UTILIZATION OF AGED ELECTRIC VEHICLE BATTERIES AS STATIONARY BUFFER STORAGE

INSIGHTS INTO PROJECT EMILAS

Dr. Matthias Vetter

Fraunhofer Institute for Solar Energy Systems ISE

Industriebatterien:
Wohin mit den Akkus der Elektromobilität?

Webkonferenz, 14. Dezember 2020

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AGENDA

- Introduction to battery research, development and services at Fraunhofer ISE
- Battery storage – Mission
- Battery storage – Market segments and market developments
- Project EMILAS
  - Introduction
  - Energy concept
  - Battery life cycle
- Conclusions

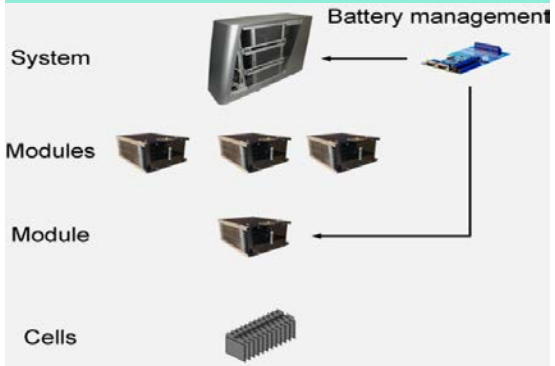
Department Electrical Energy Storage

Overview – Research, Development and Services

Battery Cell Technology
materials, architecture, production

- Development and characterization of materials and battery cells
- Development of process technologies
- Aqueous systems for stationary energy storage
- Lithium ion battery cells
- Solid state battery cells
- Technical and economical analysis
- Life cycle analysis

Battery Engineering
from cells to systems



- Cell formation
- Cell and system characterization
- Ageing and performance scrutiny
- System design and engineering
- Thermal management
- Battery management
- Algorithms for state estimation and life time prediction
- Optimized charging and operating control strategies

Applied Storage Systems
system design, integration and quality assurance

- Realization of lighthouse projects
- Business case development
- Consulting during complete life cycle of storage projects
- System modelling, analysis and optimized system design
- Simulation based storage sizing
- Energy management systems
- Technical due diligence: Site inspection, testing and monitoring

