Interreg
EUROPEAN UNION
North-West Europe
HeatNet NWE
European Regional Development Fund

Developing District Heating in North-West Europe

A Guide for Energy Companies

Who is this guide for?

This guide is meant to provide an introduction to 4th Generation District Heating and Cooling (4GDHC). Its content is intended for energy companies, not only those operating District Heating and Cooling networks, but also for traditional energy companies which may be interested in new business models for energy supply.

It is not designed to provide an exhaustive overview of every aspect related to 4GDHC. Rather, it can be used as a medium to facilitate discussions between actors involved in such projects and to seek out new business opportunities.

More detailed guides are available through the HeatNet NWE project. Please visit **www.nweurope.eu/heatnet**.

Context - What is 4GDHC?

For many years, the European Commission and the member states have been aiming to improve the energy efficiency of buildings and delivering low carbon energy to consumers. Several laws and strategy packages have been adopted to this end, such as the Energy Performance of Buildings Directive 2010, the Energy Efficiency Directive 2012, and the Heating and Cooling Strategy 2016. The process of switching from fossil fuels to renewable energy and the mandatory renovation of the existing building stock is in motion.

4GDHC has a crucial role to play in this scenario; both heating and cooling solutions evolved tremendously in the past decades. The technical evolutions of District Heating and Cooling towards a fourth generation can be synthesized into three main areas.

1. Higher energy efficiency

By delivering heat at 50-60°C (return at 25-30°C), energy losses in the distribution network are reduced, coefficients of performance and conversion efficiency of a number of technologies (e.g. heat pumps) are improved. Additionally, cooling solutions are more easily integrated (e.g. absorption chillers) and can feed the heating system (with the heat produced to generate cooling).

2. Further integration of low-carbon energy sources

The lower operating temperatures allow for the use of renewable energy and waste heat. Data-centres, waste treatment facilities, solar fields, biomass and geothermal power plants become economically viable alternatives.

3. Improvement of storage solutions

Daily and seasonal storage facilitates the adoption of renewable energy production sources, creates synergies with the electricity network by offering more possibilities to convert electricity into heat, helps smooth peak loads and consequently improves the design of the network with reduced pipe sizes.

Myth: High energy performance of buildings, an obstacle to 4GDHC

One of the questions mostly faced when addressing the topic of DHC is ‹‹how to combine 4GDHC with the growing number of high efficiency buildings and the retrofitting of the existing building stock?››. Well, the technical advantages of 4GDHC compared to the previous generations just mentioned generate new business cases.

Smaller and consistent demand of newly built buildings, as well as the low temperature heating equipments (e.g. floor heating, larger radiators) that they integrate, ease the connection to 4GDHC.

Several studies and projects have been conducted to attest the feasibility of such connections. One example is the pilot project of Lystrup in Denmark, where a low temperature district heating network (supply at 50°C) was built to expand an existing network operating at 80°C/60°C (winter/summer time), allowing the successful supply of high energy performance buildings.

Image courtesy of Aberdeen Sports Village

The benefits of 4DHC

What is the value that you create, that will make customers connect to the DHC network and prevent them from opting for another solution?

4GDHC has many benefits, displayed below:

1. Environmental sustainability

~ As mentioned previously, the European Union set goals and targets in terms of RES use and CO_2 emissions reduction. 4GDHC helps increase the share of renewable energy in the global mix, while meeting the required level of supply of energy by combining various solutions. Air quality is improved as we get rid of old fossil-fuelled equipment, and the increased use of air-conditioning heat pumps will reduce the need for cooling systems using refrigerants.

2. Increase in comfort and safety

~ Taking the energy production unit out of the dwelling will reduce inside noise and increase the space available. Plus, we limit the occurence of incidents due to poor maintenance of installations by the occupants or malfunctions of boilers.

3. Affordable energy

~ Historically, District Heating and Cooling have been developed to protect the population against oil crisis. The heat production from different sources (including local and renewable sources) reduces dependency on the fluctuations of international energy markets. DHC projects can help tackle fuel poverty of households.

4. Revenue and job creation

~ Depending on the ownership structure, local exploitation of resources offers the possibility to retain the profits at the local level, which can in turn increase the revenues of the municipality. For businesses, providing heat that was previously wasted to a district heating and cooling network means the diversification of revenue sources. Plus, existing plants oversized for their current use could benefit from connecting to a network of additional customers.

