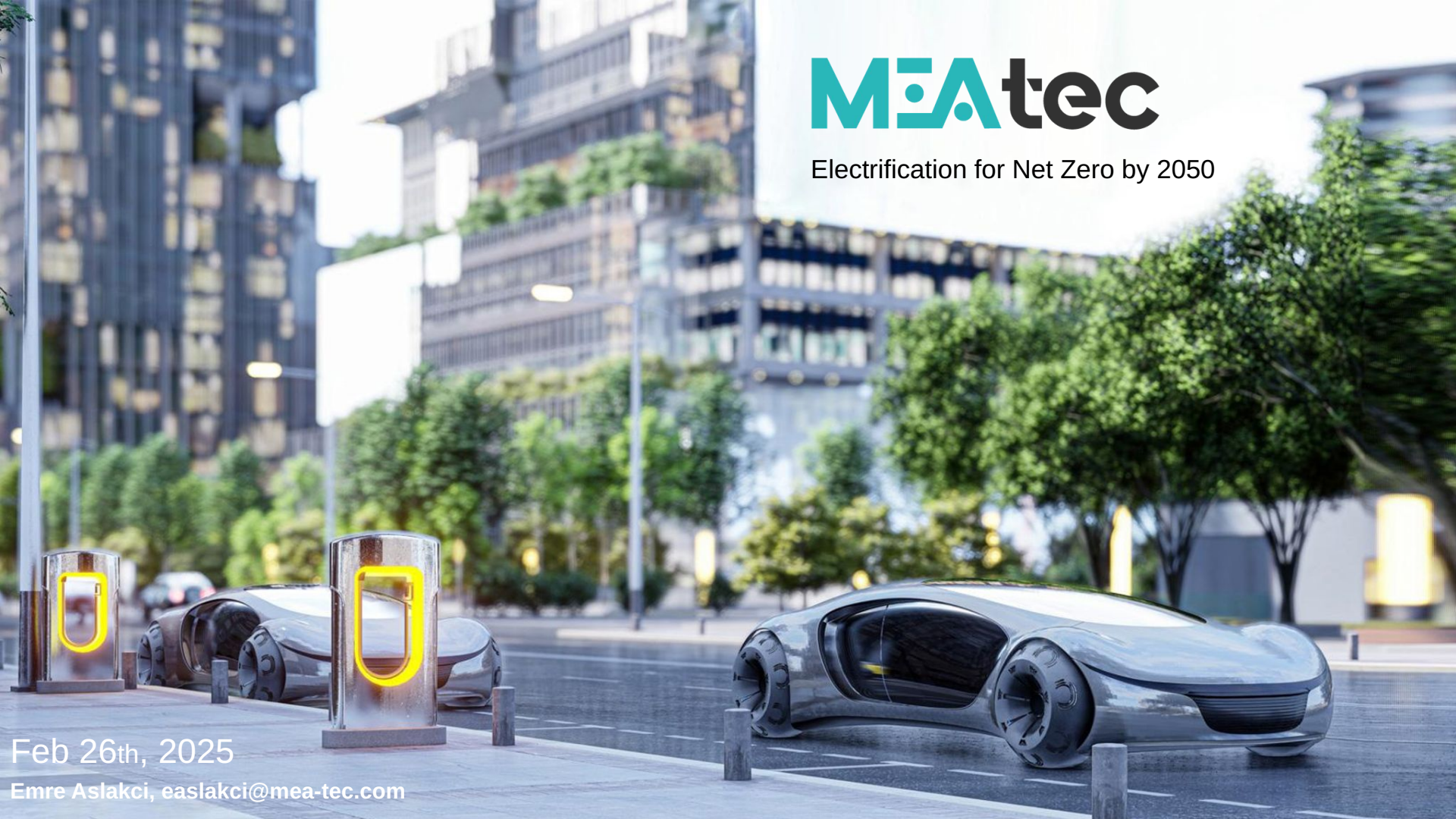


MEAtec

Electrification for Net Zero by 2050

Feb 26th, 2025

Emre Aslakci, easlakci@mea-tec.com

About MEATEC

- Turn key automotive projects
- Global and Local Customer Network
- The state-of-the-art solutions in **international standards**
- Expertise for **Battery Management Systems**