TestLab Batteries
electrical, thermal, mechanical testing

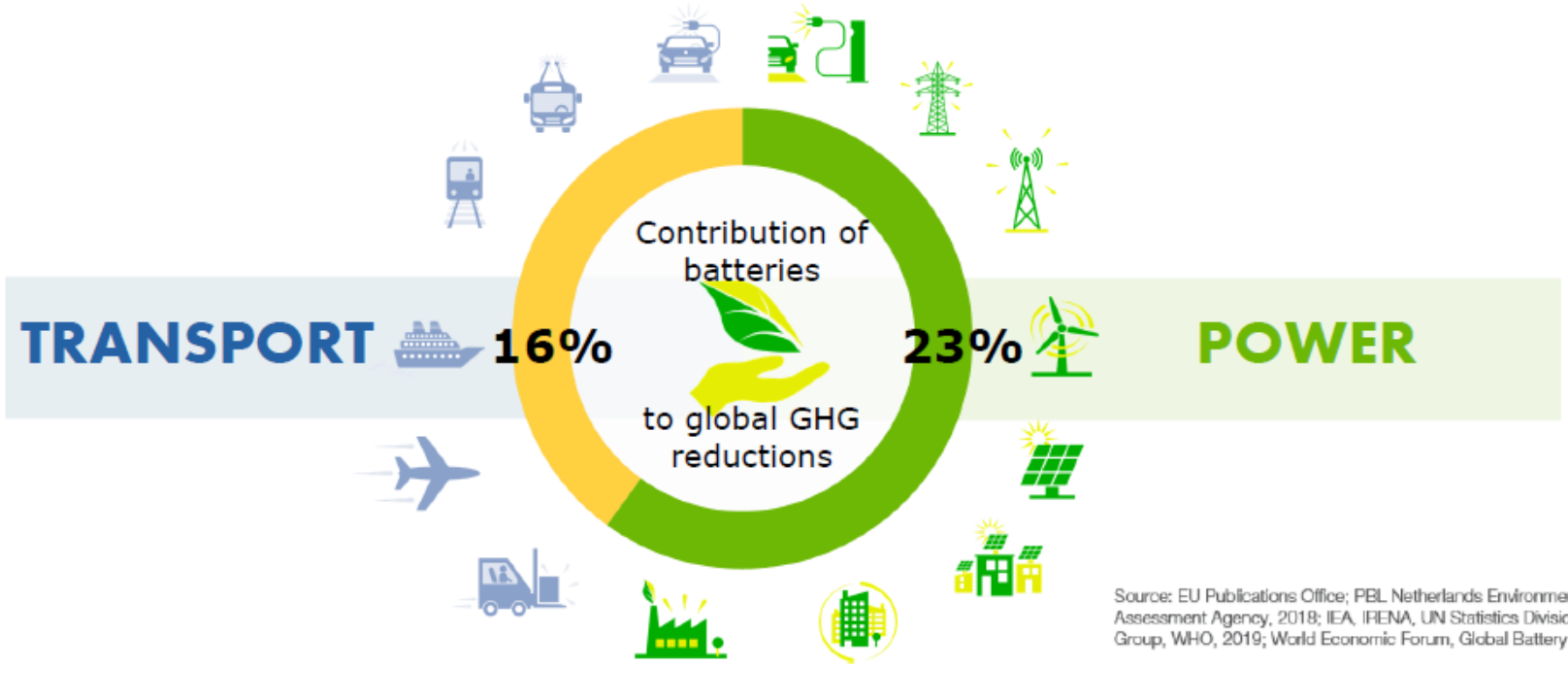
- Ageing: calendric and cyclic
- Safety: components and systems including functional safety
- Reliability: consideration of operating conditions and system behavior with aged components
- Performance: efficiency and effectiveness
- End-of-line quality control for cell production

Battery storage – Mission

Batteries Europe: Strategic Research Agenda – Extract

BATTERIES EUROPE
EUROPEAN TECHNOLOGY
AND INNOVATION PLATFORM

« Everything we can electrify will be electrified »



Source: E. Sheridan: Batteries Europe, European Technology and Innovation Platform – Overview of Strategic Research Agenda, Batteries Europe Webinar, 28th of October 2020.

