Technology trends in early low temperature system

Sven Werner

Professor emeritus

Halmstad University

Outline

- The 4GDH family and the basic question
- Two main groups of technology trends for network configurations for low temperature heat distribution
- Eight identified network configurations
- Conclusions

This presentation is based on the grosslist of early initiatives for lower heat distribution temperatures identified within the IEA-DHC TS2-project called Implementation of Low Temperature District Heating Systems, to be finalised in 2021.
https://www.iea-dhc.org/the-research/annexes/2017-2021-annex-ts2-draft/

Work in progress

Basic question

During the last decades, several early initiatives have been implemented for low temperature heat distribution. In this context, 4GDH is not a specific network configuration, but a family of several different configurations. Therefore, the following basic question is obvious:

What **network configurations** have been used in early initiatives for low temperature heat distribution?

Two main groups of network configurations

The group divider is the ability to directly supply domestic hot water by a heat exchanger

Warm district heating systems

- Supply temperatures above 50°C
- The customer temperature demands inside buildings are fulfilled without additional heat supply in substations
- Main heat sources are recycled or renewable heat that can create the required supply temperatures
- Based on traditional district heating systems

Cold district heating systems

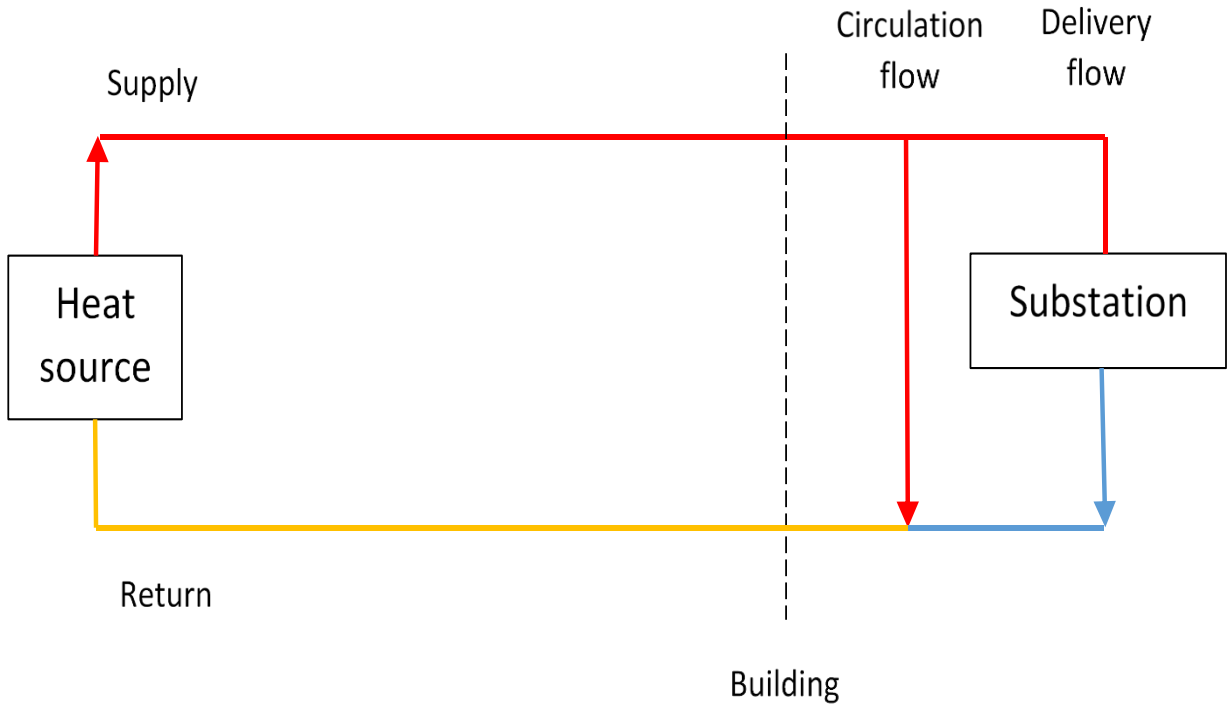
- Supply temperatures below 50°C
- Heat pumps are required in substations to fulfil the customer temperature demands inside buildings
- Main heat sources are recycled heat with low temperatures or ambient heat
- More general solutions than warm systems, since ambient heat is available everywhere

