Non-technical guide to 4DHC

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About HeatNet NWE

This document 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.guidetodistrictheating.eu.

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Introduction

Half of the European Union's energy consumption is used for heating and cooling (see Figure 1) and a third for space heating, cooling and hot water. Unfortunately, most of it is still generated from fossil fuels (see Figure 2). The share of renewable energy in the heating and cooling sector is between 13% and 20% depending on the share of renewable energy of the electricity and the district heating and cooling sector. In Europe, 9% of the heating and cooling comes from DHC but with a high variability between countries in the DHC share. In order to reduce significantly the use of fossil fuels, the European Commission adopted a heating and cooling strategy in the beginning of 2016 as part of the Energy Union Package. A great number of activities and projects have and will continue to be funded through this new strategy.

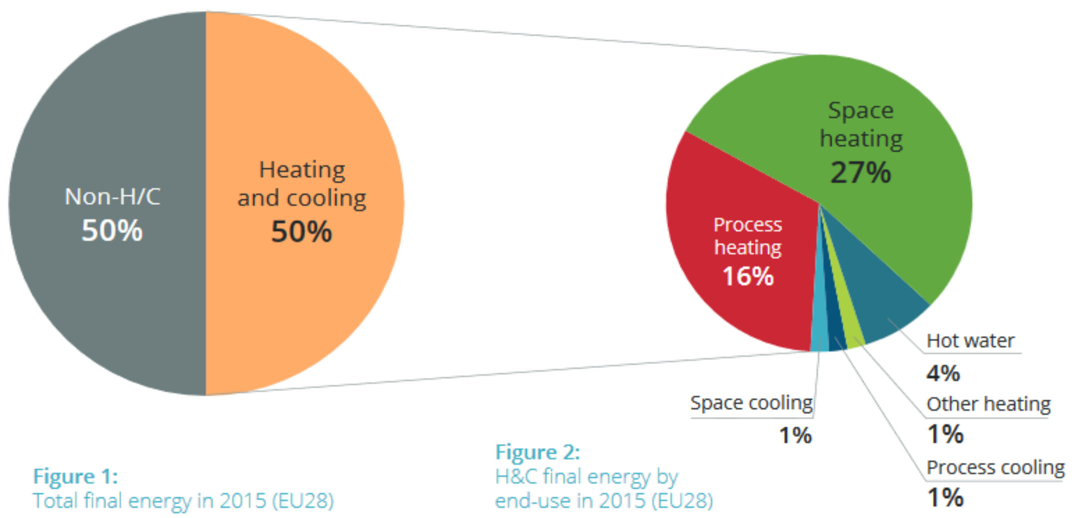

Figure 1: energy consumption in Europe (source: Heating and cooling, facts and figures, Heat Roadmap Europe, 2017)

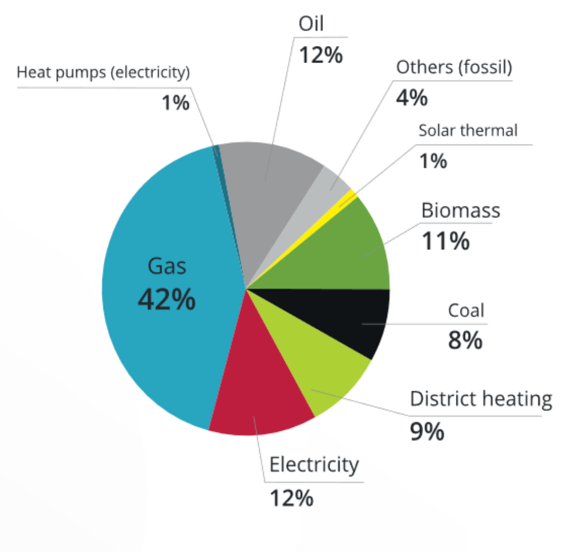

Figure 2: Heating and cooling energy mix (source: heating and cooling, facts and figures, Heat Roadmap Europe, 2017)

The Interreg project HeatNet North West Europe (NWE) ties in with the European heating and cooling strategy. The overall objective is to introduce and demonstrate 4th generation district heating and cooling (4DHC) in this part of Europe. Only 2 to 7% of heating and cooling in North West Europe is covered by district heating and cooling, whereas in North and East Europe the share of district heating and cooling can reach more than 50%. 4DHC is tried and tested elsewhere, delivering low-carbon energy systems characterized by: multiple renewable and low-carbon energy sources (including waste heat), low-temperature distribution to minimize heat losses, integrated energy storage, heat and cold supply to multiple low energy buildings.

In order to spread 4DHC in NWE, where district heating and cooling has not fully taken root, the development of new institutional and organizational frameworks is necessary. This is detailed for each country of the NWE area in Deliverable 1.1 of the Long Term Work Package of the HeatNet NWE project; the report lays out the national, regional and local policies, and gives recommendations for policy makers to develop 4DHC.

Through six living labs (Aberdeen – Scotland, Kortrijk – Belgium, Boulogne sur Mer – France, Plymouth – England, Heerlen – Netherland, Dublin – Ireland), HeatNet NWE aims to save 5,500 tCO2/year and to create a HeatNet model which will help to implement 4DHC in NWE. As an example, the Transition Roadmap of South Dublin City Council estimates that the implementation of the 4DHC developed in the course of the HeatNet NWE project will result in a potential carbon reduction of 250,000 tCO_2/year. The model will assess the technical, institutional and organizational aspects of 4^{th} generation district heating and cooling, and provide tips for further roll out of the technology.

What is 4th generation district heating and cooling?

History of DHC, from 1st generation to 4th generation DHC

As building and transport systems have evolved, district heating has developed through several generations since its first introduction, as is depicted in Figure 3. First generation district heating appeared in Europe at the end of the 19th century. At this time, the environmental impact and Carbon footprint were not main drivers in the use of district heating. Coal and oil were the main fuels used in these systems to produce high temperature heat in the form of steam.

Second-generation district heating systems started to develop in the 1930s. The energy efficiency of these systems increased because of the lowering of the temperature of the produced heat. In these systems, steam was replaced by pressurized hot water. During the oil crisis in the seventies, district heating was looked upon as a means of reducing Europe’s dependency on imported fossil fuels.

It was during this period that third generation district heating started to appear. These systems utilised cleaner sources of heat such as, biomass, waste heat from industry, geothermal energy, solar energy etc. and pipes used in these networks were pre-insulated. The temperature in these pipes also decreased and energy efficiency continued to improve. Third generation district heating is still in operation today and remains an efficient source of heat for existing buildings. Third generation district heating benefits from economy of scale due to centralized production using access to specific sources of heat. Indeed, no building-level individual heating system can exploit waste heat or deep geothermal heat and find a financial balance. Third generation DHC can significantly reduce the use of fossil fuels within highly developed areas. It enables the use of renewable energy in existing buildings and city centres. Further reduction of energy use within buildings is necessary, and the exploitation of waste heat and renewable energy may present challenges to current third generation DH systems.

The use of 4th generation district heating and cooling aims to address these challenges by adapting district heating and cooling for low energy buildings and helping the development of renewable energy by using lower temperature waste heat and connecting the electricity network and the thermal grid. To overcome these challenges, the temperature of 4DHC must be reduced further and new systems must be incorporated. These changes help with:

- Heat loss reduction;
- Increase in the efficiency of the thermal based heating production facility;
- Increase in the efficiency of heat pumps in District Heating system and increases the possibility of using different sources of low temperature heating for District Heating production;
- Implementation of daily and seasonal storage;
- Interaction between electricity grid and DHC;
- Synergy between heating and cooling production and supply;
- Use of new energy sources.

4DHC can utilize new energy sources while meeting the requirements of low-energy buildings and energy conservation measures in the existing building stock.