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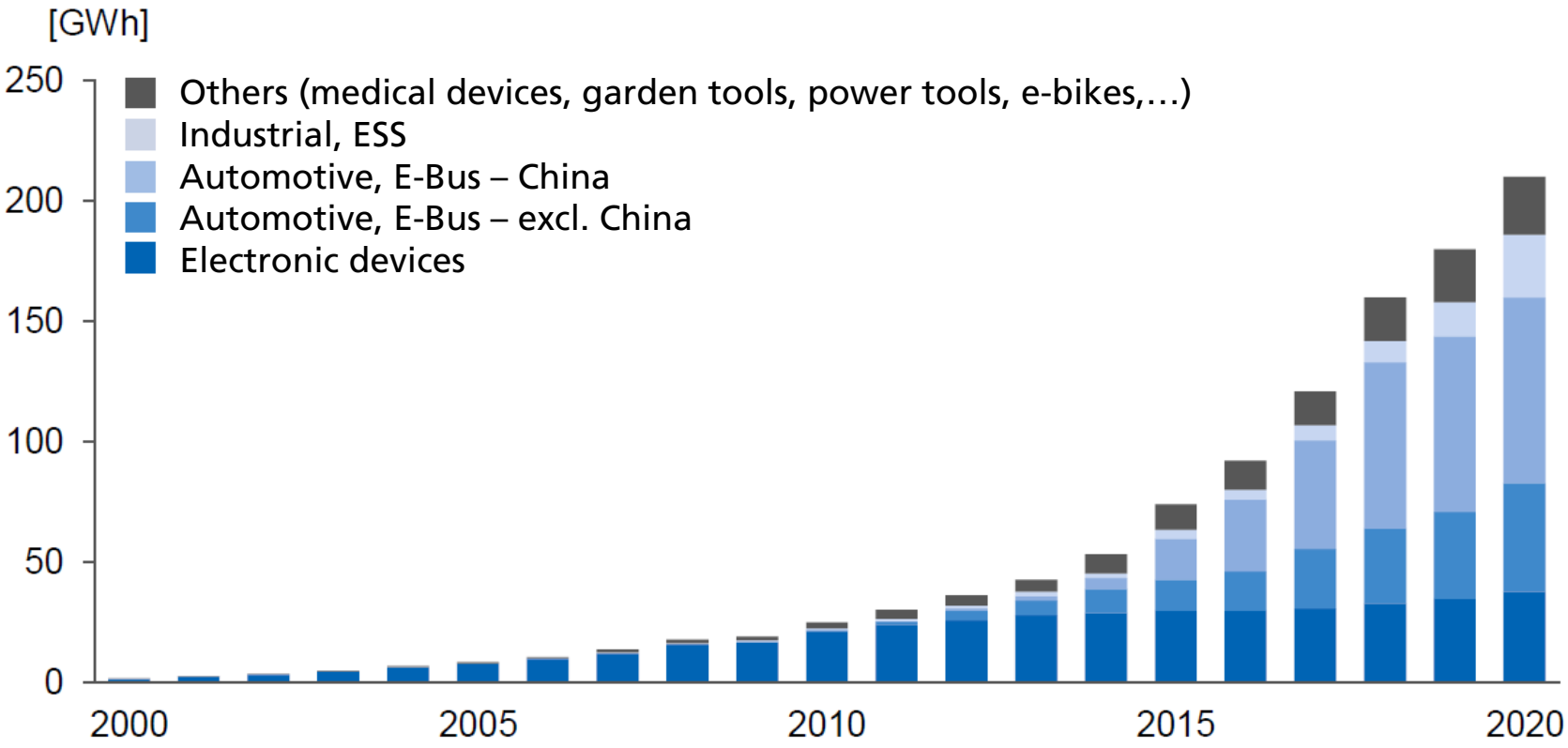
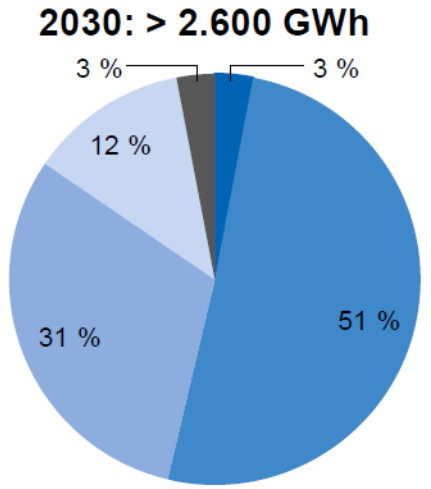
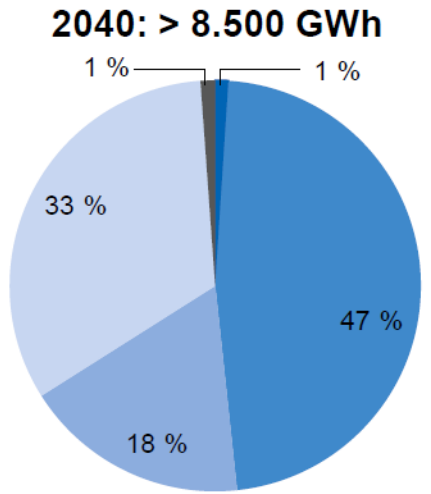
Battery storage – Market segments and market developments

Lithium-ion batteries







Sources: J. Mähliß: Trends im Lithium-Ionen Batteriemarkt, 2020; BloombergNEF, 2020; Roskill, 2020; Avicienne Energy, 2019.