2021
Founded

€ 1.5m
Earned Profit

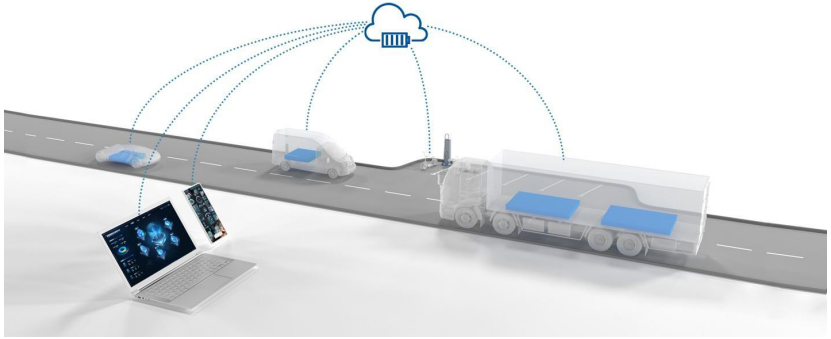
€ 1.4m
Secured Public Funding

40+ Year
Combined Industry Experience

Ankara /TR
R&D Center

Stuttgart /DE
Engineering & Sales

London /UK
R&D Center

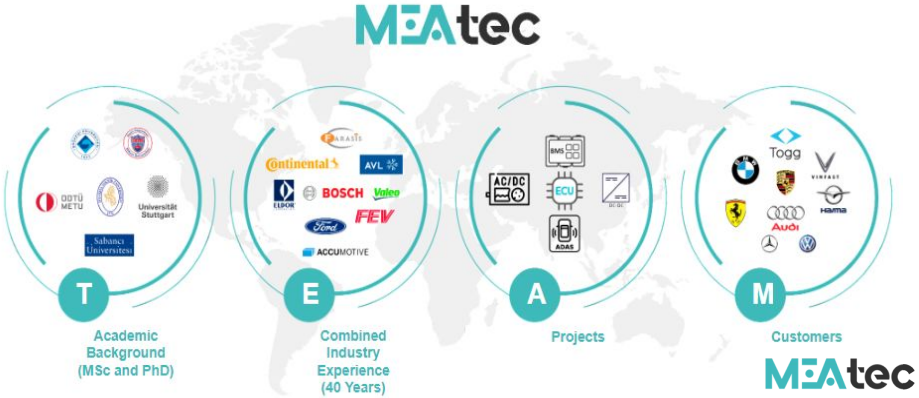


Mobility Services

- Electrified Mobility
- Connected Mobility
- Automated Mobility
- Infotainted Mobility

Engineering Services

- Hardware
- Software
- System
- Mechanic
- Test / Diagnosis



Recognitions

2021 Q3

First Customer

FARASIS

Germany

*BMS software is developed for **mass production** in **2023'Q2**.*

International Team

University Collaborations and Networks

- Bilkent University
- Sabancı University
- Southern Denmark Uni.
- Imperial College London
- Fraunhofer IAO

