NOVEL DOMESTIC HOT WATER MICROBOOSTER HEAT PUMP IN ULTRA-LOW TEMPERATURE DISTRICT HEATING

13.11.2018 4DH Conference Ålborg Denmark

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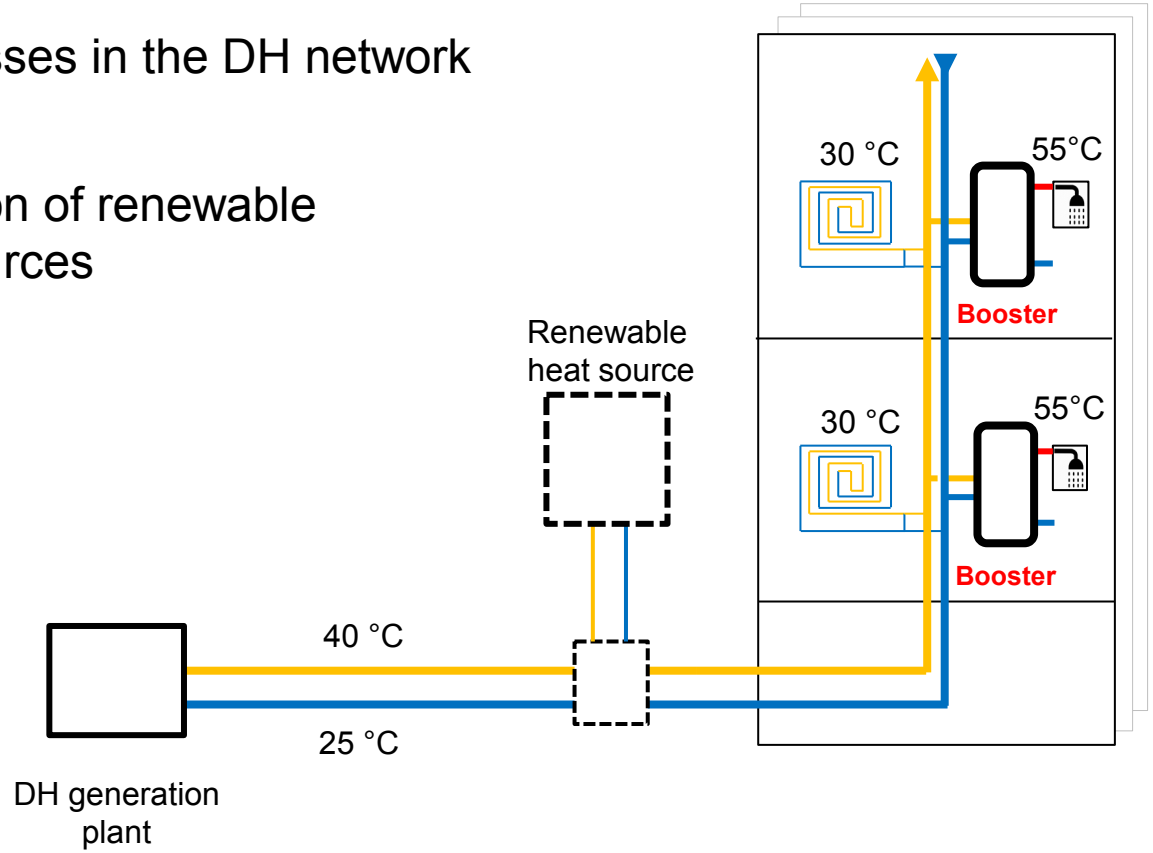
WHY ULTRA-LOW TEMPERATURE DISTRICT HEATING ?

- ✓ Improves DH heat generation efficiencies
- ✓ Decreases heat losses in the DH network
- ✓ Allows for integration of renewable distributed heat sources



4DH
4th Generation District Heating Technologies and Systems

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METRO THERM BOOSTERS

COMBI TANK

✓ Electric Booster

NEW

MICROBOOSTER HP

✓ Liquid-to-Water HP Booster

DHW HP or Air Booster

✓ Air-to-Water HP Booster

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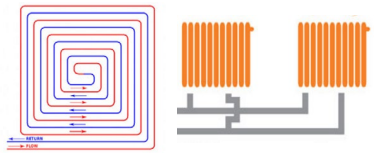
MICROBOOSTER HEAT PUMP