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Project EMILAS – Electromobility in apartment buildings via smart charging stations with 2nd life battery storage

Introduction

Objectives

- Use of 2nd life EV batteries as stationary buffer storage for building integrated charging stations
- Enabling of EV fast charging (!)
- Integration of 2nd life battery storage into building energy management system
- Coupling with building integrated PV: Increased self-sufficiency via buffer storage
- Integration of a local car sharing fleet with “bidirectional” EVs (“vehicle to building”)
- Innovative business models

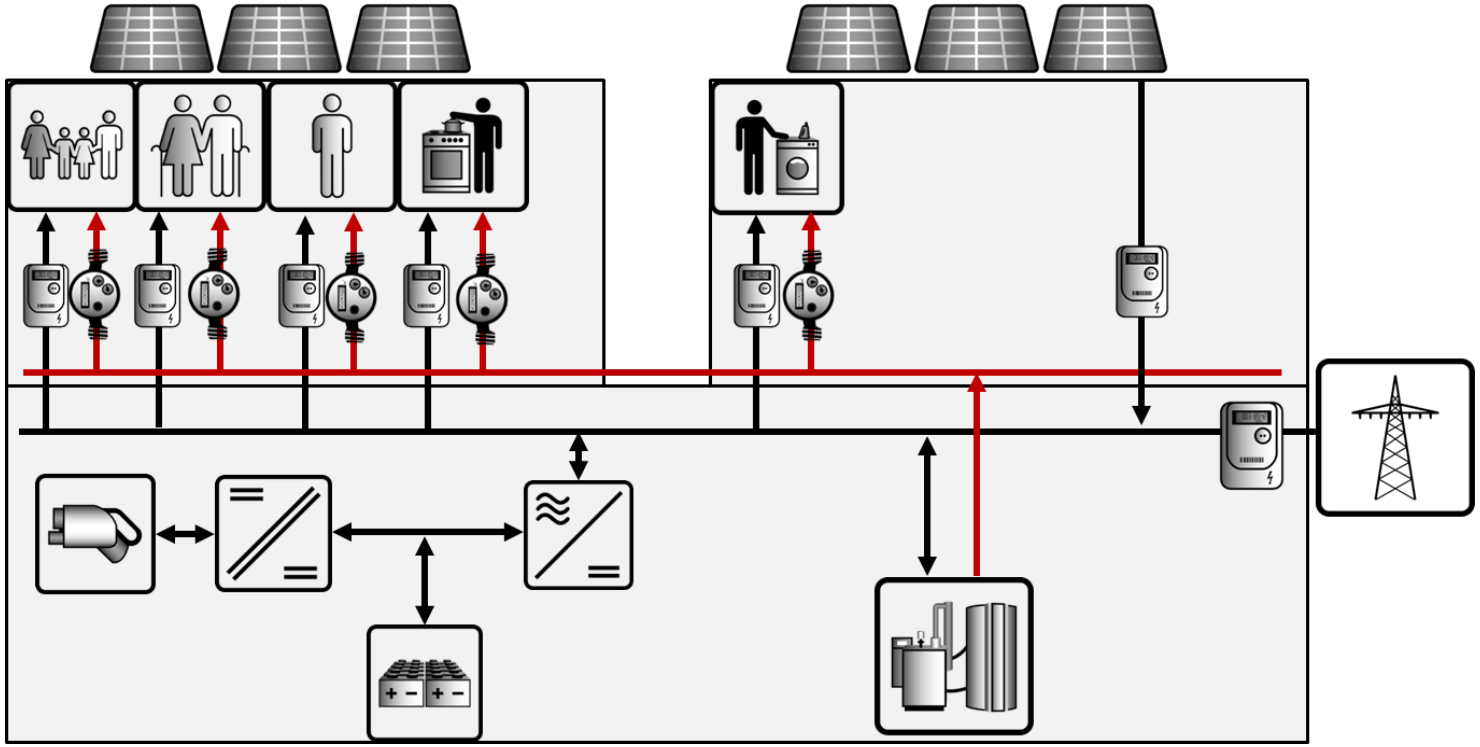
Funded by the German Federal Ministry for Economic Affairs and Energy

Project EMILAS – Electromobility in apartment buildings via smart charging stations with 2nd life battery storage

