



## COOL DH

Cool ways of using low grade Heat Sources from Cooling and Surplus Heat for heating of Energy Efficient Buildings with new Low Temperature District Heating Solutions

Final Publishable Summary Report

Reporting Period: From Oct. 2017 to Sept. 2022  
Project start date: 1. October 2017 Duration: 60 months  
Deliverable: D7.6

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Revision Version 1.3 (Febr. 2023)

Project co-funded by the European Commission within the Seventh Framework Programme		
Dissemination level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 76779

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COWI PROJECT NO.	DOCUMENT NO.
A104538	D7.6

VERSION	DATE OF ISSUE	DESCRIPTION	PREPARED	CHECKED	APPROVED
1.2	30.11.2022	Report	Reto Michael	Anette Suhr,	Reto Michael
1.3	Rev. Febr. 2023		Hummelshøj COWI	Martin Gierow, Ali Moallemi, Markus Paulsson	Hummelshøj COWI





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## List of Abbreviation

ATES	Aquifer Thermal Energy Storage
CITY2	A large shopping mall in Høje Taastrup
CHP	Combined Heat and Power
COP	Coefficient of Performance
DC	District Cooling
DCW	Domestic Cold Water
DH	District Heating
DHC	District Heating and Cooling
DHW	Domestic Hot Water
ESS	European Spallation Source research facility
HIU	Heat Interface Units
HP	Heat Pump
ICT	Information & Communication Technology
i-GRID	Intelligent grid (a Grundfos shunt solution)
KPI	Key Performance Indicator
LTDH	Low Temperature District heating
MAX IV	A synchrotron particle accelerator
PE-RT	Polyethylene Raised Temperature
PEX	Polyethylene X-bound
PV	Photo-Voltaic
RES	Renewable Energy Sources
TRF	Total Replicability Factor
TRL	Technology Readiness Level
TERMIS	A hydraulic and thermal network simulation tool
U-LTDH	Ultra-Low Temperature District heating
WTE	Waste to Energy
Xplorion	A low energy multifamily test building





# 1 Executive summary

## 1.1 Project objectives

COOL DH is an abbreviation of Cool ways of using low grade Heat Sources from Cooling and Surplus Heat for heating of Energy Efficient Buildings with new Low Temperature District Heating (LTDH) Solutions. The COOL DH project innovates, demonstrates, evaluates, and disseminates technological solutions needed to exploit and utilise sources of very low-grade surplus heat for heating of energy efficient buildings via Low Temperature District Heating.

The objective of COOL DH action is to support cities in their endeavour to plan and deploy new, efficient district heating and cooling (DHC) systems, and extend and refurbish existing ones to higher standards.

COOL DH includes several full-scale demonstrations in the City of Lund (Sweden) and the Municipality of Høje Taastrup (Denmark). The consortium consists of the utilities and municipalities of the two demonstration cities as well as leading District Heating energy specialists, consultants, and industrial manufactures.

## 1.2 Main results

The COOL DH project started in October 2017 and ended in September 2022.

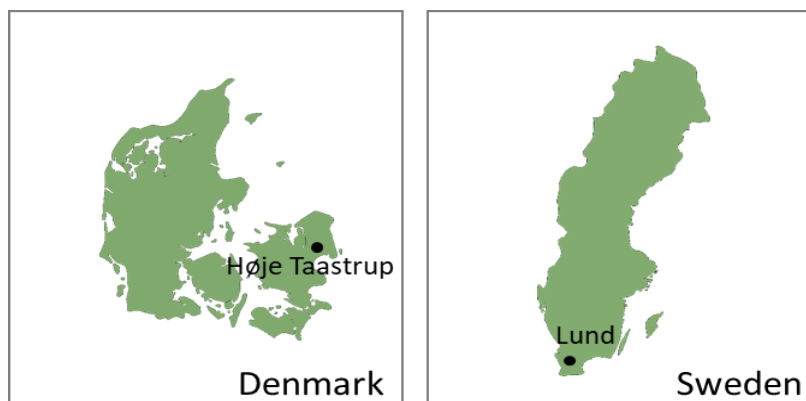
The project is an innovation action that has developed new methods, tools, and components to be used in deployment of low temperature district heating schemes. Several of the developed solutions have been demonstrated in full-scale, monitored and evaluated. Amongst these the following are the most important:



- > Utilisation of 5.8 MW renewable surplus heat from cooling of the MAX IV synchrotron particle accelerator to supply low temperature district heating in a new 225 hectares town district called Brunnshög in Lund – when fully developed it will serve up to 40.000 employees & citizens.
- > Combined production of PV supported cooling and heating 1.34 MW<sub>heat</sub> at a shopping mall, as well as at a data centre with 1.92 MW<sub>heat</sub> as prosumers using new business models.
- > Conversion of Østerby district in Høje Taastrup, with 159 consumers organised in 4 housing associations with different rulesets. The conversion is from old traditional district heating to LTDH reducing the heat loss from above 35% to about 16% in existing non-dense settlements with-out improvement of the building envelope.
- > The project developed new PE-RT plastic multi-layer prefab pipes for LTDH offering new characteristics in the following fields:
  - > use of PE-RT plastic material instead of PEX and steel, both single pipes and twin
  - > improved insulation material
  - > integrated oxygen and vapour barrier
  - > weldable coupling methods
  - > leak detection system
  - > higher flexibility for single pipes in rolls
  - > larger dimension than normal PEX
  - > raised pressure rating 13 bar(o)

The system was tested in labs and demonstrated with several kilometres of pipe installed in both in Denmark and Sweden. The development also included participation in the standardisation processes.

- > Development of a solution to recover heat loss from district heating pipes back into the system by use of collector pipes and a small, dedicated heat pump.
- > Demonstration of new passive house solutions in a low energy housing block in Lund called Xplorion with new solutions such as central booster heat pump, 3-pipe system with micro heat exchangers in the flats, improved user interface and controls etc.
- > Evaluation of methods to avoid legionella in DHW systems in relation to use of LTDH.
- > Massive dissemination activities a.o. leading to the award of The Global District Energy Climate Award in the category "New Scheme".



*Figure 1. COOL DH demonstration sites are located in the cities of Høje Taastrup and Lund in close distance west and east of Copenhagen on each side of Øresund sound.*

Høje-Taastrup Municipality has about 53,000 inhabitants and is in the Greater Copenhagen area about 20 km west of the centre of Copenhagen.

Lund Municipality is located about 15 km from Malmö in the southern part of Sweden in the region Scania (Region Skåne), and has about 128,000 inhabitants and Lund is a fast-growing university city with more than 95,000 inhabitants.

For years, Lund in Sweden and Høje Taastrup in Denmark have been frontrunners that have very ambitious climate and smart-city policies and corresponding plans for development of smart sustainable districts with LTDH and a high share of RES.

Both cities have Sustainable Energy Action Plans / Strategic Climate Action Plans and are committed to the Covenant of Mayors and/or Compact of Mayors aiming at being CO<sub>2</sub> neutral Communities.



## 2 Project details

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## 2.2 Project participants

*Table 1. List of project participants.*

No.	Participant organisation name	Country	Short name
1	COWI A/S	DK	COWI-DK
2	Kraftingen Energi AB	SE	UTIL-SE
3	Høje-Taastrup Kommune	DK	MUN-DK
4	City of Lund	SE	MUN-SE
5	Lund University	SE	UNI-SE
6	Euroheat & Power	BE	EHP-BE
7	Logstor A/S now Logstor holding Aps / Kingspan	DK	IND-DK
8	Høje Taastrup Fjernvarme Amba	DK	UTIL-DK
9	COWI AB	SE	COWI-SE
10	Alfa Laval AB	SE	IND-SE
11	Lunds Kommuns Fastighets AB	SE	HOUSE-SE
12	Cetetherm AB	SE	IND2-SE

## 2.3 Project website

During the COOL DH project, a dedicated website has been created to keep track of the process and share the activities done during the project and disseminate the results.

Website: [www.cooldh.eu](http://www.cooldh.eu)

The COOL DH website offers insights into project news, demonstrations sites (in Denmark and Sweden), detailed project description, innovations, partners, and contacts. A calendar with information on previous events during the project, including the EU conference in May 2022, can be found on the website. Finally, the website offers deliverables and results, and hyperlinks to related projects.

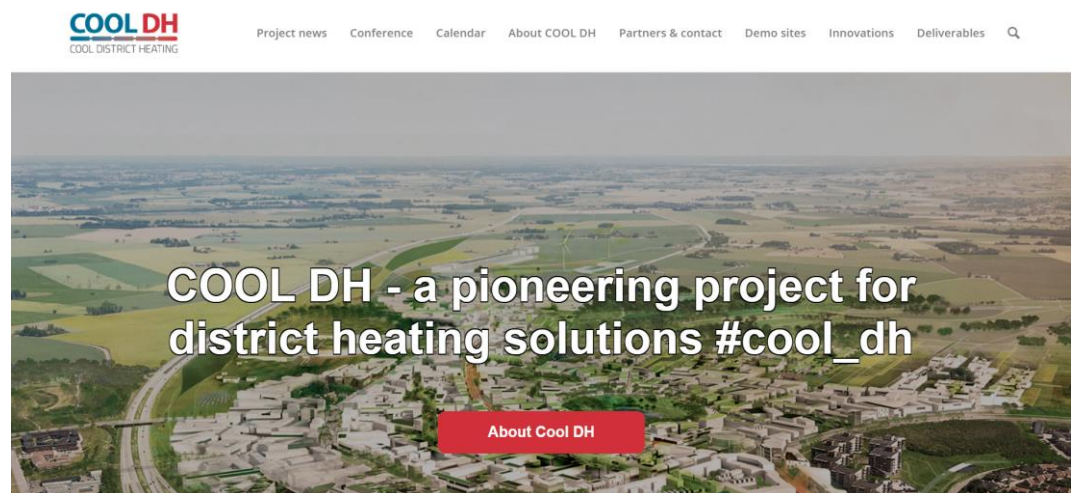


Figure 2. Screen shot of the COOL DH website.



## 3 Project content and objectives

### 3.1 General project objectives

The objective of COOL DH action is to support cities in their endeavour to plan and deploy new, efficiency district heating and cooling systems, and extend and refurbish existing ones to higher standards. Thus, it will be allowing greater uptake of renewables, recovering of excess heat or cold (heat sinks) while improving the overall efficiency of the systems.

In short, the COOL DH project:

- > Innovate, design, and build cooling and heat recovery process systems, enabling heat recovery to a LTDH (local low-temperature district heating) grid. The heat recovery systems are mainly driven by renewables.
- > Design and build low-temperature district heating grids with non-conventional pipe materials, testing new innovative pipe components introduced by COOL DH.
- > Innovate and design suitable innovative heating systems and controls inside buildings that combine LTDH with photovoltaic power produced on the buildings.
- > Develop viable business models and new pricing systems, which ensure a better (low) return temperature and provide the building companies with maximum flexibility regarding the choice of heating systems.
- > Demonstrate full systems with all needed components suitable even for ultra-low DH temperatures including investigation of systems for heating of DHW without risk of legionella.

## 4 Main science and technology results

### 4.1 Methodologies and approaches

The work method has been anchored in an incremental innovation process where the experienced key participants and invited experts from universities and industry have worked together in innovation workshops, first to collect common ground and later to define ways to improve system solutions that are collected as a catalogue of solutions, from which selected solutions have been demonstrated in full scale and evaluated.

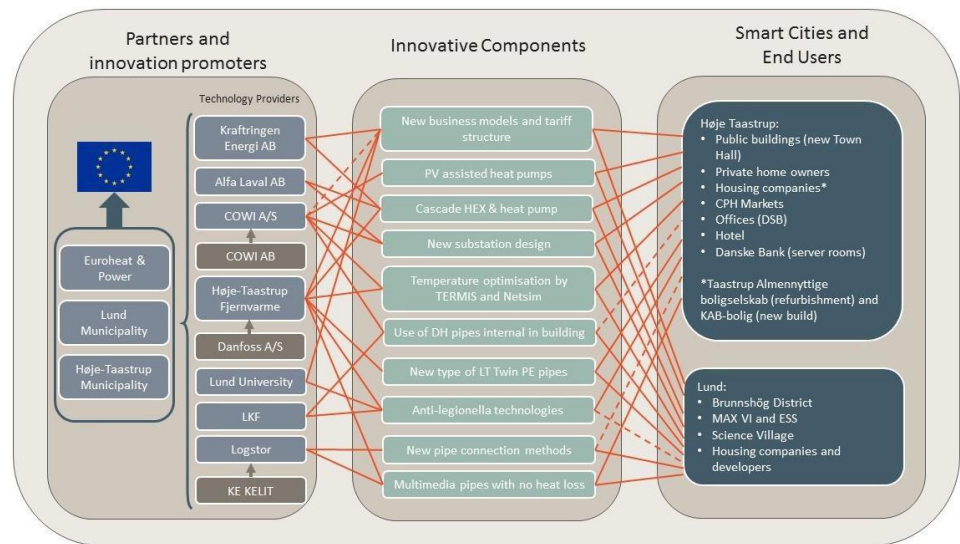


Figure 3. The project architecture, partners, components and end users.

The overall approach was to show the path for enhanced co-generation of cooling and heating and facilitate the utilisation of surplus heat and reduce use of primary energy even if generated by renewable energy sources. An example of such renewable energy is biomass that could be used for other purposes or at other locations to reduce carbon emissions.

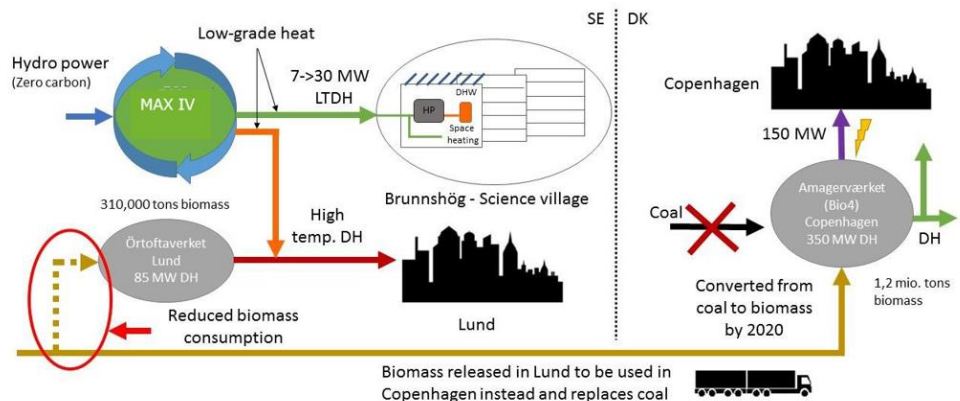


Figure 4. The conceptual approach.

## 4.2 Høje Taastrup, Denmark

### 4.2.1 Major achievements

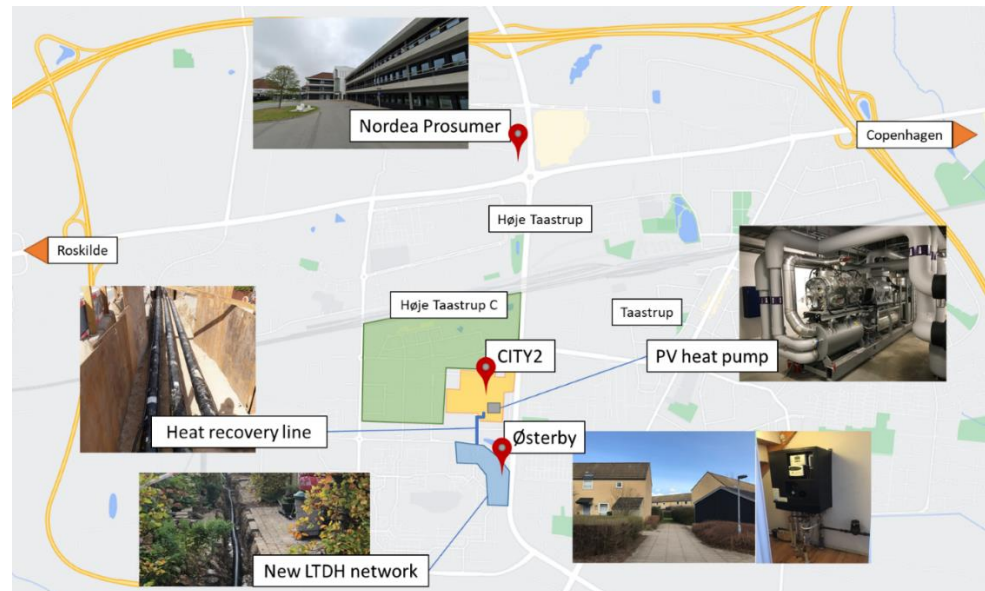


Figure 5. Overview of the demonstration sites in Høje Taastrup.

The design for Østerby demo-site in Høje Taastrup was prepared and a dialogue process with tenants and at the general assembly of the tenant's board decided to implement low-temperature district heating for most of the district and give up the traditional solution being used before. Data for the new pipe design was collected and submitted to the pipe manufacturer Logstor as design basis for the new pipe types. Construction work commenced in June 2019, including the production of the new PE-RT pipes from Logstor and was completed in spring 2020. The main transmission supply pipe has been equipped with heat recovery pipes to recovery the heat losses back to the system through a small heat pump.

The process on the supply side started by addressing the technical management of CITY2 shopping mall, as well as other potential consumers of district heating and district cooling. The installation was designed with a cascade heat pump coupled to the existing installation at CITY2 and tendered for delivery on site in November 2020. But due to delays in deliveries due to the Covid19 pandemic the completion of site work was continuing until 2021. The system co-produces cooling and heating for own use as well as to the DC and DH grids.

The prosumer connection was completed with a 1.8 MW heat pump (1.92 MW incl. pumps) and up to 1.5 MW cooling at a bank data centre. The total system was up running from early 2021.

During the project, the new Town Hall in Høje Taastrup was designed, tendered, and constructed. The project uses LTDH as well as District Cooling. The Town Hall is commissioned in end of 2022.

#### 4.2.2 KPI's on energy savings and CO<sub>2</sub> and cost for the Høje Taastrup sites

Table 2. KPI's for Høje Taastrup.

2021	HIU (159) substations In Østerby	Conversion to LTDH in Østerby 3119 m pipe	Heat loss recovery on DH twin pipe 350 m	Co-production at CITY2 1.34 MW <sub>heat</sub> & 0.99 MW <sub>cool</sub>	Prosumer installation at Bank 1.9 MW**	Total demo-case
Utilised low-grade heat (MWh/y)	*	*	*	(2,970)	7,971	10,941
Increased non-fossil supply (MWh/y)	*	*	(94)	(4,023)	11,162	15,279
Primary Energy savings (MWh/y)	*	*	(48)	(1,328)	3,057*1.2 = 3,668	5,044
CO <sub>2</sub> reduction (tonnes/y) ***	*	*	(1)	(157)	379*1.2 = 455	613
Simple pay-back period (years)	14	n.a.	8	(8-10)	(11-13)	~ 14
Investment excl. 25% VAT (€)	458,000	1,596,800	6,711	1,140,000	1,610,000	4,811,511

( ) Figures in brackets are estimated values

\* Included in co-production from CITY2. \*\* Multiplied by 1.2 to get figures for a normal full year.

\*\*\* Based on CO<sub>2</sub> eq emission factor of 42 kg/MWh for the district heating system in 2021

More KPI's are found in the monitoring report: D5.3 Monitoring report for Høje Taastrup incl. KPI's. The report is accessible at the COOL DH homepage.

## 4.3 Lund, Sweden

### 4.3.1 Major achievements



Figure 6. Overview from the demonstration site in Lund.

The LTDH project started with construction of the transmission lines together with the new tramway through the new upcoming city district called Brunnshög. The installation of the PE-RT plastic pipes from Logstor was commenced in fall of 2019. The system was connected to MAX IV to utilise surplus heat through heat pumps. In the beginning the energy is utilised at a temperature sufficient to deliver to the existing DH grid in Lund and via a shunt to Brunnshög at 65°C. When the demand is growing in Brunnshög to a level where all recovered surplus energy can be utilised, then the condenser temperature will be lowered on the heat pumps 65°C, which will increase the COP.

Several customers and plastic pipes have been added continuously to 2400 m, and about 200 individual end-user customers were connected by Sept. 2022. Customers will continue to connect while Brunnshög district grows, and the grid expands. The idea is to install all major pipes in the ground before buildings are constructed. That goes also for planting of trees, so the district is green when the houses are finished.

The building of the demonstration building Xplorion comprise a passive house with 54 flats and a cafe. The installation was in place in May/June 2020 according to plan. It includes a simulated low temperature DH connection combined with booster heat pump to raise the flow temperature inside the building and reduce the return temperature to the grid. Heat and cold domestic water are supplied through a 3-pipe system to HIU's with micro heat exchangers in each flat. This system and the choice of radiators has been topic for many discussions, and it has shown operational problems with difficulties to keep the booster heat pump in continuous operation as the return temperature was too

high. Additional analysis and tuning were performed in February 2022, including most flat heat exchangers, and the system has been in stable operation since then.

