Exhibition Pitch:

Advanced Sensing for Battery Development and Testing &

NEXT-generation physics and data-based Battery Management Systems for optimised battery utilization
NEXTBMS

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NEXT-generation physics and data-based Battery Management Systems for optimised battery utilisation

General information

- Topic:
  Physics and data-based battery management for optimised battery utilisation (Batteries Partnership)
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Consortium

NEXTBMS

RESEARCH

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TNO innovation for life

VUB EPOWERS EFFICIENT POWER ELECTRONICS, POWERTRAIN & ENERGY SOLUTIONS RESEARCH GROUP

Univerza v Ljubljani

INDUSTRY

AVL

BOSCH Invented for life

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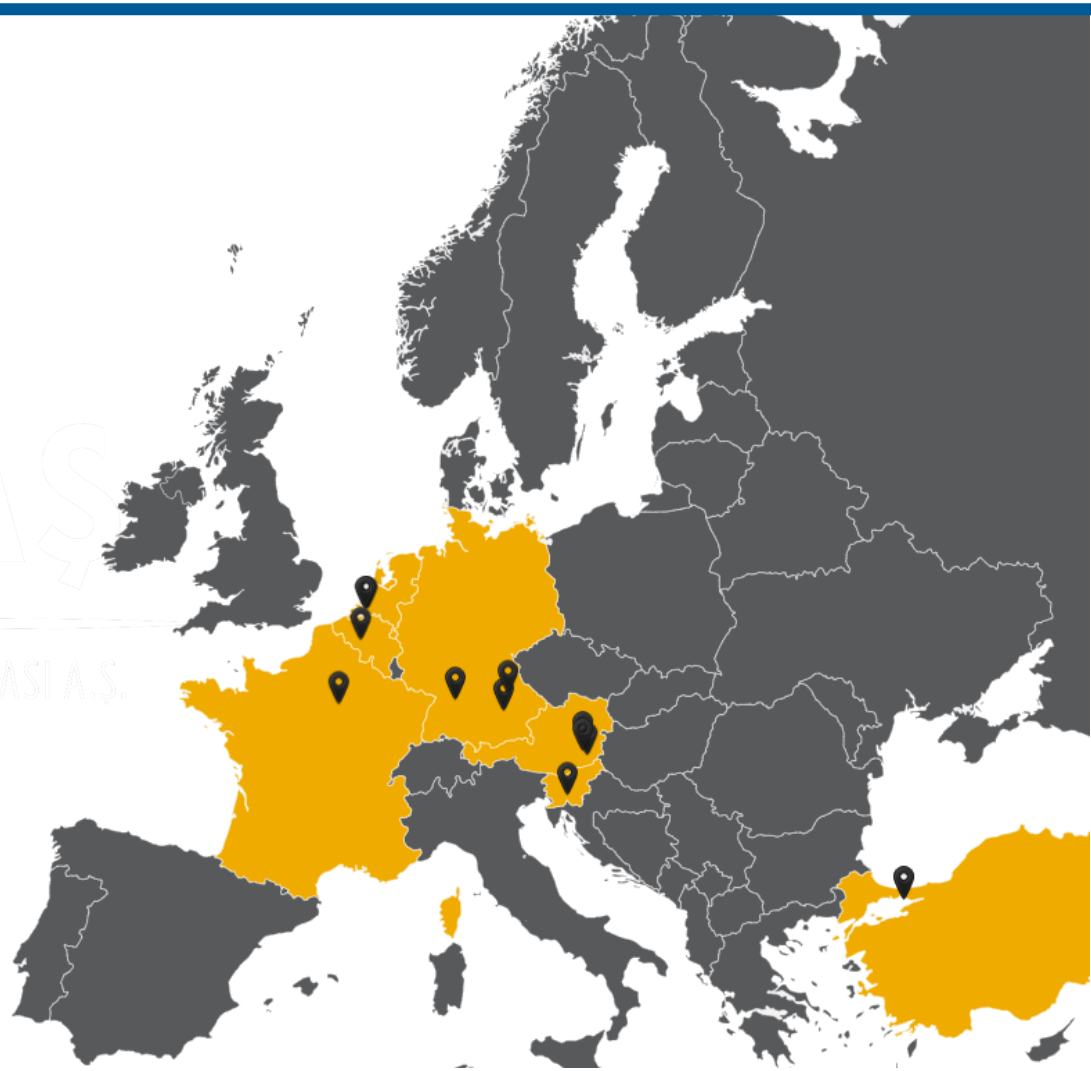