Introduction

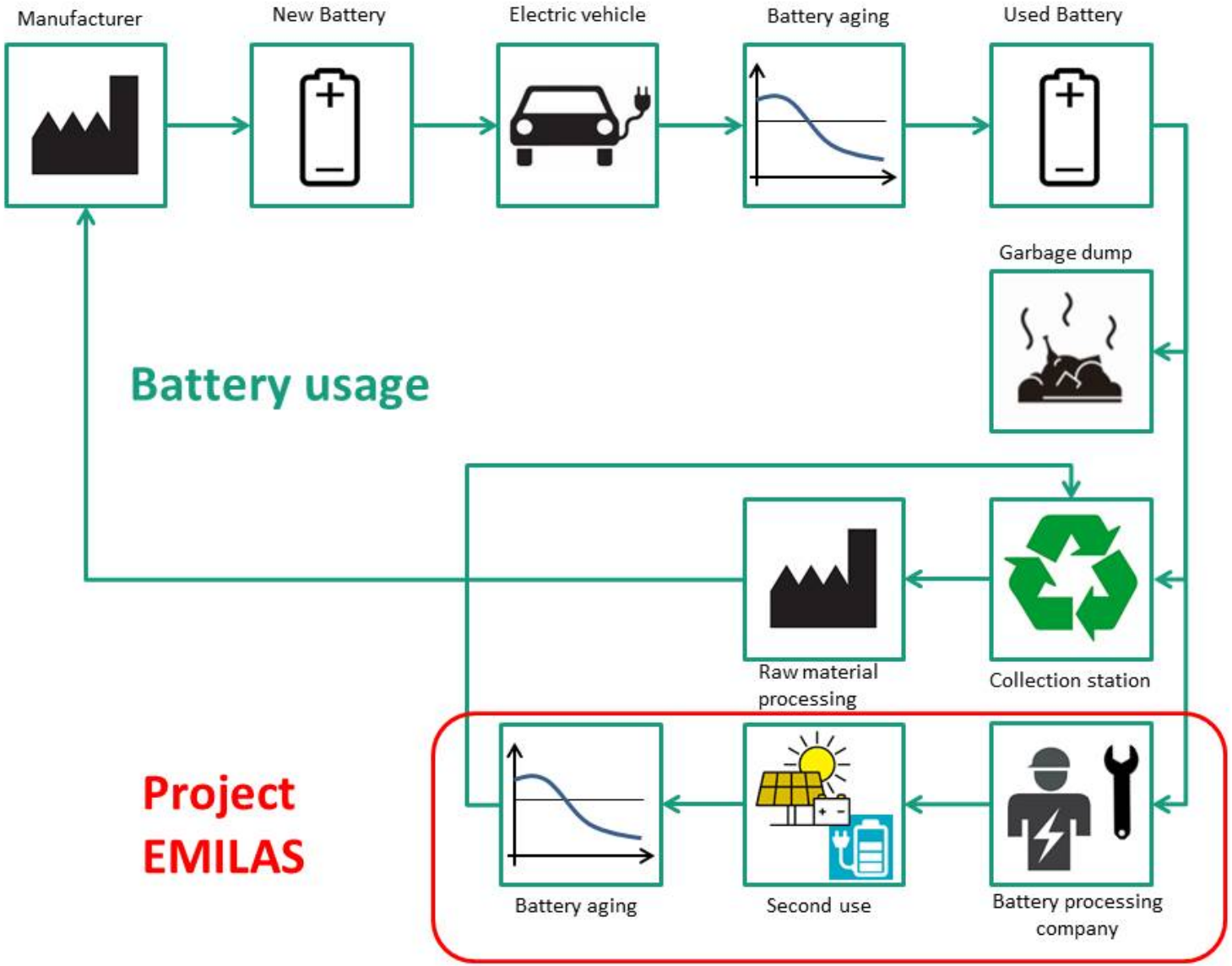
Energy concept

- PV system: 30 kWp
- CHP: 2 x 50 kW_{el}
- 2nd life battery storage: 6 x 22 – 42 kWh; 70 kW
- EV sharing:
  - 3 x AC wall box
  - 3 x DC wall box



