COUPLED HEAT AND ELECTRICITY SUPPLY OF DISTRICTS – ANALYSIS OF INNOVATIVE DISTRICT HEATING SUPPLY OPTIONS

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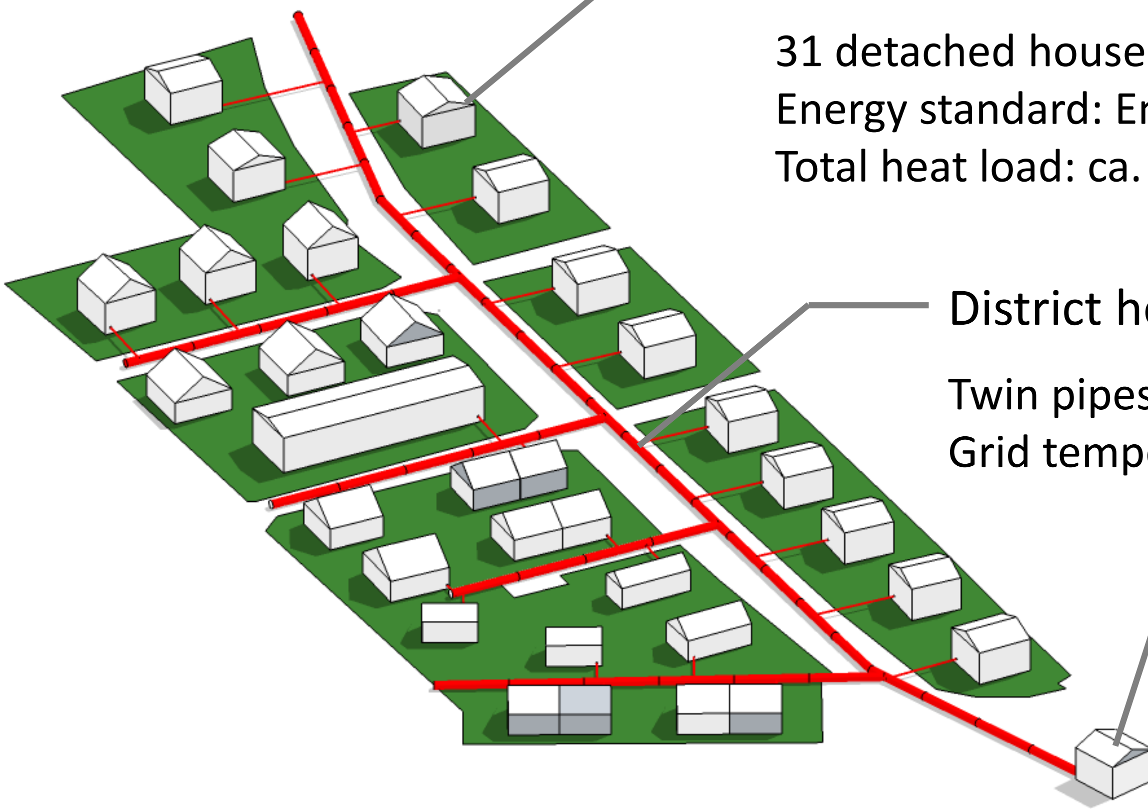
Objectives of the research

Overall aim: Development and comparison of innovative Low Temperature District Heating supply solutions for a new development area in the city Neuburg an der Donau (Germany)

- Identification of efficient supply solutions based on low-temperature heat sources (waste heat from dairy available)
- Determination of the potentials of different heat supply concepts with regard to the local heat potentials and the sector coupling
- Investigation of optimal operating strategies and business models (PV contracting, PV lease model, etc.) for the entire energy supply system

Planned new housing estate Neuburg a.d. Donau (GER)



Buildings

31 detached houses and 1 terraced house
Energy standard: EnEV 2016
Total heat load: ca. 290 kW

District heating network

Twin pipes (plastic pipes)
Grid temperature: 45 °C / 70 °C (supply)

Heat generation

water-water heat pump (HP)
Waste heat from
a dairy (20 °C)