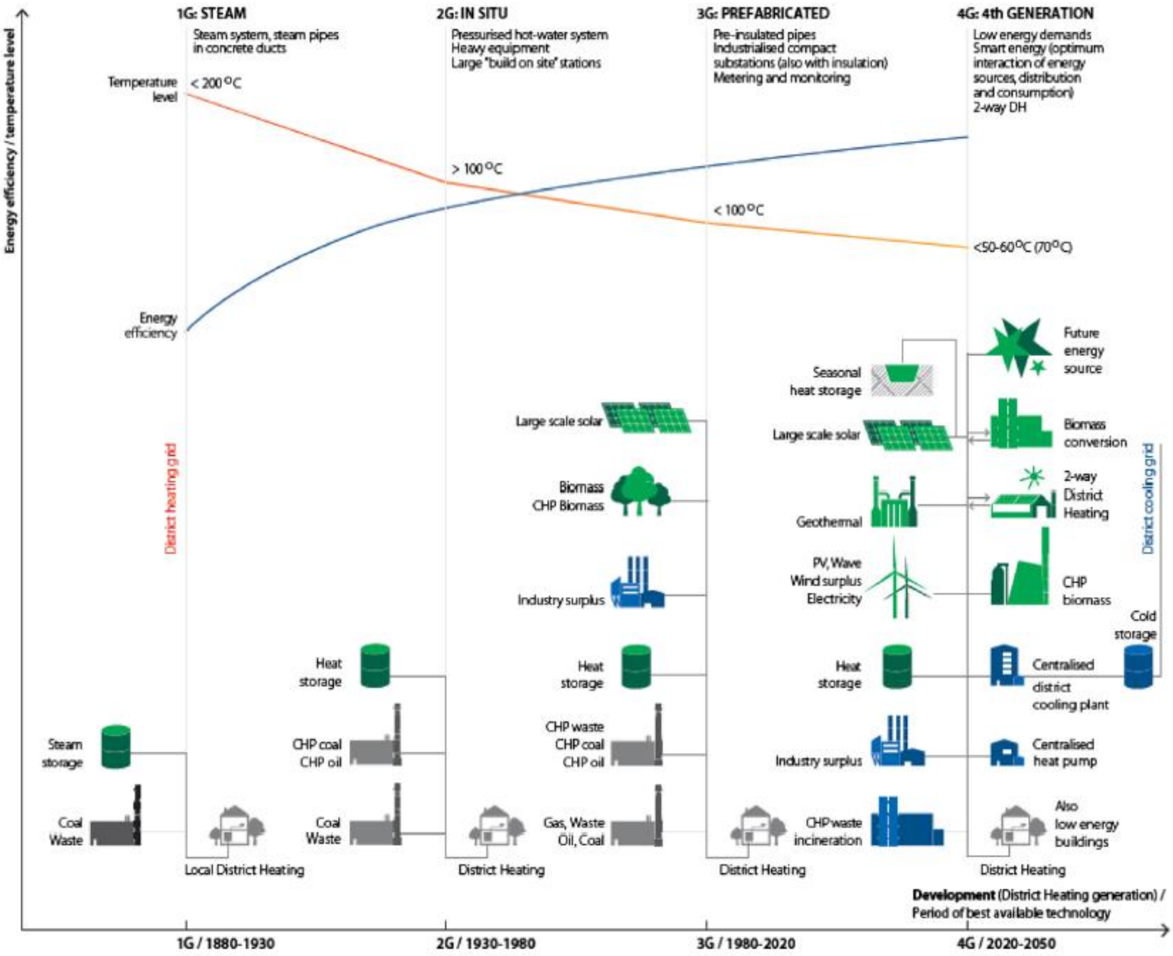

Figure 3: District Heating History (source: Lund, H, 2014, 4th generation District Heating Integrating smart thermal grids into future sustainable energy systems, Energy 2010;68:1-11)

4DHC major technical advantages

The evolution of DHC has to three major technical benefits:

Higher Energy Efficiency

Taking steps to avoid energy use is the best way to improve energy efficiency. 4DHC and their associated heating and cooling technologies have set district heating and cooling on this path. Third generation district heating such as those using biomass boilers already have higher efficiency than individual biomass systems and release significantly less particles into the atmosphere. However, 4DHC aims to achieve even higher efficiencies by reducing the temperatures in heat distribution network, leading to reduced heat losses in the pipes. The heat supply also benefits from this new range of temperature since it improves the power-to-heat ratio of steam CHP plants, allows a greater heat recovery from flue gas condensation and better coefficients of performance for heat pumps. The central solar collector fields also have a higher conversion efficiency with lower temperature.

By coupling heating and cooling, district cooling can reach a very high energy efficiency. The demand for air-conditioning is increasing in Europe and district cooling can meet this demand in major cities.

More Renewables and waste heat available

To gain independence from fossil fuels and turn to 100% green energy, every available resource must be used. Yet, most of the waste heat cannot be recovered without district heating to transport this waste heat to end-users. With 4DHC, the use of low-temperature broadens the waste heat sources that can be used (data-centres, water treatment plants, heat from sewage, etc.). Most geothermal projects would also remain less feasible without district heating since the investment remains too high for one building only; however, this is less true for geothermal projects using heat pumps rather than deep geothermal energy. Within the city centre where population density is high and multi storey buildings numerous, the use of biomass would remain complicated without district heating.

4th generation district heating can be linked with new generation district cooling (thanks to reversible heat pumps) and it becomes possible to cool using renewables or surplus heat through district cooling. An underground aquifer, a lake or oceans can easily cool buildings too.

Storage and smart energy system

To reach a high renewable energy target, the energy mix must be a combination of all available resources, one of which can be 4DHC. Flexibility and thus storage has indeed become a critical issue for electricity and with 4DHC, storing heat (daily storage as well as seasonal storage) is easier. The use of a hot water tank is a well-known simple and reliable technology, all it demands is space (on ground or underground) whereas storing electricity can be tricky, currently not financially viable and not always environmentally friendly due to materials used in batteries. In addition, it must be mentioned that the cost of thermal storage[1] represents about 2% of the cost of battery storage[2].

However, by associating the electricity network and 4th generation district heating, it is possible to store surplus wind power or other intermittent renewable energy as heat (with electric boilers or heat pumps for example). Turning electricity into heat is an easy process, which can avoid electric market malfunctions (negative price, energy security, etc.) or worse, infrastructure damage due to electricity surplus.

The main aim of reducing the temperature further is to adapt to the new low energy buildings. However, 4DHC is supposed to support also the deployment of smart energy systems, which can bring flexibility to electrical networks and help the deployment of intermittent renewable energy (wind, solar).

[1] Connolly, D., Mathiesen, B. V., & Lund, H. (2015). Smart Energy Europe: From a Heat Roadmap to an Energy System Roadmap. Aalborg Universitet.

[2] Claudia Pavarini, “Battery storage is (almost) ready to play the flexibility game”, *iea*, 8th July 2019.

Conditions for 4DHC deployment

Where to deploy 4DHC?

4DHC fits the needs of new and retrofit buildings, so they are a green and efficient solution in new areas or districts that have undertaken large retrofit programs. Several 4DHC projects in Northern Europe (Denmark, Sweden) have successfully proven that 4DHC is an advantageous solution for low energy buildings. This solution is less viable in areas with a low population density. The required population density obviously depends on the cost of the DHC, the cost of fossil fuels, the cost of renewable energy, the subsidies and the climate. Consequently, the required density is different for each country.

For example, in France, usually heat density should reach at least 1.5 MWh by linear meter of DHC pipe to be feasible but in some cases, 1 MWh/ (year.metre) is also enough to make the project viable. The IEA proposed the minimum value of 1.8 MWh/ (year.metre). Even if heat losses are reduced with 4DHC, it still requires an important heat density to avoid too much heat loss and thus are financially viable in dense area.

Because of the replacement of existing buildings with new ones and the fact that retrofitting takes time and money, existing buildings will represent the vast majority of the heat demand for decades to come. However, that does not mean that 4th generation district heating must remain anecdotic. It is indeed possible to extend traditional networks into new areas with fourth generation technology. This is investigated in the Deliverable 1.2 of the HeatNet Model “Guide to integrating 4DHC with energy efficiency retrofitting”. DHC can hence evolve according to its surroundings and adapt to it. Therefore, 4DHC is still an available solution where there is an existing old DHC for extension.

A clever place to develop a 4DHC is near a renewable source of energy. Thus if a data-centre, a wastewater treatment plant or any other available source is planned on a territory, the opportunity to assess if nearby buildings could profit from a 4DHC should be explored. Areas close to the sea, a river or above geothermal potential are also good candidates for 4DHC.

When to deploy 4DHC?

Usually, 4DHC are planned related to different operations in public domain:

- Urban renewal or development of a new district: during these vast operations, low energy buildings are planned and if the density is high enough, 4DHC can make the overall project highly sustainable;
- Vast retrofitting operation in a district;
- Renewing sewage systems;
- New bicycle highways;
- New buildings or equipment such as hospitals, university, swimming pool, etc.
- New source of renewable energy;
- High maintenance or need for renewal of an existing DHC.

Why implementing 4DHC?

The table below summarizes the advantages and disadvantages of DHC and 4DHC. The green boxes describe the advantages or disadvantages specific to 4DHC; the others are valid both for classical DHC and for 4DHC.

	Advantages		Disadvantages	
	What?	Why?	What?	Why?
Network	**Better match between heat supply and heat demand:**	With more and more new or refurbished buildings, heating demand is low and does not require high temperature anymore.	**Not for existing building without refurbishment:**	The demand in existing buildings is too high to be met with 4DHC. The heating equipment (radiators, etc.) already installed require higher temperatures. A retrofit is needed[3].
	Network heat loss reduction:	The lower the temperature, the lower the losses due to transport in the district heating.	**Legionella issue:**	Under 60°C legionella can survive in standing water and thus possibly become a health issue for domestic hot water.
	Reduction in pipeline maintenance cost:	Low temperatures lead to a reduction in thermal stress	**Authorisations and difficulty of maintenance:**	Complications and time consumption due to the implementation of a district heating in an area composed with both public and private projects and amenities (authorisations to cross roads, sidewalks or parks, or matching the schedule of private projects). The same happens when there is a need to repair or change the network.
	Different available pipe materials:	Thanks to the lower temperature, other materials than metal can be used without being damaged by the thermal stress, for example plastic and lower grade steel. In addition, the lower thermal stress also enables to dig more shallow trenches without risking the thermal buckling from pushing the backfill material above the pipe.		

[3] The Aberdeen pilot resolved this issue: instead of using low temperature, as is the case in typical 4DHC, the temperature of the water running in the pipes is medium, so that it fits with the not retrofitted buildings.

