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Session 11:

COOL DH
- General intro and Swedish site

Sara Kralmark

Kraftringen Energi AB

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COOL DH
COOL DISTRICT HEATING

Agenda Session 11

4DH

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- COOL DH (general intro and Swedish site)
  Sara Kralmark, Kraftringen
  - Development of DH plastic pipes
    Klaus G Lauridsen, Logstor
  - Xplorion
    Dennis Kerkhof, LKF
  - How to convince the locals to change into LTDH (Danish site)
    Steen G Olesen, COWI
  - HWC appliances
    Klara Ottosson
- SCA
  David Edsbäcker, Kraftringen

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COOL DH
COOL DISTRICT HEATING

Facts about us

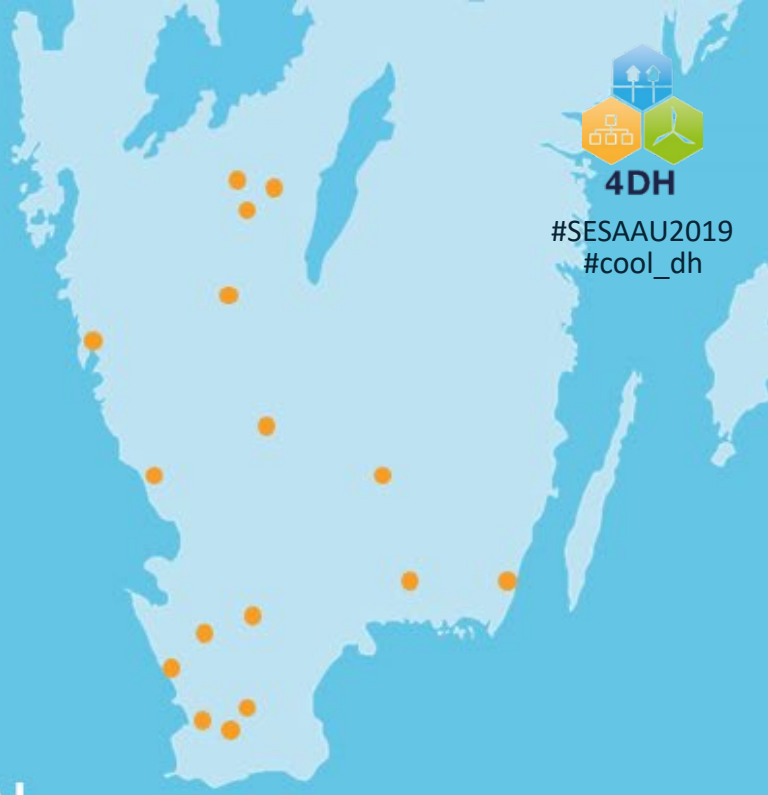
Total number of customers

260 000 pcs

- Electricity grid 105 800 pcs
- Electricity accounts 128 600 pcs
- District heating 8 800 pcs
- Gas 1 900 pcs
- Vehicle biogas 800 pcs
- Fibre 13 500 pcs (active sockets)

Employees

500 pcs



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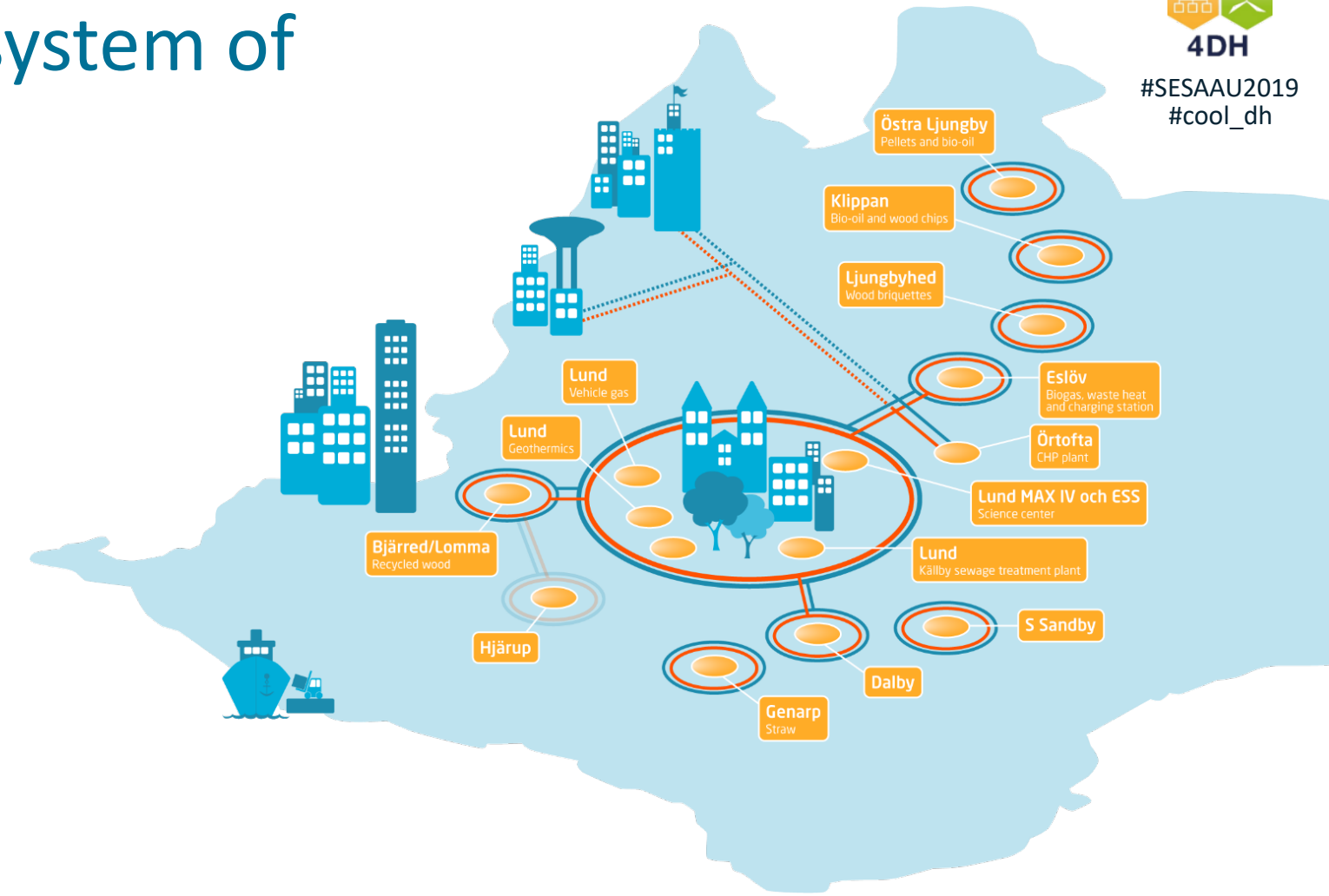
OPERATIONS IN SOUTHERN SWEDEN

- i Skåne, Halland, Blekinge, Småland, Sjuhäradsbygden och Västgötaslätten.

kraftringen

The 3rd generation DH system of Kraftringen

- Heat production:
  - Kraftringen: ≈ 970 GWh/year
  - Total: ≈ 1 100 GWh/year (app. 50 000 households)
- Kraftringen grid length (one way): ≈ 1 050 km
- **100% fossil free**



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Project partners

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kraftringen

Høje-Taastrup Kommune

LOGSTOR

HØJE TAASTRUP fjernvarme amba

LUND UNIVERSITY

EUROHEAT & POWER

Cetetherm

LKF

COWI

CITY OF LUND

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Utilizing waste heat

has the potential to accelerate the energy transition even further

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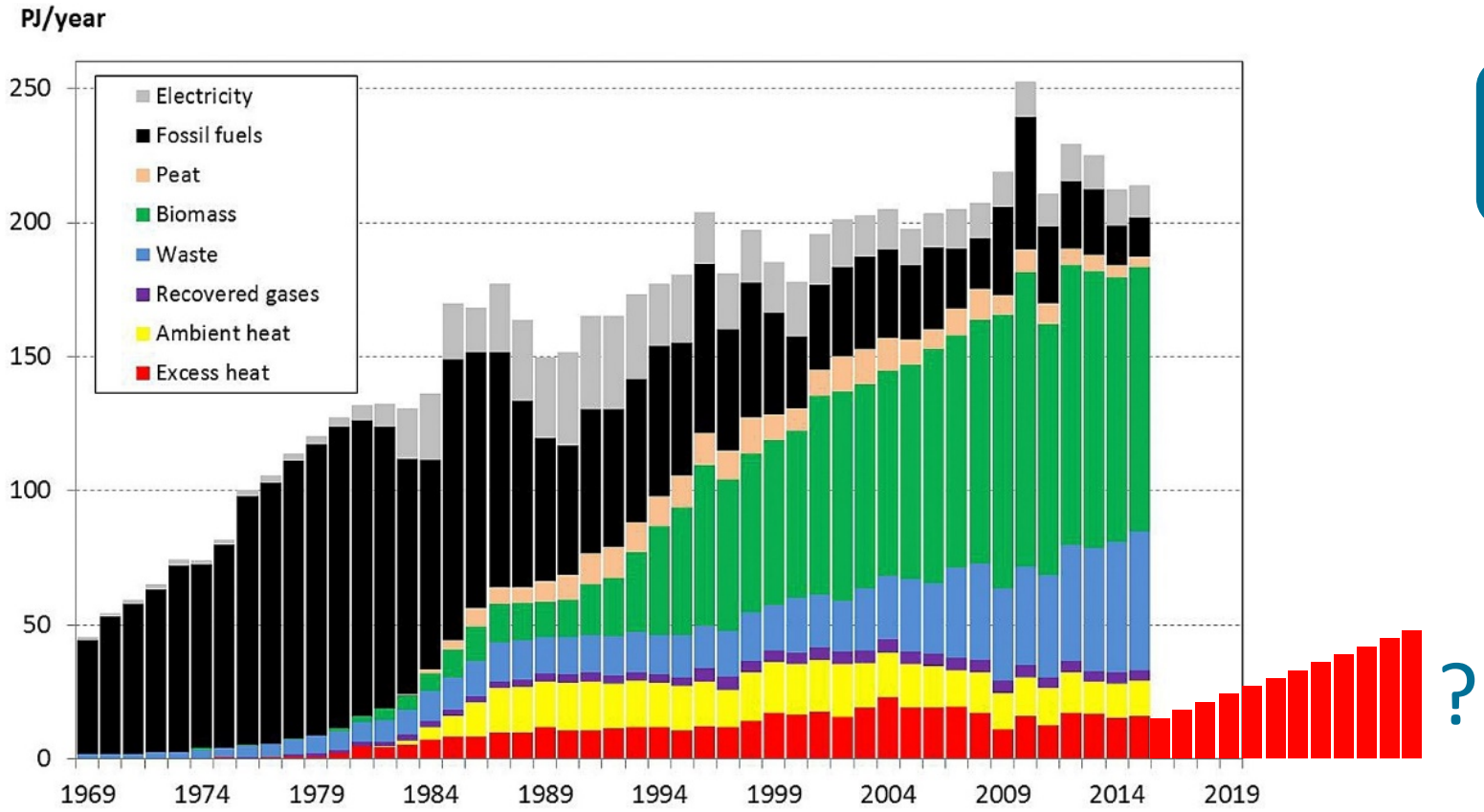