~ Jobs can be created with the development of a local biomass supply chain and, thanks to the training of local installers, to handle and maintain equipments in good condition.

5. Investment opportunity

~ Existing DHC schemes that demonstrated their effectiveness can become attractive business opportunities for funds that seek to diversify their investment portfolio with green projects.

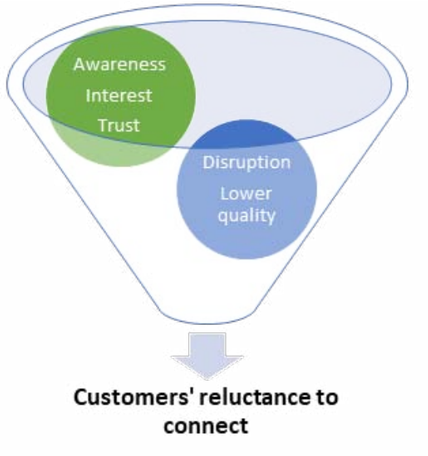
6. Energy independence

~ The exploitation of local sources of energy will lead to the reduction of importation of fossil fuels, strengthening self-sufficiency. The synergies with the electricity network will help reduce pressure on the grid.

Identifying customers' concerns

To get residential customers to connect to a district heating and cooling network, companies must first and foremost have a technical and financial offer ready, displaying the responsibilities of everyone in terms of maintenance, ownership, payments, etc. Moreover, customers have other concerns that we will now cover.

In a report prepared for the Committee on Climate Change in November 2015 by Frontier Economics Ltd, a consulting firm, five customers' non-financial barriers were identified that would fit into two categories: those induced by attitudes and those by perceptions of DHC.



• Lack of awareness

In general, people know little about alternatives to traditional heating systems such as gas boilers. For example, heat pumps are still unfamiliar to most people.

• Lack of interest

Heating technologies tend to be bought for their technical characteristics and for the savings they yield. While mentalities are evolving, solely the environmental advantages would not be a sufficient argument for people to connect, and may have to be accompanied by other sales arguments.

• Lack of trust

Trust regarding the companies which manage the whole DHC operation is key to getting people to connect to the network.

• Perceived lack of quality

Going hand-in-hand with the lack of awareness, people still tend to see DHC as a singular choice for heating and cooling. They can be afraid of losing some of their freedom of choice as how to heat or cool down their dwelling.

• Disruption

Refurbishment and installation works, the time spent contacting installers, noise, etc. are all arguments that are raised when discussing the matter of connecting to a DHC network.

Addressing customers' concerns

Now that we have these concerns in mind, what can we do to address them?

Residential customers

Before the project actually starts, you will need to create awareness about your value proposition, as DHC is not yet common in North-West Europe. Regardless of the medium of communication, people should be able to get information about DHC technology (without excluding the existing cons), a price simulation function, the timeline and allowed flexibility of the project.

Designating a « DHC ambassador » helps put a face on a project. Info-events specific to a sub-section of the district can also help create a sense of community: knowing that they are connected to their neighbours will make people feel part of a movement, making the case for the environmental message associated with DHC.

Once the network is up and running, emails, annual reports or invoices accompanied by project updates will help maintain customers' confidence. Finally, DHC projects can gather multiple actors. Establishing how complaints are taken and by whom they are handled is essential. Initiatives to ensure that a certain customer service standard is met have emerged, such as the Heat Trust Scheme by Heat Customer Protection Limited in the United Kingdom.

Corporate actors

In comparison with residential customers, you will have to modify the level of technical language used depending on who you are facing: is it an engineer, an economist or someone from the legal department? Questions about maintenance, property access, technical adjustments to current operations, etc. will arise.

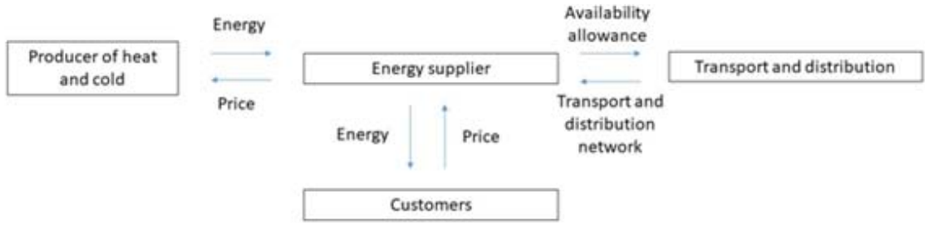
Furthermore, corporate actors may be tied to existing long-term contracts that could be difficult to break. In addition, most of the time international brands have to comply with a group's policy in terms of energy supply.