Boiler/ heating system	**Higher energy performance for biomass boiler than individual biomass boiler:**	Individual biomass boilers are rarely able to burn the gas released during the combustion and thus have a lower efficiency than large biomass boiler units. Also, it is possible to better control the fuel burned in the boiler for collective heating systems.	**Necessity of a large area for a large biomass boiler:**	The space needed in a DHC project for a biomass thermal plant is important not only because of the size of the boiler in itself but also because of the biomass storage needed. In high-density area, this parameter can be a problem.
	Multiple sources of heat can be used:	Both fossil energy and renewable or waste energy can be used on a DHC and it is possible to have several energy plants or boilers to enhance both supply security and carbon footprint	**Higher capacity, Higher regulation:**	With large boiler and energy plant, the regulation regarding security, emissions, controls, etc. is often more complicated and severe compared to standard individual boilers. Thus, it asks the project holder more work regarding those aspects.
	Heat from gas condensation:	Low temperature in a DHC allows heat utilization from flue gas condensation and thus improves the energy efficiency of the district heating.		
	Improvement CHP performance :	With lower temperature, the power-to-heat ratio of CHP is improved.		
Pollution	**Better performance of filters for biomass compared to individual system:**	Performant filters to stop particles are very expensive and thus only suited for bigger biomass boilers such as used in district heating. Thus, biomass boilers for district heating remain a more environmentally friendly solution than most individual biomass solutions.	**Biomass boilers remain problematic during peak pollution:**	Biomass emits particles in the air. During high pollution episodes, the use of biomass should be stopped or reduced.
	Treatment of ash (both wet	Unlike individual boilers, high capacity boilers are		

	and dry):	subject to strict regulation and DHC have the financial capacity to handle treatment of both wet and dry ash in order to reduce pollution. Agricultural spreading might be possible with wet ash.		
	More flexibility to switch from one solution to another during pollution peak:	DHCs with biomass boilers in most cases have gas boilers as a backup. This gas boiler can be turned on when there is a pollution peak to limit the emissions of particles as with the filters and legislation, the emission of particles remains low.		
Links with other networks	**Absorption the surplus of electricity production through storage:**	The storage of electricity is costly and can often have an impact on the environment (batteries, dam, etc.). Thanks to heat storage, renewable intermittent electricity generated during low demand hours can easily be converted into heat and used when needed in the DH. The storage of heat (centralized or decentralized) is an easy and efficient solution.	**No true business model yet for the flexibility that DHC can bring to the electricity grid:**	If there is a true and well-known electricity market and gas market, the heat market is often blurred and hard to define, thus it leads to difficulties in linking DHC with other networks.
	Improvement in the interactions between heating and cooling:	With heat pumps, cooling is produced as a by-product of heat production (and vice versa) both networks have a better efficiency if linked. Depending on the sources, a 4th generation district heating can also be reversible and become a district cooling.		

Energy sources	**higher utilization of waste heat:**	Low temperature allows further exploitation of waste heat with new sources available (datacentre, sewage, etc.)		
	Larger utilization of geothermal heat:	Thanks to heat pumps and 4 DHC, it is possible to use shallow aquifers and not only deep ones for district heating and cooling with good performance.		
Business model	**Less price volatility than with individual fossil fuelled boilers:**	Investment for the network and the energy plant is a stable and important part of the heat price, which helps to prevent the volatility of heat price.	**Long term investment:**	DHC is a capitalistic option, which requires a long-term investment perspective. In a constantly changing society, long-term investments bear more risks.

North West Europe and 4DHC potential

The successful deployment of 4DHC depends on different parameters:

- The heating and cooling demand: 4DHC needs a sufficient heat density[4], which can be lower than the one required for traditional DHC but respects certain criteria regarding peak load, operational temperatures and heaters. If a cooling demand is present on the same area, it enhances the chance of success.
- The heating and cooling resources: it is possible to transport some resources (such as biomass) but for a completely sustainable project, it is better to prioritize the local, readily available resources. In addition, some resources bring a better financial balance than others do. Waste heat is usually cheaper for example. The more resources that are available, the more likely 4DHC will be successfully implemented.
- The financial barriers: DHC networks have always asked for capital-intensive investments and this is becoming increasingly hard to obtain. Financial support is still needed and often a local municipality must be involved in the project. However, 4DHC has the advantage of reducing the expenditures on all fuels (local, renewable, waste heat), and so these savings can be converted into investments for infrastructure.
- The national and local policy: as with most of renewable energy projects, 4DHC depends heavily on the energy policy. Tax on fossil fuels or strong incentives to develop DHC is essential.

The Deliverable 2.1 of the HeatNet Model, *Guide to Financing*, tackles the financial barriers in NWE.

District heating in Europe and North West Europe

There are more than 10 000 district heating networks in the European Union, which supply around 8% of Europe's total demand for heat. However, this percentage is very different from one country to another. In Eastern and Northern Europe, the majority of the population uses DH, whereas, France, Netherland, United Kingdom, Ireland and Belgium remain below the 10% of coverage (see Figure 4 below).

[4] More than 1 MWh/m/year

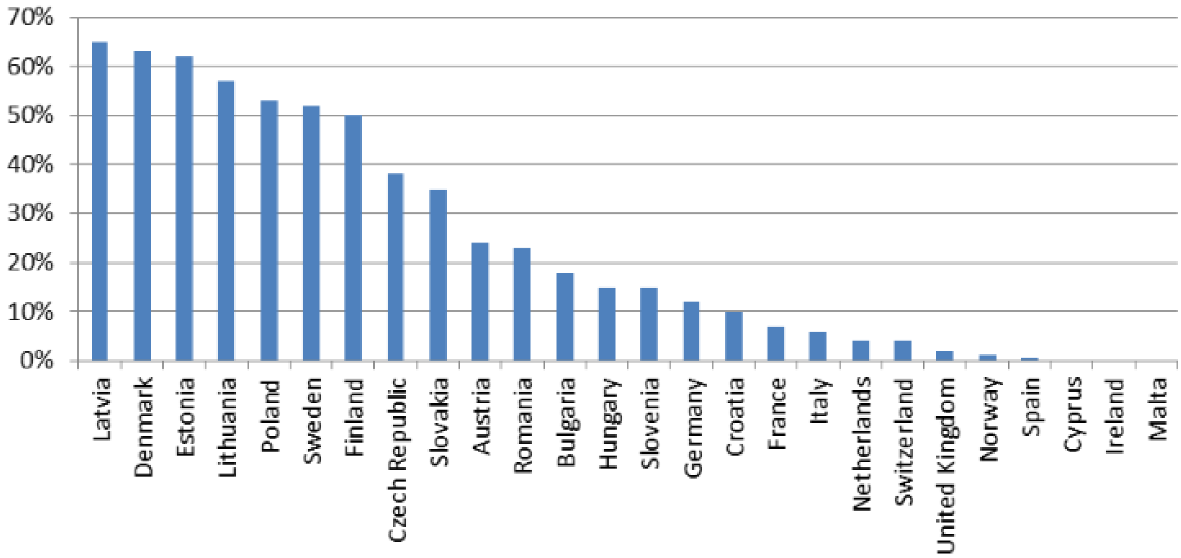

Figure 4: Percentage of the population served by district heating (2013) - source European Commission

At EU level, in 2012, DH was mostly used in the residential sector (45%). The industrial sector and the tertiary sector represent respectively 34% and 21% but once again, there is a difference in those proportions from one country to another. In Belgium, in the UK, and in the Netherlands, DH systems deliver heat mainly to industry, while in France they are used mainly for the residential and tertiary sector but scarcely for industry (see Figure 5).

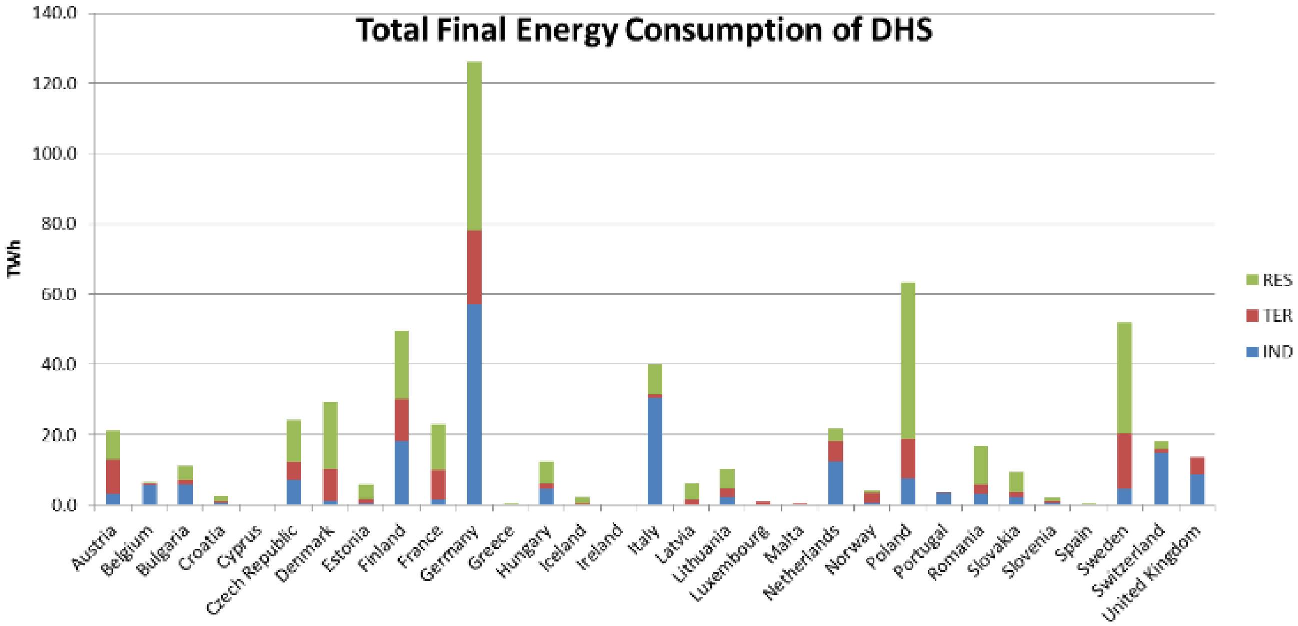

Figure 5: Total final energy consumption of DHS (source: Euroheat & Power)

Regarding the energy mix, it is even more country specific. In Eastern European countries, most of the DH networks are still fossil fuelled while in Northern Europe, renewable energy and waste heat play a much bigger part in the mix (see Figure 6).

