Case Studies

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ANNEX 57

Flexibility by implementation of heat pumps in multi-vector energy systems and thermal networks

Neuburg an der Donau, Germany

"Transformation and operational optimization of district heating grids for the development of hybrid grid structures for grid-oriented district energy supply"

Key Facts

RD&D Status: Large-scale demonstration

Type of heat pump: Decentralized HP and heating elements with district heating-system for heating

Building description: Mixed of residential and non-residential. Mix of new and existing buildings

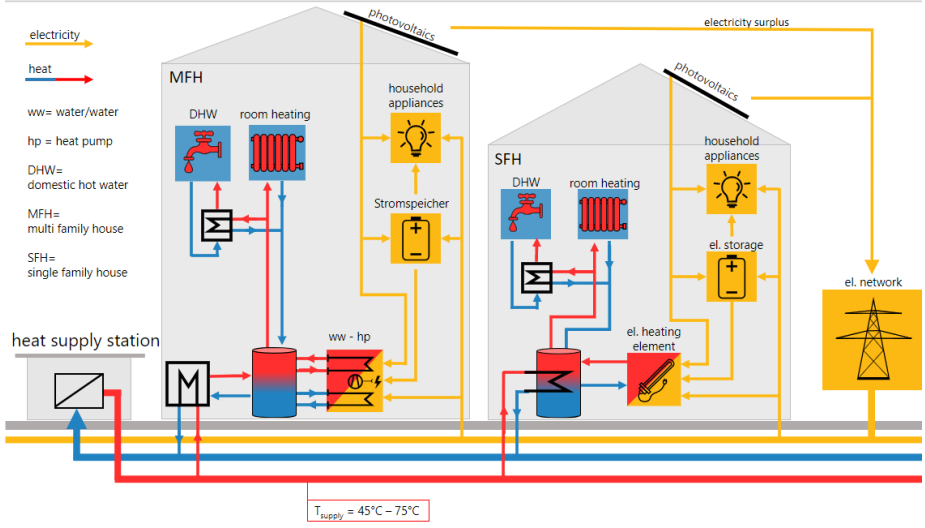
Energy distribution System: District heating, electric power grid

Energy Storage: Decentralized thermal and electric storages, (in each building)

Control for the flexible heat pump operation: District Controller: Rule based algorithm.

General description:
Number of heat pumps: 8
Water-Water HP: 8 MW
Sink temperature: 75/45°C.

Heat Source:
District Heating Grid



Summary of the project:

The main objective of the planned project is to identify and demonstrate the possibilities of optimizing the operation of district heating grids as part of a hybrid energy system in the course of the necessary transformation of the district heating supply. The focus of the investigations is on the development of a generation-oriented or grid-oriented operation of two existing physically separated energy systems in the sectors "electricity" (electrical energy systems) and "heat" (thermal energy systems). To achieve this goal, approaches for optimized and integrated operation by combining electrical distribution grids and district heating grids are being developed, tested, evaluated, and implemented, considering technical, economic, and regulatory framework conditions. First, the simulation-supported development of operating strategies for hybrid grid structures will be carried out, taking into account the grid-serving coupling of the "electricity" and "heat" sectors. The aim is to show how a comprehensive flexibilization of existing district heating systems must be designed in the context of hybrid network structures to meet future demands on the district heating system as a result of its transformation. The developed operating strategies will be tested on a test site for power and heat grids to identify synergy potentials for increasing the efficiency and flexibility of hybrid grids. Finally, the developed operating strategy will be implemented in a sample neighborhood of the city of Neuburg a. d. Donau, Germany.

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Energy supply scheme:

All buildings are connected to the DHG. And further, in the context of a hybrid grid structure, decentralized thermal storages are installed in the buildings in combination with coupling technologies. Electricity gained from photovoltaic (PV) modules on the building roofs is used in heating applications via electric heating elements in smaller buildings and heat pumps in apartment buildings. This, in combination with the DHG, allows flexible operation of sector coupling technologies and thus purchase from the power grids. The sector coupling technologies are dimensioned in relation to the domestic hot water (DHW) load in consideration of the thermal storage volume.

Flexibility – scheme and control strategy of the system:

The control strategy is based on the idea of a central district controller which considers the energy supply (heat, electricity) of a district in a whole. The background to this is the contraire interests that arise when several actors want to implement a hybrid energy system together. In practice, the actors still operate very much separately from one another and, accordingly, their economic goals are also aligned with the respective sector. In contrast, the district supplier pursues the overriding goal of the most cost-efficient energy supply across all sectors. Therefore, the district controller receives all information and data that arise in its control area and optimizes, based on an algorithm, the economic operation. The overall objective is to decarbonize the energy supply in the context of a hybrid energy system and, to implement an economic operation strategy in this context.

FACTS ABOUT THE PROJECT

Place: Germany / Neuburg an der Donau

Time Frame: Start 2021

Project leader: Fraunhofer IEE

Project partners:
Energy Efficiency Association for heating, cooling and CHP (AGFW), BBH Consulting AG, ENERPIPE GmbH, IKEM - Institute for Climate Protection, Energy and Mobility, municipal utilities in Neuburg an der Donau (Stadtwerke Neuburg an der Donau)

Contact Information/Links

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Published articles:

Fraunhofer IEE, AGFW, IKEM, BBHC, ENERPIPE, SWND (2023) "Transformation and operational optimization of thermal grids for the development of hybrid grid structures", DHC 2023, Beijing, China.

Fraunhofer IEE, AGFW, IKEM, BBHC, ENERPIPE, SWND (2022) EnEff:Wärme: HybridBOT_FW - Transformation of the urban district heating supply, Frankfurt am Main, Germany.