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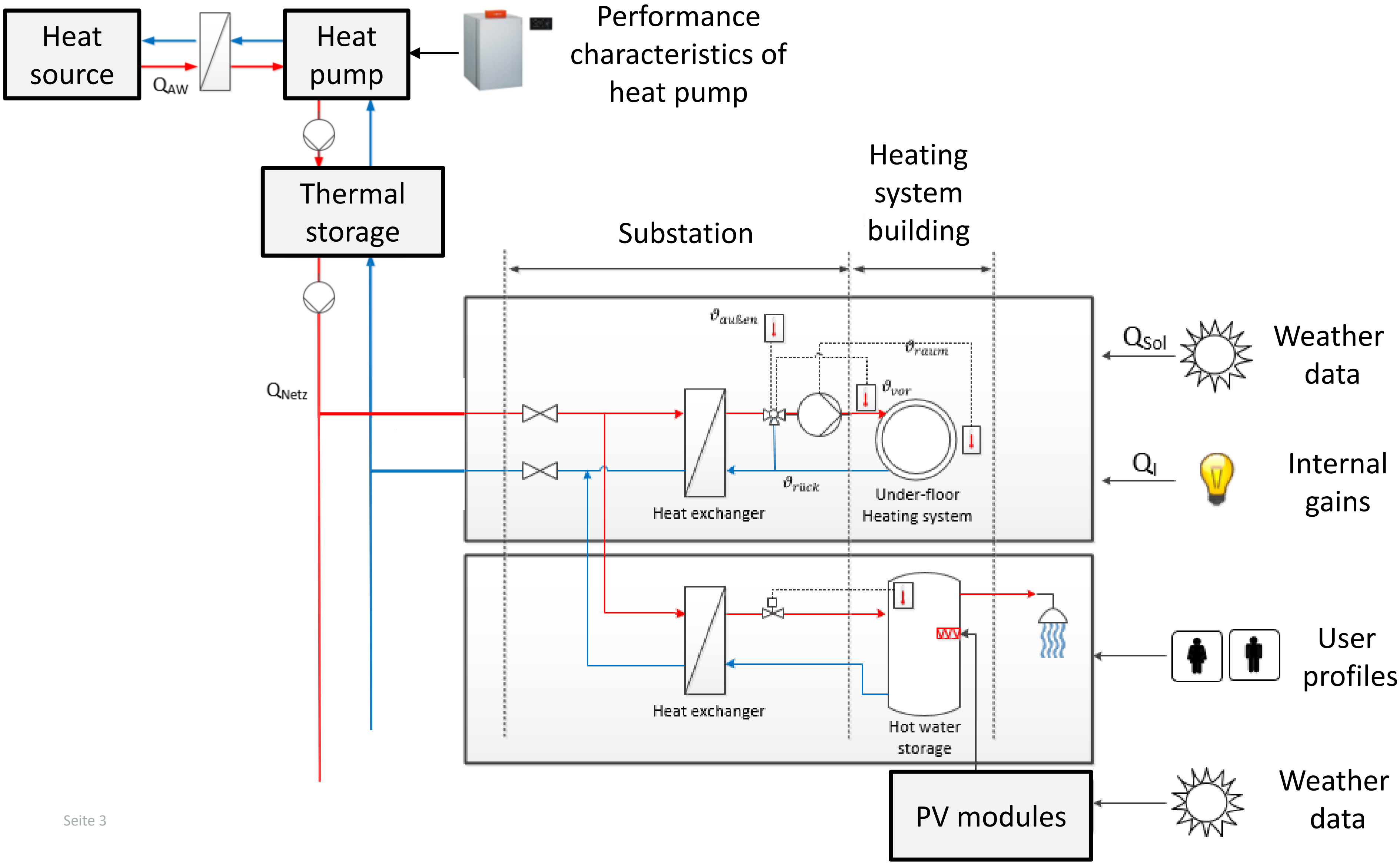
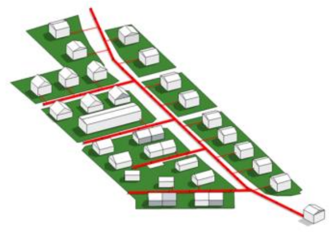
Thermo-hydraulic simulation of district heating system