In the NWE countries, there are two groups. On one side, France where DH is used, more than 40% of the energy is generated from renewable and waste sources, and on the other side, the United Kingdom, Belgium and Netherlands where gas is used and covers more than 75% of the demand.

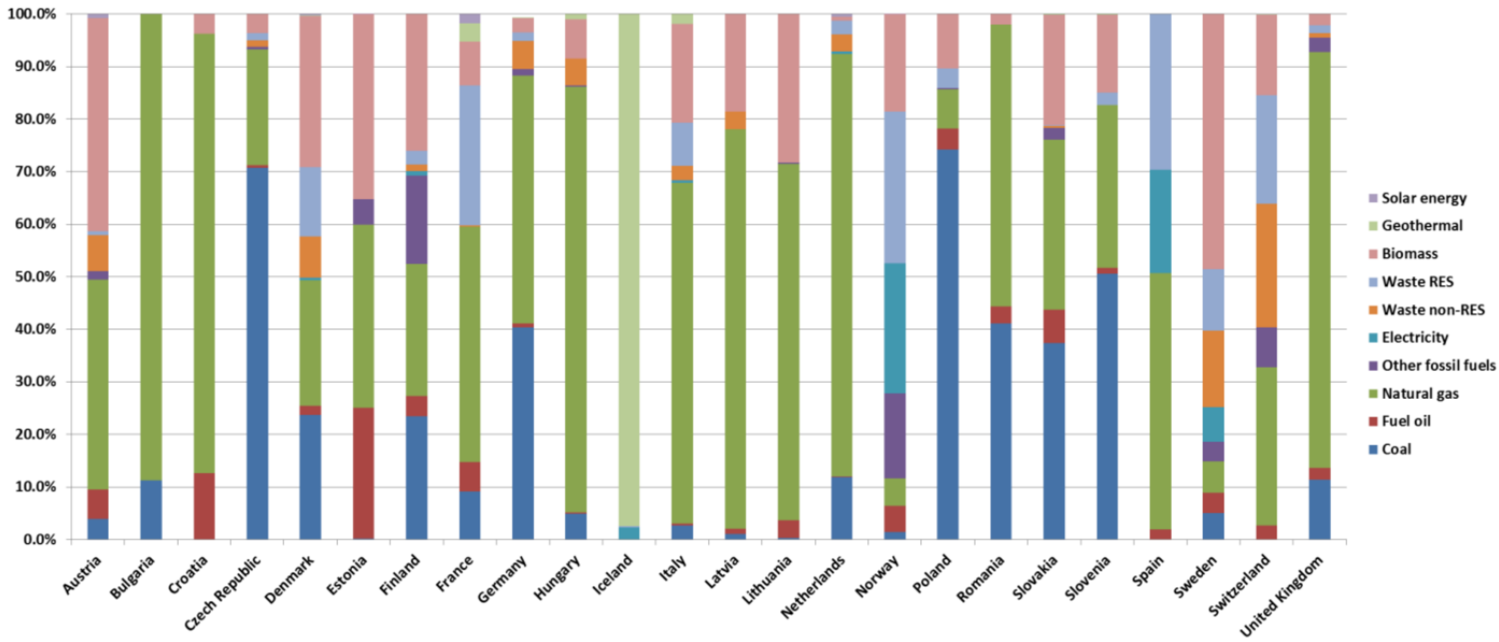

Figure 6: Share of energy carrier in DH 2012 (source: Euroheat & Power)

In comparison with separate generation of electricity and heat, combined heat and power can save around 30% of primary energy. Yet, the use of CHP also differs a lot between countries. Two countries of the HeatNet NWE area use more CHP than the average in Europe (Netherland and Belgium) while France, the United Kingdom and Ireland are far behind, as is depicted in Figure 7.

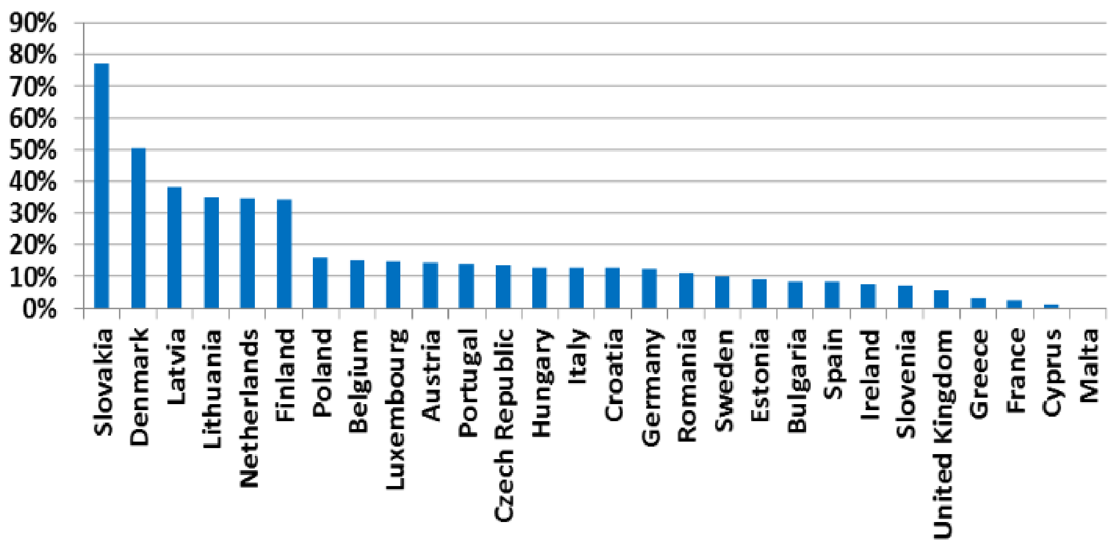

Figure 7: Share of CHP in electricity production in 2013 (source: European Commission)

Development potential

The demand

North West Europe is an area of 845,000 km² with 180 million inhabitants. It spreads through Ireland, United Kingdom, Belgium, Luxembourg, Switzerland, North of France, West of Germany and South Netherlands. Often considered as one of the most dynamic and prosperous areas of Europe, it offers great potential for DHC thanks to the density of the population through the area. Figure 9 shows the heat demand density in North West Europe is the highest in Europe. Traditional DH technology requires usually more than 100 TJ/km². Thus, the potential for deployment of DHC is very high. With 4DHC the required heat demand densities can be lower (30 TJ/km²) but the buildings must be low energy buildings.

Two major EU laws (Energy Performance of Buildings Directive 2010 & Energy Efficiency Directive 2012) ensured that every new building is a low energy building and that the question of efficient retrofitting of existing buildings is properly handled.

A good population density and low energy buildings are the two major ingredients for the successful deployment of 4DHC and these two ingredients are present in NWE.

The resources

The third ingredient for a 4DHC is the presence of renewable or waste heat sources. Regarding this aspect, NWE also possesses real advantages.

In terms of excess heat (waste to energy, thermal plants, industrial waste heat), the potential is high in NWE especially in Belgium and the Netherlands as shown in Figure 10, Figure 11 and Figure 12).

Two pilots from HeatNet NWE project, Aberdeen and South Dublin, aimed to use waste heat for their district heating: Aberdeen and South Dublin.

More information about the pilot DHC in Aberdeen is available via the following link: https://www.aberdeencity.gov.uk/services/housing/home-energy-efficiency/heatnet-delivering-low-carbon-district-heat

More information about the South Dublin pilot is available via the following links:

https://www.codema.ie/projects/local-projects/tallaght-district-heating-scheme/

http://www.dublincity.ie/ddhs

As an example of heat density at the city scale, the Figure 8 below shows a map of the heat sources identified in South Dublin, these are discussed in greater detail in the South Dublin Transition Roadmap.

