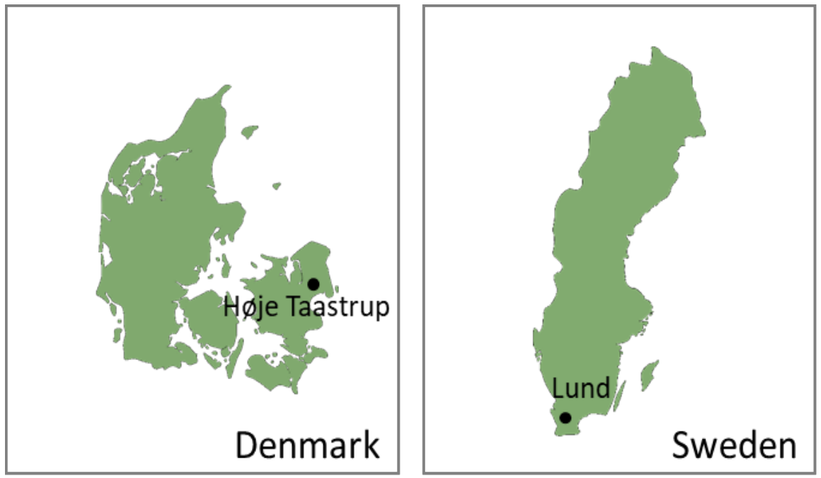
Distributed Heating Stations Supplied by Excess Heat

MONITORING & EVALUATION

"The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 767799-COOL DH- H2020-EE-2016-2017/H2020-EE-2017-RIA-IA"

Monitoring & Evaluation of COOL DH

- Energy performance (Losses, COP, Temp.)
- Environmental impacts (CO2 Emissions)
- Economic analysis
- Social studies (Experiences, Feedback)
- ***Preliminary Results on this presentation***



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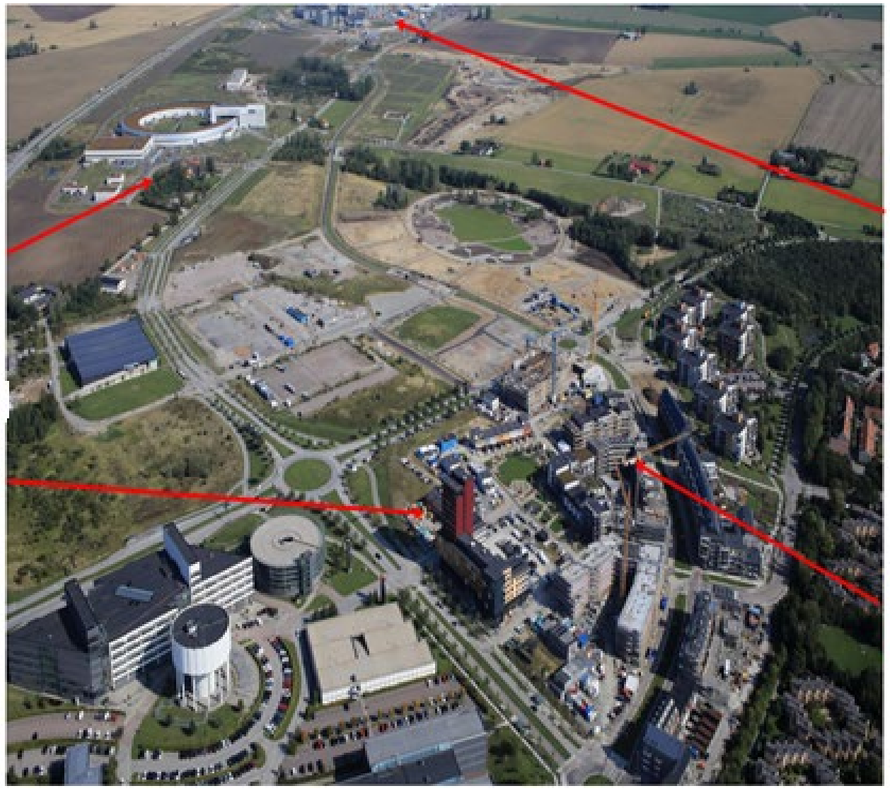
Lund – Brunnshög area

1. Xplorion Building
2. Recovery of Excess Heat at MAX IV

3. New LTDH network
4. Heat recovery pipe
5. Prosumer



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Interesting Findings

- Proper installation: Sensor adjustment
- Necessary measures: External access to heat units
- Local conditions: Using heat pumps

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1. Xplorion

- A multi-storey and passive house building
- Gross area: 4374 m^2
- Heated area: 3606 m^2
- Comprising 54 flats, bike garage, laundry, lokal room, and a restaurant

