Quantification of Flexibility Utilization for Optimized Operation of Distributed Energy Systems

Aktive Endkunden-/Prosumerpartizipation
Sebastian BERG[1]
[1]Fraunhofer UMSICHT

Motivation and research questions

Flexible operation of distributed energy systems can create economic profit. Still, flexibility potential remains unused in the majority of facilities. The goal of the research project is to determine distributed energy system parameters that provide the best flexibility utilization regarding electricity price time series.

To challenge this goal, the following research questions are addressed:
- How can the flexibility of distributed energy system operation modes be measured?
- Which distributed energy system flexibility requirements can be derived from characteristics of different price time series of the objective function?
- Which parameters determine the flexibility of a distributed energy system?

Methodology

In the first step, different distributed energy systems are conceptualized; combining energy converting units and storage. Next, optimization models of the concepts are created.

In the second step, different characteristic price time series for the objective function are created. For this, a stochastic tool generates electricity price time series.

In the third step, a solver calculates the optimized operation modes of the distributed energy system units for each objective function. The programming language is Python and the optimization modeling library is Pyomo working in the energy system modeling framework oemof.

As optimization constraints, the distributed energy system needs to cover measured energy demand of a specific facility.

In order to measure flexibility, a flexibility definition is determined based on a literature research. The flexibility of the distributed energy systems can then be evaluated.

Conclusion and outlook

The research is in an early stage. The methodology, electricity price time series and distributed energy system operation models are created by now.

Operation modes of distributed energy systems concepts are going to be optimized with respect to different price time series of the objective function. Based on the results, utilization of flexibility potential will be studied. For this, a flexibility index needs to be defined. It is preferred to build upon existing definitions in literature.