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Influence of building heat distribution temperatures on the energy performance and sizing of 5th generation DHC networks

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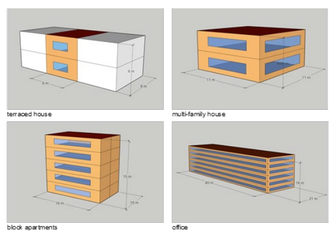
Goals

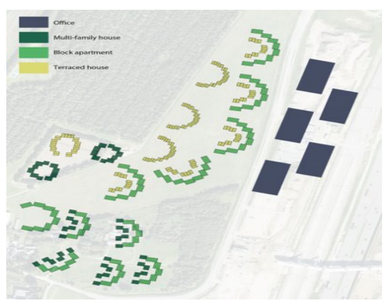
The main goal is to quantify the influence of building heat distribution temperatures at district level in the context of 5GDHC systems. Such investigation is critical as the efficiency of decentralized heat pumps, which is mainly influenced by the temperature lift, has a direct impact on the sizing and operation of the water distribution in the district piping network and its overall energy performance.

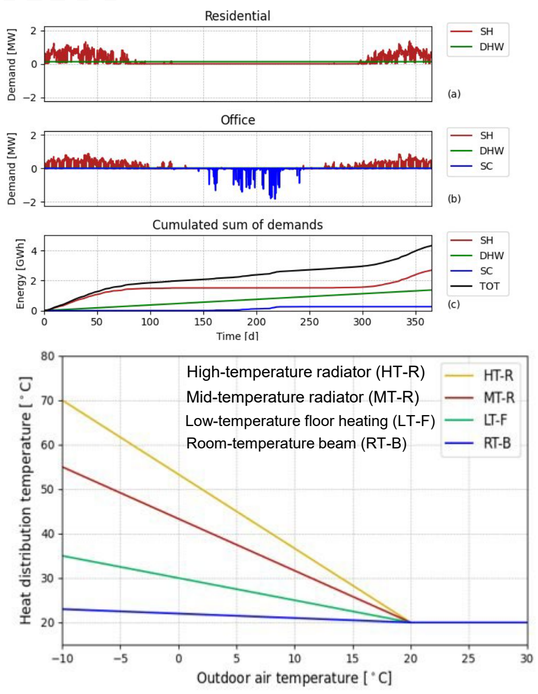
Problem

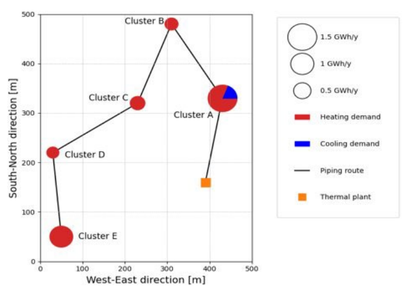
The major interest in using decentralized heat pumps is to supply heat at temperature levels adapted to each end user. This is a particular advantage in areas populated with buildings having different temperatures of heat distribution.
The overall energy performance (i.e., electricity consumption) of 5GDHCnetworks strictly depends on the typology of heat distribution systems installed in the buildings connected to the district heating systems.