Eight identified network configurations for obtaining lower temperature levels in heat distribution networks

1. Warm DH – Classic, 4GDH-2P
2. Warm DH – Modified Classic, 4GDH-3P
3. Warm DH – MultiLevel, 4GDH-nP
4. Warm DH – Return to return, 3GDH-RR
5. Warm DH – Rehabilitation, 3GDH-RHB
6. Cold DH – High, 4GDH-HP
7. Cold DH – Variable, 4GDHC-2HP
8. Cold DH – Low, 4GDHC-HP/HEX

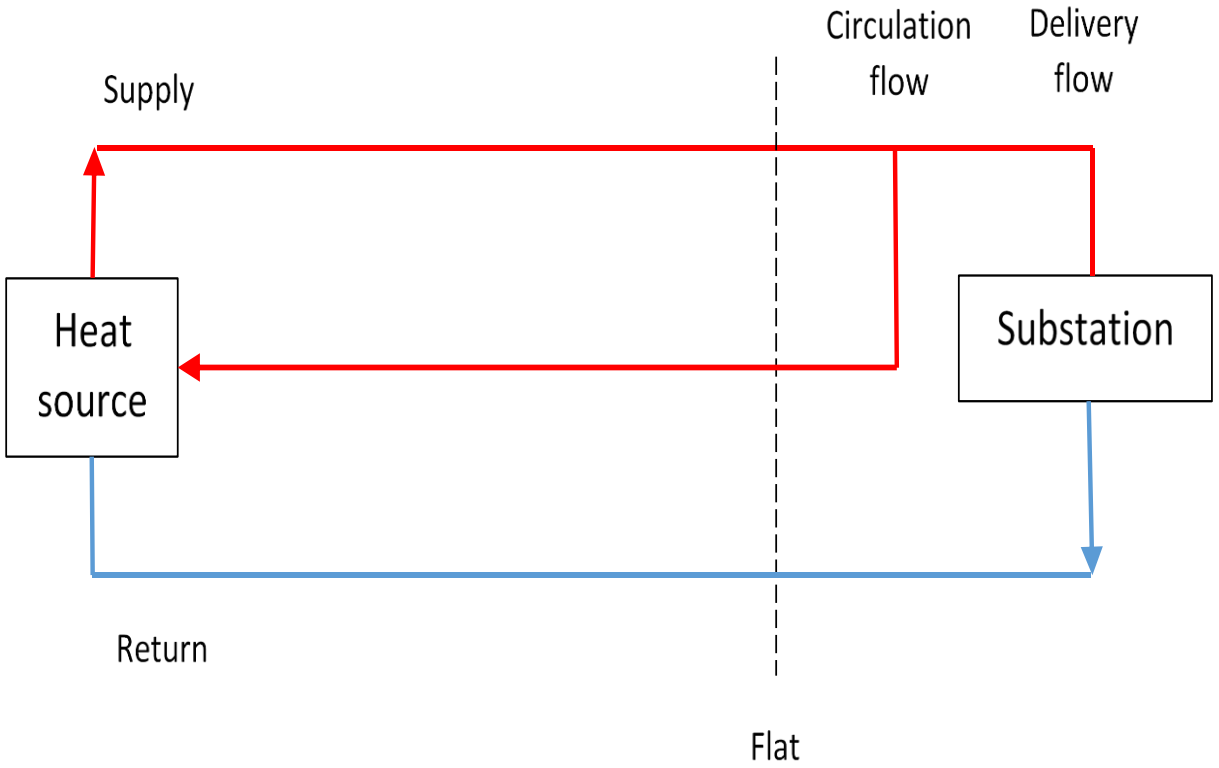
However, the pros and cons for each configuration will not be presented with respect to the limited time allocated for this short presentation

