COOL DH

Results of the COOL DH project relevant for energy system integration and the role of DHC

Demonstration of innovative solutions and business models

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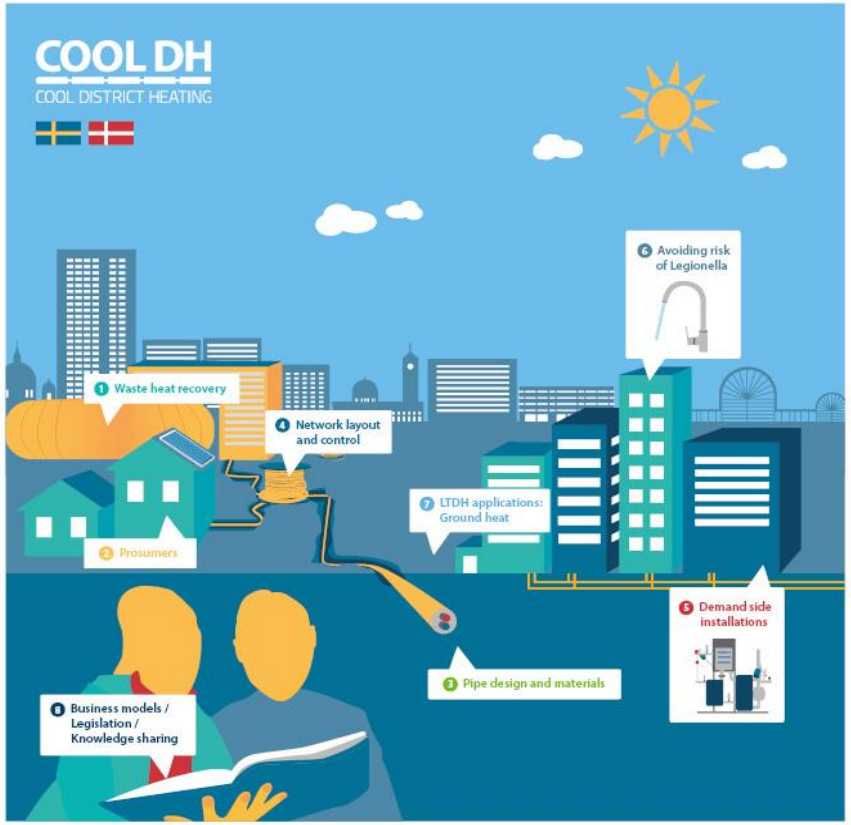

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COWI

What is the COOL DH Project?

A pioneering project for district heating solutions – showing how to use low grade heat sources and local renewable energy sources, implemented in full scale at two **demo sites**

- Implementation of full supply chain
  - Supply side (LTDH produced from RES)
  - Distribution side (new PE-RT pipes)
  - Demand side (new building substations)
  - Generic solutions

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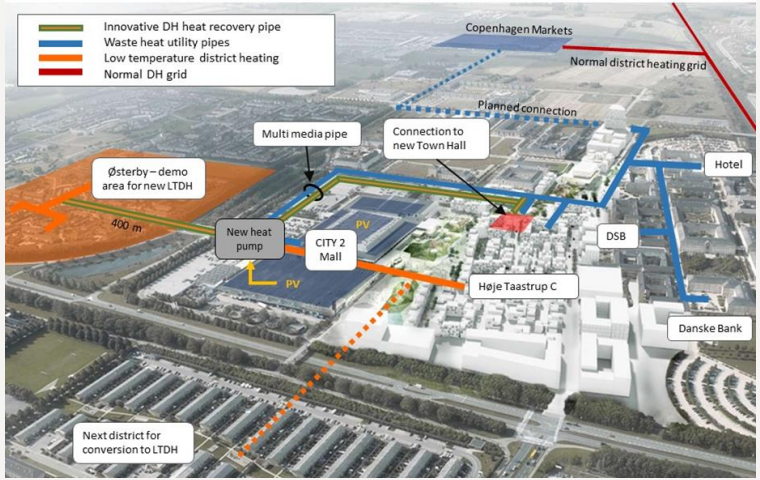
COOL DH - role of heating and cooling

