

# COOL DH Høje Taastrup Business cases and Demonstrations

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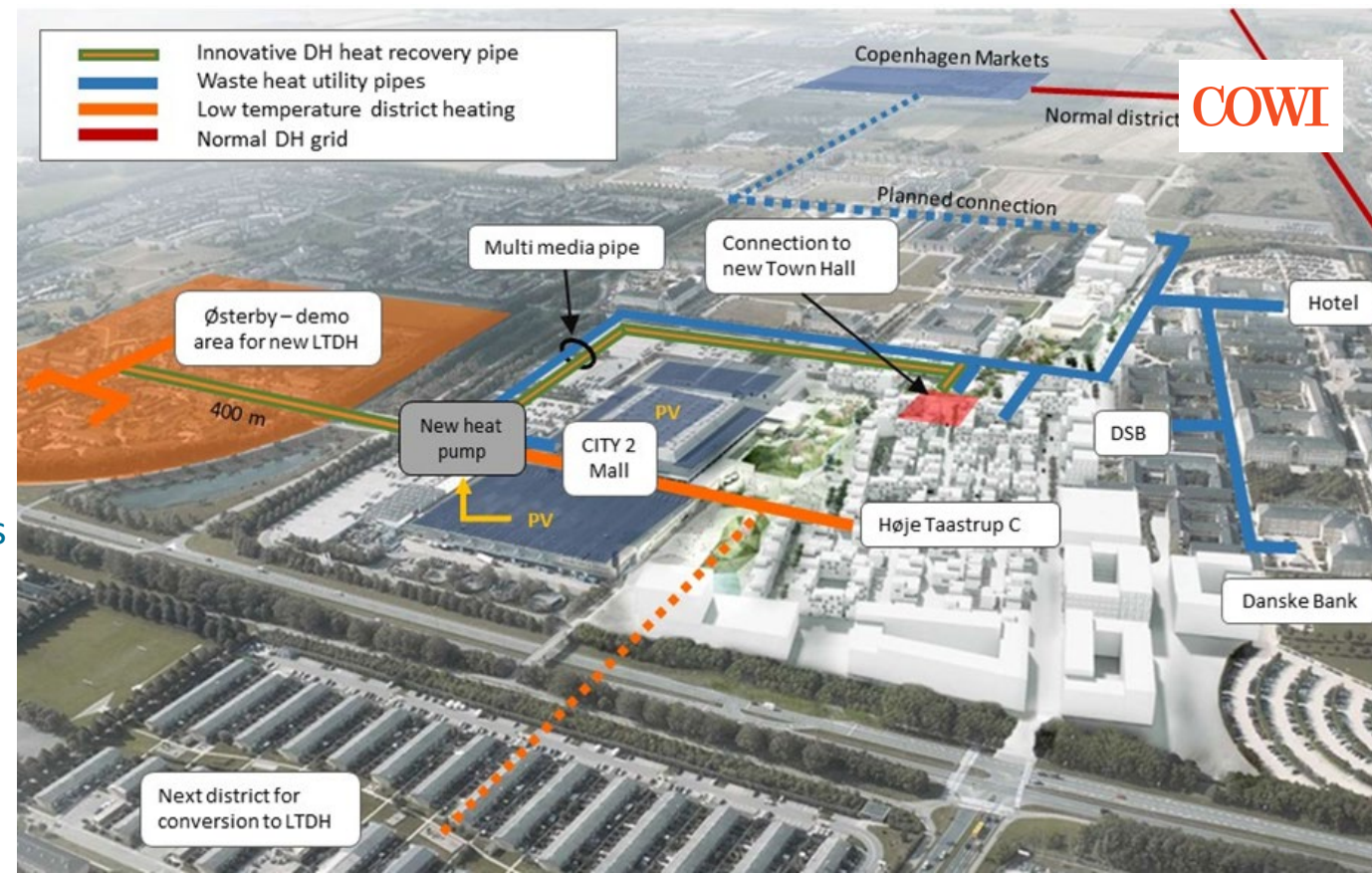


The project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement n° 767799 - COOL DH - H2020-EE-2016-2017/H2020-EE-2017-RIA-IA

# COOL DH – in Høje Taastrup

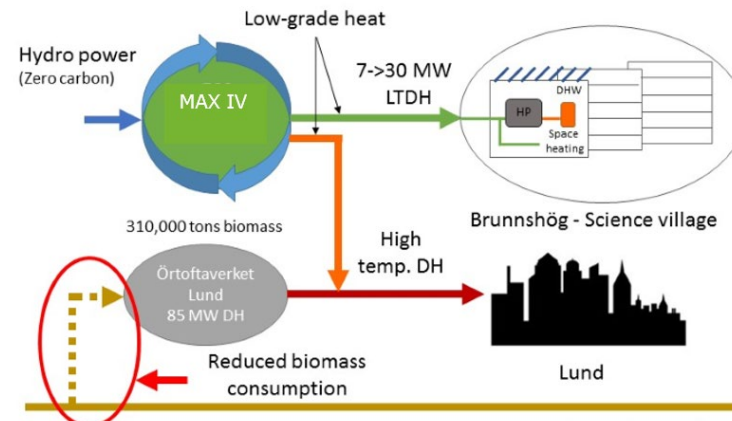
## Høje-Taastrup - Østerby (Denmark)