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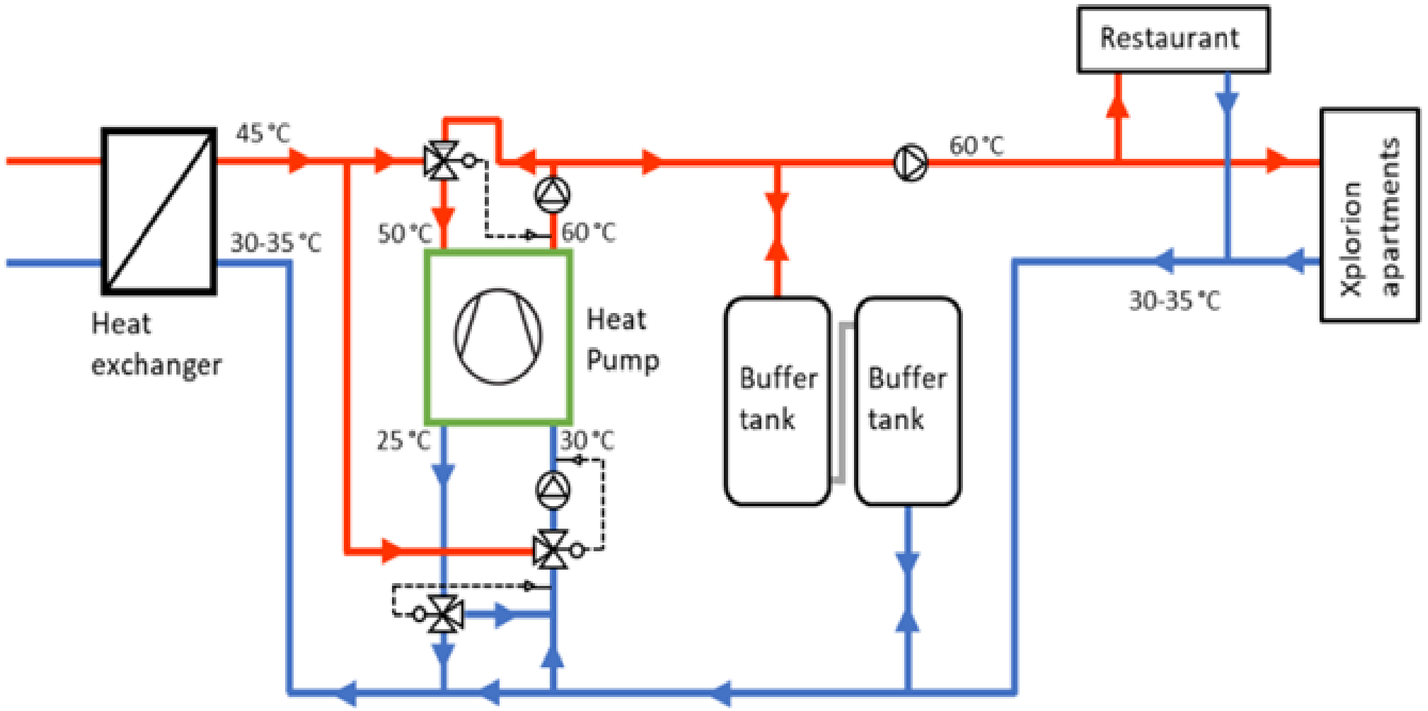
1. Xplorion – Innovations

- Booster HP to simulate ULTDH demo
- LTDH (60/30°C) + ULTDH (45/25°C)



Simplified sketch of the hot water topping system in the basement

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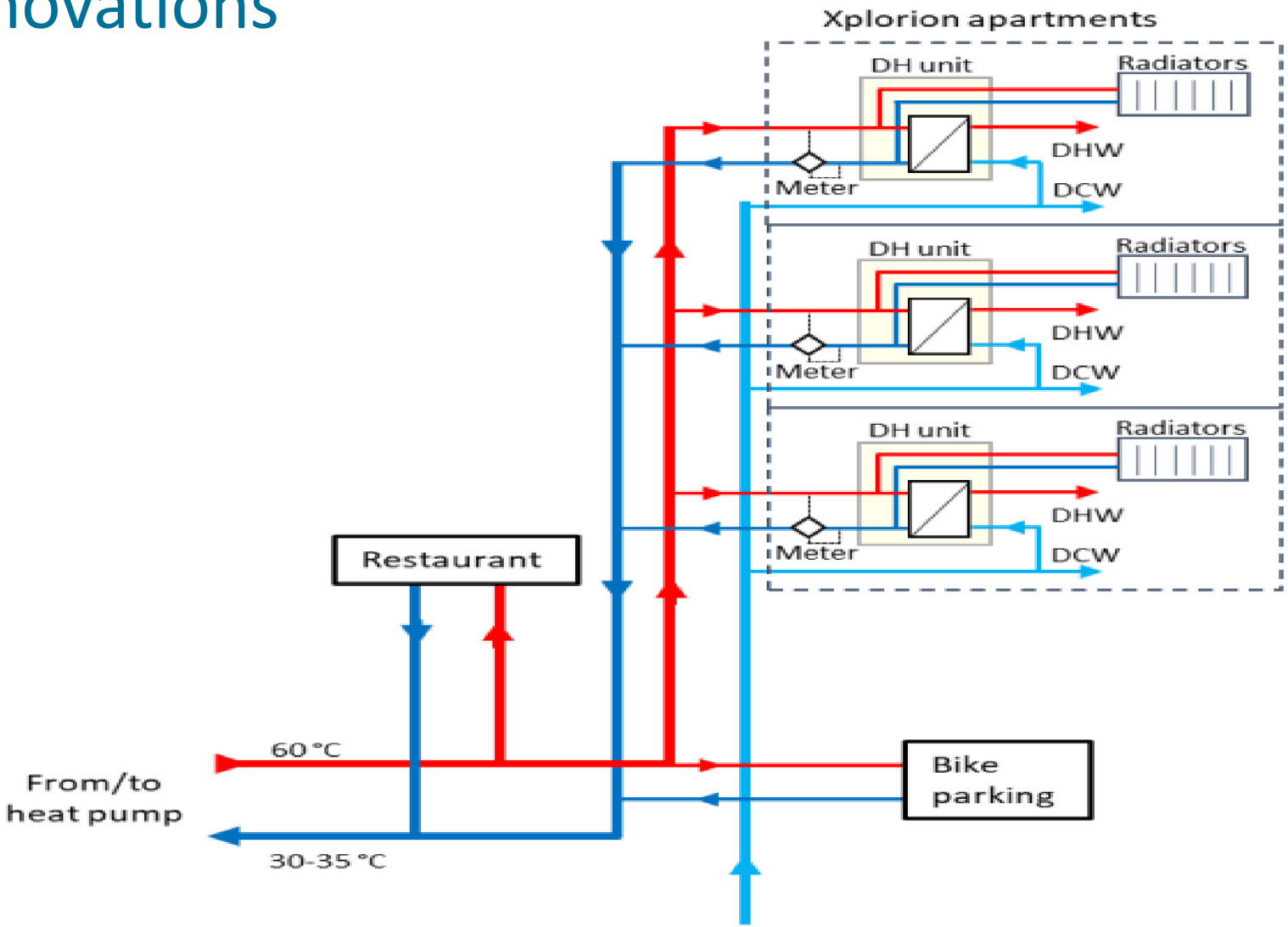
1. Xplorion – Innovations