Investigated heat supply variants

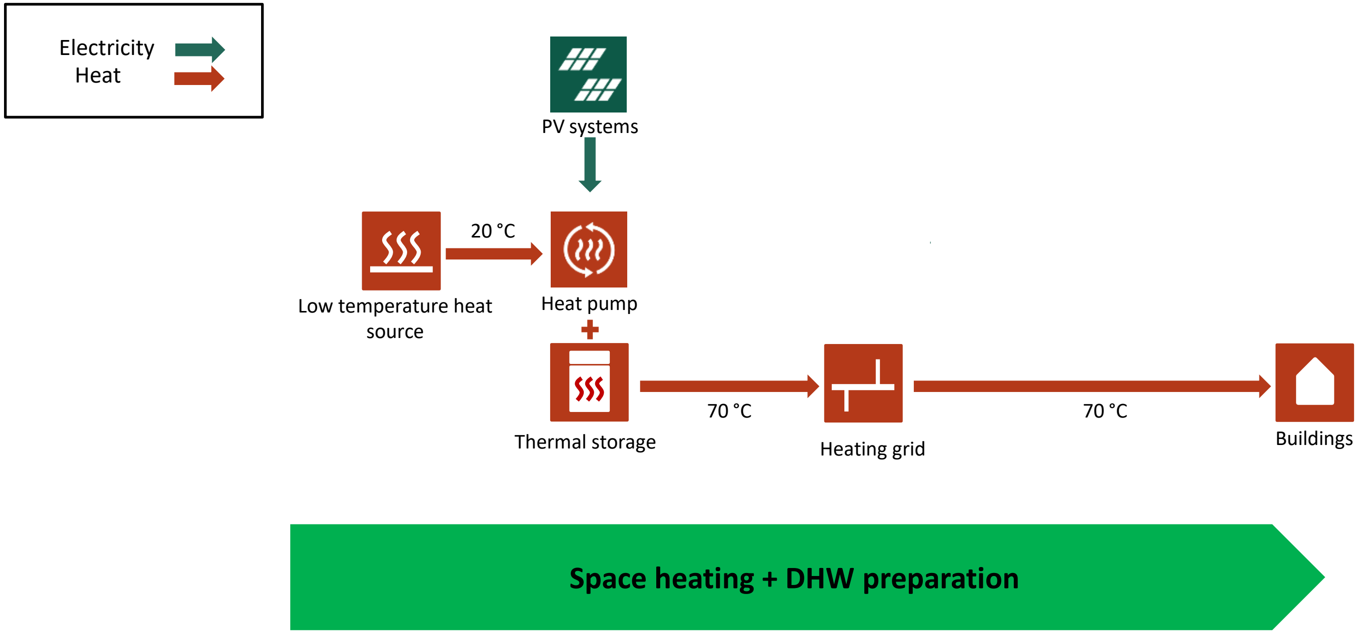
Main focus of the investigations



Variant 1	Variant 2
HP + PV + LTDH @ 70°C Heating and DHW: centralized	HP + PV + LTDH @ 45°C Heating: centralized DHW: semi-central + PV

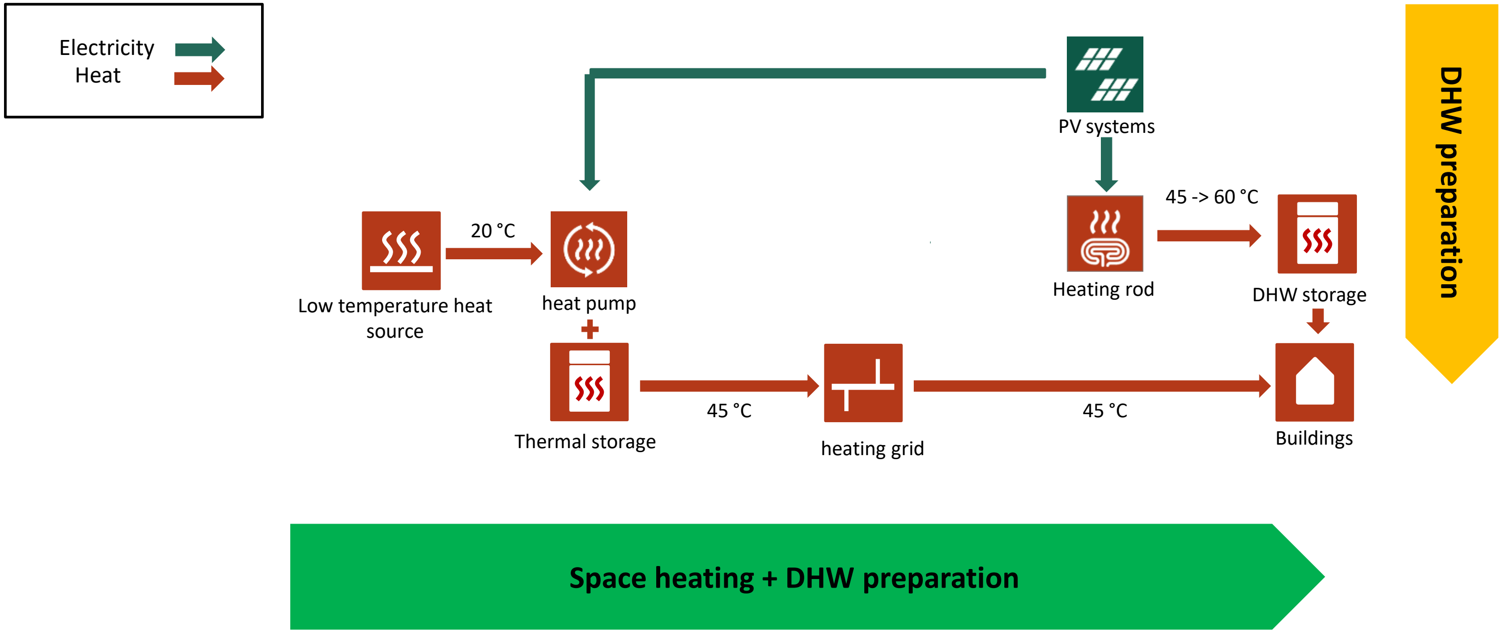
- Sector coupling (PV + heat pump / PV for DHW preparation)
- Energy efficiency of the system variant - grid losses as a function of grid temperature / Use Low temperature heat source (20°C)
- Investment and operating costs

