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Different electric supplementary heating approaches for domestic hot water supply with ultra-low-temperature district heating

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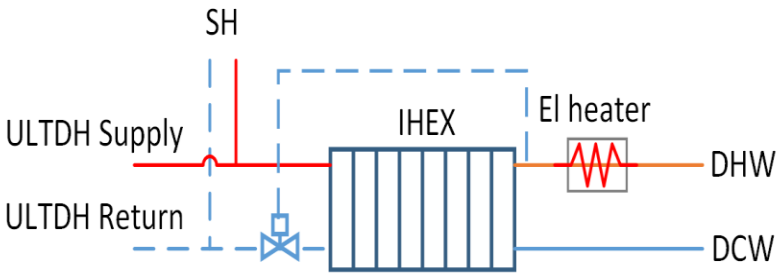
4DH
4th Generation District Heating
Technologies and Systems

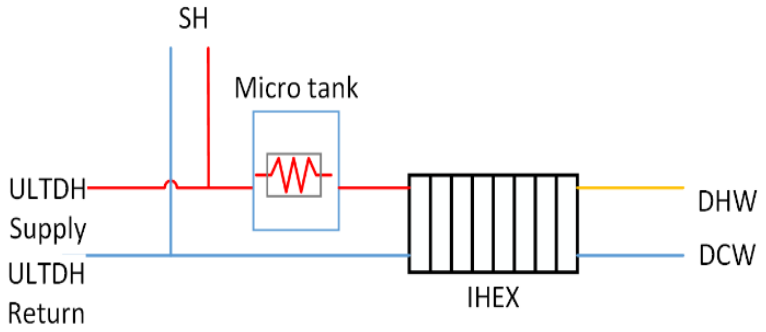
Background

- **Reason**
  - **Make utmost use of the low-temperature heat sources, realize ultra-low temperature district heating**
- **Applying situation**
  - **DH supply temperature is sufficient for comfort room temperature but not enough for DHW requirement(35<T<45-50 °C)**
- **Benefits**
  - **Remove the boundary of DH supply temperature**
  - **Increase the flexibility of the Electricity grid and Heat grid**

Comparison of two types of electric supplementary heating

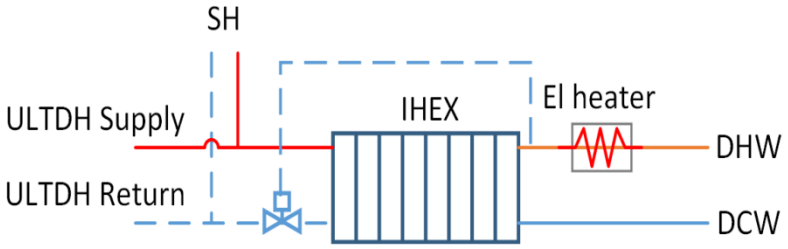


1. Direct electric heating



2. Electric micro tank

Comparison of two types of electr supplementary heating

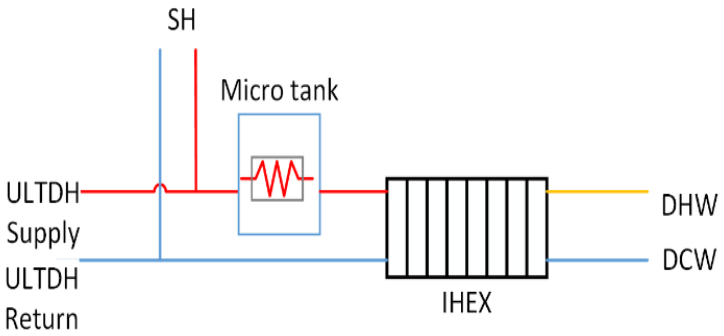


1. Direct electric heating

- Main components
  - Instantaneous heat exchanger, in-line electric heater , bypass valve
- No water storage in the system
- Required power of the electric heater

Preheated water Temperature [°C]	30	35	40
Power [kW]	12.2	7.1	2.1

Comparison of two types of electric supplementary heating



2. Electric micro tank

- Main components
  - Instantaneous heat exchanger, micro tank with electric heater
- Small water storage on the primary side, but the power rate can be much smaller
- No bypass