District heating
– a sustainable option

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Energy balance in the EU 2012

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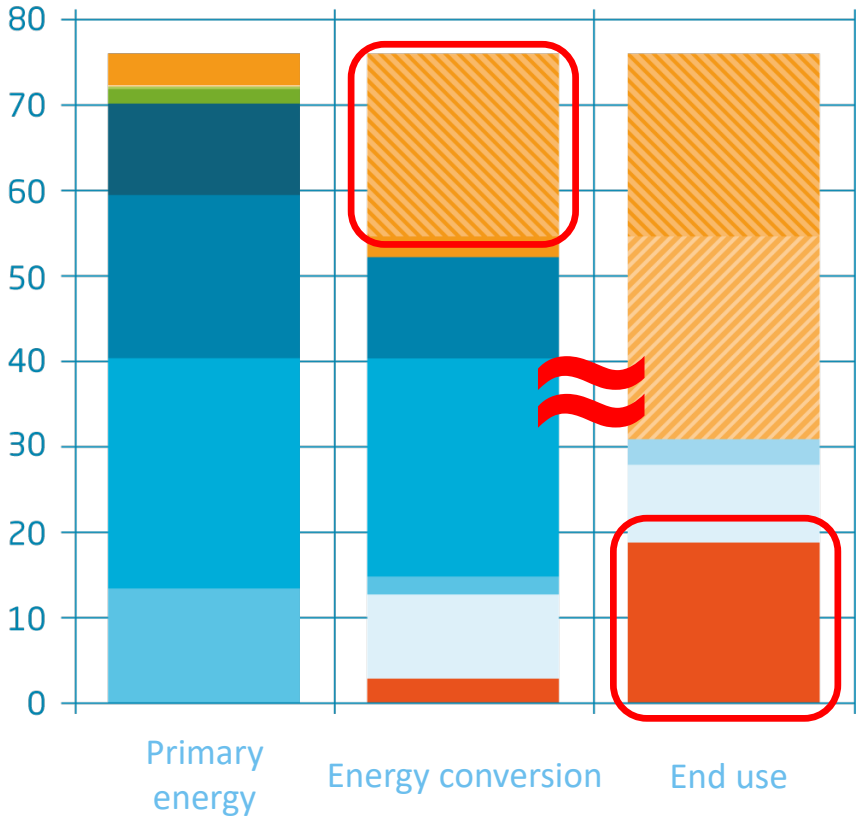

- Conversion heat losses in the energy transformation sector
- Conversion heat losses in end use
- Combustible Renewables and Waste
- Solar/Wind/Other
- Geothermal
- Hydro
- Nuclear
- Natural Gas
- Petroleum Products
- Coal and Product
- Transportation
- Electricity
- Heat

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Excess heat – to use or not to use?

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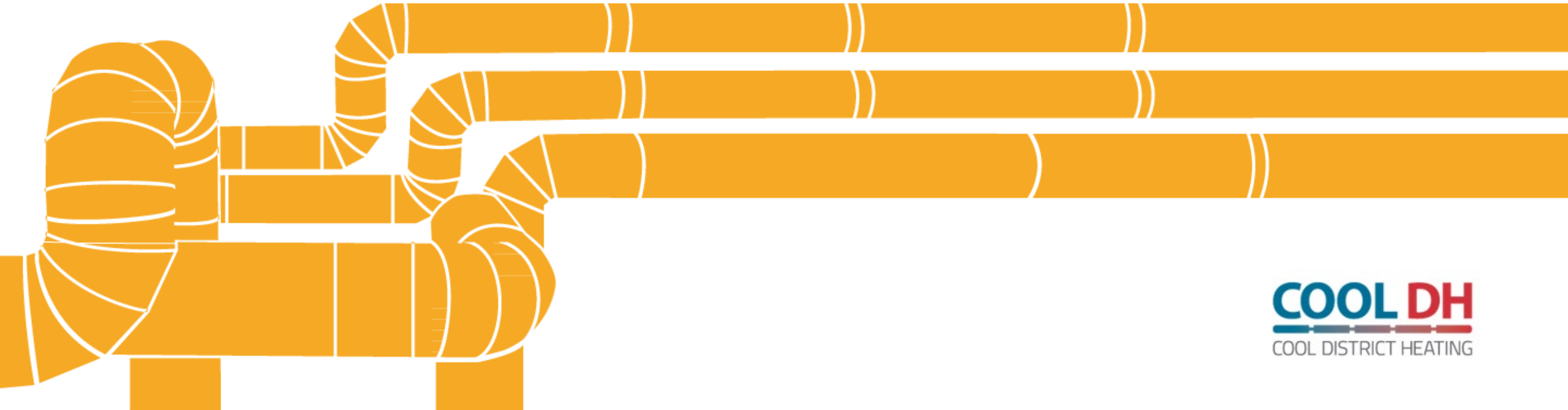
LOCALISATION

TEMPERATURE

TIME



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ESS
MAX IV

A new, sustainable district
LUND NE / BRUNNSHÖG

- A European role model for sustainable urban planning
- A regional destination for research, culture and recreation
- The worlds best research and innovation environment


The world's largest research facility with synchrotron radiation
MAX IV
• Cooling and heating supply
• Recycling of excess heat
Energy central

What are we building?
SCIENCE heats the city

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- Heat from MAX IV is recovered and used in our LTDH network (65 °C), backed by our modern DH production (>80 °C)
- 65 °C and 10 Bar
  - Legionella safe
  - Lower production costs
  - Lower heat losses
  - Heat distribution partially in plastic pipes

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Costs in DH construction projects

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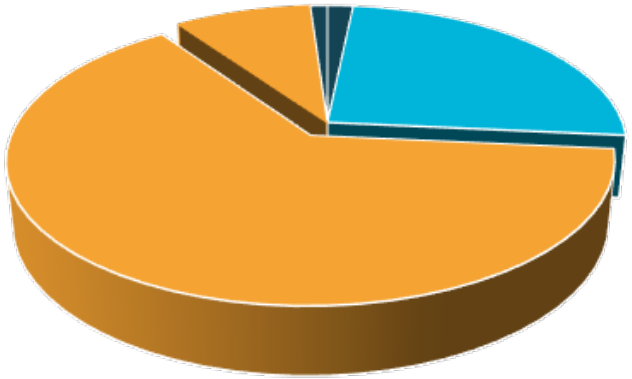
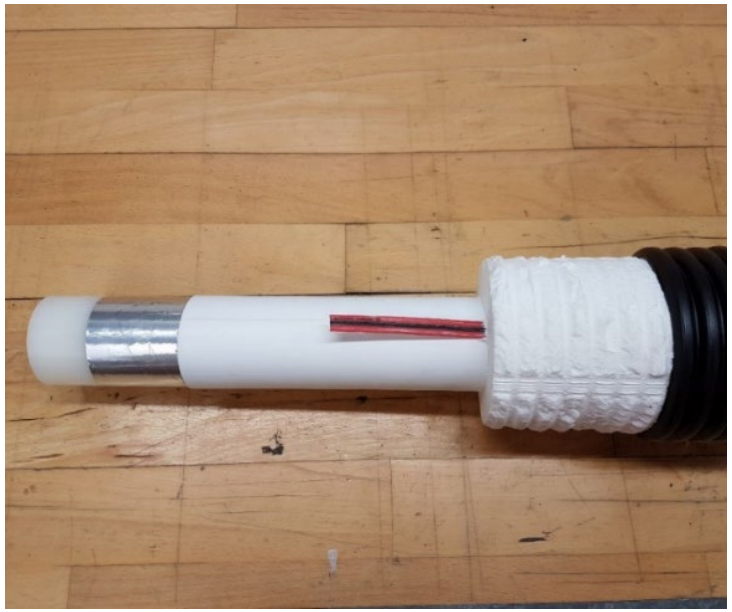
10% Design and construction management



15% Material and insulation of joints

75% Shaft, pipe handling and welding



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LTDH – project status

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- 6.5 km LTDH grid of which 2.8 km plastic pipes