1st Heat supply variant: supply temperature 70 °C



- Central heat pump + low temperature heat source (20°C) / network temperature: approx. approx. 70°C
- Central DHW preparation by thermal network
- Exploitation of sector coupling potentials: excess electricity from PV system for heat pump operation

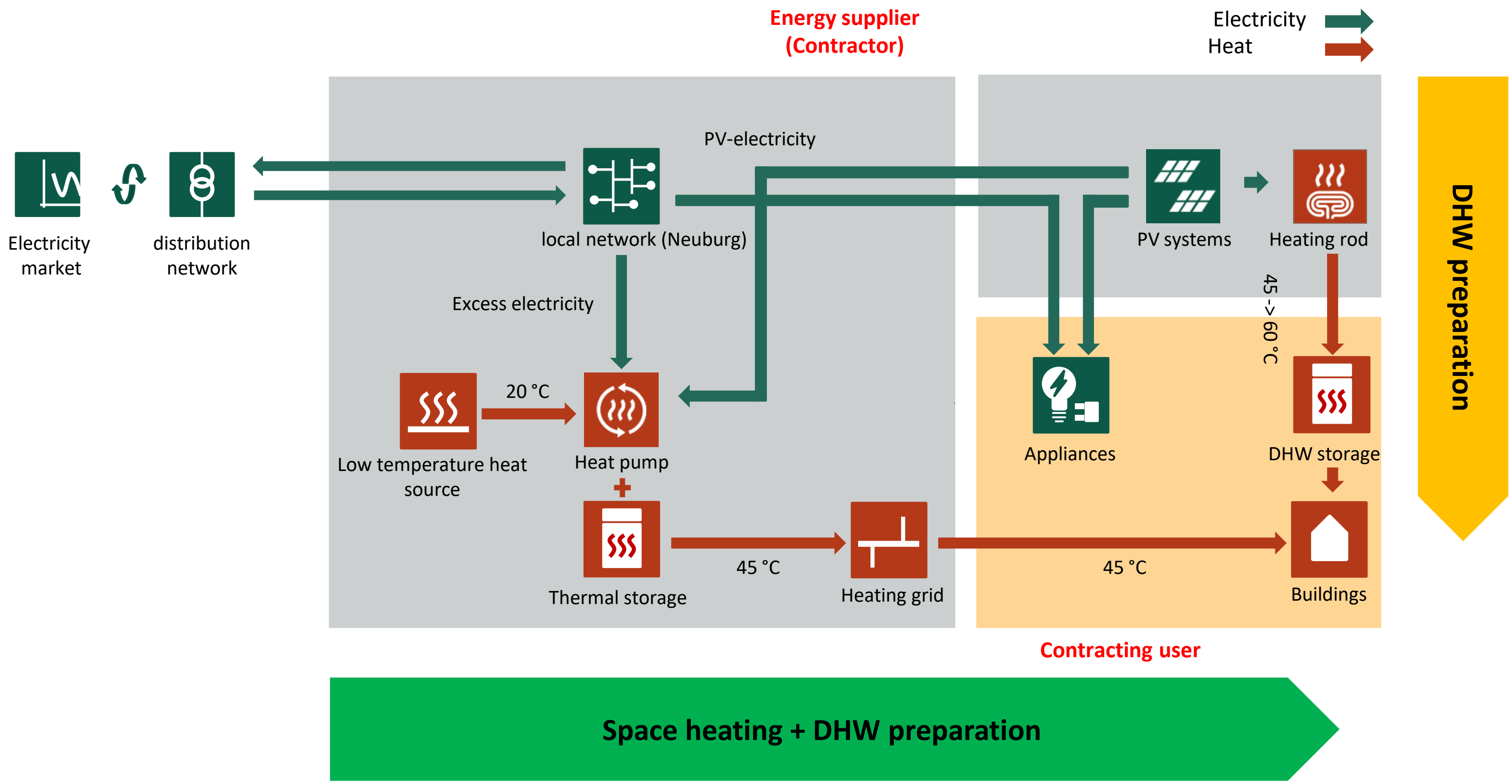
2nd Heat supply variant: supply temperature 45 °C



