Model reduction optimization for energy planning process of DER

Satya Gopisetty, Prof. Dr.-Ing. Peter Treffinger, Prof. Dr. L.M. Reindl

Hochschule Offenburg
University of Applied Sciences

Small Scale Renewable Energy Systems

Cooperative graduate school of Albert Ludwig University of Freiburg, Offenburg University of Applied Sciences and Fraunhofer Institutes
satya.gopisetty@hs-offenburg.de, peter.treffinger@hs-offenburg.de, reindl@imtek.uni-freiburg.de

Objective

To optimize the planning framework of distributed energy systems using model-order reduction approach.

State-of-the-art[1]

Distributed energy resources planning has three prominent approaches

⇒ **Guidelines**

⇒ **Single-objective**

[•] Mathematical optimization techniques [•] Heuristic optimization methods

⇒ **Multi-objective**

[•] Pareto optimality [•] Classical approaches [•] Evolutionary approaches

Both the latter approaches are supported by number of math tools and system models.

Research Question[1][2][3]

Integration of distributed energy systems into the grid network will need an optimal solution from different perspectives and one could distinguish between the following

⇒ Planner's perspective ⇒ Supplier's perspective ⇒ User's perspective

To approach the research question in an effective way, the initial step is to **reduce the model-order** equations of the systems and to **select the necessary parameters** to reduce the complexity of the perspectives which helps in the decision-making process of distributed energy resources planning process.
The complexity of perspectives is a question of dynamic multi-objective optimization problem which is at its nascent stages of research.

Research Focus

Hypothesis 1: With respect to practical application, system models with reduced complexity are required.
Hypothesis 2: It is possible to reduce model complexity of system models and keep them suitable for optimization techniques.

Develop strategies for model reduction of energy systems.

⇒ **Model reduction** and **parameterization** approach to be validated by two examples viz.

[•] Distributed energy system at HSO and [•] Badenova (real world example of utility)

Why model reduction ?

[•] It decreases complexity [•] Perform simulations faster with reliable outcomes
[•] Enable model based control design [•] Transfer models etc.

References

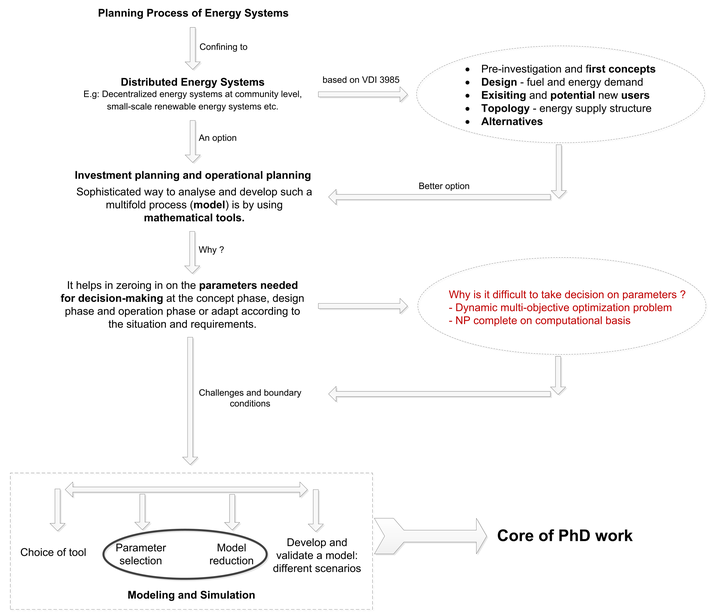
[1] A. D. Alarcón-Rodíguez, "A multi-objective planning framework for analysing the integration of distributed energy resources," Ph.D. dissertation, University of Strathclyde, 2009.

[2] M. Geidl, "Integrated modeling and optimization of multi-carrier energy systems," Ph.D. dissertation, ETH Zurich, 2007.

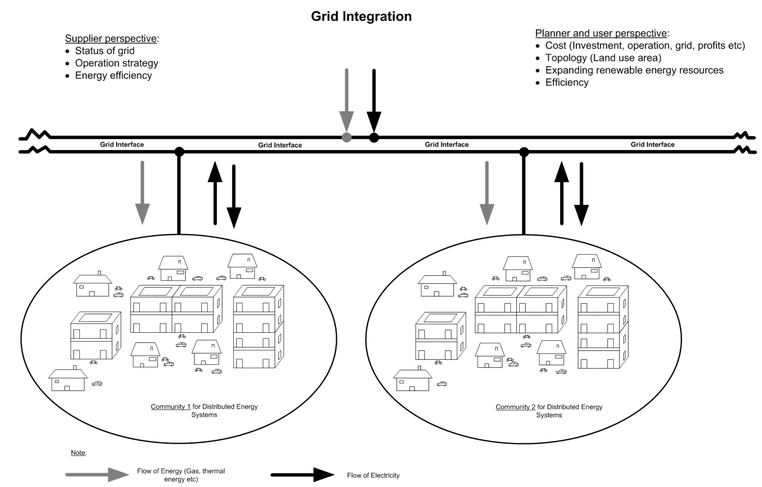
[3] V. Neimane, "On development planning of electricity distribution networks," Ph.D. dissertation, Royal Institute of Technology, 2001.

Background and Motivation

Basic architecture for the core of PhD Research



Status of grid



Progress of Work

1. Work on planning approaches and planning tools is completed.
2. Development of monitoring platform is underway.
3. Modeling of the energy systems at black box level is in progress.