An improved interface with external access to substation data to improve operation has been developed by Cetetherm and installed at this location with good result. The system will be implemented as an add-on to their present products.

#### 4.3.2 KPI's on energy savings and CO<sub>2</sub> and cost for the Lund sites

Table 3. KPI's for Lund.

2021	Xplorion demo-house 54 flats, 4374 m <sup>2</sup>	LTDH system in Brunnshög area 2400m pipes	Heat loss recovery on DH twin pipe 100 m pipes	Surplus heat recovery at MAX IV 5.8 MW heat	Distributed local energy source - Hotel 0.5 MW heat	<b>Total demo case</b>
Utilised low-grade heat (MWh/y)	(163)	*	(11,7)	17,100	145	17,420
Increased non-fossil supply (MWh/y)	(187)	*	(17)	24,800	n.a.	25,004
Primary Energy savings (MWh/y)	(150)	*	(6)	6,300	n.a.	6,456
CO <sub>2</sub> reduction (tonnes/y)	(1)	*	(0,062)	-73**	n.a.	-72
Simple pay-back period (years)	35	n.a.	(13)	12	n.a.	~15
Investment excl. VAT (€)	547,170	€ 648,000 for 872m	11,700	5,310,000	n.a.	6,516,870

() Figures in brackets are estimated values in 2022

\* Included in co-production from MAX IV

\*\* It means that there is an increase in CO<sub>2</sub> production, if the electricity used is considered renewable then the CO<sub>2</sub> savings is 295 tons per year.

More KPI's are found in the monitoring report: D5.2 Monitoring report for Lund incl. KPI's. The report is accessible at the COOL DH homepage.



## 5 Project achievements related to state-of-the-art

### 5.1 Technologies developed

The project has achieved the following milestones:

- MS1 Solutions for low temperature district heating connected appliances,
- MS2 Solutions for avoiding legionella
- MS3 System solutions for multifamily houses
- MS4 Monitoring plan
- MS5 Results of workshops on demand and distribution side
- MS6 Prototype (of new pipes from Logstor)
- MS7 Business concept
- MS8 New PE-RT-pipes installed
- MS9 3-pipe solution for multi storey building
- MS10 First demonstration buildings in Lund connected to the LTDH system
- MS11 Final monitoring plan implemented
- MS12 PV powered heat pump complete
- MS13 Buildings in Østerby connected to new LTDH system
- MS14 Demonstration activities in Lund complete
- MS15 Demonstration activities in Høje Taastrup finalised
- MS16 Replication plans for LTDH in Greater Copenhagen
- MS17 Final Conference
- MS18 Monitoring Reports

#### **New PE-RT pipes**

The project developed new PE-RT plastic multi-layer pre-fab pipes for LTDH offering new characteristics in the following fields:

- › use of PE-RT plastic material instead of PEX and steel, both single pipes and twin
- › 10% improved insulation material
- › integrated oxygen and vapour barrier
- › weldable coupling methods possible
- › leak detection system integrated on demand (new for plastic pipes)
- › higher flexibility for single pipes, delivered in rolls
- › larger dimension than normal PEX up to outside dia. 116 mm.
- › raised pressure rating up 13 bar(o)

The system was tested in labs and demonstrated with several kilometres of pipe installed in both in Denmark and Sweden. The development also included participation in the standardisation processes.

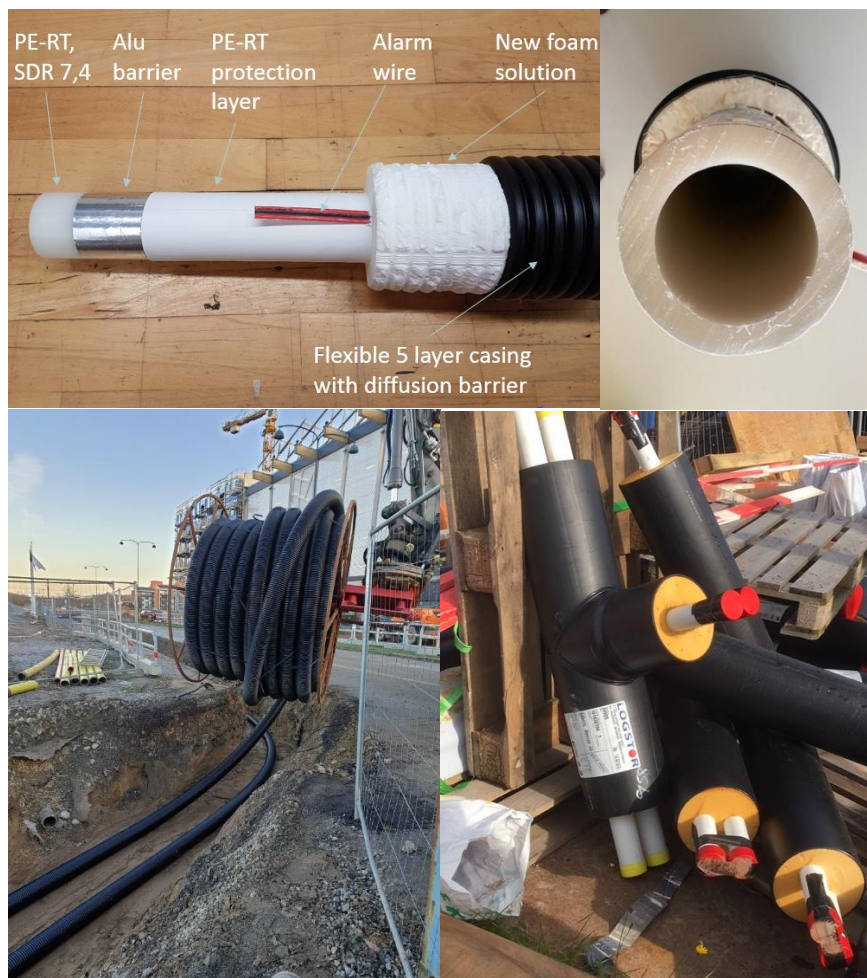


Figure 7. Principle of the new multilayer PE-RT pipes for pressure up to 13 bar(o).

### Heat loss recovery – COOL DH “zero heat loss transmission pipe”

The project has developed a solution to recover heat loss from district heating pipes back into the system by use of collector pipes and a small, dedicated heat pump.

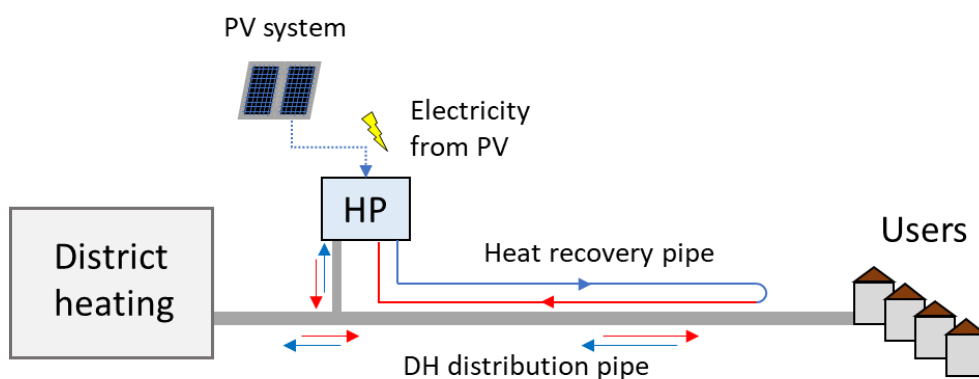


Figure 8. Principle of heat loss recovery for DH piping.

The collector pipes can recover the heat loss as well as extracting additional heat from the ground. The measured COP in Østerby is 5.9.



*Figure 9. The innovative zero loss heat recovery pipe between Østerby and CITY2 and in Lund at Frikis & Svettis.*

### **Conversion to LTDH in Østerby District (Denmark)**

The conversion of Østerby district comprise existing buildings in total 159 consumers organised in 4 housing associations with different rulesets in Høje Taastrup. The conversion is from old traditional district heating 85/50°C to a new LTDH network operated at 55/30°C aiming at reducing the heat loss from above 35% to about 16% in existing non dense settlements with-out improvement of the building envelope, as it was already relatively well insulated.

The LTDH network was developed to minimize the heat losses by using improved piping and reducing the length of the pipes and minimising the diameters. The optimization process was performed in TERMIS simulation program for the dwellings connected to the new LTDH network.

The following optimization parameters were considered:

- > Higher insulation level
- > The use of twin instead of single pipes
- > Length reduction of service pipes
- > Hydraulic optimisation
- > Replacement of existing network/installations and installations of new HIU's

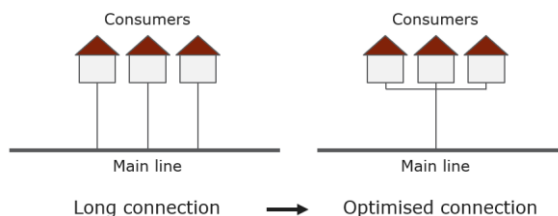


Figure 10. Illustration of pipe optimisation.



Figure 11. The new LTDH pipes in Østerby area in Høje Taastrup close to the houses.

The installation of the new LTDH network in Østerby district took place in the spring/summer of 2019 and continued with the installation of the service pipes and the connection of the users. The heat loss was aimed at being reduced from 67 to 13 kW for a 3119 m network (4.2 W/m), and monitoring showed that about 16 kW was reached (5.2 W/m) i.e., 45 kWh/m p.a., which is about 1/5 of the average heat loss per meter DH-pipe in Denmark.

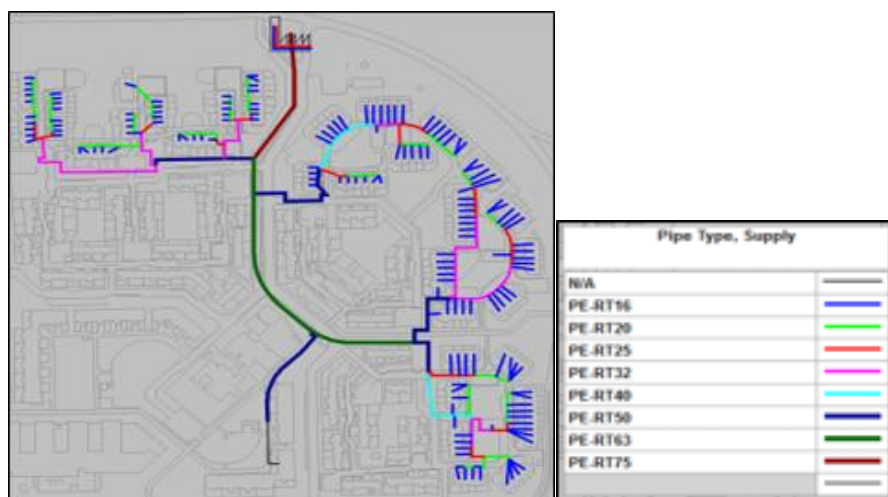


Figure 12. The LTDH network in Østerby.



*Figure 13. The PE-RT pipes in Østerby were connected using press fittings. In the future it will be electro fusion fittings as soon as these are accepted by the standards for LTDH piping systems.*

### **Co-production and prosumers in Høje Taastrup (Denmark)**

Østerby district in Høje Taastrup, is supplied from a combined production of PV supported cooling and heating  $1.34 \text{ MW}_{\text{heat}}$  at a shopping mall called CITY2. The system also supplies cooling and heating to CITY2 and as well to the surround districts through the district cooling and district heating networks at different temperature levels. An ICT controlled i-Grid solution serves as a shunt enabling the main grid to act as back-up as well as controlling the temperature and pressure needed in the system.

The business model is new as the utility has rented a room in CITY2 to install the energy central converting the consumer to a prosumer. Also, it is hereby possible to connect to the power grid behind the main meter of CITY2. Further it must be mentioned that CITY2 has  $2.1 \text{ MW}_p$  ( $16.200 \text{ m}^2$ ) photo-voltaic installed

on the roof, which can also serve as a source of renewable electricity for the heat pump and cooling machine installation.

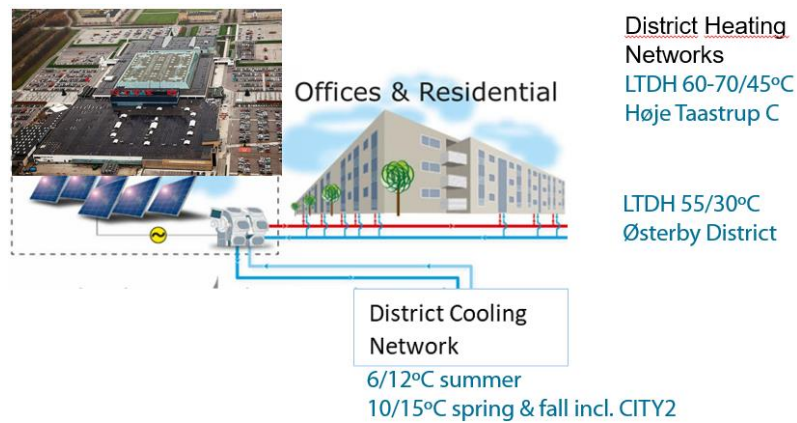


Figure 14. The concept of co-production.

The experience has shown that it is important to incorporate flexibility in the grids to enable the system to operate for many operation hours. This means that there must be sufficient cooling demand on the district cooling network or another source for cooling. On the heating side there must be sufficient demand as well during summer and effort must be taken to keep the return temperature on the district heating system as low as possible as there is a tendency to increasing return temperature during summer (as only few customers with poor return temperature could have substantial negative impact on the operation). A max return temperature limiter thermostat can be a solution to consider for lowering the return temperature a poor performing consumers.

In Høje Taastrup the flexibility is ensured by interlinking grids to provide sufficient demand on the system as well as ensuring redundancy and that the system can be operated with the production unit that is most environmental friendly.

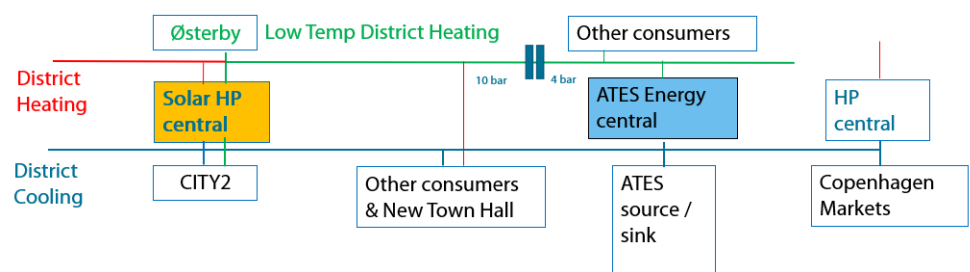


Figure 15. Interlinking Energy Centrals and Consumers.

The other prosumer installation concerns a cooling of a bank's data centre with 1.92 MW<sub>heat</sub> as prosumers using the year-round cooling need as source for supplying district heating in an industrial/commercial district. Up to 6500 yearly full load hours are expected.

The heat pump was installed in 2020 in the Bank. The heat pump uses heat from the servers to deliver hot water, and at the same time it provides cooling for the server room. This new solution is expected to supply heat to approx. 700 households. The solutions developed in the COOL DH project can be replicated in many sites and sizes.

### **Surplus heat recovery at MAX IV in Lund (Sweden)**

In Lund the COOL DH demonstrates the utilisation of 5.8 MW renewable surplus heat from cooling of the MAX IV synchrotron particle accelerator to supply low temperature district heating in the new 225 ha town district under construction, called Brunnshög in Lund – when fully developed it will serve up to 40.000 employees & citizens.

The facility uses high-velocity electrons emitting high-energy light to conduct research and studies on materials.



*Figure 16. Aerial view of MAX IV research facility.*

The total installed capacity at MAX IV is 5.8 MW for the heating circuit and 5.2 MW for the cooling circuit. The system supplies both the high and low-temperature district heating network. This installation can inspire further developments of LTDH systems and allow for such systems to be replicated in other places. The system will be further expanded as the Brunnshög area

develops. The total available source of low-grade heat including ESS will grow to 250 GWh/year by 2027 with a maximum capacity of 40 MW.

The recycled fossil-free surplus heat system installed at the MAX IV facility recovers the heat produced by the cooling system and supplies low-grade heat to the new LTDH network. An innovative heat exchanger and heat pump coupling was developed and installed to fulfil the cooling demand of the research facility and, at the same time, recover the heat produced in the process to supply the LTDH network connected to the Brunnshög area. In this way, the efficiency of the recovery system was increased. The electricity for the heat pumps is produced by renewable resources and therefore, the LTDH system is entirely supplied by RES. As can be seen in *Figure* , the heat pump system was designed with energy efficiency in mind and includes:

- > Division into several temperature levels
- > Optimization of the cooling temperatures
- > Cascade coupling of the individual units

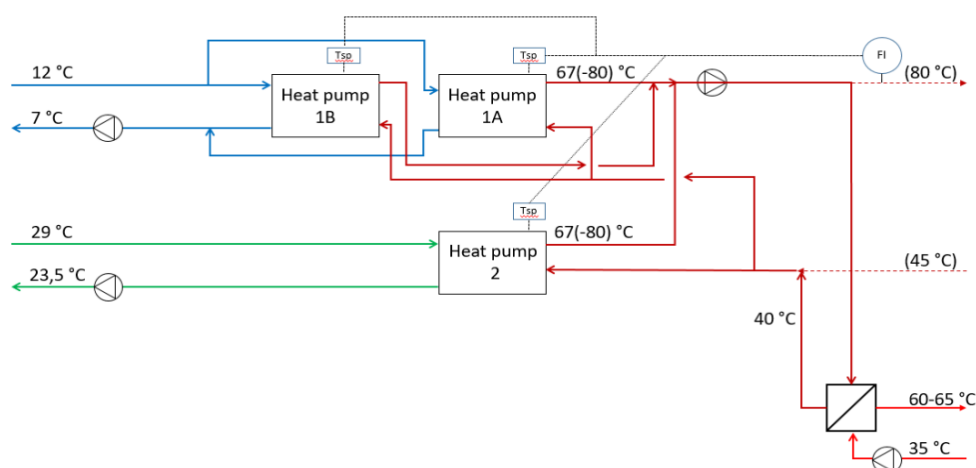


Figure 17. Simplified heat pump coupling system at MAX IV.

In the beginning the temperature from the heat pump will up to 80°C to be able export the surplus heat to the traditional DH network in Lund, but when Brunnsbög is fully developed and the demand on the grid matches the amount of surplus heat, then the temperature will be lowered to 67°C enabling the most far away consumer to receive 65°C in supply.

### LTDH in Brunnshög, Lund (Sweden)

In COOL DH the installation of the first 2400 m PE-RT pipes was carried out and about 200 individual end-user customers were connected in what is to become one of the biggest LTDH networks totally heated by renewable energy resources.



Figure 18. Schematic view of LTDH in Brunnshög.

### Low temperature installations in Xplorion housing block, Lund (Sweden)

Demonstration of new passive house solutions in a low energy housing block in Lund called Xplorion with new solutions such as central booster heat pump, 3-pipe system with micro heat exchangers in the flats, improved user interface and controls etc.

The idea of using a booster heat pump is to test a solution that would be able to connect to ultra LTDH with a supply temperature of e.g., 45°C and still be able to use a normal house-installations and full fill the Swedish demands on DHW temperature. Further the system can increase the capacity in the LTDH system and at a lower cost as there is a fee for every degree the return temperature is above 20°C.

The practical experience is however that the system is very sensitive to balancing of the system and correct functioning radiators as the system requires a return temperature to the heat pump of below 35°C to be able to operate the system. For the same reason oversized radiators are recommended.

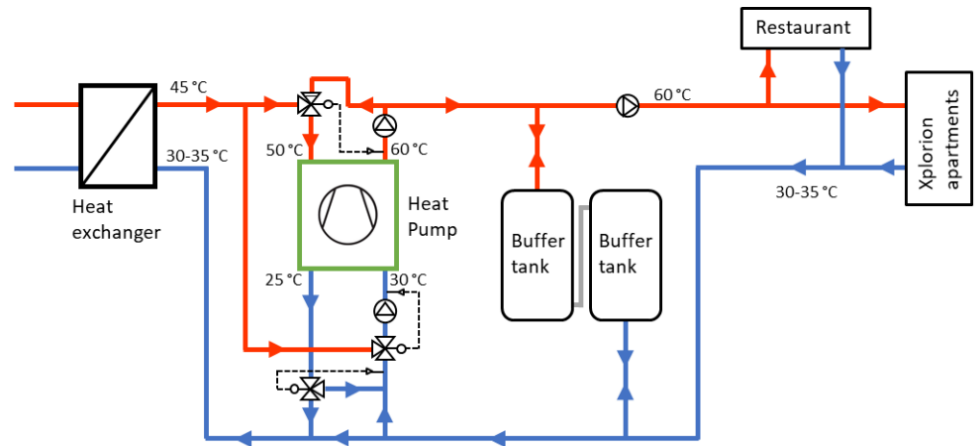


Figure 19. Principle diagram of the booster heat pump installation at Xplorion.