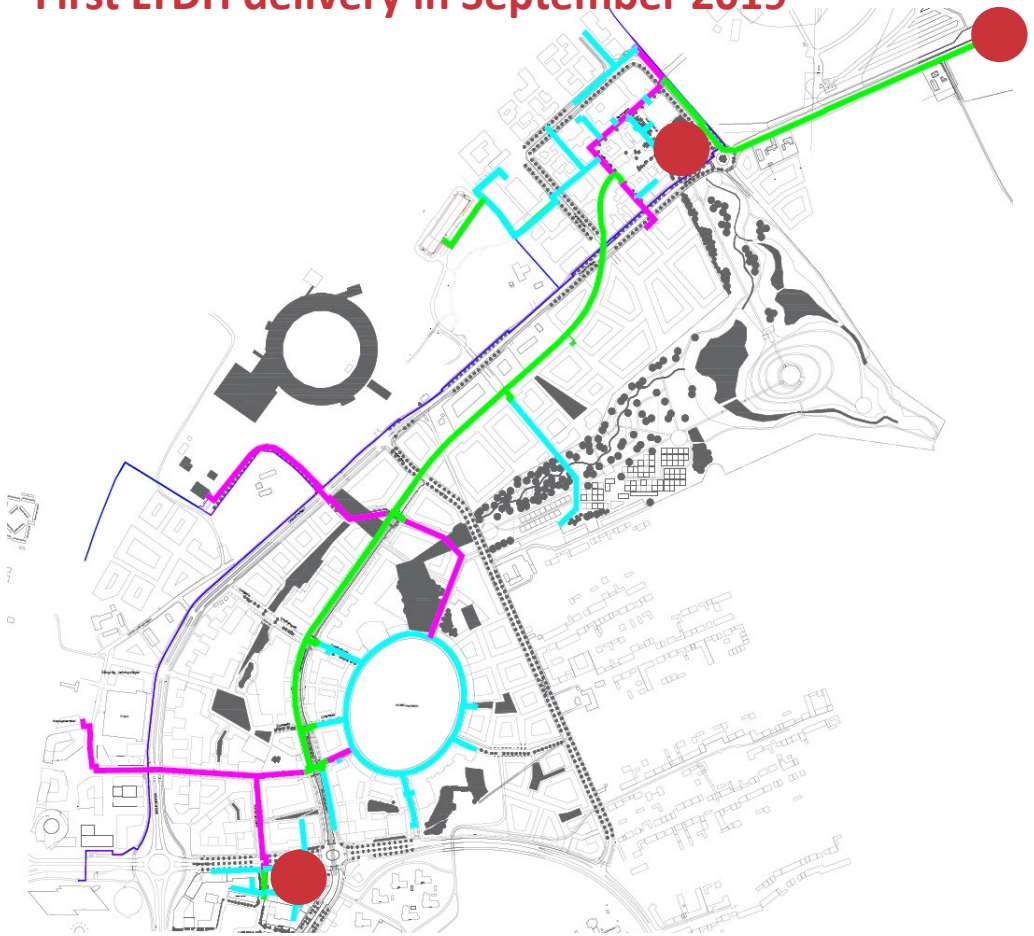
  LTDH steel built 2018 (2,5 km along tramway)

  LTDH steel planned 2019 (0,6-1 km)

  LTDH plastic planned (start autumn 2019)

  Conventional DH (existing)

First LTDH delivery in September 2019



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COOL DH
COOL DISTRICT HEATING

COOL DH

COOL DISTRICT HEATING

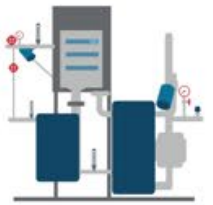
1 Waste heat recovery

2 Prosumers

3 Pipe design and materials

4 Network layout and control

5 Demand side installations



6 Avoiding risk of Legionella

7 LTDH applications: Ground heat

8 Business models / Legislation / Knowledge sharing

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Thank you for your attention!

Any questions or remarks?

Sara Kralmark
Project manager, Business development
Contact: sara.kralmark@kraftringen.se

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EXTRA

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COOL DH
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Brunnshög in 2035

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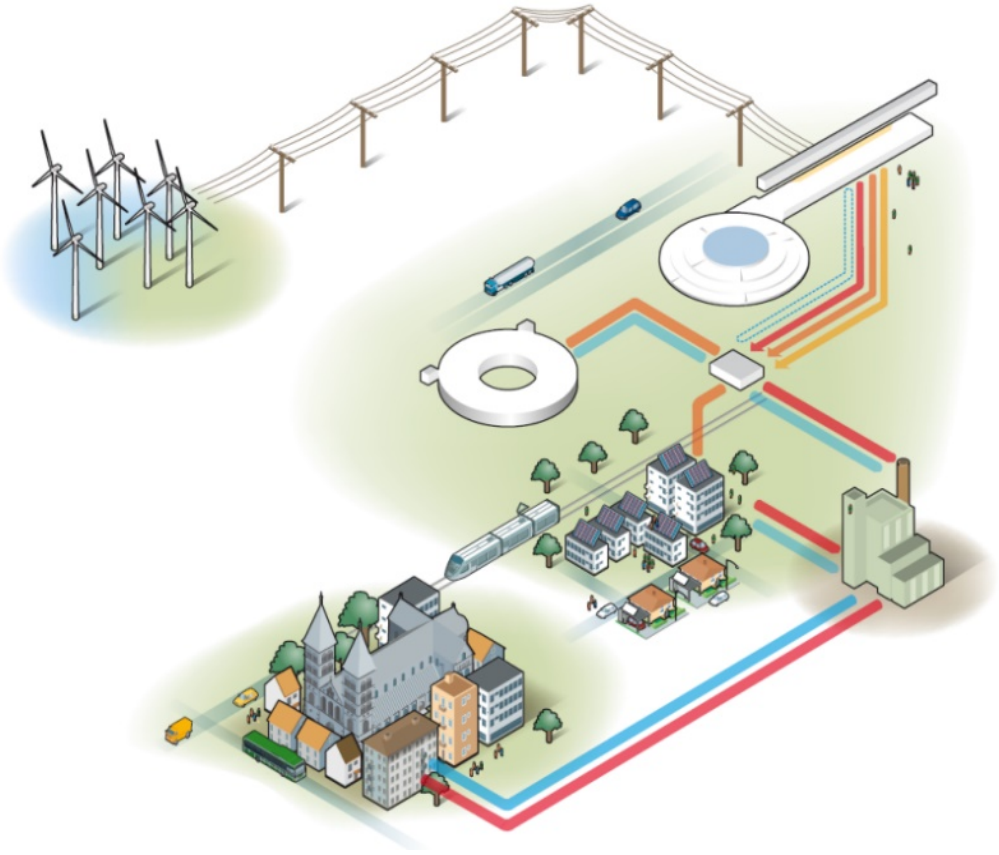
ESS
100 GWh/y (DH 80 °C)
100 GWh/y (DH <80 °C)

MAX IV
28 GWh/y (DH 65 °C)

Brunnshög's need
23 GWh/year (DH 65 °C)



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HEAT PUMPS FOR COOLING AND
HEAT RECOVERY

- Joint project, collaboration
  Lund University and Kraftringen
- Appr 20 GWh cooling
  35 GWh district heating

Cooling demand divided into three systems according to temperature levels: 7ºC, 23ºC and 48ºC

COOL DH
COOL DISTRICT HEATING

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Innovative piping system in COOL DH

Senior Product Manager:

Klaus Grønnegaard Lauridsen

LOGSTOR

klgla@logstor.com

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Low temperature District Heating - norms and standards

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AS-IS: Standard pipe systems today is preinsulated steel pipes.

- Steel service pipe, minimum 30 years service life, continuous operation 120 ^{0}C and peak temperature of 140 ^{0}C
- Minimum requirements to the preinsulated components and system is defined in the European standards

TO-BE: With a low temperature system running between 55 -85 ^{0}C the calculated theoretical life time of the pipe system is beyond 1000 years.

- For a low temperature 4th generation District Heating system this is over engineered and too expensive. We need to start pushing for updated standards to fit the real needs

European standards for preinsulated pipe systems

LOGSTOR

- EN253 – pipes
- EN448 – Fittings
- EN488 – Steel valves
- EN489 – Joints
- EN15698 – Twin pipes (part 1 and 2)
- EN13941 – Design and installation
- EN14419 – Surveillance system
- EN15632 – Flexible systems
  - Part 1 – general and test methods
  - Part 2 – Bonded plastic service pipes
  - Part 3 – non bonded system with plastic service pipes
  - Part 4 – Bonded system with metal media pipes

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COOL DH
COOL DISTRICT HEATING

“Bubbles/new ideas” that is being evaluated and proven/tested by field test

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New service pipe material on flexible pipes- PE-RT

Better insulation properties

Collect and reuse heat loss from straight pipes – multi pipe system

New connection methods on flexible pipes– welding

Alarm wires for leak detection together with plastic service pipes

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COOL DH
COOL DISTRICT HEATING

“Bubbles/new ideas” that is being evaluated and proven/tested by field test under the COOL DH umbrella

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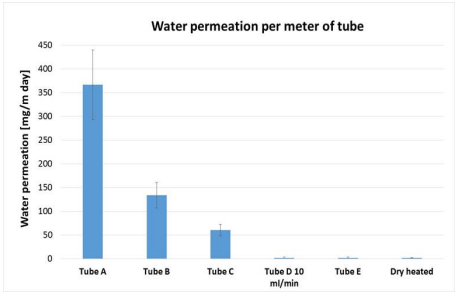
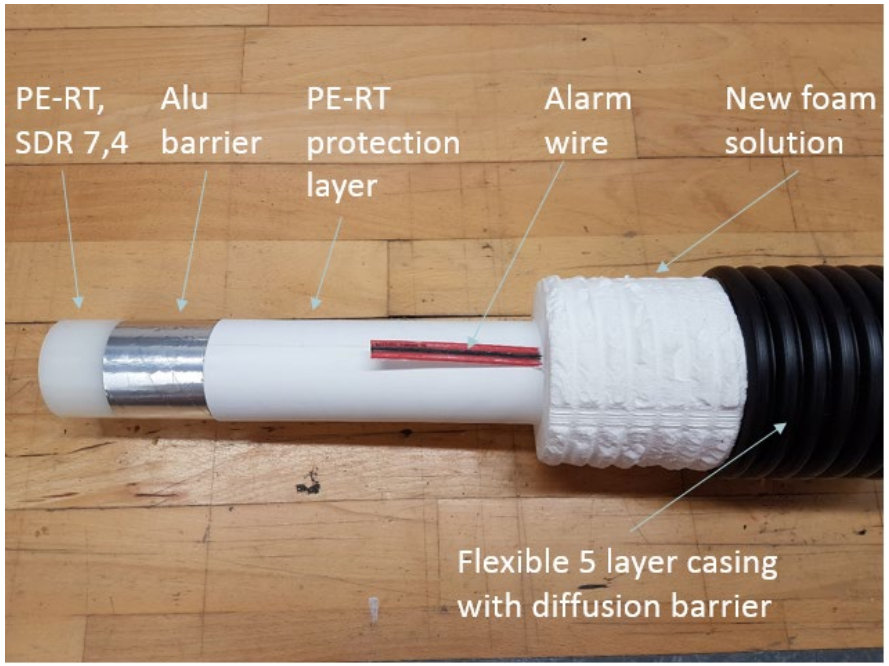
New service pipe material on flexible pipes- PE-RT



Aim:

- Flexible pipes that can be **welded together** in 100 m length as well in 12 m length.
- With oxygen and water **vapour barrier**.
- Can be in **different pressure classes** – here 10 bar, max. 65 ^{0}C
- Service pipe dimensions **up to D110 mm**.
- Improved lambda – average around **0,0020 W/mK**
- D32 mm and below: **a multilayer AluPERT pipe – within the flexible standard EN15632**
- Above D32 mm: **a mono layer AluPERT pipe. Fully tested according to the flexible standard – but outside anyway**



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“Bubbles/new ideas” that is being evaluated and proven/tested by field test under the COOL DH umbrella

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New connection methods on flexible pipes– welding

Aim:

- Usage of existing press and compression couplings available on marked today
- Pipes that can be welded together
  - Butt/mirror welding – single pipes
  - Electrofusion welding. Still in progress as no supplier today offer this in the right material!