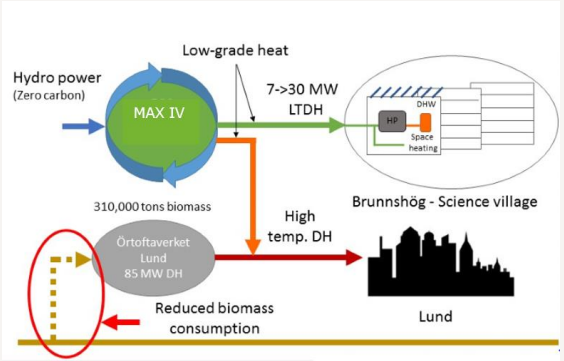


Høje-Taastrup - Østerby (Denmark)

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

Lund - Brunnshög (Sweden)

- ***New district under development for 40.000 people***
- New LTDH network (65/35°C) with new PE-RT pipes
- Surplus heat from research facilities (Max IV / ESS)
  X-ray particle accelerators heating the district
- Passive house multiapartment demonstration building, Xplorion



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CITY2 as prosumer in Høje Taastrup

- Large PV installation from 2014 combined with a **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 CITY2 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 m² PV on the roof (2.1 MWp)

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CITY2 shopping mall in Høje Taastrup,

DC 6-12 / 10-15 °C
incl. CITY2

LTDH 60-70 / 45 °C
Høje Taastrup C

LTDH 55 / 30 °C
Østerby District

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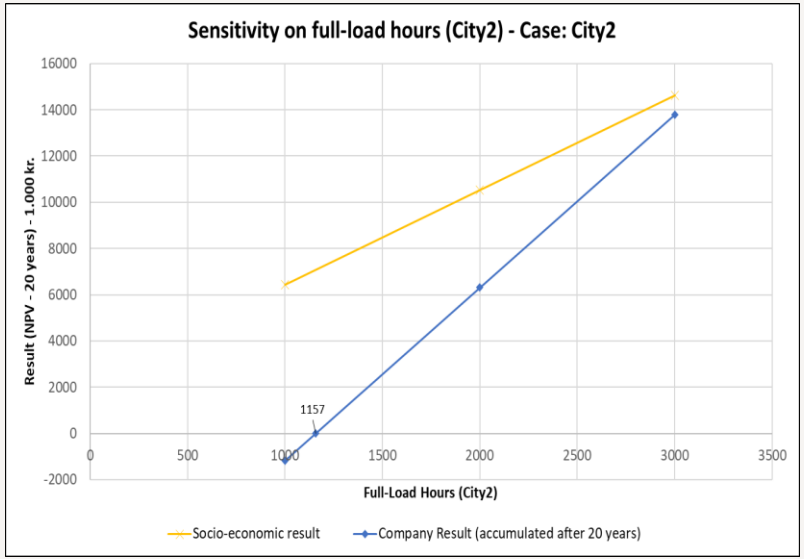
CITY2 Co-production of cooling and heating, 70°C

Type of installation	**Prosumer Heat Pump**
Installation location	**CITY2**
Capacity (Heat Pump)	**1341 kW heat +** **990 kW cooling**
Efficiency, Heat Pump $COP_{system\ incl.\ pumps}$	**(1341+990)/(268.1+176.5) = 5.24** (design at 100% load)

Cost of electricity: 0.06 €/kWh in 2021
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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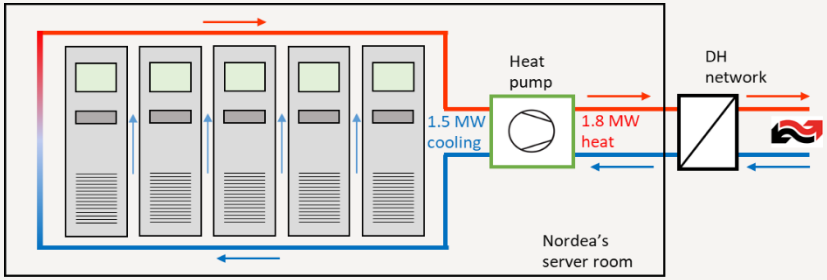
Business Model, Bank building, LTDH 60°C

