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aufgrund eines Beschlusses des Deutschen Bundestages

M5BAT: Project EMMuseBat

Modular **M**ulti-**M**egawatt **M**ulti-Technology **M**edium Voltage – **Bat**tery Storage System

System configuration

- Power: approx. 6 MW AC
- Energy: approx. 7.5 MWh AC
- 5 transformers 1260 kVA
- 10 inverter 680 kVA
- 3 MW FCR marketable
  (frequency containment reserve)

Battery unit	Technology	Energy (DC) in kWh
1	*Lead-Acid (OCSM)*	*1,066*
2		*1,066*
3	*Lead-Acid (OPzV)*	*842*
4		*740*
5 - 8	*LMO/NMC*	*775 each*
9	*LFP*	*738*
10	*LTO*	*230*
Sum	**M5Bat**	**7,782**

The battery storage M5BAT consists of 10 parallel battery units with a total DC energy of nearly 7,8 MWh. Each battery unit is connected to an individual inverter. From the inverter AC side, the inverters are connected in pairs to the five transformers. The system is connected to the local medium-voltage grid. Figure 1 shows that some battery units are built into 20“-Containers on top of the building, while other battery units are installed inside the building. The battery storage system is controlled by an energy management system which is developed an continuously improved by researchers from PGS. The parallel structure of M5BAT lowers the overall efficiency of the storage but increases the availability significantly.