Still under development:

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“Bubbles/new ideas” that is being evaluated and proven/tested by field test under the COOL DH umbrella

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Aim:

- Improve the heat loss by new insulation properties with **lambda reduction of 0,001 - 0.002 W/mK**
  - **We have reached this – equal to an average heat loss reduction on up to 8-10 % compared to today**

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“Bubbles/new ideas” that is being evaluated and proven/tested by field test under the COOL DH umbrella

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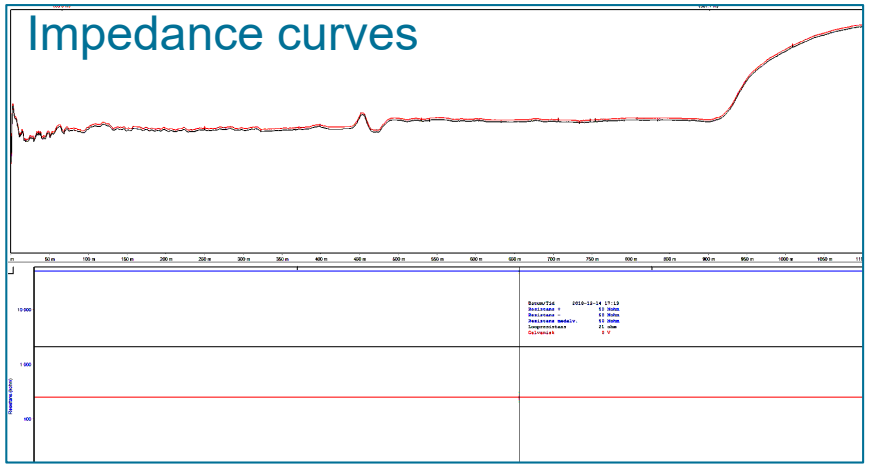
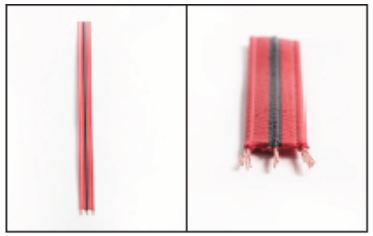
Alarm wires for leak detection together with plastic service pipes

Aim:

- Offer leakage **alarm system** for pipes with composite service pipes
- Ensure performance and **minimum heat loss** for the full lifetime





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“Bubbles/new ideas” that is being evaluated and proven/tested by field test under the COOL DH umbrella

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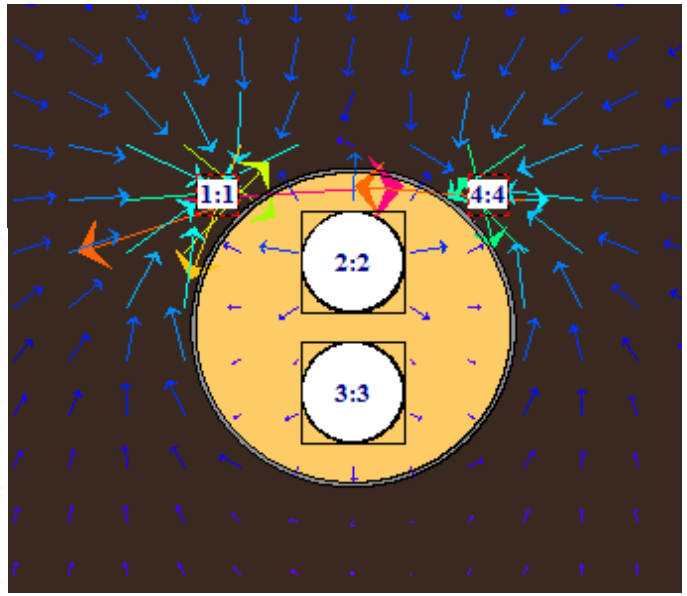
Collect and reuse heat loss from straight pipes – multi pipe system

Aim:

- New pipe system using adding heat recovery pipes connected to a heat pump to regain heat-loss from the District Heating pipes
- Different alternatives and positions have been simulated together with COWI
- In final design the simulation show **a positive energy recovery balance** together with ground heat from surrounding soil



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COOL DISTRICT HEATING

Low temperature District Heating

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How far are we to a real alternative to preinsulated steel pipes?

Main challenge here is the existing EN Standards!

European standards for preinsulated pipe systems

LOGSTOR

- EN253 – pipes
- EN448 – Fittings
- EN488 – Steel valves
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- EN15698 – Twin pipes (part 1 and 2)
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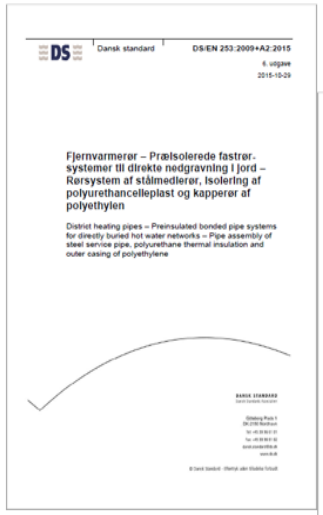

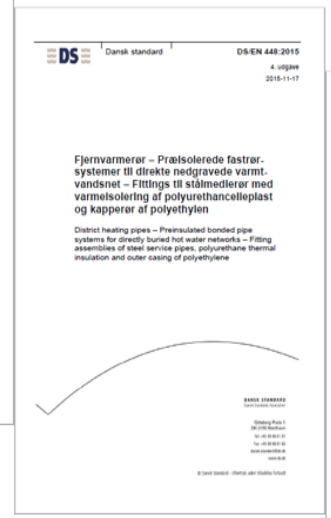

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Session 11:

How to convince the locals to change to Low Temperature District Heating, Østerby example

Steen Gravenslund Olesen

COWI Denmark

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What is COOL DH about?

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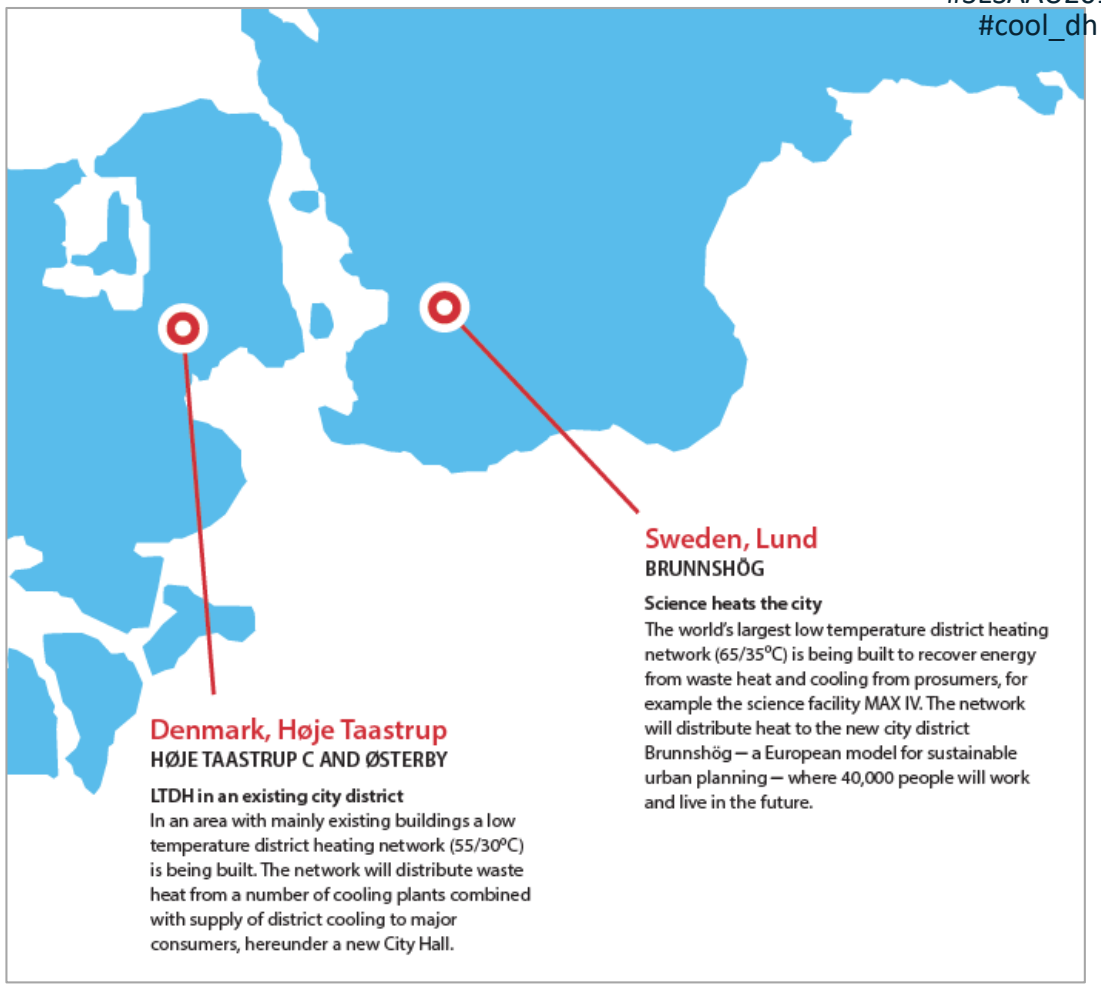
Innovative project to utilize low grade heat sources, introduce RES and optimize low temperature DH solutions and implementation in two **demo sites**

Høje-Taastrup - Østerby (Denmark)