1. Warm DH – Classic, 4GDH-2P



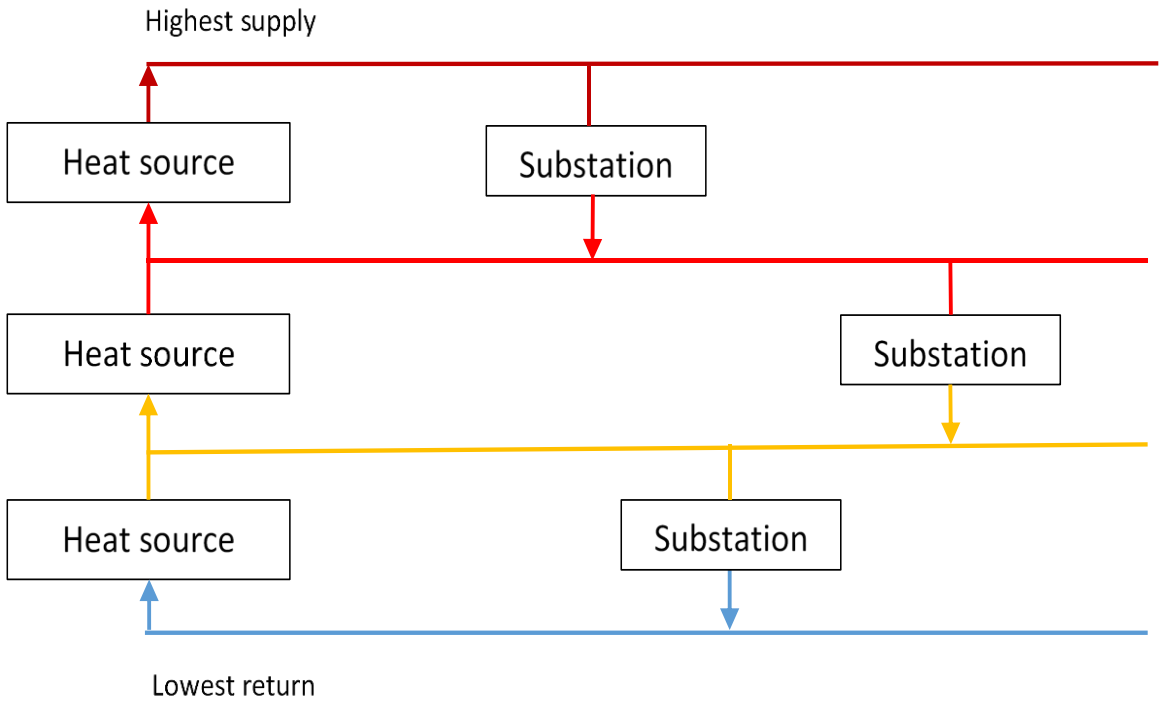
Feature: Classic 3GDH technology with two pipes is used with lowest possible temperatures, but inherit three major malfunctions from the 3GDH technology (legionella risk, blending circulation and delivery flows, and short thermal lengths in heat exchangers).
Typical temperatures: 65/60 – 35/30 °C
Installation examples: Lund-Brunnshög, Aarhus-Lystrup, Munich-Ackermannbogen, Linköping-Ullstämma, Graz-Reininghaus, Salzburg-Lehen, Chemnitz-Brühl, Freiburg-Gutleutmatten, Munich-Freiham, Stuttgart-NeckarPark, Slough-Greenwatt Way,