In general, those actors will require a personal approach in order to find the right intermediary inside the organisation, to assess their specific needs and to determine the best moment to connect.

More information specific to energy consumers and the public sector can be found in similar guides produced as part of the Interreg HeatNet NWE project.

Roles of market players

In a feasibility study, 3E, Greenvis Energy Solutions and Stibbe (2013) broke down the roles of the actors in a DHC project as follows:



A number of possibilities of how these roles are allocated exists, ranging from fully integrated into one organisation, to unbundled roles (see table on the opposite page).

Mix-models can also be found, where an organisation takes on two functions.

While not highlighted in the table on the opposite page, maintenance operations are a key aspect of the project. Several examples exist where poor maintenance led to the decommissioning of a network.

Administration, metering and billing functions also need to be distributed among partners.

As the study demonstrates, this distribution will depend on several factors:

- Integration of heat and cold production functions
- Compensation mechanisms
- Numbers of producers and customers
- Expertise and risk appetite of actors
- Contractual relations

SCENARIO: INTEGRATION

BENEFITS

- Low organisational costs
- High administrative efficiency

DISADVANTAGES

- All risks are internalised
- If only a few customers are connected, strong interdependence which often implies long-term contracts
- Particular attention to the consequent natural monopoly effect; protection of consumers is needed

ADDITIONAL INFORMATION

- Often found where a public company owns an energy production source (e.g. waste incinerator)

SCENARIO: UNBUNDLED ROLES

BENEFITS

- Attribution of risks to the partner best suited to manage them

DISADVANTAGES

- The energy supplier bears the majority of the risk by buying the energy at a certain cost and selling it at another one. The other parties (debtors) will need strong financial guarantees from the energy supplier.

ADDITIONAL INFORMATION

- The energy supplier is the key actor who makes the link between the production side and the demand side

Contractual relationships

Contracts will need to be established to, amongst others, clarify the roles, responsibilities, risks and level of service quality to achieve.

The District Heating Manual for London, published by the Greater London Authority in 2013, lists the most commonly-used contracts and the attached requirements:

TYPE	DESCRIPTION	CONTRACTS REQUIRED
ESCo	An energy services company (ESCo) undertakes to supply heat to the customers, and for that purpose to build and operate the DH system. This could be set up with a defined set of consumer buildings to be connected, or to provide the service to developments within a defined area.	· Master agreement · Connection contract · Heat supply contract · Service level agreement (SLA) · Property leases
Wholesale supply of energy (Design-Build-Operate)	A sponsor appoints a single contractor to design, build, operate and supply wholesale heat and electricity. The sponsor sells the energy retail to consumers, and may be a consumer itself.	· DBO Contract · Wholesale heat supply contract with SLA · Connection contract · Property leases
Network delivery and operation	A sponsor (such as an owner of tenanted properties) appoints one or more contractors to design, build, operate and maintain a DH network but the sponsor remains the asset owner and contracts to supply heat and electricity to consumers. The sponsor may also purchase the fuel required.	· D&B contract · O&M contract with SLA · (Metering and billing contract) · (Connection contract)
Network operation	An operator is contracted to run a DH system that has already been constructed, for example under a main building contract. The operator may also be contracted to undertake metering and billing and customers services, if the landlord wishes to outsource these activities.	· O&M contract with SLA (Metering and billing contract)

DHC often involves both private and public stakeholders to a certain extent. Public authorities should be consulted when developing a DHC project as they may find strong incentives to take a role.

In that respect, a variety of contractual relationships involving public and private parties can be encountered, such as those listed in the table to the right.

BLT	Build - Lease - Transfer
BOO	Build - Own - Operate
BOOT	Build - Own - Operate - Transfer
BOT	Build - Operate - Transfer
BRT	Build - Rent - Transfer
D&B	Design - Build
DB(F)O	Design - Build - (Finance) - Operate
PFI	Private Finance Initiative
FBOOT	Finance - Build - Own - Operate - Transfer
O&M	Operation - Maintenance

Adapted from CoolHeating (2017) & Greater London Authority (2013)

Additional resources

• Lystrup's case
Christiansen & co (2012), « Technical paper: Results and experiences from a 2-year study with measurements on a low-temperature DH system for low energy buildings », published for the DHC13, the 13th International Symposium on District Heating and Cooling