- ***Existing area*** composed by renovated buildings
- New LTDH network (55/30°C) with new PE-RT pipes
- LTDH supplied by City2 shopping center's cooling system

Lund - Brunnshög (Sweden)

- ***New district*** under development
- New LTDH network (65/35°C) with new PE-RT pipes
- Surplus heat from research facilities (Max IV/ESS)



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Høje-Taastrup municipality

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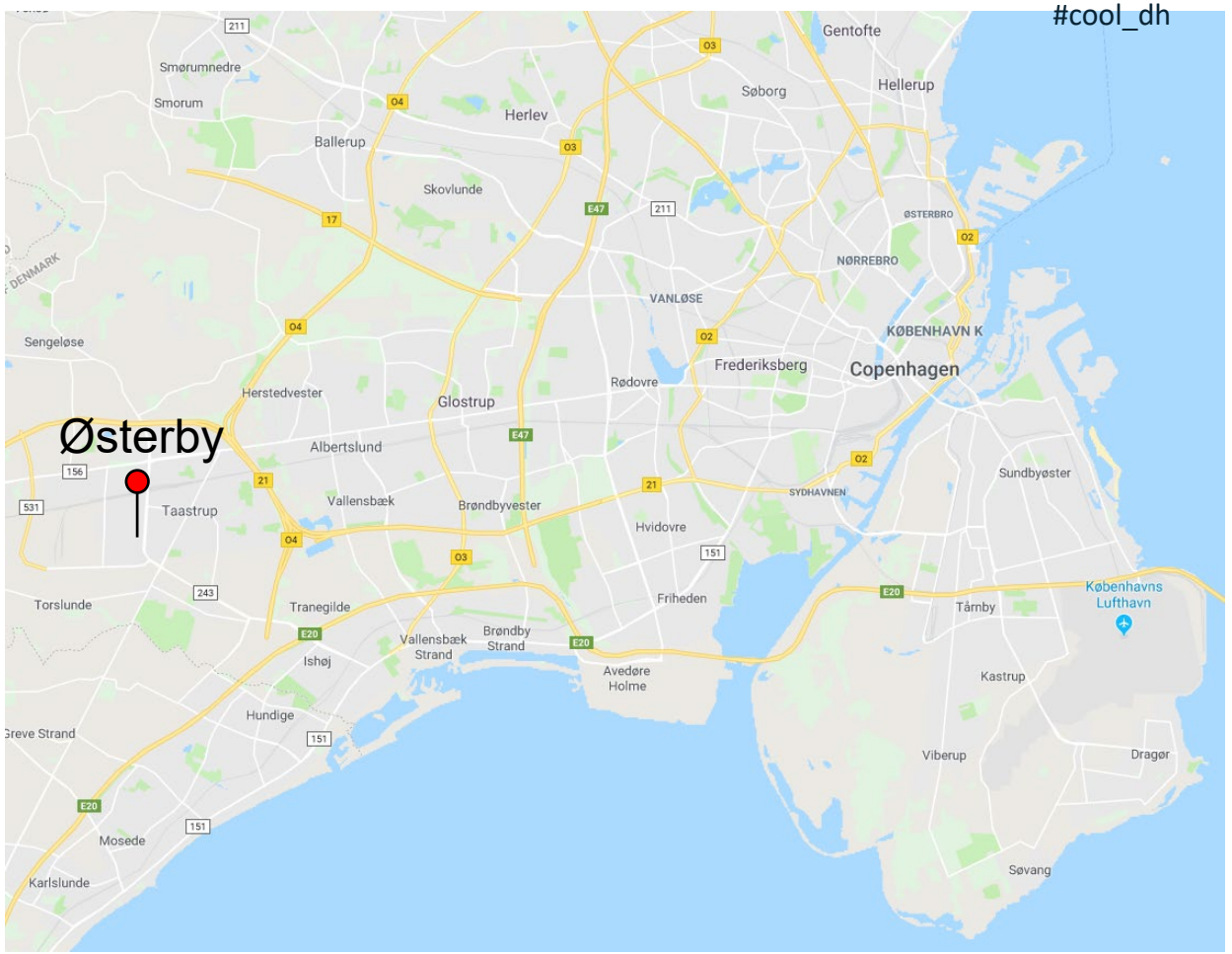
Municipality with 50.000 people about 20 km west from Copenhagen

- Requirements by the Danish Society for Nature and Conservation: minimum 3% reduction of CO_2 emissions per year on a continuous basis
- Høje-Taastrup achieved more than **25% reduction** in CO_2 emissions since 2015
- Interest in COOL DH project



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Østerby District – Today COOL DH

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Approx. 36.000 m^2 building stock from the 80'ties

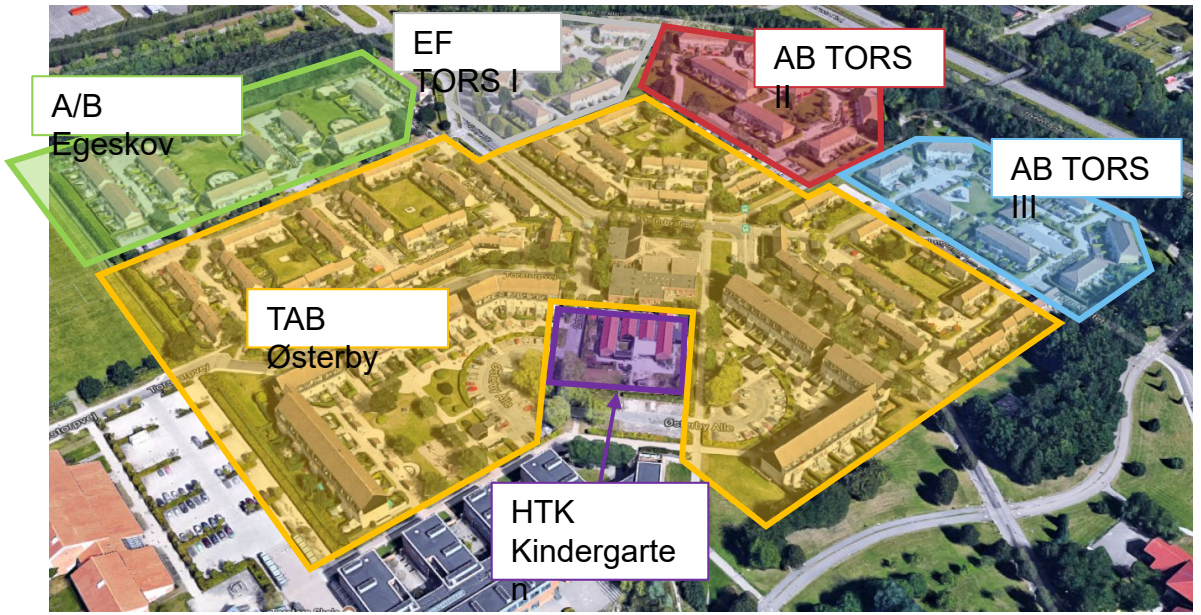
- 158 terraced houses
- A public kindergarten
- Social housing company

District heating network

- **+35 years old**
- **One main heat exchanger**

Organization (6 groups)

- Kindergarten
- Social housing
- 4 housing associations



COOL DH
COOL DISTRICT HEATING

Østerby District – Today COOL DH

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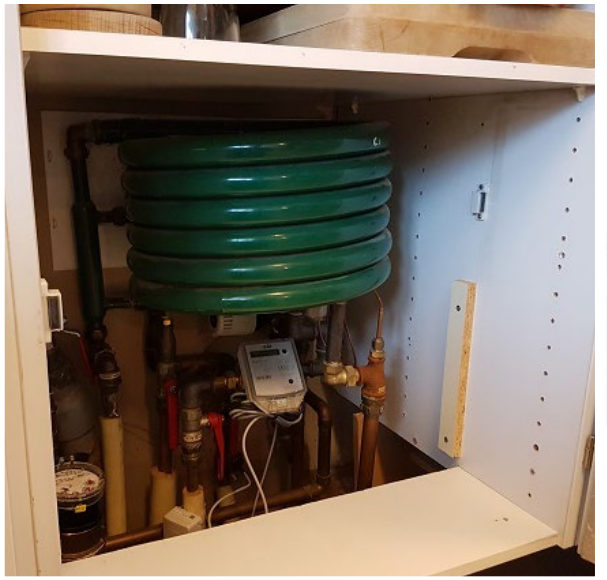
Heating association **(DK: Varmelaug)**

- Responsible towards the utility company
- Maintenance of heating station
- DH supply to the **6 groups of costumers**
- Billing for the groups' consumption

Costumers (6 groups)

- Different organizations (4 ownership models)
- Pay for the supply and the internal heat losses
- Different installations in each group
- Different ways to measure consumption and pay the bills
- Different savings for renovation



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How to convince the locals to change to LTDH?