2. Warm DH – Modified Classic, 4GDH-3P



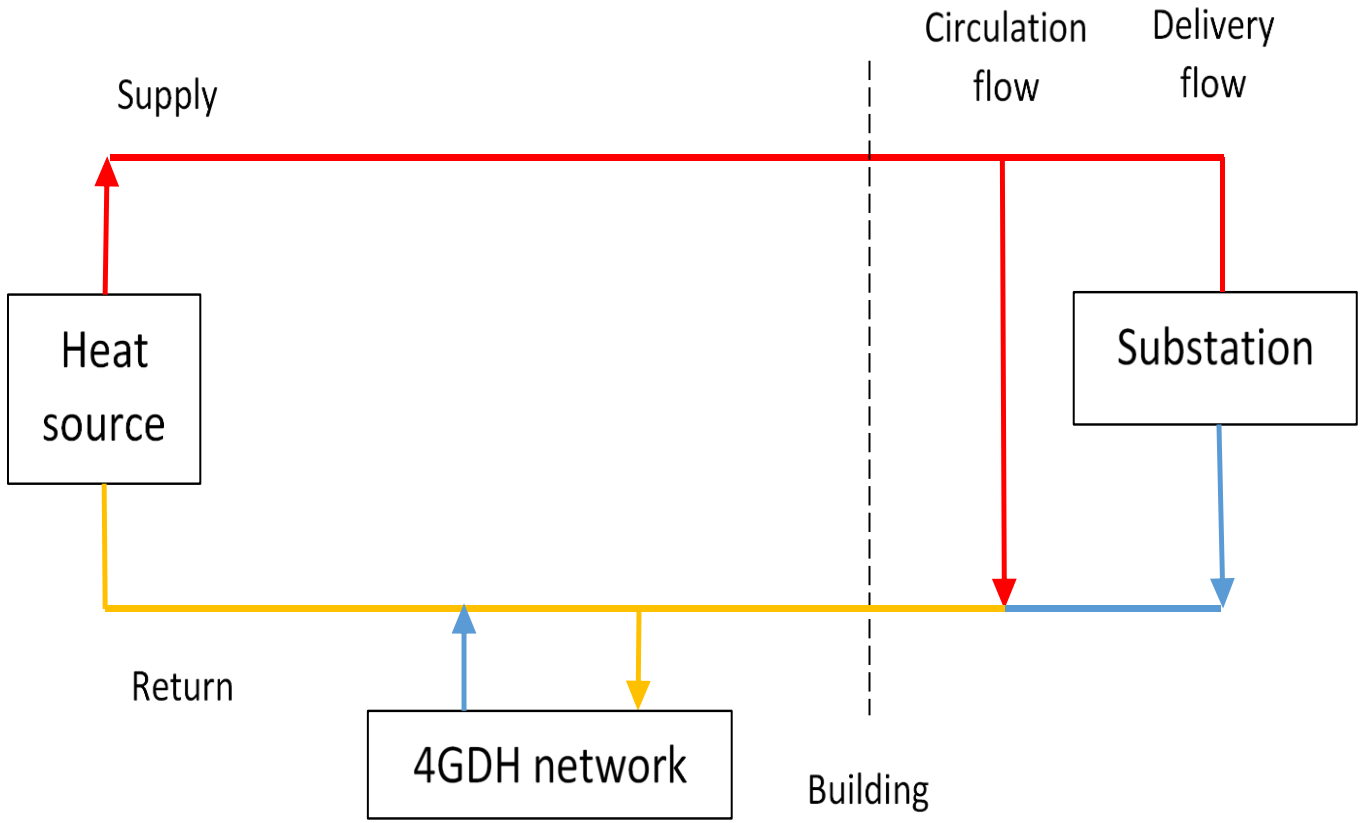
Feature: Modified classic 3GDH technology with 3 pipes by eliminating the three major malfunctions in the 3GDH technology (legionella risk, mixing circulation and delivery flows, and short thermal lengths in heat exchangers). More info: http://www.sciencedirect.com/science/article/pii/S0360544217322004
Typical temperatures: 55/50-25/20 °C
Installation example: Halmstad-Ranagård (planned)