✓ *Liquid-to-water heat pump flexibly exploiting almost any liquid heat source to produce DHW ultra efficiently.*

Wide operational envelope



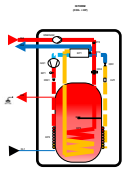
Temp. source in: 5 - 60°C
Temp. water max: 65°C

Top Performance

COP: 3.7 – 8.5
Heat-Up: 06:00 – 03:50

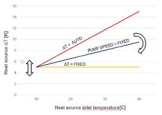
Flexible control

3 operating modes
- Direct
- Pre-heating
- Interim



4 product configurations
- Pump (+ Coil)
- Valve (+ Coil)

3 flow control strategies
- FIXED ΔT
- AUTO ΔT
- FIXED Flow



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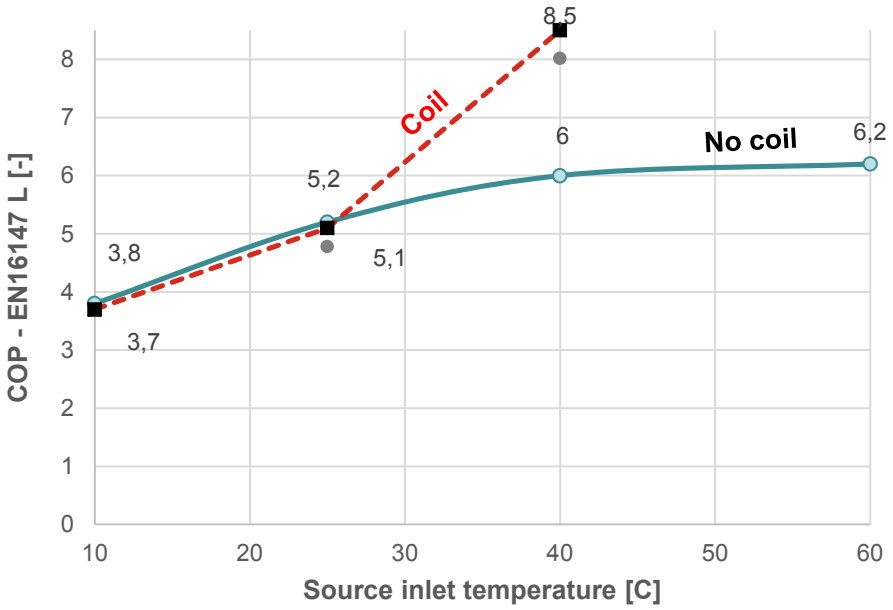
MICROBOOSTER DHW PERFORMANCE

EN16147

- ✓ 24H Tapping
- ✓ L tapping
- ✓ Including tank heat losses
- ✓ Including pump consumption



Input data for steady-state simulations

- ✓ Single heat-up cycle
- ✓ Only Heat Pump
- ✓ No pump consumption
- ✓ No tank heat losses
- ✓ W40/28 - W53.5 °C

Component	Parameter	Unit	Value
Compressor	Volumetric efficiency avg.	-	0.82
	Isentropic efficiency avg.	-	0.57
	Heat losses	%	5
Evaporator	DELTA T pinch avg.	K	2.5
	Superheat avg.	K	6
Condenser	DELTA T pinch avg.	K	5
	DHW setpoint tempearture	C	53.5
	Average condensing temperature	C	51.5

