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Cooperative district heating in the making.

Inspiration from Denmark and first achievements in the Netherlands

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Foreword

In the Netherlands district heating has a market share of only 5% because Dutch citizens and industries are heavily dependent on natural gas, which was abundantly available in the Dutch underground. The extraction of natural gas was a cash cow for the Dutch state but has led to continuously high CO2 emissions and severe problems with earthquakes, forcing the Dutch government to reduce the volume of extraction and eventually to stop extraction in 2030. From a position as a net exporter of natural gas, the Netherlands has become an importer natural gas. At the start of the war in Ukraine in 2022, the Netherlands imported 15% of its demand for natural gas from Russia. Citizens and industries are suffering from extreme price levels for natural gas, and the urgency to find sustainable solutions for heating is now broadly felt. In 2019, a broad coalition of stakeholders in the Netherlands signed a Climate Agreement to achieve the emission reduction target of 55 % in 2030. For the built environment with 7 million households the transition from natural gas to renewable sources of heating and cooking will imply a strong increase of district heating. Because of the high level of population density, potentially up to 50 % of the houses will be connected to district heating in 2050. Therefore, the Dutch society is in a search for more knowledge about district heating, and more specifically about cooperative district heating. In the Netherlands there is only one district heating cooperative delivering heat for more than 10 years, but around 80 citizen initiatives are in the process to establish a district heating cooperative.

In Denmark, cooperative district heating is a widespread with 323 cooperatives on a total of 385 district heating companies. Therefore, there is a lot of practical experiences with cooperative district heating and know-how that the Dutch society may use to expand cooperative district heating in the Netherlands.

However, what might work in Denmark may not work in the Netherlands. Therefore, this report attempts to investigate some of the main differences and obstacles, but also similarities between the Danish and Dutch situation that may make it easy to adopt Danish know how in the Dutch context.

With this report we hope to inspire and bring new insights on how to expand cooperative district heating in the Netherlands, with export of Danish know-how to the Netherlands. This reports also contributes to the development of a Dutch support structure for district heating cooperatives, inspired by Danish know-how. The support structure, currently under construction, will enable the development of at least 1000 Dutch district heating cooperatives that develop, build, and operate district heating projects.

The report is written by EBO Consult and Energie Samen Buurtwarmte. EBO Consult is a Danish company specialized in supporting and managing district heating cooperatives in the Copenhagen Region. Energie Samen Buurtwarmte coordinates the development of the support structure in the Netherlands in close cooperation with their members, the district heating cooperatives in the Netherlands, and with partners of the open Coalition for Cooperative Heat. This coalition is open for new partners and hopefully this report will inspire new partners to join.

We hope you will enjoy the reading!

Executive summary

In this chapter, we will introduce the main conclusions from the report.

The emergence of cooperative district heating

The reason why district heating cooperatives have managed to develop in Denmark is due to a historic and cultural condition. It has always been a part of Danish history and culture to solve local issues together. Back in the days, when the money was fewer, it was a normal procedure to locally share the investments in assets, and afterwards share the benefits of the assets. When the oil crisis happened during the 1970s - 1980s, it created heating problems, because of the limited supply of oil, resulting in a high oil price. The crisis developed a national and local need for changing the heating source. Because of the cultural tradition of solving problems locally, it was a natural development that the heating problems partly managed to be solved through district heating cooperatives, supported by national legislation. Today, the 323 district heating cooperatives are primarily located in smaller cities.[1]

In the Netherlands, cooperatives are also common in the energy sector. Since the 1980s wind cooperatives were established, but the provision of heat was organised with cheap natural gas from the big Dutch gas bell in province of Groningen. The first district heating cooperative was established in 2008. In the period 2010-2015 some cooperative attempts with district heating failed. Since 2015 the number of district heating initiatives has grown to 80 in 2021. The prospects for cooperative district heating are great because for an important part of neighbourhoods for which a central and large-scale heat solution is (for the time being) not available, but for which a smaller-scale and collective heat solution is possible and has a greater social value than individual solutions. This could be a solution for 45% of the 13.000 neighbourhoods in the Netherlands. An open Coalition Cooperative Heat has published the ambition for at least 1000 district heating cooperatives in 2030.[2]

Why district heating cooperatives?

The reason why district heating cooperatives are widespread in Denmark is because they are:

- One of the most effective ways to protect consumers, because they focus on keeping heating price as low as possible.
- Locally rooted with a high engagement and support from the local society, which is crucial when changing energy infrastructure.
- Important players in the green transition because of their focus on long-term planning. The focus is not on short-term profit making.
- Important to sustain a well-functioning regulation. The Danish regulation is effective because it is based on transparency in the heating prices and in the actual costs of the district heating company. The only companies with incentives to share their actual cost with the regulator is the district heating cooperatives.
- Important for citizens, 70 % of the Danes that participated in a survey conducted by Voxmeter for the Danish Association of District Heating think that it is important to keep cooperatives and the non-profit principle in the district heating sector.[3]

[1] Described in chapter: Role of cooperatives in the heating market
[2] Described in chapter: Role of cooperatives in the heating market
[3] Described in chapter: Role of cooperatives in the heating market

In the Netherlands, cooperative district heating is one variant of the three routes to make the built environment more sustainable: the individual route to help individual houses become more sustainable, the contingent route and the collective heat route. The collective heat route has a growing support in the Dutch society, and specifically the cooperative variant of it. Four advantages of cooperative district heating:

- If citizens themselves direct their heat supply, they feel a great responsibility for it, and this leads to greater support and faster realization. This is also apparent from the evaluation of the Natural Gas-Free Neighbourhoods Living labs.
- Citizens that organise themselves for district heating solution are more focused on affordable tariffs in the district than profit-oriented district heating companies.
- Better use of locally available low temperature heat sources.
- And district heating cooperatives are well placed to shave the peaks and drops in the supply of (green) electricity with power to heat, especially if the cooperatives also own the means of production for renewable electricity. Cooperatives that operate 4th of 5th generation district heating systems can balance the supply and demand of renewable energy in the district and avoid grid congestion. Congestion of electricity in the grid has rapidly become a huge problem in the Dutch energy system.

The urgency to reduce the dependence of natural gas has increased since Russia started a war in Ukraine. In that context a stronger supportive political framework for cooperative district heating is needed. It can be justified based on the track record of cooperatives in the renewable energy sector and based on experiences in Denmark.

- The development of district heating cooperatives is acceptable for many municipalities because the added value of cooperatives for the expansion of wind and solar energy on land is widely acknowledged. The wind cooperatives have proven that they are able to realize renewable energy projects quicker than commercial developers [4]. In the Dutch Climate Agreement, Energie Samen successfully lobbied for targeting 50% local ownership of renewable energy projects. Many municipalities are taking this target very seriously in the policy frameworks they create for approval of renewable energy projects.
- The Danish experience with the cooperative organizational model has let to 323 district heating cooperatives on a total of 385 district heating companies. None of the cooperatives have gone bankrupt, and their track record regarding consumer tariffs and quality is good.
- The cooperative approach involves citizens in the decision-making process of the heating project, resulting in widespread acceptance on the spatial impact of the heating system. The approach by commercial and public heating projects, in which citizens are informed about the project, result in widespread resistance.

Differences and similarities

Here we will describe the main differences and similarities between Denmark and The Netherlands with a focus on cooperative district heating.

The main conclusions from the chapter about the political framework are:

[4] Jaclijn Matijssen,2019 The cooperative wind of change? https://www.gelderland.nl/Jaclijn-Matijssen

- **Role in the development of energy politics:** In Denmark, the political position of cooperatives is established trough the Danish Association of District Heating. The Danish Association of District Heating participates in the development of energy politics, which align politics and public interests. In the Netherlands, the political framework for the heating market is in a development phase to create the conditions for a rapid expansion of district heating in the Netherlands. Energie Samen is currently working on establishing their political role in the development of energy politics, by representing the interests of district heating cooperatives. The specific role of energy communities is not fully accepted by the government or put into policy or law concerning district heating.
- **Gas price reference:** In Denmark, gas prices are no longer used as reference in the project proposals when expanding district heating. In the Netherlands gas prices are still used as reference in project proposals. The government is filling the gap between the costs for natural gas and renewable district heating by means of subsidy.

The main conclusions from the chapter about the legal framework are:

- **Legal position:** In Denmark, the position of district heating cooperatives is legally equal to the positions of district heating companies, directed by municipalities and commercially owned companies. The equal level playing field is centered around the non-profit principle and the procedures to ensure that the tariffs are based on acceptable costs of production. If this principle would be adopted as cornerstone for expansion of district heating in the Netherlands, cooperatives would also have an equal level playing field. But since the Dutch government does not seems to be willing to adopt this principle in the Heat Act 2.0, it is necessary to ensure market access of cooperatives by distinguishing district heating cooperatives clearly from profit-oriented district heating companies, by making use of the EU definition of energy communities.

  The reason why there is a difference between the two countries is due to the characteristics of the heating markets. The Dutch heating market is competitive because it is regulated to enable district heating companies to make "a reasonable" profit. It follows that the district heating cooperatives are likely to be competing with profit-oriented companies if the area has profit-potential. This might lead to cherry-picking by commercial companies for the "easy" projects and cooperatives having no competition in areas where it is difficult to realize a profitable project. In Denmark, the heating market is regulated by the non-profit regulation, which follows that there is no competition between district heating companies, and, therefore, it is not necessary to legally support district heating cooperatives.

- **License:** In the Netherlands, the ACM (national regulatory authority) provides the heat supply license. It is the ACM that approves the capacity of a district heating company to deliver heat, and the requirements on district heating companies include an extensive administrative organization and internal control system (AO/IC) approved by an accountant. When establishing a new Danish district heating cooperative, it is necessary to establish the company and develop its statutes, which must be sent to the Danish Utility regulator to be registered. It follows that the new district heating cooperative does not have to prove to the Danish Utility regulator at forehand that it is able of handling all the procedural, financial, and administrative processes to operate and deliver district heating. In other words, developing a district heating cooperative is easier in Denmark than in the Netherlands.