- 3-pipe system



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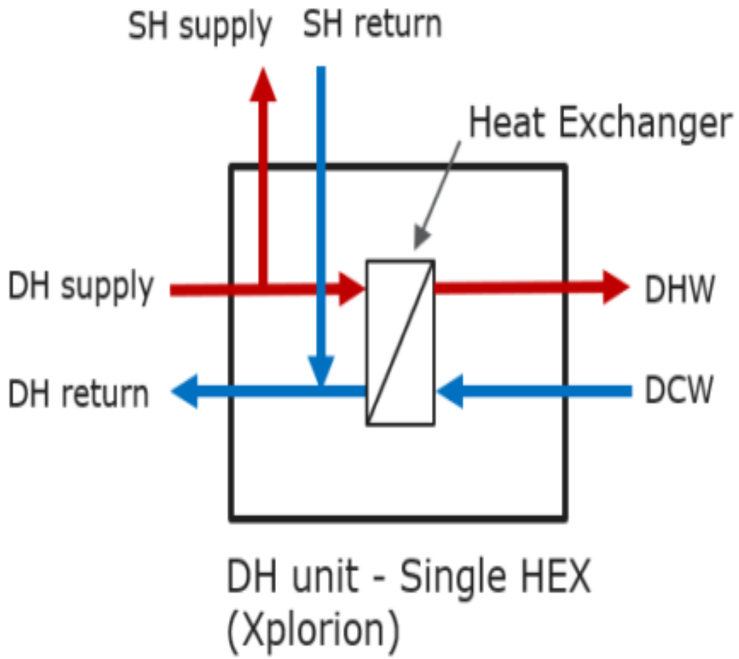
1. Xplorion – Innovations

- Flat stations with Micro Heat Exchangers (Heating units)



DH unit - Single HEX
(Xplorion)

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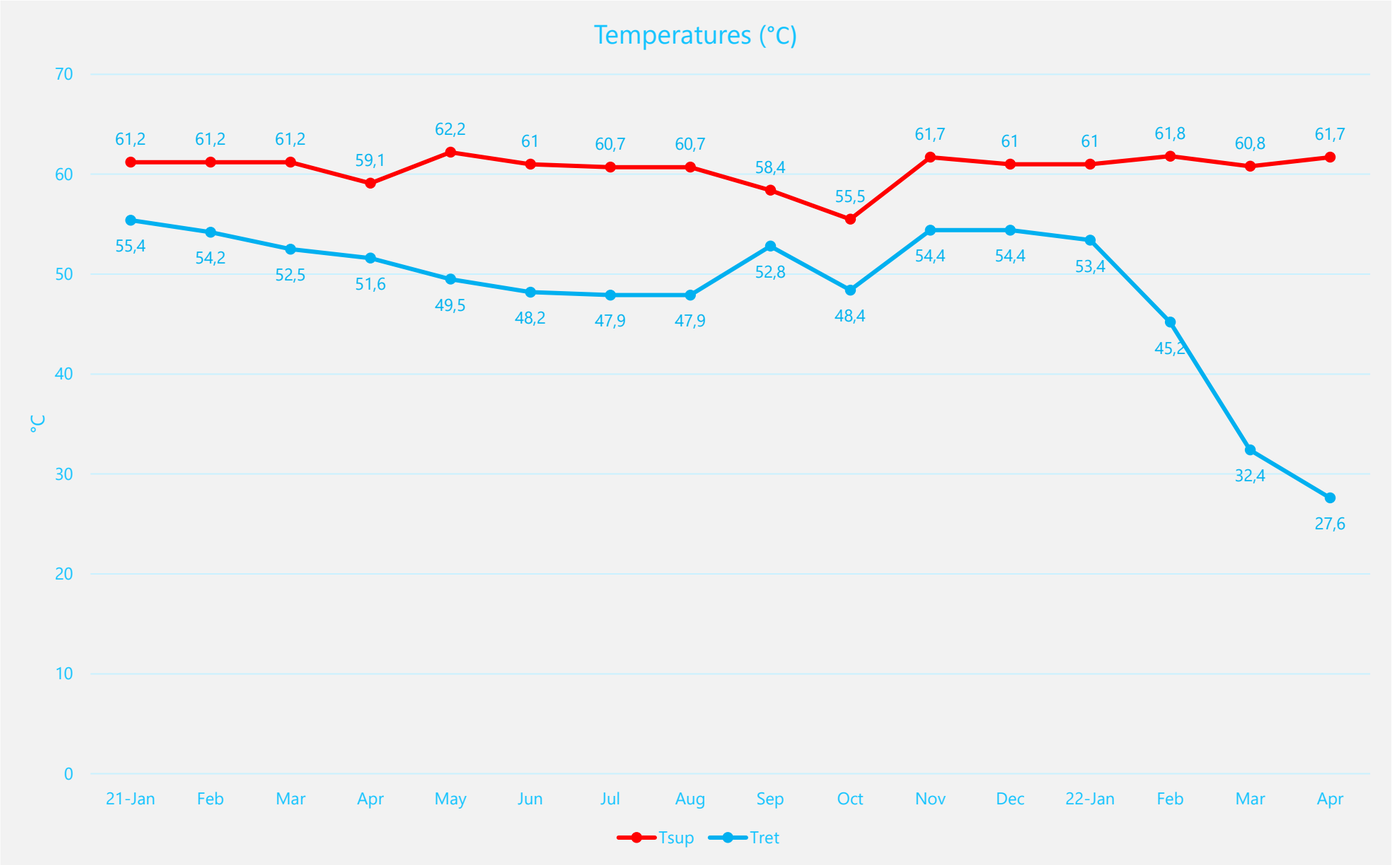
1. Xplorion – Distribution Temperatures