Booster COP avg: 6.7

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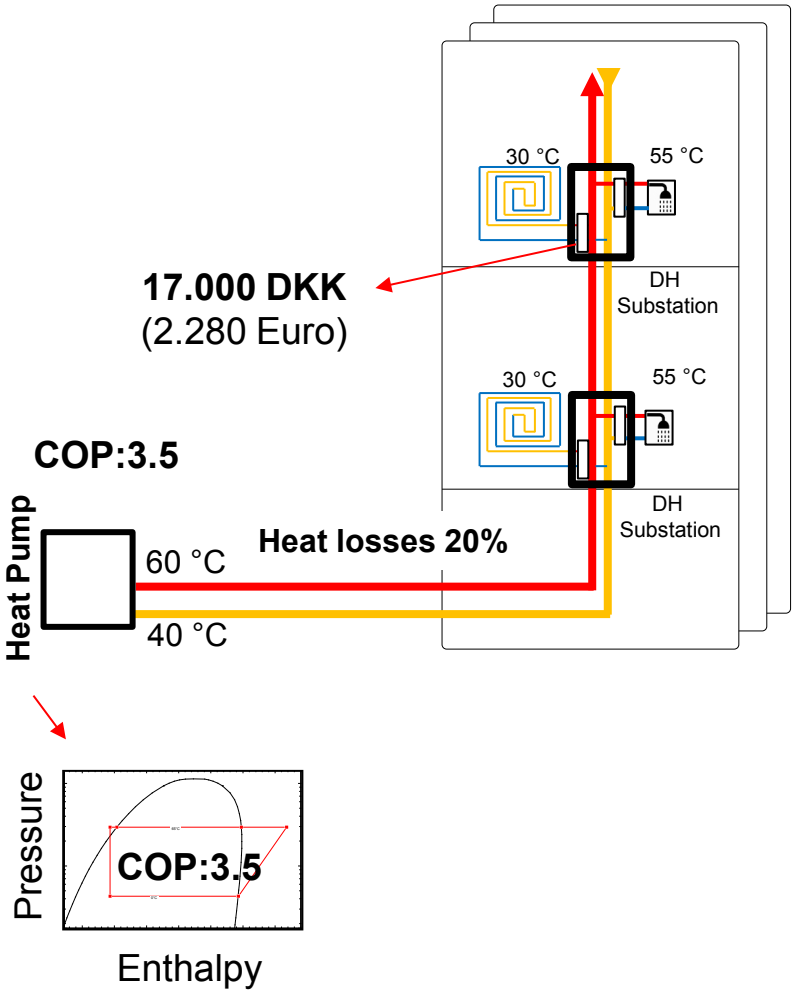
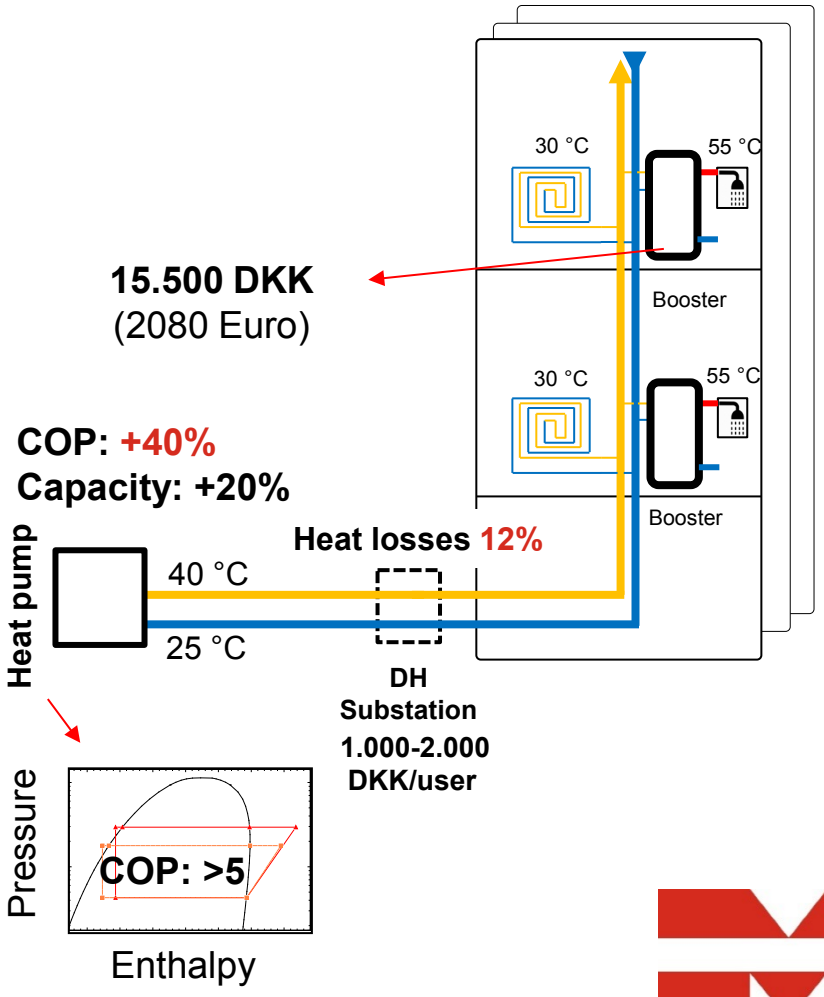
CASE COMPARISON