BEPA Batteries European Partnership Association

EUREKA

HORIZON EUROPE

TÜBİTAK

5 Approved Grant-Funded Projects

Other Customers

MAGNA

Austria

Nidec

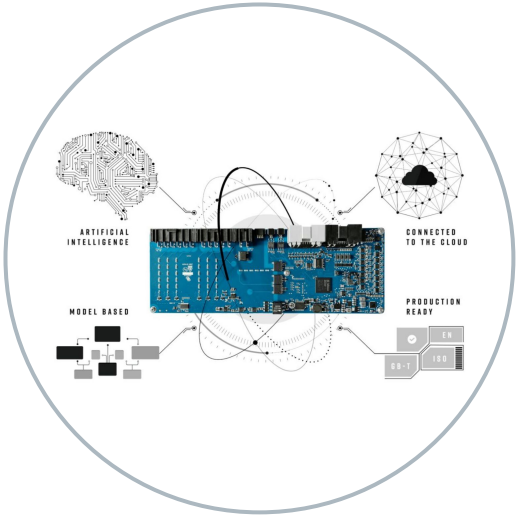
Germany

Worldwide Offices

2025 Q1

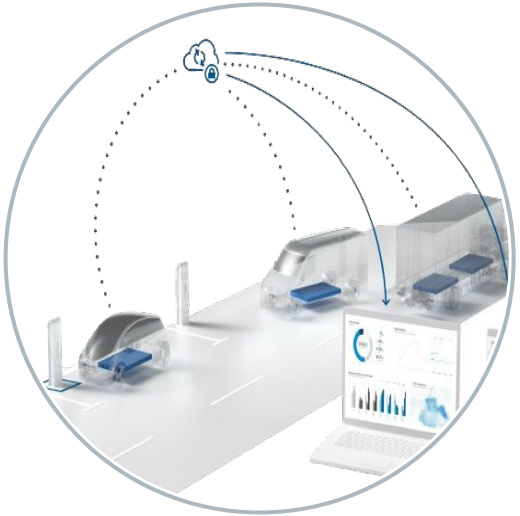
MEAtec

MEAtec's Solutions for **Battery Systems**



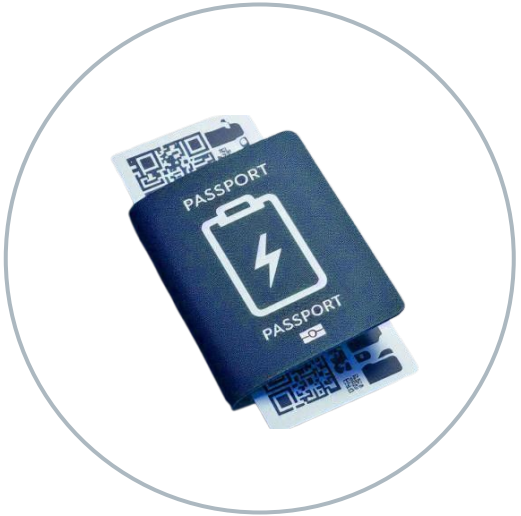
Battery Management System

Commercialized



Battery in Cloud

Will be ready on 2025'Q2



Battery Passport

Will be ready on 2025'Q3

Our Expertises

DIGITAL TWIN

1

- Physics-Informed Cell Modeling
- Reduced-Order Cell Modeling
- Advanced Equivalent Circuit Models (ECM)

BATTERY CLOUD ANALYTICS

2

- Machine Learning Models for SOC, SOH, RUL, and Early Fault Prognosis
- Integrated Cloud Solutions Compatible With Platforms Like Aws and Azure

BATTERY MANAGEMENT SYSTEM

3

- High-Performance Hardware Design
- Wireless BMS Technology
- Model-Driven Software Development

SMART FAST CHARGING

4

- Anode-Controlled Predictions
- AI Algorithms and Cloud Integration
- PID Controller Design for Charge Optimization

SECOND-LIFE BATTERY APPLICATIONS

5

- End-Of-Life Battery Diagnostics via Cloud Analytics and Battery Passport Integration
- Decision-Making Tools For Second-Life Applications Of Batteries

DIGITAL BATTERY PASSPORT PLATFORM

6

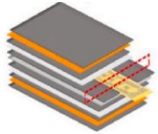
- Implementation Of EU Regulations For Transparent Data Management
- Real-Time Data Integration with BMS Connectivity
- Blockchain-Based Secure Data Exchange

D2-01: Development of Sustainable and Design-to-Cost Batteries with (Energy-) Efficient Manufacturing Processes and Based on Advanced and Safer Materials

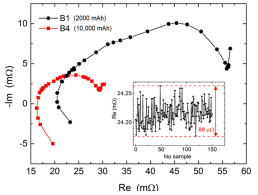
Call Scope

- Adapting Sensing solutions to improve lifetime and state of health detection.
- Quantification of degradation mechanisms at early stage to determine the best strategy for beyond the first life.

Our Contribution



Implantable resistance temperature detectors



EIS curves measured for two batteries of different capacity

- Meatec can deploy **high-precision sensors** such as electrochemical impedance spectroscopy (EIS), temperature and voltage sensors, inside prismatic battery cells for continuous, real-time monitoring to assess internal conditions without disruption.
- Meatec will use **cell-level measurement data to develop on-board BMS algorithms to calculate accurate battery SOC and SOH,** ensures safer and more efficient battery operation by enabling **subtle control** and deeper insights into **pack performance**.