- > Area with *renovated/existing buildings*
- > New LTDH network (85/50=>55/30°C )using PE-RT pipes
- > Supplied from CITY2 shopping center's cooling system
- > Heat recovery also from bank (data center)



## Lund - Brunnshög (Sweden)

- > *New district under development for 40.000 people*
- > New LTDH network (65/35°C) with new PE-RT pipes

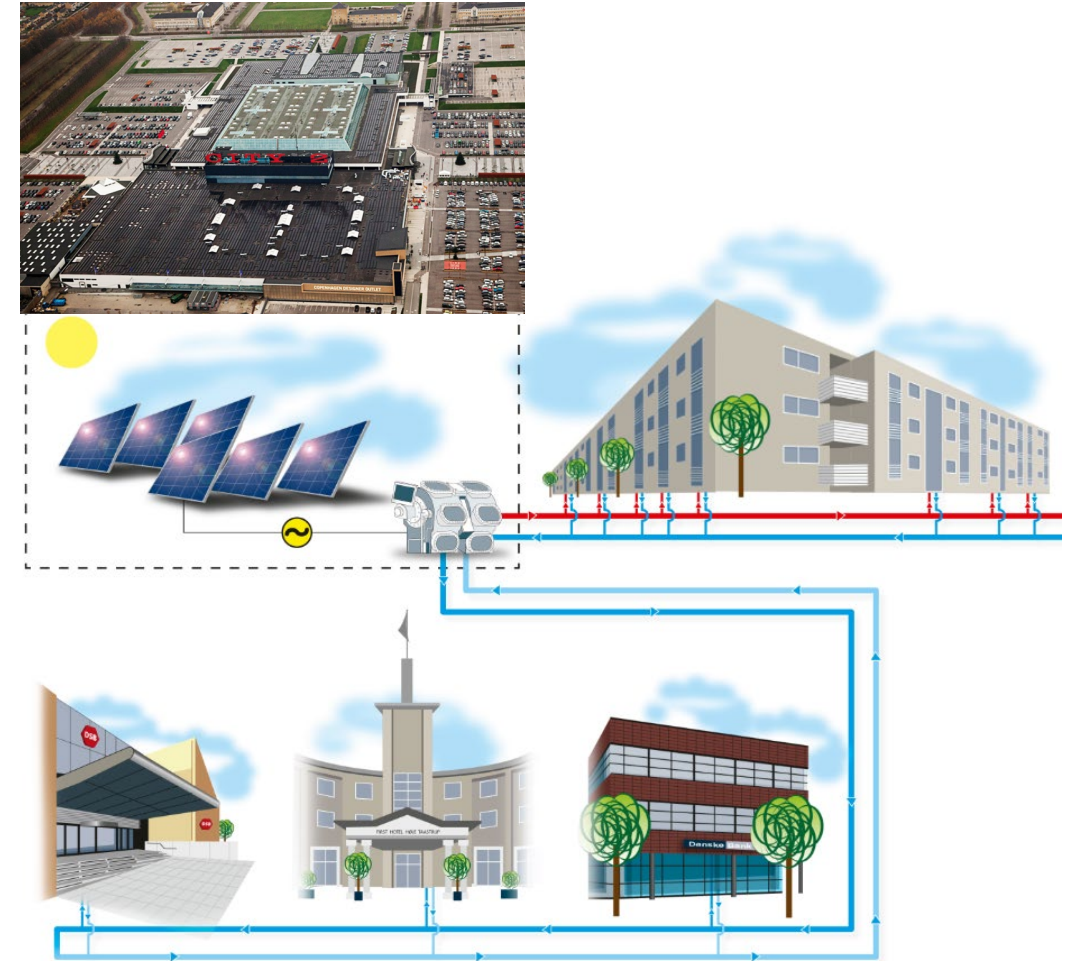


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# Høje-Taastrup C -> Østerby

## Key Questions

- How to design local low temperature DH grids?
- How to integrate local renewables - prosumers?
- Business model?





# City2 as prosumer

- **Background:**
- Large PV installation from 2014 combined with **successful EE strategy** has led to excess of local electricity
- 10 years favorable **feed-in tariff** for local production decreases yearly and runs out in 2024
- **Business model:**  
DH Company approached CITY 2 with a proposition to **co-produce and deliver heating & cooling** based on the excess PV power, and to **rent a room** in the basement of the premises and to **take over the ownership (BOO)** and operate it as flexsumer in interplay with parallel local energy sources



16,200 m<sup>2</sup> PV on roof (2.1 MW)