LTDH



ULTDH (+ MICROBOOSTER HP)



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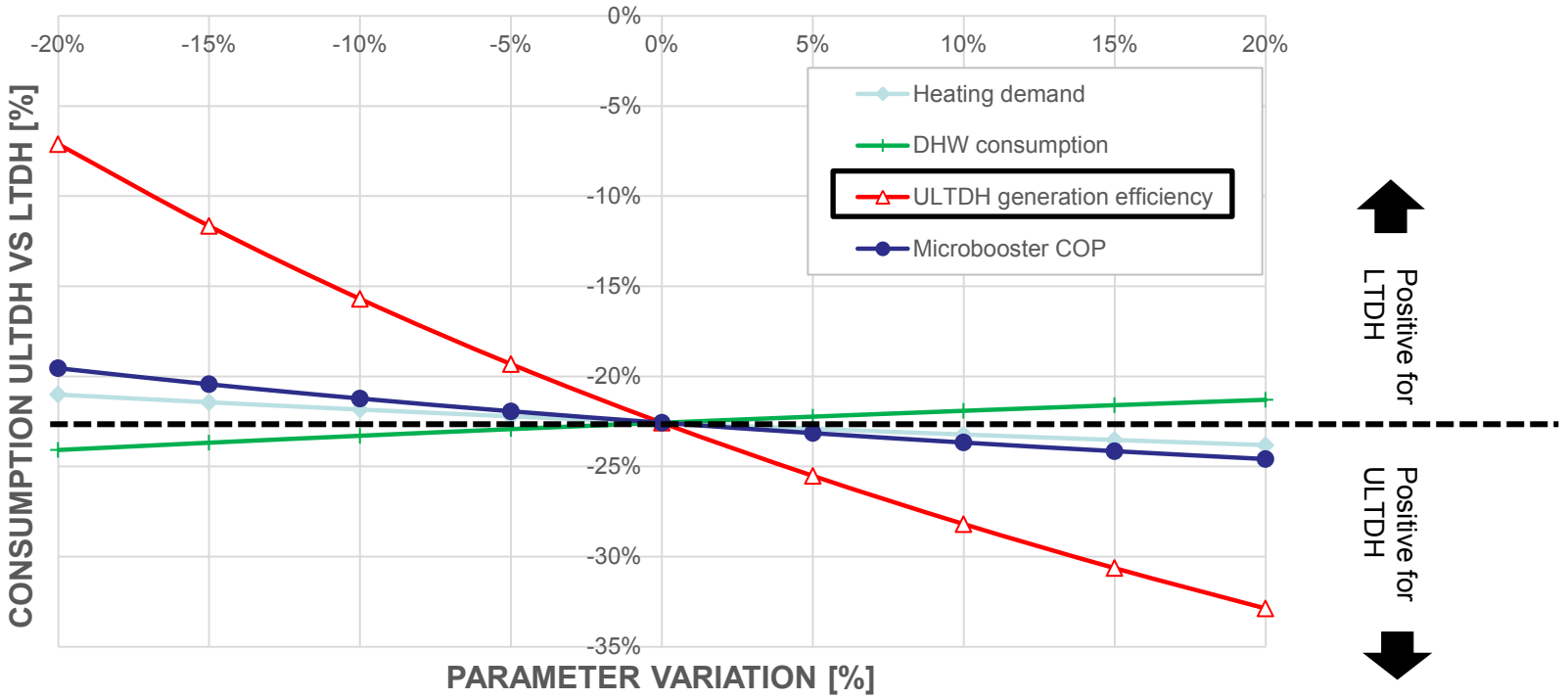
RESULTS AND SENSITIVITY