- Central heat pump + low-temperature heat source (20°C) / network temperature: approx. 45°C
- Semi-decentralized DHW preparation: preheating by thermal network and reheating with PV (el. heating rod and heat pump)
- Utilization of sector coupling potentials: excess electricity from PV system for DHW preparation and heat pump operation

Business model: Sector coupling - electricity and heat

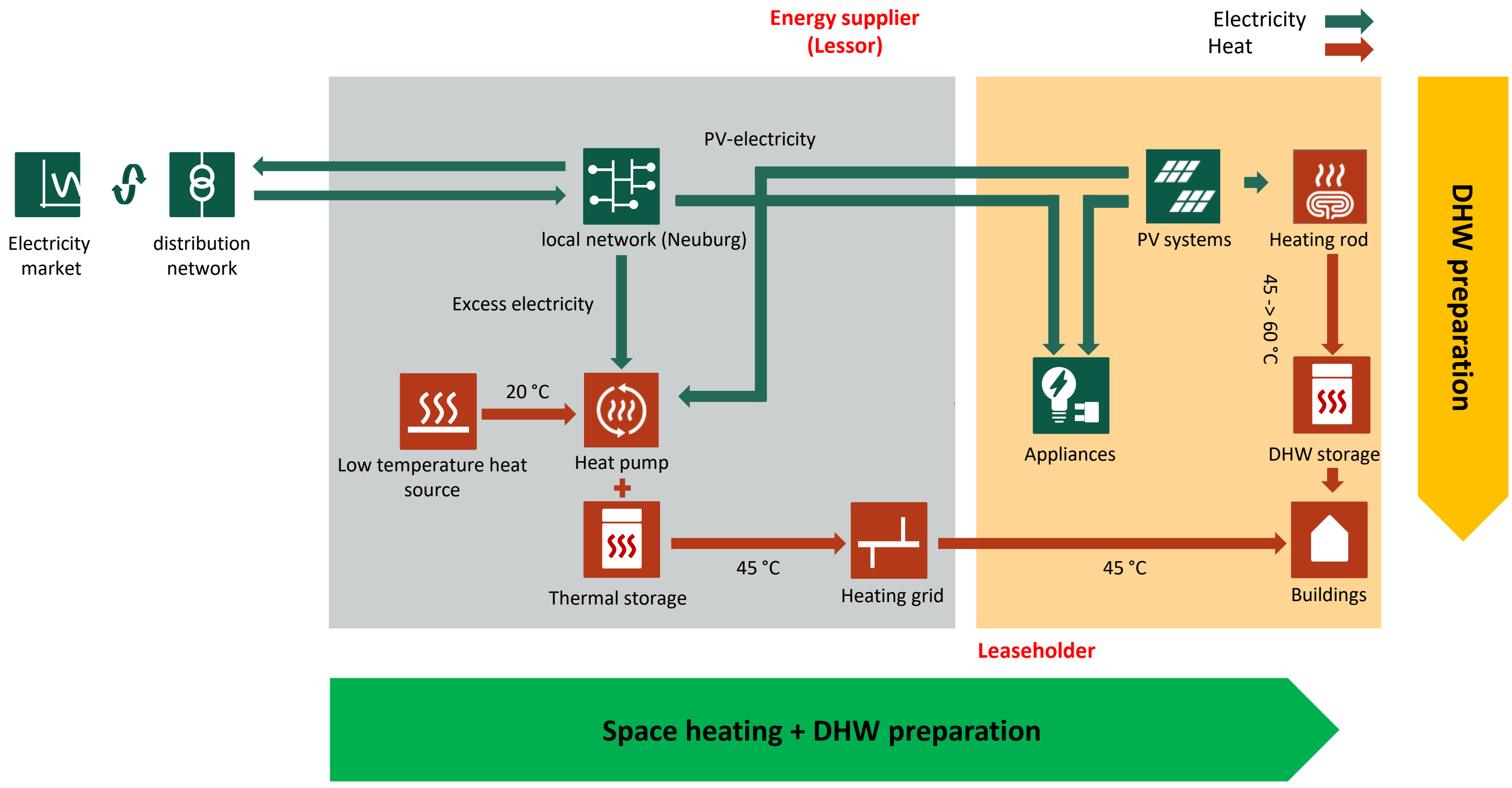
Example 1: Heat network operation with PV contracting