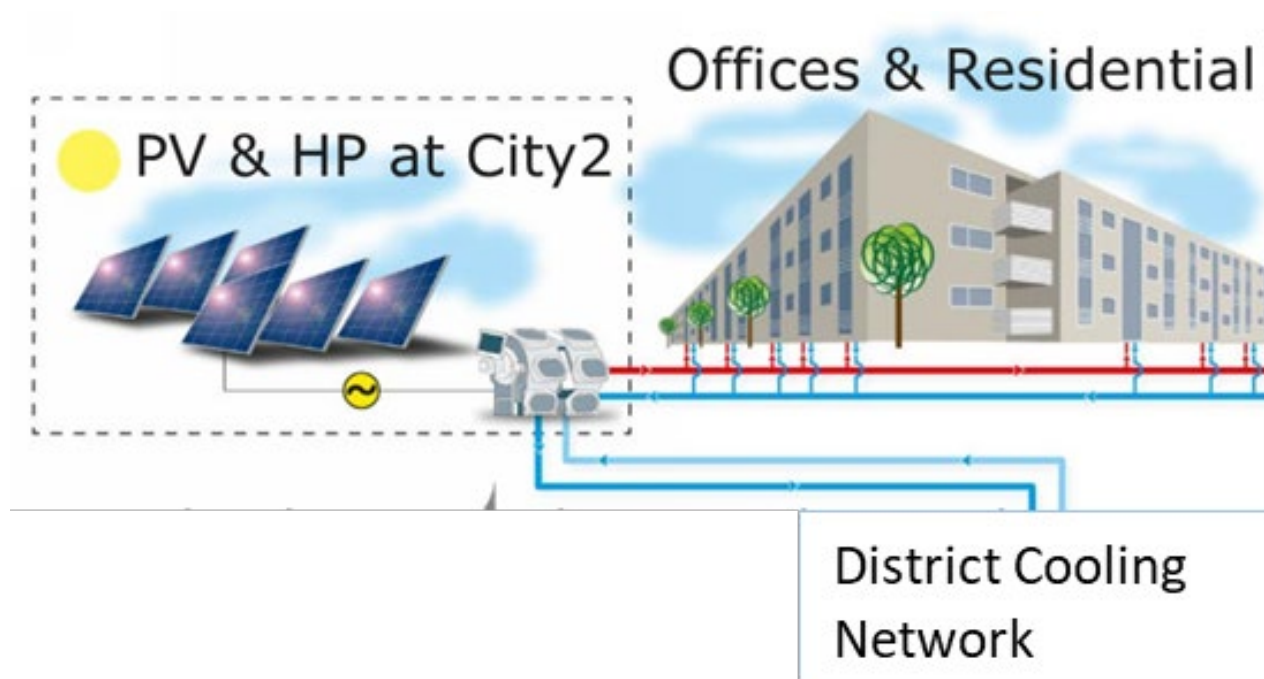
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# Benefits

- Co-production of 1.3 MW heating and 1.0 MW cooling (+1.5 MW backup from DC)
- Production connected to district cooling network and district heating system i.e.
  - Not limited by demand internally of City2 and Østerby district
  - External cooling grid is a resource for heat co-production
  - => More operation hours possible
- Electricity at low cost from PV
- Existing cooling machine reused i.e. lower investment



# Supplies from CITY2 shopping mall in Høje Taastrup



District Heating  
Networks

LTDH 60-70/45°C  
Høje Taastrup C

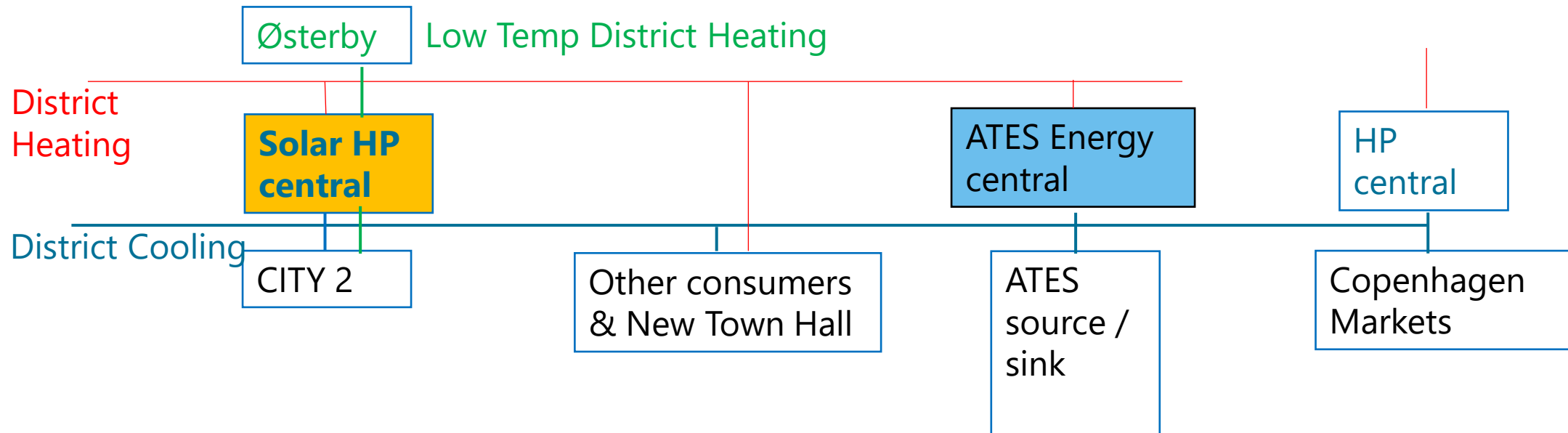
LTDH 55/30°C  
Østerby District

6/12°C summer  
10/15°C spring & fall  
incl. CITY2



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# Interlinking Energy Centrals and Consumers is important