ULTDH vs LTDH:
-23% Total system energy consumption

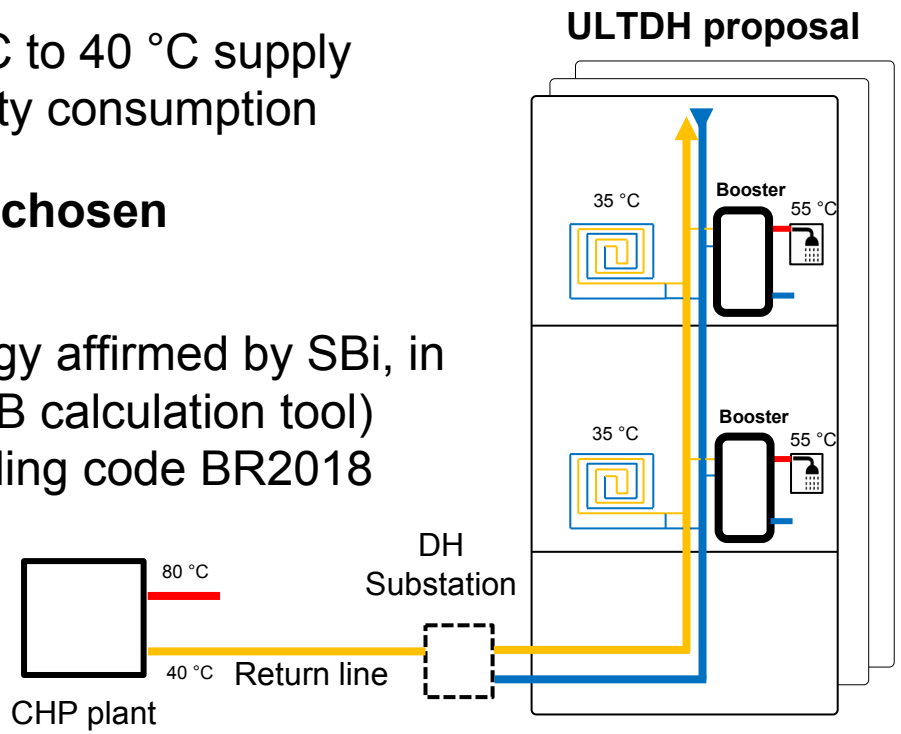


TRONGÅRDEN PROJECT

- ✓ 200 new households in Lyngby (Denmark)
  - **Question: Conventional DH or ULTDH ?**
- ✓ **Challenges:**
  - Additional space requirement
  - Primary energy factors
  - No DH price differentiation from 80 °C to 40 °C supply temperature to offset price of electricity consumption

→ **Conventional DH was chosen**

- ✓ **Positive** :
  - Microbooster performance methodology affirmed by SBi, in Be18 calculation program (Danish EPB calculation tool)
  - Energy Requirements for Danish building code BR2018 accomplished (32 kWh/m^2)
  - Investment cost not an issue



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ULTDH IN EUROPE

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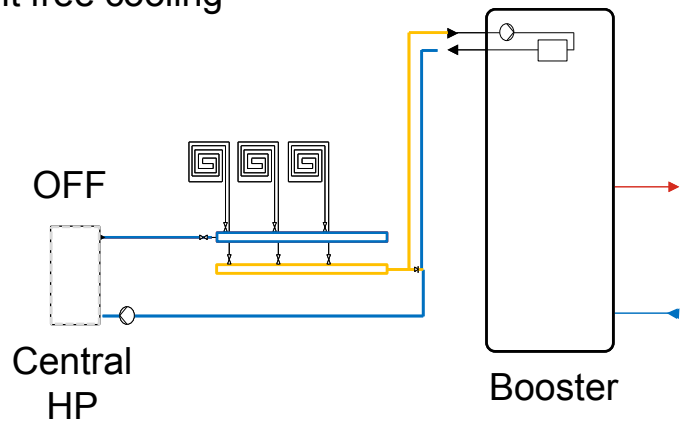
Horizon 2020
EU Demonstration Project on ULTDH

MICRO-ULTDH GRID

- ✓ **Microbooster in serial connection with floor heating**
- ✓ **Low return temperatures**
- ✓ **In summer: Central HP OFF**
  - Low cost heat source
  - Light free cooling