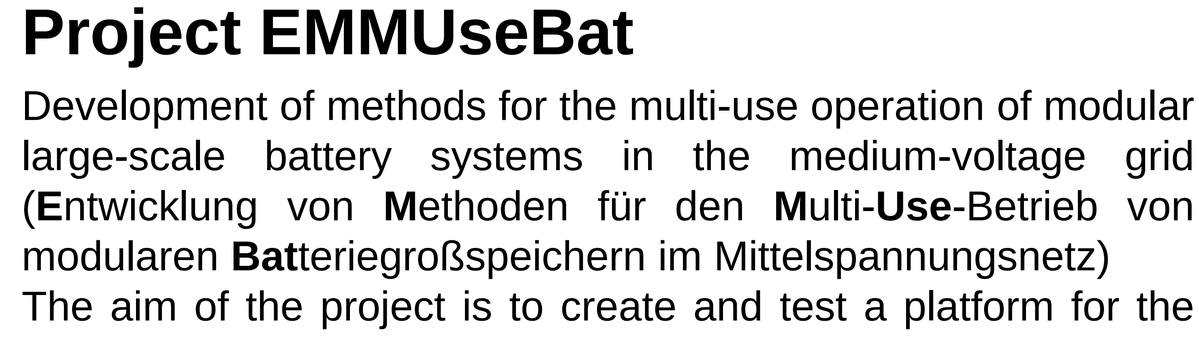

Figure 1: Battery storage M5BAT, Aachen, Hüttenstraße 9

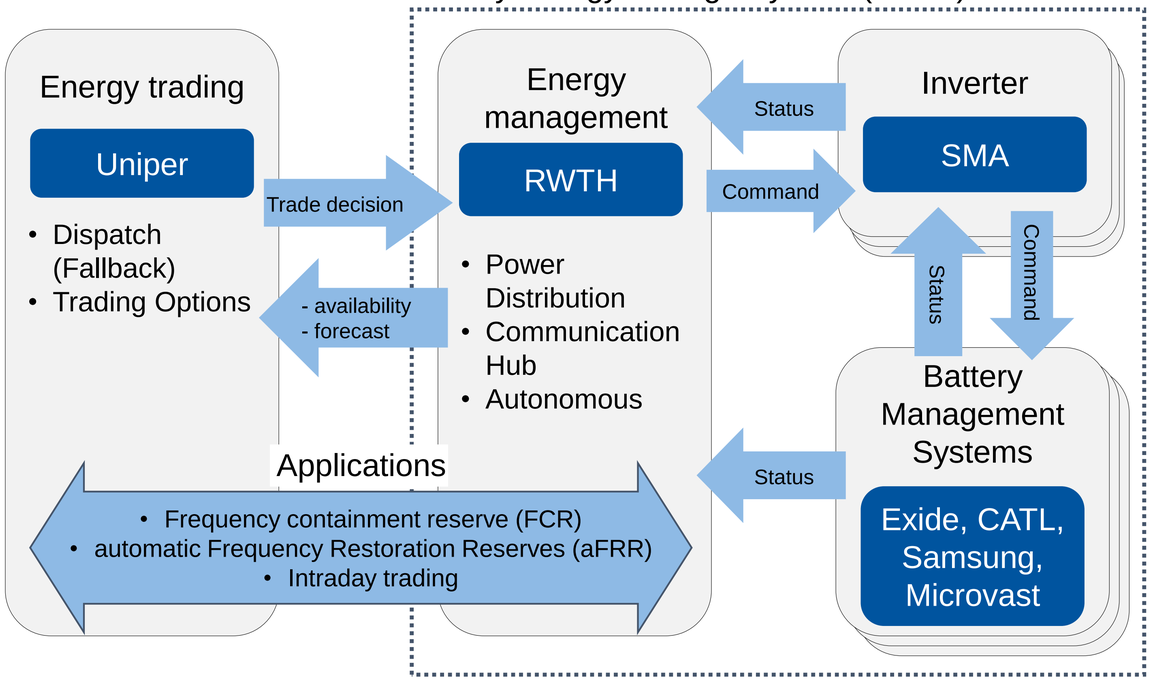

Figure 2: Communication and energy management system diagram

Project EMMUseBat

Development of methods for the multi-use operation of modular large-scale battery systems in the medium-voltage grid (**E**ntwicklung von **M**ethoden für den **M**ulti-**Use**-Betrieb von modularen **Bat**teriegroßspeichern im Mittelspannungsnetz)

The aim of the project is to create and test a platform for the development and testing of new energy management algorithms for large-scale battery systems in various market fields. For this purpose, a digital twin of the system control of the 5 MW storage M5BAT is developed, which will be used for testing new control algorithms for the vertical and horizontal partitioning of the storage as well as for the preliminary work for testing new marketing channels. The focus is on the development and testing of algorithms that enable battery storage systems of different topology and technology (cell chemistry) to be controlled as economically as possible, for one or more simultaneously served market applications. The goal is to enable a multi-use operation or so-called value stacking, in which several applications with different load profiles and operating requirements are served simultaneously by a single storage system, taking into account the technological characteristics of the battery types installed as well as battery efficiency and life time maximization.

Research topics and goals

- Development and improvement of the M5BAT energy management system (EMS)
  - Development of a digital twin of the control system
  - Methods for partitioning of battery storage systems
  - Implementing multiple applications in the EMS
- Multi-Use operation of different market applications
- Battery aging in real world application (currently FCR)
  - Battery diagnostics like SOH measurement during operation
- Data collection, storage and evaluation
- Research on efficiency improvements
- Research on optimized economics for energy storage

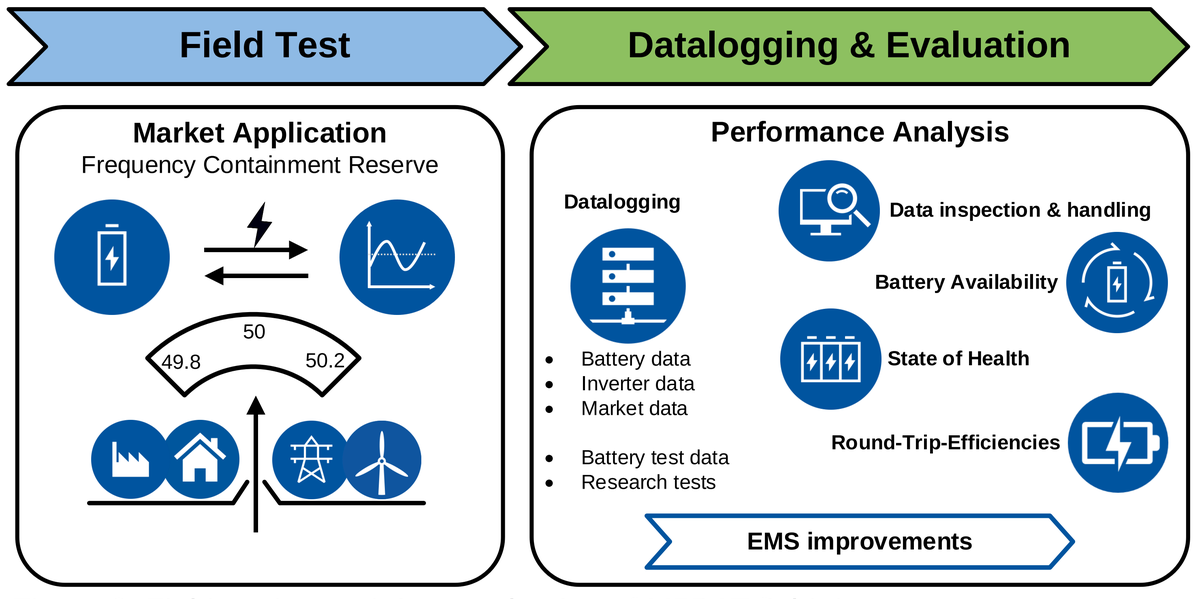

Figure 3: Field testing and data evaluation of M5BAT field data

RWTH Aachen University | E.ON Energy Research Center
Institute for Power Electronics and Electrical Drives (ISEA)
Mathieustraße 10 | 52074 Aachen | Germany
www.isea.rwth-aachen.de
+49 (0)241 80-96920| +49 (0)241 80-92203

Battery storage M5BAT
Lucas Koltermann | Mauricio Celi Cortés
Hüttenstraße 9 | 52068 Aachen | Germany
www.isea.rwth-aachen.de/go/id/pipl
+49 (0)241 80-49359 | m5bat@isea.rwth-aachen.de