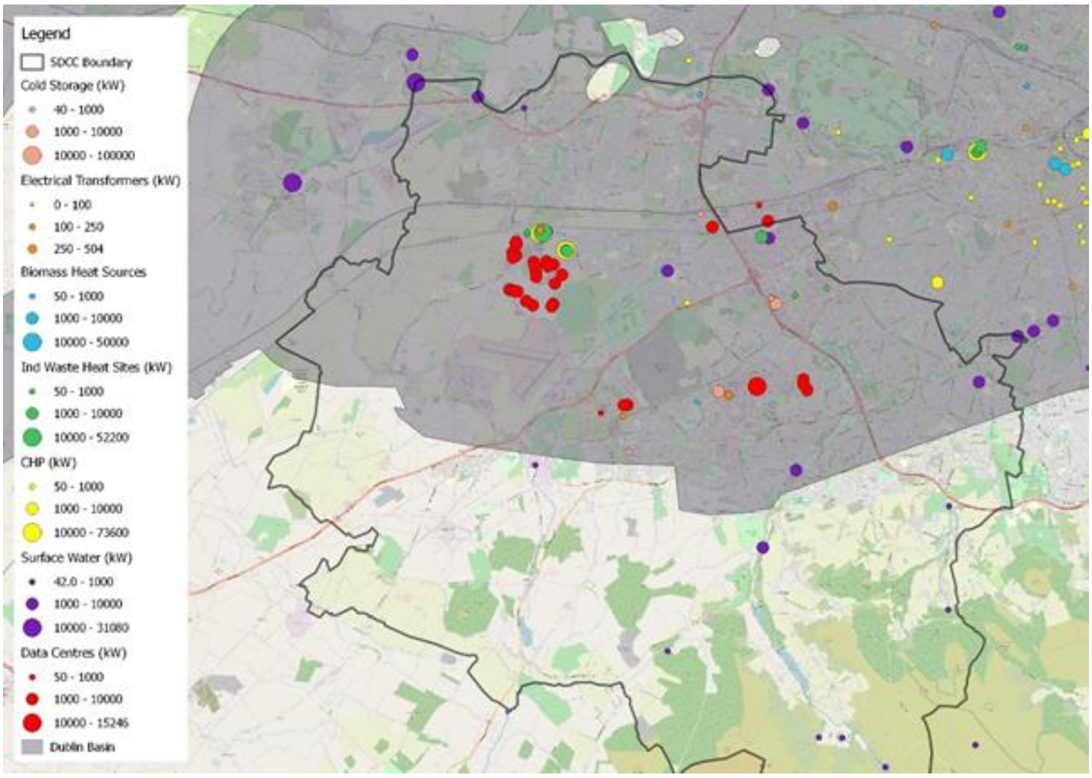

Figure 8: Heat sources identified in South Dublin

Regarding other sources of energy, the solar radiation is about the same level in NWE than in Northern or Eastern Europe. NWE has a long coastline, allowing deployment of heating and cooling systems thanks to the calorific energy from the sea. In fact, the only renewable resources that seem greater in other places in Europe is wood resources (Figure 13). However, thanks to agriculture, the straw resources are higher in NWE (Figure 14) and the potential use of methane can help to fuel district heating.