Battery life cycle

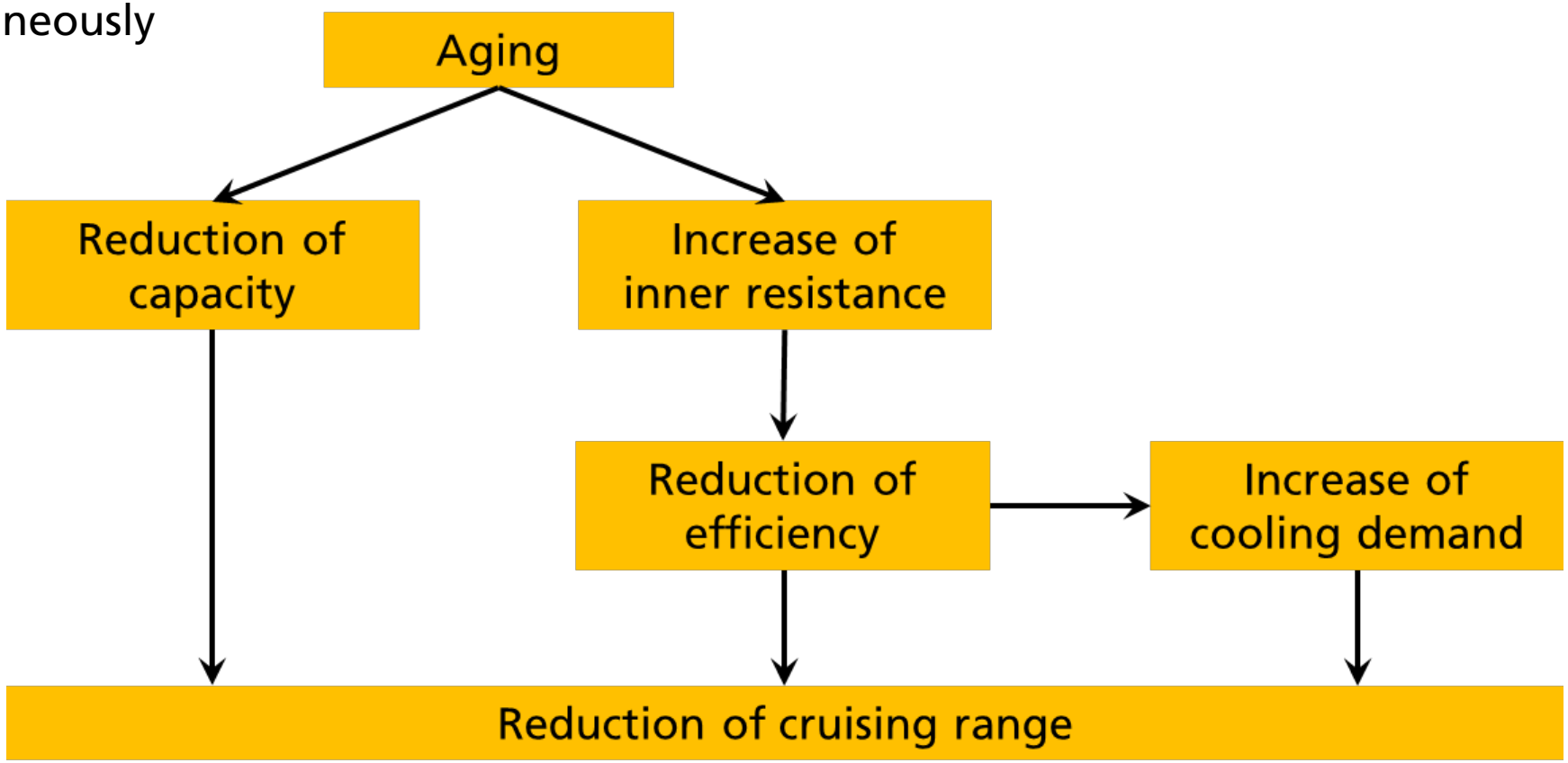
Prolonging useful life time via 2nd life applications



