The reservoir low temperature network:
A new topology for simultaneous heating and cooling
Fig. 1. Surveyed 5GDHC systems by country.
Fossiles → Renewables

- 60 °C
- 35 °C
- 18 °C
- 10 °C Thermal grid

Heat pump
Heat pump
Direct

Warm water
Space heating
Cooling
Simple and Robust
Efficient
Flexible and Expandable
Cheap
Reservoir low temperature network (RLTN)
Simple and Robust

Efficient

Flexible and Expandable

Hydraulic decoupling

One line

Main loop control

Modul structure

Expandable

One line
Specific studies
8% reduction in electricity consumption of heat pumps (green line)
Heat transfer rate (kW) vs. \( V_i (\text{m}^3 \text{h}^{-1}) \)

- **Load is infinitely large volume**
- **Load is coil heat exchanger**
- **Heat transfer characteristic of the heat exchanger**

At \( V_m \), the heat transfer rate reaches a peak.
District cooling becomes more and more important with increasing air temperatures due to climate change, in particular in urban areas. The waste heat generated by cooling is ideally recycled for heating and domestic hot water, either immediately or time delayed using seasonal storages. Here, we present a new network topology, the reservoir low temperature network, that provides optimal mutual benefit for simultaneous heating and cooling and is, at the same time, robust in operation, flexible toward network expansion and more cost effective compared to other low temperature network topologies. We define low temperature networks as networks below 20 °C. In such systems, heat pumps supply the warm water for heating, whereas heat exchangers supply direct cooling. In the reservoir low temperature network, water continuously circulates in a ring line, which represents the “reservoir”. Clients withdraw water from this line, transfer heat and reinject the water into the same line. Clients can be residential buildings, industrial facilities, seasonal storages or even entire district heating or cooling networks.

In this work, we present a virtual, but realistic district with yearly heating and cooling demands and analyse three low temperature network topologies with respect to the energy consumption, investment costs and robustness in operation. We further present a general method to estimate savings at planning stage based on expected yearly demand profiles.