Figure 20. The compact booster heat pump at Xplorion that is designed for operation with up 35°C on the evaporator side, which is not normal for standard ground source heat pumps, as they are normally limited to max 20°C in the cold side.

The idea of the 3-pipe system (2 heating pipes and 1 DCW pipe) is to reduce cost of piping and reduce internal heat losses. But taking the HIU's in the apartment into the economics, then the cost is higher than a normal system with a big HIU on the ground floor. Another concern is that the HIU are in the apartments i.e., that they can't be accessed for service and adjusting with-out an agreement with the tenants to get access to the apartment.

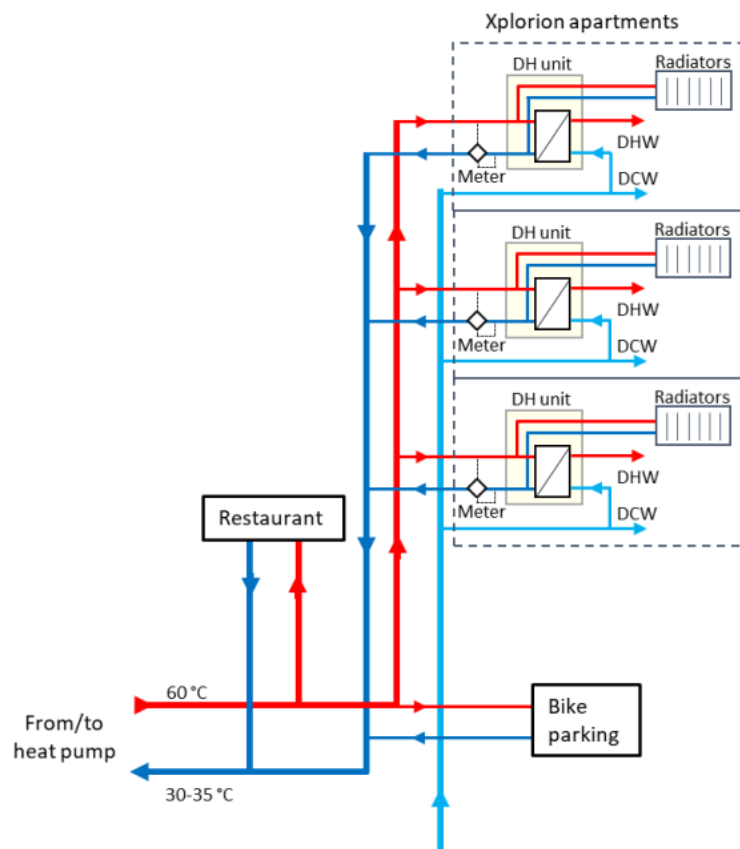


Figure 21. Principle diagram of the 3-pipesystem and HIU's micro heat exchangers at Xplorion.



Figure 22. Photo of the LT HIU with micro heat exchanger installed at Xplorion and 3-pipe system installed. The white box is the ventilation unit with heat recovery.



*Figure 23. 100 kWh battery storage for PV left (250m<sup>2</sup> PV array), and the booster heat pump right, at Xplorion seen from outside at the top.*



## 5.2 Overviews of exploitable knowledge

### Høje Taastrup

Table 4. Exploitable knowledge from demos in Høje Taastrup.

Exploitable Knowledge (description)	Exploitable product(s) or measure(s)	Sector(s) of application	Time for commercial use	Patents or other IPR protection	Owner & Other Partner(s) involved
LTDH development and new design concepts	Experience in finance, legal, organisation, design & operation	Housing districts	Available on market 2022 TRL9	Know-how	COWI UTIL-DK
New PE-RT plastic pipes	Pipes up to d.116 mm single and d.63 mm for twin for PN 13 bar(o) incl. leak detection	DH utilities	Available on market 2023 TRL8	Know-how / IPR	IND-DK
Heat recovery from main lines => zero heat loss transmission lines	Experience in design and operation	DH utilities	Demo in market 2021 TRL8	Know-how	COWI
Combined cooling and heating production	Heat Pumps and controls Experience in design and O&M	RES Integration / Energy	Available on market 2021 TRL8-9	Know-how	UTIL-DK COWI
Connection of prosumers	Experience in legal, design and operation	Energy Efficiency	Available on market 2021 / Development TRL8	Know-how	COWI UTIL-DK
New business models	Experience in legal, finance, organisation, design & operation	Large consumers like datacentres, shopping malls and offices	Available on market 2021 TRL9	N/A	UTIL-DK COWI
Tool for calculation of heat losses for internal piping	Experience in design and optimization of energy efficiency	Building developers and designers	Available on COOL DH homepage since 2020	Know-how	COWI



## Lund

Table 5. Exploitable knowledge from demos in Lund.

Exploitable Knowledge (description)	Exploitable product(s) or measure(s)	Sector(s) of application	Time for commercial use	Patents or other IPR protection	Owner & Other Partner(s) involved
Building refurbishment	Experience in finance, legal, organisation	Housing Buildings	Available on market TRL9	N/A	HOUSE-SE
LTDH development	Experience in finance, legal, organisation, design & operation	Mixed Districts	Available on market 2022 TRL9	Know-how	UTIL-SE MUN-SE
New PE-RT plastic pipes	Pipes up to d.116 mm single pipes with leak detection	DH Utilities	Available on market 2023 TRL8	Know-how / IPR	IND-DK UTIL-SE
Heat recovery from main lines	Experience in design and operation	DH Utilities	Demo in market 2021 TRL8	Know-how	UTIL-SE COWI
Waste-water heat recovery	Experience in design solution O&M	Special house	Available on market	N/A	HOUSE-SE (COWI)
New substation digital connectivity interface	Experience in design and operation	Housing / Utilities	Available on market	Know-how	IND-SE2 UTIL-SE
Substation with micro heat exchangers	Experience in design and operation	Housing / Utilities	Available on market	N/A	IND-SE2 HOUSE-SE
Combined DHC Energy Production Central	Design O&M	DH / DC Substation	Available on market 2020	Know-how	UTIL-SE
Anti-Legionella solutions	Design solutions and legislation.	Buildings	Available on market	Know-how	UNI-SE COWI
New business models	Experience in legal, finance, organisation, design & operation	Large consumers like data centres, shopping malls and offices	Available on market 2020 TRL9	Know-how	UTIL-SE



### 5.2.1 Lessons learned beyond state-of-the-art

Before and in connection with the technical demonstrations and monitoring the COOL DH carried out several investigations on system designs, as part of this process a series of thematic workshops were held:

#### **Thematic workshops on demand side**

The workshops covered the following topics

- > Solutions for avoiding risks of legionella
- > Solutions for local integration of renewable energy sources, by local exploitation of renewable energy sources at the buildings
- > Substation solutions
- > System solutions for multifamily houses and tertiary buildings.

The conclusion was that water temperatures above 55°C supply and 50°C in circulation return is needed together with constant water movement in all pipes of at least 0,05 m/s to be safe if DHW is prepared centrally either preheated or fully heated. If DHW is prepared very close to the tap with small water volumes (i.e. <3 l) in the pipes then 45-50°C should be safe in a plug flow system with frequent daily use. Otherwise, you need electrochemical water treatment or chemical doze. Blind ends with stagnant water must be avoided.

#### **Thematic workshops on distribution side of LTDH**

- > New design concepts for optimisation of LTDH distribution systems
- > New pipe components for LTDH distribution systems underground
- > New high-efficient pipe types for internal distribution in buildings
- > New metering concepts.

The outcome was inspiration for optimizing design using TERMIS simulation or similar. With available plastic materials it is possible to increase the operation pressure up to 13 bar(o) instead of the normal 6 bar(o) (hereby pipe dimensions can be reduced and with that also costs and heat losses are reduced).

This however may introduce the need of installing a booster pump to ensure enough driving pressure to secure the needed flow in the district.

#### **Thematic workshops on supply side installation for LTDH**

- > Optimising cascade couplings for optimal use of low-temperature sources
- > Integration of additional renewable energy sources on the supply side.
- > Seasonal storage

Couplings of heat pumps were discussed. The info from the workshop fed into the investigations and simulations of actual systems for optimising cascade couplings for optimised use of low temperature sources.



*Figure 24. Photo of the new 1.341 MW heat pump installed at CITY2.*

Table 6. Pro's et Con's for the demonstrations.

Pro et Con's				
Lund				
ID	Location	Plant	Pro	Con
D3.1	Xplorion	Topping heat pump	The system enables production of DHW in an ultra LTDH system. Enables higher temperature difference in DH systems which increased capacity of the pipes, reduces heat loss and enables better utilisation of low grade heat sources.	Investment cost is high.  The heat pump uses electricity that represent an additional operation cost unless surplus PV electricity is available.
D3.2	Xplorion	3-pipe system	The system has 2 warm pipes less, but diameter has be increased. Construction cost for piping is reduced.	The system requires installation of HEX units for DHW preparation The system has to run at 55°C flow temperature also during summer, i.e. no summer stop of heating.
	Xplorion	LT HIU with micro heat exchanger	Enables reduction of DHW to 50°C (even 45°C in some countries when pipe distance to tap is short ref. 3-litre rule.	Increased cost, and heat loss and bypass . Total system is more expensive with out being significant more efficient than a DH unit on block scale. thermostat may increase return temperature if tenants interfere or if not properly set.
D3.9	MAXIV	Central co-production	Uses surplus heat from cooling plants, and saves energy and provides income.	Complicated system that must be carefully designed. Uses additional electricity.
	Brunnshög	District heating	Distributes LTDH.	Takes up space in street tracé.
D3.5	Brunnshög	1400 m	Plastic pipes with less heat loss, no corrosion, leak detection and longer life span. Easy to install in single pipe system above 12°C.	Can only be delivered up to dia 116 mm.
D3.6	Brunnshög	2400 m	Plastic pipes with less heat loss, no corrosion and leak detection system and longer life span.	Electrofusion couplings are not yet available for DH purpose.
D3.7	Friskis	Heat recov. pipe	Good way of elimination heat loss.	Needs a constant load to be efficient The heat pump increases cost and need electricity for operation.
D3.10	Motel L	Local waste source	Selling district cooling and at the same time use it as energy source to produce DH is energy- and cost efficient.	Cooling is mostly available during summer where the need for DH is low. DH system must therefor be supplemented with other source.
Høje Taastrup				
ID	Location	Plant	Pro	Con
D4.1	Østerby	DH units	Replaces old installation all up to the single user, saves maintenance, heatloss and cost.	Cost to be financed. (but is less than replacing existing worn out system).
D4.2	Østerby	District Heating	Gridloss reduced significantly O&M taken over by utility.	Time consuming process to convince tenants departments. Twin pipes in PE-RT are too rigid to work with during winter, and connection of twin-pipes needs two persons.
D4.3	Østerby	Heat recov. pipe	Recovers heat loss from the main pipes and is used year round with high COP.	Cost for small heat pump Uses electricity.
D4.4	CITY2	PV Heat pump	Co-production of cooling and LTDH with many operation hours is interesting. Electricity must be provided cheap or on basis of surplus heat from renewable PV power. Load leveling on electricity grid.	The heat pump capital cost and cost for use of electricity during operation. Redundency and flexibility on system level is required to allow for optimal operation.
D4.5	Prosumer Nordea	Heat pump	Providing cooling energy and providing of surplus heat to the DH systems saves energy and provides income. Many operational hours as the customer is a datacentre.	The heat pump capital cost and cost for use of electricity during operation.



## 6 Impact of the project on relevant sectors

### 6.1 Political and regulatory sector

Project has influenced politicians on local, national, and European level. The project was presented at a high-level decision-maker seminar at COWI with participation of the Danish Minister of Climate, Energy and Supply and the Mayor of City of Lund– and it was influencing on the following changes in legislation and reduction of energy tax for utilisation of surplus heat in Denmark. The above meeting, with presentation of the COOL DH project, has with other lobby work, pushed the politics towards better framework conditions for utilisation of surplus heat. Further the legislative framework was studied and recommendations on how to avoid legionella is presented in relation to the different national rules in EU.

Based on experiences concerning the energy policy framework of the involved countries and the EU, the observations made by other EU-funded projects, also including the input from the COOL DH dedicated webinar, the COOL DH project has summarised a list of energy policy recommendations at the EU level:

#### **COOL DH Policy recommendations**

The propositions listed below aim at improving the competitiveness of the district heating and cooling sector, which enables greater efficiency and the integration of renewables, in the EU legislative framework.

The measures recommended also promote the upgrade of waste heat in the EU legislation that would enable its market uptake.

- introduce a carbon tax (e.g. for all new constructions that use fossil-fueled heating) that will include externalities and tally the future damage costs of carbon emissions by a penalty;
- ensure a level of playing field for all heat supply technologies, including waste heat recovery solutions;
- define waste heat and treat it evenly with renewables;
- make waste heat recovery standard by obliging all new constructions to utilise excess heat from possible processes;
- allow local non-fossil co-production of heat at the consumer level also in areas where district heating connection is obligatory;
- require a maximum allowable return temperature from consumers to the district heating network.

## 6.2 Municipalities

Meetings in the Task Force for Climate Action Plan 2030 was held on the Town Hall of Høje Taastrup. There were 12 key participants included the mayor and 4 local politicians being member of the City Board. Also participating were representatives of the Business Forum, Cooperative Housing Company, The Agenda Council and environmental & Energy Centre and Municipal key officers.

It is the plan to phase-out all fossil-gas consumption and replace with collective district energy solutions. Today the DH supply in Høje Taastrup is 85% non-fossil, and it is planned that this figure will reach 100% in 2025.



*Figure 25. The new Town Hall in Høje Taastrup that has also been connected to both LTDH and DC.*

COOL DH has influenced neighbouring Municipalities and Utilities both in Denmark and Sweden hereunder with Cities Webinar and dedicated workshops and Replication plans for districts in the Municipalities of Ballerup, Gladsaxe, Gentofte and Herlev in Greater Copenhagen area as well as study visits to representative sites with participation from many nationalities.

## 6.3 Population

Public competitions regarding use of excess heat have been carried out. An output of seven ideas for use of an excess of lukewarm district heating water were chosen. An illustrator was procured, to produce a presentation material that can be used as an interaction material in the meeting with citizens, to illustrate situations that focus on both sustainability and availability to all citizens. The illustrations were accompanied by texts and presented on big posters as an exhibition during a cultural event in the city of Lund called Kulturnatten (Culture Night). The exhibition served as inspiration for a dialogue with the citizens, who were invited to give their own ideas on other possible uses for excess district heating water. The dialogue with citizens about DH in new formats is important as to brand DH in a more attractive way.

The website: [www.cooldh.eu](http://www.cooldh.eu) was continuously used and updated. The webinars held by COOL DH and video clips as well as the public deliverables can be found on the website.

## 6.4 Technicians and professionals

COOL DH developed:

- > A tool for calculation of heat losses from internal pipes in buildings.
- > A working paper on new design concepts for optimisation of LTDH distribution systems
- > A draft design manual for new pipe components for LTDH distribution systems underground (will be released when the product is fully commercialised)
- > A system to recover heat losses from DH main pipes using collector pipes coupled to a heat pump.

## 6.5 Construction and industry sector

Kingspan Logstor (IND-DK) developed a new type of PE-RT pipes for LTDH use.

- > The advantage of using PE-RT pipes is that they are flexible above 10°C and they come on coils (for single pipes) which implies a faster installation, and they are independent of availability of steel welders. It is well known in the business, that it can be difficult to find skilled steel welders.
- > The PE-RT pipe system developed within this project is a good product, but they are not the only product that can be used in a LTDH network. It is important to consider the best system for each specific project and to look at the possibility of using both plastic and steel pipes.
- > There is an aluminium barrier in the pipes to secure water diffusion and oxygen diffusion in the pipes used in the COOL DH project – this is further combined with a leak-detection system, which is new for plastic pipes.
- > In smaller dimensions, the PE-RT pipes are somewhat cheaper than steel pipes, but cost savings are foremost achieved in the installation of the pipes.
- > The product is in the process being approved as a LTDH product. The electrofusion coupling is also an important factor to be solved, something that is absolutely possible.

Cetetherm (IND-SE2) developed an improved user interface for HIU's

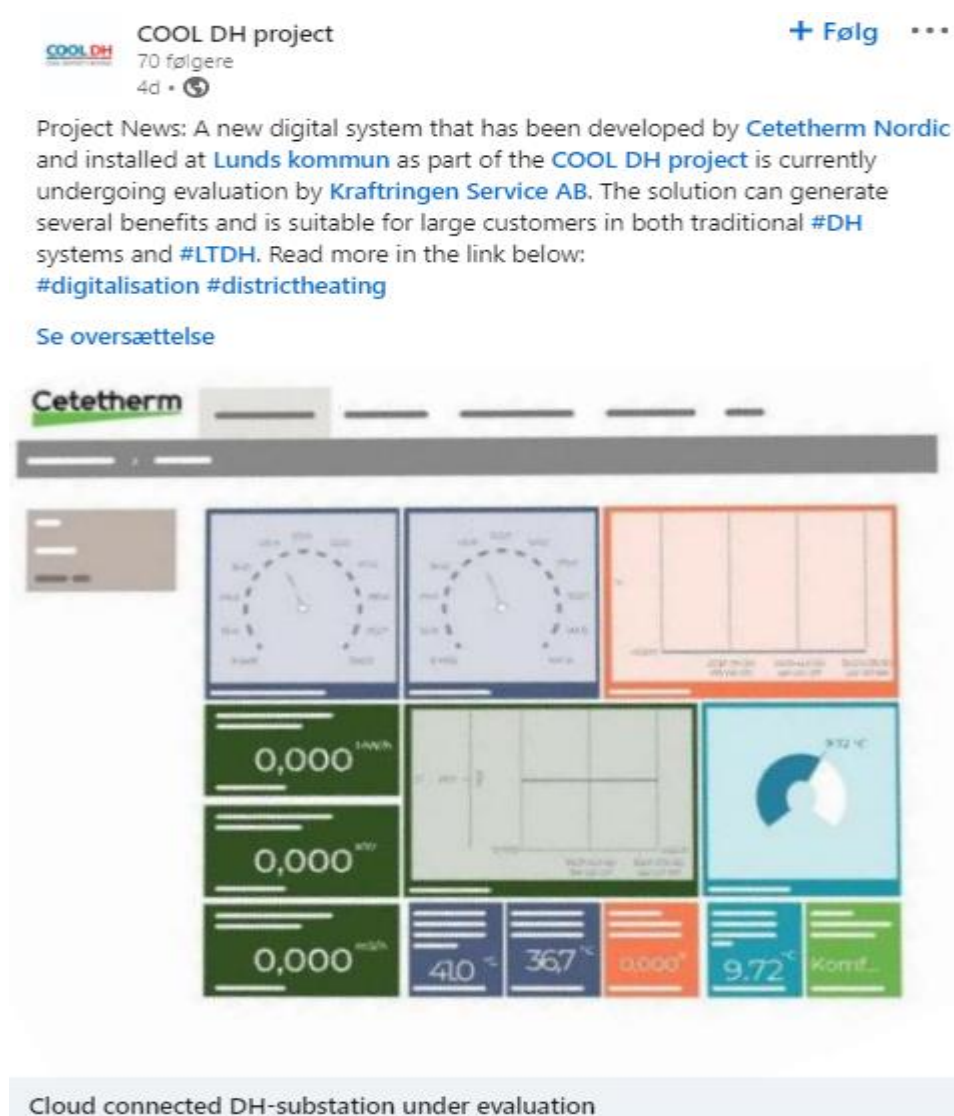


Figure 26. The new user interface for HIU's developed by Cetetherm.



## 6.6 Perspectives of the COOL DH project

The methods, tools concepts and products used in the COOL DH project can be used generically in most places of northern and Central Europe. In Sweden and Denmark alone, there are more than 800 DH utilities with areas that could be converted to LTDH.

COOL DH opens for new business models for combined district heating and cooling which can also be applied to data centres.

In Høje Taastrup there are now connections to Copenhagen Market, an ATES energy central and CITY2 prosumer heat pump together on a common district cooling loop, which enables flexibility and redundancy in the system.

In Lund we see continued expansion of LTDH in Brunnshög district in Lund and in Lund in general. Kraftringen will continue to use PE-RT pipes. The Municipal planners also learned that pipe lay out must be decided early when planning new districts to have the infrastructure available early stage and save construction costs.