Battery life cycle
Influence of cell aging

Aged cells in battery electric vehicles

→ Several effects result in reduction of cruising range simultaneously

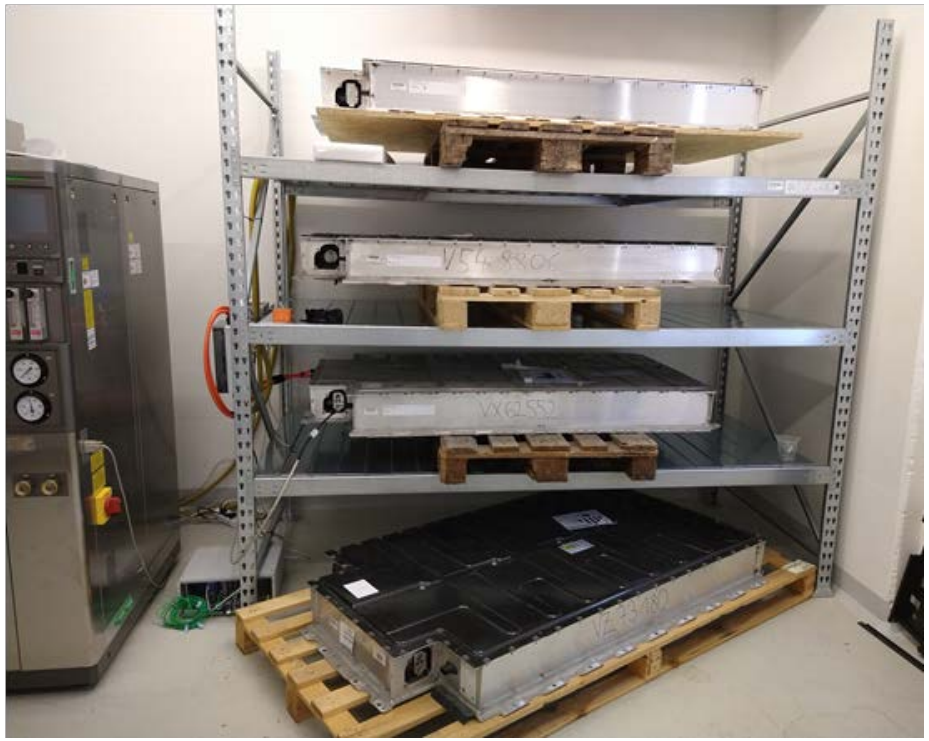


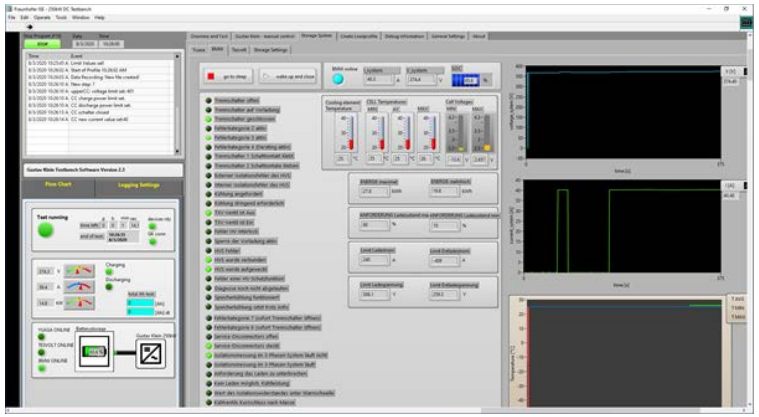
Battery life cycle

Prolonging useful life time via 2nd life applications

Test bench for initial check up @ Fraunhofer ISE

- 250 kW / 1000 V
- Customized software solution
- CAN communication
- Recording of spatial temperature distribution
- Pulse measurement, time resolution 1 msec
- Stress tests with high discharge currents