# Business Model CITY2: Co-production of cooling and heating, Selling both heat and cooling

Type of installation	Prosumer Heat Pump
Installation location	CITY2
Capacity (Heat Pump)	1341 kW heat + 990 kW cooling
Efficiency, Heat Pump COP <sub>system</sub> incl. pumps	$(1341+990)/(268.1+176.5) = 5.24$ (design at 100% load)

Cost of electricity: (confidential)

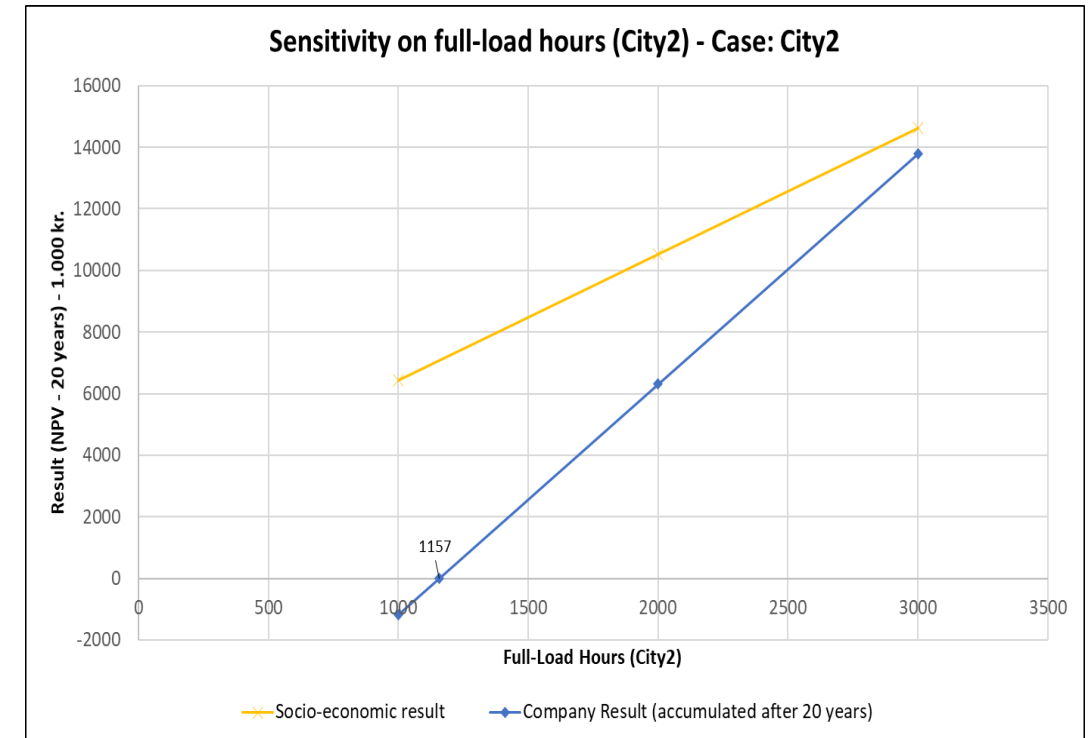
Cost of sold cooling in average: (confidential)

Cost of sold heat in average: 0.056 €/kWh

Total cost for the demo installation: 1.14 mio. €

Simple pay-back period 8-10 years

COP primary energy: 2.5



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# Business Model, Bank building, LTDH 60°C

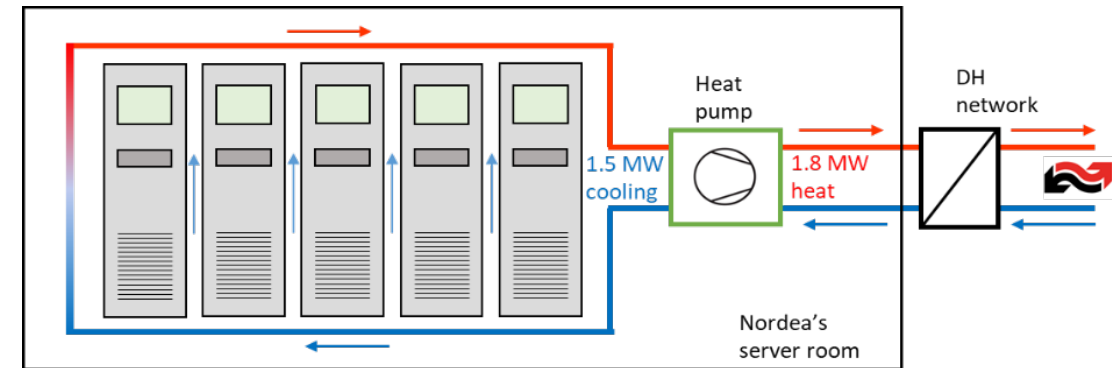
- Utility invest in heat pump, pay electricity and **get cooling energy for free**
- Bank provides space & use free cooling 9/14°C continuously 5.000-6.500 max hours p.a.