30 MICROBOOSTERS CURRENTLY RUNNING IN SMALL ULTDH-GRID IN AUSTRIA

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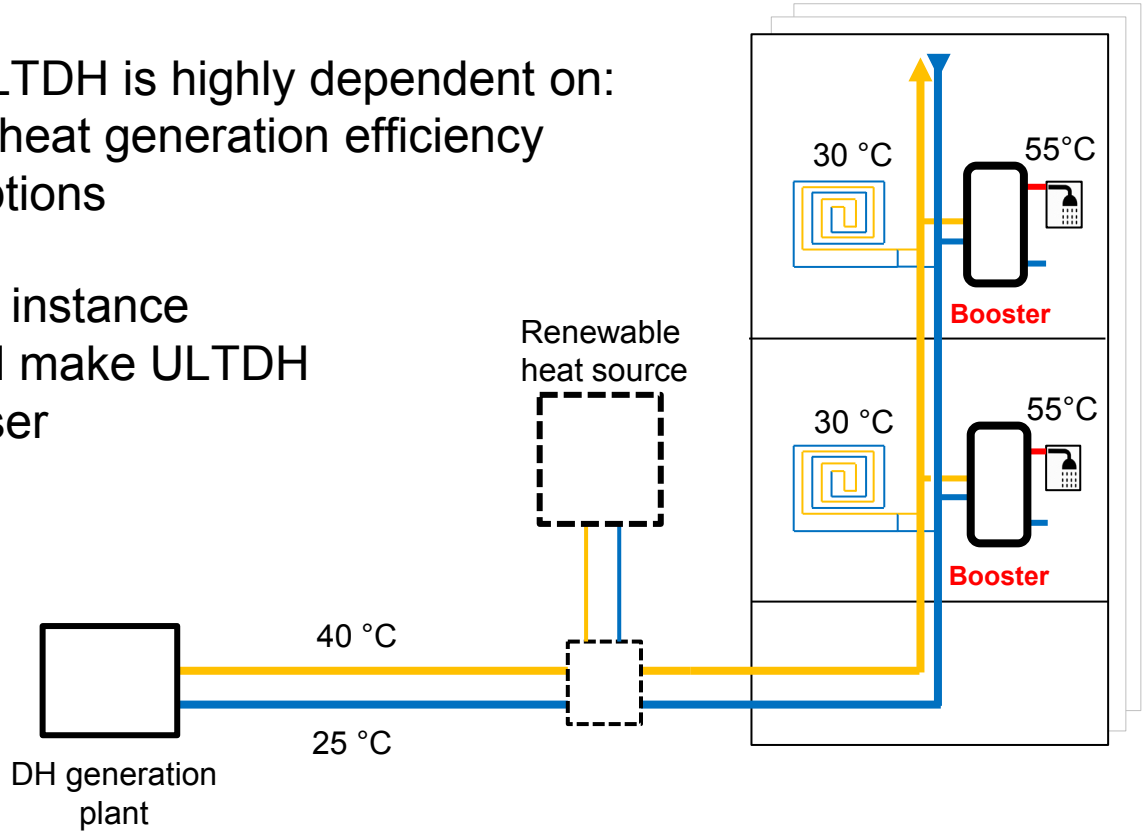
CONCLUSIONS

- ✓ ULTDH can be investement-cost neutral compared to LTDH
- ✓ ULTDH can be more energy efficient than LTDH
- ✓ The economic feasibility of ULTDH is highly dependent on:
  - DH temperature effect on heat generation efficiency
  - The heat price and tarif options
- ✓ Variable heat source cost, for instance during summer periods, could make ULTDH more attractive for the final user



Novel Domestic Hot Water Microbooster Heat Pump in Ultra-Low Temperature District Heating

Thank you

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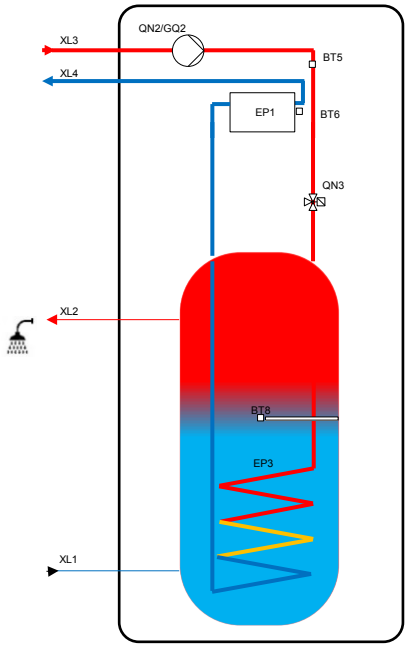
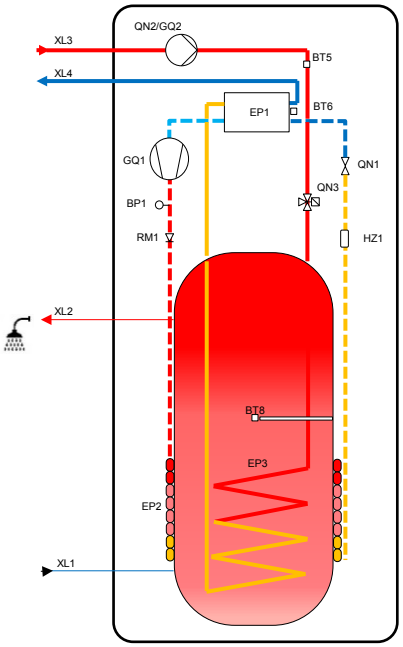
Date: 13.11.2018