- Utility invest in heat pump, pay electricity and get cooling energy for free
- Bank provides space & use free cooling 9/14°C continuously 5000-6500 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. €
Simple pay-back period approx.: 11 years.
COP primary energy: 3.11



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Can we use LTDH in existing buildings? Yes, we can!

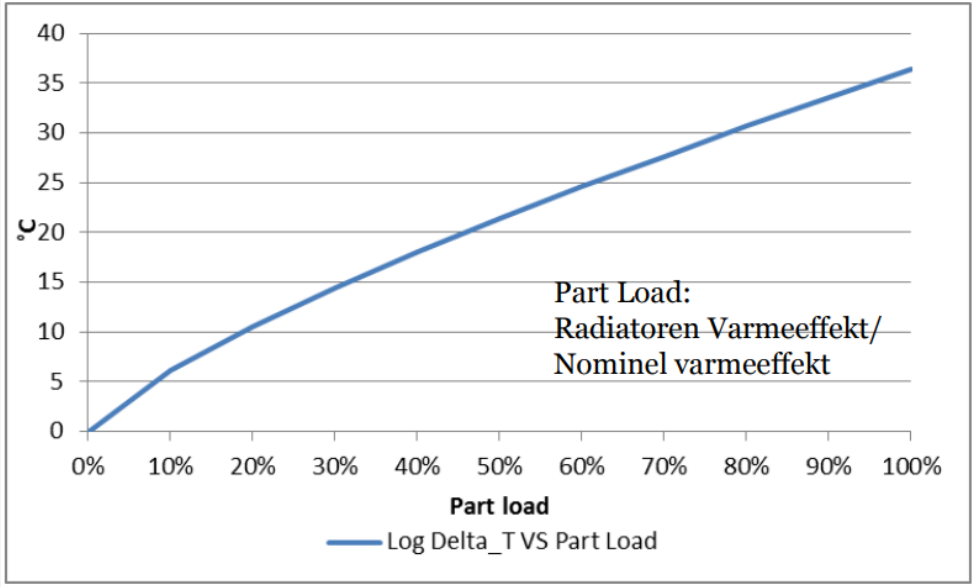
Domestic Hot Water

Tank = 65°C
Heat Exchanger = 55°C
Local HEX = 50°C (3 litre rule)
With booster = 35-40°C

Radiator yield example

Original 70/40/20°C =100%
LTDH 55/35/20°C = 60%

LTDH at 55/35°C fits if 40% energy saving is achieved e.g. with change to low energy glassing / heat recovery on ventilation



Radiator output in relation to Log Delta T (between room temperature and mean radiator temperature)

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Solutions for ultra-LTDH

Available innovative technologies:

1. Smart controlled electric heater
2. Micro-booster heat pump LTDH / PV(T)
3. Indoor air-booster heat pump

Integration of RES for DHW production (temperature boosting when connected to ULTDH/LTDH)

- Possibility of using DH as heat source/pre-heating
- Use of RES as heat source, and eventually introduction of PV to supply electricity

Air-booster

Smart control el-heater

Microbooster

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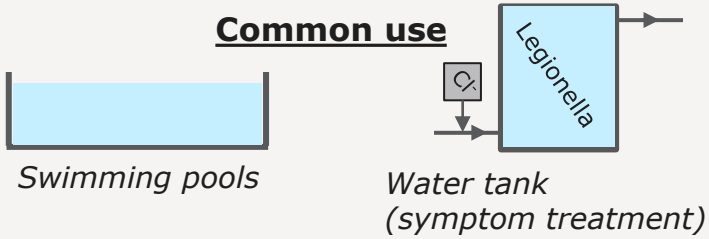
Solutions for anti Legionella treatment