3. Warm DH – MultiLevel, 4GDH-nP



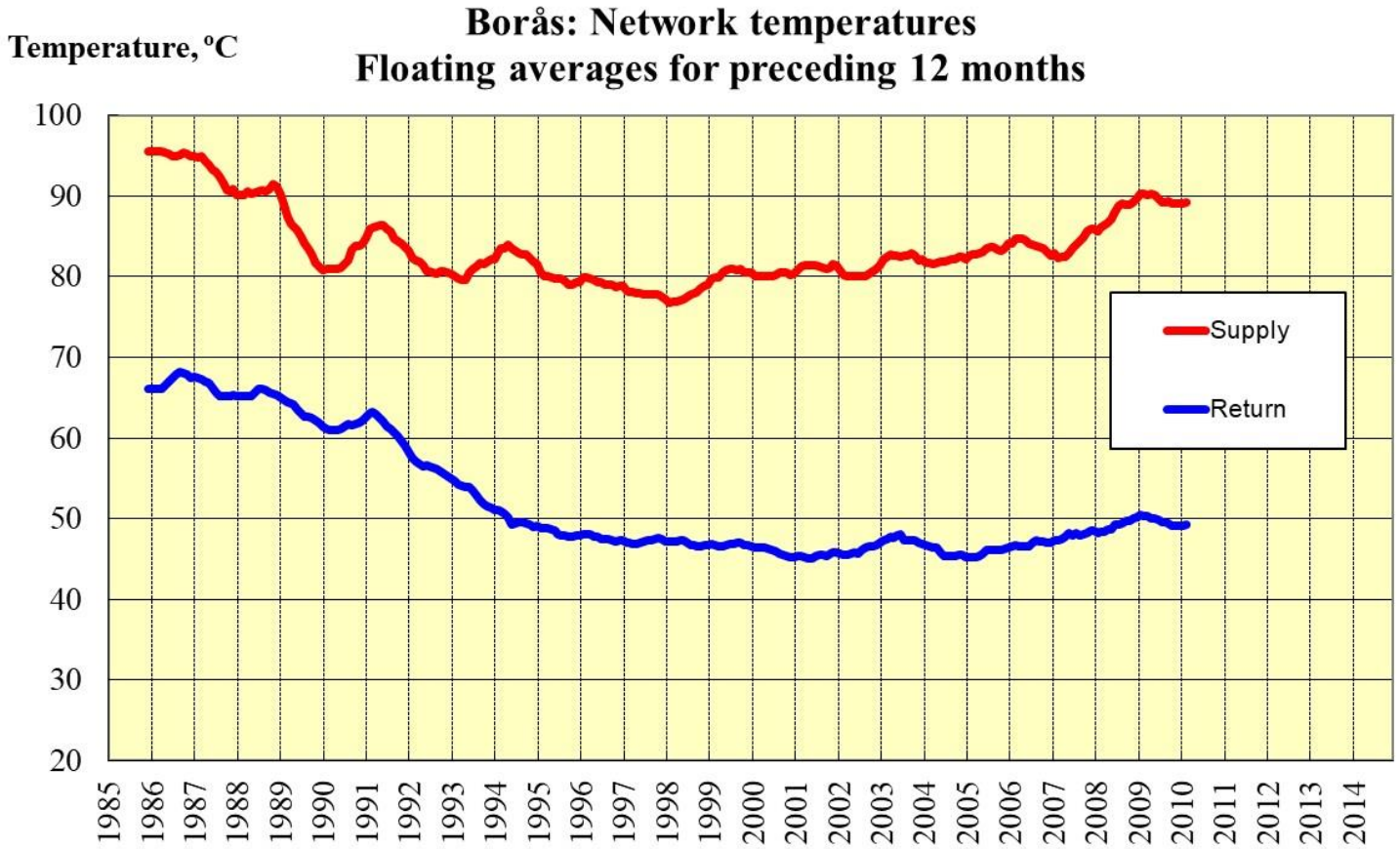
Feature: Combination of 3GDH and 4GDH technologies by installing more than two parallel pipes. Customers are connected between suitable temperature levels depending on the customer temperature demands. One customer can be connected between the high and medium temperatures, while another customer can be connected between the medium and low temperature.
Typical supply temperatures: 50-120 °C
Installation examples: The Semhach networks in Chevilly-Larue and L'Hay Les Roses (south of Paris), Naters-Reka Feriendorf, Dongen-Plan Beljaart, the former Volvo assembly plant in Uddevalla