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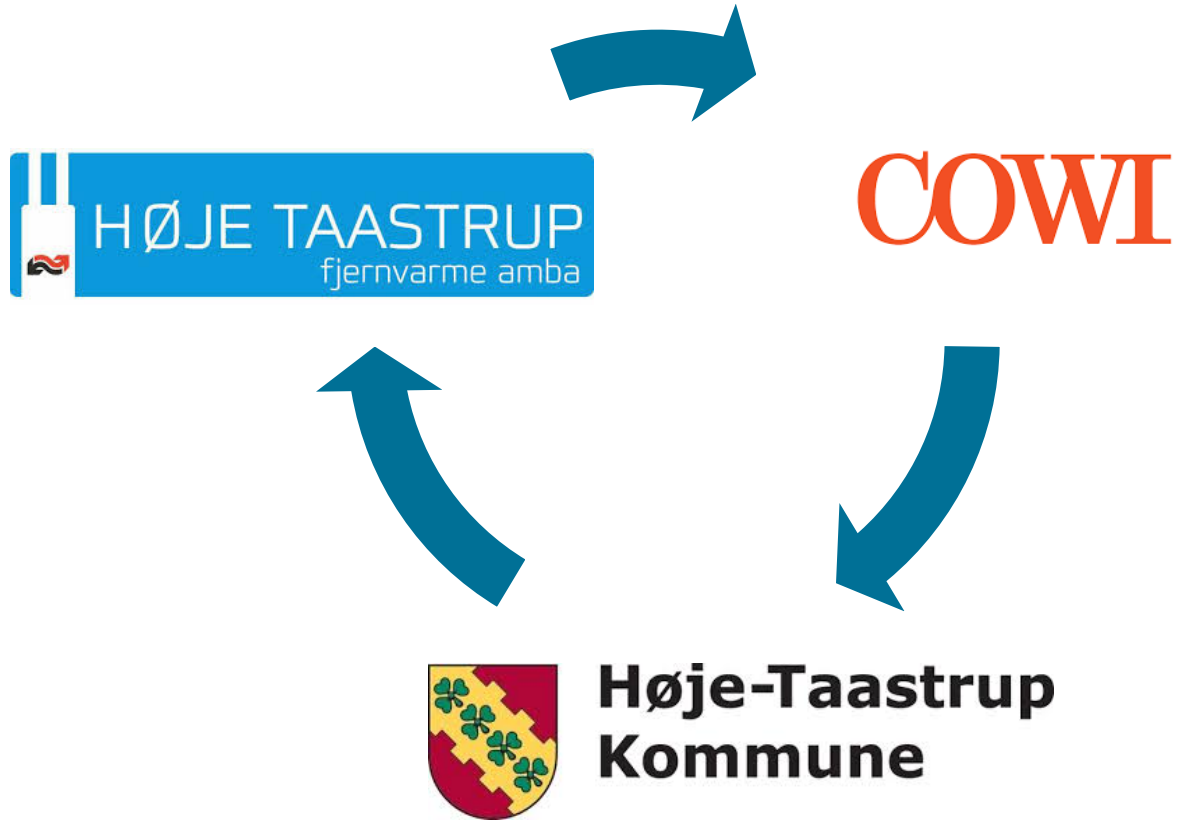
House tenants barely know what keep they warm in winter and how they get hot water!

- Necessary to make a **detailed action plan** to answer the question

Collaboration between:

- Høje Taastrup Fjernvarme (DH company)
- Høje-Taastrup Municipality
- COWI A/S



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COOL DH
COOL DISTRICT HEATING

Focus on your stakeholders different decision triggers

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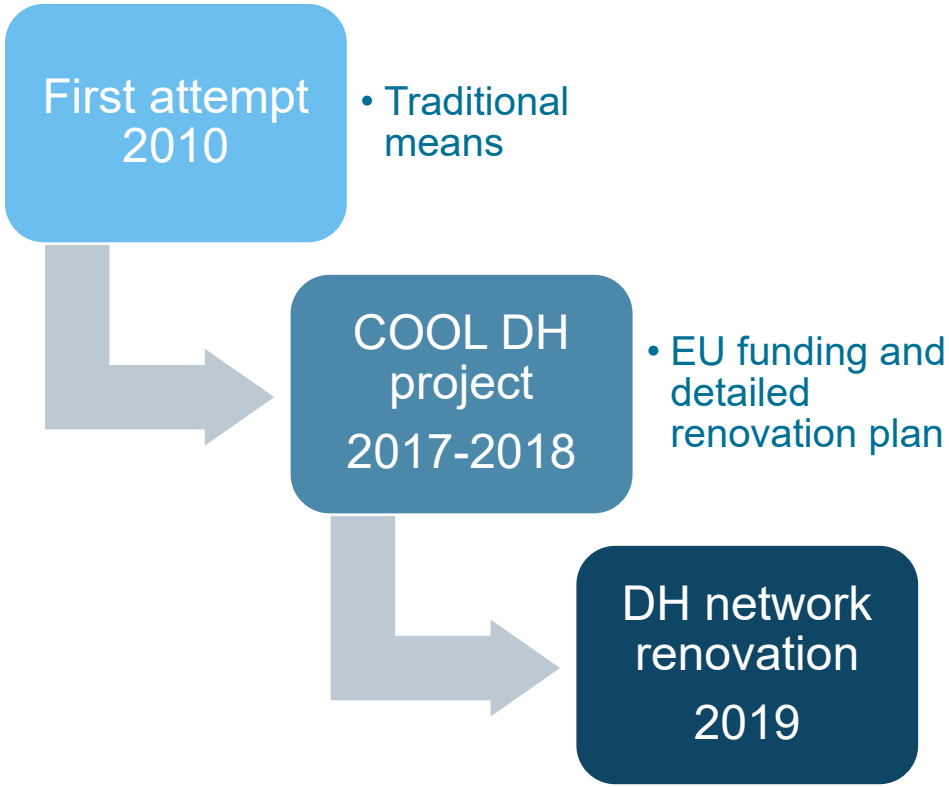
First attempt in 2010 by the utility company with **traditional means**

- Renovate the existing/old DH network to a traditional DH network
- Did not work since the DH association did not accept –focus on technical feasibility and a standard offer with no further explanation.

Second phase: EU support with COOL DH project

- After the **presentation and decision process** the tenants accepted the innovative solutions from COOL DH project in 2018
- **Focus on decision triggers combined with economic and technical feasibility studies**
- **Detailed calculation** of **micro and macro economy** and numerous **meetings** with all stakeholders.



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COOL DH
COOL DISTRICT HEATING

Process - Roadmap

2017

November

December

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Step 0

Meetings with the local heating association “Varmelaug”

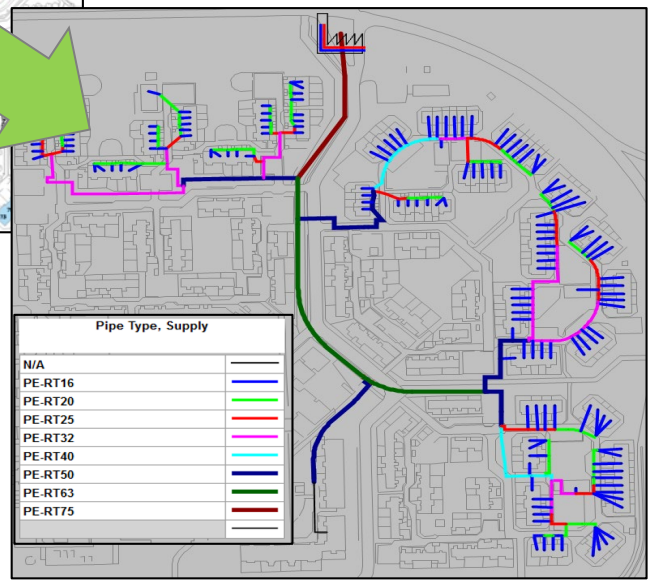
- Project introduction
- Macro and micro economy calculations for the heating association, housing associations and final users (with different pay schemes e.g.: subscription, upfront payment)
- Detailed total economic calculations for every sub area in Østerby with different ownership and regulatory framework

OUTPUT:

- The heating association was interested and approved the plan. External funding from EU improved the interest.
- First Q&A sessions with board

Existing DH network

New LTDH network



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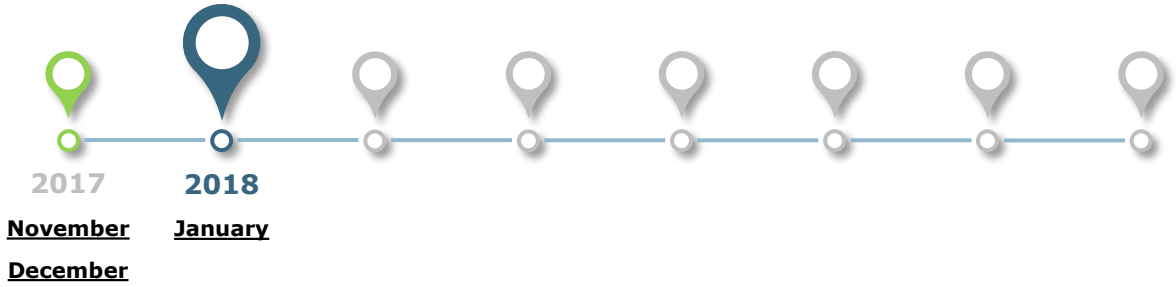
Process - Roadmap



4DH

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Step 1

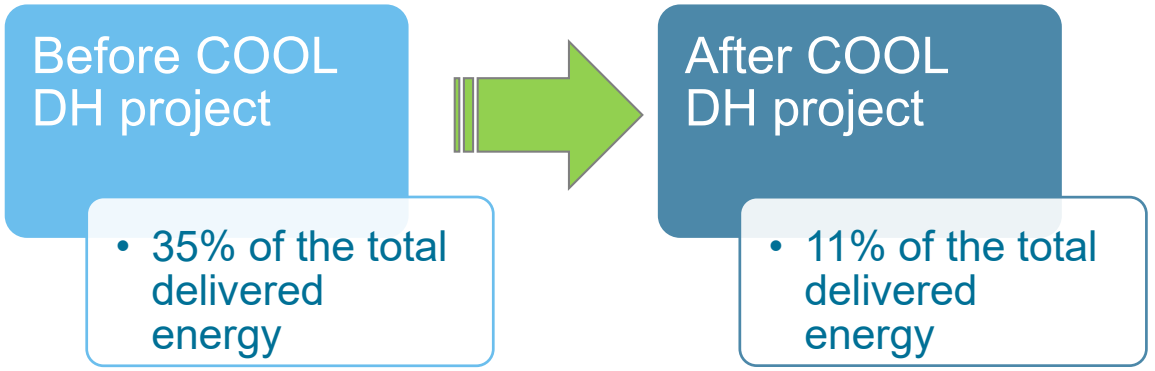
Tenants information meetings

- Explanation and presentations of the project with special focus on the economy and detailed Q&A session

OUTPUT:

- First contact with the responsible from the different associations (groups) - Stakeholders analysis
- First acceptance from the tenants. The system is old and requires a deep renovation
- **Initially, economy and environment were equally relevant for the tenants – closer to the decision they again fully focused on private investment.**