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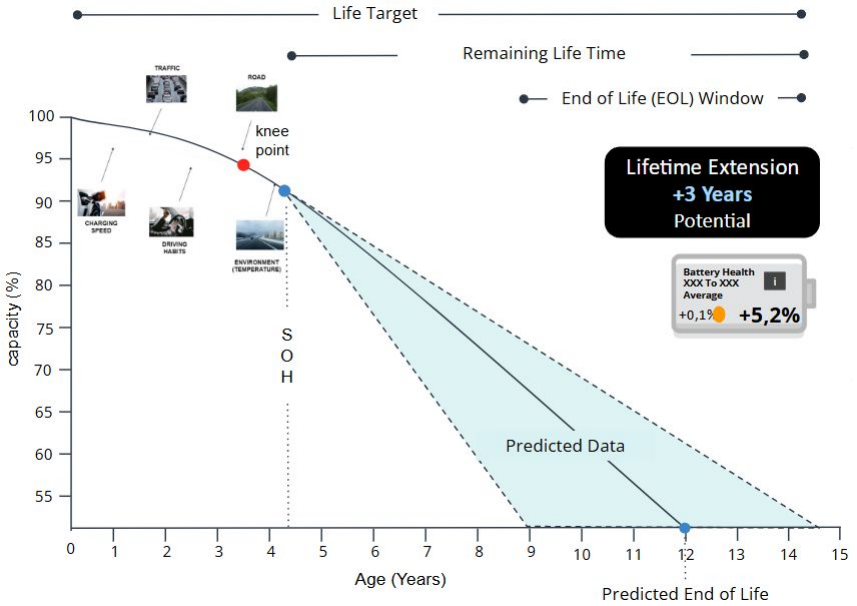

- **Machine learning** and **predictive modeling** quantify early degradation trends (e.g., capacity fade, resistance increases) to develop accurate SOH models. Combined with **physics-based methods** that provide deep insights into battery chemistry, this approach effectively handles large-scale data and predicts subtle degradation, enhancing battery lifetime and health detection.

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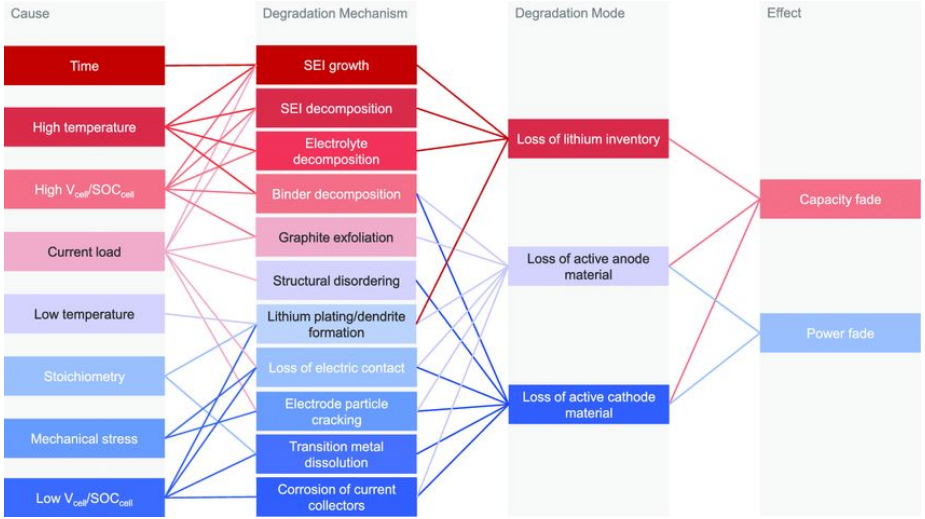

- Meatec BMS with machine learning & physics based aging models not only just identify the degradation behavior but also quantify the mechanisms as anode based or cathode based or Loss of Lithium inventory (LLI) through effective non destructive methods like differential voltage analysis 6 incremental capacity analysis.

https://www.researchgate.net/publication/311577607_Degradation_diagnostics_for_lithium_ion_cells

D2-01: Development of Sustainable and Design-to-Cost Batteries with (Energy-) Efficient Manufacturing Processes and Based on Advanced and Safer Materials

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Our Contribution

Grade A:	Battery shows little signs of degradation and could be reused in a new EV.
Grade B:	Battery shows some signs of degradation but can still be repurposed for most second-life applications, for example, stationary energy storage.
Grade C:	Battery is heavily degraded but still functional. They are typically deployed in backup power systems
Grade D:	Battery is unsuitable for any second-life applications and should be recycled.

- This early-stage data is then used to devise **targeted strategies** for extending battery life and facilitating **second-life application** and repurposing **decisions**, ensuring informed maintenance decisions that support battery longevity beyond the first life.