Høje Taastrup Municipality has during the COOL DH project period increased the share of non-fossil energy in the DH supply from 51% to 85% and has decided to go 100% fossil free and to transform present natural gas heated enclaves to be served by district heating (low temperature) or the use of individual heat pumps. Given the 2022 energy crisis and the sudden raise of gas prices this is expected to be achieved already in 2026 in-stead of originally planned for 2030. Lund City is already 99% fossil free in the heat and power supply!

COOL DH was awarded "The Global District Energy Climate Award" by the International District Energy Association in November 2021 as the District Energy Award for the "New Scheme" category. The demo site of Brunnshög was elected as one of the most innovative projects in the world in the field of DH. The award in the category "New Scheme" is given to a new type of district energy system with high ambition and aspiration – and which have achieved a high level of energy efficiency.



## 7 Dissemination

### 7.1 Dissemination results

The dissemination has been ongoing during the whole project.

The Main figures are:

- > The website had more than 9,000 unique visitors during the whole project period and in total more than 43,000 pageviews.
- > Four workshops with 170 participants.
- > Six official project study tours with 730 participants (620 on virtual tours and 110 physical attendees).
- > Presentations on 15 European and International conferences and promotions on 9 national conferences.
- > Three webinars with 500 live views and more than 700 web views.
- > Four bi-annual newsletters were published before changing to shorter monthly newsletters.
- > Social media:
  - > On Twitter 18 posts were on COOL DH and they received 144 reactions.
  - > On LinkedIn 47 posts were on COOL DH and they received 700 reactions.

Following videos have been produced in the project period and are all published and uploaded project website [www.cooldh.eu](http://www.cooldh.eu)

1. [COOL DH – a pioneering project for district heating solutions](#)
2. [Low temperature district heating in Østerby, Høje-Taastrup](#)
3. [A virtual study tour to Brunnshög and the world's largest LTDH-grid](#)
4. [Design Guide for Low Temperature District Heating COOL DH in Høje-Taastrup](#)



## 7.2 Summary of plan for using and dissemination of knowledge

One of the main objectives of the COOL DH project is the replication of the activities developed in the project into other areas, and the boosting of energy efficiency criteria in construction and retrofitting of DH systems and use of low-grade surplus heat and renewable energy sources.

The plan for disseminating the knowledge obtained include:

- > To continue to participate in forums, congresses, and conferences
- > To participate in awards for the recognition of the work developed in the project
- > To train technicians to ensure a better operating the energy systems in the buildings
- > To disseminate the project on all levels including newspapers, technical journals, TV, radio, internet, and after the end of the project also scientific papers.

Municipalities are not only disseminating the results of the project by participating in conferences or congresses and awards but also by continuing the urban development plans building on use of the developed systems and methods. Neighbouring Municipalities have been approached exchanging inspiration and preparing for replication plans.

Finally, a Scientific paper will be prepared with the title "New PE-RT plastic District Heating pipes – opportunities and early experiences" that is going to be published in "Applied Energy" Journal in early 2023.

*Table 7. Exploitation plan.*

[illegible]

### Replication potential

In the summary report of Heat Roadmap Europe 4 (HER4) the authors highlight the importance of an increased share of DH in the European heating sector to fulfil the goals for decarbonization [1]. The expressed minimum recommended share of DH for selected member states are summarized in Figure 27. In the HER4 summary [1] the share of waste energy in the future DH network is estimated to be 25% but might increase if the potential of using low grade waste energy and large scale heat pumps would be included. The heat recovered from industries is one of the keys for an efficient and resilient heating sector in Europe [1].

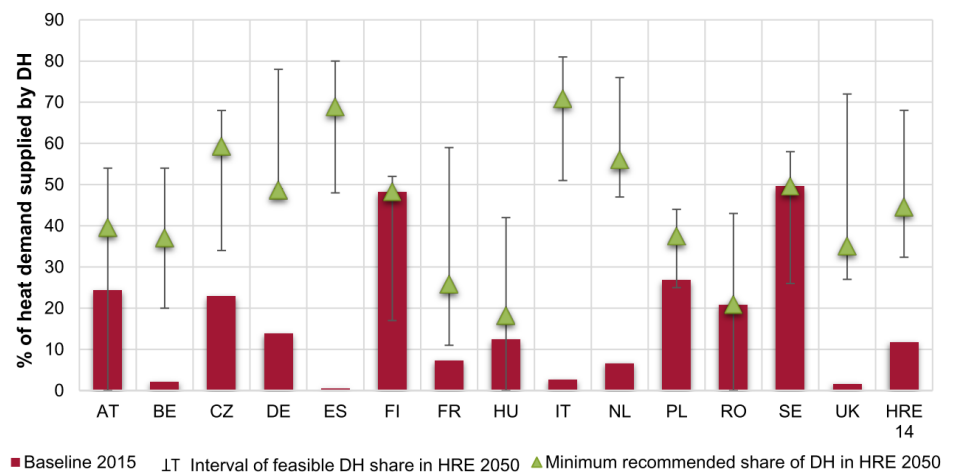


Figure 27. Minimum recommended share of DH 2050 and baseline 2015. [1]

Within the EU Stratego project a background report [2] is presented quantifying the amount of excess heat available for DH in Europe. The potential study shows that the potential of usage of excess heat from industry sector in Europe is rather large. However, the study is focusing on excess heat from industry which in general has rather high temperature level. By including low temperature excess heat, or waste heat, the potential of using waste heat will increase. The COOL DH project demonstrates how to utilize low grade waste energy by demonstration of combined heating and cooling appliances delivering energy to a LTDH system.

At present there are several projects on European level focusing on low temperature district heating. The interest in increasing for use of low temperature waste heat as a path towards decarbonize of the heating sector. The project Heat Road Map Europe [3] aims at developing low carbon heating and cooling strategies for Europe. An increased share of District Heating in the European heating sector is a door opener for increased usage of waste energy for the heating sector. However, to enable increased usage of waste energy there is a need for new DH systems in many cities and countries in Europe,

especially in countries with low share of district heating (such as France, Netherlands, Belgium [1]), see figure 27.

### The Replication Factors for COOL DH

Replicability is an ability of a system or process to be repeated in different locations and times to obtain the similar results. The replication analysis can be divided in three paces: Identification of factors affecting replicability, evaluation of the factors, and determination of path and its barriers [4].

Table 8. The main replicability factors related to COOL DH are as below [4].

Factors	COOL DH
<b>Standardization</b> determines whether the solution can be implemented by different manufacturers.	Standard methods and solutions to establish LTDH systems. CEN standardization to include PE-RT pipes similar to PEX pipes in the DH sector.
<b>Interoperability</b> is a quality of a system with to work with other implemented systems. Interoperability denotes exchanges between a range of similar systems or even between past and future revisions of the same system.	Different independent systems are working together and have proper interactions through defined interfaces.
<b>Market design</b> defines pricing and business model including tariffs and taxes. It can also be related to the roles and responsibilities of different market actors and the processes between them.	Wherever is needed a new business model is designed to meet the market requirements. There are no "one size fits all" solutions here.
<b>Regulatory factor</b> in each area allows the project to be replicated. It indicates the dependency of the solution on national or local regulation and feasibility of the project.	The project run in two different regulatory systems and the solutions are flexible to be adapted by different regulation systems.
<b>Level of Acceptance</b> is determined by support and accept of all involved partners.	All involved partners are convinced and participated from day one.

### Factors Assessment

To quantify the replicability factors a comprehensive assessment should be done to calculate replicability index inspired by [4]. In this methodology specific data from demonstrations can be gathered by means of a questionnaire.

If the replicability index is greater than 75, then the replicability is high. This indicates that most of the necessary conditions are in place. If the score for the index is 50-75, then the replicability is moderate, and several issues may need

to be addressed. Necessary actions should be taken prior to or during the implementation of the pilot project. If the score is less than 50, then the replicability is low. A significant effort is needed to create the prerequisites of replication planning and implementation [4].

### Results

Every technology presented has been evaluated for five parameters and the sum represent the total estimated replication factor from 0 - 100%. The results of the replication analysis can be found in below.

Table 9. Total replicability factor TRF for each tested technology.

	LT HIU		PE-RT Plastic pipes		Heat recovery pipes		Booster HP for ULTDH	Co-production and heat recovery	Heat recovery in different temperature	Prosumer		Ground heating
Site number	Lund 1	Høje Taastrup 1	Lund 2	Høje Taastrup 2	Lund 3	Høje Taastrup 3	Lund 1	Høje Taastrup 4	Lund 4	Lund 5	Høje Taastrup 5	Lund 6
Factors												
Standardization	4	4	1	1	4	4	2	2	2	4	3	4
Interoperability	2	4	3	3	2	2	3	3	3	4	4	4
Market design	3	2	3	3	4	4	4	2	2	4	3	4
Regulatory factor	4	4	4	4	4	4	4	4	4	4	4	4
Level of Acceptance	4	4	3	3	2	2	3	4	4	4	4	4
<b>Sum</b>	<b>17</b>	<b>18</b>	<b>14</b>	<b>14</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>15</b>	<b>15</b>	<b>20</b>	<b>18</b>	<b>20</b>
<b>TRF (%)</b>	<b>85</b>	<b>90</b>	<b>70</b>	<b>70</b>	<b>80</b>	<b>80</b>	<b>80</b>	<b>75</b>	<b>75</b>	<b>100</b>	<b>90</b>	<b>100</b>



## 7.3 Conclusions

The COOL DH project has demonstrated several technical solutions to make use of waste heat at medium low and low temperatures supplying heat for space heating and domestic hot water in low temperature district heating systems. Waste heat sources can be found in many places in a city, and the replicability factor in general can be said to be high because of this. Many of the tested technologies are using existing products that can be found on the market, but that are used in new configurations, for example heat pumps and heat exchangers. New pipes have been developed, manufactured, and tested within the project and has shown significant economic savings during the installation phase by demonstrating a new way to lay district heating pipes. The main obstacle for district heating is the financing since it is associated with high investment costs. District heating can fulfil two major purposes. The first is decarbonization where residual heat and renewables can be used for heat and electricity supply. The other one is security of supply since local assets can be utilized. Both purposes should increase the level of acceptance and work as an incentive to change possible regulatory factors or even introduction of economic incentives to build district heating systems in districts without district heating.

The major findings regarding replicability from the COOL DH project are:

- 1 Generally, LTDH networks improve the potential to utilise surplus heat and thereby the potential for replicability of the tested technologies in COOL DH.
- 2 The demonstrations generally show a high or very high replicability potential. In combination with a very large market potential for new DH-systems, the limitation is not the tested technologies, but rather energy strategies for heating, production capacity for DH-components and construction of new district heating systems.
- 3 Within the project, new products have been developed and in other cases existing technology has been tested in new applications.
- 4 The project exhibits technical functionalities for all the demonstration as well as economic viability in most cases. An exception is flat specific HIUs, where the installation costs increase significantly. There are, however, other advantages having this, like low risk of Legionella growth, the enabling of individual metering and charging and the better possibilities for the tenants to control their indoor temperature.
- 5 In Lund, the system temperatures have been chosen so that property owners do not have to install new technology for radiator systems and hot water preparation. This, of course, affects the TRF positively.
- 6 In Høje Taastrup, installations were made in an established area in existing buildings, which is more challenging. The high heat losses in the old



secondary grid, however provided substantial saving marginal in lowering the system temperatures. However, this means that replicability decreases for areas without these margins.

## 7.4 References

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- [9] Market and stakeholder analysis: ReUseHeat Deliverable 1.4, 2019.

## 8 Appendices

### 8.1 List of Deliverables

No.	Deliverable name	WP number	Resp.	Nature	Dissemination level
			Company	Other (O)	Consortium (CO)
				Report (R)	Restricted (RE)
				Demonstration (D)	Restricted (PP)
				Prototype (P)	Public (PU)
D1.2	Thematic workshops demand side	WP1	1 - COWI-DK	Other (O)	Public (PU)
D1.3	Thematic workshops distribution side	WP1	1 - COWI-DK	Other (O)	Public (PU)
D1.4	Thematic workshops supply side	WP1	5 - UNI-SE	Other (O)	Public (PU)
D2.1	Report on solutions for avoiding risk of legionella	WP2	2 - UTIL-SE	Report (R)	Public (PU)
D2.10	Calculator on savings for new high efficient pipe types for internal distribution in buildings	WP2	7 - IND-DK	Other (O)	Public (PU)
D2.11	Working paper on optimising cascade couplings for optimal use of low temperature sources	WP2	2 - UTIL-SE	Report (R)	Public (PU)
D2.13	Work document / flyer on added value of LTDH systems	WP2	4 - MUN-SE	Other (O)	Public (PU)
D2.5	Working paper on LTDH connected appliances	WP2	2 - UTIL-SE	Report (R)	Public (PU)
D2.6	Report on improved use of individual metering concepts	WP2	5 - UNI-SE	Report (R)	Public (PU)
D2.7	Working paper on new design concepts for optimisation of LTDH distribution systems	WP2	1 - COWI-DK	Report (R)	Public (PU)
D3.3	Business model for "Google Play" or "App Store" of DH grid	WP3	2 - UTIL-SE	Other (O)	Public (PU)
D4.1	Demonstration of new type of substations	WP4	8 - UTIL-DK	Demonstration (D)	Public (PU)
D4.2	Converting Østerby area from traditional DH (85/50oC) to LTDH	WP4	8 - UTIL-DK	Demonstration (D)	Public (PU)
D5.2	Monitoring report for Lund incl. KPIs	WP5	5 - UNI-SE	Report (R)	Public (PU)
D5.3	Monitoring report for Høje-Taastrup incl. KPIs	WP5	5 - UNI-SE	Report (R)	Public (PU)
D5.4	Working paper on result of optimisation using smart meters	WP5	5 - UNI-SE	Report (R)	Public (PU)
D6.10	Webinar DK-SE	WP6	4 - MUN-SE	Other (O)	Public (PU)
D6.11	Newsletters and other info material incl., news on social media	WP6	4 - MUN-SE	Other (O)	Public (PU)
D6.13	Workshop and webinar 1	WP6	6 - EHP-BE	Other (O)	Public (PU)
D6.14	Workshop and webinar 2	WP6	6 - EHP-BE	Other (O)	Public (PU)
D6.15	Meetings with policy makers	WP6	6 - EHP-BE	Other (O)	Public (PU)
D6.16	2 Webinar addressing cities	WP6	6 - EHP-BE	Other (O)	Public (PU)
D6.17	Final conference	WP6	6 - EHP-BE	Other (O)	Public (PU)
D6.18	Participation in European conference	WP6	6 - EHP-BE	Other (O)	Public (PU)
D6.5	Installation guideline, brochure / pamphlet and video clip	WP6	10 - IND-SE	Other (O)	Public (PU)
D6.6	Slide series for inspiration	WP6	4 - MUN-SE	Other (O)	Public (PU)
D6.7	COOL DH web page	WP6	4 - MUN-SE	Other (O)	Public (PU)
D6.8	Video clips	WP6	4 - MUN-SE	Other (O)	Public (PU)
D6.9	Seminars, innovation workshops, conference participation, study tours	WP6	4 - MUN-SE	Other (O)	Public (PU)
D7.6	Final reports including cost statements	WP7	1 - COWI-DK	Report (R)	Public (PU)



## 8.2 Dissemination lists



Beneficiary	Date of publication	Type of activity	Sub type	Title	Name of media	Type of audience	Approximately size of audience	Language
UTIL-SE	11. Oct. 2017	Press and brochures	Article 2 pages	Miljonstöd för lågtemperaturmät i Brunnshög (Millions in support for low temperature grid in Brunnshög)	<a href="http://nordiskaprojektenergi.se/miljonstod-for-lagtemperaturmat-i-brunnshog">http://nordiskaprojektenergi.se/miljonstod-for-lagtemperaturmat-i-brunnshog</a>	Energy industry in Sweden	20.000	Swedish
EHP-BE	01 Nov. 2017	Internet platforms	Link in the website of the organisation	COOL DH: Cool ways of using low grade Heat Sources for District Heating	<a href="https://www.euroheat.org/our-projects/cool-dh-cool-ways-using-low-grade-heat-sources-district-heating/">https://www.euroheat.org/our-projects/cool-dh-cool-ways-using-low-grade-heat-sources-district-heating/</a>	DHC stakeholders, utilities, academia, companies, public audience, energy suppliers, public authorities, general public	50.000	English
COWI-DK	10. Nov. 2017	Press and brochures	Article 3 pages	Huse i Lund skal have fjernvarme fra laboratorier. (Buildings in Lund will get district heating from laboratories)	INGENIØREN <a href="https://www.ing.dk/artikel/huse-lund-skal-have-fjernvarme-laboratorier-208381">https://www.ing.dk/artikel/huse-lund-skal-have-fjernvarme-laboratorier-208381</a>	Public. Technical people and other medias	125.000	Danish
COWI-DK	13. Nov. 2017	Internet platforms	Block	Block from Brian Seeberg Senior Vice president at COWI/ committed to creating green and energy efficient solutions	<a href="https://www.linkedin.com/feed/update">https://www.linkedin.com/feed/update</a>	High level connections and followers	1.500	Danish
COWI-DK	14. Nov. 2017	Press and brochures	Article and press release	Lavtemperatur-fjernvarmeprojekt kan vise vej til fremtidens energisystem Lowtemperature-district heatingproject can show the way to the energysystem of the future.	COWI homepage <a href="http://www.cowi.dk/menu/nyhederog-media/nyheder/industrienergi">http://www.cowi.dk/menu/nyhederog-media/nyheder/industrienergi</a>	Public. Technical people in the nordic countries , energy planners, energy companies, consultants	20.000	Danish
MUN-DK	14. Nov. 2017	Press and brochures	Article 2 pages	Høje-Taastrup baner vej for fremtidens energisystem. (Høje-Taastrup shows the way for the energysystem of the future)	<a href="http://hoje-taastrup.dk">Høje-Taastrup Kommune</a>	Public	40.000	Danish
COWI-DK	15. Nov. 2017	Press and brochures	Article 5 pages	Økonomisk rugstød til køleenergi og overskudsvarme. 30 millioner til udvikling og test af lavtemperaturfjernvarmeløsninger i Høje Taastrup og i Lund.(Millions of DKK for development and test of low temperature district heating solutions in Høje Taastrup and in Lund)	ENERGY SUPPLY <a href="https://www.energy-supply.dk/article/view/567442/okonomisk_rugstod_til_koleenergi_og_overskudsvarme">https://www.energy-supply.dk/article/view/567442/okonomisk_rugstod_til_koleenergi_og_overskudsvarme</a>	Public. Technical people in the nordic countries , energy planners, energy companies, consultants	20.000	Danish
EHP-BE	16. Nov. 2017	Internet platforms	Article 2 pages	New urban area will be heated with surplus heat from laboratories	EUROHEAT & POWER <a href="https://www.euroheat.org/news/new-urban-area-will-be-heated-surplus-heat-laboratories">https://www.euroheat.org/news/new-urban-area-will-be-heated-surplus-heat-laboratories</a>	Public. District heating and power industry in Europe and abroad	60.000	English
EHP-BE	16. Nov. 2017	Other activity	Introduction of the project	DHC+ Steering Committee	Presentation	DHC stakeholders, utilities, academia, companies	100	English
COWI-DK	17. Nov. 2017	Press and brochures	Article 1/2 page	Huse i Lund skal have fjernvarme fra laboratorier (Houses in Lund will have district heating from laboratories)	INGENIØREN, weekly national technical newspaper	The Danish Society of Engineers	68.000	Danish
COWI-DK	18. Nov. 2017	Press and brochures	Article 1 page	Kold fjernvarme i Høje-Taastrup skal bane vej for varme fra Apple (Cold district heating in Høje-Taastrup will pave the way for utilizing heat from Apple (datacentre))	DKNYT <a href="https://www.dknyt.dk/artikel/93321/kold-fjernvarme-i-hoje-taastrup-skal-bane-vej-for-varme-fra-apple">https://www.dknyt.dk/artikel/93321/kold-fjernvarme-i-hoje-taastrup-skal-bane-vej-for-varme-fra-apple</a>	Public. Technical people in the nordic countries , energy planners, energy companies, consultants	34.000	Danish
COWI-DK	30. Nov. 2017	Press and brochures	Article 1 page	Projektet Cool District Heating, Økonomisk rugstød til køleenergi og overskudsvarme (The project COOL DH. Economic backup for utilising cooling energy and surplus heat)	Kunde og varmepumper no 6 2017 <a href="http://www.kulde.biz">www.kulde.biz</a>	Technical people in the nordic countries , energy planners, energy companies, consultants	3.400	Norwegian
EHP-BE	01. Dec. 2017	Press and brochures	Newsletter article 1 page	COOL DH Project Kicked off	<a href="https://www.euroheat.org/uncategorized/euro-heat-power-newsletter-december-2017/">https://www.euroheat.org/uncategorized/euro-heat-power-newsletter-december-2017/</a>	DHC stakeholders, utilities, academia, companies	2.000	English
MUN-SE	01. Jan 2018	Internet platforms	Homepage	COOL DH webpage	COOL DH homepage <a href="http://WWW.COOL-DH.EU">http://WWW.COOL-DH.EU</a>	Public	?	English

