

Bachelor-/Masterarbeit

Forschungsgebiet: Active distribution networks and Microgrids planning

Mathematical model of microgrids with presence of flexible loads for the planning problem

Electrical energy is one of the modern society pillars. Therefore, a challenge for engineers should be to guarantee a reliable, efficient and sustainable electricity supply. This has given rise to a sharp increase of the penetration level of distributed energy resources (DER's) such as distributed generation (DG's) and distributed storage (DS's). Hence, the traditional unidirectional power delivery with a centralized generation has switched into a bidirectional power delivery with a decentralize generation. In that way, an active participation at the demand side, together to both new loads such as electrical vehicles (EV's) and active management systems have brought about the concept of Active Distribution Networks (ADN's).

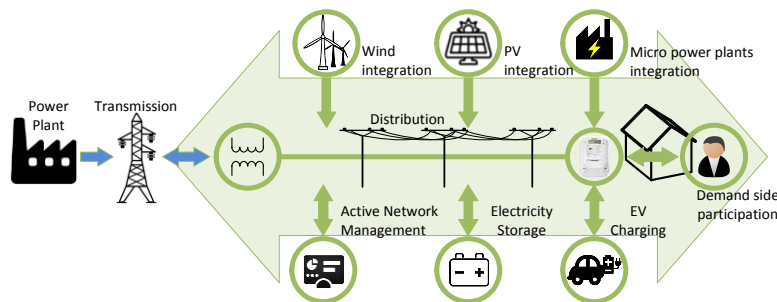


Figure 1. Active distribution networks concept

One example of ADN's are microgrids, which are self-controlled entities (ADN's) that can operate in both grid-connected and islanded modes. Therefore, because of the particular features of these distribution networks, the traditional planning and operation techniques must be reviewed and modified. For example, the main target of the power distribution planning is to optimally design the distribution network in order to supply the future demand, but for the microgrids planning case, DER's and active demand should be considered [1].

As a consequence, several models and methods are being proposed to solve the microgrids planning problem [1]. However, because of the current steady increase of the penetration level of intermittent nature resources, novel energy storage systems (ESS's) and flexible loads, there is still a huge lack of knowledge behind the planning problem. Thus, an appropriate optimization problem must be formulated.

The optimization problem is in general formed by the mathematical model, objective functions, decision variables and constraint functions. Therefore, the microgrid's mathematical model have to contemplate properly all the elements of the network, for example, all the sizable loads such as alkaline electrolysers, heat pumps and electric vehicles, whose use has increased because of their flexibility and energy storage characteristics. This flexible loads will affect the usual demand profile, where both controllable and uncontrollable loads, as well as demand response (DR) options, have to be taken into account.

The research question of this work is: How can flexible loads and demand response be considered as part of a probabilistic microgrids planning problem?

The objectives of this work is: To develop a microgrids mathematical model with penetration of flexible loads for the planning problem

The below activities are suggested:

- Literature review on microgrids planning, demand response, and flexible loads
- Microgrids planning optimization problem definition based on state-of-the-art test cases
- Microgrid mathematical model development with the presence of flexible loads
- Model validation and comparison against base cases
- Evaluation of the allowable model uncertainty

The work is intended to be developed in the English language.

The outcomes of this work must be shown in an oral presentation, and it is completely desirable the production of at least one international conference or journal paper.

The work is for students of Elektro-/Informationstechnik as Bachelor-/Masterthesis.

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