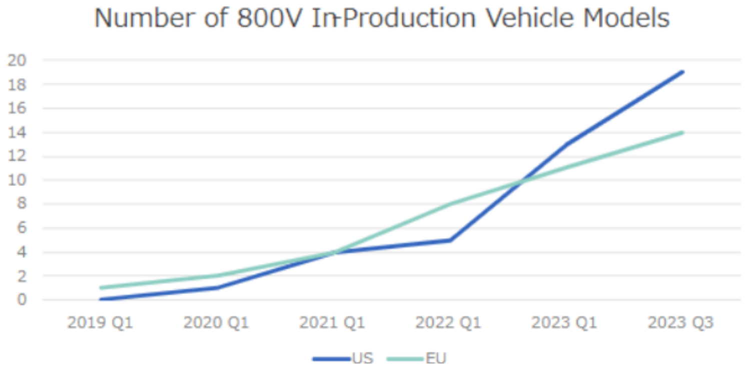
What were We thinking about in 2020? 400 V vs 800 V technologies

	400V Architecture	800V Architecture
Faster Charging Times	Charge times are typically current-limited either due to the capacity of the cables or the heat generated by the higher currents.	Supports higher power charging due to lower current needed for similar power.
More Power	Higher power potential with similar current profiles and smaller motors.	Can provide more power to the motors for faster acceleration.
Low-Current Cable Support	Many high-power chargers use 200A cables, limiting 400V vehicles to slower-than-expected charging speeds.	Higher voltage enables the use of lower current cables. This applies to both charging and the powertrain.
No Additional Hardware Needed	400V vehicles are already compatible with both 400V and 800V chargers.	Requires a DC/DC converter to be able to charge on existing 400V charging infrastructure.
Greater Efficiency and Range	Heavier components and less energy recovery potential compared to 800V. Higher currents produce more heat.	Able to capture more power from regenerative braking. Less energy lost to heat. Overall lighter build leads to better efficiency/range.
Lighter Components	Current limitations lead to heavier cables, power equipment, and motors being used due to lower voltage.	Lighter cables, power equipment, and motors can be used due to high voltage supporting lower current.
Lower Cost to Build	No new architecture required and existing high-volume components can be used.	Requires a rework of vehicle architecture and investment into new electronic components.

Source: SBD Automotive







OEMs with 800V models

US	EU
Audi Genesis GMC Hyundai Kia Porsche	Audi Hyundai Kia Porsche

Future is (>) 800 V, but when will it be a reality?

MARBEL

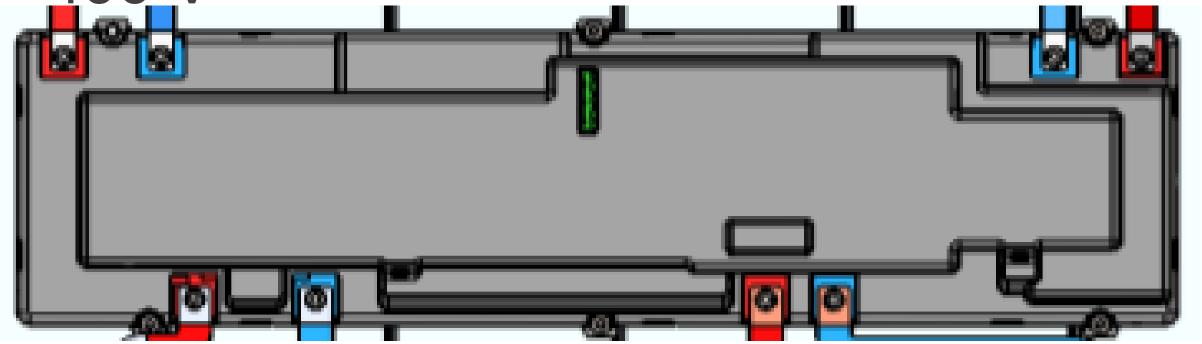
MARBEL SWITCHABLE JUNCTION BOX

Switchable architecture 400V / 800V

- Pro → Versatility for (dis-)charging
  ↓Cell-stress when charging > 150kW
  ↑Battery Lifetime & Safety
  Safety (only one 400V when necessary)