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LIGHT METALS TECHNOLOGIES
BATTERY TECHNOLOGIES
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Aim of NEXTBMS

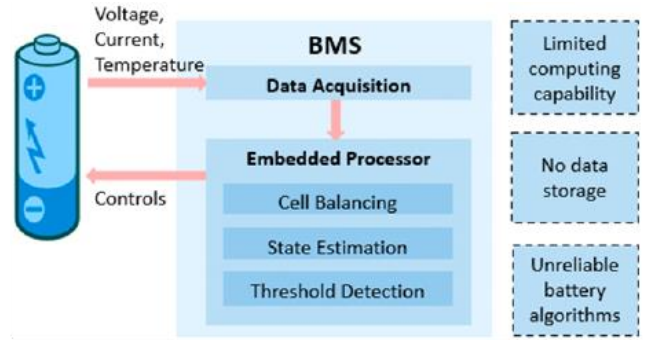
- Development of an advanced battery management systems (BMS)
  - built on fundamental knowledge and experience with the physicochemical processes of LIBs,
  - enhancing significantly current modelling approaches, including the readiness for upcoming LIB material developments.
- NEXTBMS further introduces optimized sensors and measurement techniques
  - to meet modelling needs and to optimize models based on physical sensor data,
  - crucial for physical cell configurations to form a framework for advanced battery state prediction and –control
- NEXTBMS ensures that the next generation of BMSs will enable higher performance, safety, and longer lifetime of the battery cells for an overall optimal utilization of the battery system.

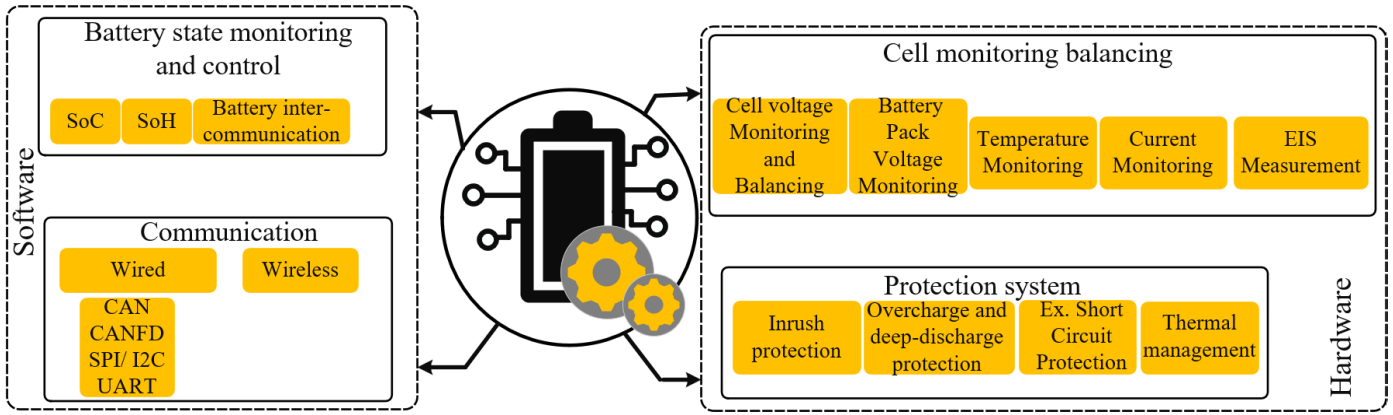
Technical Objectives (TO)