The main conclusions from the chapter about financial issues are:

- **Tariff regulation:** In the Netherlands, the tariff regulations are founded on the NMDA principle which means that the prices should not surpass the costs which a user of natural gas would have for the same amount of heat. Every year, at the end of December, the ACM publishes the maximum prices that district heating companies are allowed to ask from their customers for the supply of heat and cold. Danish district heating is based on local heat supply monopoly. Since it is a monopoly it is founded on a non-profit principle, where costs and revenues balance. The non-profit regulation has proven to be the most efficient in protecting consumers, because the surplus is repaid to consumers in the form of lower consumer prices. It is not possible for district heating companies to make a profit on producing and supplying heat in Denmark, because of the non-profit regulation.
- **Financial structure:** In Denmark, the financial structure for developing district heating is established through municipal guaranteed loan through Kommunekredit. In the Netherlands, there is no financial support structure yet. Sometimes subsidies are available, and in the exploitation phase commercial banks are prepared to provide loans under the condition that the cash flow is sufficiently stable.
- **Heat price transparency:** To incentivize keeping a lower heating price, the Danish Utility Regulator benchmark each year the heating prices for each company in a public report. The district heating companies put an honour in having a low heating price, because it symbolizes that everything is under control. In addition, the companies with the highest heating prices in the benchmarking will be investigated by the Danish Utility Regulator. Based on the price control accountancy in September, prepared by the district heating companies, the Regulator also controls whether each district heating company charges the consumers with the correct heat price, based on the budget. In the Netherlands, commercial district heating companies set one consumer price for all their district heating systems, and the profits or losses of individual district heating systems are hidden. And district heating companies tend to demand prices close to the maximum prices allowed by the ACM.

The main conclusions from the chapter about the organizational structure of the district heating cooperative are:

- **Legal forms**: In Denmark, the cooperative legal structure is the dominant form in which the activities are structured. There are no other legal entities involved in the ownership structure, because the cooperation with different partners in the cooperative structure is settled by a distribution of voting rights in the cooperative itself. In the Netherlands the cooperative is often one of the legal forms involved in the organisational set-up. In many cases the assets of the cooperative are structured in a limited company owned partly or for the full 100% by the cooperative. This is also due to the lack of a financing mechanism for cooperative district heating, which forces cooperatives into an ownership structure with municipalities, commercial service organisations or DSO affiliates. The different partners distribute the shares in the limited company. It needs to be seen how stable these structures will be.
- **Social housing corporations:** In the Netherlands, the social housing corporations are not allowed to become a member in the board of a district heating cooperative. This is an undesirable legal constraint for the Dutch district heating cooperatives that would like to benefit from the expertise of social housing corporations to develop and operate a

district heating company to keep energy prices low for the homeowners as well as for tenants of the social housing corporations. In Denmark, it is nationally regulated that social housing corporations are allowed to participate in the district heating cooperative. The social housing corporations are important to involve, because they often represent a large part of the heat demand and sometimes the renters form the majority of citizens living in a city.

- **Affiliates of DSOs**: In the Netherlands the chapter about market regulation in the Heat Act 2.0 is under discussion because not only cooperatives but also affiliates of DSOs are knocking in the door of the Ministry of Economic Affairs for market access. In many cases district heating cooperatives and affiliates of DSOs are establishing partnerships for the development and operation of district heating projects. In Denmark DSOs do not play a role in the heat market.
- **Shared service organization:** The Danish company, EBO Consult, is a service organization for district heating cooperatives that wish to be fully or partly managed. EBO Consult functions as the link between the board of directors and the consumers. The planning of the strategic direction and the general decision-making of the cooperative occurs in the board of directors, but it is EBO Consult that execute the decisions of the board. In the Netherlands, district heating cooperatives are developing a cooperative shared service organisation for the development and the operation of cooperative district heating projects. EBO Consult has been the source of inspiration for this shared service organisation.

The main conclusions from the chapter about the municipal involvement are:

- **Role of municipality:** In Denmark, the role of municipalities are defined when it comes to district heating and its expansion. The municipality can take on different roles that accelerate the expansion of district heating and the green transition. The four roles that the municipality can take are: a company, an authority, an "owner" of the district heating cooperative, and a facilitator of district heating. In the Netherlands, the Dutch government has put responsibility on municipalities to direct the heating transition, but most municipalities do not have the resources, the staff nor the knowledge to carry out this task yet. Many municipalities are looking for their role, some only want to be a facilitator where others want to participate as owner of the district heating company.
- **Relation between the municipality and the district heating cooperative:** According to the Danish Heat Supply Act, the municipality must – in cooperation with the existing district heating company – develop heat plans. Since district heating cooperatives are widespread, it is often district heating cooperatives that collaborate with the municipalities. In the Netherlands, the district heating cooperatives in many cases first have to compete with commercial district heating companies to be chosen as a partner for the municipalities.

The main conclusion from the chapter about technologies is:

- **Similar technologies:** The technologies used to produce heat are similar. The main differences are the use of biomass, which is more widespread in Denmark compared to the Netherlands, while heat and cold storage is more widespread in the Netherlands. In both countries pilots are taking place regarding 4th and 5th generation district heating including storage of heat.

The main conclusion from the chapter about the demand for connecting to district heating is:

- **Image:** The main difference between Denmark and the Netherlands is the image of district heating. District heating has existed in Denmark for a long time - it is common and widespread. It follows that there exist a lot of great examples and best practices throughout the country. The main reasons for why homeowners choose district heating in Hvidovre is because it is an easy, stable, secure, green, and cheap heating source. In the Netherlands, homeowners often have no image at all because it is unknown to them. And in the cities with district heating the image is often negative, because it is regarded as too expensive. Sometimes distrust of commercial district heating companies also plays a role because they feel they are connected to a monopoly without transparency about the price. The result is that there is little motivation for connecting to district heating.
- **Motives for district heating:** For Dutch citizens the price for heating is most important. Natural gas has been a cheap commodity in the Netherlands and alternative heat sources were more expensive. District heating is interesting when it is cheaper than natural gas. Other motives are the space needed for the installation, the environmental impact, and the nuisance during installation. Cooperative district heating projects connect to another set of motives of citizens in the energy transition such as are better solutions through more careful processes in the neighbourhood, positive social impacts and increased local democracy.
- **Marketing strategy:** In Denmark, EBO Consult offers a package deal to cooperatives, ensuring minimum nuisance during realisation. The package deal is part of the marketing campaign via formal and informal channels. In the Netherlands, in the first semester of 2022 two district heating cooperatives in Amsterdam and Wageningen have implemented a marketing campaign to get residents to sign for connecting to district heating. Both campaigns were successful as a result of gradual built up of support for district heating by the cooperatives over a period of years. Residents in both districts trust the work and effort that the cooperative has been putting in the district heating project. And the sharp increase of prices for natural gas has given extra motivation to sign for district heating.

The main conclusion from the chapter about tendering is:

- **Tendering process:** In general, the tendering process in the Netherlands and Denmark is similar because both countries are under EU regulation. In Denmark, EBO Consult has a lot of experience with tendering, while district heating cooperatives in the Netherlands are beginning to learn how to do it.

The main conclusion from the chapter about construction is:

- **Competition level:** The main difference between the Netherlands and Denmark is the number of construction companies specialized in district heating. When tendering in Denmark, there are often five to seven companies competing. In the Netherlands, the district heating market is smaller than in Denmark and there is less competition among construction companies. This is one of the reasons why heat prices are 38% to 65% higher in the Netherlands compared to Germany, Denmark and Sweden.

The main conclusions from the chapter about maintenance are:

- **Compensation payments:** According to the Dutch heating law, the consumers must be compensated financially when there is an interruption in the heat supply. It costs 35 Euros for an interruption of 8 hours and for every extra 4 hours there are 20 Euros extra compensation. In Denmark, it is not regulated on a national level, but on a local level. In Hvidovre, it is regulated under the technical regulations of the district heating cooperative, where it says that the consumers must accept that it is sometimes necessary to close the heat supply to maintain the district heating grid.
- **Certified district heating plumbers:** In Denmark, the plumbers can be certified in district heating when finalizing an education called Fjernvarmens Serviceordning. The aim of the education is to improve the operation of the district heating units and to ensure that the technical service of the district heating units is executed in the same way and with a high quality. In the Netherlands, Techniek Nederland has a specialized training programme for plumbers, but there is a lack of plumbers specialized in district heating.

Take aways from Denmark for cooperative district heating in the Netherlands

The success of district heating cooperatives in Denmark is the result of a set of conditions that have been created and optimized since the 1970s. The building blocks for the Danish success can be transferred to the Netherlands and accelerate the expansion of cooperative district heating in the Netherlands. Translated to the Dutch context the building blocks that are needed consist of:

- Market access with regulation that encourages district heating cooperatives
- Access to cheap financing sources for development expenditures and capital expenditures
- Governance models of municipalities and district heating cooperatives
- Access to knowledge for cooperatives and municipalities

Market access: Modelling the Dutch heat market on the basis of the non-profit principle is too much asked in the Dutch situation where profit-oriented companies dominate the heat market. To define energy community for heat (warmteschap) in the Heat Act 2.0, is in the Dutch situation an effective way to provide market access to cooperatives and to direct a part of the district heating market towards 'not for profit' and towards treating district heating more as a utility like drinking water. District heating cooperatives are intrinsically motivated to reduce the heat price for their residents. Benchmarking of production costs and tariffs among district heating cooperatives nationally and internationally will create a dynamic towards lower heat prices for the consumers.

Access to cheap financing sources: The KommuneKredit is one of the cornerstones of the Danish success that can be transferred to the Netherlands. Access to cheap financing sources for district heating cooperatives can be justified with the non-profit principle in the same way as it is done in Denmark. In the Netherlands the Bank Nederlandse Gemeenten (BNG) and the Waterschapsbank (WSB) are having similar functions as KommuneKredit and they can provide the financing of capital expenditures for the expansion of district heating. A solution needs to be found for the Dutch municipalities that are in bad financial health and have no capacity to provide municipal guarantees on loans from a district heating cooperative. A work around for the municipal guarantee could be a National Guarantee Fund for cooperative district heating. In

Denmark the cooperatives have direct access to the KommuneKredit, and that would be the way forward also for cooperatives in the Netherlands. Because applying the non-profit principle would imply that cooperatives are not building up capital on their balance sheet access and will be dependent on easy access to capital.