Beneficiary	Date of publication	Type of activity	Sub type	Title	Name of media	Type of audience	Approximately size of audience	Language
COWI-DK	11. Jan. 2018	Other activity	Speakers and panel discussion and reception + video	High level decision seminar with Danish Minister of Energy, Supply and Climate, Lars Chr. Lilleholt and top representatives of Energy Industry and Energy Organisations. At the seminar the Mayor of Lund Anders Ahlmlund presented the COOL DH project	DECISSION SEMINAR, hosted at COWI headquarters	Special invited decision makers on high level, utilities, municipalities and secretaries og organisations of interest in the energy sector	120	Danish/Swedish
EHP-BE	1. Febr 2018	Networks and EU events	Euroheat & power platform	COOL DH: Cool ways of using low grade Heat Sources for District Heating	<a href="https://www.euroheat.org/our-projects/cool-dh-cool-ways-using-low-grade-heat-sources-district-heating/?hlite=%22legionella%22">https://www.euroheat.org/our-projects/cool-dh-cool-ways-using-low-grade-heat-sources-district-heating/?hlite=%22legionella%22</a>	Public. Energy people in EU and abroad	?	English
UTIL-SE	21/22. Feb. 2018	Other activity	Conference	Framtidens Fjärrvärme-conference, Stockholm (The future of District Heating - conference, Stockholm)	Conference	DHC stakeholders, utilities, academia, companies		Swedish
COWI-DK	12. Marts 2018	Internet platforms	Announcement		Linked-in	Network connections	-	Danish
UTIL-DK	19. Marts 2018	Press and brochures	Article	Køling producerer lavtemperatur fjernvarme i Høje Taastrup. Konceptet testes på 400 forbrugere. (Cooling to produce low temperature district heating in Høje Taastrup. Concept to be tested on 400 users)	ENERGY SUPPLY <a href="https://www.energy-supply.dk/article/view/587235/koling_producerer_lav_temperaturfjernvarme_i_hoje_taastrup?rel=related">https://www.energy-supply.dk/article/view/587235/koling_producerer_lav_temperaturfjernvarme_i_hoje_taastrup?rel=related</a>	Public. Technical people in the nordic countries, energy planners, energy companies, consultants	20,000	Danish
MUN-SE	25. Apr. 2018	Other activity	Conference, Rool-up	Urban Magma-conference, Lund	Urban Magma	Municipalities, utilities, companies	-	English
EHP-BE	01. May 2018	Newsletter	Article 1 page	COOL DH Project website launched	<a href="https://www.euroheat.org/uncategorized/euroheat-power-newsletter-may-2018/">https://www.euroheat.org/uncategorized/euroheat-power-newsletter-may-2018/</a>	DHC stakeholders, utilities, academia, companies	2,000	English
UTIL-SE	22. May 2018	Other activity	Seminar presentation with time for questions in the end	Building the the world's largest low temperature district heating network	<a href="https://nordiccleanenergyweek.com/sessions/building-the-worlds-largest-low-temperature-district-heating-network/">https://nordiccleanenergyweek.com/sessions/building-the-worlds-largest-low-temperature-district-heating-network/</a>	Professionals interested in energy and politics	120	English
MUN-SE	22. May 2018	Other activity	Nordic Clean Energy Week, Malmö	COOL DH – nya sätt att använda Fjärrvarme med låg temperatur (COOL DH - new ways to use distict heating with low temperature)	Klimatkommunerna: <a href="https://us2.campaign-archive.com/?u=b9cfc960214cbca85c09b6342&amp;id=3ee93badf3">https://us2.campaign-archive.com/?u=b9cfc960214cbca85c09b6342&amp;id=3ee93badf3</a>	Professionals in communes within sustainable development	500	Swedish
MUN-SE	31. May 2018	Internet platforms	Blog post on the national blog: Hållbar stad	Lund utvecklar Fjärrvarme för hållbara städer (Lund develops district heating for sustainable cities)	<a href="https://hallbarstad.se/hallbaralund/lund-utvecklar-fjernvarme-for-hallbara-stader/">Bloggen hållbar stad: https://hallbarstad.se/hallbaralund/lund-utvecklar-fjernvarme-for-hallbara-stader/</a>	Professionals within sustainable city development	1,000	Swedish
HOUSE-SE	20. Jun. 2018	Internet platforms	Article	LKF är med i EU-projektet COOL DH (LKF is part of the EU project COOL DH)	<a href="https://www.lkf.se/Om-Lkf/Nyheter-lista/LKF-ar-med-i-EU-projektet-COOL-DH/">https://www.lkf.se/Om-Lkf/Nyheter-lista/LKF-ar-med-i-EU-projektet-COOL-DH/</a>	Tenants	?	Swedish
MUN-SE	27. Jun. 2018	Internet platforms	Article	Lund banar väg för en klimatsmart framtid genom fjärrvärme (Lund shows the way for a climate smart future using District Heating)	<a href="https://www.lund.se/nyheter-och-nyhetsarkiv/2018/2018-lund-banar-vag-for-en-klimatsmart-framtid-genom-fjernvarme/">https://www.lund.se/nyheter-och-nyhetsarkiv/2018/2018-lund-banar-vag-for-en-klimatsmart-framtid-genom-fjernvarme/</a>	Citizens & media	2,000	Swedish
MUN-SE	27. Jun. 2018	Press and brochures	MyNewsDesk	Fjärrvärmeprojekt i Lund visar vägen till en klimatsmartare framtid (District Heating project in Lund shows the way to a more climate smart future)	<a href="http://www.mynewsdesk.com/se/lund/pressreleases/fjernvarmeprojekt-i-lund-visar-vaegen-till-en-klimatsmartare-framtid-2559460">MyNewsDesk: http://www.mynewsdesk.com/se/lund/pressreleases/fjernvarmeprojekt-i-lund-visar-vaegen-till-en-klimatsmartare-framtid-2559460</a>	Media	All Swedish media	Swedish
MUN-SE	27. Jun. 2018	Press and brochures	Trade journal, article in Energipress	Fjärrvärmeprojekt i Lund visar vägen till en klimatsmartare framtid (District Heating project in Lund shows the way to a more climate smart future)	<a href="http://www.energiexpress.se/fjernvarmeprojekt-i-lund-visar-va-gen-till-en-klimatsmartare-framtid">Energiexpress: http://www.energiexpress.se/fjernvarmeprojekt-i-lund-visar-va-gen-till-en-klimatsmartare-framtid</a>	Professionals within energy	1,000	Swedish
MUN-SE	28. Jun. 2018	Other activity	Seminar	ÅF Offshore Race, Stockholm		Professionals	-	Swedish
MUN-SE	29. Jun. 2018	Press and brochures	Article in Skånska Dagbladet	Nya lösningar för fjärrvärme (New solutions for District Heating)	<a href="https://web.retriever-info.com/services/archive/displayPDF?documentid=057471201806292668728ef8428d92d5e8718bd04f032&amp;serviceid=2">https://web.retriever-info.com/services/archive/displayPDF?documentid=057471201806292668728ef8428d92d5e8718bd04f032&amp;serviceid=2</a>	Citizens	17.000	Swedish



Beneficiary	Date of publication	Type of activity	Sub type	Title	Name of media	Type of audience	Approximately size of audience	Language
MUN-SE	11. sept. 2018	Newsletter	Electronic newsletter	Welcome to COOL DH newsletter #1	<a href="http://www.cooldh.eu/district-heating/cool-dh-newsletter-1-september-2018/">http://www.cooldh.eu/district-heating/cool-dh-newsletter-1-september-2018/</a>	Professionals	20	English
EHP-BE	25. Sept. 2018	Internet platforms	Conference presentation	DHC+ meeting; Helsinki	DHC+ meeting	Professionals	-	English
UTIL-SE	01. Oct. 2018	Press and brochures	Interview	Shortcut Magazine	<a href="http://shortcut.se/number-one/artiklar/kraftingen-bygger-framtidens-cirkulara-energisystem/">http://shortcut.se/number-one/artiklar/kraftingen-bygger-framtidens-cirkulara-energisystem/</a>	Professionals	-	
UNI-SE	13/14. Nov. 2018	Scientific publications	Paper and presentations	4GDH final conference, Aalborg Solutions to avoid legionella	4G DH Conference <a href="https://www.4dh.eu/conferences/conference-2018">https://www.4dh.eu/conferences/conference-2018</a>	Utilities, companies, academia	1,500	English
UTIL-SE	14/15. Nov. 2018	Other activity	Presentation	SVEBIO, Växjö	SVEBIO <a href="https://www.svebio.se/eventemang/stora-biokraft-och-varmekonferensen-2/">https://www.svebio.se/eventemang/stora-biokraft-och-varmekonferensen-2/</a>	Utilities, companies, academia	200	Swedish
MUN-DK	21. Dec. 2018	Press and brochures	Article	Fremtidens Rådhus i Høje Taastrup (The Town hall of the future in Høje Taastrup)	Building & Licitation <a href="https://www.building-supply.dk/article/view/639134/se_billederne_fremtidens_radhus_i_hoje_taastrup">https://www.building-supply.dk/article/view/639134/se_billederne_fremtidens_radhus_i_hoje_taastrup</a>	Public. Technical people in the nordic countries, building developers, companies, consultants	30,000	Danish
MUN-SE	01. Jan. 2019	Other activity	Video	Video clip	<a href="http://www.vimeo.com/313788811">www.vimeo.com/313788811</a>	Public	-	Swedish
MUN-SE	21 januari 2020	Newsletter	Electronic newsletter	LTDH-DISTRICT HEATING GOING LIVE WITH VALUABLE LESSONS LEARNED – COOL DH NEWSLETTER #3	<a href="http://www.cooldh.eu/low-temperature-district-heating/ltdh-district-heating-going-live-with-valuable-lessons-learned-welcome-to-cool-dh-newsletter-3/">http://www.cooldh.eu/low-temperature-district-heating/ltdh-district-heating-going-live-with-valuable-lessons-learned-welcome-to-cool-dh-newsletter-3/</a>	Professionals	20	English
UTIL-SE	23/24. Jan. 2019	Other activity	Presentation, poster	Distributionsdagarna (distribution days)	Exposition	Utilities, companies, academia	-	Swedish
MUN-DK	28. Jan. 2019	Press and brochures	Article	Høje Taastrup Rådhus (Høje Taastrup Town hall)	<a href="https://www.building-supply.dk/article/view/639134/se">https://www.building-supply.dk/article/view/639134/se</a>		30,000	Danish
UTIL-SE	01. Feb. 2019	Press and brochures	Article	Interview with Energiföretagen Sverige	Energiföretagen. Magasin	Utilities, companies, academia	6,000	Swedish
HOUSE-SE	26. Mar. 2019	Press and brochures	Sydsvenskan newspaper Frontpage B-delen	Byggstart för huset som slipper parkeringsplatser (Building start for the house with-out demand for parking places)	<a href="mailto:ledere@sydsvenskan.se">ledere@sydsvenskan.se</a>	Citizens in general	210,000	Swedish
MUN-SE	27 mars 2019	Newsletter	Electronic newsletter	Welcome to COOL DH newsletter #2	<a href="http://www.cooldh.eu/low-temperature-district-heating/welcome-to-cool-dh-newsletter-2/">http://www.cooldh.eu/low-temperature-district-heating/welcome-to-cool-dh-newsletter-2/</a>	Professionals	20	English
MUN-DK	14. May 2019	Press and brochures	Article	Halvdelen af alle bygge grunde nu solgt, 110 lejligheder på vej (Half of all building plots now sold in Høje Taastrup C, 110 dwelling on the way)	Lokalavisen Taastrup Bolig	Local citizens	20,000	Danish
MUN-DK	14. May 2020	Press and brochures	Newsletter	HTC næsten udsolgt	Energy Supply	Professionals	20,000	Danish
MUN-DK	14. May 2019	Press and brochures	Article	Krav til kommende datacentre, overskudsvarme skal genanvendes (Demands to coming datacentre, surplus heat must be utilised)	Lokalavisen Taastrup Bolig	Local citizens	20,000	Danish
UTIL-SE	26. Jun. 2019	Study visit	Site visit	Halmstad Energi study visit to Brunnshög	Bus	Professionals	10	Swedish
MUN-SE	04. Jul. 2019	Press and brochures	Trade journal	Dansk-Svenskt projekt utforskar lågtempererad fjärrvärme (Danish-Swedish project explores low temperature district heating)	<a href="https://hallbartbyggande.com/dansk-svenskt-projekt-utforskar-lagtempererad-fjarrvarme/">https://hallbartbyggande.com/dansk-svenskt-projekt-utforskar-lagtempererad-fjarrvarme/</a>	Professionals within sustainable city development	3,000	Swedish
UNI-SE	05. Sept. 2019	Other activity	Lecture for master students	LTDH and COOL DH	Meeting	Students	50	Swedish
COWI-DK	09. Sept. 2019	Networks and EU events	International workshop adjacent	Contractors Meeting on heat and cold utilisation called by EU	EASME Smart Energy Systems Conference 2019	Other EU funded projects	21	English
UNI-SE	10-11. Sept. 2019	Scientific publications	4 tracks in parallel plus side event	5th International Conference On Smart Energy Systems	SES 4GDH	Professionals	60	English
MUN-SE, UTIL-SE, COWI-DK	17. Sept. 2019	Internet platforms	Webinarium	COOL DH Webinar on business models	<a href="https://lund.solidtango.com/live/cool-dh-webinar-on-t">https://lund.solidtango.com/live/cool-dh-webinar-on-t</a>	Professionals	25	English

Beneficiary	Date of publication	Type of activity	Sub type	Title	Name of media	Type of audience	Approximately size of audience	Language
MUN-SE, UTIL-SE	18. Sept. 2019	Study visit	Site visit	Smart City Sweden study visit to Brunnsbög		City planners from Lithuania	10	English
EHP-BE	19. Sept. 2019	Internet platforms	Webinarium	COOL DH 1st European Technical Webinar	<a href="https://www.youtube.com/watch?v=doPvZrXup">https://www.youtube.com/watch?v=doPvZrXup</a>	Professionals	45	English
UTIL-SE	21. Sept. 2019	Other activity	Exhibition	Lågtempererad fjärrvärme på Brunnsbög under Kulturnatten	Kulturnatten	Citizens	50	Swedish
UTIL-SE, UNI-SE, IND-DK, COWI-DK	24. Sept. 2019	Networks and EU events	5 presentations: 1) Challenges with low temp district heating 2) Brunnsbög - building the world's biggest low temp district heating network with surplus heat 3) Demo Østerby Høje-Taastrup, rebuilding an existing grid to lowtemp 4) Innovation process for new plastic pipes for LTDH 5) Plastic pipes in Brunnsbög	The Future of Thermal Networks Conference + Exhibition	U-Tube LowTEMP, Sustainable Business Hub, COOL DH, Kraftringen, Intereg, Smart City Accelerator, Urban Magma	Municipalities, energy agencies, utilities, companies, academia, associations, institutes, consultants, manufacturers from 16 countries	150	English
UTIL-SE	24. Sept. 2019	Study visits	Inauguration	Inauguration of LTDH grid in Lund	Bus	Utilities, municipalities	40	Swedish
MUN-SE	25. Sept. 2019	Study visit	Site visits	Eon on study visit at Brunnsbög	Bus	Professionals	10	Swedish
EHP-BE	02 Oct. 2019	Networks and EU events	Presentation	Cool ways of using surplus heat (COOL DH demo sites)	ReUseHeat policy workshop on waste heat recovery investments	Policy makers, experts	40	English
COWI-DK	09. Oct. 2019	Networks and EU events	International workshop adjacent to C40 meeting in Copenhagen	Innovation Workshop	COOL DH event at COWI headquarters in Kgs. Lyngby	Utilities, companies, academia, associations, institutes, consultants, manufacturers from 10 countries	40	English
MUN-DK	09. Oct. 2019	Study visits	Site visits	Site visit to Brunnsbög Science Village Scandinavia, MAXIV & ESS, Ørtofte Power Plant and Kraftringen AB and Demos	Bus	- do -	40	English
COWI-DK	10. Oct. 2019	Study visits	Site visits	Site visit to Copenhagen Utility HOFOR, Seawater / Waste Water heatpump, Høje Taastrup District Heating Utility, Østerby, CITY 2 and Solar Heating Plant	Bus	- do -	40	English
MUN-SE & UTIL-SE	20 Oct. 2019	Study visits	Site visits	Study visit from Beijing	-	Professionals from China	25	English
UTIL-SE	23-24 Oct. 2019	Conference	Presentation	Conference about district heating stations and energy meters	<a href="#">Swedenergy</a>	Professionals	40	Swedish
UTIL-SE	06 Nov. 2019	Study visits	Site visits	The Skåne Association of Local Authorities visits Brunnsbög	-	Property managers	30	Swedish
UTIL-SE	19 Nov. 2019	Conference	Site visits	Climate and energy kick 2019	Public Housing Sweden	Housing professionals	100	Swedish
HOUSE-SE	20 Nov. 2019	Conference	Presentation	Climate and energy kick 2019	Public Housing Sweden	Housing professionals	150	Swedish
UTIL-SE	20 Nov. 2019	Conference	Presentation	Bruxelles Green Energy Park	<a href="http://www.greenenergypark.be">www.greenenergypark.be</a>	Professionals	40	English
MUN-SE	12. Dec. 2019	Innovation webinar	Webinar	COOL DH innovation webinar	<a href="http://www.cooldh.eu">www.cooldh.eu</a>	Professionals	80	English
EHP-BE	12. Dec 2019	Other activity	Presentation	Meeting with DG ENER officers to speak about COOL DH overview and objectives		Policy makers	2	English
COWI-DK	5. Feb. 2020	Other activity	Experience exchange	Meeting with energy planners and system developers of Copenhagen Utility HOFOR district heating.	Workshop at COWI	DH professionals	8	Danish & English
UTIL-SE	12 Feb. 2020	Conference	Presentation	Future district heating	-	DH professionals	15	Swedish
UTIL-SE	03 Mar. 2020	Seminar	Presentation	Energy communicators network	-	Energy industry in Sweden	10	Swedish
UTIL-SE	04 Mar. 2020	Conference	Presentation	Sweco Sustainability week, Theme: Energy	Sweco Sustainability week	Sustainability professionals	25	Swedish
MUN-SE	31 Mar. 2020	Webinar	Presentation	Technical solutions that makes LTDH a success – this is how we do it!	<a href="http://www.cooldh.eu">www.cooldh.eu</a>	Professionals and students	100	English
EHP-BE	16 Apr. 2020	Webinar	Presentation	COOL DH & Celsius Talk: Low Temperature District Heating	<a href="#">DHC+ Talks</a>	Cities, public authorities, DHC community	120	English
UTIL-DK	24 Apr. 2020	Press and brochures	Newsletter	Første spadestik til 70.000 m3 varmelager (First shovel on 70.000 m3 heat storage)	<a href="https://www.energy-supply.dk/article/view/747857/nordea-og-hoje-taastrup-fjernvarme-gar-sammen-om-overskudsvarme-i-2020?ref=newsletter&amp;utm_medium=email&amp;utm_source=newsletter&amp;utm_campaign=daily">https://www.energy-supply.dk/article/view/747857/nordea-og-hoje-taastrup-fjernvarme-gar-sammen-om-overskudsvarme-i-2020?ref=newsletter&amp;utm_medium=email&amp;utm_source=newsletter&amp;utm_campaign=daily</a>	Public.Technical people in the nordic countries , energy planners, energy companies, consultants	20,000	Danish