400 V

400 V



CHARGER
400V / 800V

INVERTER
400V / 800V

MARBEL SWITCHABLE JUNCTION BOX

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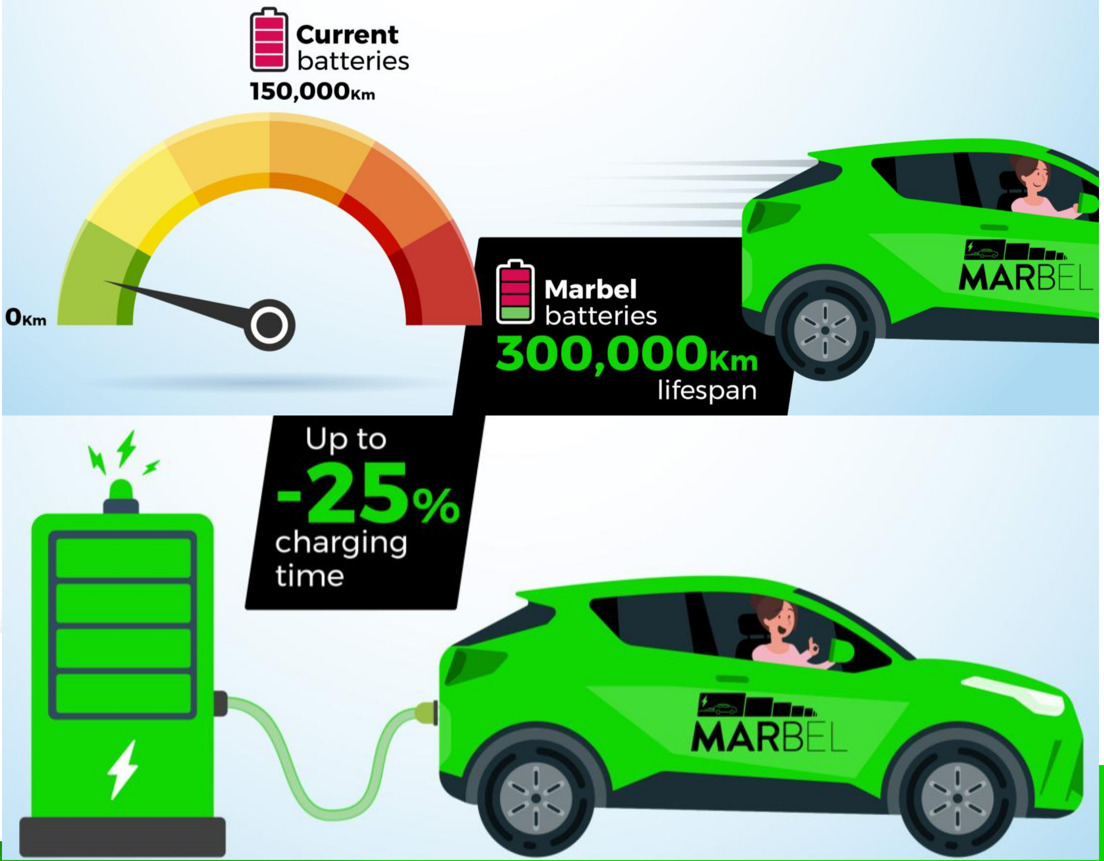
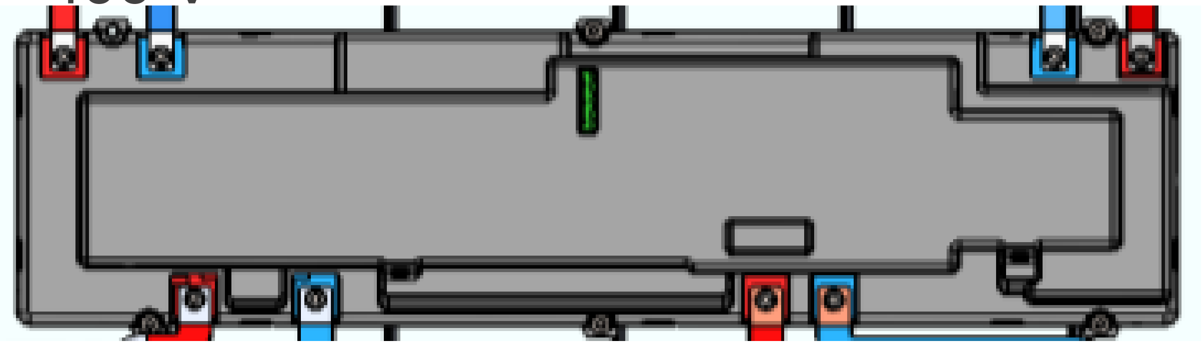