For the financing of the development expenditures, Energie Samen prefers to have a cooperative development fund for district heating instead of subsidies. A development fund managed by Energie Samen enables the process of standardizing and exchanging best practises in a fast feedback loop. Energie Samen can provide all initiatives with the necessary information, professional project managers, and legal support and can enforce professionalizing the sector, ultimately refusing loans when a cooperative does not take the necessary steps to develop a sustainable project and governance. Whereas a subsidy instrument places the burden to judge the feasibility of the project on the provider of the subsidy who has less instruments to create the necessary development in governance and project management. This model has been tested for the financing of renewable energy projects (wind and solar) and is the preferred model for the expansion of cooperative district heating as well.

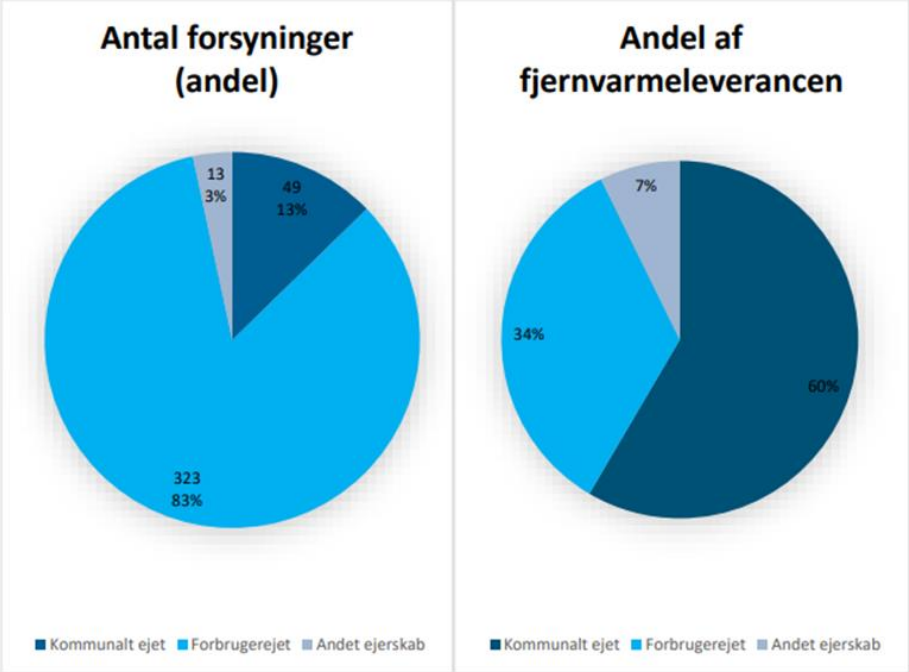
Governance models: With municipalities in the position to direct the heat transition and providing municipal guaranteed loans (if they can) to district heating cooperatives, it is important that the governance models ensure a close cooperation between the municipality and the district heating cooperative. In Denmark these governance models are well-established. These models can be transferred to the Netherlands to ensure long-term trust in district heating.

Access to knowledge: The transfer of Danish knowledge and experience with cooperative district heating to the Netherlands can accelerate the expansion of is district heating in the Netherlands. Energie Samen and EBO Consult will continue to cooperate for this end. In the Netherlands Energie Samen is structuring the knowledge in an academy that is open for cooperatives, municipalities and NGOs that are willing to participate in the academy, based on the principle of reciprocity. That implies that knowledge is available open source under the condition that stakeholders are prepared to share their knowledge as well. Knowledge about district heating is being developed in the network of Buurtwarmte under creative commons rules. Transfer of knowledge from Denmark to the Netherlands can take different forms including joint projects and training.

The role of cooperatives in the heating market

Denmark

Today, there are 385 district heating companies in total supplying consumers with heat. The ownership types vary – 13 are commercial owned, 49 are municipal owned and 323 are district heating cooperatives.[5] The district heating cooperatives are primarily located in smaller cities, while the municipal owned are in the bigger cities.



Figuur 1: Number of ownership types and quantity share of district heating delivery for 2019[6]

Number of ownership types and quantity share of district heating delivery for 2019. The dark blue colour represents municipal owned. The light blue colour represents cooperative owned. The grey colour represents a different ownership, which is typically private owned.[6]

But how did the district heating cooperatives manage to develop? The explanation is a historic and cultural condition. It has always been a part of Danish history and culture to solve local issues together. Back in the days, when the money was fewer, it was a normal procedure to locally share the investments in assets, and afterwards share the benefits of the assets. When the oil crisis happened during the 1970s - 1980s, it created heating problems, because of the limited supply of oil, resulting in a high oil price. The crisis developed a national and local need for changing the heating source. Because of the cultural tradition of solving problems locally, it was a natural development that the heating problems partly managed to be solved through district heating cooperatives, supported by national legislation. The development mainly happened in the smaller cities. Today, the cooperative structure is still present in different sectors, especially in the energy supply sector – from water, electricity to heat supply.

[5] https://forsyningstilsynet.dk/media/7241/fjernvarmestatistik-2019_revideret.pdf
[6] https://forsyningstilsynet.dk/media/7241/fjernvarmestatistik-2019_revideret.pdf, page 13

The cooperative development is still currently going on. Today, there are multiple examples of local citizens in Denmark that join forces to solve local heating problems by establishing district heating cooperatives. There are also examples of district heating cooperatives developing in municipalities, where there already exist a municipal owned district heating company. It is only possible if it happens in an area, where the existing district heating company has not established a district heating grid. For example, the municipal owned district heating company in Svendborg provides district heating to the main city, but not to the smaller cities located in Svendborg municipality. Therefore, local citizens in Ollerup, Vester Skerning, and Ulbølle joined forces in an ambition of developing a cooperative owned district heating company. It illustrates how different ownership types can co-exist and create district heating and contribute to the energy transition, which is possible due to the legal framework in Denmark.

Protection of consumers

The most effective way to protect consumers is through district heating cooperatives, where consumers own the supply monopoly regulated by the non-profit regulation.[7] The explanation is simple: district heating cooperatives focus on keeping the lowest heating price.[8] The basic principle of consumer co-ownership is to join local efforts in order to deliver services which is not available in the market. Therefore, cooperatives are always locally rooted with a high engagement of the local society. It follows that the ones that make the decisions are also the ones that must live with it.

According to the Danish Heating Association, one of the benefits of district heating cooperatives are their capability to long-term planning, because of their focus on consumer interest. They do not think on short-term profit making. Therefore, district heating cooperatives also play a vital role in the green transition, where it is all about thinking and making long term goals. In addition, it is crucial to have local commitment and support, when changing energy infrastructure.

The argument that the most effective way to protect consumers are through district heating cooperatives is supported by a report from the Danish Utility Regulator, where scientist conclude that cooperatives are important when sustaining a well-functioning regulation. They conclude that:

- District heating cooperatives are the most cost-effective model resulting in lower heating prices.
- The success of the regulation depends on whether the regulator receives all necessary information, which especially depends on types of ownership. The regulation is ineffective when there is no transparency in the heating prices and the actual costs of the district heating company.
- The only companies with incentives to share their actual cost with the regulator is the district heating cooperatives. In this situation, the regulator, the district heating cooperatives, and the consumers have the same interest in consumer protection.

[7] The non-profit regulation will be described in the chapter about financial issues.

[8] https://www.information.dk/debat/2021/06/kommer-forbrugerne-gode-saelge-fjernvarmeselskaber-private-interesser

- The aim of commercial companies is to make a profit, and, therefore, they do not have an interest to help the regulator with missing pieces of information.[9]

According to a survey conducted by Voxmeter for the Danish Heating Association, 70 % of the Danish people thinks that it is important to keep cooperatives and non-profit in the district heating sector.[10]

The Netherlands

In the residential sector most Dutch household depend on natural gas for heating. About 5.5% of Dutch households are connected to a district heating network (CBS, 2018).

The number of private and public district heating companies in the Netherlands with a license to deliver district heating registered at the ACM has grown from 6 in the year 2000 to 23 in the year 2020.**Fout! Bladwijzer niet gedefinieerd.** None of these district heating companies is a cooperative. Today, Thermo Bello is the only operational district heating cooperative, but it does not require a licence because of its small scale. The market for district heating is dominated by five companies: Vattenfall (multinational based in Sweden), Eneco (owned by multinational Mitsubishi based in Japan), Ennatuurlijk, Stadsverwarming Purmerend and HVC. These five companies own 12 (of 13) large-scale heat networks and around 158 small-scale heat networks with less than 5000 connections. Stadsverwarming Purmerend and HVC are publicly owned companies. Stadsverwarming Purmerend is only active in Purmerend. HVC is owned by 46 municipalities and 6 water boards and operates a heat network in 5 municipalities. Other companies in the market are focusing on a specific technology. In the market for heat-cold storage, Eteck owns 230 heat networks and Vaanster 148.**Fout! Bladwijzer niet gedefinieerd.** The biggest heat networks with 40.000-55.000 houses are located in Utrecht/Nieuwegein, Rotterdam, Almere and West-Brabant (area in and around Tilburg and Breda). The first heat network in the Netherlands was realized in 1923 in Utrecht. Other large-scale networks are in Purmerend, Amsterdam Zuid and Amsterdam Oost, Den Haag Ypenburg, Arnhem Duiven and Westervoort, Leiden, Amsterdam Westpoort and Amsterdam Noord, Enschede and Lelystad.[11] In 2017, the demand for district heating was 58,4 PJ net heat, of which 35,5 PJ by the industrial sector, 20,1 PJ by the residential and services sector, and 2,8 PJ by other sectors. District heating was offered by 128 district heating networks of which 120 hot water networks for the residential sector and 8 steam networks for the industrial sector. For the residential sector the heat output was delivered to 410.000 customers, and for the industrial sector to 60 customers.**Fout! Bladwijzer niet gedefinieerd.** For the record, district heating cooperative Thermo Bello is producing heat for 350 Heat equivalents being private customers and school buildings and office buildings. It is fair to say that till today cooperative district heating does not show up in the Dutch statistics.