INNOVATION:

- use the water treatment technologies in LTDH as prevention of Legionella (before it was only for hospitals and swimming pools)

- Sterilization:
  - Chlorination
  - Electrochemical treatment
  - Ultraviolet light
  - Ozone
  - Ionization
  - Photocatalysis

Innovation

Integration of existing sterilization solution in DHW heating for LTDH networks

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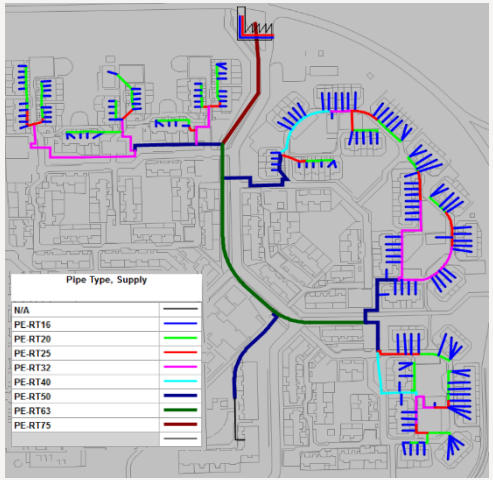
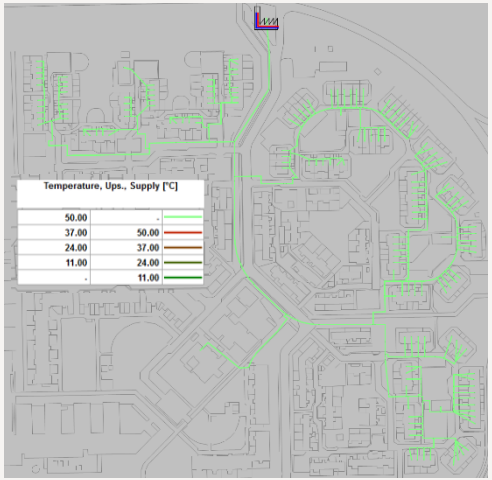
Solutions to reduce grid loss





Network design (TERMIS simulations):

- Length optimisation
- Hydraulic optimisation
  - Higher velocity/pressure rating

- Heat loss reduction in the network
  - Reference network (85/50°C) → 0%
  - Temperature reduction (80/40°C) → 18%
  - New LTDH network with twin pipes (55/30°C) → 55%
  - Optimized LTDH (55/30°C) → **66%**

- Heat loss aim: **10.8%** of delivered energy in terraced housing area

- Energy loss in the network
  - Existing network (85/50°C) → 35% (approximately)
  - Optimized LTDH (55/30°C) → **7%** (ideal)