• Customers' non-financial barriers
Frontier Economics Ltd London (2015), « Research on district heating and local approaches to heat decarbonisation - Annex 1: Overcoming barriers to district heating »

• Customer service standard
Heat Trust Scheme, www.heattrust.org

• Business models and governance
- 3E, Greenvis Energy Solutions, Stibbe (2013), « Haalbaarheidstudie warmtenet Genk-Zuid »
- Centre for Sustainable Energy (2013), « A guide to Community Energy Services Companies »
- Chittum&co (IEA, 2017), « Annex XI Final Report: Governance Models and Strategic Decision-Making Processes for Deploying Thermal Grids»
- CoolHeating (2017), « Guidelines on improved business models and financing schemes of small renewable heating and cooling grids »
- Greater London Authority (2013), « District Heating Manual for London », p.46-51
- The Association for Decentralised Energy & CIBSE, Launch of Heat networks: code of practice for the UK (2015), PowerPoint accessible on http://www.cibse.org/
- UNEP (2015), « District Energy in Cities - Unlocking the Potential of Energy Efficiency and Renewable Energy »

Further information

This guide has been developed as part of the HeatNet NWE project, which is part-funded through the Interreg NWE programme and aims to increase the uptake of 4DHC networks across North-West Europe. As part of this project, the partners are developing the *HeatNet Model*, which will help the public sector to begin implementing 4DHC networks, and the *Transition Roadmaps*, which will outline the partners' experience in developing six district heating pilots across North-West Europe. *The HeatNet Guide to Financing* is also currently being developed and will give a broad overview of the various sources available to finance district heating schemes.

For further information on these reports and on the HeatNet NWE project, please visit: **www.nweurope.eu/heatnet**.

If you are interested in district heating projects and would like further information, please contact your local contact point within the HeatNet NWE project (see individual contact details on the next page).

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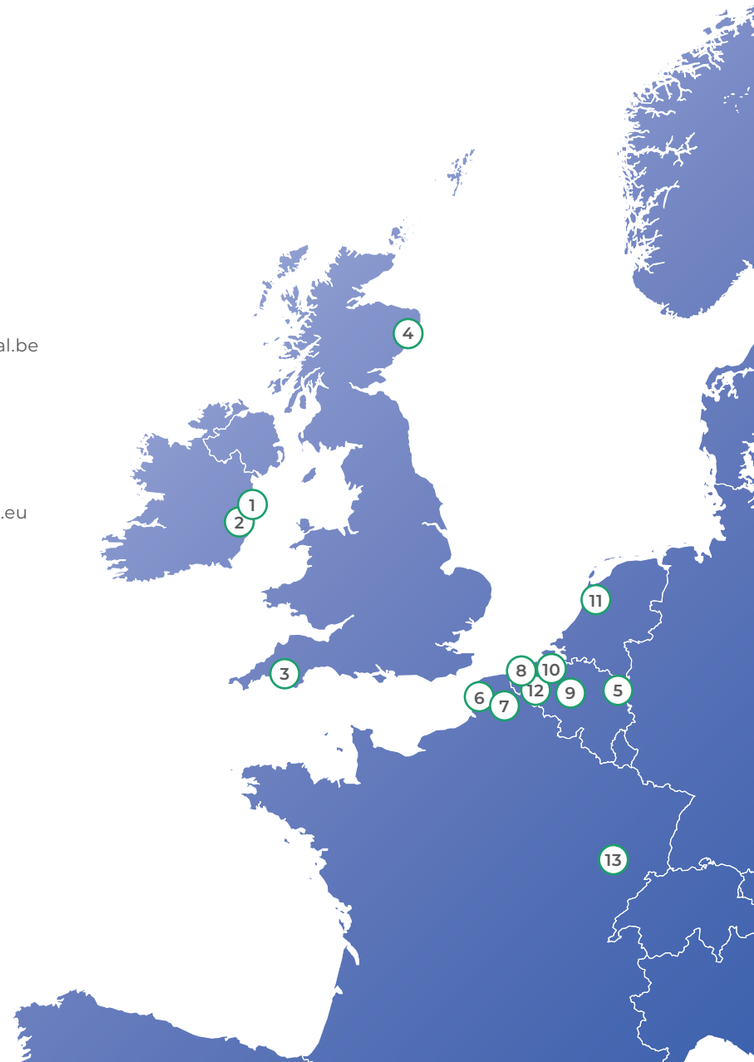

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