- Low supply temperature: 60°C
- Return temperature decreased from 55°C to around 30°C
- Currently: 60/30°C
- U-LTDH mode



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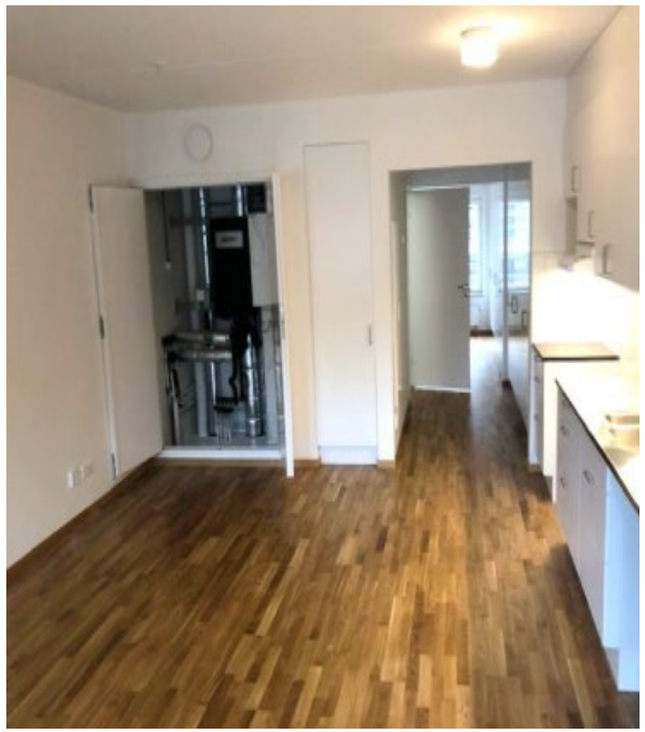
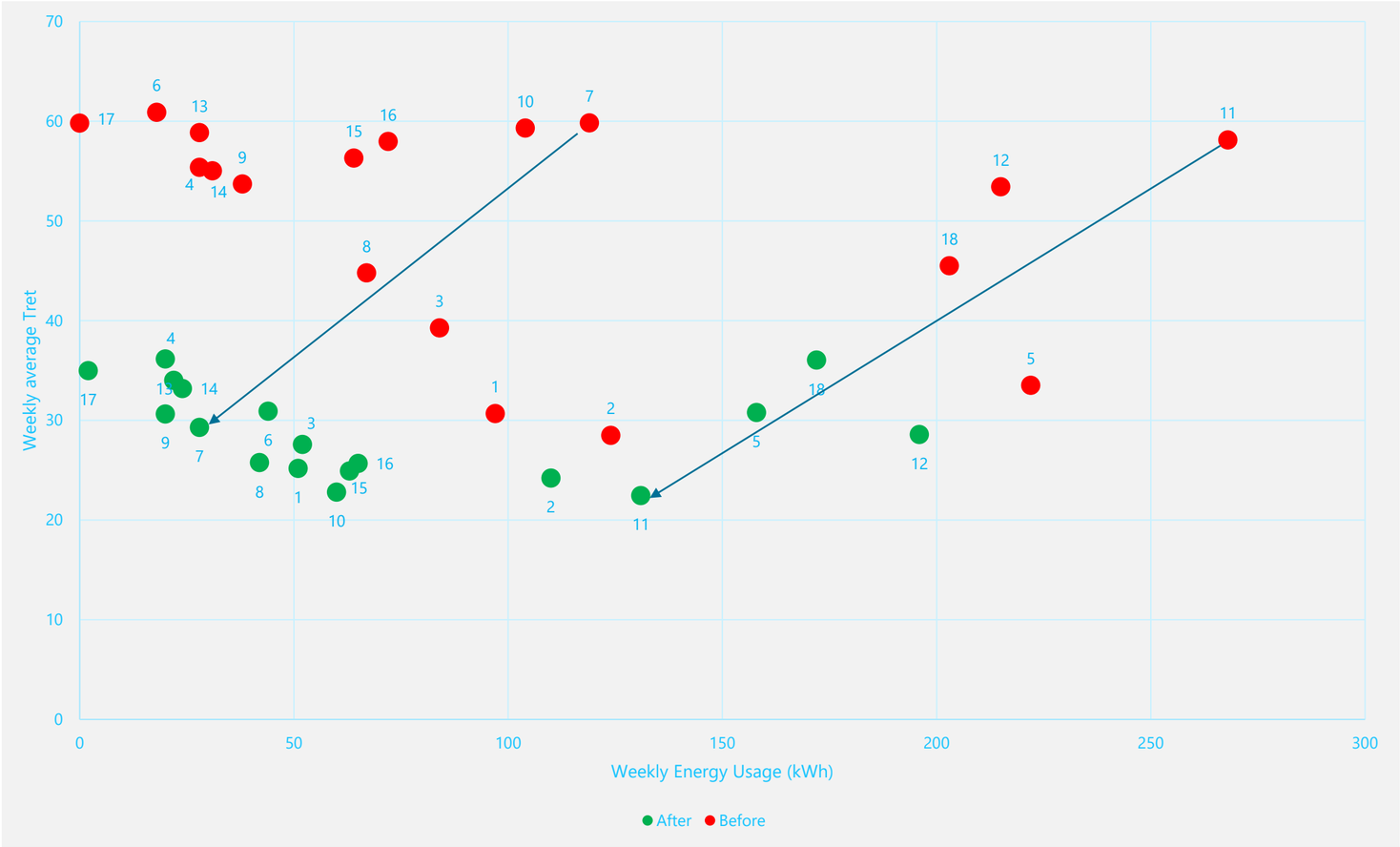
1. Xplorion – Sensor adjustment for Tret