Type of installation	Prosumer Heat Pump
Installation location	Nordea Bank
Capacity (Heat Pump)	1920 kW heat + 1500 kW cooling
Efficiency, Heat Pump $COP_{heat}$	3.67 in practice incl. pumps and ancillaries

Cost of sold heat in average: 0.056 €/kWh

Total cost for the demo installation: 1.61 mio. €

COP primary energy: 3.11

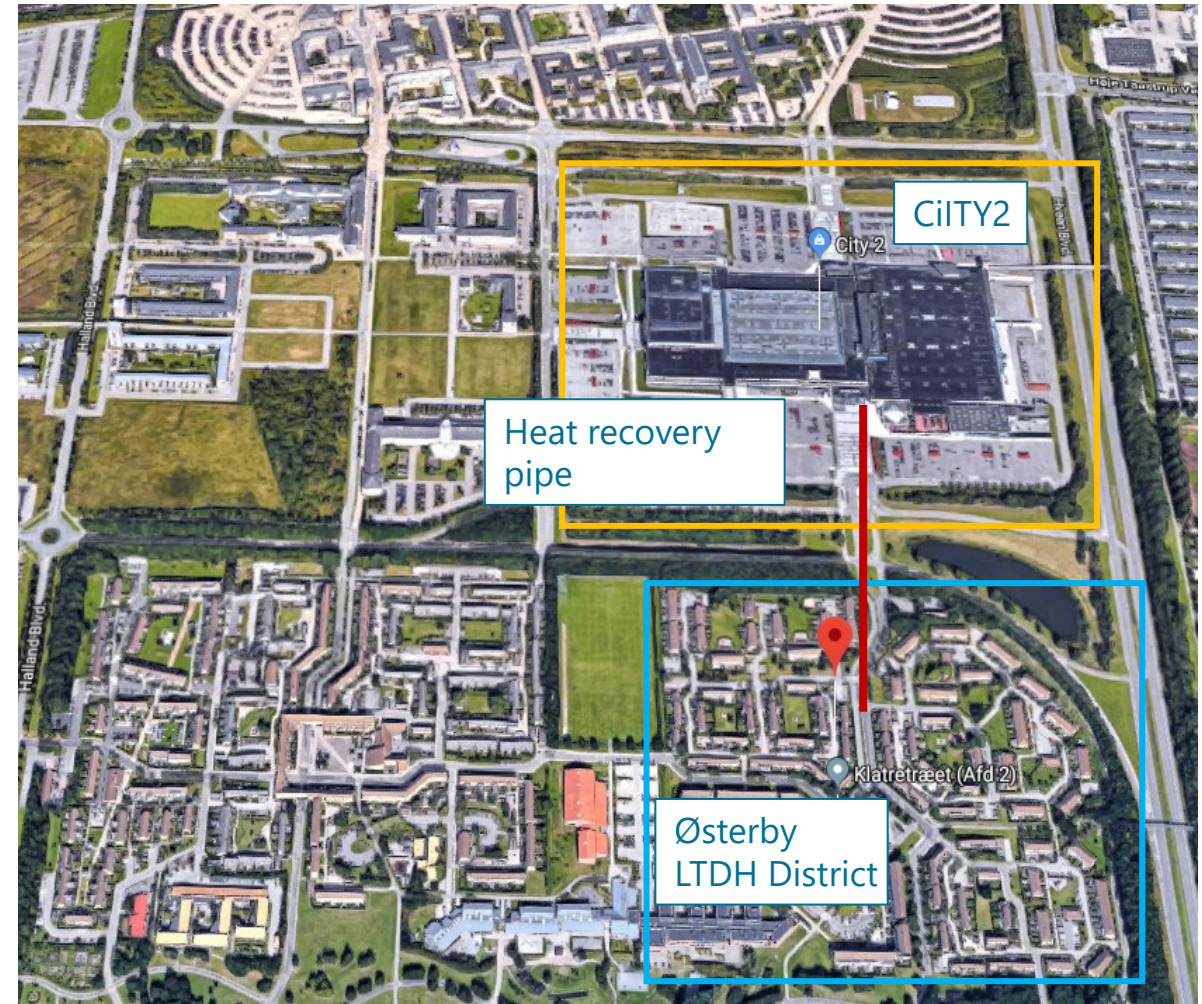


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# Distribution side

## Implementation in Østerby district:

- Heat Pump connected to the LTDH district
- Aiming at ZERO loss transmission pipes!

