NRGISE

Simulation Framework for Energy Storage Systems

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Motivation

NRGISE

Find optimal energy system configuration

- Optimal storage sizing
- Optimal control strategy
- Energy system configuration

By

- Including a detailed cost model
- Including storage aging

Storage (Aging) Modelling

Different modeling detail levels for different use cases

- Implementation of different storage models with different levels of detail
  - *Energy Reservoir*: fast and simple
  - *Charge Reservoir*: not as fast, but detailed
- Aging models for different cell chemistries
- Investigation of aging aware control strategies possible

Money Matters

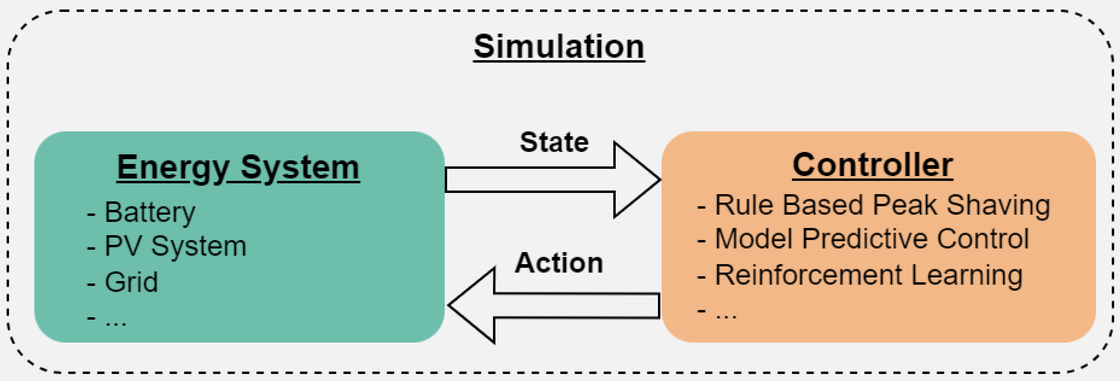
An accurate cost model supports investment decisions in practice

- Cost model validated in expert interviews with industry representatives
- Detailed calculation of the electricity bill including grid charges and taxes
- Estimation of various cost elements, including:
  - Procurement, installation and construction cost
  - Maintenance cost
  - Replacement cost

Architecture

Flexibility as key requirement

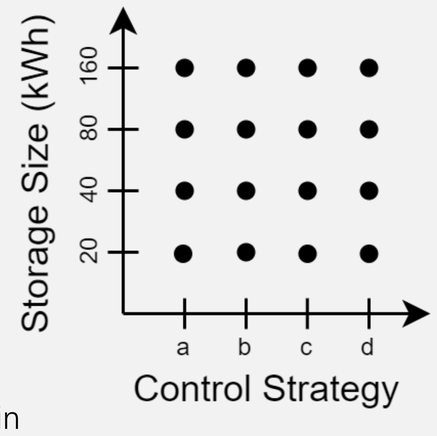
- Inspired by reinforcement learning environments
- Clear separation between controller and energy system model
- Energy system model can be assembled from any number of components
- Controller can be transferred to the field



Grid Searching for the Best Configuration

Flexibility is key again

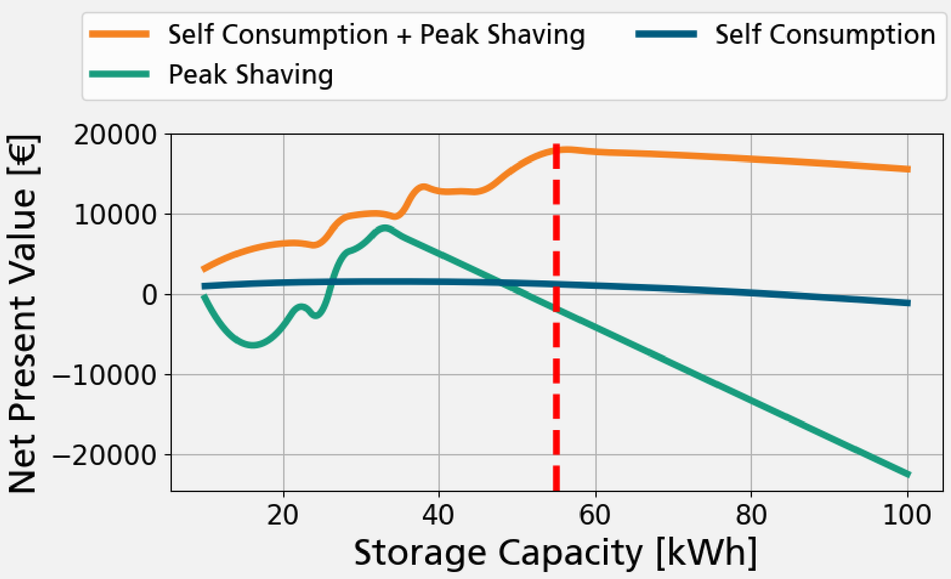
- Definition of an arbitrary search space
- Each combination within the search space is simulated
  - We are *not only* interested in the best solution
  - Inspired by hyperparameter optimization in machine learning using **grid search**
  - Runtime per simulation with a time delta of 15 minutes for one year takes about 0.2 seconds on an i5-1245U CPU with 1.6GHz
  - Parallel execution makes large search spaces possible



Example Results

Research Project DABESI

- "How do storage control strategy and sizing relate to each other?"



Research Project BetterBat

- "How suitable is a cell for an application?"
- Simulation of 267 cells
- The following plot shows the results for peak shaving