4. Warm DH – Return to return, 3GDH-RR



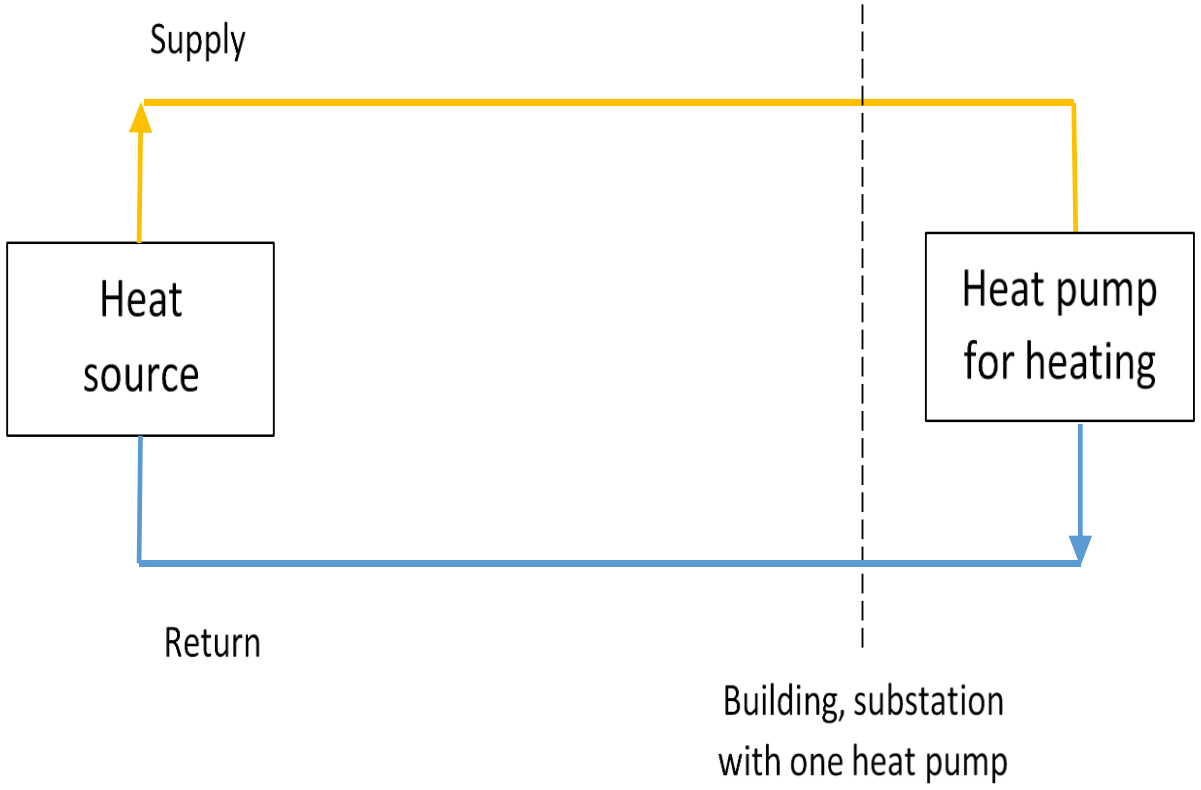
Feature: Combination of 3GDH and 4GDH technologies by using the return water in the 3GDH network as the main heat source for the secondary 4GDH network.
Installation examples: Höje Tåstrup-Sönderby, Stockholm-Norra Djurgårdsstaden, Brecia-Via Carlo Venturi, Nottingham-Sneinton,