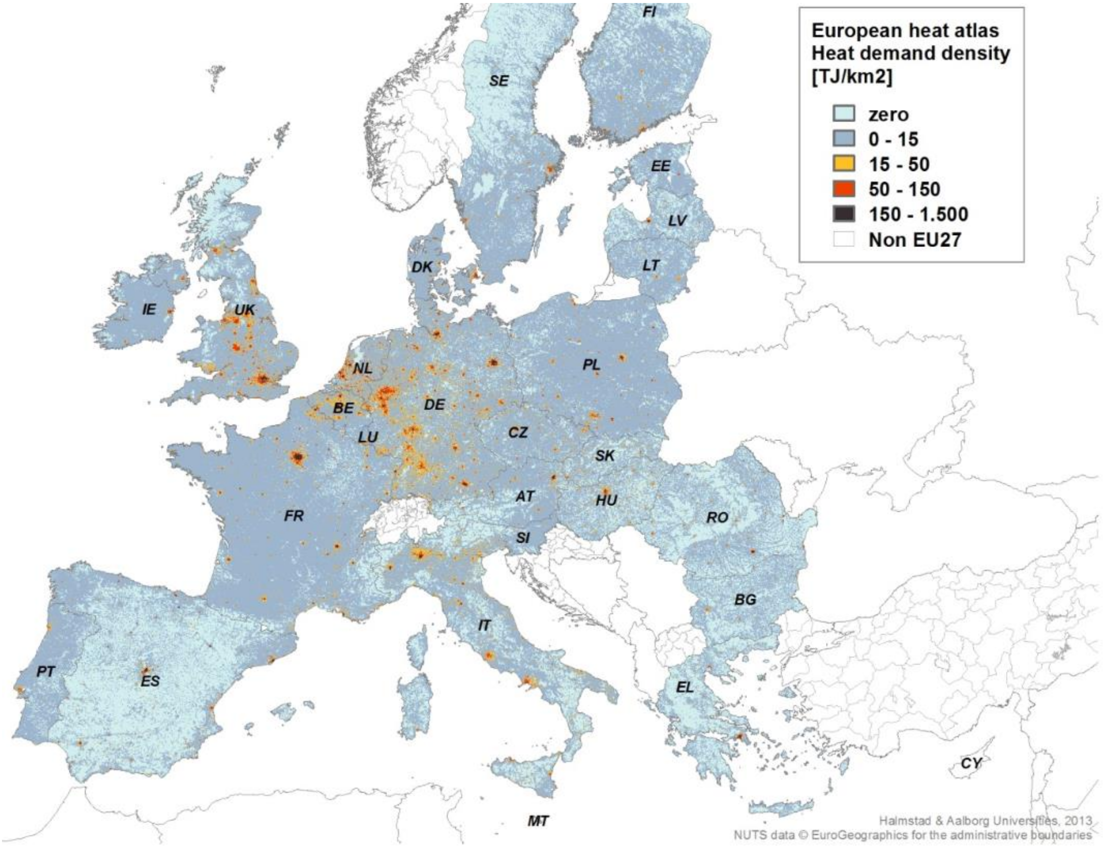

Figure 9: European Heat Atlas – Heat Roadmap Europe

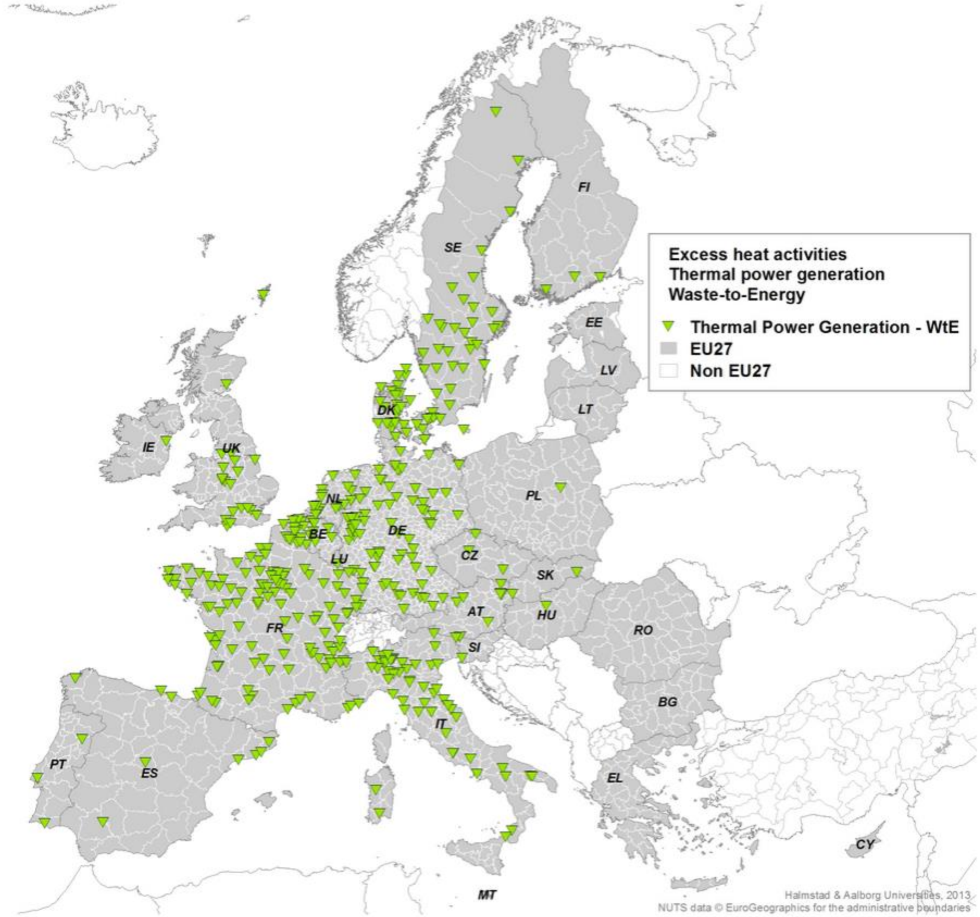

Figure 10: Surplus Heat from Waste-to-energy – Heat Roadmap Europe

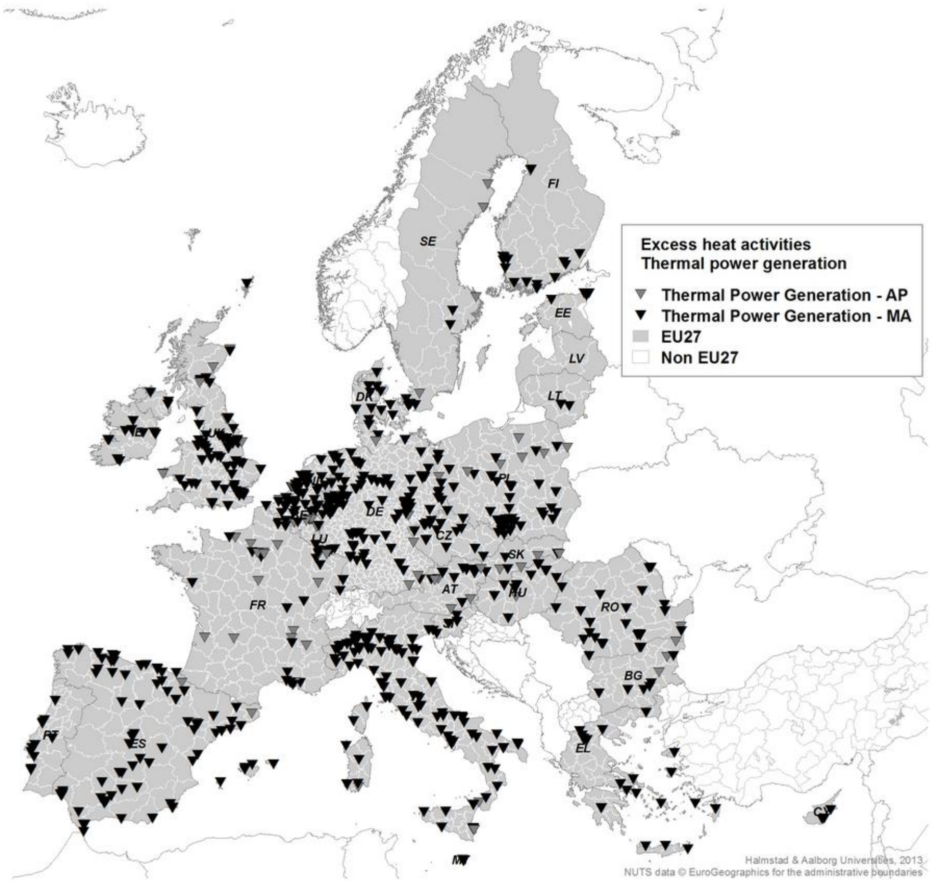

Figure 11: Surplus heat from Thermal power generation – Heat Roadmap Europe

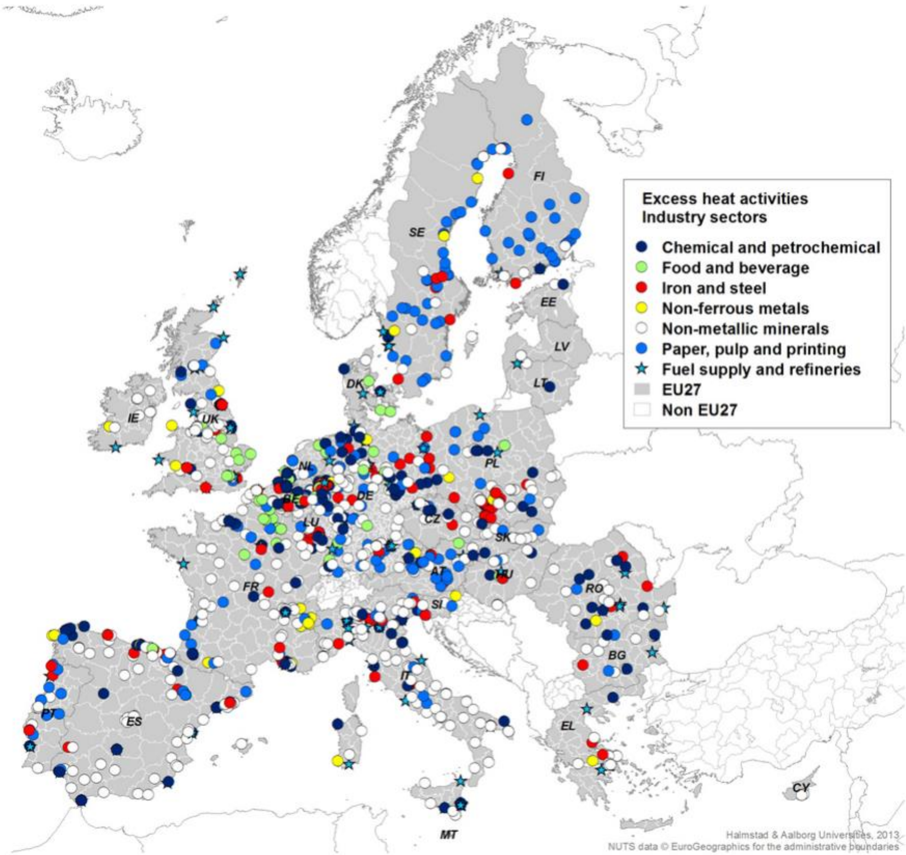

Figure 12: Surplus heat from industry – Heat Roadmap Europe

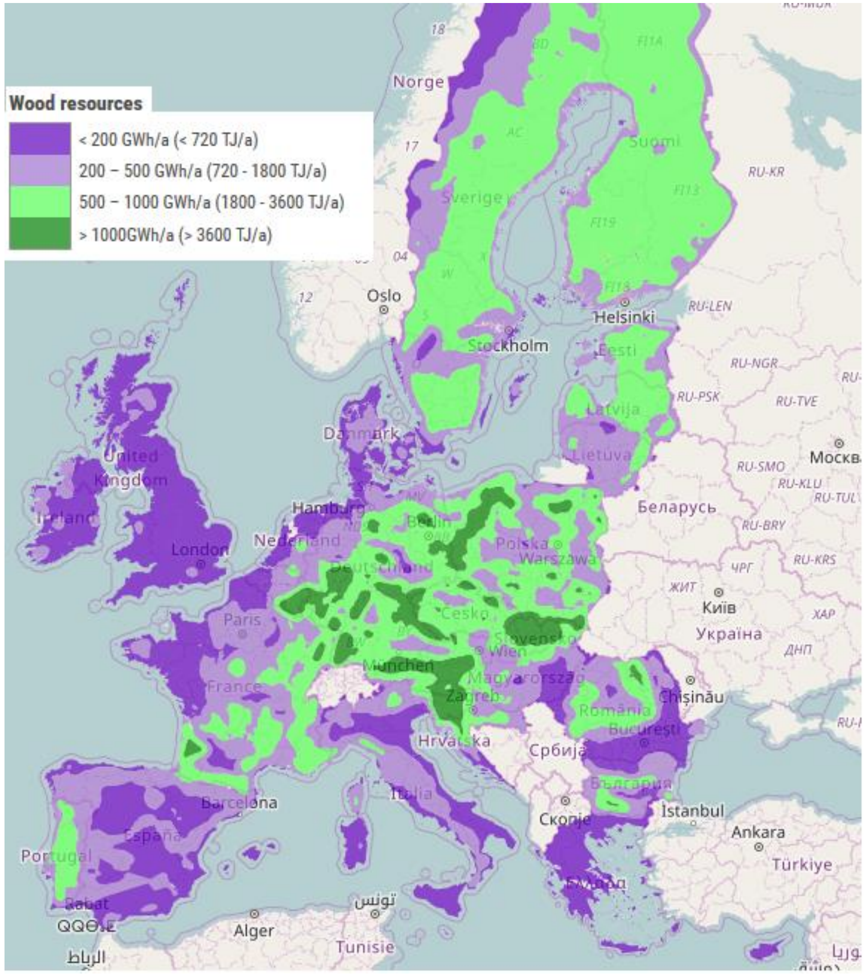

Figure 13: Wood resources - Heat Roadmap Europe (Stratego)

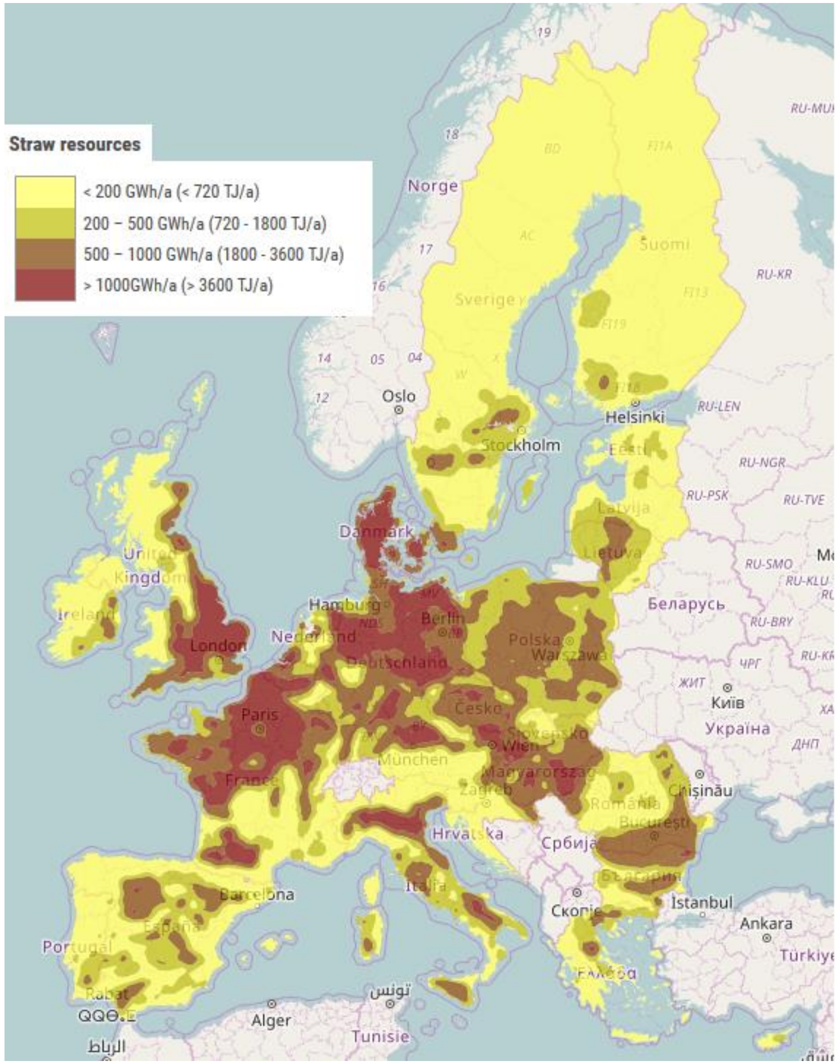

Figure 14: Straw resources - Heat Roadmap Europe (Stratego)

It appears that numerous factors for a successful district heating and cooling projects are present in NWE for both creation or conversion and extension. However, barriers to deployment of 4DHC persist and HeatNet NWE aims to guide stakeholders to overcome them.

Potential through conversion or extension of traditional district heating

Six regions are part of the HeatNet NWE in five different countries. In those countries, the share of district heating in the heating market is low in comparison with most European countries. The map in Figure 15 shows the distribution of district heating and highlights the disparity between Northern and Eastern Europe and North West Europe.

