Bidirectional heat transfer stations in district heating grids

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The secondary-side integration of renewable energy into district heating (DH) systems can be considered as complex in many cases. The properties of the renewable energy must be considered such as their available temperature level, their performance class and their logistics. Energy management systems that guarantee a system-wide control of district heating systems are already state of the art. However, a bidirectional heat transfer station (for heat supply and uptake) in combination with an intelligent control strategy for the entire district heating system (for new constructions and for existing systems) still has to be developed. Requirements of the primary (e.g. energetic optimization of the heating plant, minimizing distribution losses) and secondary side (e.g. security of supply) must be taken into account.

Setup

A detailed consideration of the following two decentral heat sources is done:

- Solarthermics
- Use of waste heat (e.g. chiller) through heat pumps

The characteristics of different infeed variations (infeed by return rise, forerun rise and flow from the return to the forerun) are also investigated. The schema in Fig. 1 enabled all three variants by the actuation of corresponding valves.

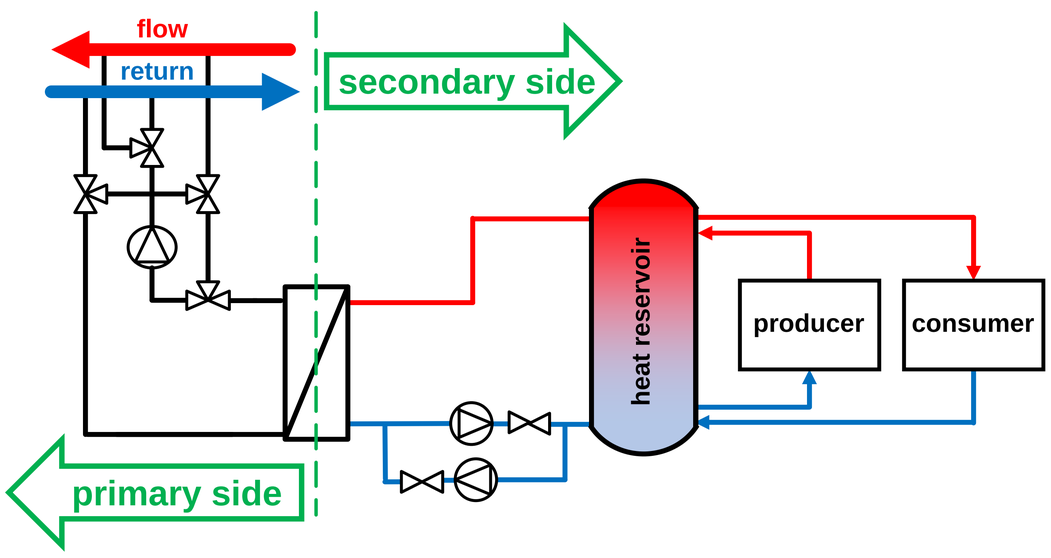

Fig. 1: *Hydraulic schema*

While in a laboratory test, the control of a prosumer is examined, a numerical model is used to examine the effects of several prosumer on the entire grid.

Numerical model

The simulation model consists of two parts. The first model part depicts the primary side of the DH system as detailed as possible, including the central heat source and the heat distribution system. Data from a real-life medium-sized district heating system is used as reference.

The second model (Fig. 2) forms the secondary side and is individually set for each prosumer. The model considered multiple layer/buffer storages located at different consumers. The model can be used to predict the time of heat input (into the DH system) and the temperature level of this heat (Fig. 3).

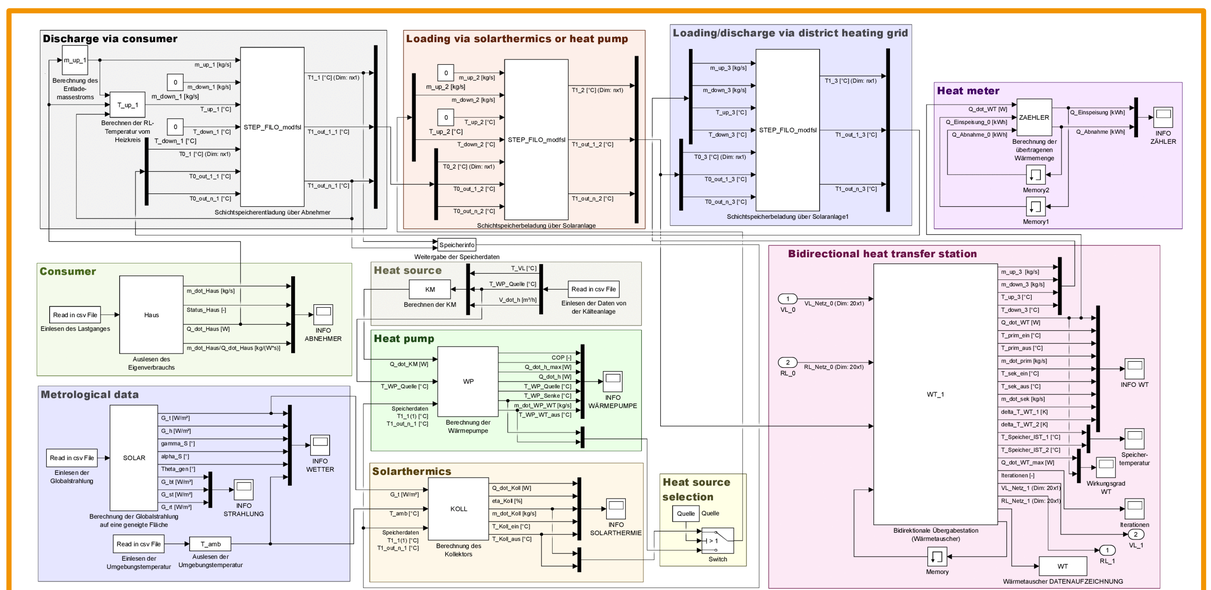

Fig. 2: *Numerical model of the secondary side*

The two model parts allow an energetic and economical investigation of DH systems with a large number of prosumers. This is enabled by combining the secondary and primary side model. The primary side model receives data on the prosumers' strategy from the secondary side model. Hydraulic problems such as flow reversals can be also investigated.

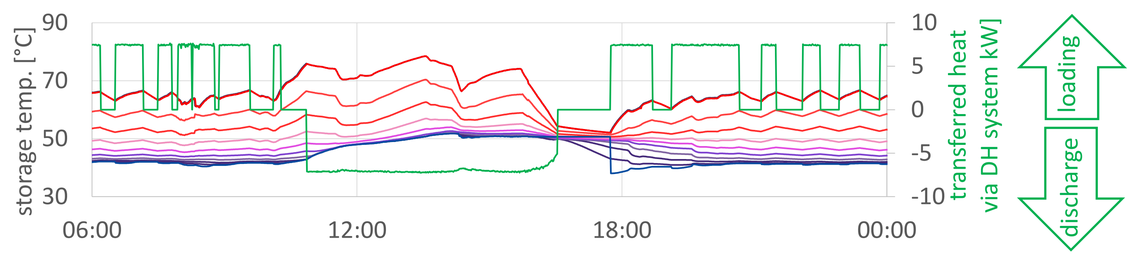

Fig. 3: *Operation of a bidirectional heat transfer station*

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