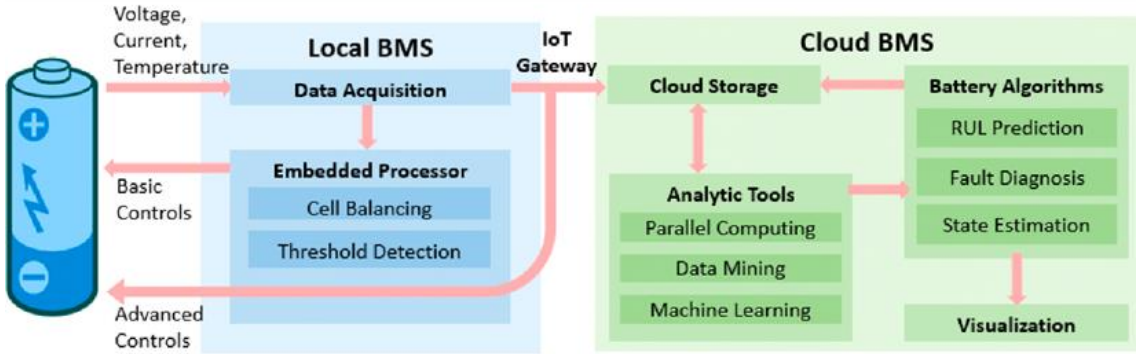
- NEXTBMS will realize this by means of the following scientific and technical objectives (TO)
  - **TO 1** Advanced physics-based and adaptable battery models
  - **TO 2** Advanced data acquisition combining sensor-based solutions at battery system/module level and model generated values
  - **TO 3** New control algorithms with advanced state estimators and data-based algorithms to increase utilization while ensuring safety and reliability of the advanced BMS system

Requirements capture and impact assessment

- New solutions that facilitate the efficient and durable use of LIB to improve performance
  - in the xEV mobile sector, by strengthening of sustainability aspects (like predictability, state estimation quality) and lower cost basis
  - in stationary applications such as grid balancing and storage of energy from variable renewable sources (e.g. wind or solar energy)







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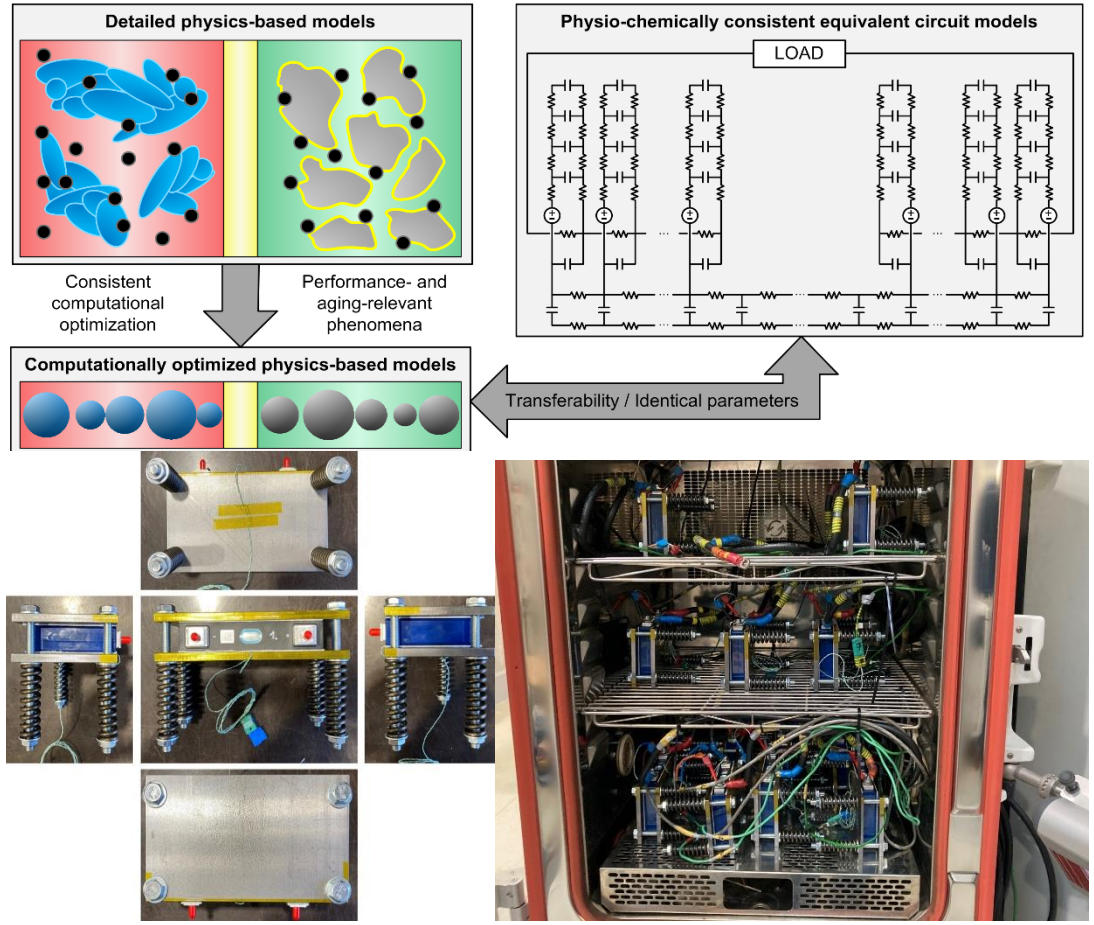
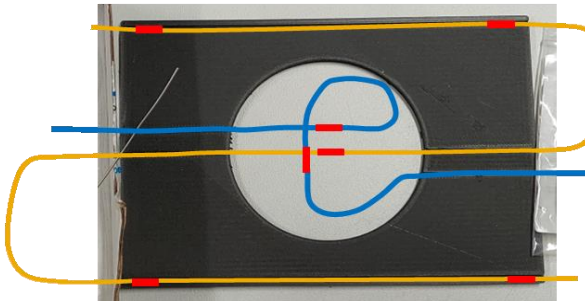
TO1: Physics and data-based models and BMS software