- PV system and heating elements are owned by the utility (contractor) that sells heat to building owner (contracting user)
- Advantages: Exemption on EEG-surcharge of 40%, partly reduction of taxes and total exemption of network charges

Business model: Sector coupling - electricity and heat

Example 2: Heat network operation with PV lease model

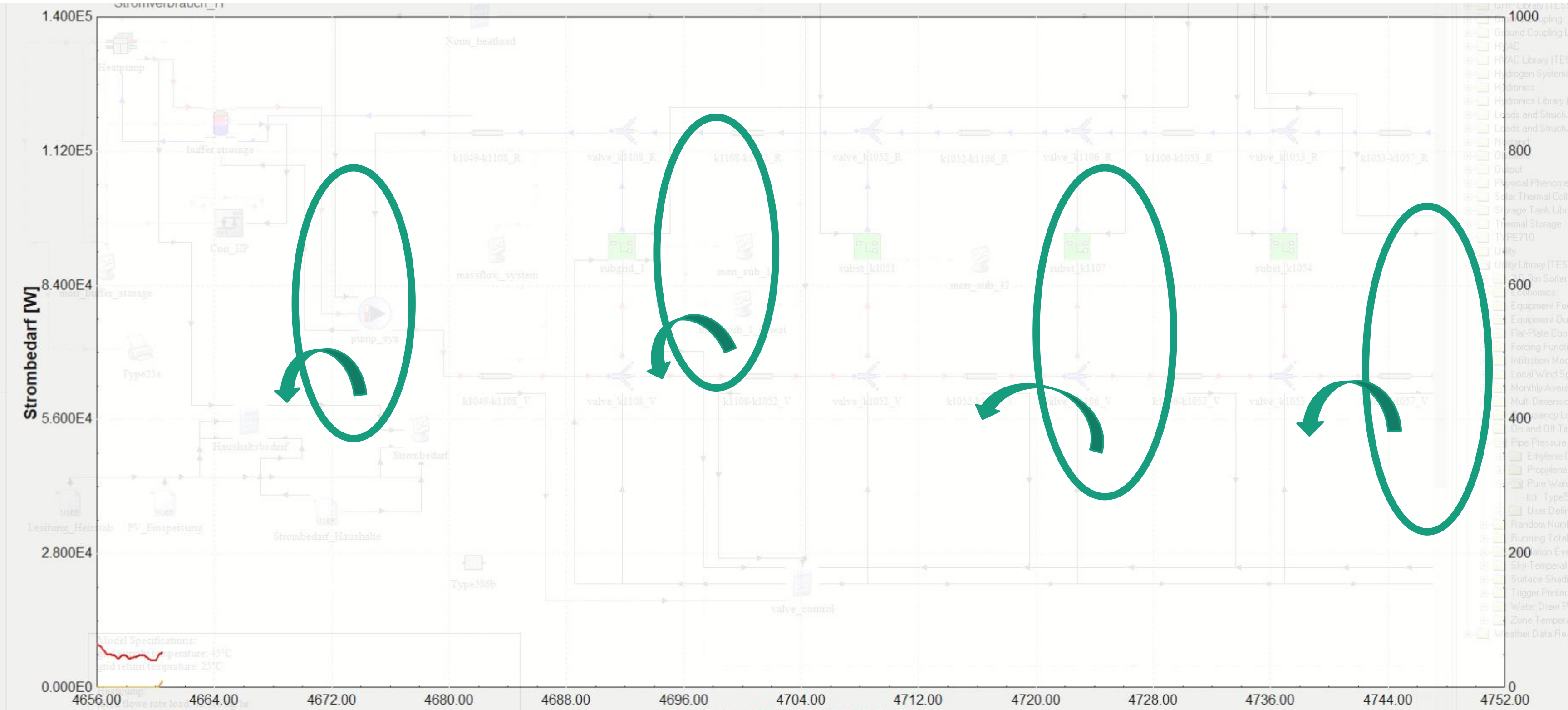


- Building owner (leaserholder) leases a PV system from the utility (lessor) that is assigned to the building owner
- Advantages: Exemption on EEG-surcharge of 100 %, partly reduction of taxes and total exemption of network charges

Integrated energy management - electricity and heat

Load shifting potential (4 days in July)

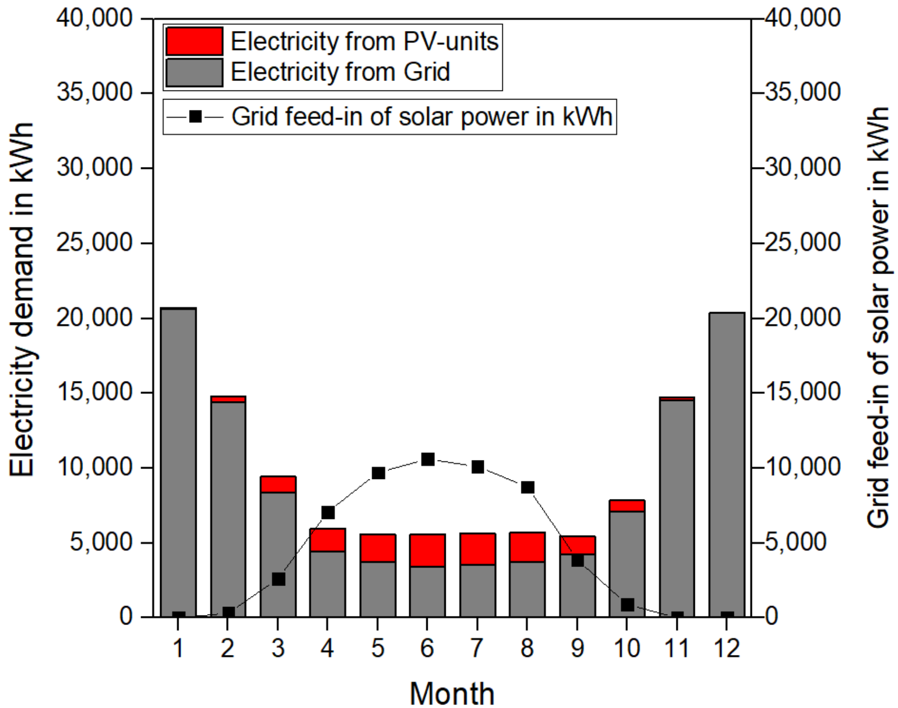
- Total electricity load (household appliances + heat pump + el. heating rod)
- Power load of heat pump
- Power generation with PV-modules



- Increased self consumption of solar power by means of peak shaving

Integrated energy management - electricity and heat

Load shifting potential



- Estimated self consumption of solar power in summer around 35 percent
- Grid feed-in of solar power around 10 MWh in May, June and July -> Load shifting potential
- Reduction of EEG-surcharge, electricity tax and grid charge by means of Peak-Shaving

Interim conclusions

- Low-temperature heat network with a heat pump shows high potentials for optimised use of local waste heat for heat supply
- Regulatory framework conditions should support operating models for sector coupling
- By means of sector coupling, network operators can reduce the operating costs of the heating network and also improve the economic efficiency of PV systems by increasing their own consumption.

… next steps

- Simulation of the heating network with different temperature levels in the simulation environment TRNSYS
- Development of control strategies for peak shaving
- Evaluation of the considered operating models under consideration of energetic, economic and regulatory boundary conditions

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