400 V 400 V



CHARGER
400V / 800V

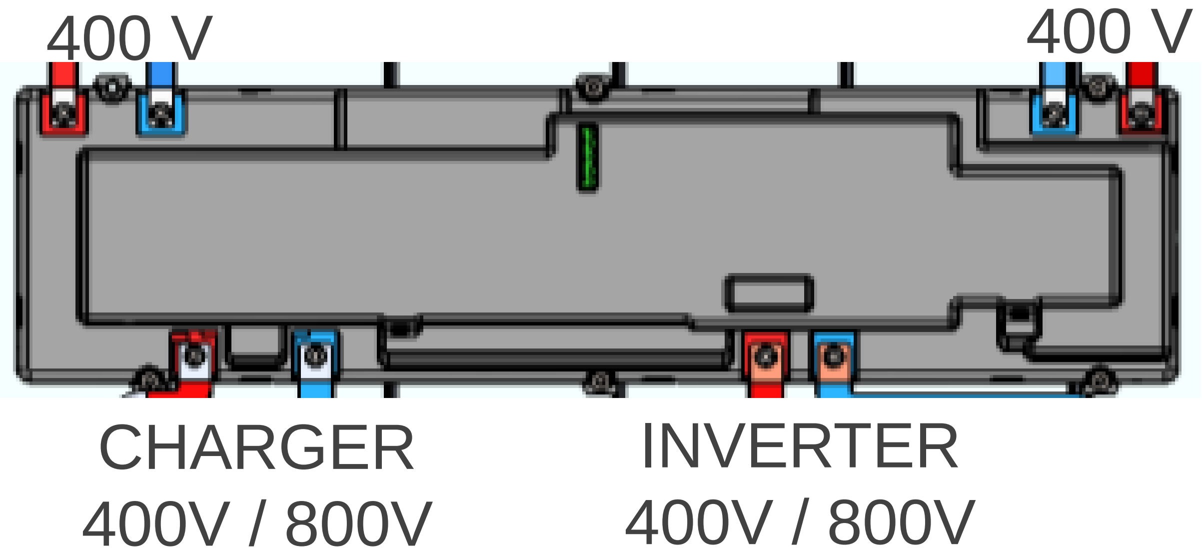
INVERTER
400V / 800V

MARBEL SWITCHABLE JUNCTION BOX

Switchable architecture 400V / 800V

- Pro → Versatility for (dis-)charging
  ↓Cell-stress when charging > 150kW
  ↑Battery Lifetime & Safety
  Safety (only one 400V when necessary)