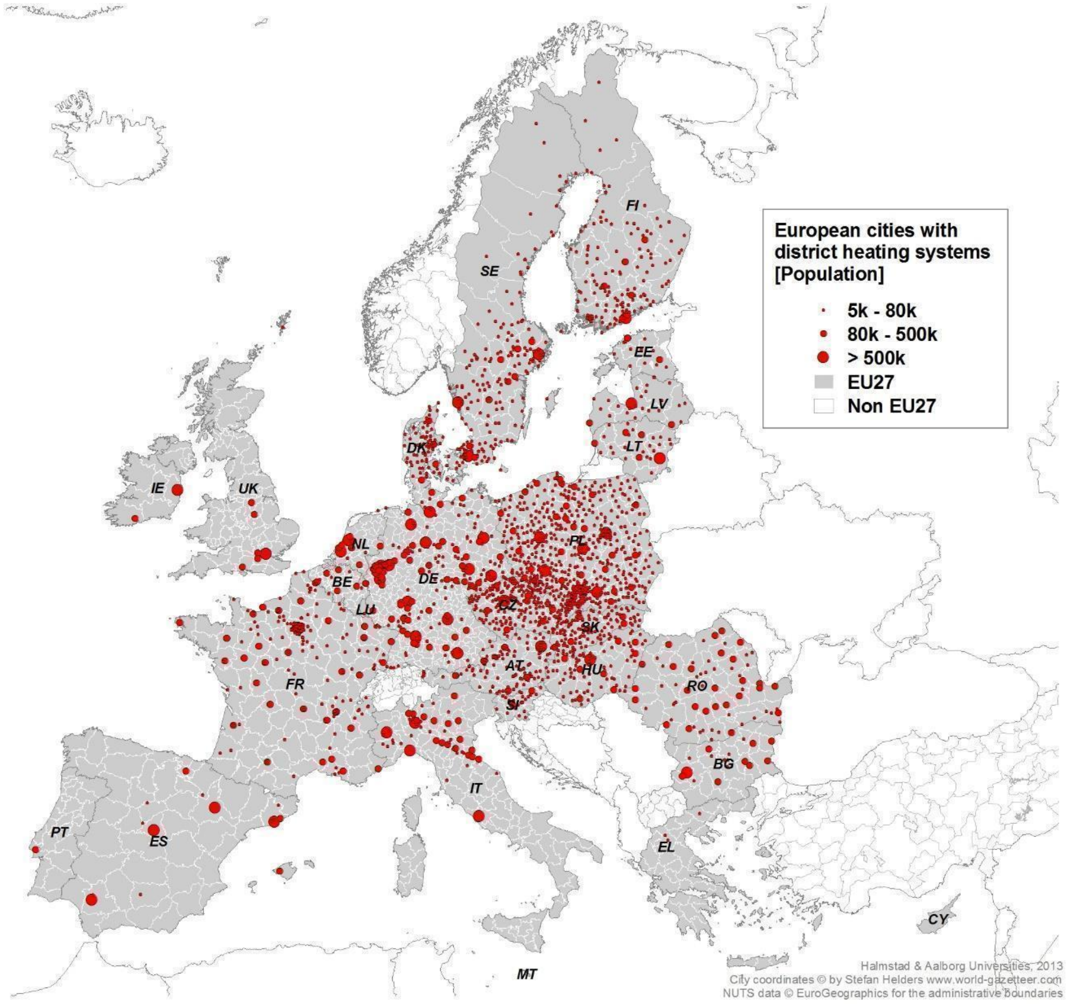

Figure 15: District heating systems in Europe – Heat Roadmap Europe

In North West Europe, the potential for 4DHC deployment through conversion or extension of traditional district heating is relatively low but not absent. Sometimes, implementing 4DHC is easier in case of an extension or a conversion and thus this aspect will be studied in the HeatNet NWE project on one pilot site: that of Boulogne-Sur-Mer.

More information about the pilot 4DHC in Boulogne sur Mer is available via the following link: http://www.ecoliane.fr/

European policy

The 2009 European directive on renewable energy[5] has defined targets on renewable energy for every Member State and each country has fixed a path to reach its target. This path sometimes included District Heating and Cooling development.

To go further, the 2012 European directive on energy efficiency[6] has established the development of feasibility studies regarding connections to district heating, imposed heat metering at each substation, and has also asked complete national evaluation of the district heating deployment potential through a national heat map. Furthermore, this directive has led to an obligation to carry out a cost-benefit analysis regarding the use of waste heat in district heating.

In February 2016, the Commission proposed an EU heating and cooling strategy. This was a first step in exploring the issues and challenges in this sector, and solving them with EU energy policies.

More information about the EU strategy on Heating and Cooling is available via the following links:

https://ec.europa.eu/energy/sites/ener/files/documents/1_EN_ACT_part1_v14.pdf

https://ec.europa.eu/energy/sites/ener/files/documents/1_EN_autre_document_travail_service_part1_v6_0.pdf

The Renewable Energy Directive[7] was revised in 2018. In this new version, the directive sets that Member States should increase the share of renewable energy sources in their heating and cooling sector by 1.3 percentage points per year (article 23.1). It also states that District Heating and Cooling should contribute to this increase and to that extent, member states can implement at least one of the two following measures. The first measure consists in increasing of at least 1 percentage point per year the renewable and waste sources share in DHC production from 2021 to 2030; the second measure addresses DHC networks that must develop; and so these structures should consider linking and buying heat or cold from renewable and waste energy producers.

The Energy Efficiency Directive[8] was also revised in 2018. It affects District Heating and Cooling networks on the subject of consumption metering and costs division. Indeed, the directive states that, in housing buildings, metering devices should be implemented for each unit (e.g. each apartment). In addition, end-users should receive, along with their bills, information concerning the fuels used and the emissions from the network. Both of these recommendations allow empowering the consumers.

[5] https://eur-lex.europa.eu/legal-content/FR/ALL/?uri=CELEX:32009L0028

[6] https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=celex%3A32012L0027

[7] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG&toc=OJ:L:2018:328:TOC

[8] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.328.01.0210.01.ENG

European research and projects on 4DHC

The EU has already supported the heating and cooling sector with more than 166 million EUR of funding for research, demonstration and market uptake of improved heating and cooling solutions through H2020, FP7 and Intelligent Energy Europe programs.

Regarding District Heating and Cooling in particular, in 2014 and 2015, under the H2020 program, seven projects on district heating optimisation (14.2 million EUR of EU funding) have been developed, amongst which STORM and Flexynets. Another 10.2 million EUR has supported storage and 11.6 million EUR the recovery of waste industrial heat.

The EU has also financed projects regarding Smart cities amongst which Celsius Cities, which focused on district heating and Pitagoras, for 22.4 million EUR.

The support of the heating and cooling market had also received another 10,1 million EUR with projects on DHC planning (Stratego), support for policy makers (progRESsHEAT), promotion of DHC (SmartReFlex, RESD H/C Spread) and new business models (SDH, BiogasHeat).

To find all the European Projects on district heating and cooling please follow the link below:

https://ec.europa.eu/energy/sites/ener/files/documents/overview_of_eu_support_activities_to_h-c_-_final.pdf

HeatNet NWE Country by Country

Belgium

Maturity of the DHC sector and of the policies linked to it in Belgium are different in Flanders and in Wallonia.

Regarding Wallonia, there are approximately 40 district heating projects. These are predominantly small projects (less than 1 km and around 400 kWth in average). District heating remains a marginal heating solution in this region, mostly because of the low density that exists in many areas. Municipalities own more than half of these projects and more than 70% of them are fuelled with biomass (CHP, boilers and methane). However, in Wallonia, more than half of the population is still using oil for heating and because of the oil price and the environmental impact of this fossil fuel there is a real opportunity for district heating in Wallonia.

Regarding Flanders, there are 14 district heating schemes in Flanders producing more than 500 000 MWh/year. The majority of the projects are based on waste heat. Flanders has a lot of waste heat due to its industrial sector; however, only 5.1% of the heat comes from renewable and waste heat, and the principal source of heat is gas.

In both Flanders and Wallonia, the barriers to develop DHC are numerous (lack of knowledge, lack of incentive legislation, fear of the consumers, etc.). Recently, policy makers and energy companies seem more interested into DHC because of the efficiency and the possible CO_2 emission reduction of DHC projects. Besides, there are numerous opportunities to develop DHC using waste heat (Figure 16).

More information about the situation in Belgium via the following links:

In Flanders:

ODE, Warmtenetwerk Vlaanderen, viewed 5 August 2019, https://warmtenet.ode.be/

Warmtenetwerk Vlaanderen 2018, *Leidraad warmtenetten voor lokale besturen*, viewed 5 August 2019, https://images.ode.be/20181026155741609-wnvl-leidraad-warmtenetten-april2018.pdf

In Wallonia:

Wallonie Economie, Clusters Wallonie, viewed 5 August 2019, http://clusters.wallonie.be/tweed-fr/

More information about the Belgium policy is available in the following documents:

The Deliverable 1.1 of the Long Term work package, *Recommendations for policy makers*, reviews the policy, legal and regulatory context of each NWE country.

As part of the HeatNet NWE project, a transition roadmap for South West Flanders was written, it focuses on the case of this region of Belgium.

In Wallonia, a decree on the organization of the thermal energy market and thermal energy networks is being discussed by the Wallonia Parliament during the year 2019[9].

The Figure 16 below displays the heat synergy opportunities for cities, regarding waste to energy facilities, and other industrials compounds, both for Belgium and for the Netherlands.