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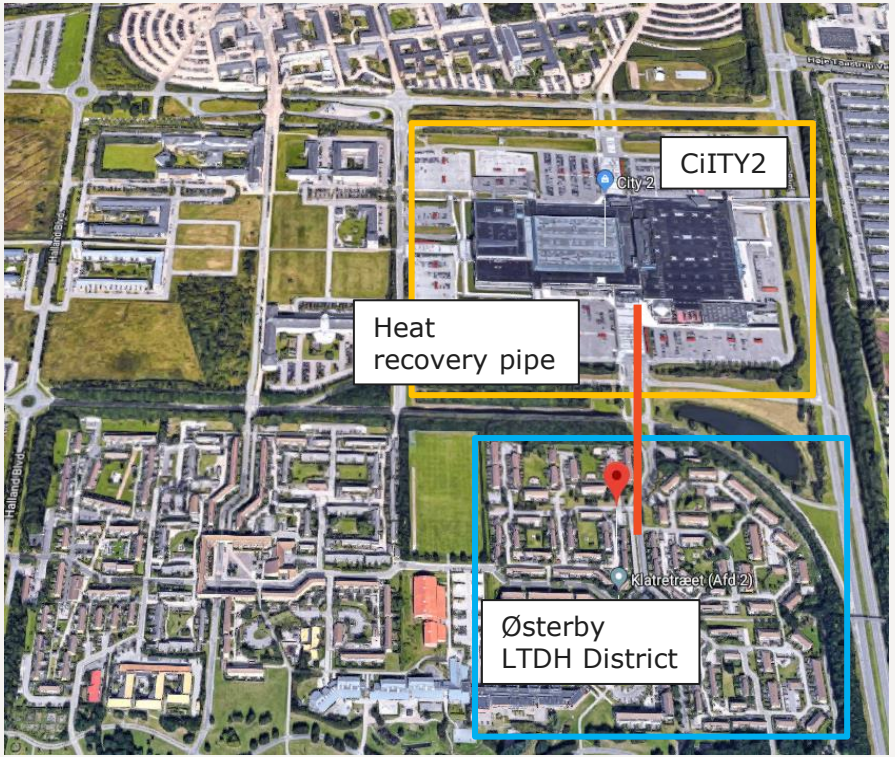
Innovations – Distribution side

Implementation in Østerby district:

- Heat pump connected to the LTDH district
- ZERO loss transmission pipes!



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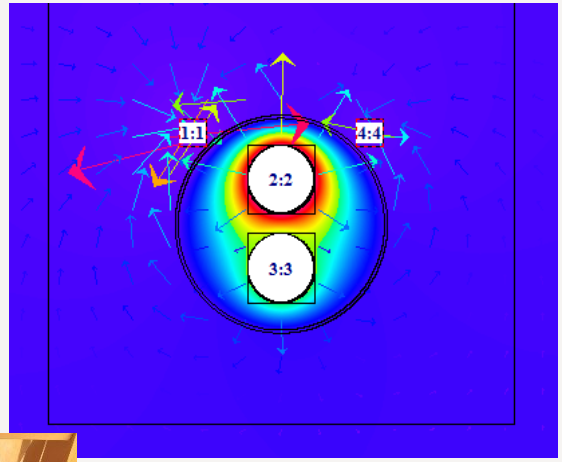
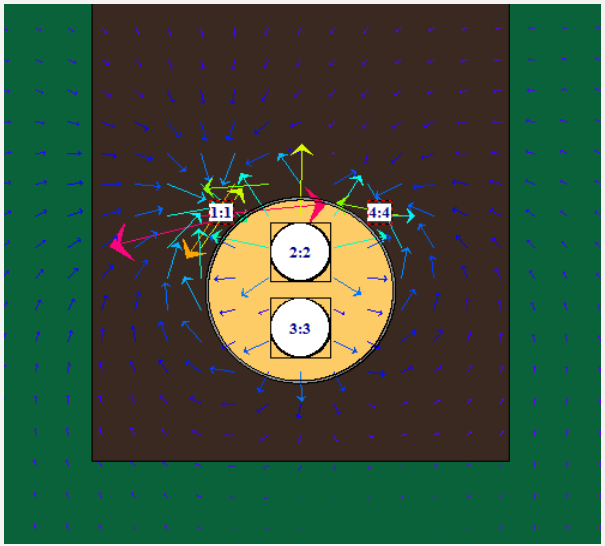
Innovations – Distribution side

INNOVATION:

- Heat recovery pipes (zero-loss pipe)
  - Based on HEAT2 simulations (heat transfer)