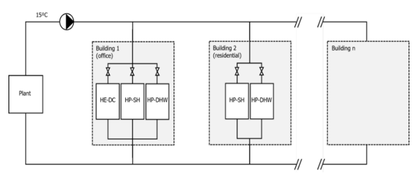
Introduction



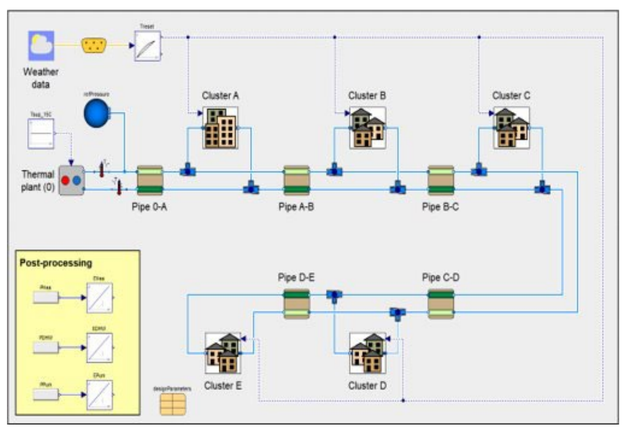


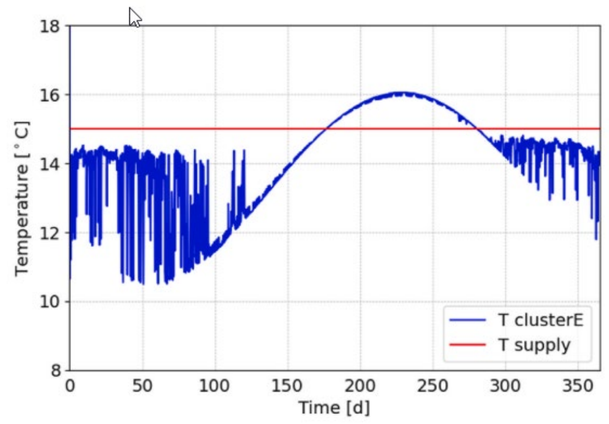


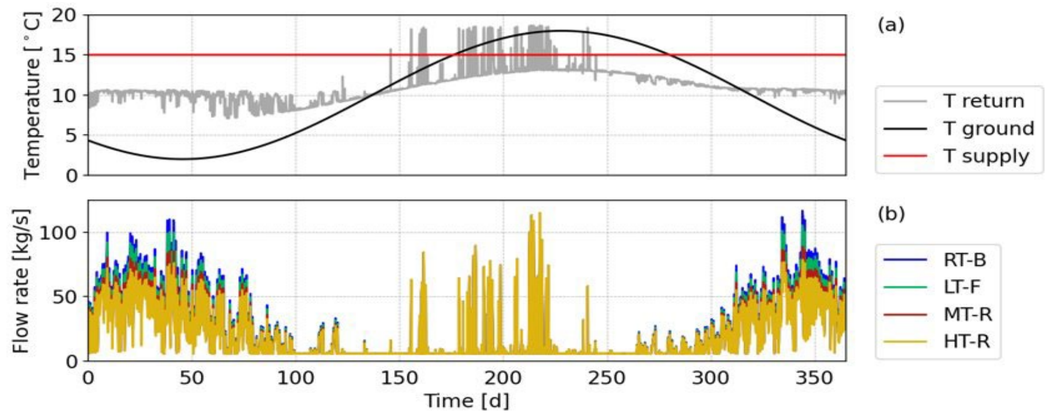




Method



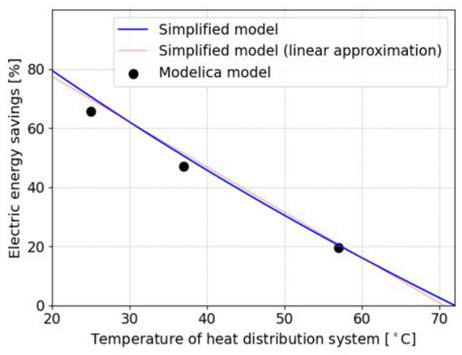




Results

$$S_{el,HP} = -1.53 \cdot T_{con,SH} + 108$$

About 1.5% of electric energy savings can be achieved for each temperature degree reduction in the heat distribution system.



Conclusions

A holistic system design for the 5GDHC technology is an important aspect since building heat distribution systems and district network are intertwined and affect each other's operation and performance.

The use of low heat distribution temperatures in building systems has two opposite effects on the electric energy consumption of 5GDHC systems:

- Decentralized heat pumps operate with higher COPs, with a consequent reduction of the electric energy consumption for the compressors.
- A higher amount of heat flow rate is required by the heat pump evaporator, leading to higher water mass flow rates in the network, with a consequent increase in electric energy consumption for the circulation pumps.

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