MODES OF OPERATION

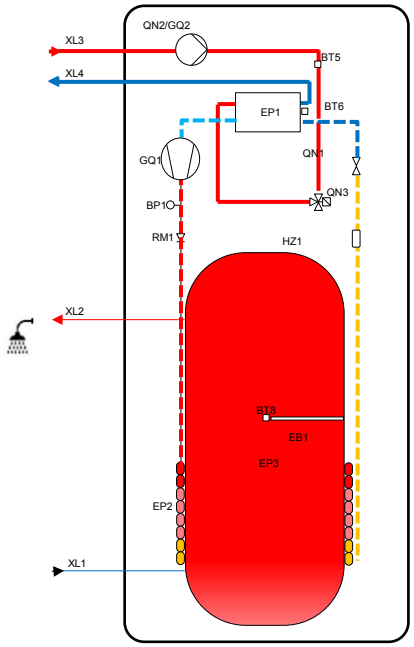
PRE-HEATING (COIL)



INTERIM (COIL + HP)



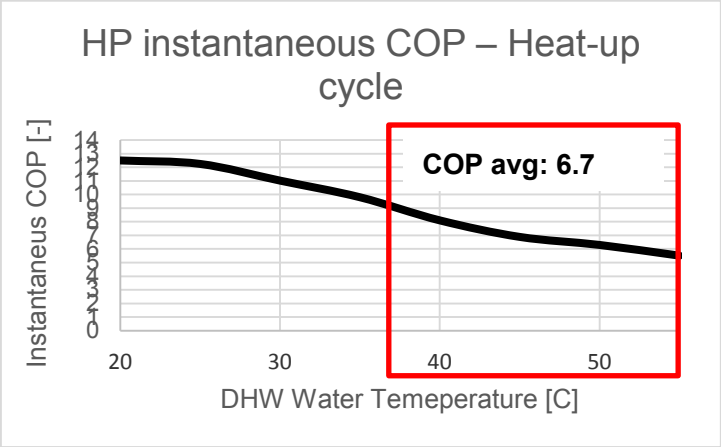
HP operation (HP)



HEAT PUMP COP W40/28C - DHW37/53.5C

- Only Heat Pump
- No pump
- No heat losses
- Single heat-up cycle

Test results – Heat-up cycle



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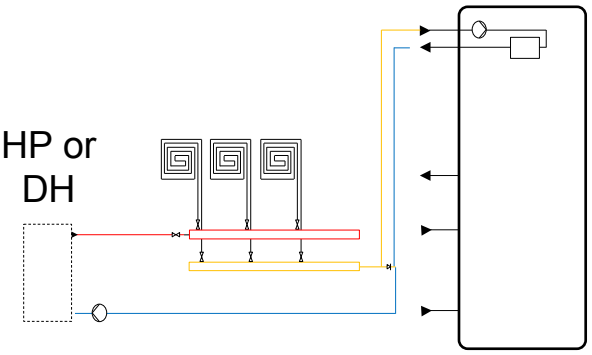
HP COP avg: 6.7