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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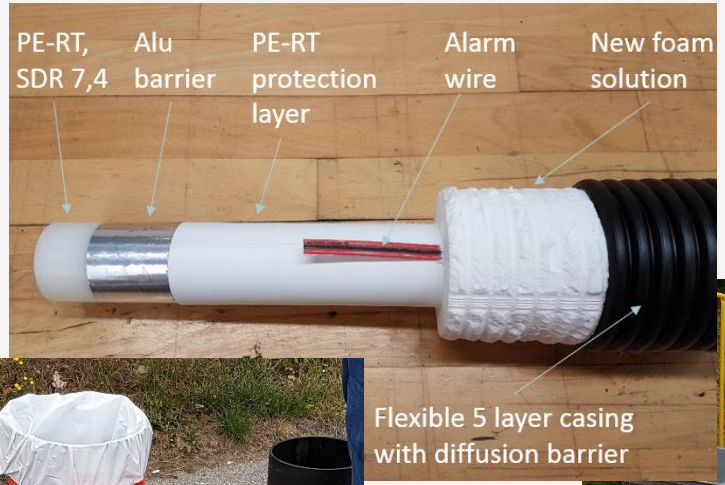
Innovations – New Plastic Pipes

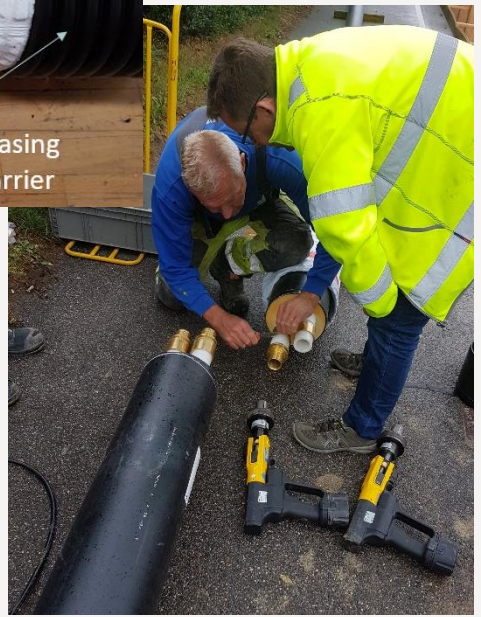
INNOVATION

New technologies:

- New PE-RT pipes (higher pressure)
- Diffusion barrier
- Welding connections
- Leakage alarm

- Usage of existing press and compression couplings available on marked today
- Pipes can be welded together
- Butt/mirror welding for single pipes
- Electrofusion welding. Still in authorisation progress





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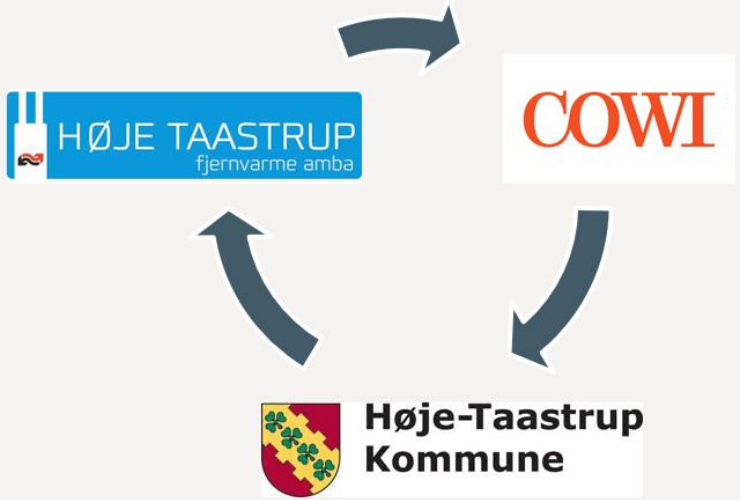
How to convince the locals to change to LTDH?

House tenants barely know what keep they 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



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Policy recommendations

1. Remove regulative barriers against local/distributed **co-production** based on renewables and/or waste heat (both for thermal and electric energy)

2. Regulation to ensure the use of low-grade waste heat from **data centres** for district heating production

3. Incentives / legislation to enforce utilization of heat from cooling machines (e.g. from supermarkets)

4. Allow local part co-production also in areas already served by District Heating

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Thank-you for your attention

Q&A

LTDH District Østerby in Høje Taastrup

www.cooldh.eu

Or contact

rmh@cowi.com

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