Prospects for cooperative district heating

The Dutch district heating market is expected to increase in the coming decades because of the phase out of natural gas. 7 million houses and 1 million other buildings need to be heated with a renewable heat source. A study of PBL in 2017 estimated that 350 PJ, which is 60 to 75% of the heat demand can be delivered by district heating networks based on renewable heat

[9] https://www.danskfjernvarme.dk/maerkesager/oekonomisk-regulering/udspil/den-fremtidige-regulering-af-fjernvarmeselskaberne

[10] https://www.danskfjernvarme.dk/maerkesager/oekonomisk-regulering/udspil/den-fremtidige-regulering-af-fjernvarmeselskaberne

[11] https://www.sirm.nl/docs/Publicaties/20190131-SiRM-def-rapport-Regulering-kleinverbruikers-warmtenetten.pdf

sources that are available in the Netherlands.[12] Compared to the 58,4 PJ net heat demanded in 2017 an increase towards 350 PJ would imply a 600% increase of heat demand covered with district heating. About 80 municipalities in the Netherlands (less than 20% of all the Dutch municipalities) have a heat network.**Fout! Bladwijzer niet gedefinieerd.** The number of municipalities with a heat network is expected to increase and that offers opportunities for cooperative district heating. In the Netherlands, a district heating cooperative is a relatively young phenomenon. The first generation of wind cooperatives owning wind turbines has existed since the 1980s and a new wave of cooperatives involved in the production of solar energy has emerged since 2010. The first district heating cooperative Thermo Bello emerged in 2008 in Culemborg and that is still the only cooperative that is producing, transporting and delivering heat. In the period 2010-2015 some cooperative attempts with district heating failed. The development of district heating cooperatives was triggered in 2015 by the announcement of the Dutch government that stakeholders in the built environment need to prepare themselves for a future without natural gas in 2050. Spontaneously, energy cooperatives and citizen groups started to develop heating plans for their district or village. The number of initiatives grew from 5 in 2015 to 78 in 2021 (see the table beneath).[13,14] Most of the initiatives are in the initiation phase, 10 projects are in the development phase, and 2 are in the construction phase. Since in 2018 the Living Labs for Natural Gas-Free Neighbourhoods were installed, some cooperatives have been enabled to realise a district heating project. It is expected that before 2025 at least 5 cooperatives will be delivering district heating to their citizens as a result of these living labs.

Table 1: Growth of the number of energy communities and initiatives and projects on district heating

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Number of energy communities	243	313	389	498	585	623	676
Collective heat	5	9	Not measured	27	54	77	78

Also in 2018, the first steps were taken to establish Buurtwarmte as one of the activities of Energie Samen. In the summer of 2019 Buurtwarmte started as a network of district heating cooperatives, with the mission to enable citizen initiatives to play a full role in the transition towards a Natural-Gas Free neighbourhood. Energie Samen became a partner in the Participation Coalition that has been funded by the Ministry of Internal Affairs to support local initiatives for Natural Gas-Free Neighbourhoods in the development of a partnership with their municipality. In 2020 Energie Samen discovered that independently from each other Alliander, Rabobank and Klimaatverbond Nederland were also thinking about a support structure for cooperative district heating. This led to the open Coalition Cooperative Heat that published a strategic ambition in October 2021 and moved on with a further elaboration of plans in 2022.

[12] https://www.pbl.nl/sites/default/files/downloads/pbl-2017-toekomstbeeld-klimaatneutrale-warmtenetten-in-nederland-1926_1.pdf
[13] https://www.hieropgewekt.nl/uploads/inline/Lokale%20Energie%20Monitor%202020_DEF_lr_16-02.pdf
[14] https://www.hieropgewekt.nl/uploads/inline/Lokale%20Energie%20Monitor%202021_def_digitaal.pdf

This open Coalition is determined to develop a support structure for cooperative district heating. The open Coalition for Cooperative Heat together with the cooperative and municipal supporters, wants to pave the way for a broad roll-out of collective cooperative district heating in the Netherlands. The ambition is that by 2030 at least 1000 neighbourhoods will be supported to use a scalable, modular and future-proof collective heating solution that is owned by the neighbourhood. This gives the neighbourhood approach, one of the spearheads in the Dutch Climate Agreement for the built environment, a concrete future perspective. This is the case for an important part of neighbourhoods for which a central and large-scale heat solution is (for the time being) not available, but for which a smaller-scale and collective heat solution is possible and has a greater social value than individual solutions. According to the Open Coalition for Cooperative Heat this could be a solution for 45% of the 13.000 neighbourhoods in the Netherlands.

Discussion of differences and similarities of the role of cooperatives in the heat market

Table 1: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Market share of district heating in residential heating methods	65%	5,5%
Number of operational cooperatives	323	1
Market share of cooperative district heating	83% of the companies 34% of the demand for district heating	nihil
Structure of the district heating sector	Mainly cooperatives and publicly owned companies	Commercial companies and publicly owned companies
Prospects for cooperative district heating	Existing cooperatives will have more customers	At least 1000 cooperatives

Remarks

- The difference between the two countries regarding the importance of cooperative district heating is striking. The develop of cooperative district heating started in the oil crisis in the 1970s in Denmark and took off in 2015 in the Netherlands. In the Denmark district heating in residential buildings is normal, while few Dutch households have district heating. In Denmark the cooperative structure is dominant in the district heating sector while in the Netherlands commercial companies dominate the market of which two multinational companies.

Political framework

Denmark

Agreement of climate law

In 2019, the Danish parliament agreed to commit to a binding climate law with an ambitious goal to reduce Denmark's CO_2 emissions with 70 % in 2030 compared to 1990, and to a long-term goal of climate neutrality in 2050.

The climate law includes a sub-target mechanism, where the existing government every fifth year sets a climate goal with a ten-year perspective. To realize the sub-target, the government is obliged to develop a climate action plan with a ten-year perspective. Not only do the government have to develop a plan but they also have a duty to act on it. Therefore, the Climate, Energy, and Supply minister is obliged to present short – and long-term actions that show the way to the sub-target climate goal. The actions are followed up by a climate counsel which is an independent expert group that advises about how the transition to a climate-neutral society can take place in the most cost-effective way.

The climate agreement is organized in a yearly climate program. In February, the climate council evaluates whether the duty to act is accomplished in the previous year and gives recommendations to the efforts in the present year. In April, the Danish Energy Authority publishes a yearly climate status and projections report. In September, the Climate, Energy, and Supply Minister evaluates whether it is possible to reach the sub-target, and whether the duty to act is accomplished in the present year. If the Minister evaluates that the duty to act is accomplished, new actions or decided actions must be realized. After the yearly agreement of the Finance Act, the Climate, Energy, and Supply Minister presents a statement, including the effects of the government's climate policy. Here, the Danish Parliament evaluates whether the duty to act is accomplished, and whether the government follows it. A majority in the Danish Parliament can demand other actions to be launched, and in the worst case a majority can express mistrust to the Climate, Energy, and Supply Minister.[15]

To help the climate counsel, a climate dialogue forum has been established. The aim of the forum is to validate the recommendations from the climate council. The forum consists of 41 members, whereas one of the members is the Danish District Heating Association that represents the majority of district heating companies in Denmark on a political level. The association is responsible for the cooperation between the government and the district heating sector, where negotiations and long-term political goals can be agreed on in open discussions. The cooperation has been extremely important, which is proved by the fact that the government sometimes have had to change their political goals, because it did not match the reality and interest of the Danish district heating sector.

Agreement for energy and industry

The agreement for energy and industry is based on the climate law. The agreement is a first movement toward a 70 % reduction of CO_2 emissions compared to the 1990 in the energy and industry sector.

In this section, initiatives and actions focused on the district heating sector will be highlighted.

[15] https://kefm.dk/Media/1/D/aftale-om-klimalov-af-6-december-2019%20FINAL-a-webtilg%C3%A6ngelig.pdf

To develop the heating sector in a green direction, the Danish Parliament agrees that heating with oil and natural gas should be phased out, and replaced with heat pumps, district heating and other green heating technologies. To accomplish it, the Danish Parliament works with initiatives that make green heating attractive for the consumers and with initiatives that improve the conditions for expanding green heating.

To make green heating attractive for the consumers: the Danish Parliament has agreed to make heating with fossil fuels more expensive. Therefore, the tariff on fossil fuels will increase from the 1st of January 2021. In addition, the Danish Parliament has launched four different grants to consumers. The aim is to motivate consumers to convert from heating based on fossil fuels to green heating solutions.

- The first grant is primarily to the conversion from oil or natural gas to heat pumps, but it is only households located in areas, where it is not possible to install district heating that can receive the grant.
- The second grant is to heat pumps on subscription.
- The third is to the expansion of district heating, and
- The fourth is to natural gas conversions.

The third and fourth grants are particularly interesting for district heating companies. The third grant is called the district heating grant, which supports the expansion of district heating to areas where there is no district heating today. The district heating company can receive 2.600 euros per household from the grant, but maximum to the number of households that constitute the minimum of conversions making the conversion project realizable. The minimum of conversions is defined as the number of households in an expansion project that creates balance in the corporate finance of the district heating company. The aim of the grant is to lower the prices for the consumers by creating a higher conversion rate and making the district heating expansion projects more realizable.

The fourth grant is the decoupling grant, supporting the conversion from natural gas into a greener heating source. When decoupling natural gas, consumers must pay kr. 1.100 euros in fee to the natural gas company. With the decoupling grant, the consumer can cover the fee. The aim of the grant is among others to motivate consumers with natural gas, living in a district heating area, to convert into a greener heating source, such as district heating.

To improve the conditions for expanding green heating: the agreement includes several changes in the regulation of the district heating sector.

- First, the district heating companies have free choice of their investments. It follows that district heating companies no longer are bound to natural gas or combined heat and power production plants.
- Second, to promote the conversion to heat pumps in the district heating sector, heat pumps are subject to the same rules as industrial surplus heat, geothermal heat, solar heating, and heat produced with biogas or biomass. These changes follow that more and more district heating companies will implement heat pumps in their grid.
- Third, district heating companies no longer need to compare their prices with natural gas in expansion projects. When expanding district heating, it is a legal demand to develop a project proposal that must be approved before the realization of the project. To get the project proposal approved, it must prove that the project benefits the society, the consumer, and the district heating company economically. Earlier when the

prices for natural gas were lower than prices for district heating, it was extremely difficult to develop a project proposal that could be approved. Therefore, the new regulation where it is no longer a legal demand to compare district heating with natural gas prices is a tremendous step in the right direction for expanding district heating.[16]

In 2022, several parties joined a partial agreement about green electricity and heat because of the increase on energy prices. A new political ambition is to phase out natural gas as a heating source before 2035. With the partial agreement, the ambition is to speed up the green transition and the expansion of district heating.[17]

The Netherlands

The Dutch Climate Agreement

The Netherlands is aiming to reduce greenhouse gas emissions by 49% by 2030 and by 95% by 2050 – compared with 1990 levels. In 2019 the Climate Agreement defined policies and measures to support the achievement of these targets. It was developed through a collaborative process involving parties from across Dutch society.[18] Energie Samen is also one of the signatory parties.