5. Warm DH – Rehabilitation, 3GDH-RHB



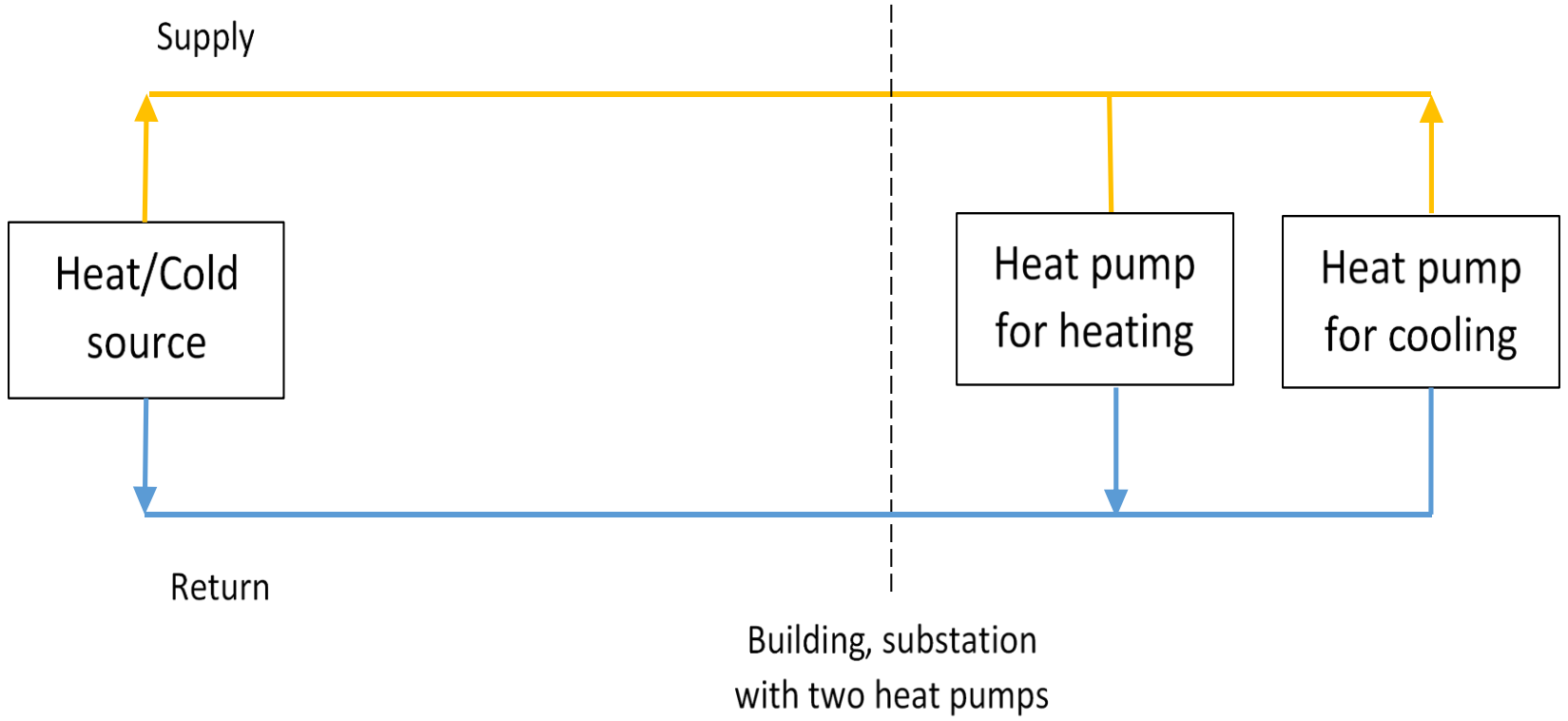
Feature: Rehabilitation of existing systems by elimination of malfunctions in substations and customer heating systems, especially shortcuts in radiator systems. Reduced return temperatures provide opportunities to lower supply temperatures.
Installation examples: Borås, Albertslund, Darmstadt-Lichtwiese campus,