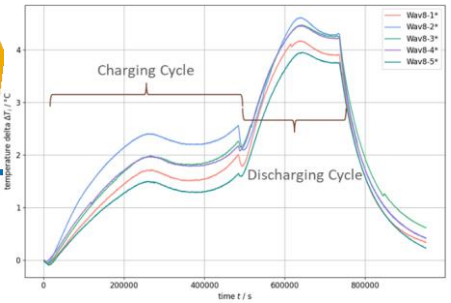
- Development of scalable physics-based BMS models tracking the performance and degradation states of the battery with higher accuracy compared to currently applied semi-empirical BMS models
- For the parameterization of the physio-chemically consistent equivalent circuit models, electrical and aging characterization tests for NMC chemistries are currently performed
- AIT, along with project partner TNO, is responsible for the electrical and aging characterization tests of the NMC cells to be used for the NEXTBMS battery module prototypes

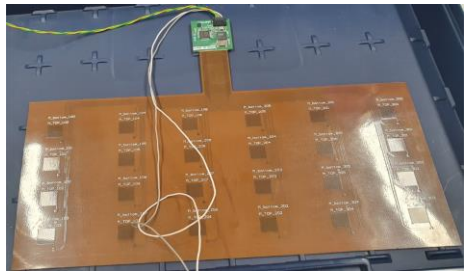


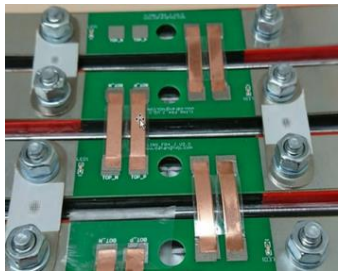
TO2: Development and prototyping modular battery modules with BMS HW

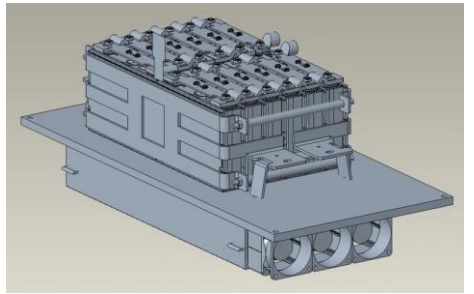
- Modelling approaches are improved by optimizing HW sensors and measurement techniques
- Combining physical sensor information with virtual sensors (model outputs) enables accurate estimation of SoC, SoH, SoF and SoP
- Use of advanced HW sensors for more accurate
  - temperature measurements with higher spatial resolution (fibre optical sensors)
  - mechanical strain measurement (Li plating and safety indications)
  - synchronised voltage- and current measurement
  - on-board electrochemical impedance spectroscopy (EIS)
- Housing design, E/E design and BMS development
- AIT assembles two lab-scale prototype modules
  - testing of the battery module prototypes and the innovative sensor concept developed by AVL