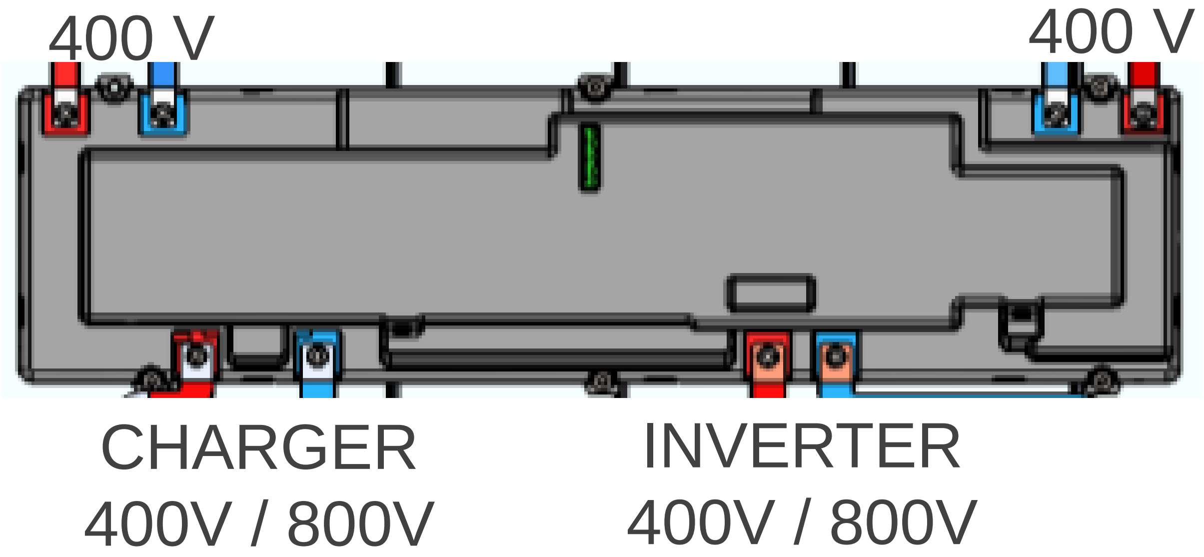
- Con → Future is (>)800V in EV & EVSE
  ↑Components = ↑Weight & Cost
  Contactor's ageing when cycled



MARBEL SWITCHABLE JUNCTION BOX

Aluminium busbars (instead of Copper)

- Pro → ↑Sustainability vs Copper
  ↓Weight & Cost vs Copper



MARBEL

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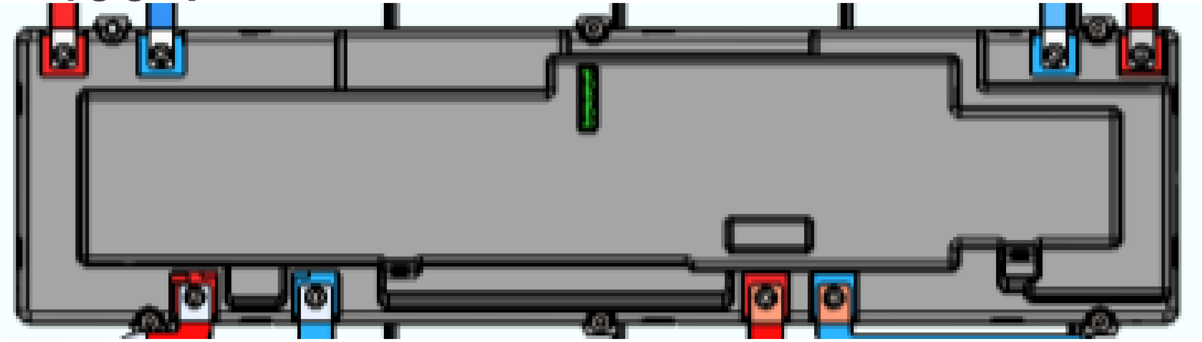
400 V