- Difficulty: Internal access to FS





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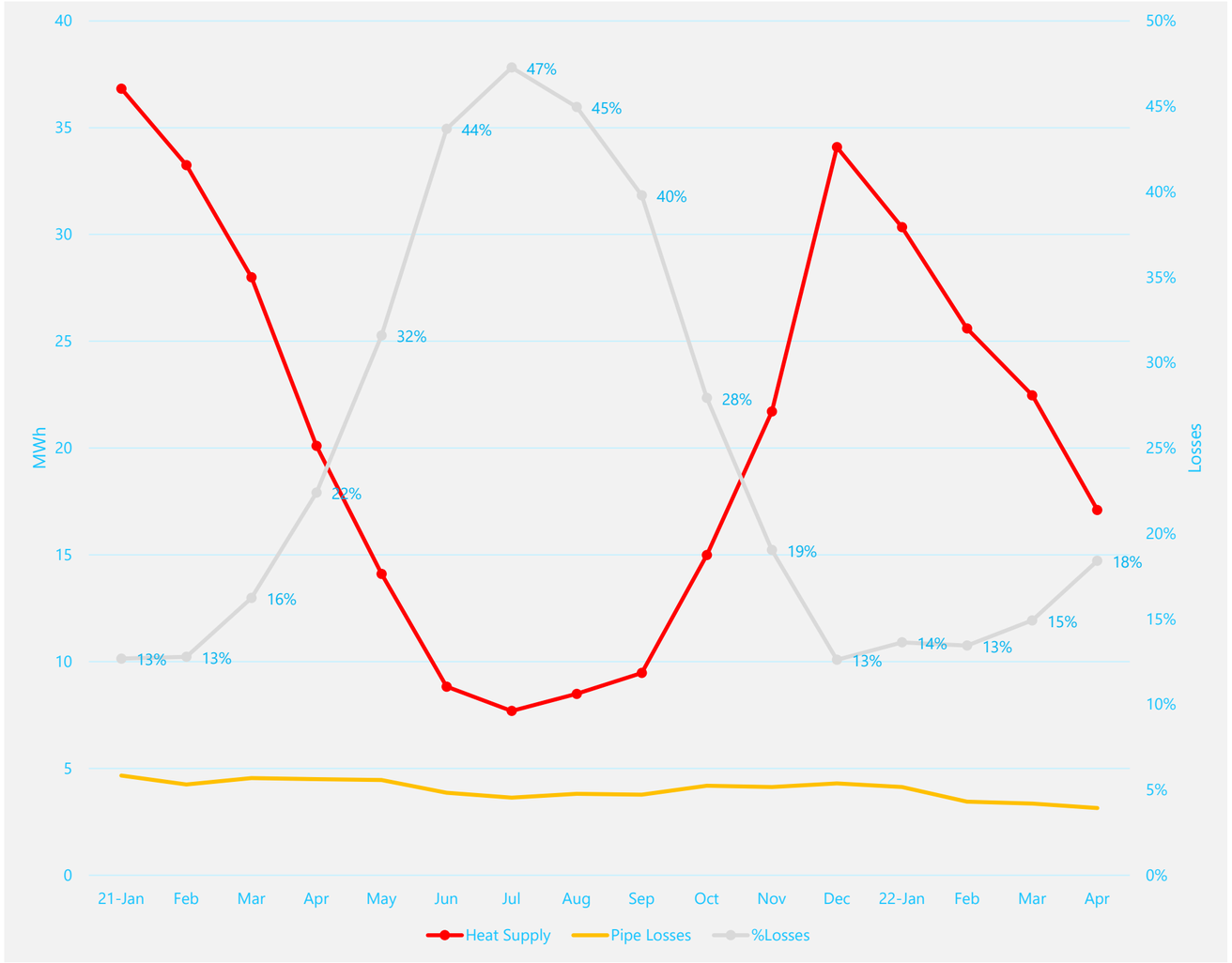
1. Xplorion – Heat Demand

- **2021 Data**
  - Heat supply = 237 MWh
  - Heat use = 187 MWh
  - Pipe losses = 50 MWh (21%)



