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Sector Coupling Potentials of a 5th Generation District Heating and Cooling Network

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1. Introduction

This poster presents the development and application of an urban building energy simulation model to analyse an existing 5th generation district heating and cooling network (5GDHC) in Zürich, Switzerland with regard to possible sector coupling potentials. We evaluated, how the heat energy production through large industrial heat pumps and the total thermal capacities of the 5GDHC network can provide flexibilities for power to heat applications.

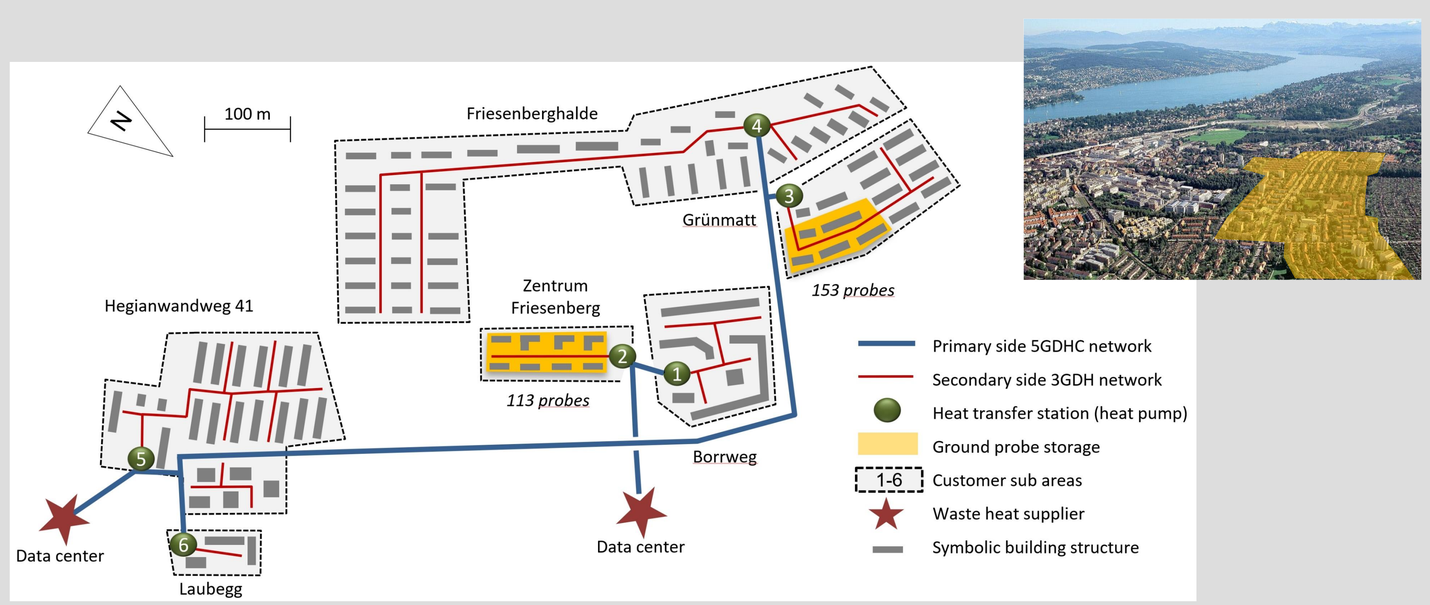

Figure 1: Schematic layout of the 5GDHC network FGZ Zürich, Switzerland; top right: areal view, location of the investigated housing area in the city of Zürich with lake Zürich in the background

2. Methods

In a first step a multi model dynamic simulation was set up using the simulation environment IDA ICE. A previously developed urban energy simulation model formed the basis to implement the special requirements of the investigated 5GDHC network. This was followed by the calibration of the simulation model using monitoring data of the existing 5GDHC network. In a second step the flexibilities of network sub areas were systematically investigated using step response tests. This was done with respect to key performance indicators like heat-up time or electrical energy consumption as a function of different boundary conditions like room air temperature or super positioned outdoor climate conditions (sun-air temperature).