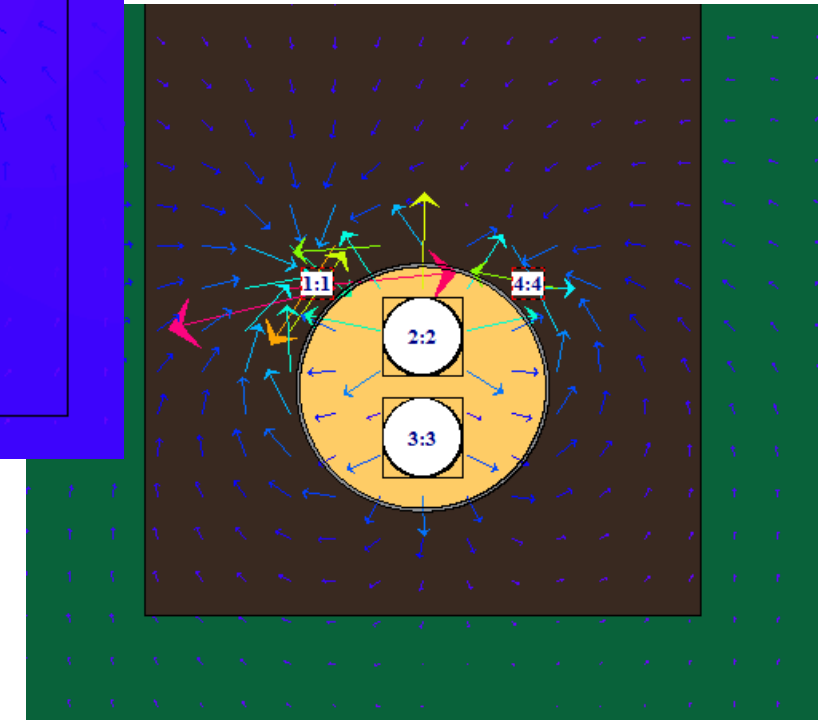
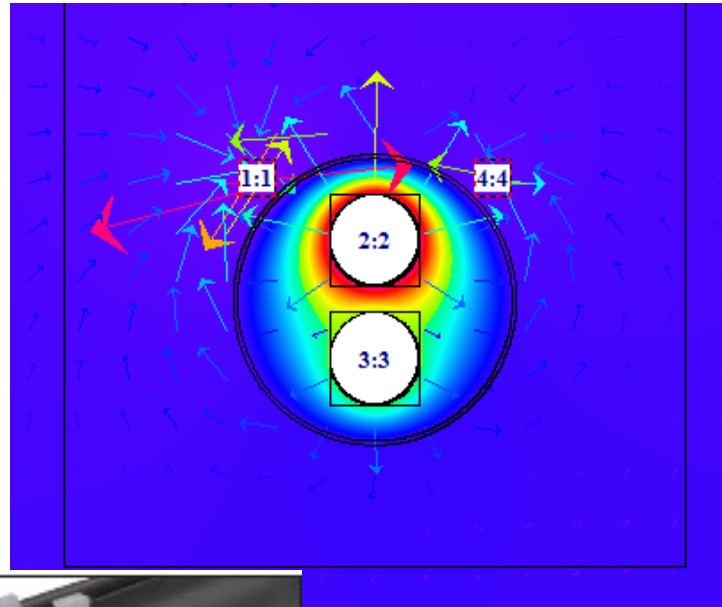


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# COOL DH (“zero loss pipe”)

Heat recovery pipes ( => zero-loss pipe)

- > Based on HEAT2 simulations (heat transfer) at 3/7°C brine temp



Total recovered energy [kWh/m/yr]	167.4
Heat from the DH pipe [kWh/yr/m]	75.7
Heat from the soil [kWh/yr/m]	91.7



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# Østerby District

Approx. 36.000 m<sup>2</sup> building stock from the 80'ties

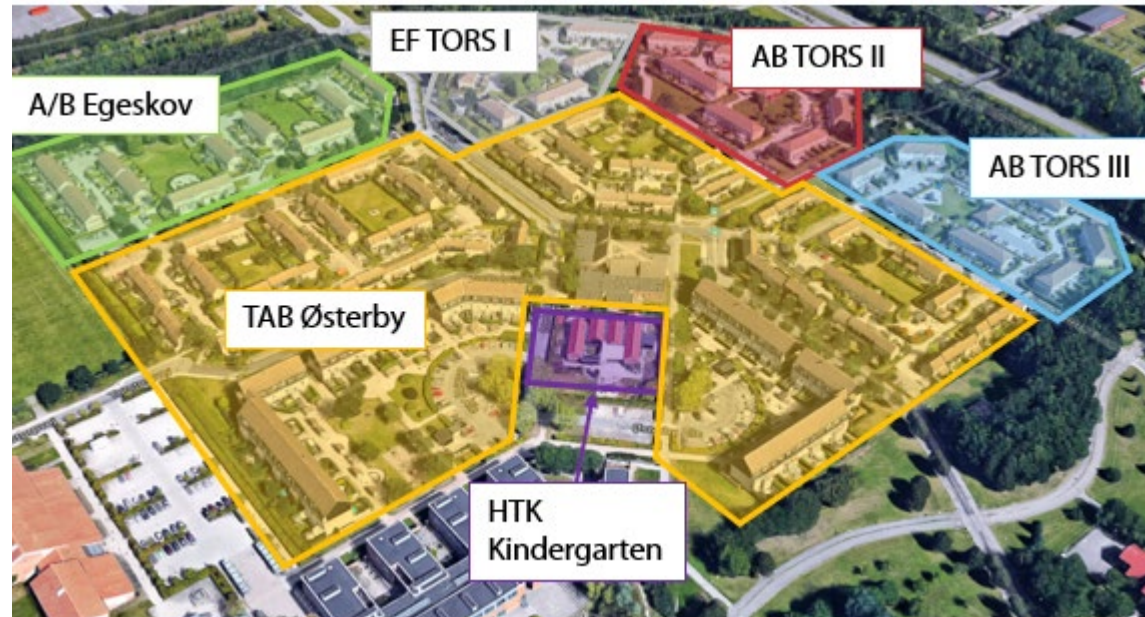
- 158 terraced houses
- A public kindergarten
- Social housing company