The principal goal of the Climate Agreement touches on everyday life. Citizens, businesses and public authorities will have to rely on one another to be able to contribute to this objective. For that reason, the Climate Agreement is a social pact.
At the same time, the Climate Agreement constitutes a large part of the implementation of the first Climate Plan under the Climate Act, in which the Dutch government will outline the key points of its climate policy for a ten-year period. Under the Climate Act, the primary responsibility for the Climate Plan is political. From the perspective of the Climate Act and at a national level, it is the responsibility of the government and the House of Representatives to make decisions regarding the policy to be implemented and the corresponding benefits and burdens, while considering the democratic process by which all public authorities shall under all circumstances be bound. Embedding this policy in both politics and society is critical to realising the objectives not merely on paper, but also in practice.

The implementation of the agreements will remain in the hands of the participating parties, including the Dutch government, as much as possible. In this way, the parties themselves bear primary responsibility for effective implementation of the agreements reached and are jointly responsible for implementing their part of the Climate Agreement.
Civil organisations will only be able to fulfil their responsibilities if they are involved in the implementation process as a full partner. Sector-specific implementation committees are set up for this purpose under the direction of the relevant ministers. The Climate Agreement includes agreements in five sectors: 1) Electricity, 2) Built Environment, 3) Industry, 4) Agriculture and land-use, and 5) Mobility. Four different ministries are responsible for the implementation of the Climate Agreement.

1. The Ministry of Economic Affairs and Climate Policy for Electricity and Industry
2. The Ministry of Internal Affairs for the Built Environment
3. The Ministry of Agriculture, Nature and Food quality for Agriculture and land-use

[16] https://fm.dk/media/18085/klimaaftale-for-energi-og-industri-mv-2020.pdf

[17] https://www.regeringen.dk/media/11470/klimaaftale-om-groen-stroem-og-varme.pdf
[18] https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/national-climate-agreement-the-netherlands

4. The Ministry of Infrastructure and Water for Mobility.

The Minister of Economic Affairs and Climate Policy has a coordinating responsibility and will monitor the overall coherence that is envisaged as a result of the Climate Agreement, including in relation to the cross-sector themes it has identified.

Energie Samen is represented at the implementation committee Electricity and is in the process of applying for a position in the committee Built environment.

Targets and ambitions for the Built environment for 2030

In 2050 7 million homes and 1 million non-residential buildings need to be free from natural gas. That implies energy saving and use of renewable heat and electricity. A first target for 2020 is to make 1,5 million homes more sustainable tackling one district at a time. The aim is to steadily increase the pace of sustainability efforts to over 50,000 existing homes per year by 2021. By 2030, the target is to have settled into a rhythm of 200,000 homes per year. The objective is to ensure a reduction of 3.4 Mt of carbon dioxide in the built environment by 2030, compared to the reference scenario. Roughly 1,5 million existing homes will have to be made more sustainable and carbon dioxide emissions in existing non-residential buildings will have to be cut by an additional 1Mt by 2030.

Agreements for the Built Environment

A structured approach was chosen, tackling one district at a time. The municipalities play a crucial role in this regard. Alongside residents and building owners, a meticulous process will have to be completed to determine the best solution for each district, for when houses are no longer heated with traditional central-heating boilers on natural gas. Solutions may vary from one district to the next. If the area has been densely developed, contains many high-rise buildings or has homes that were built before 1995, then a district heating grid will often be the most suitable solution. If the area contains new homes set out in a spacious district, then an all-electric solution may be better. For many districts, the natural gas network will remain in place beyond 2030 and may even be used for green gas or hydrogen. Insulating and burning less gas, sustainable or otherwise, with a hybrid boiler might offer a sensible temporary solution. However, the condition of the homes is not the only relevant factor; the wishes of the residents and challenges in the district other than energy supply equally determine the pace and the outcome. The mission of Energie Samen Buurtwarmte is to enable collectives of residents to play a full and equal role in de heat transition, alongside municipalities. In the Climate Agreement this is referred to as the neighbourhood approach.

In 2021 all Dutch municipal councils produced a Transition Vision for Heat that aims to establish a realistic technological perspective as well as a time schedule within which to transition away from natural gas. Potential alternative energy infrastructures (all-electric, district heating, green gas) are already known for districts for which the transition has been scheduled before 2030. When the potential alternatives have been identified in the transition vision for heat, the municipality will start to determine the implementation plan per district (WUP: wijkuitvoeringsplannen). This is an implementation plan comparable to the instrument in the Environment and Planning Act. That residents of the districts need to participate in these plans is not in question. But the Climate Agreement is vague about the question how they should be enabled to participate. Energie Samen was not invited to participate on the table for the built environment when the Climate Agreement was drafted. Now, in the implementation of the Climate Agreement, the practical experience that Energie Samen has gained will be important for the implementation committee, to make progress on the neighbourhood approach.

The aim of the Dutch government is that the necessary investments will be paid back with the revenues of a lower energy bill (woonlastenneutraliteit). In 2020 a governmental advisory organization PBL published a report stating that 'woonlastenneutraliteit' is an unrealistic aim for very many homes under the present and intended policies. In the short-term additional subsidies are required to fill the gap. The potential for cost reduction through innovation and standardization, and bundling demand is still unclear.[19]

There are different programmes put in place:

-Programme 'Natural Gas-free Districts' (Programma Aardgasvrije Wijken). This programme includes a Knowledge and Learning Programme (KLP: Kennis -en leerprogramma) and Test Beds for Natural Gas-free Districts (Proeftuinen Aardgasvrije Wijken)

a) The KLP is designed for all 352 municipalities in the Netherlands to find a way learning by doing on six themes: Direction and Organization; Costs and Financing; Technical solutions; Juridical issues; Participation and Communication; and Connection with social economic issues (Integral sustainable district development). Under the theme Participation and Communication, a subprogramme is financed with five NGOs in which Energie Samen participates. From 2019 to 2021 these organisations supported 388 citizen initiatives of which 120 realised a formalized collaboration with their municipality. The Climate Agreement also includes agreements on the development of participation principles and participation guidelines.

b) Under the Test Beds (Proeftuinen) there have been three rounds of calls of proposals from municipalities, (in 2018, 2020 and 2022) with 64 plans approved. In the three rounds also some cooperative district heating projects were approved. These pilots are important for the growth of cooperative district heating in the Netherlands because they provide funding for the development costs as well as subsidy for the negative business caseup to maximum 10.000 Euro per house.

-Funding of Sustainable building and renovation. In 2020 making a new connection to district heating is also approved under the ISDE subsidy scheme with a subsidy of 3325 Euro per house. To reduce the administrative burden of these subsidies, and to make sure the funds are available for the project, two district heating cooperatives are experimenting with a new approach in which these funds are channelled directly to the cooperatives that are developing a district heating project. In the same ISDE subsidy scheme individuals can also apply for individual heat pumps. The heat pumps can be installed anywhere, also in areas with district heating or in areas where a district heating network is being developed or planned.

-Obligation for Houses and Utility buildings to have an energy label, if they want to sell it.

-Network Aquathermy (NAT) around a Green Deal Aquathermy, with a Community of Practice and Research Programmes and pilots. Energie Samen is a partner in the NAT. The justification for the funding of this network is a report by research organization CE Delft that the heat demand expected in 2030 will be 333 Petajoule (PJ), with aquathermy providing more than 50% of the heat sources with surface waters (150PJ), wastewater (56PJ) and drinking water (4 PJ). Many local heat initiatives are inventorying opportunities for aquathermy in their districts.

[19] Woonlastenneutraal koopwoningen verduurzamen (2020). Verkenning van de effecten van beleids- en financieringsinstrumenten. Planbureau voor de Leefomgeving en Amsterdam School of Real Estate.

-The Netherlands Heating Expertise Centre (ECW: Expertise Centrum Warmte) is set up for the 352 municipalities providing technical and financial support and tools. For example, ECW offers a tool to support municipalities with the Transition Vision Heat, and a template for Businesscases District Heating. For Energie Samen good cooperation with the ECW is important to ensure a good connection between municipalities and local initiatives in the heat transition. Energie Samen is part of the advisory committee of the ECW.

-National Programme Regional Energy Strategy (NPRES). For the implementation of the Climate Agreement the Netherlands is divided in 30 Energy Regions, covering all 352 municipalities. Municipalities are thus forced to cooperate with each other, beyond their own boundaries. Each of the Energy Regions had to propose a regional energy strategy (RES) to produce renewable electricity with wind power and solar power. The strategy should also include a chapter on the sustainable heat sources that are available in an Energy Region to allow houses and utility buildings to become free from natural gas. The national Programme RES supports each of the Energy Regions with their strategy. The strategy of an Energy Region needs approval of each of the local councils. The strategies of the 30 Energy Regions, all summed up, should be sufficient to reach the targets set for 2030. In case that the strategy is not ambitious enough, the municipalities in an Energy Region will be confronted with it and they will have to adjust their strategy.

-Natural gas phase out in new construction. New buildings (homes and small commercial buildings) will no longer be fitted with gas connections. From 2021 onwards the costs of disconnecting from the gas grid (around 800 Euro) will no longer be charged upon the homes that are disconnecting. The DSOs will pay for these disconnection costs themselves.

Climate ACT: Ensuring targets are reached

The Climate Act prescribes governance that is specifically geared toward safeguarding the targets, for which the Minister of Economic Affairs and Climate Policy bears ultimate responsibility (1st line). The Act sets out the following aspects:

- Climate Plan: contains the key points of the government policy to be implemented in the next ten years. The first Climate Plan will be based on the Climate Agreement. The Climate Plan will first be published in 2019, can be amended in 2021 and will be revised and readopted at least once every five years;
- Climate and Energy Report (KEV) published by PBL: the KEV, which is published by the Netherlands Environmental Assessment Agency, provides a report of actual and forecast CO2 emissions in the Netherlands (and broader energy management). The KEV will be published each year as of 2019;
- Climate Memorandum: contains a Government Appraisal regarding the targets, accompanied by any additional policy intentions to achieve those targets. This will first be published in 2020 and on an annual basis thereafter.