6. Cold DH – High, 4GDH-HP



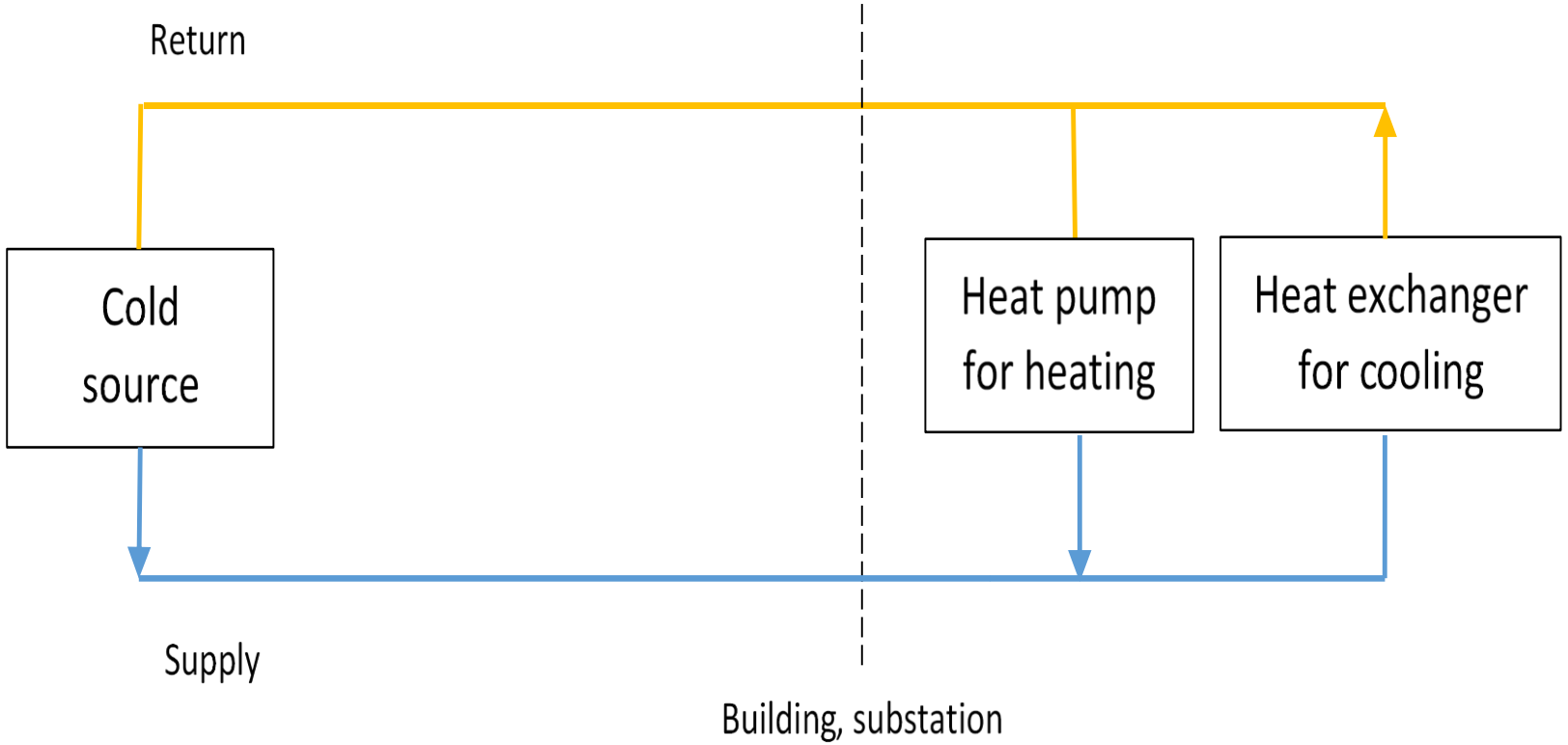
Feature: The supply temperatures are high enough for space heating, while heat pumps are required for final preparation of domestic hot water.
Typical supply temperatures: 25-45 °C
Installation examples: Silkeborg-Balle bygade, Aarhus-Geding, Hague-Duindrop, Ulstein-Fjordvarme,

7. Cold DH – Variable, 4GDHC-2HP



Feature: Hybrid configuration offering both district heating and district cooling.
Typical supply temperatures: 10-30 °C, supply temperatures are lower during the winter when heating demands dominate, while the opposite is valid during the summer when cooling demands dominate.
Installation examples: Bergen University, Lund-Medicon Village, Zürich-ETH Campus Hönggerberg, London-London South Bank University,

8. Cold DH – Low, 4GDHC-HP/HEX



Feature: Basically a district cooling but some heat pumps are installed for heating purposes by using the warmer return water as heat source.
Typical supply temperatures: around 5-10°C
Installation examples: Örebro-Hospital, Geneva-Lac Nation,

Conclusions

- Selection of new network configuration depends on the temperature level of the available heat source
- Lower heat distribution temperatures are important in both new and existing district heating systems
- Many early implementations of new low temperature heat distribution provide important experiences
- Identified malfunctions in existing systems should be avoided in new systems