## District heating network

- +35 years old
- One main heat exchanger and local grid

## Organization (6 groups)

- Kindergarten
- Social housing
- 4 housing associations



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**COOLDH**  
COOL DISTRICT HEATING

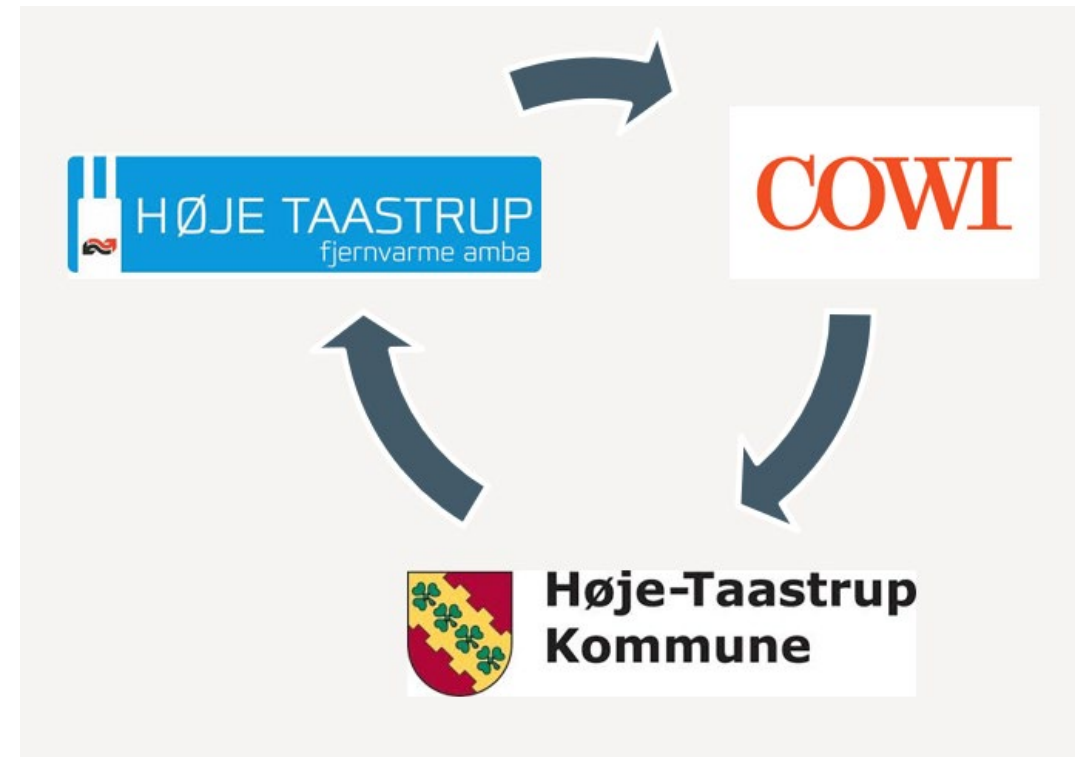


# How to convince the locals to change to LTDH?

House tenants barely know what keep them warm in winter and how they get hot water!

- > Necessary to make a **detailed action plan** to answer the questions
- > Find decision triggers e.g. limited lifespan of existing pipes
- > Know economic consequence for each customer
- > Make pilot installations and get local ambassadors on your side

Tight counselling collaboration between



# COOL DH approach in Østerby

- Before

- Building partly retrofitted (e.g. low energy windows)
- Oversized self owned grid with >35% local grid loss, 85/50°C
- Old pipes below houses with need for replacement

- After

- New pipes now owned by utility – grid loss <15% grid loss, 53/30°C at consumer
- New local DH units with no DHW circulation => ensures low DH return temp.
- Business model:

Partly financed by the bill through utility (units paid by fixed yearly subscription over 20 years)

Grid and maintenance taken over by utility

No further risks for consumer

Overall a +20% reduced cost for the consumers



# Consumer Key Figures (DKK incl. VAT)

## Traditional DH upgrade (20 years)

- DH Lifetime extension: 12.0 m.DKK
  - DH Units: 1.2 m.DKK
  - DH consumption/costs: 1.0 m.DKK/y
  - CAPEX & OPEX: 2.2 m.DKK/y
- corresponding to **13.8 t.DKK/dwelling/y**

## NEW LT (COOL) DH upgrade (20 years)

- NEW LT DH system: 6.2 m.DKK
  - LT DH Units (subscription): 450 t.DKK/y
  - DH consumption/costs: 900 t.DKK/y
  - CAPEX & OPEX: 1.7 m.DKK/y
- corresponding to **10.9 t.DKK/dwelling/y**

- **Annual savings: 0.5 m.DKK/y (~20%)**  
**corresponding to 2.9 t.DKK/dwelling/y**