400 V



CHARGER
400V / 800V

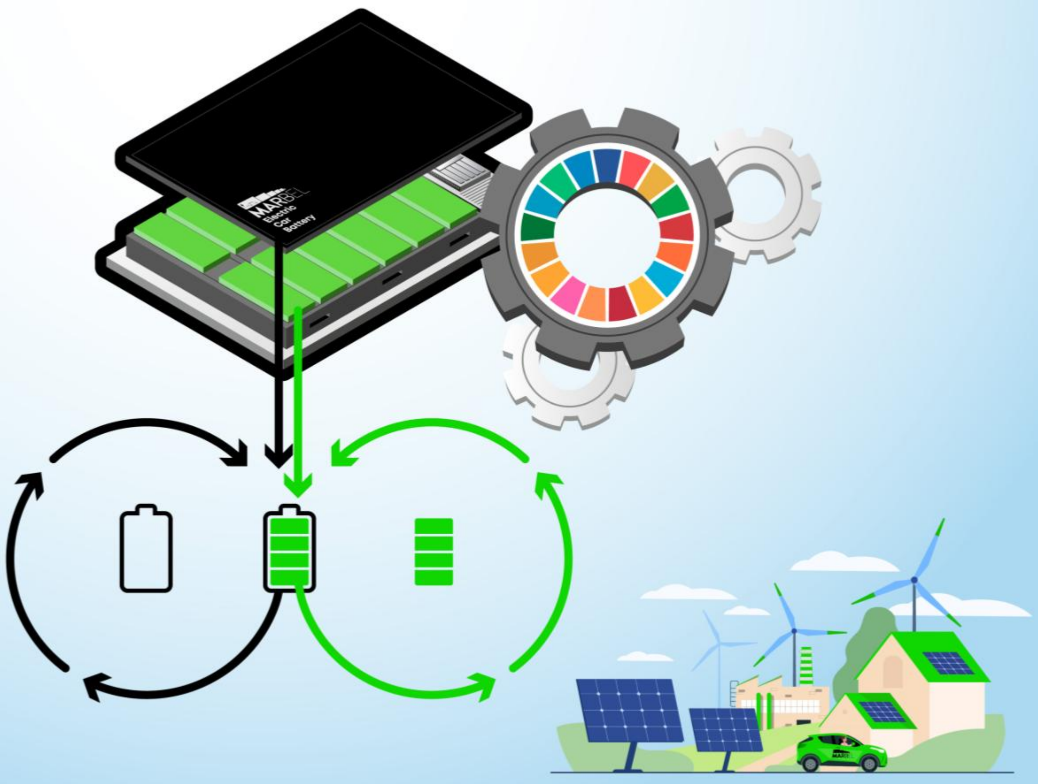
INVERTER
400V / 800V

MARBEL SWITCHABLE JUNCTION BOX

Aluminium busbars (instead of Copper)

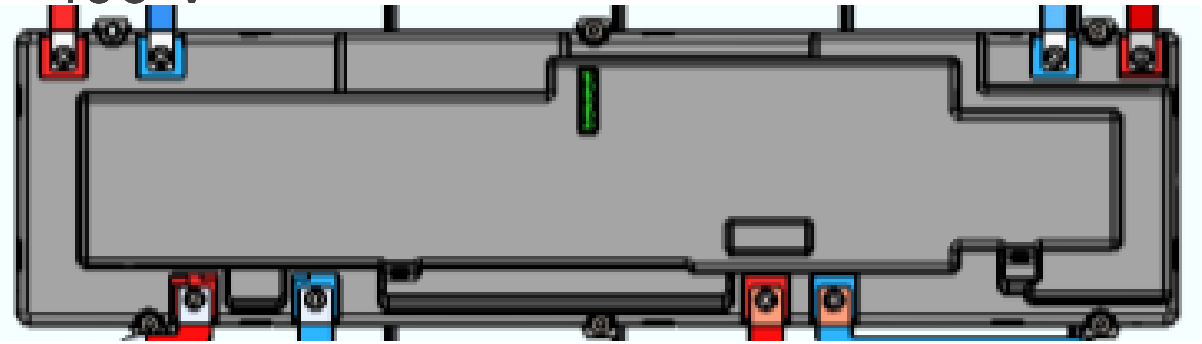
- Pro → ↑Sustainability vs Copper
  ↓Weight & Cost vs Copper

