The policy objectives of the energy transition in Germany are very ambitious: thus, 80 percent of the electricity power needs by 2050 should come from renewable energy sources. The North Sea island Pellworm already reached this value and is therefore a suitable place as a pilot region for a power system with energy storages and an extremely high proportion of distributed power generation from biomass, photovoltaics and wind.

All these components need a sophisticated control and management system connecting distributed generation, energy storages and a flexible demand. In addition, cross-disciplinary topics such as heat generation can continue to play an important role.

The aim of the project “Smart Region Pellworm” includes as a central element the building up and operation of such a smart grid. Hybrid storage is used to map the different fields of application of storage systems. In addition to two stationary storage facilities with different technologies (li-ion battery and redox-flow battery) there are also unidirectional storage systems, e.g. electric storage stoves, heat pumps, and the biogas plant on the island.

Within the framework of this project comprehensive analysis of present and future business models of hybrid storage systems are performed for market, grid and local supply. The experience gained during realization and operation should feed into the analysis of transferability of the Pellworm approach to other distribution grids and the investigation of business models.
Realization

The task of Fraunhofer IOSB Advanced System Technology (AST) includes the question of the optimal operational management of hybrid storage systems for various use cases. Therefore an extensive analysis of measurement data of the energy system is being conducted, and all relevant electric and thermic components are being modelled and integrated in optimization models of the particular operational management strategies.

Based on examined business models all objective functions of the operational management will be created. Thereby, both financial and technical restrictions of the energy system must be regarded, including data of customers and feed-in, current grid condition and also exogenous influencing, such as meteorological data and special conditions, such as feed-in management. A special challenge is the combination of different, partly opposing objective functions for operational management. Mapping of various chronological levels of operational management is possible because of a multi-stage optimization approach.

The core of the operational management solution is the energy management system EMS-EDM PROPHET®. Here the implementation of the operational management strategies in the form of optimization models takes place. During the startup phase the basic functions of the operational management solution are tested. These functions build the basis for the complex operational management strategies in the demonstration phase.

Evaluation

Evaluation of relevant parameters of the energy system, with and without being actively influenced by the operational management strategies, provides an essential statement of functionality of the operational management strategy. Through different scenarios the operational management was evaluated using quality factors. The presentation of all proportionate influences of the requirements of the business models and the specifi cations of the grid management attracts special attention during the analysis. Another main focus of the analysis will be the detailed view on the behavior of the complete system in special situations.

Project Partner

- E.ON Hanse AG (consortium manager)
- Gustav Klein GmbH
- Fraunhofer Institut AST und UMSICHT
- Fachhochschule Westküste
- RWTH Aachen IFHT
- Saft Batterien GmbH
- Schleswig-Holstein Netz AG