MUN-SE	28 maj 2020	Newsletter	Electronic newsletter	CORONA, WEBINARS, CPS AND NEW SUBSTATIONS: COOL DH NEWSLETTER #4	<a href="http://www.cooldh.eu/district-heating/corona-webinars-and-inspiration-welcome-to-cool-dh-newsletter-4/">http://www.cooldh.eu/district-heating/corona-webinars-and-inspiration-welcome-to-cool-dh-newsletter-4/</a>	Professionals	20	English
EHP-BE	30 June 2020	Press and brochures	Newsletter	Save the date: The Future of Thermal Grids	<a href="#">DHC+ Updates</a>	DHC Community	700	English
EHP-BE	30 Aug. 2020	Press and brochures	Newsletter	Subscribe to the COOL DH newsletter	<a href="#">DHC+ Updates</a>	DHC Community	700	English
MUN-SE	2 Sept. 2020	Newsletter	Electronic newsletter	COOL DH Our latest news	COOL DH newsletter	Subscribers	20	English
UTIL-SE	15. sept. 2020	Presentation	Conference	Greening our cities with DH	Digital conference	Municipalities, utilities etc	50	English
UTIL-SE	17 sept. 2020	Presentation	Conference	SPARK conference	Digital conference	Municipalities, industry	50	English
UTIL-SE	31 Sep 2020	Presentation	conference	User meeting Energy Opticon	Digital workshop	Utility, industry	50	Swedish
EHP-BE	30 Sept. 2020	Press and brochures	Newsletter	COOL DH at The Future of Thermal Grids Conference	<a href="#">DHC+ Updates</a>	DHC community	700	English
MUN-SE	7 Oct. 2020	Newsletter	Electronic newsletter	COOL DH Our latest news	COOL DH newsletter	Subscribers	20	English
UTIL-SE	7 Oct. 2020	Presentation	Workshop	Skanska Bridge Summit	Digital workshop	Industry	75	English
UTIL-SE	20 Oct. 2020	Presentation	Seminar	GEODE Autumn Seminar	Digital seminar	Utility, municipality	20	English
UTIL-SE	21 Oct. 2020	Presentation	Conference	Fjärrvärme centraler och Energimätare	Digital conference	Utility, industry	100	Swedish
EHP-BE	30 Oct. 2020	Press and brochures	Newsletter	From the tradition to the future: the Østerby case	<a href="#">DHC+ Updates</a>	DHC community	700	English
COWI-DK	30 Oct. 2020	Internet platforms	Dialogue meeting	Future og District Heating in Greater CPH.	Teams	HOFOR, VEKS, CTR, VF utilities	8	Danish
COWI-DK	02 Nov. 2020	Internet platforms	Dialogue mmeting	COOL DH erfa	Teams	Utilities	5	Danish
UTIL-DK	5 Nov. 2020	Press and brochures	Newsletter	Nordea og Høje Taastrup går sammen om overskudsvarmen (Nordea and Høje Taastrup Fjernvarme joins effort on using surplusheat)	<a href="https://www.energy-supply.dk/article/view/747857/nordea_og_hoj_e_taastrup_fjernvarme_gar_sammen_om_overskudsvarmen?ref=newsletter&amp;utm_medium=email&amp;utm_source=newsletter&amp;utm_campaign=daily">https://www.energy-supply.dk/article/view/747857/nordea_og_hoj_e_taastrup_fjernvarme_gar_sammen_om_overskudsvarmen?ref=newsletter&amp;utm_medium=email&amp;utm_source=newsletter&amp;utm_campaign=daily</a>	Public. Technical people in the nordic countries , energy planners, energy companies, consultants	20.000	Danish
EHP-BE	17 Nov. 2020	Networks and EU events	Webinar	From the tradition to the future: the Østerby case	Teams	DH professionals and energy planners, policy makers, public authorities	-	English
MUN-SE	25-nov-20	Internet platforms	Conference workshop	Innovation workshop by COOL DH project - Solutions for safe tap water in buildings connected to low temp networks.	Future of Thermal Grids 2020	DH professionals and energy planners	200	English
MUN-SE	26 Nov. 2020	Internet platforms	Conference workshop	Innovation Workshop by COOL DH project - How to introduce and replicate low temperature DH solutions	Future of Thermal Grids 2020	DH professionals and energy planners	200	English
MUN-SE	26-nov-20	Virtual study visit	Conference guided film	Virtual study visit to Lund and the world's largest Low Temperature District Heating-grid	Future of Thermal Grids 2020	DH professionals and energy planners	200	English

Beneficiary	Date of publication	Type of activity	Sub type	Title	Name of media	Type of audience	Approximately size of audience	Language
UTIL-DK	27 Nov. 2020	Press and brochures	Press release	Østerby project	Energy supply	Energy professionals		Danish
UTIL-DK, MUN-DK	27 Nov. 2020	Press and brochures	Press release	Østerby project	Lokalavisen	Public in general		Danish
COWI-DK	2 Dec. 2020	Internet platforms	Dialogue meeting	COOL DH erfa	Teams	Utilities	5	Danish
UTIL-DK, MUN-SE	Dec. 2020	Newsletter	Homepage	Nordea as prosumer	<a href="http://www.cooldh.eu">www.cooldh.eu</a>	Professionals		English
COWI-DK	8 Dec. 2020	Press and brochures	Press release	Solarcells on CITY* and LTDH in Høje Taastrup	<a href="http://Solceller.på.CITY2.og.lav.fremlobstemperatur.i.Høje.Taastrup.-Energy.Supply.DK.(energy-supply.dk)">Solceller.på.CITY2.og.lav.fremlobstemperatur.i.Høje.Taastrup.-Energy.Supply.DK.(energy-supply.dk)</a>	Energy professionals		Danish
UTIL-DK, COWI-DK	30 Dec. 2020	Press and brochures	Newspaper article	Solceller på CITY 2 giver beboerne mere fjernvarme for pengene (Solarcells on CITY 2 provides citizens with more district heating at less cost)	Lokalavisen Taastrup	Public in general	20.586	Danish
MUN-DK	14 Jan. 2021	Study visits	Replication site visits	COOL-DH workshop & site visit: LTDH Østerby, VP City2	Workshop	Invited from neighbouring utilities and municipalities in Greater Cph.	14	Danish
UTIL-SE	28 Jan. 2021	Internet platforms	Digital Workshop	The Role of DH in the modern energy system Fjärrvärmens roll i ett modernt energisystem.	Workshop	Professionals		Swedish
MUN-SE	10 Mar. 2021	Internet platforms	webinar	Positive Energy Districts och klimatneutrala grannskap	SGBC Syd Medlemsmöte	Professionals	50	Swedish
UTIL-SE, MUN-SE	22 April 2021	Internet platforms	Webinar	About Brunnshög and sustainable city development . 08.00-09.30 AM.	Webinar	Professionals		Swedish
Mun-DK	6 May 2021	Other activity	Workshop on heat planning	How to heat plan - a day to day approach. Challenges we often see. Inspiration from Denmark - perspectives from municipalities and a DH company. Heat supply and development in Høje-Taastrup. This presentation included information about the COOL-DH project.	DBDH (Danish Board of District Heating, Workshop sponsored by the Danish Energy Agency and the Danish Ministry of Foreign Affairs Affairs and the German region Baden-Württemberg.	Energy planners and Municipal servants from EU	50	English
UTIL-DK	1 July 2021	Newsletter	e-mail group	Varmepumper rykker ind på hovedstadens fjernvarmenet	Intelligent Energy	Professionals	5.000	Danish
UNI-SE	7 July 2021	Other activity	On line conference	Combining cooling and heating as a Central Production System (CPS) for a LTDH network	"Lessons learned from the Integration of Heat Pumps" at Institute of Refrigeration (IOR) in UK	Professionals		English
MUN-DK	14 Sept. 2021	Internet platforms	Article	A smart energy system coming to place in Danish Høje-Taastrup	Celsius city - <a href="https://celsiuscity.eu/a-smart-energy-system-coming-to-place-in-danish-hoje-taastrup/">https://celsiuscity.eu/a-smart-energy-system-coming-to-place-in-danish-hoje-taastrup/</a>	Professionals		English
UNI-SE	21 Sept. 2021	Other activity	Conference	COOL DH - A pioneering project to implement LTDH systems as an integrated part of smart energy systems	7th International Conference on Smart Energy Systems, 21st September 2021, Copenhagen	Professionals	400	English
EHP-BE	29 Sept 2021	Internet platforms	Webinar	About 5th Generation DH. 10.00-11.00 AM. 10 minute presentation about COOL DH	Celsius Webinar	Professionals		English
UTIL-SE	21 Oct. 2021	Other activity	Meeting	Meeting with Statkraft and Norsk Energi, about COOL DH.	Meeting arranged through Norwegian Energy	Professionals		Scandinavian
UTIL-SE	26 Oct. 2021	Other activity	Meeting	Meeting with "City Council Mississauga Lakeview" from Canada	Meeting arranged by Sweheat and TVL	Politicians		English
MUN-SE, UTIL-SE	11 Nov. 2021	Networks and EU events	Ceremony - receiving award	"Low temperature district heating in Brunnshög" has been selected as the winner for the 7 <sup>th</sup> Global District Energy Climate Award in the category New scheme.	International District Energy Association <a href="https://www.districtenergyaward.org/event-and-ceremony">https://www.districtenergyaward.org/event-and-ceremony</a>	Professionals worldwide		English
MUN-SE	17 Nov. 2021	Other activity	Dialogue meeting	Temamöte: Fjärrvärme	Municipal meeting	Professionals	20	Swedish
COWI-SE	17 Nov. 2021	Internet platforms	Linked-in Sweden	Think if households could be heated with surplus heat from malls, datacentres etc	Linked-in	COWI-SE Followers	173.584	Swedish
COWI-DK	18 Nov. 2021	Internet platforms	Linked-in Denmark	Opvarmning af huse med overskudsvarme. Heating of households with surplus heat	Linked-in	COWI-DK Followers	172.590	Danish
UTIL-SE	18 Nov. 2021	Networks and EU events	Hybrid Conference	"The world's largest Low Temperature District Heating (LTDH) network – Lund, Sweden"	EU LowTEMP 2.0 hybridconference on 4 <sup>th</sup> Gen DH for the Baltic Sea Region arranged by IMPPAN (Szewalski Institute of Fluid Flow Machinery Polish Academy of Science)	Professionals	100+	English
UTIL-SE	23 Nov. 2021	Networks and EU events	Meeting	"Pricing incentives to optimise the return temperature in DHC networks"	Celsius Forerunner Group (CFG) "Fossil Free"	Professionals		English
COWI-DK	26 Nov. 2022	Other activity	Meeting	ERFA meeting, with IS Vestforbænderen, Gladsaxe/Gentofte District Heating	Replication Meeting	Professionals	8	Danish
MUN-SE	26 Jan. 2022	Internet platforms	Article	Brunnshög – Where Science Heats the City - Celsius Initiative	Celsius city - <a href="https://celsiuscity.eu/brunnshog-where-science-heats-the-city/">https://celsiuscity.eu/brunnshog-where-science-heats-the-city/</a>	Professionals		English



Beneficiary	Date of publication	Type of activity	Sub type	Title	Name of media	Type of audience	Approximately size of audience	Language
MUN-SE	31 Jan. 2022	Press and brochures	Newspaper article	"Brunnshög - Where Sience Heats the City	EUROHEAT & POWER <a href="https://emagazine.ehp-magazine.com/de/profiles/ae22e601d266/editions/4143f707d262ef839254/preview_pages">https://emagazine.ehp-magazine.com/de/profiles/ae22e601d266/editions/4143f707d262ef839254/preview_pages</a>	Professionals		English
EHP-BE	13 Feb. 2022	Press and brochures	Newsletter	COOL DH Conference	Euroheat & Power Newsletter	Professionals	1,100	English
EHP-BE	14 Feb. 2022	Press and brochures	Newsletter	COOL DH Conference	DHC+ Updates	Professionals	700	English
MUN-SE	23 Feb. 2022	Internet platforms	Webinar	The world's largest LTDH grid - in Lund	Celsius Talk: Cities Going Carbon Neutral - <a href="https://celsiuscity.eu/celsius-talk-cities-going-carbon-neutral/">https://celsiuscity.eu/celsius-talk-cities-going-carbon-neutral/</a>	Professionals	30	English
EHP-BE	15 Mar. 2022	Press and brochures	Newsletter	COOL DH Conference	Euroheat & Power Newsletter	Professionals	1,100	English
MUN-SE	16 Mar. 2022	Study visits	Site visit	Energy solutions in Brunnshög - visit by a Turkish delegation	German development agency GIZ	Professionals	25	English
EHP-BE, COWI-DK et. AL.	17 Mar. 2022	Networks and EU events	Workshop	Policies and Innovative Solutions for Efficient District Heating, in collaboration with Entrain, Tempo, Celcius and Reward Heat projects	conference	Professionals and Municipal servants	40	English
COWI-DK	22 Mar. 2022	Networks and EU events	Hybrid Conference, Portugal	WG10.2 Energy systems integration - role of heating and cooling, DHC infrastructure, energy storage	Concerted Actions Plenary Meeting	Invited National representatives	50	English
MUN-SE, UTIL-SE, COWI-DK	23 Mar. 2022	Study visits	COOL DH technical workshop	Cool DH technical workshop and site visit with neighboring utilities: Öresundskraft, Landskrona Energi and Halmstad (HEM)	Replication Meeting	Professionals	25	Swedish
UTIL-DK	29 Mar. 2022	Study visits	Site visit	Site visit to demonstration plants in Høje Taastrup	Meeting	Professionals	8	English
EHP-BE	31 Mar. 2022	Press and brochures	Newsletter	COOL DH Conference	DHC+ Updates	Professionals	700	English
MUN-SE	8 Apr. 2022	Newsletter	e-mail group	Marketing final conference	Sustainable Business Hub	Professionals	5,000	Swedish
MUN-SE	19 Apr. 2022	Newsletter	e-mail group	Marketing final conference	Klimatkommunerna	Professionals	2,000	Swedish
EHP-BE	20 Apr. 2022	Press and brochures	Newsletter	Policy Webinar & COOL DH Conference	Euroheat & Power Newsletter	Professionals	1,100	English
EHP-BE	29 Apr. 2022	Networks and EU events	Webinar	COOL DH Policy Webinar	Zoom	Municipal servants and professionals		
MUN-SE	29 Apr. 2022	Networks and EU events	Meeting	About COOL DH and Brunnshög	Brunnshögsgruppen	Professionals	10	Swedish
EHP-BE	30 Apr. 2022	Press and brochures	Newsletter	COOL DH Conference	DHC+ Updates	Professionals	700	English
MUN-SE	9 May. 2022	Internet platforms	Movie	About COOL DH in Brunnshög for the EU Day 9 of May	Skåne European Office	Public		Swedish
MUN-SE, UTIL-SE, EHP-BE, COWI-DK	18 May 2022	Networks and EU events	Hybrid Conference and Site Visits, Sweden	TOWARDS NEXT GENERATION OF DISTRICT HEATING	Conference in Malmö / Lund, Sweden	Local Authority Manufacturer / Equipment Supply NGO, University, Utility / Heat supplier Consultancy / Engineering Professionals	134 (88 + 46 IRL)	English
MUN-DK, UTIL-DK, EHP-BE, COWI-DK	19 May 2022	Networks and EU events	Hybrid Conference and Site Visits, Denmark	TOWARDS NEXT GENERATION OF DISTRICT HEATING	Conference in Høje Taastrup, Denmark	Local Authority Manufacturer / Equipment Supply NGO, University, Utility / Heat supplier Consultancy / Engineering Professionals	124 (75+49 IRL)	English
UNI-SE	13-14 Sept 2022	Other activity	Conference at AUC	Xplorion: An Innovative Sustainable Building Supplied by (u-)Low Temperature District Heating System	8th 4DH conference for Smart Energy Systems	Professionals and Academia	60	English



## 8.3 Monitoring Factsheets

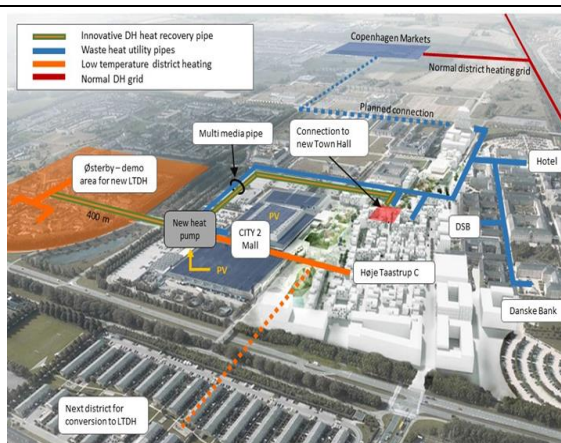
### 8.3.1 Monitoring factsheets -DK

#### COOL DH - Høje Taastrup

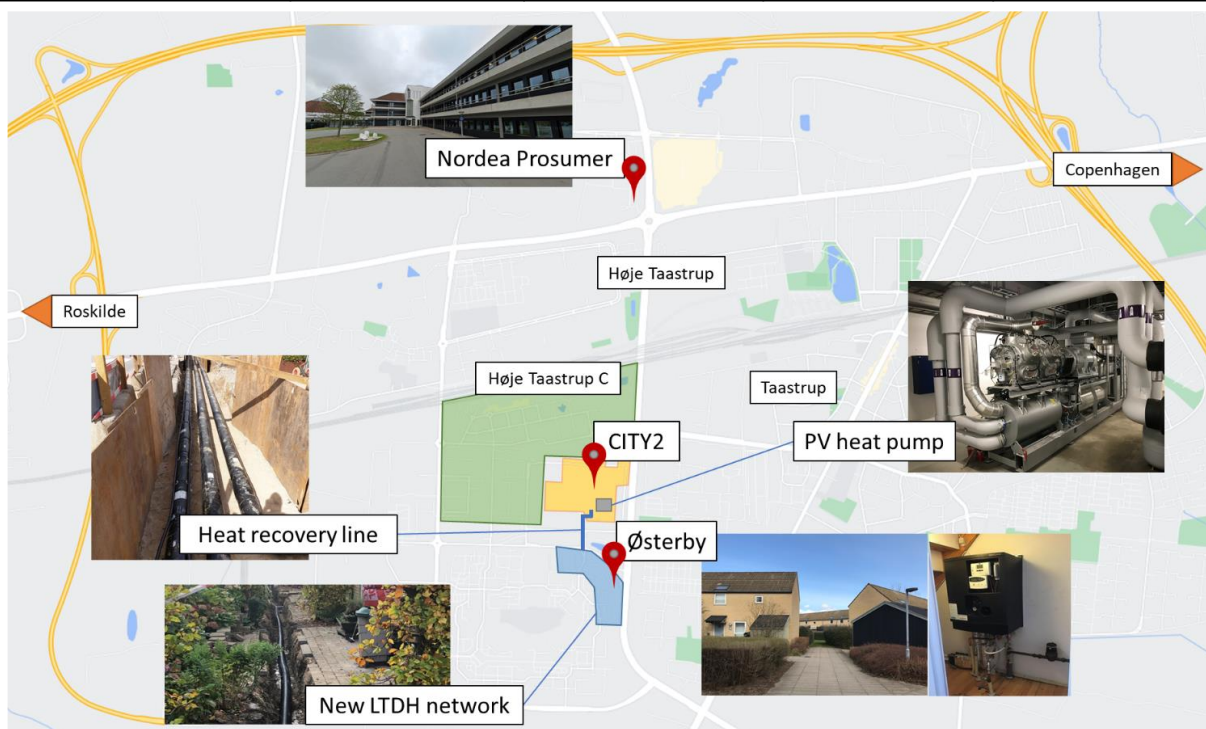
##### General Data

56°09'N 10°13'E

Country	Denmark
Region	Capital Region
City	Høje Taastrup
Start of COOL DH activities	1 <sup>st</sup> October 2017
End of COOL DH activities	30 September 2022



Demonstration	Østerby DH	CITY2	Nordea	CITY2 Heat recovery
Type of RES	RES based Low Temperature District Heating network	PV / heat pump	Heat pump	Heat recovery heat pump
Installation type	PE-RT plastic pipes	Cooling and heating co-production	Datacenter surplus heat recovery	Pipe heat loss recovery and heat pump
Year of installation	2019	2020	2020	2020
Address	Østerby district, 2630 Taastrup	Cityringen 4, 2630 Taastrup	Helgeshøj Alle 33, 2630 Taastrup	Cityringen 4, 2630 Taastrup



## Østerby - LTDH

### General Data

Cederlunden, Olivenlunden and Palmelunden, Høje Taastrup

Year built	1986
Window refurbishment	2012-2014
Address	Østerby district, 2630 Taastrup:
Building function	Residential
Building type	Terraced houses
Number of Apartments	158 + 1 (institution)
Number of houses	413 in total district
Gross Floor Area (m <sup>2</sup> )	12.604
Gross Volume (m <sup>3</sup> )	31.730
Total Investment cost [Euro]	1.99 mio. €



	Before (1986)	Actual (2021)
Roof [W/m <sup>2</sup> K]	0,2	0,2
Ground floor [W/m <sup>2</sup> K]	0,3	0,3
Windows [W/m <sup>2</sup> K]	2,9	1,8
External walls [W/m <sup>2</sup> K]	0,4	0,4