Heat losses in the DH network



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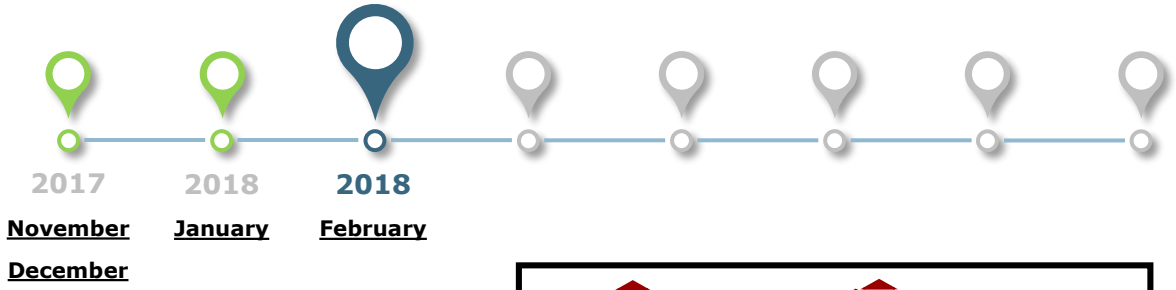
COOL DH
COOL DISTRICT HEATING

Process - Roadmap



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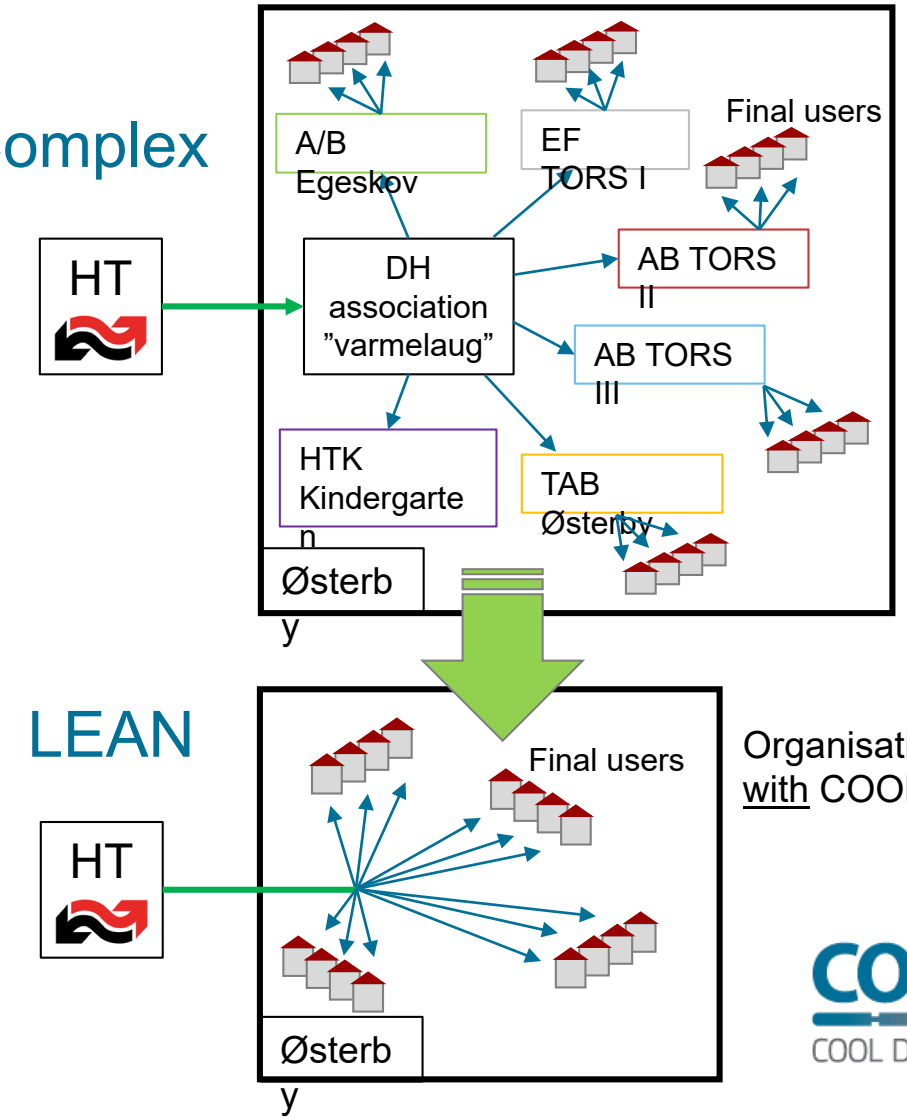
Step 2

Principle decision meeting for “yes” to COOL DH

- Final discussion about the detailed total economic calculations for every sub area and individual tenants in Østerby with different ownership and regulatory framework

OUTPUT:

- Acceptance from all the parts (board), anyway
- Dependent by the ”yes” from the tenants/association users.
- Planning of next level decision triggers



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COOL DH
COOL DISTRICT HEATING

Process - Roadmap

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Step 3

Tenants information meetings/board meetings in Østerby association and sub-associations of tenants

- 2 meetings with each housing association (2x4)

OUTPUT:

- Discussion and presentation (Q&A) about the installation process and practical procedures for the renovation.
- Necessary to be precise, to make the tenants comfortable and confident with the coming decision and support the coming individual consumers in their decision.

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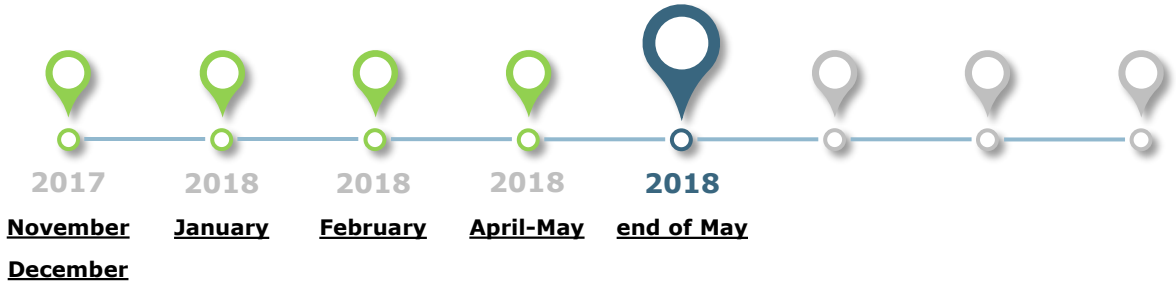
COOL DISTRICT HEATING

Process - Roadmap



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Step 4

"Varmelaug" meeting

- Decision of closing the local heating supply association after LTDH supply is completed

OUTPUT:

- Presentation of the next phase, and
- Planning of **test installation** as well as the contracts for each tenant/user.

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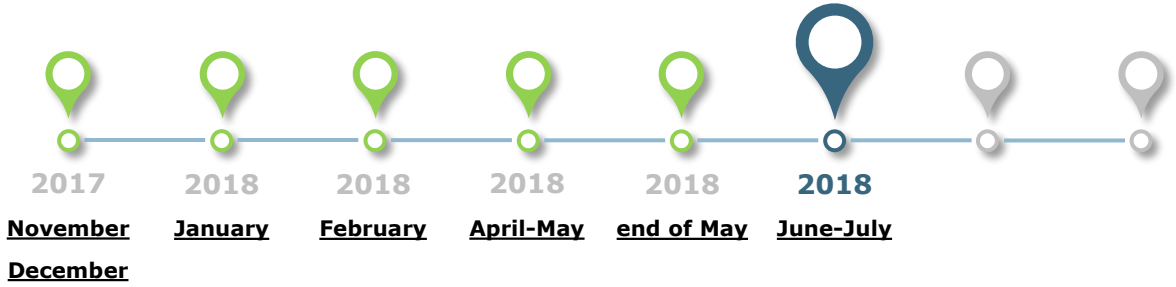
Process - Roadmap



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Step 5

Preparation and signature of contracts from the coming 159 new users/houses.

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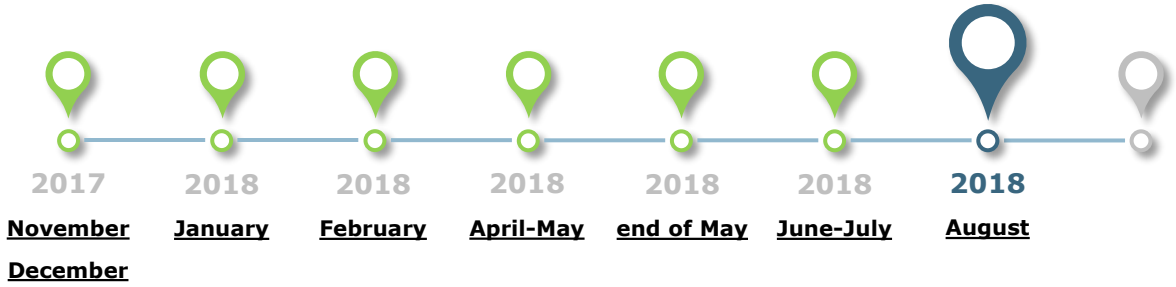
COOL DH
COOL DISTRICT HEATING

Process - Roadmap



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Step 6

Planning meeting with board members (from housing association)

- Internal meetings were held as well for coordination and planning of the strategy

OUTPUT:

- Presentation of the final plan for the installation/renovation phase

Suggestion: Important to keep all the parts updated on the process as well as the interest on the that (plan/arrange meetings and show the results)

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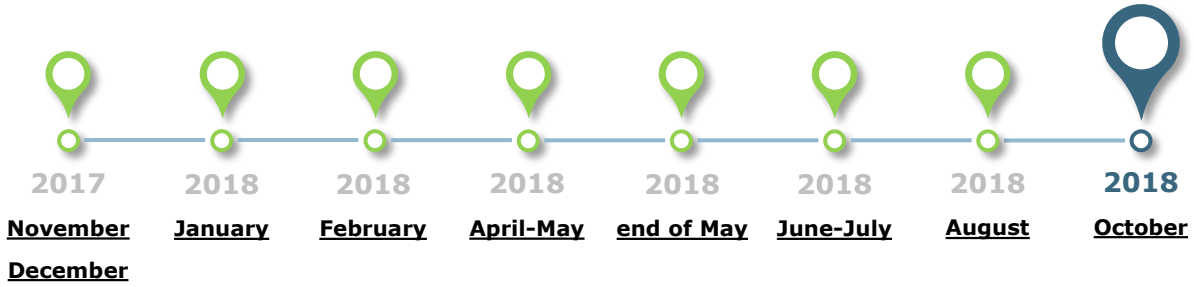
Process - Roadmap