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1. Xplorion – Pipe losses

- **2021**
- Annual pipe losses: 13.9 kWh/m^2 (Ref.: 10.2 kWh/m^2)
  - High return temp. ⟶ Fixed
  - Not 100% insulation
  - 1 out of service heat meter ⟶ Fixed

- **2022**
- Pipe losses decreased by % 20 – 25 →
- Estimation: Pipe losses **15%**

- Annual pipe losses = **10.3 kWh/m^2**

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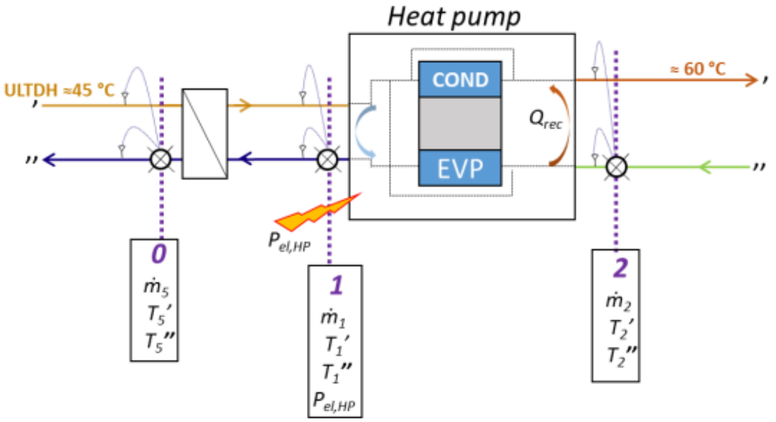
1. Xplorion – Booster HP

- After fixing high return temperature issue in March 2022, HP got back to work to provide ULTDH demo

	Sep. 2021	April 2022
$Q_{hp,out}$ (kWh)	10720	17250
Electricity (kWh)	3833	1966
T_{ret} of flats (°C)	**55** →	**39**
Increased Temp. (°C)	40 to 59	49 to 59
COP	**2.8** →	**8.8**



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1. Xplorion – Environmental Impacts

- Reference values: *Heating: 11.4 kg/MWh ; Cooling: 1.3 kg/MWh ; Electricity: 41.9 kg/MWh*

- **CO_2 emissions in April 2022:**
- (1.966 x 41.9) – (17.25 MWh x 11.4 kg/MWh) = **- 114 kg**
- 2022 Estimation in CO_2 reduction: **1.3 tons**

- **If it would be in Høje-Taastrup**
- (1.966 x 161.9) – (17.25 MWh x 54.5 kg/MWh) = **- 622 kg**

- **Primary Energy Saving (PES)** in April 2022: **13 MWh**
- 2022 Estimation: **153 MWh**

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1. Xplorion – Economic data

- Baseline Scenario (LTDH) = € 93,733
- Booster HP Scenario (ULTDH) = € 142,961
- Increased Investment = **€ 49,228**
- Annual Saving = Not enough data
- PB year = ?

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2. Recovery of Excess Heat at MAX IV

- Purpose: Supply cooling demand of the facility and at the same time recovering the surplus heat from low temperature heat source to provide local conventional DH + LTDH networks

- Capacity: 5.8 MW for the heating and 5.2 MW for the cooling circuit

- DHS is entirely supplied by renewable electricity by a CHP

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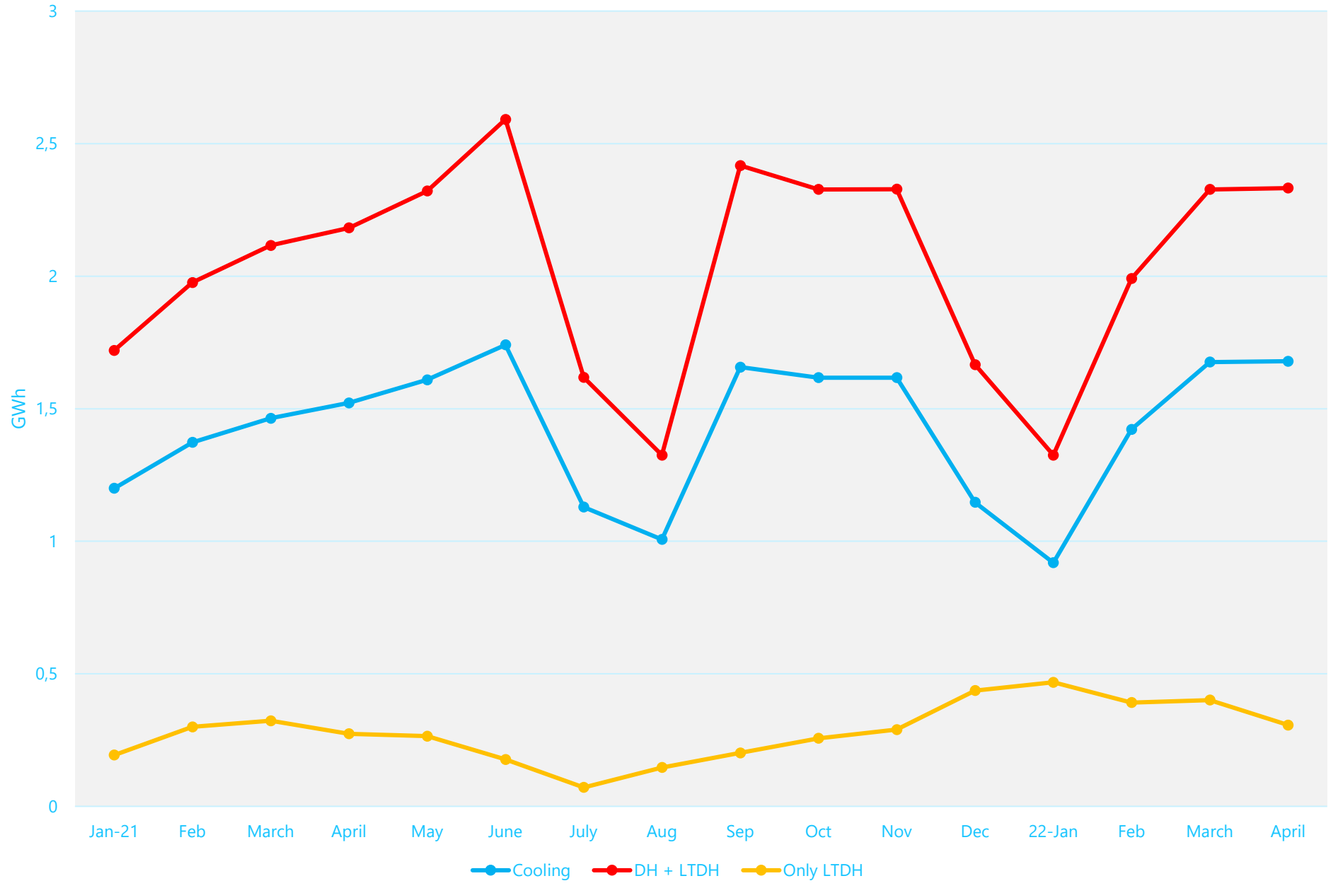
2. MAX IV – Energy Balance