Period	Total heating delivered		Heat consumption (users)	Heat losses *)	Supply temperature to Østerby	Return temperature to Østerby
	Total MWh	Total/m <sup>2</sup> kWh/m <sup>2</sup>				
January 2021	168	13,3	136	32	86	39
February 2021	155	12,3	129	26	86	39
March 2021	134	10,6	110	24	71	40
April 2021	101	8,0	80	21	65	39
May 2021	75	6,0	55	20	61	38
June 2021	37	2,9	21	16	62	37
July 2021	31	2,5	16	15	63	38
August 2021	44	3,5	24	20	61	38
September 2021	49	3,9	29	20	69	35
October 2021	83	6,6	63	20	74	37
November 2021	106	8,4	93	13	68	39
December 2021	165	13,1	138	27	77	39
<b>Total</b>	<b>1.148</b>	<b>91,1</b>	<b>894</b>	<b>254</b>	<b>70,3</b>	<b>38,2</b>
January 2022	161	12,8	131	30	80	39
February 2022	138	10,9	111	27	79	38
March 2022	128	10,2	100	28	79	38
April 2022	99	7,9	74	25	77	38
May 2022	62	4,9	40	22	72	36
June 2022	34	2,7	n.a.	n.a.	63	37
July 2022	34	2,7	n.a.	n.a.	62	38
August 2022	37	2,9	n.a.	n.a.	66	39
September 2022	56	4,4	n.a.	n.a.	69	38
October 2022	63	5,0	n.a.	n.a.	n.a.	n.a.
November 2022	108	8,6	n.a.	n.a.	n.a.	n.a.
December 2022	163	12,9	n.a.	n.a.	n.a.	n.a.
<b>Total</b>	<b>1.083</b>	<b>85,9</b>	<b>456</b>	<b>132</b>	<b>71,9</b>	<b>37,9</b>


\*) at interim elevated temperatures of 77/38°C in 2022



## CITY2 - Main heat pump

### General Data

Cityringen 4, 2630 Taastrup

<b>New RES</b>	Heat pump: Heating and cooling	
Year installed	2020	
Installation type	Cooling and heating co-production - Heat pump	
Address	Cityringen 4, 2630 Taastrup	
Installed heating capacity	1.34 MW	
Installed cooling capacity	1.0 MW	
Estimated annual energy production at 3,000 full load hours	4,023 MWh heating + 2,970 MWh cooling	
Total Investment cost [€]	1.14 mio. €	
Supply/return temperatures, loop 1	60-70°C / 45°C	
Supply/return temperatures, loop 2	55°C / 30°C	
Cooling: supply/return temperatures, summer	6°C / 12°C	
Cooling: supply/return temperatures, winter	10°C / 15°C	

Period	Operation hours	Heat delivered to CITY2	Heat delivered to CITY2 north	Heat delivered to CITY2 south	Supply temperature to CITY2	Return temperature to CITY2
	h	MWh	MWh	MWh	°C	°C
January 2021	n.a.	1.096	331	765	n.a.	n.a.
February 2021	n.a.	1.103	417	686	n.a.	n.a.
March 2021	n.a.	850	313	537	n.a.	n.a.
April 2021	n.a.	681	244	437	n.a.	n.a.
May 2021	n.a.	338	125	213	n.a.	n.a.
June 2021	744	86	21	65	62,0	37,0
July 2021	720	82	20	62	63,0	38,0
August 2021	744	129	36	93	61,0	38,0
September 2021	840	184	56	128	69,0	35,0
October 2021	n.a.	383	127	257	74,0	37,0
November 2021	n.a.	594	172	422	68,0	39,0
December 2021	n.a.	954	281	673	77,0	39,0
<b>Total</b>	<b>3.048</b>	<b>6.479</b>	<b>2.142</b>	<b>4.337</b>	<b>67,7</b>	<b>37,6</b>
January 2022	744	890	259	631	81,0	37,0
February 2022	672	779	230	549	81,0	36,0
March 2022	743	641	192	449	82,0	38,0
April 2022	720	451	134	317	76,0	36,0
May 2022	744	218	64	154	65,0	64,0
June 2022	720	122	30	92	65,0	64,0
July 2022	672	77	22	55	62,0	38,0
August 2022	840	94	25	69	66,0	39,0
September 2022	720	145	36	110	72,0	36,0
October 2022	744	231	62	169	74,0	40,0
November 2022	720	520	144	376	76,0	36,0
December 2022	721	821	231	590	83,0	38,0
<b>Total</b>	<b>8.760</b>	<b>4.989</b>	<b>1.428</b>	<b>3.562</b>	<b>73,6</b>	<b>41,8</b>

## CITY2 - Main heat pump

### General Data

Cityringen 4, 2630 Taastrup

<b>New RES</b>	Heat pump: Heating and cooling	
Year installed	2020	
Installation type	Cooling and heating co-production - Heat pump	
Address	Cityringen 4, 2630 Taastrup	
Installed heating capacity	1.34 MW	
Installed cooling capacity	1.0 MW	
Estimated annual energy production at 3,000 full load hours	4,023 MWh heating + 2,970 MWh cooling	
Total Investment cost [€]	1.14 mio. €	
Supply/return temperatures, loop 1	60-70°C / 45°C	
Supply/return temperatures, loop 2	55°C / 30°C	
Cooling: supply/return temperatures, summer	6°C / 12°C	
Cooling: supply/return temperatures, winter	10°C / 15°C	


Period	Total cooling delivered	Volume	Supply temperature to CITY2	Return temperature to CITY2	Electricity consumption	COP <sub>h</sub>	COP <sub>c</sub>
	MWh	m <sup>3</sup>	MWh	MWh	MWh		
January 2021	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
February 2021	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
March 2021	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
April 2021	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
May 2021	0,6	722	10,0	15,0	n.a.	n.a.	n.a.
June 2021	218	29.035	10,0	16,4	n.a.	n.a.	n.a.
July 2021	399	51.723	9,0	15,6	n.a.	n.a.	n.a.
August 2021	230	32.540	9,0	14,1	n.a.	n.a.	n.a.
September 2021	117	15.111	9,0	15,7	n.a.	n.a.	n.a.
October 2021	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
November 2021	1,0	n.a.	10,0	15,0	n.a.	n.a.	n.a.
December 2021	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
<b>Total</b>	<b>966</b>	<b>129.131</b>	<b>9,8</b>	<b>15,2</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>
January 2022	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
February 2022	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
March 2022	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
April 2022	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
May 2022	n.a.	n.a.	10,0	15,0	n.a.	3,14	5,29
June 2022	122	13.811	6,0	13,7	3,20	3,13	5,25
July 2022	305	n.a.	7,0	13,4	n.a.	n.a.	n.a.
August 2022	468	n.a.	7,3	14,7	n.a.	n.a.	n.a.
September 2022	n.a.	n.a.	10,0	15,0	n.a.	n.a.	n.a.
October 2022	0	n.a.	10,0	15,0	n.a.	n.a.	n.a.
November 2022	0	n.a.	10,0	15,0	n.a.	n.a.	n.a.
December 2022	0	n.a.	10,0	15,0	n.a.	n.a.	n.a.
<b>Total</b>	<b>894</b>	<b>13.811</b>	<b>9,2</b>	<b>14,7</b>	<b>n.a.</b>	<b>3,13</b>	<b>5,26</b>



## Nordea Heat Pump

### General Data

Helgeshøj Alle 33, 2630 Taastrup

<b>New RES</b>	Heat pump	
Year installed	2020	
Installation type	Data center surplus heat	
Address	Helgeshøj Alle 33, 2630 Taastrup	
Installed heating capacity	1.8 (1.92) MW <sub>heat</sub>	
Installed cooling capacity	1.5 MW <sub>cool</sub>	
Total Investment cost	1.61 mio. €	
Annual total CO2 savings	1690 [t]	
Primary energy factor (electricity)	2,1	

Period	Operation hours	Heating delivered	Volume	Supply temperature	Return temperature
	h	MWh	m <sup>3</sup>	°C	°C
January 2021	408	1.180	35.791	73,0	43,0
February 2021	27	43	1.214	73,0	41,0
March 2021	778	1.295	38.384	73,0	42,0
April 2021	697	1.173	34.626	73,0	42,0
May 2021	703	1.188	34.872	73,0	42,0
June 2021	23	40	1.265	73,0	44,0
July 2021	n.a.	n.a.	n.a.	n.a.	n.a.
August 2021	165	522	18.381	73,0	47,0
September 2021	692	1.116	38.126	73,0	45,0
October 2021	755	1.197	33.686	73,0	43,0
November 2021	695	1.078	30.182	73,0	43,0
December 2021	677	1.040	30.207	73,0	43,0
<b>Total</b>	<b>5.620</b>	<b>9.872</b>	<b>296.734</b>	<b>73,0</b>	<b>43,2</b>
January 2022	459	1.233	35.466	73,0	43,0
February 2022	671	1.030	29.935	73,0	43,0
March 2022	706	1.058	30.742	73,0	43,0
April 2022	450	676	19.695	73,0	43,0
May 2022	331	511	15.439	69,0	30,0
June 2022	Summer closed	n.a.	n.a.	n.a.	n.a.
July 2022	Summer closed	n.a.	n.a.	n.a.	n.a.
August 2022	Summer closed	n.a.	n.a.	n.a.	n.a.
September 2022	529	771	24012	69,0	32,0
October 2022	744	1217	34625	69,0	39,0
November 2022	720	1167	26361	73,0	35,0
December 2022	744	1096	25133	75,0	39,0
<b>Total</b>	<b>5.354</b>	<b>8.759</b>	<b>241.408</b>	<b>71,9</b>	<b>38,6</b>

## Nordea Heat Pump

### General Data

Helgeshøj Alle 33, 2630 Taastrup

<b>New RES</b>	Heat pump
Year installed	2020
Installation type	Data center surplus heat
Address	Helgeshøj Alle 33, Taastrup
Installed heating capacity	1.8 MW <sub>heat</sub>
Installed cooling capacity	1.5 MW <sub>cool</sub>
Total Investment cost	1.61 mio. €
Annual total CO2 savings	1690 [t]
Primary energy factor (electricity)	2,1



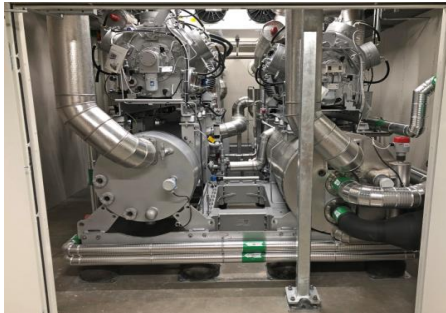
Period	Cooling delivered	Volume	Supply temperature	Return temperature
	MWh	m <sup>3</sup>	°C	°C
January 2021	842	161.837	9,0	13,5
February 2021	31	6.893	9,0	12,9
March 2021	921	187.152	9,0	13,2
April 2021	836	164.908	9,0	13,4
May 2021	841	166.097	9,0	13,3
June 2021	28	5.006	9,0	13,8
July 2021	n.a.	n.a.	9,0	n.a.
August 2021	370	72.733	9,0	13,4
September 2021	795	158.160	9,0	13,3
October 2021	864	176.042	9,0	13,2
November 2021	779	144.811	9,0	14,0
December 2021	744	136.840	9,0	14,0
<b>Total</b>	<b>7.051</b>	<b>1.380.479</b>	<b>9,0</b>	<b>13,5</b>
January 2022	879	149.574	9,0	14,0
February 2022	735	125.104	9,0	14,0
March 2022	756	129.376	9,0	14,0
April 2022	483	79.992	9,0	14,2
May 2022	363	56.803	9,0	14,5
June 2022	n.a.	n.a.	n.a.	n.a.
July 2022	n.a.	n.a.	n.a.	n.a.
August 2022	n.a.	n.a.	n.a.	n.a.
September 2022	551	82.242	9,0	14,6
October 2022	870	124.718	9,0	14,8
November 2022	871	124.607	9,0	15,0
December 2022	836	119.599	9,0	15,0
<b>Total</b>	<b>6.344</b>	<b>992.015</b>	<b>9,0</b>	<b>14,5</b>



## Nordea Heat Pump

### General Data

Helgeshøj Alle 33, 2630 Taastrup

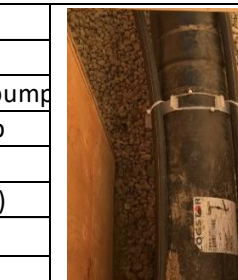
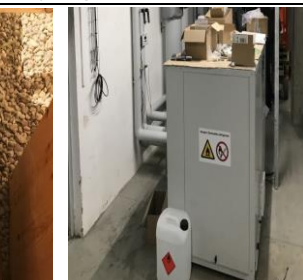
<b>New RES</b>	Heat pump	
Year installed	2020	
Installation type	Data center surplus heat	
Address	Helgeshøj Alle 33, Taastrup	
Installed heating capacity	1.8 (1.92) MW <sub>heat</sub>	
Installed cooling capacity	1.5 MW <sub>cool</sub>	
Total Investment cost	1.61 mio. €	
Annual total CO2 savings	1690 [t]	
Primary energy factor (electricity)	2,1	

Calculations				
Period	Electricity from grid	Primary energy saved	COPh including pump	COPtotal including pump
	MWh	MWh	-	-
January 2021	324	1.342	3,60	6,20
February 2021	5	63	6,74	6,20
March 2021	362	1.456	3,54	12,48
April 2021	626	694	2,34	6,09
May 2021	504	971	2,67	3,67
June 2021	0	68	n.a.	4,34
July 2021	n.a.	n.a.	n.a.	n.a.
August 2021	89	705	5,16	9,31
September 2021	309	1.262	3,57	9,31
October 2021	329	1.370	3,63	6,15
November 2021	297	1.233	3,62	6,25
December 2021	206	1.351	4,61	6,25
<b>Total</b>	<b>3.051</b>	<b>10.515</b>	<b>3,31</b>	<b>5,62</b>
January 2022	419	1.232	3,10	5,04
February 2022	213	1.318	4,45	8,29
March 2022	290	1.205	3,61	6,26
April 2022	186	768	3,60	6,23
May 2022	141	578	3,57	6,20
June 2022	n.a.	n.a.	n.a.	n.a.
July 2022	n.a.	n.a.	n.a.	n.a.
August 2022	n.a.	n.a.	n.a.	n.a.
September 2022	216	870	3,56	6,12
October 2022	335	1384	3,60	6,20
November 2022	321	1364	3,71	6,43
December 2022	302	1298	3,77	6,54
<b>Total</b>	<b>2.423</b>	<b>10.017</b>	<b>3,62</b>	<b>6,23</b>

## CITY2 - Heat recovery heat Pump

### General Data

Cityringen 4, 2630 Taastrup

<b>New RES</b>	Heat pump	 
Year installed	2020	
Installation type	Pipe heat loss recovery - Heat pump	
Address	Cityringen 4, 2630 Taastrup	
Installed capacity [kW]	6 kW	
Pipe length	350 m double (700 m total)	
Est. annual prod.	70.5 MWh	
Total Investment cost [€]	6.711	

Period	Operation hours	LTDH		Brine		Recovered heat	Electricity consumed	Delivered heat
		Supply temperature	Return temperature	Supply temperature	Return temperature			
		°C	°C	°C	°C	MWh	MWh	MWh
January 2021	n.a.	86	39	n.a.	n.a.	n.a.	n.a.	n.a.
February 2021	n.a.	86	39	n.a.	n.a.	n.a.	n.a.	n.a.
March 2021	n.a.	71	40	n.a.	n.a.	n.a.	n.a.	n.a.
April 2021	n.a.	65	39	n.a.	n.a.	n.a.	n.a.	n.a.
May 2021	n.a.	61	38	n.a.	n.a.	n.a.	n.a.	n.a.
June 2021	n.a.	62	37	n.a.	n.a.	n.a.	n.a.	n.a.
July 2021	n.a.	63	38	n.a.	n.a.	n.a.	n.a.	n.a.
August 2021	n.a.	61	38	n.a.	n.a.	n.a.	n.a.	n.a.
September 2021	n.a.	69	35	n.a.	n.a.	n.a.	n.a.	n.a.
October 2021	n.a.	74	37	n.a.	n.a.	n.a.	n.a.	n.a.
November 2021	n.a.	68	39	n.a.	n.a.	n.a.	n.a.	n.a.
December 2021	n.a.	77	39	n.a.	n.a.	n.a.	n.a.	n.a.
<b>Total</b>	<b>n.a.</b>	<b>70,3</b>	<b>38,2</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>	<b>n.a.</b>
January 2022	n.a.	80	39	n.a.	n.a.	n.a.	n.a.	n.a.
February 2022	n.a.	79	38	n.a.	n.a.	n.a.	n.a.	n.a.
March 2022	5	79	38	n.a.	n.a.	0,03	0,02	0,05
April 2022	n.a.	77	38	n.a.	n.a.	n.a.	n.a.	n.a.
May 2022	n.a.	72	36	n.a.	n.a.	n.a.	n.a.	n.a.
June 2022	5	70	47	n.a.	n.a.	0,03	0,02	0,05
July 2022	78	62	38	16	21	1,18	0,34	1,52
August 2022	122	68	37	17	22	1,90	0,53	2,43
September 2022	196	72	34	16	21	2,96	0,91	3,91
October 2022	204	69	38	16	21	2,72	1,35	4,07
November 2022	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
December 2022	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>Total</b>	<b>610</b>	<b>72,8</b>	<b>38,3</b>	<b>16,3</b>	<b>21,3</b>	<b>8,8</b>	<b>3,2</b>	<b>12,0</b>

Monitored at interim conditions

COP=3,74

### 8.3.2 Monitoring Factsheets – SE

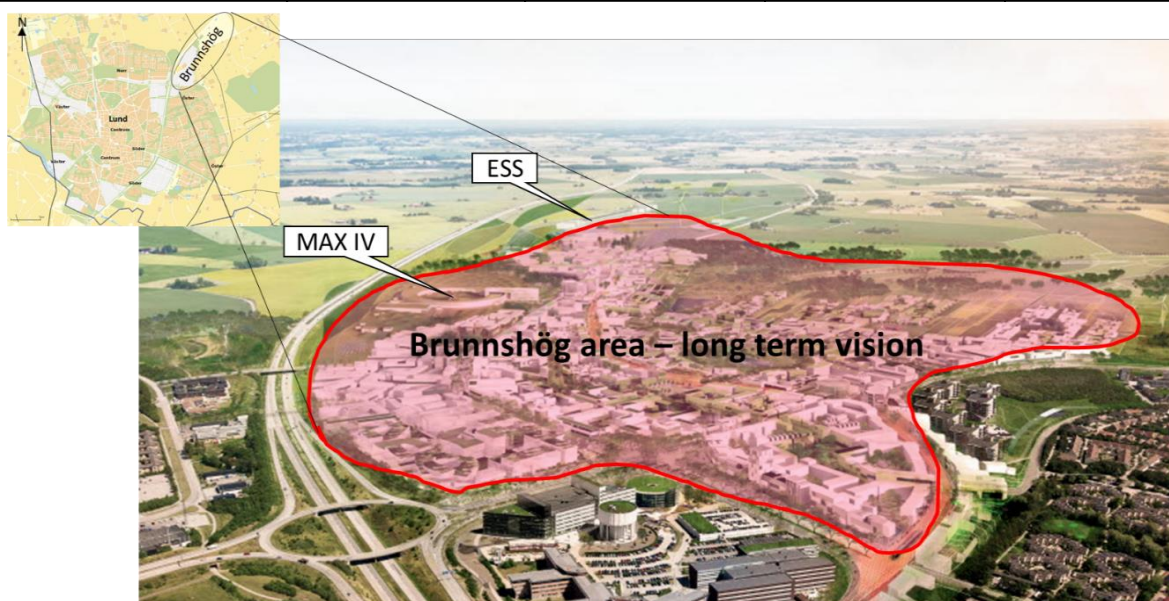
#### COOL DH - Lund

##### General Data

55°7029'N 13°1929'E

Country	Sweden	
Region	Skåne	
City	Lund	
Start of COOL DH activities	1 <sup>st</sup> October 2017	
End of COOL DH activities	31 <sup>st</sup> October 2022	

Demonstration	Xplorion	MAX IV	Lomma	Brunnshög
Type of RES	PV, and RES DH driven hot water booster heat pump and 3-pipe	RES driven heat pumps for coproduction of cooling and heating	Heat recovery pipes and supplementary heat pump	RES based Low Temperature District Heating network
Installation type	Smart building solutions	Surplus heat recovery	Heat loss recovery PEM40 pipes	PE-RT pipe network
Year of installation	2020	2018	2021	2021
Address	Brunnshögsgatan 19, Solbjerstorget 1-3, 221 01 Lund	Fotongatan 2, 224 84 Lund	Gustavshemsvägen 1A, 227 64 Lund	Brunnshög District, Lund






## Xplorion - Innovation and demonstration building

### General Data

Solbjer, Southern Brunnshög, Lund

<b>New RES</b>	HW booster, heat pump, three pipe solution	
Year installed	2020	
Installation type	Smart building solutions	
Address	Brunnshögsgatan 19, Solbjerstorget 1-3	
Heat pump capacity [MW]	35.6 kW <sub>heat</sub>	
Expected full load hours	2500 h/year	
Gross area	4374 m <sup>2</sup>	
Heated area	3606 m <sup>2</sup>	
Number of flats	54	
PV system	226 m <sup>2</sup>	
Incoming temperature range	35-65°C	