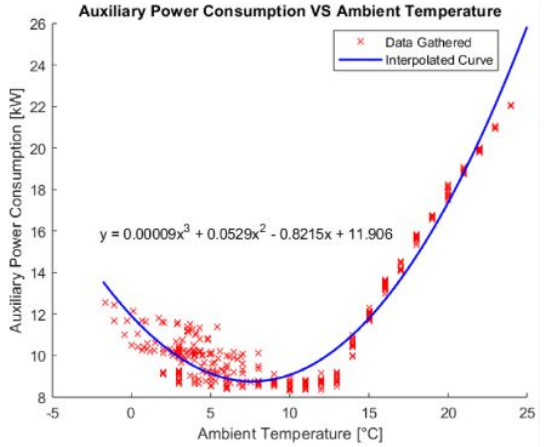
D2-02: Cost-effective next-generation batteries for long-duration stationary storage

Call Scope

- Battery technologies with minimal required auxiliary services, storage in a wide range of State-of-Charges (SOCs), and minimal voltage slippage.
- Projected lifetime of 20 years with minimised self-discharge in operating and ambient conditions typical of the selected application.
- Minimum round-trip efficiency of 50% at energy storage system (AC) level and 75% at cell level.

Our Contribution

- MEATEC can implement advanced interoperable **hardware design and** sophisticated **software algorithms**, minimizing the need for excessive power consumption by auxiliary systems.
- Integrating **AI-driven predictive models** and **smart BMS** solutions can significantly **reduce auxiliary loads** by **optimizing operations** and **reducing idle consumption**.
- **Next-gen battery systems** should focus on **low-power auxiliary designs**, **efficient component selection**, and **real-time adaptive controls** for enhanced performance.



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Our Contribution

- MEAtec can implement **advanced control algorithms** to prevent the risks of deep discharging or overcharging by accurately estimating the **State of Charge (SOC)** and ensuring it remains within the safe operational limits.
- By delivering ancillary services such as **Frequency Containment Reserves** and **peak shaving**, BESS are operated with high efficiency and intelligence, optimizing the entire **State of Charge (SoC)** range.
- Meatec can accurately and efficiently monitors the **aging mechanisms** through its **machine learning** or model based aging models to effectively track the **voltage slippage.**
- The approach is not only enhances system efficiency but also reduces **operational costs by 30%** and extends **battery life by 20%**.

D2-02: Cost-effective next-generation batteries for long-duration stationary storage

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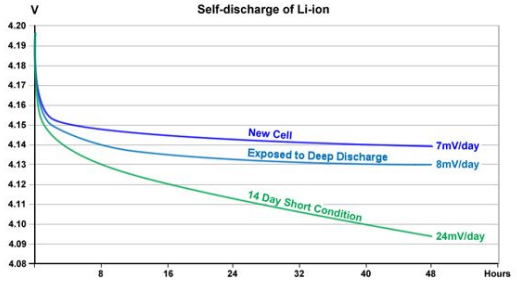
Our Contribution

- MEAtec can implement effective **charge protocol and charging** strategies help in reducing the chances of self discharges. By ensuring optimal storage conditions, such as maintaining a **moderate temperature range**, the **self-discharge phenomenon** in batteries can be significantly reduced.
- MEAtec can implement advanced **thermal management algorithms** that efficiently control the temperature, preventing the **BESS** from being stored at excessively high temperatures.
- **This intelligent temperature regulation** minimizes internal resistance and slows down the self-discharge process, ultimately improving the battery's performance, longevity, and overall efficiency.



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- Minimum round-trip efficiency of 50% at energy storage system (AC) level and 75% at cell level.

Our Contribution

- Meatec BMS provides efficient algorithms that detect and avoid frequent high speed charging rates and focus more on controlled slower charge methodologies to improve Round Trip Efficiency (RTE).
- Meatec BMS can control and optimize charge/discharge cycles, keeping the battery within an optimal SOC range and reducing unnecessary energy losses.
- It also optimally maintains the temperature to minimize the losses from heat generation together with effective cooling systems.

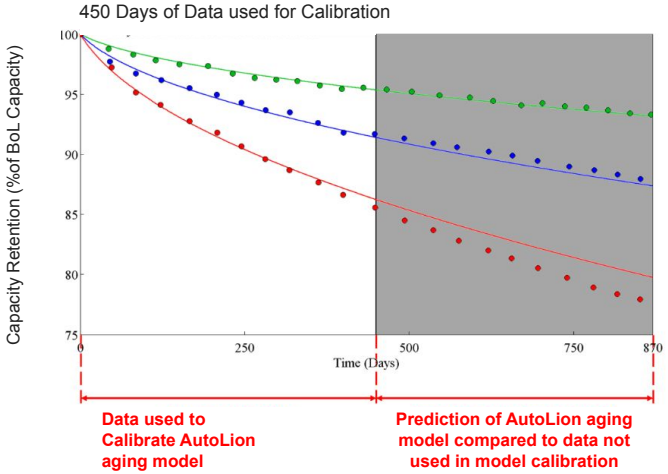
$$\text{RTE} = \frac{\text{Energy Delivered (Discharge)}}{\text{Energy Stored (Charge)}} \times 100$$