The Climate Act cycle will align with the European accountability cycle. The submission of the Climate Plan will be aligned with the submission of the Integrated National Energy and Climate Plan (NECP). Europe calls for a progress report every two years, which will be streamlined with the Climate Memorandum.

Discussion of differences and similarities of the political framework

Table 2: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
DH politics	DH is a mean to reduce CO_2 emissions. Natural gas as heating source should be phased out.	
Development of national energy politics	Strategic and open cooperation between the government and the district heating sector, enabling public interests and alignment. Legislation enhancing the development and expansion of district heating.	Energie Samen that represents the district heating cooperatives has been excluded from the negotiation tables regarding district heating so far. Actions undertaken to impact energy politics include consultations, lobby and strategic partnerships
Stage	Expanding district heating network	District heating development
Position cooperatives	Established through the Danish Association of District Heating	The position of Energie Samen is not fully accepted by the government nor is it put into policy or law.
Point of view on cooperatives	Proven party in society	Not convinced by cooperative way of working
Subsidies for DH	DK grants are similar to grants in NL	
Sector district heating	Industrial	Built environment
Gas price reference	Gas prices are no longer the reference in the approval of project proposals	Gas prices are the reference in project proposals, and the government is filling the gaps with subsidy.
Tax	More on gas, less on electricity	

Remarks

- The ambitions of the Danish and Dutch governments are similar. They want to reduce CO_2 emissions, and they consider district heating as one of the means to do so. However, the two countries are at different stages when it comes to (cooperative) district heating. In Denmark, district heating is a well-established sector with a high share in the heating market. The political focus is on expanding district heating and making district heating a more available, sustainable and attractive heating source through different grants. In the Netherlands, district heating is representing a small percentage of the heating market in a limited number of cities and towns with 95% of the households in the Netherlands connected to natural gas. In the transition away from natural gas the prospects for district heating are estimated at 50% of the heating

market [20]. Thus, district heating may become a "new and big" player in the heat market replacing natural gas as a heat source. Therefore, the political framework for the heat market is in a development phase to create the conditions for a rapid expansion of district heating in the Netherlands. And as part of the policy framework for this expansion, the government is focusing on market regulation by defining roles, tasks and responsibilities of municipalities, cooperatives, private companies, DSOs, social housing corporations, the Netherlands Authority for Consumers and Markets (ACM), etc. The proposals for market regulation will be incorporated in the Heat Act 2.0, the Dutch legal framework for the district heating market.

- The roles of district heating cooperatives are also at different stages in the two countries. In Denmark, the cooperative organizational model is an acknowledge and often used organizational model that has been used to expand district heating. On a political level, district heating cooperatives are represented through the Danish Association of District Heating. The association is responsible for the cooperation between the government and the district heating sector, where negotiations and long-term political goals can be agreed on in open discussions. The cooperation also facilitates that public interests are involved in the energy politics since the Danish district heating companies directly answer to consumers.
- In the Netherlands, although there are 3309 active cooperatives in different sectors, cooperative district heating is a new phenomenon. [21] Since 2009 only one district heating cooperative has been delivering heat. In 2015 the development of new energy communities took off, and since then ten district heating cooperatives were formed that have reached the development phase. In the coming years some of these cooperatives will start delivering district heating. Thus, from a Dutch policy perspective the cooperative organizational model has not yet proven its added value for the heating transition and for the expansion of district heating. The growth of district heating cooperatives in the Netherlands in the past years has benefitted from the Programme for Test Beds for Natural Gas-free Districts. Dutch municipalities were competing for grants under this programme in three rounds, and some municipalities developed a grant proposal together with a district heating cooperative. It is important for the development of a supportive political framework for cooperative district heating in the Netherlands that the cooperative projects approved under this programme, will be successful and demonstrate added value in the expansion of district heating.

Legal framework

Denmark

The Heat Supply Act

The district heating supply in Denmark is mainly regulated by the Heating Supply Act, as wells legal criteria describing how to make a project proposal and rules for calculating which project proposal reflects the most sound consumer economy. The overall purpose of the legislation is to further the use of renewable energy, to secure the most economical and environmentally friendly, use of energy for heating buildings and supplying hot water, to reduce the energy supply's dependence on fossil fuels.

[20] Source different studies o.a. from PBL
[21] Het Nederlandse Coöperatieve landschap- 2020 Cooperatie nummer 645 december 2020 jaargang 82

District heating supply act allows companies can be constituted by only municipalities, by municipalities and commercial owned companies and by cooperatives. The position of district heating cooperatives is legally equal to the positions of district heating companies, directed by municipalities and commercial owned companies. They are all subject to the same legislation regulating the district heating area and there is no specific support for district heating cooperatives.

The establishment of a district heating system is based on thorough heat planning. It is the responsibility of the municipality to make a district heat plan. The municipality must ensure that heat supply planning is taken into account in connection with other municipal and local planning, and that it does not conflict with other legislation such as the Planning Act, the Building Act and the Environmental Protection Act etc.

If the district heating system is owned by a municipality or a subsidiary company owned by the municipality and the municipality wants to sell it or merge with another district heating system, owned by another municipality, the municipality is obliged to offer the district heating system to the consumers.[22] This is also the procedure when there is a transfer of part-ownership, e.g., some shares in the company owned by a municipality. If the municipality overrules that obligation the selling or merge agreement will be declared nullified.[23]

The Danish Utility Regulator

The Danish Utility Regulator is a public institution. The main goal of the Danish Utility Regulator is to maintain a strong and effective supervision of the utility sector including electricity, natural gas, and district heating. In other words, the Danish Utility Regulator monitors that all district heating companies comply with the Heat Supply Act. The monitoring is done with consumer interests as a top priority. The focus is not whether it is a municipal, commercial, or cooperative owned district heating cooperative, the focus is whether the supplier is able to deliver energy with fair prices, which in the end benefit the consumer.

"The Danish Utility Regulator's purpose is securing consumer interests in the utility sectors by striving for a higher level of efficiency, the lowest possible costs in the short and long term, a stable and secure supply, and a cost-effective development in technology and climate-friendly initiatives."[24]

The tasks are carried out in accordance with the sector laws – the Danish Utility Regulator works towards a higher level of transparency in the utility sector to provide stable framework conditions for suppliers, and to create effectively integrated supply markets in accordance with national legislation and EU regulation.

"*This entails that we:*

- *Monitor and analyze conditions in the utility sectors essential to the Danish Utility Regulator's tasks;*
- *Monitor and analyze conditions in the utility sectors with the purpose of making proposals for development of legislation;*
- *Provide information and analysis of matters in the utility sectors at the request of the Minister for Energy, Utility, and Climate*
- *[….]*

[22] The Act § 23 f.
[23] The Act § 23 f, 5.
[24] https://forsyningstilsynet.dk/about-us

- *Set a price cap on heat from waste incineration plants.*

We approve:

1. *[….]*
2. *Return on share capital in the district heating sector.*

We supervise:

1. *[….]*
2. *That costs related to the disruption of a consumer's supply due to termination of an agreement are borne by the consumer;*
3. *Network and distribution companies' costs for energy savings in the energy, natural gas and district heating sectors;*
4. *The collective energy companies' agreements in relation to market demands, the provisions in the supply laws, requirements for independence, and non-discrimination. This applies to separate identity, rules regarding independence, and the companies' implementation of internal monitoring programs to ensure compliance;*
5. *That district heating companies only include necessary costs in heating prices;*

Furthermore, we:

1. *[….]*
2. *Compile price statistics and monitor the prices of heat on the Danish district heating market;*
3. *Compile district heating statistics and heat price statistics."*[25]

Heat planning

It is the municipality together with the district heating companies that are responsible for developing a heat plan.[26] The municipality can demand that a local heat plan shall be made by the cooperative. If it is considered necessary according to the execution of the heat plan, the municipality can decide that specific heating systems are not allowed to be established in existing or new buildings.[27] The municipality can for example prohibit new oil installations at the consumers, and they can demand the oil installations to be changed.

The municipality is also accountable for ensuring that changes and the extension of the district heating system are in line with the Heat Supply Act.[28] To establish or expand district heating, the district heating cooperative is responsible for developing, preparing, and sending a project proposal to the municipality for approval. The project proposal must include socio-economic, user-economic, company-financial, and environmental analyses for different heating sources. The municipality then must approve the heating source that has the largest economic benefits.

To prepare the project proposal, the Danish Energy Agency provides several socio-economic assumptions. The assumptions include fuel prices, electricity prices, costs of emissions and interest rates.

The municipal role in heat planning will be elaborated in the chapter about municipal involvement.

[25] https://forsyningstilsynet.dk/about-us
[26] The Act § 3.
[27] The Act § 14.
[28] The Act § 4.

The Netherlands

Heat Act

The Dutch Heat Act is into force since 1 January 2014 after preparations of more than a decade and extensive discussions and criticism of a Bill that was submitted in 2003 by members of Parliament. The Act aims to protect heat users from a potential abuse by the heat suppliers' monopoly position by regulating the supply of heat to small-scale users. Suppliers of heat (not just district heating) are required to arrange for reliable and affordable heat supply against reasonable conditions and good quality service. For this purpose, the Act introduced a license obligation for the supply of heat, as well as price regulation with a mandatory maximum tariff for supply of heat.

In the context of the Paris Climate Agreement, the prospects for district heating have changed. Natural gas is still the dominant source of heating in the Netherlands, but a transition is expected towards district heating with sustainable heat sources. In that context a revised Heat Act – adopted by Parliament on 3 July 2018 – entered into force on 1 January 2020. Yet another bill to amend this act is already being prepared. This bill, which the Ministry of Economic Affairs and Climate calls the Wet Collectieve Warmtevoorziening (further referred to as Heat Act 2.0), anticipates the coming energy transition where heat networks are expected to play an increasingly important role as an alternative to gas. To facilitate decision-making and investment in the construction and operation of heat networks, the ministry is using the Heat Act 2.0 to elaborate on the roles and responsibilities of public and private parties, and outline the prerequisites for creating a reliable, affordable and sustainable collective heat supply. The main themes of the Heat Act 2.0 will be market regulation, tariff regulation, and sustainability.