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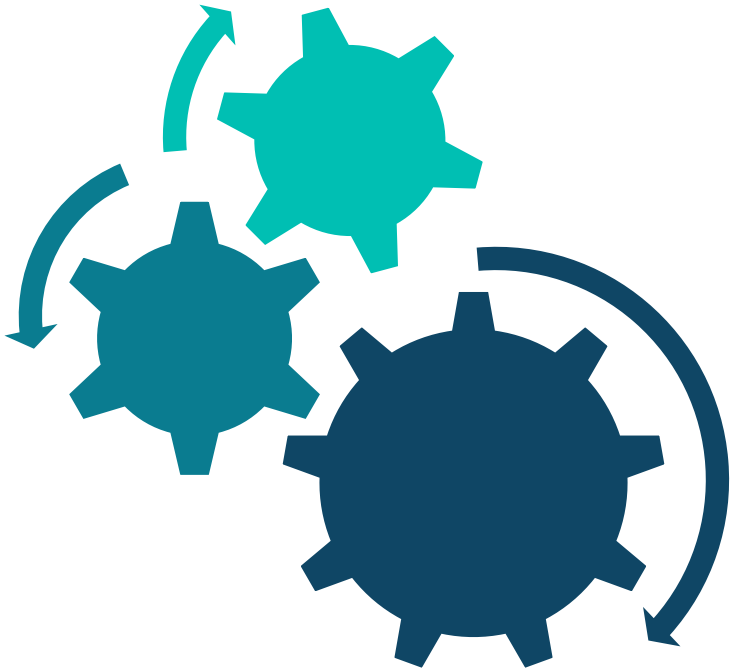
Step 7

Høje Taastrup Fjernvarme established test dwellings and held follow-up meetings to show detailed plans of piping trace and location of the heat exchangers

- 4 series of meetings



OUTPUT:

- The installation procedure/plan is ready and the renovation can start!
- The detailed installation process was presented to the users.

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COOL DH
COOL DISTRICT HEATING

How to convince the locals to change to LTDH?

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In short, key is to

- Carefully prepare a **stakeholder analysis, identify potential risks** and **design attractive decision triggers** targeted the different stakeholders
- ***Know your numbers* – be prepared to give immediate to your stakeholders**
- Prepare a **detailed plan** for the **dialogue** with board members and tenants
- **Spend enough time** with the tenants to inform them thoroughly. Especially when the margin is limited

NB: Environmental awareness and sustainability count for long in the decision process but not in the final decision stage.

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Session 11:

How to convince the locals to change to Low Temperature District Heating, Østerby example

Steen Gravenslund Olesen

COWI Denmark

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Østerby District – COOL DH

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COOL DH project innovates all the parts of the DH network

- Supply side
- Distribution side
- Demand side

The existing network will be replaced and converted to a LTDH network

- LTDH supplied by City2 shopping center's cooling system
- Introduction of new PE-RT pipes
- The network designed is optimized
- The system will be **converted from collective installation to individual installations**
- Introduction of DH units at the consumers

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Østerby – Demo site objectives

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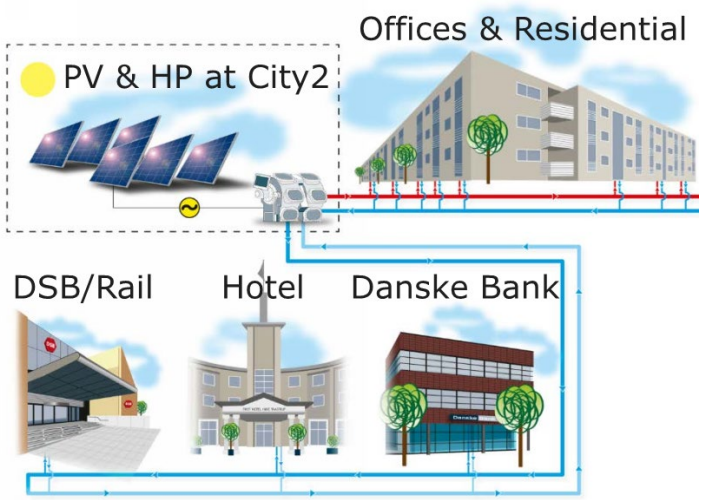
Create a sustainable town development in Høje-Taastrup with low energy/emission buildings at a reasonable cost

- Create a remarkable Danish showcase
- Demonstrate innovative solutions for LTDH
- Use renewable energy & ICT-based control systems
- Hands-on experience → seeing is believing
- Verify the economics



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Østerby – Demo site

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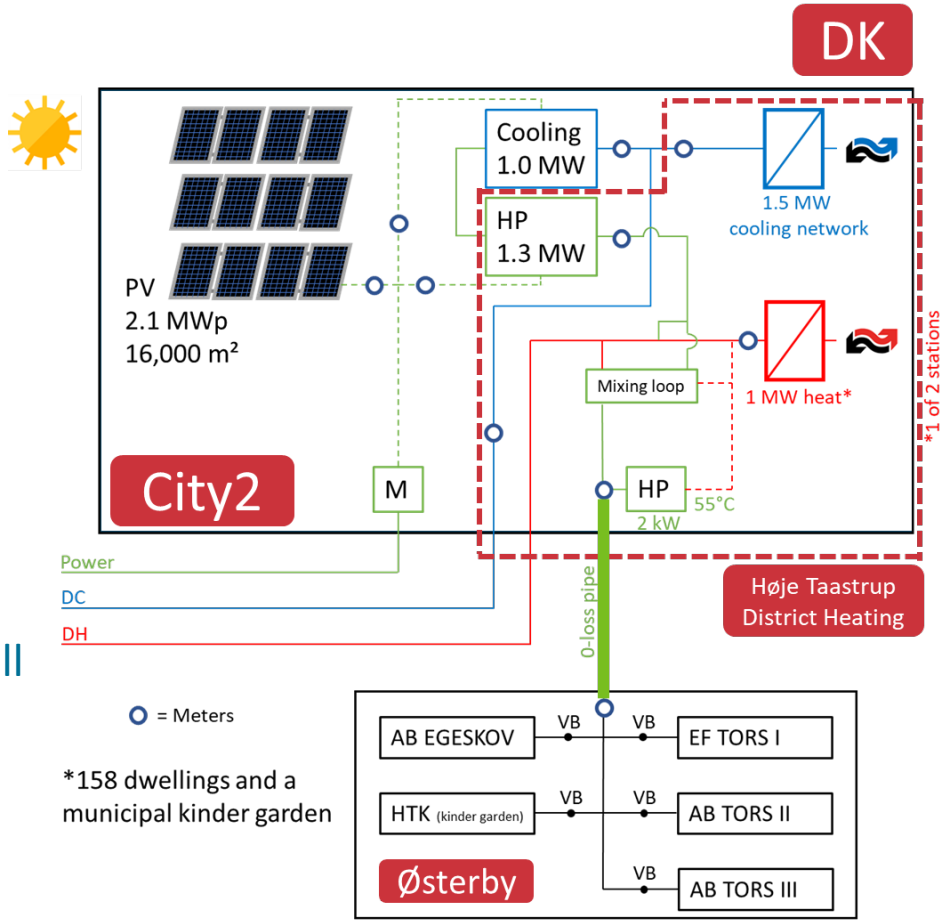
Høje-Taastrup Municipality aims for CO_2 reduction

Renovation of existing buildings led to (relatively) high heat losses from the old (30 years) DH network

- DH network renovation and conversion to LTDH
- Integration of RES and low-temperature heat source
- The shopping Mall City2's cooling system will provides LTDH using a heat pump
- The coming heat pump will be supplied from the shopping Mall City2's 2.1 MWp PV system
- It is planned to supply Østerby witha **zero-loss heat pipe**



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LTDH Connected Appliances

Written by: Sara Kralmark, Kraftringen

Presented by: Klara Ottosson, Kraftringen

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Disposition

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- Heat driven appliances – background
- System solutions
- Potential electricity savings
- Experience from pilot tests
- Alternatives – hot water connected appliances

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Heat driven Appliances

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- Developed in research projects in 2004-2014
- Asko Appliances Ltd – the company behind the development
- Were never commercialized and there are no plans to resume the production
- Required at least 55 °C and max 80 °C heating water circuit

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System solutions

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- Separate circuit
  - Originates from main substation.
  - High installation cost.
  - Not suitable in low energy buildings.
- Secondary heating system – Västeråsmodellen
  - Secondary distribution line between main substation and household.
  - Requires substation in each household.

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Results from lab tests

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*Assuming an annual number of 280 process cycles ** Assuming an annual number of 220 process cycles *** Assuming an annual number of 160 process cycles

48 %
(0.48 kWh/cycle)

74 %
(0.43 kWh/cycle)

65 %
(2.27 kWh/cycle)

Asko HWC appliance	Average electric energy usage per cycle (kWh)	Avergare electric energy usage per cycle at 55 ˚C heating water (kWh)	Average reduction of electric energy usage per cycle at 55 ˚C heating water (kWh) (%)	Annual average reduction of electric energy usage (kWh) at 55 ˚C heating water
HWC dishwasher	1	0.52	0.48 (48 %)	134.4*
HWC washing machine	0.72	0.28	0.43 (74 %)	95.6**
HWC tumble dryer	3.51	1.24	2.27 (65 %)	363.8***
SUM:	*5.23*	*2.04*	*3.18*	***593.8***

Total: 594 kWh/year

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Experiences from tests - Västerås

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- Nearly 200 households with heat driven appliances.
- Dishwashers and washing machines are working great!
- Heat driven appliances have been requested by new customers.

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Appliances with alternative tap water connections

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Dishwashers connected to hot water

- Requires a machine design with heat resistant hoses.
- Manufacturers: Asko, Miele, Bosch.
- Electricity savings of around **35 %** (0.3 kWh/cycle).

Washing machines connected to hot *and* cold water

- Requires a machine design with heat resistant hoses and two water connections.
- Only available as *professional* machines.
- Manufacturers: Asko, Miele, Podab.
- Electricity savings of **60-87 %** (0.6-1.3 kWh/cycle)

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Conclusions

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- **Heatdriven appliances** would have been suitable at Brunnshög but not in Høje-Taastrup / Østerby.
- Regular **dishwashers** can be connected to hot tap water instead of cold tap water. Possible electricity substitution: Around 35 %.
- Some **professional washing machines** have two possible water intakes. Possible electricity substitution: 60-87 %.
  - No temperature requirements!

Households

Shared laundry rooms

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Thank You!

Tack!

Tak!

Merci!

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