Project Fact Sheet

Technische Hochschule Ingolstadt
Institute of new Energy Systems

Project Title	**Bavarian Research network Energy – Sector Coupling and Micro-Grids (STROM) Subproject 7 "Decentralised Energy Management"**
Keywords	control strategies, energy management, sector coupling, appartement buildings, artificial intelligence, forecast

Project Details

Project Start	2021	**Duration**	3 Years
Funding Authority	Bayerische Forschungsstiftung		
Project Budget	245.700 € (subproject THI)	**Project ID**	AZ-1473-20
Project Leader	Prof. Dr.-Ing. Wilfried Zörner		
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Project Partners CitrinSolar Energie und Umwelttechnik GmbH, Eichenseher Ingenieure, Gemeinnützige Wohnungsbaugesellschaft Ingolstadt GmbH, Sarauer Energietechnik GmbH, xNet GmbH

Description

Within the framework of the research project, intelligent building system control is being investigated and compared with conventional control strategies. In this context, an intelligent control system is characterised by an AI/forecast-based control logic. In a first step, different building models and suitable renewable energy systems with storage are created. These are used to simulate the heat and electricity supply as well as the consumption in the buildings and the electricity demand for electric vehicles (e-vehicles). During the simulation, different control algorithms are investigated. The gained results provide information about the specific advantages and disadvantages of different control strategies. The overall objective of the project is to determine possible savings potentials as well as the economic efficiency of AI/forecast-based controllers.

The research subproject "Decentralised Energy Management" is an integral part of the research network "Energy - Sector Coupling and Micro-Grids". The research network develops technical solutions for sector coupling and planning principles to accelerate dissemination and examines the regulatory framework. At the beginning of the sub-project, characteristic building and energy data are collected. These will be used to model different buildings as well as suitable renewable building energy systems and to use them for subsequent simulations. In this first step, different RE-based technology portfolios, including energy storage, are identified and evaluated in order to determine suitable energy systems for the different building types. After a technical characterisation of the technology portfolios, the energy systems can be designed for the building types based on weather data, heating and electricity loads as well as data on the additional electricity demand due to the use of e-vehicles. Information on the user behaviour of the residents is necessary to determine characteristic data on e-vehicle use. In this way, charging times and the necessary energy can be determined and considered in the energy system design. Once the overall system design has been completed, the data can be used for the physical modelling of the buildings and regenerative energy systems. These are then used for the simulation. After determining and selecting typical control algorithms for the respective energy systems, these can be implemented in the system simulation. The simulation of the control strategy, the energy supply and consumption, enables a technical evaluation of the systems investigated. On the basis of characteristic heating and electricity load profiles, which contain demand-based energy consumption data of the residents, as well as data on user-specific e-vehicle use, the systems can be evaluated. By comparing these conventional control algorithms with AI/forecast-based control algorithms, an evaluation of a smart controller can be made. First, however, a suitable AI/forecast-based control algorithm must be developed. This should predict the energy demand of the house residents for a short time and control the system according to the determined demand. Through continuous feedback from the system on the predicted demand values, an intelligent control system can learn and adapt. In addition to the building energy system, such a control system can consider external influences such as price/grid signals, whereby a decentralised energy management system can also have a grid-supportive effect. By implementing short-term forecasting of electricity and heat demand, energy supply and consumption can be simulated again for the building models. A subsequent comparison with the characteristic heating and electricity load profiles including the user-specific data of e-vehicle use allows an evaluation of the smart control. Through a techno-economic evaluation and comparison with conventional control, possible advantages of such a control approach can be identified. This final evaluation of the results allows reliable statements to be made about the advantages and disadvantages of the respective control system. With the findings derived from this on possible savings potential and the economic efficiency of AI/forecast -based controls, the objective formulated at the beginning can be fulfilled.