The act envisages that market regulation will help realise a reliable, affordable and sustainable heat market. To safeguard these public interests, the ministry has identified three principles for market regulation: that market regulation be consistent with the market's technical and economic characteristics and that regulations contribute to market efficiency; that there be sufficient room for a local tailored approach due to the diversity of potential heat sources and systems; and that the government and municipalities have adequate means to safeguard the public interest in the future.

Market regulation

Market regulation is a new issue in the Heat Act 2.0 and is not regulated yet. The lawmakers of the Heat Act 2.0 are proposing that municipalities determine 'heat parcels' (warmte kavels) for district heating and appoint a district heating company (DHC) per parcel to make a heat plan for that parcel. The Bill provides the standards for an open and transparent procedure and strict criteria for appointing a DHC. The criticism of Energie Samen on the proposed procedure is that it does not provide an equal playing field for energy communities of residents, and that it favours instead commercial DHCs or commercial project developers entering the heat market. In its consultation reaction to the bill, in July 2020, Energie Samen proposed to include the European definition of energy communities, to make it easier for municipalities to appoint a local heat cooperative that emerges within a heat parcel as DHC. The lawmakers of the Ministry of Economic Affairs and Climate Policy have not been receptive to the arguments and claim that the special provisions for small collective heat systems will be good enough for energy communities of residents. But Energie Samen does not identify with 'small collective heat systems' but with 'democratic heat systems', referred to as 'Warmteschappen' in line with European Regulations on energy communities.

Small collective heat systems

The thinking behind the special provisions for small and collective systems are based on the present Heat Act which differentiates between DHCs which require a heat supply permit and small suppliers that are allowed to supply heat without a permit. The permit requirement does not apply to a supplier which:

a. supplies heat to a maximum of 10 consumers at any one time;
b. supplies heat to an annual maximum of 10,000 gigajoules; or
c. is the landlord, as defined in the Heat Act, or owner of the building to which heat is being supplied.

The suppliers without a permit must meet some basic organisational, financial and technical requirements to carry out their task (according to the Heat Act), while DHCs with a permit must demonstrate that they can fulfil all the obligations set out in the act.

Likewise, the new Heat Act 2.0 will diminish the number of obligations on the small collective heat systems. In the first proposal the maximum was set at 500 homes. After the round of consultations on the Heat Act 2.0 the Minister announced a maximum of 1500 connections of homes as well as non-residential buildings.

Heat company (DHC)

It is acknowledged that production, transportation and supply of heat currently constitute a closed system. The Heat Act only regulates the supplier of heat and not the whole chain, while in practice the chain is often split between the supplier who also owns the transportation infrastructure, and the producer of heat. To ensure security of heat supply, the Heat Act 2.0 likely will require an integral Heat Company that is responsible for the whole chain. This requirement would exclude a position of DSOs in the Heat market, because they are legally restricted to do anything else than energy transportation. After the elections for parliament in 2021, the new government has come to an agreement with the DSOs on access to the market for District Heating transportation infrastructure. The Ministry is now convinced that public institutions including DSOs and their subsidiary companies should get a major role in the development and maintenance of district heating transport infrastructure. The role of energy cooperatives in the ownership district heating transportation infrastructure is not part of the agreement with the DSOs. Energy Samen who used to lobby together with the DSOs for a better Heat Act in a Heat coalition, has formed a new Coalition Cooperative District Heating, to ensure access of energy cooperatives to the heat market, and ownership of the supply chain.

Tariff regulation based on the price of natural gas

The Heat Act includes a mandatory maximum tariff for supply of heat to small scale users with a connection off less than 100 kW. This mandatory tariff is based on the so called 'not-more-than-otherwise' principle (referred to as the "NMDA-principle"), which means that the price is derived from the average costs incurred by a party when using natural gas for heating.

The Netherlands Authority for Consumers and Markets (ACM)

The ACM is an independent administrative body and belongs to the national government but is not part of a ministry.[29] When preparing and announcing decisions, ACM adheres to the rules of the General Administrative Law Act (Awb). The goal of the ACM is to enable the well-functioning of markets for people and companies. The ACM enforces the rules of the game that

[29] https://wetten.overheid.nl/BWBR0033043/2013-04-01/

apply to companies by countering unfair practices and encouraging them to comply with the rules. ACM provides information about the rules of the game so that everyone knows these rules and can stand up for their rights.

The powers and duties of the ACM include:

- Providing Information to consumers so that they can stand up for their rights.
- Research of possible unfair practices. The ACM has duties to enter places, to ask for information, to request access to information and to take data.
- When companies do not obey the rules the ACM will warn them, but the ACM also has juridical duties to force them, including the right to penalize the company with a financial penalty. The penalties that are published on the website of the ACM. The ACM can also publicly warn consumers against unfair practices of companies.

In several sectors, including the energy sector, the ACM imposes additional rules to stimulate competition, because competition in these sectors does not happen by itself. In the energy sector the ACM is responsible for the regulation of energy companies, the transmission system operators (TSOs) and distribution system operators (DSOs) of the electricity and natural-gas networks in the Netherlands. Since the start of the Heat Act in 2014, the ACM is also responsible for the regulation of district heating companies. The duties of the ACM regarding district heating companies include the duty to set maximum prices, to monitor compliance with the Heat Act and the maximum prices, to request for information, and to appreciate requests for a delivery license.

Sustainability

The current Heat Act has a strong focus on regular district heating, which means the supply of heat at a temperature of 90° Celsius. The Act does not consider recent developments in heat supply that make use of lower temperatures.

For the revised Heat Act, much discussion has taken place on third party access (TPA) for heat producers. Although the Ministry of Economic Affairs liked the idea of it, it decided not to introduce *regulated third party access* for heat producers, due to the complexity and diversity of the current heat networks, the different forms of heat generation and the large variety in the development phase of the current heat networks. Instead, the revised Heat Act introduced a model of so-called 'negotiated access' to the heat network. To strengthen the position of the heat producers, the revised Heat Act ensures that, at the request of a heat producer, the operator of the heat grid needs to enter negotiations concerning access to the network. A producer can request the network owner to provide the following information:

- available transport capacity on the heat grid;
- the applicable tariffs, if necessary;
- technical characteristics such as pressure or flow rate; and
- the transportation profile.

The revised Heat Act does not contain any provisions on third-party supplier access. Therefore, heat consumers are (still) unable to choose between multiple suppliers.

Sustainability is a new issue in the Heat Act 2.0 and is not regulated yet. The new Bill requires mandatory yearly reporting of DHCs on sustainability. Moreover, to reach national CO2 emission reduction targets the Bill will introduce diminishing average CO2 emission norms towards 2030,

from 40 kg CO2 per unit delivered heat in gigajoule down to 25 kg CO2 per unit delivered heat in gigajoule in 2030.

In its consultation reaction to Heat Act 2.0 Energie Samen proposed to create more room for innovative *integrated energy systems at district level*, and 4th and 5th generation heating and cooling networks.

Discussion of differences and similarities of the legal framework

Table 3: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Heat law	Heat Supply Act established	Heat Act established since 2014 and currently is Heat Act 2.0 under negotiation
Legal position of district heating cooperatives	The position of district heating cooperatives is legally equal to the positions of district heating companies, directed by municipalities and commercially owned companies.	District heating cooperatives are not recognized as different than commercially owned companies.
Support for district heating cooperatives	No support for district heating cooperatives	No support for district heating cooperatives
Regulator	Utility regulator monitors that all district heating companies comply with the Heat Supply Act. It develops price statistic two times per year, which gives an overview of the current situation in the district heating sector	ACM monitors compliance with the Heat Act, operate a licence system for district heating companies and define maximum prices for district heating setting price cap;
Responsible of local heat planning	Municipality or cooperation between municipality and a district heating cooperative	Municipality
Approval of local heat plans	Municipality has the power to approve or reject project proposals at the end of the development phase, when the proposals are ready for implementation	Market for District Heating is not regulated under the Heat Act yet. The government intends to regulate the market under Heat Act 2.0, with municipalities assigning heat parcels to district heating companies at the beginning of the development phase, based on a procedure that

		might lead to (or might not) a bankable project proposal.
License	Not necessary with a license. Only necessary to establish the district heating company and its statutes, which must be registered at the Danish Utility regulator	ACM (national regulatory authority) provides heat supply license (only) based on procedural/financial/administrative process plan of heat supply company

Remarks

- The Danish legal framework for district heating is well-established through the Heat Supply Law, while in the Netherlands the Heat Act 2.0 is under negotiation and development. So far, the Heat Act only regulates the maximum prices while the Heat Act 2.0 will also regulate market access and sustainability of district heating. While cooperatives in Denmark have been a fundamental pillar in developing and expanding district heating, in the Netherlands policy makers so far have not recognized the potential of cooperatives. Cooperative district heating needs to get a proper place in legal proposals for Heat Act 2.0, to foster market access of cooperatives to the heat market. A proper place means that a definition of a Warmteschap (energy community in the field of heat) is included in the Heat Act in order to differentiate cooperatives from commercially owned companies. European law already defines energy communities, and that definition needs to be incorporated in Heat Act 2.0.
- Danish district heating cooperatives are legally positioned in the same way as the municipal and commercially owned district heating companies. They are regulated the same way, which means that there is no financial or legal support for the district heating cooperatives. But even though there is no direct support for district heating cooperatives, one could argue that there is an indirect support through the incorporation of district heating cooperatives in the Heat Supply Law. The incorporation demonstrates a general acceptance of district heating cooperatives in the Danish district heating sector, which is currently lacking in the Dutch context. However, it is not only the incorporation in the Heat Supply Law that supports the development of district heating cooperatives, but also the non-profit principle that regulates the financial district heating framework. The principle will be elaborated in the chapter about Financial Issues.
- The main difference between the Danish Utility Regulator and the Dutch ACM regarding district heating is related to price setting. In Denmark, the heat prices are not regulated by setting maximum prices but are regulated by the non-profit principle (cost price plus model) and the Heat Supply Law that determines which costs can be included in the heat price. Moreover, the Danish Utility Regulator supervises the district heating prices by developing benchmarks of heat price statistics as a mean to identify potential for cost reductions and lower consumer prices. In Denmark, it is not well-seen to be in the high end of the benchmarks, because the statistics are publicly accessible. In the Netherlands, the dependency of households on natural gas is so big (95%) that the consumer price of natural gas determines the maximum prices for district heating. And although district heating companies do not need to ask the maximum price if their production costs are lower, they tend to establish price levels at or close to the price maximum. The only incentive for commercially owned district heating companies to reduce consumer prices is when their profits are obviously for the ACM too big. There is no public transparency about the costs of district heating and consequently it is generally considered by the customers as too expensive.