- Con → Ni-coating (↓Sustainability)
  Non recycled Al (↓Sustainability)



400 V

400 V



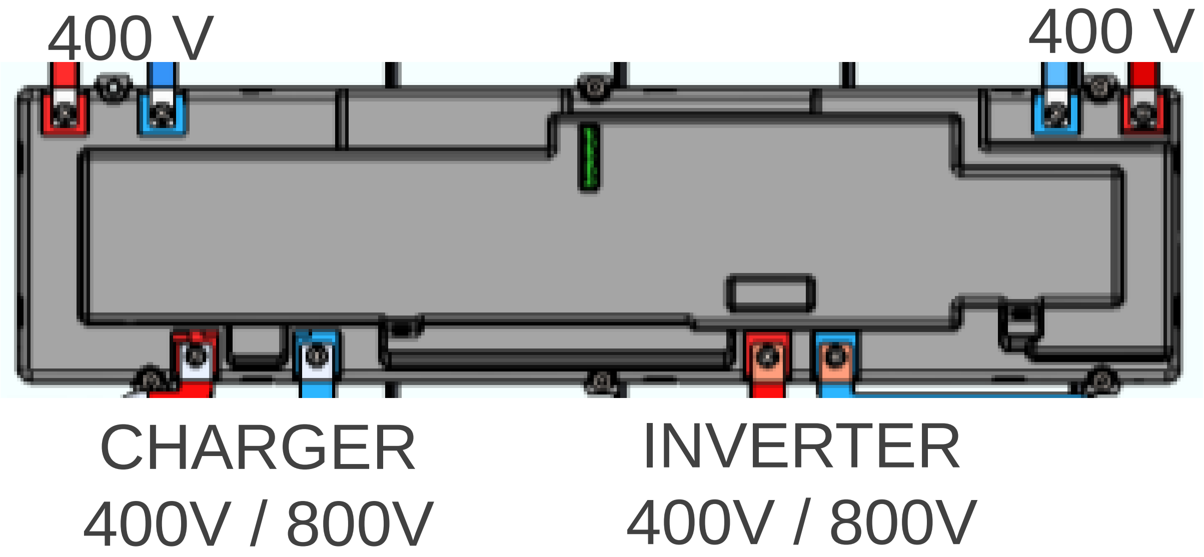
CHARGER
400V / 800V

INVERTER
400V / 800V

MARBEL SWITCHABLE JUNCTION BOX

Optimized Housing (Brackett/Cover)

- Pro → ↑Sustainability + ↓Weight & Cost.