Period	PV	Heat delivered	Supply temperature	Return temperature	Total heat consumption	DHW consumption	Space Heating
			T <sub>supply</sub>	T <sub>return</sub>			
	MWh	MWh	°C	°C	MWh	MWh	MWh
January 2021	n.a.	36.830	61,2	55,4	32.160	8.915	23.245
February 2021	n.a.	33.250	61,2	54,2	29.000	6.983	22.017
March 2021	3,87	28.000	61,2	52,5	23.456	7.139	16.317
April 2021	5,29	20.100	59,1	51,6	15.600	6.423	9.177
May 2021	5,61	14.110	62,2	49,5	9.653	6.788	2.865
June 2021	6,25	8.830	61,0	48,2	4.973	5.047	-
July 2021	5,30	7.690	60,7	47,9	4.055	4.369	-
August 2021	4,48	8.490	60,7	47,9	4.673	4.974	-
September 2021	4,26	9.470	58,4	52,8	5.702	5.520	182
October 2021	2,59	14.990	55,5	48,4	10.803	5.993	4.810
November 2021	1,97	21.710	61,7	54,4	17.577	6.418	11.159
December 2021	2,27	34.090	61,0	54,4	29.792	5.681	24.111
<b>Total</b>	<b>41,9</b>	<b>237.560</b>	<b>60,3</b>	<b>51,4</b>	<b>187.444</b>	<b>74.250</b>	<b>113.883</b>
January 2022	2,59	30.340	61,0	53,4	26.205	6.037	20.168
February 2022	2,19	25.600	61,8	45,2	22.159	5.306	16.853
March 2022	5,01	22.470	60,8	32,4	19.119	6.120	12.999
April 2022	6,84	17.100	61,7	27,6	13.953	6.286	7.667
May 2022	8,67	8.850	60,4	29,2	5.610	6.067	-
June 2022	7,96	6.910	62,8	32,1	3.951	5.262	-
July 2022	8,49	5.910	60,7	32,4	3.014	4.599	-
August 2022	14,76	5.620	61,0	33,0	2.854	2.854	-
September 2022	3,50	6.760	60,0	31,0	3.816	3.816	-
October 2022							
November 2022							
December 2022							
<b>Total</b>	<b>60,0</b>	<b>129.560</b>	<b>61,1</b>	<b>35,1</b>	<b>100.681</b>	<b>46.347</b>	<b>57.687</b>



## Xplorion - Innovation and demonstration building

### General Data

Solbjer, Southern Brunnshög, Lund


<b>New RES</b>	HW booster, heat pump, three pipe solution	
Year installed	2020	
Installation type	Smart building solutions	
Address	Brunnshöggatan 19, Solbjergstorget 1-3	
Heat pump capacity [MW]	35.6 kW <sub>heat</sub>	
Expected full load hours	2500 h/year	
Gross area	4374 m <sup>2</sup>	
Heated area	3606 m <sup>2</sup>	
Number of flats	54	
PV system	226 m <sup>2</sup>	
Incoming temperature range	35-65°C	

Period	Heat delivered	Flats	Bike Garage	Laundry	Common room	Ventilation
	MWh	MWh	MWh	MWh	MWh	MWh
January 2021	36.830	29.306	1.897	559	245	153
February 2021	33.250	26.163	2.002	235	258	342
March 2021	28.000	21.279	1.517	379	236	45
April 2021	20.100	14.434	505	447	179	35
May 2021	14.110	9.205	113	174	125	36
June 2021	8.830	4.823	-	18	99	33
July 2021	7.690	3.922	1	7	61	64
August 2021	8.490	4.547	-	25	67	34
September 2021	9.470	5.537	-	51	82	32
October 2021	14.990	10.328	126	205	107	37
November 2021	21.710	16.601	505	313	116	42
December 2021	34.090	27.309	1.701	482	130	170
<b>Total</b>	<b>237.560</b>	<b>173.454</b>	<b>8.367</b>	<b>2.895</b>	<b>1.705</b>	<b>1.023</b>
January 2022	30.340	24.239	1.381	314	155	116
February 2022	25.600	20.378	1.256	286	183	56
March 2022	22.470	17.641	1.000	269	167	42
April 2022	17.100	12.971	451	334	160	37
May 2022	8.850	4.988	-	466	119	37
June 2022	6.910	3.499	-	303	117	32
July 2022	5.910	2.619	-	288	73	34
August 2022	5.620	2.834	-	371	66	33
September 2022	6.760	3.388	-	316	79	33
October 2022						
November 2022						
December 2022						
<b>Total</b>	<b>129.560</b>	<b>92.557</b>	<b>4.088</b>	<b>2.947</b>	<b>1.119</b>	<b>420</b>

## MAX IV - Heat recovery system

### General Data

Brunnshög district, Lund, Sweden

<b>New RES</b>	Heat recovery	
Year of installation	2018	
Installation type	Surplus heat recovery	
Address	Fotongatan 2, Lund	
Installed capacity - heating circuit	5.8 MW	
Installed capacity - cooling circuit	5.2 MW	
T <sub>supply</sub> /T <sub>return</sub> , heating loop 1	75-80°C / 45°C	
T <sub>supply</sub> /T <sub>return</sub> , heating loop 2	55-65°C / 30°C	
T <sub>supply</sub> /T <sub>return</sub> , cooling summer	7°C / 16°C	
T <sub>supply</sub> /T <sub>return</sub> , cooling winter	22°C / 27°C	
Estimated annual recovered heat	30,000 MWh	

Period	Operating hours	Heat delivered	Volume	Supply temperature	Return temperature	Heat delivered to LTDH	Heat delivered to DH	Heat delivered to MAX IV
	h	MWh	V m <sup>3</sup>	T <sub>supply</sub> °C	T <sub>return</sub> °C	MWh	MWh	MWh
September 2020	720	2.330	n.a.	76,4	47,0	82	2.170	78
October 2020	744	2.253	n.a.	75,8	43,5	127	2.002	124
November 2020	720	2.105	n.a.	76,2	45,5	125	1.847	133
December 2020	744	1.796	n.a.	76,1	47,3	153	1.461	182
<b>Total</b>	<b>2.928</b>	<b>8.484</b>	<b>0</b>	<b>76,1</b>	<b>45,8</b>	<b>487</b>	<b>7.480</b>	<b>517</b>
January 2021	744	1.720	52.700	76,1	48,1	194	1.297	229
February 2021	672	1.976	61.600	76,1	48,6	300	1.465	211
March 2021	744	2.116	65.700	75,9	48,3	323	1.641	152
April 2021	720	2.182	64.500	75,5	46,5	274	1.796	112
May 2021	742	2.321	62.200	75,8	43,8	265	2.000	56
June 2021	720	2.591	81.400	76,3	49,00	177	2.387	27
July 2021	737	1.618	57.300	75,6	51,4	72	1.622	65
August 2021	744	1.541	45.500	76,6	47,6	147	1.482	59
September 2021	720	2.417	65.400	76,0	44,3	202	2.215	43
October 2021	744	2.327	61.400	75,7	43,2	257	2.170	79
November 2021	720	2.328	60.300	75,7	42,6	290	1.916	122
December 2021	744	1.666	47.400	75,8	45,7	437	1.002	227
<b>Total</b>	<b>8.751</b>	<b>24.803</b>	<b>725.400</b>	<b>75,9</b>	<b>46,6</b>	<b>2.938</b>	<b>20.993</b>	<b>1.382</b>
January 2022	744	1.325	38.400	75,0	45,4	468	688	169
February 2022	672	1.991	50.800	75,5	41,9	392	1.448	151
March 2022	743	2.327	59.400	75,7	42,1	401	1.773	153
April 2022	720	2.332	59.700	75,3	41,8	307	1.922	103
May 2022	744	2.476	66.100	75,6	43,5	226	2.209	41
June 2022	720	2.666	83.700	75,5	48,2	180	2.458	28
July 2022	738	1.657	61.800	74,2	51,2	161	1.427	69
August 2022	744	1.864	64.400	74,9	50,5	161	1.669	34
September 2022	720	2.427	69.300	74,7	44,7	187	2.189	51
October 2022	744	2.461	88.490	74,9	42,5	265	2.129	67
November 2022	720	2.268	87.202	74,2	43,9	345	1.815	108
December 2022	744	1.915	91.060	74,2	49,7	588	1.114	213
<b>Total</b>	<b>8.753</b>	<b>25.709</b>	<b>820.352</b>	<b>75,0</b>	<b>45,5</b>	<b>3.681</b>	<b>20.841</b>	<b>1187</b>


\*) The supply temperature over time be reduced to 65°C, when Brunnshög is developed to utilise all the produced heat



## MAX IV - Heat recovery system

### General Data

Brunnshög district, Lund, Sweden

<b>New RES</b>	Heat recovery	
Year of installation	2018	
Installation type	Surplus heat recovery	
Address	Fotongatan 2, Lund	
Installed capacity - heating circuit	5.8 MW	
Installed capacity - cooling circuit	5.2 MW	
T <sub>supply</sub> /T <sub>return</sub> , heating loop 1	75-80°C / 45°C	
T <sub>supply</sub> /T <sub>return</sub> , heating loop 2	55-65°C / 30°C	
T <sub>supply</sub> /T <sub>return</sub> , cooling summer	7°C / 16°C	
T <sub>supply</sub> /T <sub>return</sub> , cooling winter	22°C / 27°C	
Estimated annual recovered heat	30,000 MWh	


Period	Total cooling delivered	Low temp cooling				Medium temp cooling		
	MWh	MWh	T <sub>supply</sub> °C	T <sub>return</sub> °C		MWh	T <sub>supply</sub> °C	T <sub>return</sub> °C
September 2020	1.594	857	7,0	15,9		737	22,1	27,2
October 2020	1.581	823	7,0	16,9		758	22,0	27,1
November 2020	1.470	748	7,0	16,8		723	22,1	27,1
December 2020	1.261	666	7,0	15,8		595	22,1	26,8
<b>Total</b>	<b>5.906</b>	<b>3.094</b>	<b>7,0</b>	<b>16,4</b>		<b>2.813</b>	<b>22,1</b>	<b>27,1</b>
January 2021	1.200	673	7,0	16,6		527	22,0	26,6
February 2021	1.373	677	7,0	17,2		696	22,0	27,2
March 2021	1.464	748	7,0	17,1		716	22,1	27,1
April 2021	1.522	778	7,0	17,0		745	22,1	27,2
May 2021	1.609	837	7,0	16,4		771	22,1	27,2
June 2021	1.741	978	7,0	15,6		763	22,3	27,2
July 2021	1.129	809	7,0	14,2		320	22,0	25,4
August 2021	1.007	681	7,0	14,8		326	22,0	25,1
September 2021	1.657	892	7,0	15,6		765	22,3	27,1
October 2021	1.617	859	7,0	16,8		758	22,3	27,2
November 2021	1.617	867	7,0	17,9		749	22,4	27,2
December 2021	1.147	656	7,0	15,5		491	22,3	26,2
<b>Total</b>	<b>17.083</b>	<b>9.455</b>	<b>7,0</b>	<b>16,2</b>		<b>7.627</b>	<b>22,2</b>	<b>26,7</b>
January 2022	919	531	7,0	13,5		388	22,0	26,2
February 2022	1.422	735	7,0	16,3		687	22,1	27,2
March 2022	1.676	899	7,0	16,6		777	22,0	27,2
April 2022	1.679	914	7,0	16,4		764	22,0	27,2
May 2022	1.762	983	7,0	15,5		779	22,0	27,2
June 2022	1.841	1.062	7,0	16,4		779	22,0	27,2
July 2022	1.069	767	7,0	13,1		302	22,0	24,1
August 2022	1.312	914	7,5	14,5		399	22,3	25,6
September 2022	1.692	920	7,0	15,5		772	22,7	27,3
October 2022	1.706	822	7,0	15,3		784	22,4	27
November 2022	1.579	843	7,1	15,5		736	22,4	27
December 2022	1.219	716	7,0	14,8		584	22,6	26
<b>Total</b>	<b>17.876</b>	<b>10.106</b>	<b>7,1</b>	<b>15,3</b>		<b>7.751</b>	<b>22,2</b>	<b>26,7</b>



## MAX IV - Heat recovery system

### General Data

Brunnshög district, Lund, Sweden

<b>New RES</b>	Heat recovery	
Year of installation	2018	
Installation type	Surplus heat recovery	
Address	Fotongatan 2, Lund	
Installed capacity - heating circuit	5.8 MW	
Installed capacity - cooling circuit	5.2 MW	
Tsupply/Treturn, heating loop 1	75-80°C / 45°C	
Tsupply/Treturn, heating loop 2	55-65°C / 30°C	
Tsupply/Treturn, cooling summer	7°C / 16°C	
Tsupply/Treturn, cooling winter	22°C / 27°C	
Estimated annual recovered heat	30,000 MWh	

Period	Heat delivered	Total cooling delivered	Electricity consumption	COP		
	MWh	MWh	MWh	COPh	COPc	COPT
September 2020	2.330	1.594	806	2,89	1,98	4,87
October 2020	2.253	1.581	757	2,98	2,09	5,06
November 2020	2.105	1.470	729	2,89	2,02	4,90
December 2020	1.796	1.261	641	2,80	1,97	4,77
<b>Total</b>	<b>8.484</b>	<b>5.906</b>	<b>2.933</b>	<b>2,89</b>	<b>2,01</b>	<b>4,91</b>
January 2021	1.720	1.200	638	2,70	1,88	4,58
February 2021	1.976	1.373	725	2,73	1,89	4,62
March 2021	2.116	1.464	765	2,77	1,91	4,68
April 2021	2.182	1.522	762	2,86	2,00	4,86
May 2021	2.321	1.609	793	2,93	2,03	4,96
June 2021	2.591	1.741	913	2,84	1,91	4,74
July 2021	1.618	1.129	673	2,40	1,68	4,29
August 2021	1.541	1.007	560	2,75	1,80	4,55
September 2021	2.417	1.657	818	2,95	2,03	4,98
October 2021	2.327	1.617	779	2,99	2,08	5,06
November 2021	2.328	1.617	793	2,94	2,04	4,98
December 2021	1.666	1.147	590	2,82	1,94	4,77
<b>Total</b>	<b>24.803</b>	<b>17.083</b>	<b>8.809</b>	<b>2,82</b>	<b>1,94</b>	<b>4,75</b>
January 2022	1.325	919	490	2,70	1,88	4,58
February 2022	1.991	1.422	654	3,04	2,17	5,22
March 2022	2.327	1.676	760	3,06	2,21	5,27
April 2022	2.332	1.679	757	3,08	2,22	5,30
May 2022	2.476	1.762	817	3,03	2,16	5,18
June 2022	2.666	1.841	941	2,83	1,96	4,79
July 2022	1.657	1.069	646	2,57	1,65	4,22
August 2022	1.834	1.312	996	1,87	1,32	3,19
September 2022	2.427	1.692	841	2,89	2,01	4,90
October 2022	2.461	1.706	832	2,96	2,05	5,01
November 2022	2.268	1.579	811	2,80	1,95	4,74
December 2022	1.915	1.219	746	2,57	1,63	4,20
<b>Total</b>	<b>25.679</b>	<b>17.876</b>	<b>9.291</b>	<b>2,77</b>	<b>1,92</b>	<b>4,69</b>

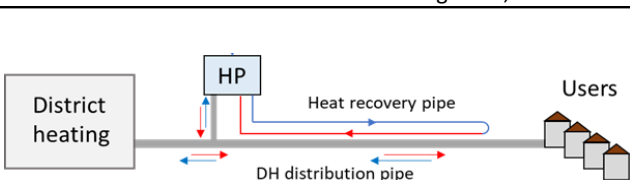


## Heat recovery pipes and heat pump

### General Data

Gustavshemsvägen 1A, 227 64 Lund

<b>New RES</b>	Heat recovery - Heat pump
Year installed	2021
Installation type	PEM40 pipes and heat pump
Address	Gustavshemsvägen 1A, 227 64 Lund
Total pipe section length [m]	100 (double)
Total capacity [kW]	6,0
Est. annual prod.	125
Total Investment cost [€]	11.668





Period	Operation hours	Recovered heat	Heat delivered to DHW	Brine/Isopropyl alcohol (IPA) 27%		Electricity consumption	COP
				T <sub>supply</sub>	T <sub>return</sub>		
	h	MWh	MWh	°C	°C	MWh	COPh
January 2021	87	192	313	16,6	9,8	121	2,6
February 2021	183	123	378	12,8	7,4	255	1,5
March 2021	145	198	402	16,4	10,8	204	2,0
April 2021	111	159	316	19,9	15,0	157	2,0
May 2021	90	139	266	22,5	17,4	127	2,1
June 2021	58	82	162	28,4	24,4	80	2,0
July 2021	77	198	308	29,9	25,2	110	2,8
August 2021	127	399	594	26,2	21,6	195	3,0
September 2021	173	623	903	24,3	18,6	280	3,2
October 2021	248	879	1.282	17,4	13,4	403	3,2
November 2021	261	961	1.400	14,3	10,3	439	3,2
December 2021	295	878	1.344	8,9	5,4	466	2,9
<b>Total</b>	<b>1855</b>	<b>4.831</b>	<b>7.668</b>	<b>19,8</b>	<b>14,9</b>	<b>2.837</b>	<b>2,7</b>
January 2022	325	966	1.476	9,7	6,1	510	2,9
February 2022	332	936	1.419	9,6	6,1	483	2,9
March 2022	341	1.067	1.609	10,2	6,6	542	3,0
April 2022	273	902	1.348	13,5	9,9	446	3,0
May 2022	235	885	1.279	18,9	15,6	394	3,2
June 2022	150	564	810	25,1	19,9	246	3,3
July 2022	109	389	560	26,4	23,4	171	3,3
August 2022	124	460	651	28,3	24,1	191	3,4
September 2022	200	790	1.122	22,7	18,3	332	3,4
October 2022							
November 2022							
December 2022							
<b>Total</b>	<b>2.089</b>	<b>6.959</b>	<b>10.274</b>	<b>18,3</b>	<b>14,4</b>	<b>3.315</b>	<b>3,1</b>

## LTDH network in Brunnshög

### General Data

Brunnshög, Lund, Sweden

<b>New RES</b>	LTDH network		
Year installed	2021		
Installation type	PE-RT pipe network		
Address	Brunnshög, Lund, Sweden		
Total pipe length [m]	1.860		
Heat delivered from	MAX IV		
Heat planned from	ESS		

Period	Operating hours	Total heat delivered	Total heat consumed	Heat loss *)	Supply temperature $T_{\text{supply}}$	Return temperature $T_{\text{return}}$	COP
	h	MWh	MWh	MWh	°C	°C	
January 2021	744	194	158	36	64,1	46,1	0,8
February 2021	672	300	168	132	66,6	47,0	0,6
March 2021	744	323	170	153	67,1	48,4	0,5
April 2021	720	274	125	149	67,0	49,2	0,5
May 2021	744	265	81	184	66,8	54,1	0,3
June 2021	720	177	40	137	67,0	60,8	0,2
July 2021	744	72	35	37	66,6	58,7	0,5
August 2021	744	147	45	102	66,8	57,2	0,3
September 2021	720	203	52	151	67,0	56,5	0,3
October 2021	744	257	108	149	67,0	54,2	0,4
November 2021	720	290	149	141	67,0	51,4	0,5
December 2021	744	437	262	175	67,0	48,7	0,6
<b>Total</b>	<b>8760</b>	<b>2.939</b>	<b>1.393</b>	<b>1.546</b>	<b>66,7</b>	<b>52,7</b>	<b>0,5</b>
January 2022	744	468	267	201	66,9	47,9	0,6
February 2022	672	392	210	182	66,9	49,0	0,5
March 2022	744	401	210	191	67,0	52,4	0,5
April 2022	720	307	135	172	67,0	54,4	0,4
May 2022	744	226	95	131	67,0	57,6	0,4
June 2022	720	180	55	125	67,0	60,0	0,3
July 2022	744	161	50	111	63,0	55,0	0,3
August 2022	744	161	Missing	Missing	64,0	56,0	n.a.
September 2022	720	187	Missing	Missing	67,0	57,0	n.a.
October 2022	744	265					
November 2022	720	345					
December 2022	744	588					
<b>Total</b>	<b>6552</b>	<b>3.681</b>	<b>1.022</b>	<b>1.113</b>	<b>66,2</b>	<b>54,4</b>	<b>n.a.</b>

\*) The high heat losses are a result of few consumers. This leads to higher return temperatures and higher heat losses.