- Total Heating Production = 34.3 GWh
- Heat for LTDH network = 4.5 GWh
- Cooling Production = 22.8 GWh
- Electricity Consumption = 11.5 GWh



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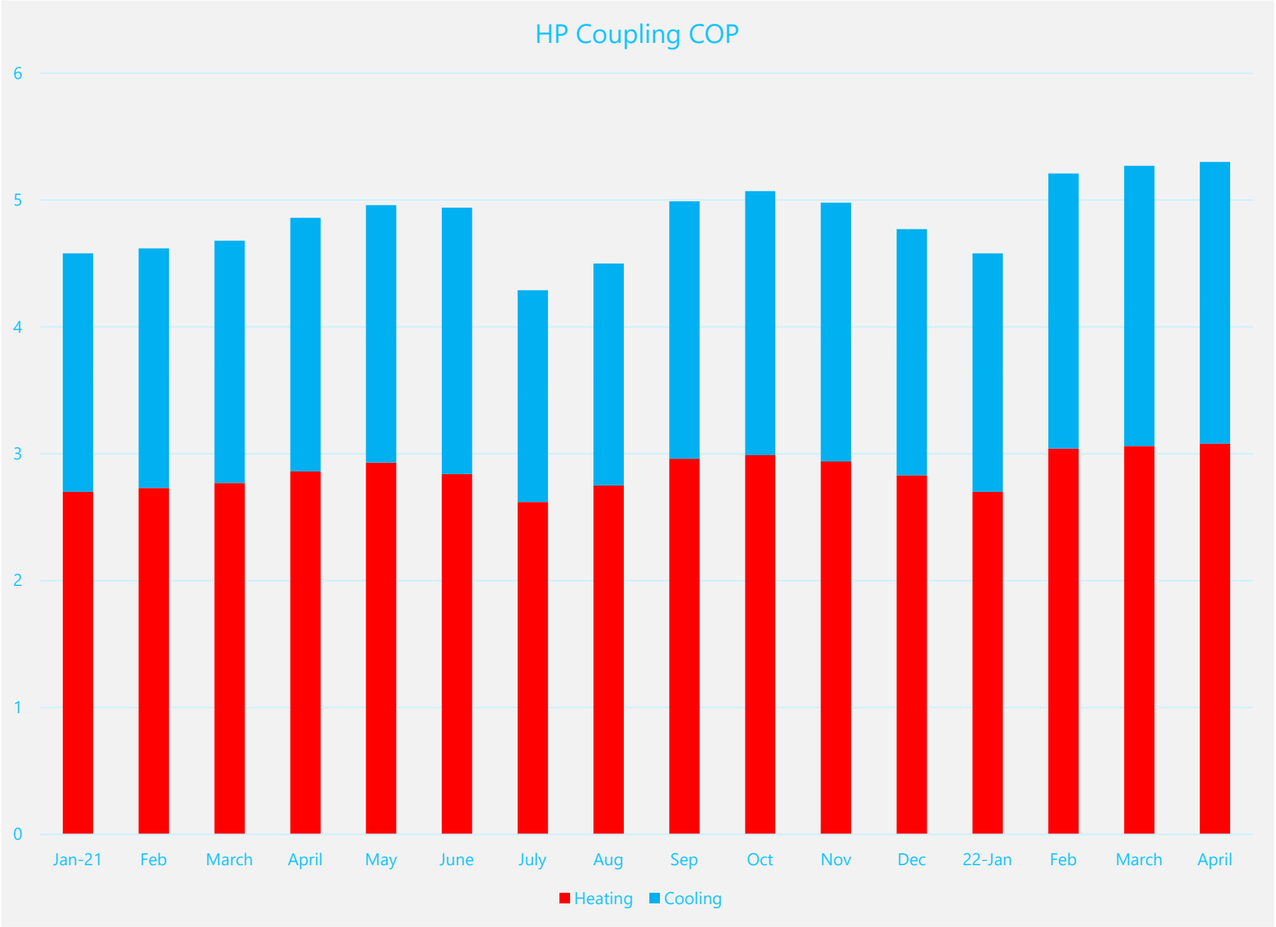
2. MAX IV – Performance of HP