# Consumer Key Figures (EUR incl. VAT)

## Traditional DH upgrade (20 years)

- DH Lifetime extension: 1.61 m.EUR
- DH Units: 0.16 m.EUR
- DH consumption/costs: 0.13 m.EUR/y
- CAPEX & OPEX: 0.3 m.EUR/y

corresponding to 1.85 t.EUR/dwelling/y

## NEW LT (COOL) DH upgrade (20 years)

- NEW LT DH system: 0.83 m.EUR
- LT DH Units (subscription): 60 t.EUR/y
- DH consumption/costs: 120 t.EUR/y
- CAPEX & OPEX: 0.23 m.EUR/y

corresponding to 1.46 t.EUR/dwelling/y

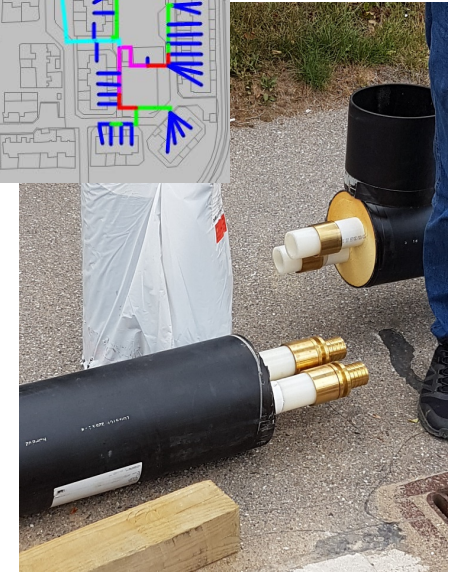
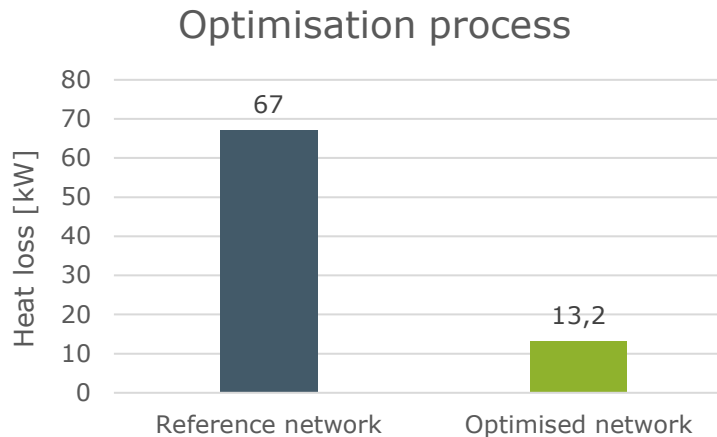
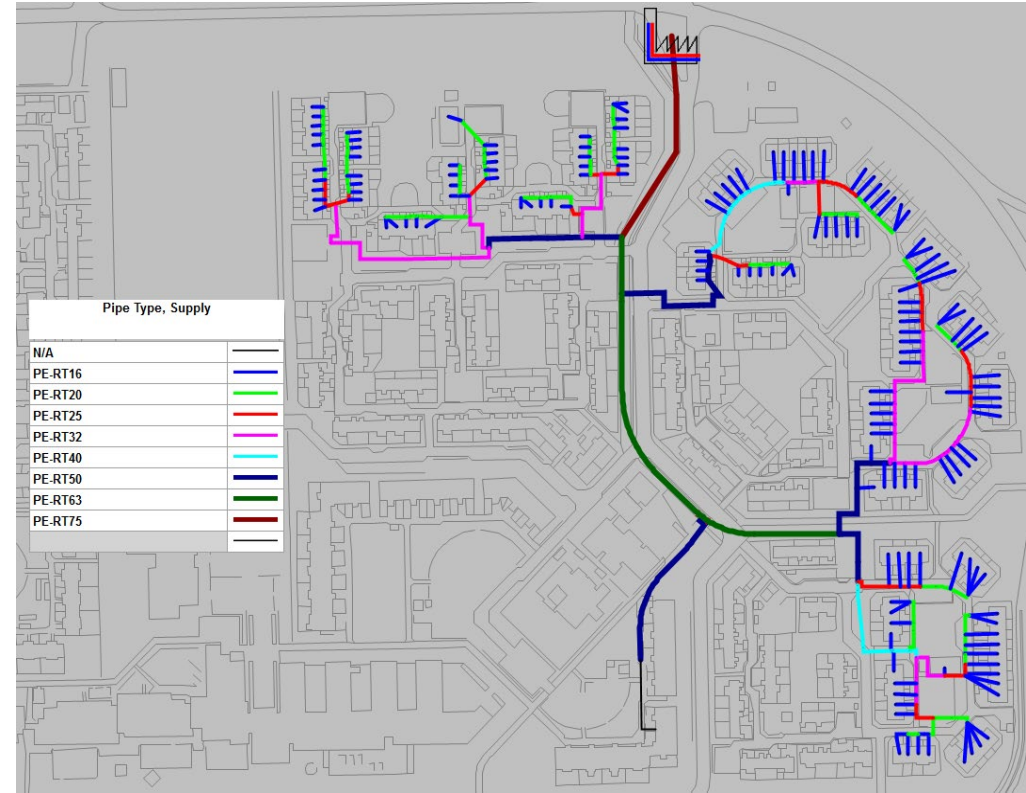
- **Annual savings: 70 t.EUR/y (~20%)**  
**corresponding to 390 EUR/dwelling/y**





# Heat Loss reduction in Østerby LTDH

- Existing network (high heat losses)
- Better insulation/twin pipes
- Hydraulic optimization (smaller pipes)
- Length optimisation
- Aim:
  - Reduced heat loss in the network
  - Optimal operation



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COOL DISTRICT HEATING