POSSIBLE CONFIGURATIONS AND INSTALLATIONS

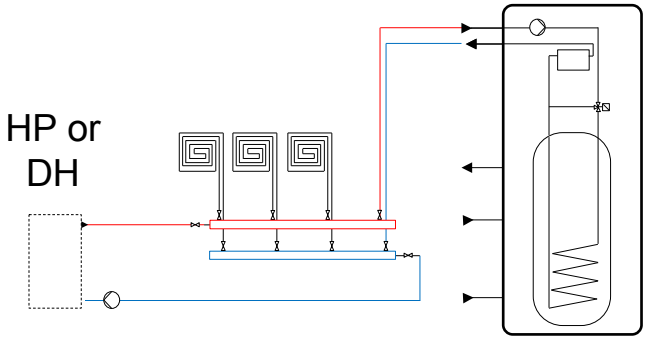
NO COIL

PUMP



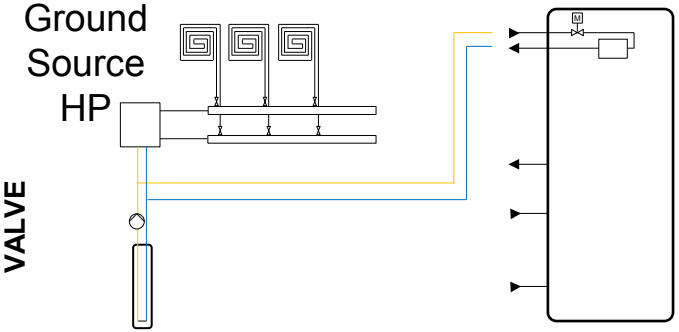
Heat source: **T <30 °C,**
Heat source available pressure: **limited**

COIL

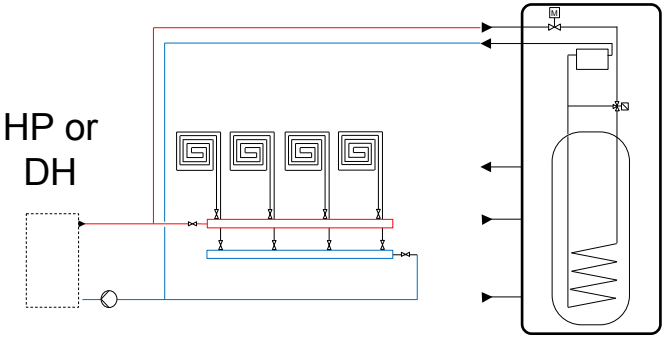


Heat source: **T >30 °C,**
Heat source available pressure: **limited**

VALVE



Heat source: **T <30 °C,**
Heat source available pressure: **un-limited**



Heat source: **T >30 °C**
Heat source available pressure: **un-limited**

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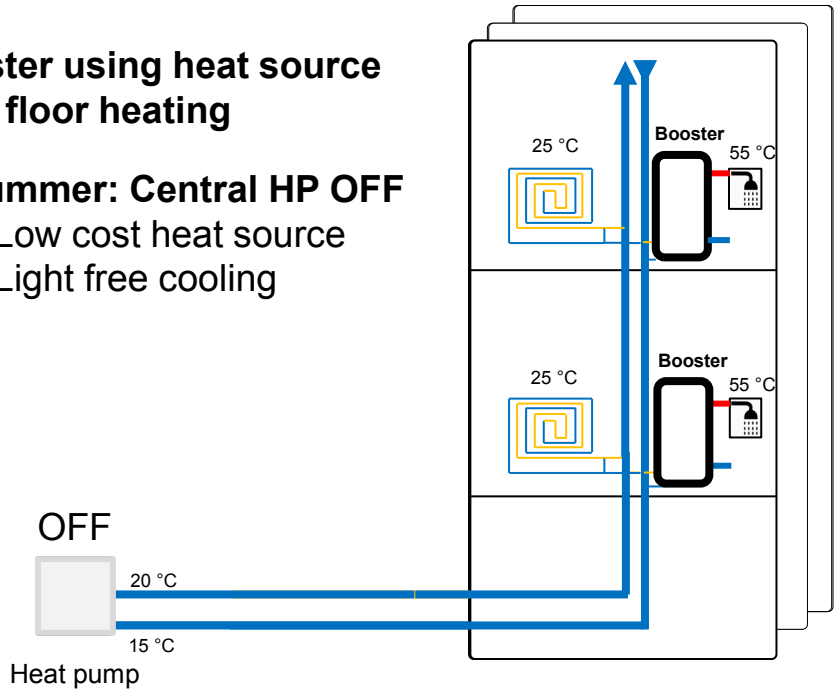
ULTDH IN EUROPE

RELaTED

ULT DH Demonstration Project
(Horizon 2020 EU Project)

MICRO-ULTDH GRID

- ✓ **Booster using heat source from floor heating**
- ✓ **In summer: Central HP OFF**
  - Low cost heat source
  - Light free cooling



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