Battery life cycle

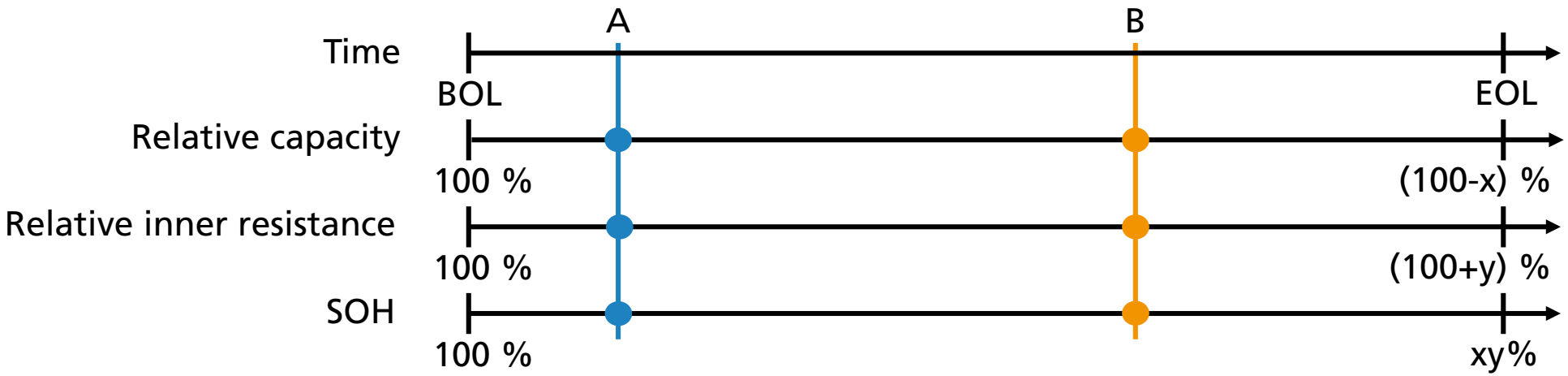
Prolonging useful life time via 2nd life applications

Characterization of 2nd life batteries

- SOH determination for 2nd life application
  - SOH-C: Current capacity / Nominal capacity
  - SOH-Ri: Current inner resistance / Nominal inner resistance
- Approach: Based on pulse response → Fast

Task:

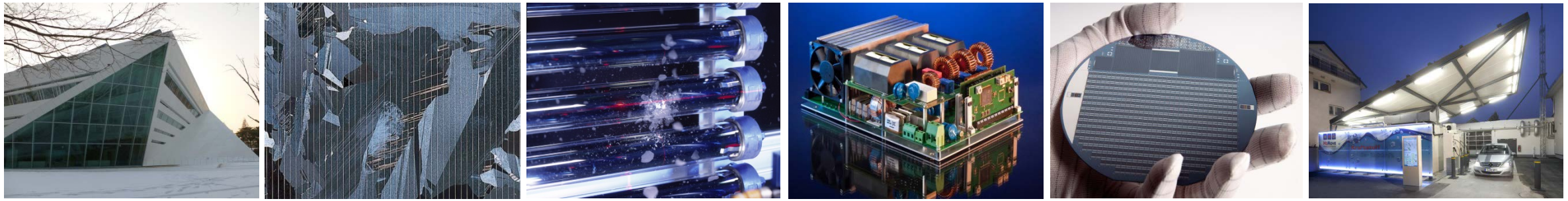
Evaluating efficiently state of used EV battery at point of time B



Conclusions

- Electromobility towards mass markets
  - "CO_2 backpack" of battery cell production has to be addressed
    - → One approach: Prolonging useful life time of EV batteries via 2nd life applications
      - → Improvement of carbon footprint
  - Charging at home has to be enabled also in apartment buildings
    - → Use of decentralized (renewable) power generation capacities
    - → Stationary buffer storage enables flexible charging of EVs
- Challenges for usage of EV batteries in 2nd life applications
  - Qualification
    - → Not time consuming !
    - → But: Reliable results !
  - System integration
    - → Standardization would facilitate economic viable solutions

Thanks for your attention !!!



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www.ise.fraunhofer.de

matthias.vetter@ise.fraunhofer.de