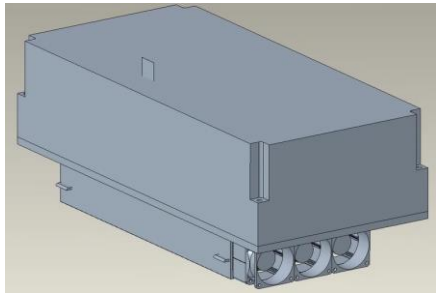






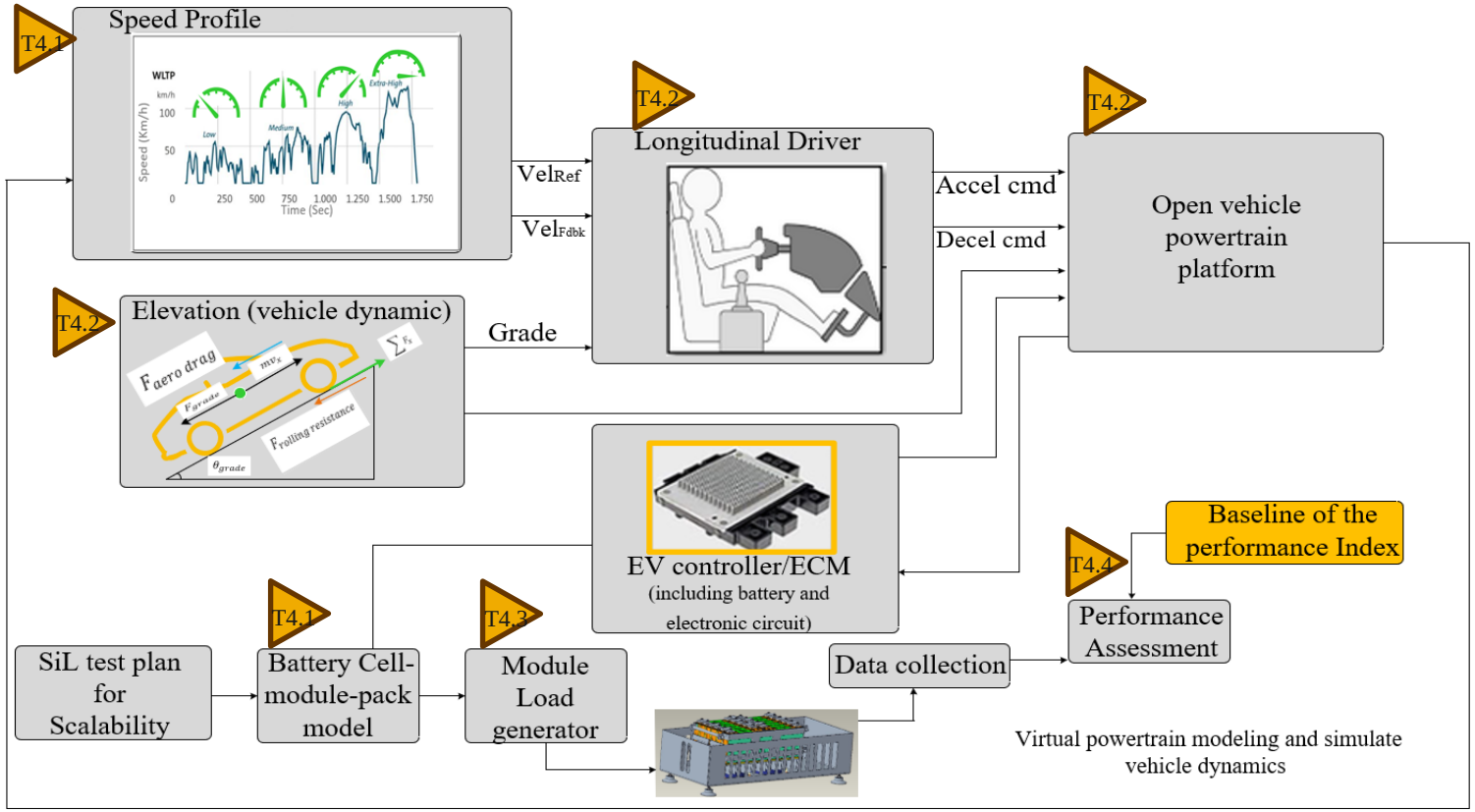






TO3: Use case realisation on lab-scale and upscaling towards system-level validation

- Performance test of the BMS through HiL
- SiL approaches will be used to virtually upscale the prototype to a system voltage of 400V and 800V
- Vehicle simulation platforms are used to develop appropriate battery pack sizing methodology for EV applications
- Using the vehicle simulators, power and energy demands for different mission profiles will be acquired
- An EDF lab-grid/platform will be utilized for stationary applications



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