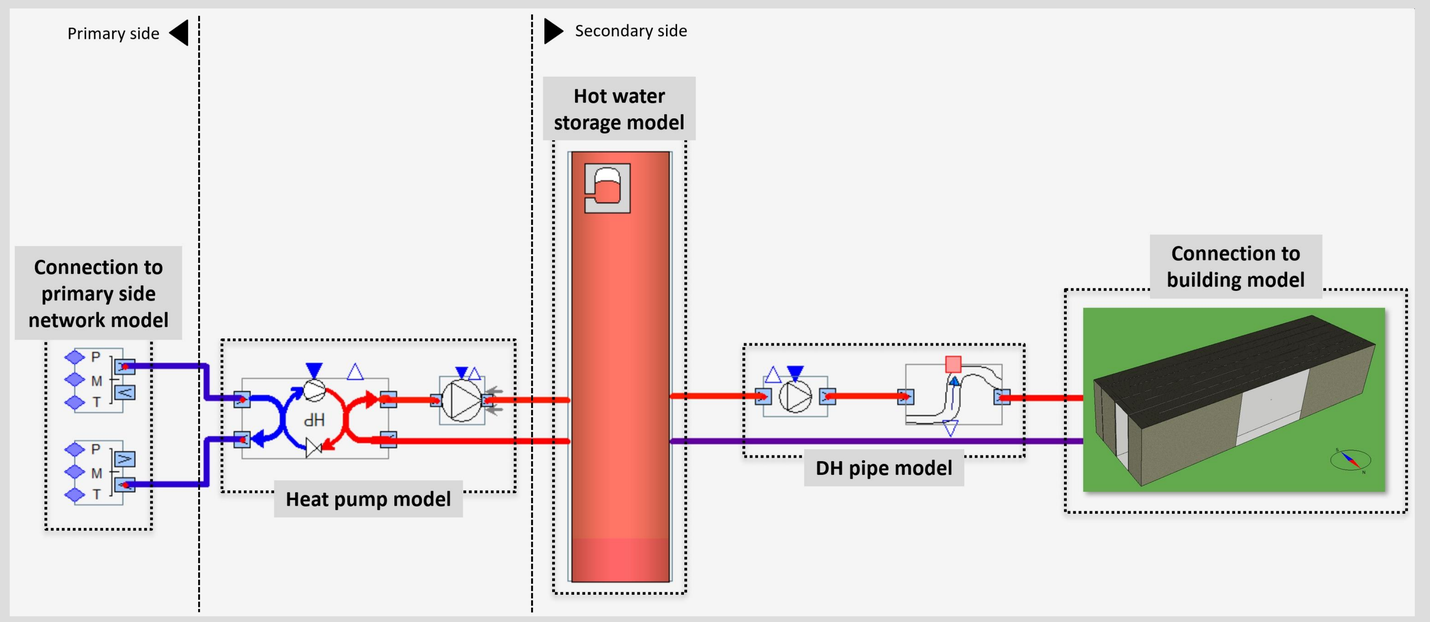

Figure 2: Schematic layout of the plant model in the simulation framework

3. Results

Figure 3 shows results of step response tests with 24°C target temperature. In the full factorial tests, the room air start temperature and the super positioned outdoor climate conditions (sun-air temperature) are varied. The two characteristic diagrams show values of time span and electrical energy consumption for the heat-up test. A map point with starting conditions 21°C room air and 0°C sun-air temperature is shown as an example. This map point shows at heat up time of 58 minutes and 850 kWh of electrical energy consumption to reach the target room temperature of 24°C.

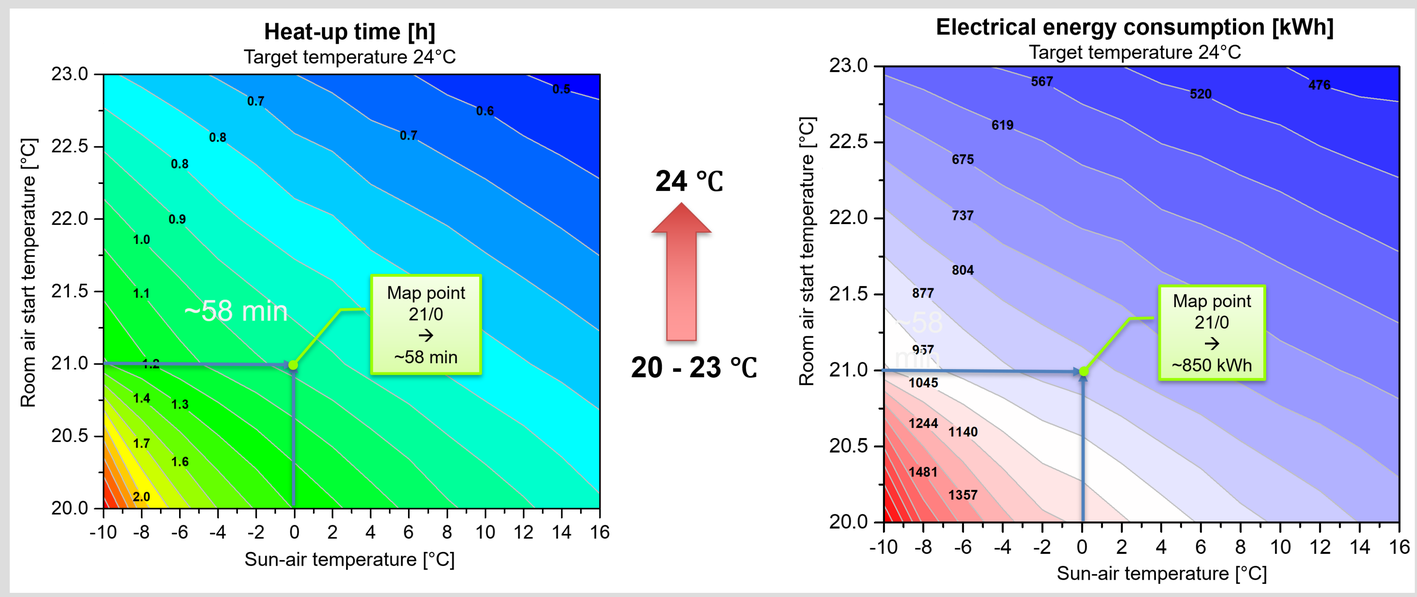

Figure 3: Characteristic diagrams of step response tests with 24°C target temperature; left: heat-up time, right: electrical energy consumption

4. Discussion

The aim of this research work was to evaluate the sector coupling potential of the investigated 5GDHC network using a dynamic urban building energy simulation model. The effects of different boundary conditions of the buildings on the electric energy demand of the heat pumps could be shown. With the used step response tests the flexibilities could be put into numbers for the targeted KPIs. And so, it could be stated that the investigated 5GDHC network shows considerable potential for power to heat sector coupling. Especially, as expected, configurations with greater thermally activated masses offer higher flexibilities. They can be used to participate in the balancing energy market or to purchase the required amount of electrical energy on the spot market at the most favorable conditions.

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