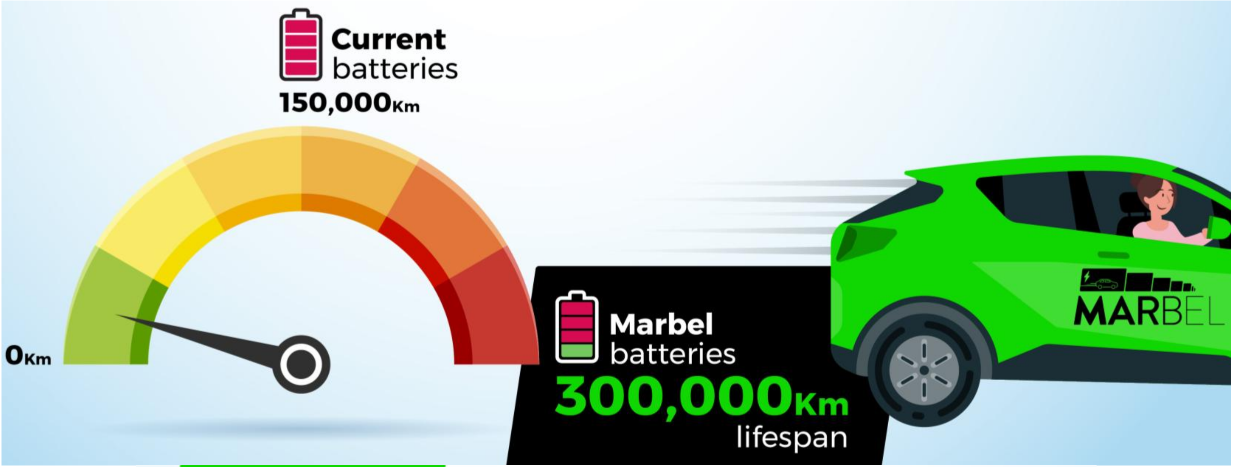


MARBEL

MARBEL SWITCHABLE JUNCTION BOX

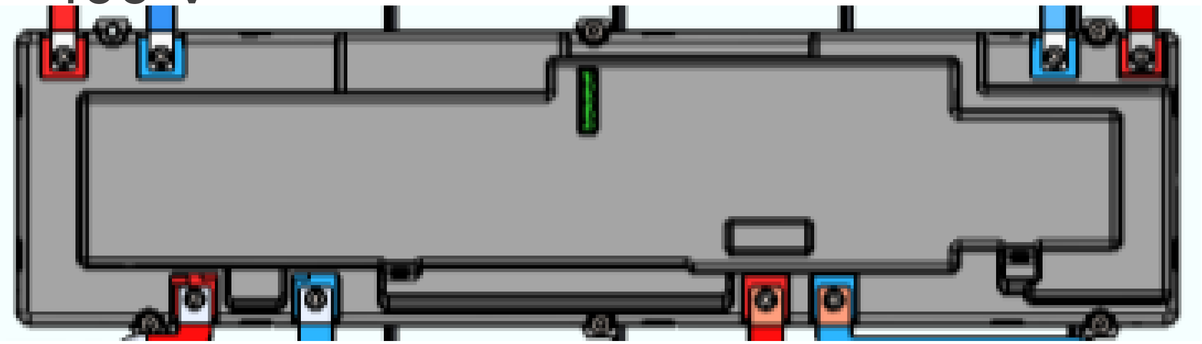
Optimized Housing (Brackett/Cover)

- Pro → ↑Sustainability + ↓Weight & Cost.



