

## Bachelor thesis

# Stochastic Economic Dispatch of Hybrid Energy Storage Systems Coupled with Renewables and Heat Sector

### Topic

Energiespeicher

### Focus

- ☒ Theory
- ☒ Literature
- ☒ Simulation
- ☒ Programming
- ☐ Construction
- ☐ Hardware
- ☐ Experiments

### Courses of Study

- ☒ Electrical Engineering
- ☒ Mechanical Engineering
- ☒ Mathematics
- ☒ Process Engineering

### Starting Date

As soon as possible

### Please send your application to:

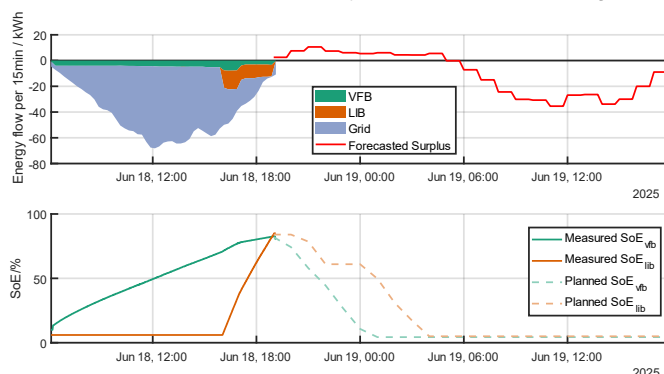
M.Sc. Lakshimi Narayanan  
Palaniswamy

[lakshimi.palaniswamy@kit.edu](mailto:lakshimi.palaniswamy@kit.edu)

Battery Technology Center  
Building 444 CN, Room 220  
Phone: +49 721 608-28160  
[www.batterietechnikum.kit.edu](http://www.batterietechnikum.kit.edu)

### Motivation

As a part of the project, BiFlow an innovative stationary Hybrid Energy Storage System (HESS) is researched at ETI. The HESS includes a 72 kWh Lithium Ion Battery (LIB) and 120 kWh Vanadium Redox Flow Battery (VFB) installed at Stage76, Bruchsal.



Source: L.N.Palaniswamy et.al, "A Piece-wise Model-based MILP Approach for Optimal Dispatch of Hybrid Energy Storage Systems with Practical Validation" ECCE EU 2025, Birmingham, GB

The HESS is used for self-consumption improvement of the building, where it stores surplus PV + Wind as per availability and gives back the energy when required. In order to dispatch the HESS economically, an optimized operation strategy is required. The optimization must be able to reduce operational losses of HESS by intelligently splitting the load between the two systems, and also improve the profit of driving the HESS at the same time. Additionally, the optimization must keep a check on the HESS aging, track the uncertainties of the renewable energy forecast, and update the operation strategy accordingly. Thus, a stochastic optimization is aimed for in this work.

### Tasks

- Research various ways of stochastic optimizations in Mixed Integer Linear Programming and Heuristic optimization.
- Extend the optimization framework from previous work with stochastic optimization.
- Simulation and validation of the developed techniques for various weather scenarios and economic metrics.

Strong programming skills in Python is a must. Knowledge of MATLAB/Simulink is good to have. Strong understanding of renewable energy systems and its economic operation is recommended. Reliability, an independent way of working, fast comprehension and good German and/or English skills are appreciated.

### Required Documents for Application:

- Curriculum Vitae
- Transcript of Records