- Average COP_h = 2.9
- Average COP_c = 2.0
- Average total COP = 4.9



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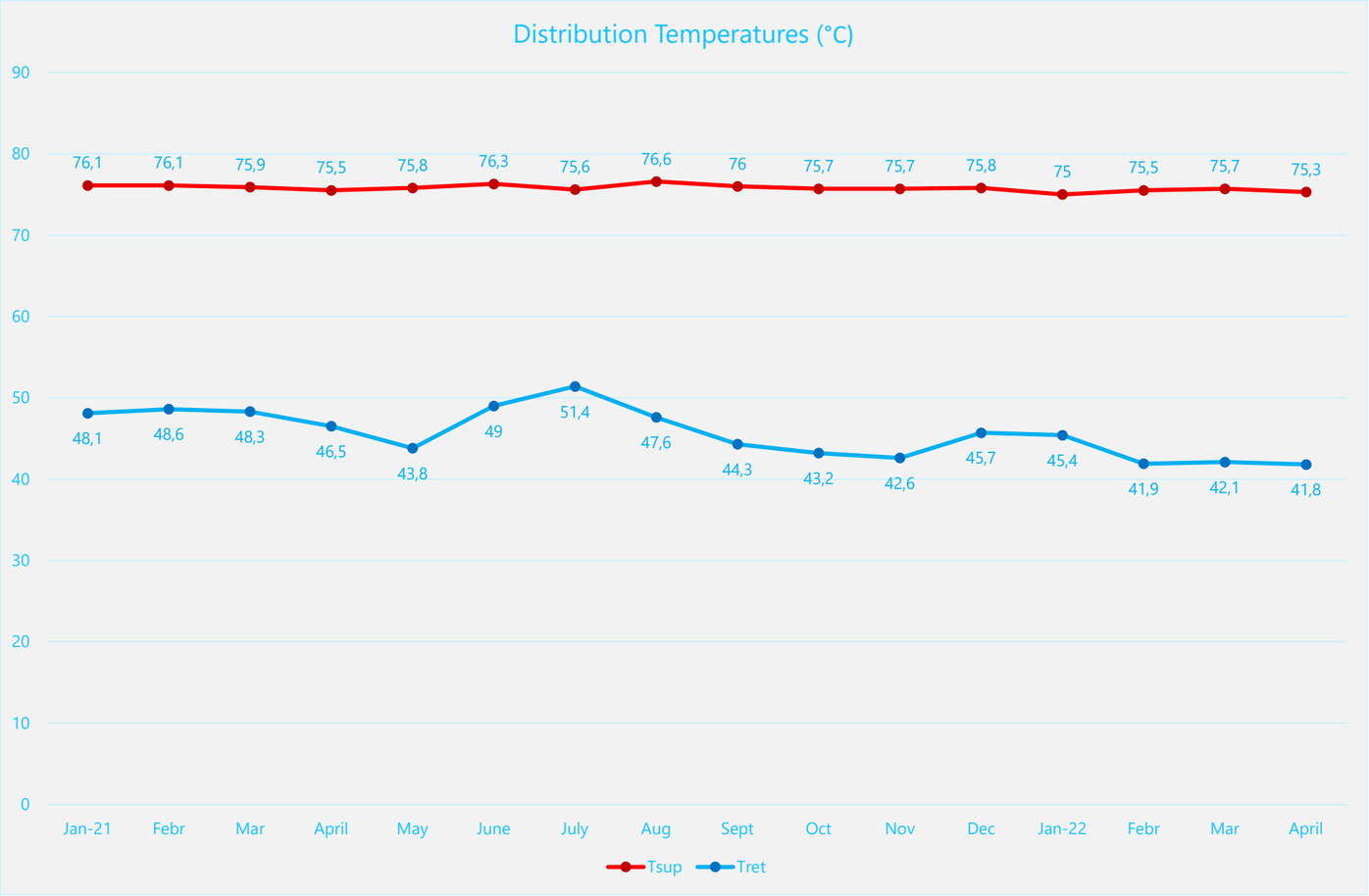
2. MAX IV – Distribution Temperatures

- DH 75/40 °C → 65/35 °C
- LTDH 67/50°C
  - (Developing network)



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2. MAX IV – Environmental Impacts

- **CO_2 emissions since Jan. 2021:**
- (11500 x 41.9) – (32600 MWh x 11.4 kg/MWh) – (22800 x 1.3) = **+ 81 tons!**
  - (KR has Green cert.= - 401 tons)

- **If it would be in Høje-Taastrup**
- (11500 x 161.9) – (32600 MWh x 54.5 kg/MWh) – (22800 x 80.75) = **- 1756 tons**

- **Natural Gas:** 32600 MWh x 202 kg/MWh = **+ 6585 tons**

- **PES since Jan. 2021:**
  - Heating bonus method: 32.6 GWh
  - Allocation method: **18.3 GWh**

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2. MAX IV – Economic data

- Total cost in project: **€ 305,000**

- Heat for LTDH cost: 2900 MWh X 30 €/MWh = € 87,000
- Electricity cost: 800 (Allocated to LTDH) X 77 = € 61,600
- Annual saving: 87000 – 61600 = **€ 25,400**

- Payback = 305,000 / 25,400 = **12 years**

- Heating bonus method: PB = 305,000 / 87,000 = **3.5 years**

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Thanks For Your Attention

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