400 V

400 V



CHARGER
400V / 800V

INVERTER
400V / 800V

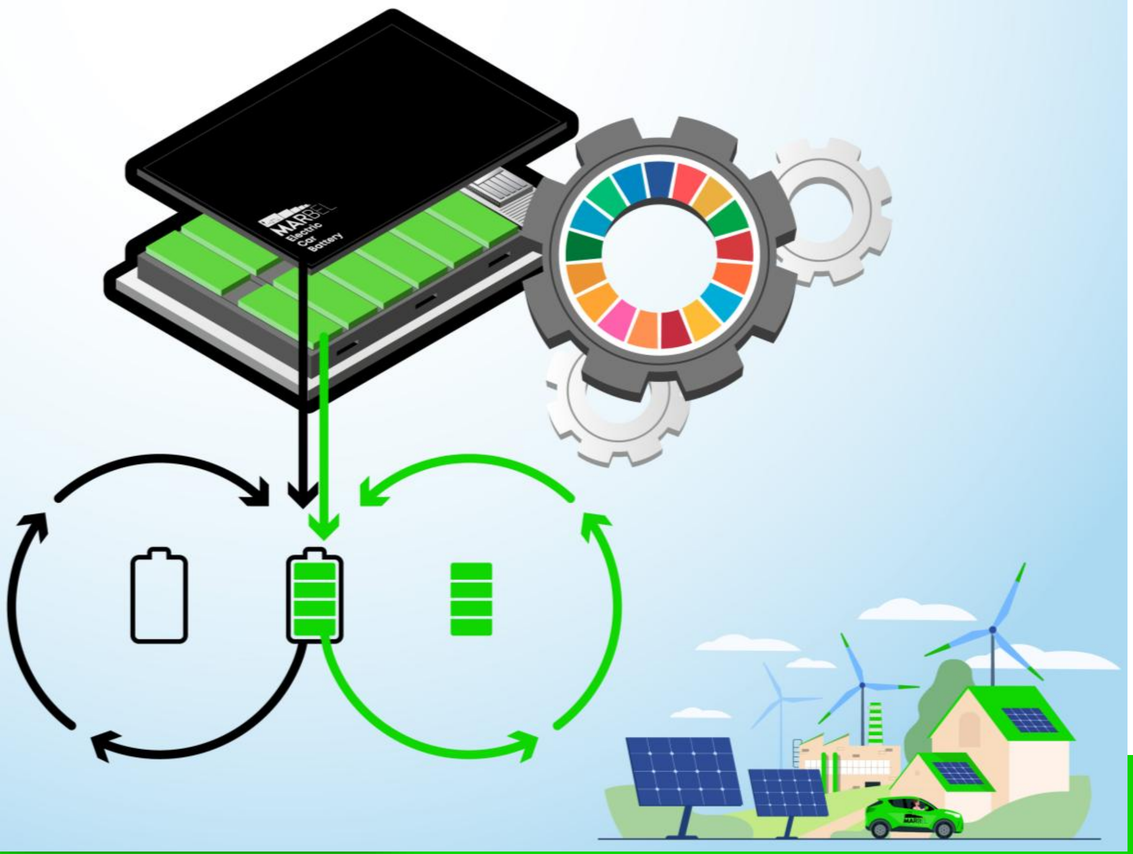
MARBEL SWITCHABLE JUNCTION BOX

Optimized Housing (Brackett/Cover)

- Pro → ↑Sustainability + ↓Weight & Cost.

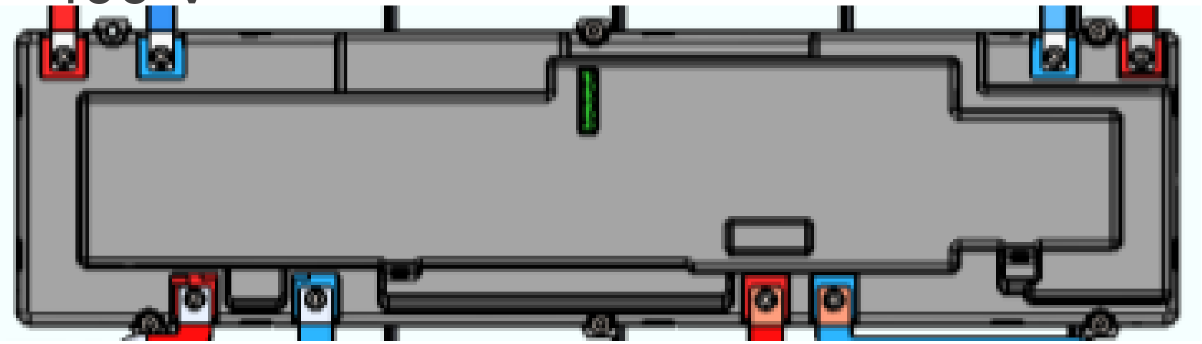
- Con → Non recycled Plastic* (↓Sustainability)

**Polypropylene (PP) & Polyamide (PA)*



400 V

400 V



CHARGER
400V / 800V

INVERTER
400V / 800V

MARBEL

Manufacturing and assembly of modular and reusable EV battery for environment-friendly and lightweight mobility

THANK YOU!

PRESENTER NAME: Alberto Gómez Núñez
FICOSA AUTOMOTIVE S.L.U.
EMAIL: alberto.gomeznunez@ficosa.com
DATE: 26th November 2024

A project coordinated by:

eurecat