Dimension of the micro tank with different supply temperatures

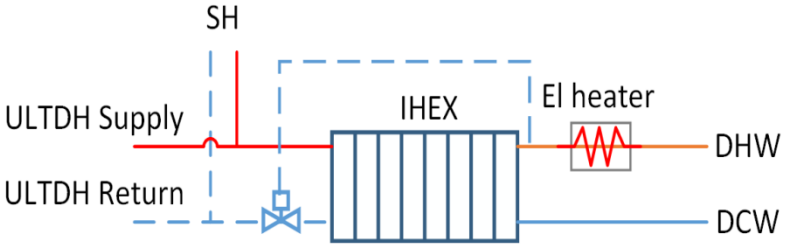
Design parameters (according to DS439)		
Kitchen	15L	45°C
shower	42L	40°C
Set-point of the tank		90°C
Time interval		20min

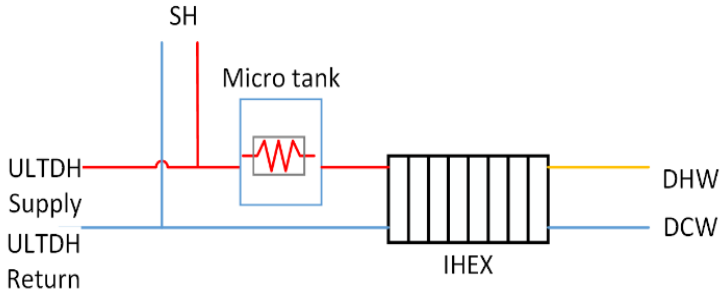
Assuming the service pipe: AluFlex 16-16/110, length 10m, water content ~1L, electric tank power: 2.4kW

Results			
DH scenarios [°C]	35	40	45
Micro tank [L]	8.8	4.0	2.0

Comparison of energy performance

λ of the pipe :0.022 W/mK, ground T: 10 °C





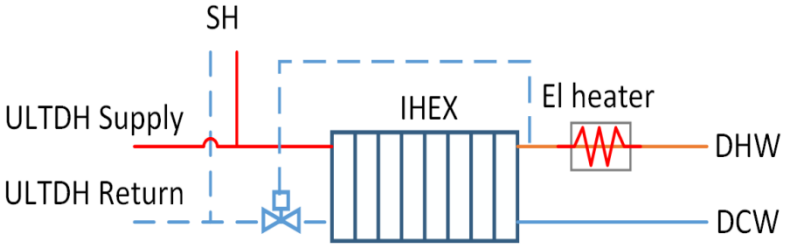
DH scenarios	35	40	45
Bypass set-point T [°C]	30	35	40
Bypass heat loss [W]	20.0	24.5	28.9
Average return T[°C]	23.2	26.1	29.4

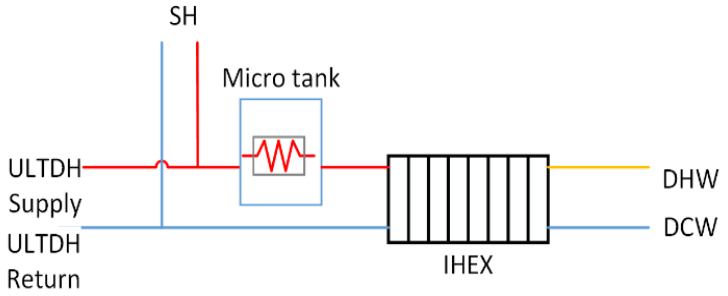
DH scenarios	35	40	45
Micro tank heat loss [W] [ref]	11.6	6.9	4.4
Considering Primary factor (2.5) [W]	29.1	17.3	10.9
Average return T[°C]	18.8	18.8	18.8

([ref] Quooker energy analysis, 10W for a 7-liter storage)

Comparison of economy performance

DHW demand: 2000 kWh/year, assumed DH price: 0.8 DKK/kWh, assumed electricity price: 2.0 DKK/kWh





DH scenarios	35	40	45
Cost of electricity [DKK/kWh]	0.9	0.6	0.3
Cost of heat [DKK/kWh]	0.5	0.7	0.8
Integrated Price [DKK/kWh]	1.4	1.3	1.1
Investment	6949 DKK [Ref]		
Refurbishment of power input	4000 DKK		

DH scenarios	35	40	45
Cost of electricity [DKK/kWh]	1.0	0.6	0.3
Cost of heat [DKK/kWh]	0.5	0.6	0.7
Integrated Price [DKK/kWh]	1.5	1.2	1.0
Investment [DKK]	6987 DKK [Ref]		

[Ref] price from online seller

Conclusion

- Ultra-low temperature district heating can be implemented with electric supplementary heating with acceptable economy
- Electric micro tank has better performance
  - lower heat loss
  - low average return temperature
  - lower energy (total)cost

Thank you for your attention!

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