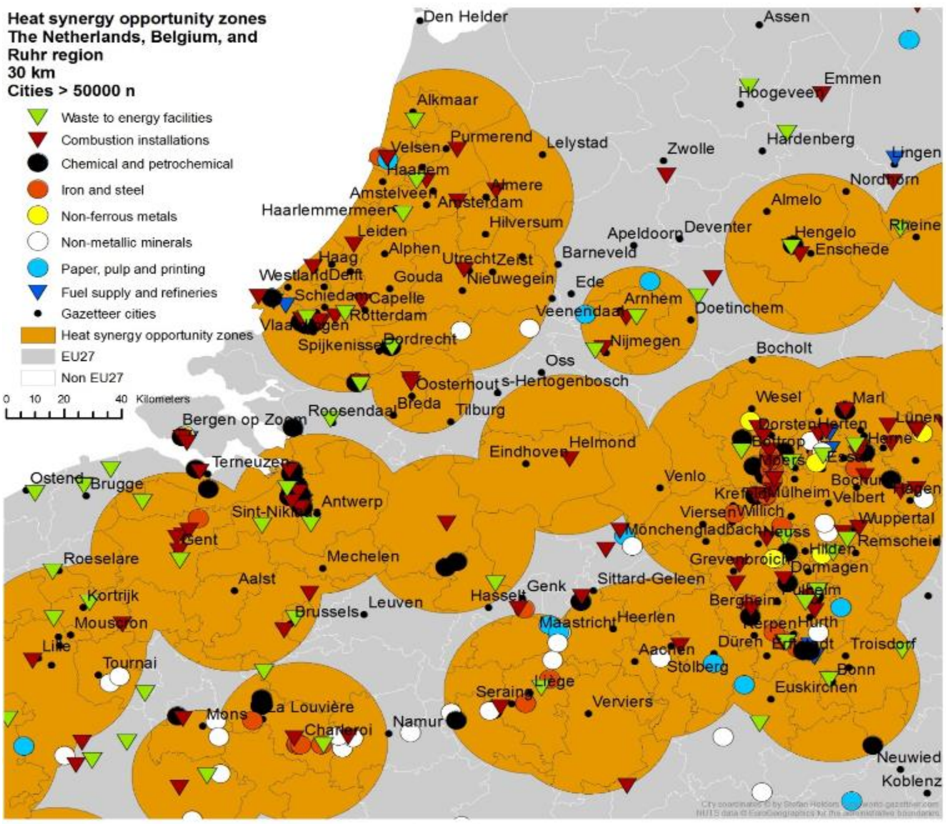

Figure 16: Heat Opportunity in Belgium and Netherland (source: Urban Persson, Linneaus University)

9 http://nautilus.parlement-wallon.be/Archives/2018_2019/DECRET/1402_1.pdf

France

France possesses more than 669 district heating schemes and around 22 district cooling projects (data from 2016). The heat production through district heating is 33,043 GWh with more than 5,000 km of pipes. The main beneficiary is the residential sector (56% of the heat delivery).

In France, around 6% of the population is heated through a district heating, a figure below the European countries still but the improvements in the DHC sector have led to a massive deployment of renewable energy in the French DHC energy mix. In 2016, 53% of the heat in district heating came from waste heat and renewable energy (25% of waste heat from incineration plants). The use of biomass is increasing every year but gas still accounts for 39% of the energy mix in district heating.

The average CO_2 content is 0.126 $kgCO_2$/kWh, which is much better than the content of oil, coal and gas. The average price of heat in a DHC in France is 74.40€/MWh (subscription included).

The policy regarding district heating is favourable since 2009 with the setting of subsidies, tax benefits and other favourable legislation.

More information about the French situation is available in the following documents:

Réseaux de chaleur et territoires 2019, *Les réseaux de chaleur en France*, Réseaux de chaleur et territoires, viewed 5 August 2019, http://reseaux-chaleur.cerema.fr/les-reseaux-de-chaleur-en-france

Réseaux de chaleur et territoires 2019, *Les chiffres clés de l'énergie – Edition 2018*, Réseaux de chaleur et territoires, viewed 5 August 2019, http://reseaux-chaleur.cerema.fr/les-chiffres-cles-de-lenergie-edition-2018

Energie et environnement par SiaPartners 2017, *Les réseaux de chaleur en France de 2015 à 2030, 15 ans pour mobiliser 10 Mds d'investissements dans les infrastructures*, Energie et environnement par SiaPartners, viewed 5 August 2019, http://www.energie.sia-partners.com/20170608/les-reseaux-de-chaleur-en-france-nouvelle-etude-energylab-sia-partners

To learn more about the French policy:

Réseaux de chaleur et territoires 2019, *Politiques publiques*, Réseaux de chaleur et territoires, viewed 5 August 2019, http://reseaux-chaleur.cerema.fr/tag/politiques-publiques

Agence de l'Environnement et de la Maîtrise de l'Energie 2019, *Le fonds chaleur en bref*, Agence de l'Environnement et de la Maîtrise de l'Energie, viewed 5 August 2019, https://www.ademe.fr/expertises/energies-renouvelables-enr-production-reseaux-stockage/passer-a-laction/produire-chaleur/fonds-chaleur-bref

Ireland

There are 35 district heating schemes in Ireland which deliver 38.5 GWh. It is less than 1% of the share of the heat market. The main beneficiary of DHC is the commercial sector (78% of the heat delivered) and most of the heat comes from gas CHP.

There is a lack of knowledge as well as policy issues that make it difficult to deploy district heating in Ireland. However, district heating is starting to get increased recognition as a cost-effective, low-carbon heating source in Ireland. This is obvious in national documents such as the Project Ireland 2040: National Development Plan

2018-2027[10] that states that the government will commit funding to “Support new initiatives in district heating in cities and large towns”, and through the provision of capital funds for two DHC systems in Dublin through the national Climate Action Fund (CAF).

More information on the Irish situation is available via the following links and documents:

Irish District Energy Association (IRDEA), District Energy, IRDEA, viewed 5 August 2019, https://www.districtenergy.ie/

EuroHeat and Power 2017, *District energy in Ireland*, EuroHeat and Power, viewed 5 August 2019, https://www.euroheat.org/knowledge-hub/district-energy-ireland-2/

To learn more about the Irish policy:

Codema, BioXL 2016, A guide to District Heating in Ireland, Sustainable Energy Authority of Ireland (SEAI), viewed 5 August 2019,
https://www.seai.ie/resources/publications/2016_RDD_79._Guide_District_Heating_Irl_-_CODEMA.pdf

Netherland

There are 400 district heating schemes in the Netherlands, with more than 4000 km of pipes. District heating accounts for 4.4% of the heat market supplying mainly tertiary and residential buildings. 80% of the heat comes from renewable and waste heat sources (mainly incineration plants). Gas CHP are also widely deployed.

The Netherlands benefit from a rather favourable policy regarding the development of district heating and exemplary projects are currently being developed such as the heat highway in Amsterdam. However, because of the reserves of gas in the Netherland, this fossil energy remains dominant in the heat sector and district heating faces numerous barriers to compete with it.

More information regarding the situation and policy on DHC in the Netherlands is available in The Deliverable 1.1 of the Long Term work package, *Recommendations for policy makers*.

United Kingdom

In the UK, 72% of the overall heat demand is supplied by natural gas and 77% of the domestic heat is covered by natural gas boilers. Only 2% of the overall heat demand (around 12,000 GWh) is supplied through heat networks. However, this number includes both district heating networks (at least two buildings and 1 customer) and communal heat networks (1 building but more than 1 customer). There are 5,500 district heat networks and 11,500 communal heat networks. These figures might seem enormous but the overall use of district heating in terms of kilometres of pipe is relatively low.

The main beneficiary of heat networks is the industrial sector (16% of the demand of the industrial sector), followed by the commercial sector (4% of the demand). Heat from heat networks represents only 0.2% of the demand of the domestic sector.

The main energy used in heat networks is natural gas through boilers (56%) and natural gas through CHP (32%). Biomass from CHP or boilers accounts for 10% of the heat production and energy from waste only 1%.

[10] Project Ireland 2040: http://npf.ie/

Regarding the policy, heat networks in the UK are largely unregulated and subsidies are still weak regarding renewable heat. However, various instruments exist to support heat networks such as the Scottish Government's District Heating Loan Fund, the Renewable Heat Incentive (2011) and the UK Government Heat Network Investment project (2018).

To learn more about the UK situation:

Department for Business, Energy and Industrial Strategy 2018, *Energy consumption in the UK (ECUK) 2018 Data tables*, viewed 5 August 2019, https://www.gov.uk/government/statistics/energy-consumption-in-the-uk

Association for Decentralised Energy (ADE) 2018, Market Report: Heat Networks in the UK, The ADE, viewed 5 August 2019, https://www.theade.co.uk/assets/docs/resources/Heat%20Networks%20in%20the%20UK_v5%20web%20single%20pages.pdf

Stratego 2015, *Enhanced Heating and Cooling Plans to Quantify the Impact of Increased Energy Efficiency in EU Member States*, Heat Roadmap Europe, viewed 5 August 2019, https://heatroadmap.eu/wp-content/uploads/2018/11/STRATEGO-WP2-Country-Report-Italy.pdf

Department of Energy and Climate Change 2015, *Assessment of the Costs, Performance, and Characteristics of UK Heat Networks*, United Kingdom Government, viewed 5 August 2019, https://www.gov.uk/government/publications/assessment-of-the-costs-performance-and-characteristics-of-uk-heat-networks

Information on the policy context of DHC in the United Kingdom is available in Deliverable 1.1 of the Long Term work package, *Recommendations for policy makers*.