D2-05: Accelerated multi-physical & virtual testing for battery aging, reliability, safety evaluation

Call Scope

- Shortened development time of battery cells and battery systems by minimising the experimental testing effort, thus reducing the overall costs and the time to market;
- Increased battery reliability and safety through better understanding of ageing, and safety-relevant (deactivation, degradation, failure) mechanisms;
- New multi-physical test strategies supplemented by virtual testing are required taking into account the most impactful parameters on ageing, reliability and safety and their dependencies.

Our Contribution



- Meatec can develop **digital twins** and **virtual testing frameworks** using **physics-based** and **data-driven** methods to **simulate battery behavior**, reducing the need for extensive experimental testing via simulation-informed **DoEs** that **lower costs and speed up time to market**.

D2-05: Accelerated multi-physical & virtual testing for battery aging, reliability, safety evaluation

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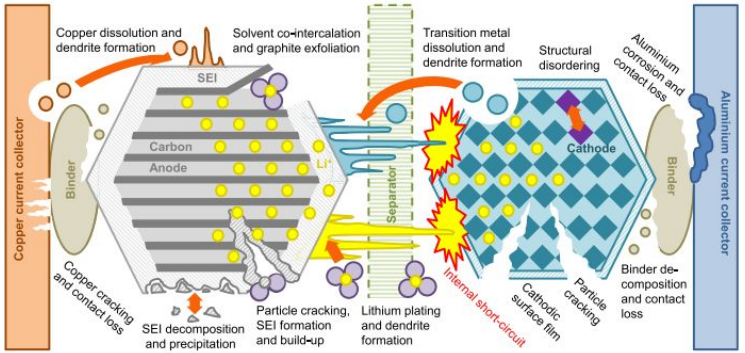

- Meatec can combine modeling approaches to deeply understand **aging** and **safety-related** degradation mechanisms (e.g., particle cracking, SEI formation, lithium plating at cell level; thermal runaway, mechanical vibrations, internal short circuits at pack level), using these insights to drive **predictive maintenance** strategies and enhance **battery safety**.

https://www.sciencedirect.com/science/article/pii/S0378775316316998

D2-05: Accelerated multi-physical & virtual testing for battery aging, reliability, safety evaluation

Call Scope

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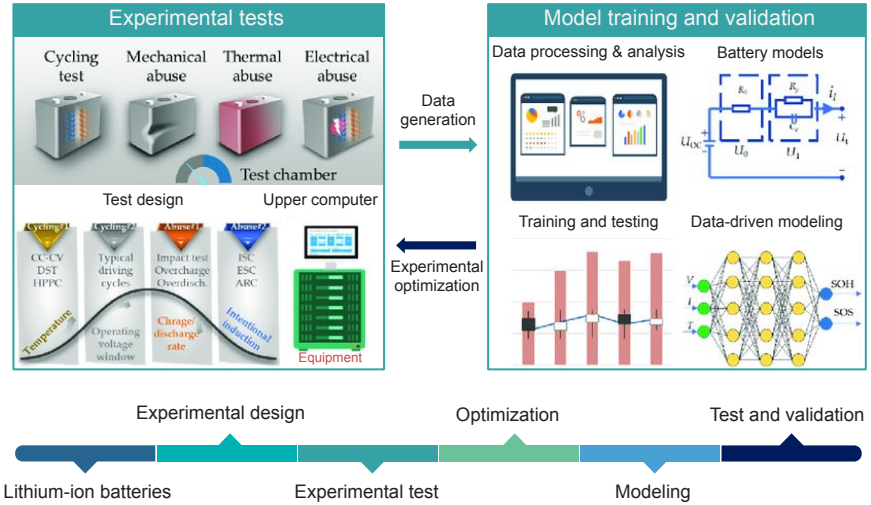
- Increased battery reliability and safety through better understanding of ageing, and safety-relevant (deactivation, degradation, failure) mechanisms;
- New multi-physical test strategies supplemented by virtual testing are required taking into account the most impactful parameters on ageing, reliability and safety and their dependencies.

Our Contribution

- Meatec can integrate **virtual testing** with targeted experimental validation to devise **multi-physical test** strategies that address the key parameters affecting aging, reliability, and safety and their interdependencies.



https://www.mdpi.com/2313-0105/8/10/142

Thank you

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