- Another difference between the Danish Utility Regulator and the Dutch ACM is related to license giving. When establishing a new Danish district heating cooperative, it is necessary to establish the company and develop its statutes, which must be sent to the Danish Utility Regulator in order to be registered. It follows that the new district heating cooperative does not have to prove to the Danish Utility Regulator at forehand that it is cable of handling all the procedural, financial, and administrative processes in order to operate and deliver district heating. In the Netherlands, it is the ACM that approves the capacity of a district heating company to deliver heat, and the requirements on district heating companies include an extensive administrative organisation and internal control system (AO/IC) approved by an accountant. In other words, developing a district heating cooperative is easier in Denmark compared to the Netherlands.

Financial issues

Denmark

Tariff regulation

Danish district heating is based on local heat supply monopoly. Since it is a monopoly it is founded on a non-profit principle, where costs and revenues balance. The Heat Supply Act defines which cost can be included in the heat price – however, it is only costs that are necessary and related to supplying heat. [30] It is also possible to include depreciation of assets and costs, which allow the district heating company to be financially sustainable both in short and long term. The price of heating is not the same and they can vary between and within a district heating area, but they are all regulated by the Heat Supply Act.

The non-profit principle can be deviated from when renewable energy production plants supply heat to a district heating grid (e.g. heat pumps, solar thermal, geothermal, biogas or biomass installations). The district heating company is allowed to calculate a surplus based on these technologies. Industrial businesses can also calculate a surplus when they deliver excess heat to the district heating grid.[31]

To ensure efficiency and to keep an overview of the district heating market, the Danish Utility Regulator develops price statistics two times per year. Therefore, the district heating company must prepare two yearly accountancies and a budget to the Danish Utility Regulator. In the end of each year, the district heating company must prepare a budget for the next year, which determines the heat price.
In September, there is a follow up of the budget. The district heating company must prepare a price control accountancy – to make sure the consumers are charged with a correct heat price and to check whether the district heating company follows the non-profit principle. To finish the accountancy year, the district heating company must also prepare an annual accountancy.

According to the Heat Supply Act, the consumers are entitled to know the heating price before they consume it. Therefore, the district heating company is obliged to notify the consumer if there are remarkable changes in the heating prices. In fact, the consumers should be notified three months before it is realized. Because of the non-profit regulation it is also prohibited to plan a surplus or a deficiency in a financial year. If the annual report shows a surplus or a deficiency, it should be balanced in the next financial year over the heating price – either by paying back the money to the consumers or by a de- or increase in the heating price.

[30] The Act § 20.
[31] The Act § 20 b.

Municipal guaranteed loans

A municipality can provide a loan guarantee for financing the capital investment or operational activities. [32] With the municipal loan guarantee, the district heating company can receive a loan at KommuneKredit. The members of KommuneKredit are 98 municipalities and 5 regions that are solidaric liable. The association must not make a profit, and it is based on the premise that the municipalities and the regions are more creditworthy together than separately. Because of the high rating of KommuneKredit, the association can take up loans under favourable conditions and to on-lend at accordingly favourable rates. This is for example often necessary when the district heating company wants to establish a district heating grid or expand it.

When establishing or expanding district heating it is common that the district heating companies finance the construction phase with a loan called construction credit offered by KommuneKredit. Construction credit is a temporary financial method with a variable interest rate. The loan ensures that there are sufficient financial resources during the construction phase through larger deposits. When the construction phase is finalized, the final financing is established with KommuneKredit.

However, it is only municipal owned companies or companies with a loan guarantee from the municipality that can take up a loan at KommuneKredit. Moreover, the aim of the loan must fulfil the following criteria:

- The purpose must be public/municipal.
- The activity must be included in the loan act.
- The company must not be exposed to competition.
- The company must not be commercial.
- The non-profit principle must be followed.[33]

The municipal guaranteed loans create different advantages:

- It ensures a cheap and stable financing of the Danish heating supply.
- It ensures that district heating can expand in all areas in Denmark.
- It ensures financing of new projects and expansion of existing district heating grids.

Today, Pensions funds are also interested in financing district heating projects, and they are competing with KommuneKredit to offer the best financing method.

Co-financing or not?

When expanding district heating, the cooperative can decide whether a project is going to be co-financed or not by the future consumers. If the cooperative chooses a co-financing model, it follows that the consumers must pay for the individual district heating installation. The co-financing model is a way to minimize the project investments. The cooperative can also choose to pay for the individual installation by making the payment a part of the project investments. This financial model can affect the heating price negatively, because the project investments become higher. The leasing model is also a financial model, which is often used by

[32] The Act §2 d.
[33] https://www.danskfjernvarme.dk/-/media/danskfjernvarme/nyheder/files/dfj-publikationer/energi-p%C3%A5-toppen-handout.pdf

cooperatives. In this model, the cooperative owns the individual district heating installation, which is leased to the consumer through a monthly fee.

The Netherlands

Tariff regulation

The price of district heating can vary between district heating companies, but they are all regulated by the Heat Act. District heating is based on local heat supply monopoly. Since it is a monopoly, it is founded on the NMDA principle which means that the prices should not surpass the costs of a user of natural gas would have for the same amount of heat. Every year, at the end of December, the ACM publishes the maximum prices that district heating companies are allowed to ask from their customers for the supply of heat and cold. The ACM also determines the maximum prices for the measurement of heat and cold, the connection tariffs, the disconnection tariffs, as well as the maximum tariffs for the rent of heat delivery units. The ACM is using different methods to determine the maximum prices that are described in the Heat Act. The first method is the natural gas reference method, based on the principle that the maximum tariff for district heating should not surpass the costs an average user of natural gas would have for the same amount of heat. This method also applies to the measurement tariff. The second method is cost-based where the ACM bases the maximum tariffs on the weighted average actual costs of the different tariff categories. The weighted average actual costs are based on information provided by the heat companies. The maximum tariffs for connection and disconnection in 2021 are based on information of heat companies over the period 2016 to 2020, indexed with inflation.

The procedure to determine the maximum price includes:

1. Meetings with stakeholders: the ACM organizes two meetings with the district heating companies and Energie Nederland (the association of all energy companies), one in the spring and one in the fall, one meeting with organizations representing the users of district heating and a joint meeting with the district heating companies, Energie Nederland and the organizations representing the users.
2. Collection of data: The ACM is using data provided by the district heating companies and data available in the market. The data provided by the district heating companies are leading because they are supposed to be most accurate and reflecting the real costs.
3. Request for information to district heating companies: For the decision of the maximum tariffs for 2021 the ACM has requested information about the years 2016 to 2018 and additionally also 2019. The data about more recent years are more readily available, and best reflect the real costs. The fluctuations over the years are levelled out by taking the average costs over 4 years. The request for information was sent to 20 district heating companies representing 90% of the users. In some cases, additional questions were asked to clarify the data provided.[34,35]

District heating companies with more than one project are allowed to set one price level for all their district heating projects and level out the profits and losses over the different projects. The ACM supervises if they not to make too much profit over the sum of all the projects. The profits on a single project in the whole project portfolio may be substantially higher than the unwritten norm of 7%. In the development of the Heat Act the district heating companies successfully lobbied against a norm for maximum profit.

[34] https://www.acm.nl/sites/default/files/documents/tarievenbesluit-warmte-2021.pdf
[35] https://www.acm.nl/sites/default/files/documents/tarievenbesluit-warmte%202022.pdf

Since 2020 The Netherlands Authority for Consumers and Markets (ACM) sets multiple tariffs that are associated with the supply of heat and cooling. The maximum tariffs for 2021 and 2022 are:

Maximum tariffs (Euro incl. 21%VAT)	2021	2022
Fixed tariff per year	478,60 (space heating + hot tap water) 239,30 (only space heating) 262,86 (lukewarm water) 239,30 (only hot tap water) 238,45 (cold/cooling in thermal storage system)	494,58 248,77 269,18 248,77 244,18
Variable tariff per GJ	25,51	53,95
Measurement tariff per year	26,83	27,47
Connection fee t/m 25 meter	4.878,04	4.959,14
Connection fee per meter longer than 25 meter	219,68	224,49
Disconnection fee heat	277,88 (temporarily) / 3.199,62 (final)	290,16 / 2893,67
Disconnection fee cold (cooling)	277,88	290,16

Table 2: Maximum heat tariffs 2021 and 2022[36]

The Heat Act also includes an article on compensation in case of an interruption. Consumers are now always entitled to compensations, even if such compensations are not mentioned in their contracts with their heat suppliers. In case of an interruption that lasts longer than 8 hours, consumers will receive a compensation of 35 euros per connection. If an interruption lasts longer than 12 hours, they will receive an additional compensation of 20 euros for each continuous 4-hour period after the initial period.
The Bill is granting heat suppliers dispensation from the compensation requirement for one interruption per year, provided that such interruption is resolved within 24 hours. In addition, the supplier will now be excluded from the obligation to pay compensation where the interruption is not caused by the heat network of the supplier or network operator or by an extreme situation that is not attributable to the supplier.

In the Heat Act 2.0 it is proposed to decouple the link with natural gas and move toward a cost-based tariff regulation with mandatory maximum tariffs per technology. The Ministry plans to make this transition in 10 years' time. In its consultation reaction to Heat Act 2.0 Energie Samen proposed to substitute mandatory maximum tariffs per technology for cost-based tariff regulation based on uniform and strict bookkeeping standards, public transparency and national and international benchmarking.

[36] https://www.acm.nl/nl/publicaties/tarievenbesluit-warmteleveranciers-2022

Price levels of district heating compared to other European countries

The consumer prices for district heating in the Netherlands are 38% to 65% higher than in Denmark, Germany and Sweden. The integral tariff is 40 Euro per GJ in the Netherlands for an average use of 26 GJ in Germany it is 29 Euro for an average use of 31 GJ, in Denmark 26 Euro for an average use of 65 GJ and in Sweden 24 Euro for an average use of 46 GJ. [37]

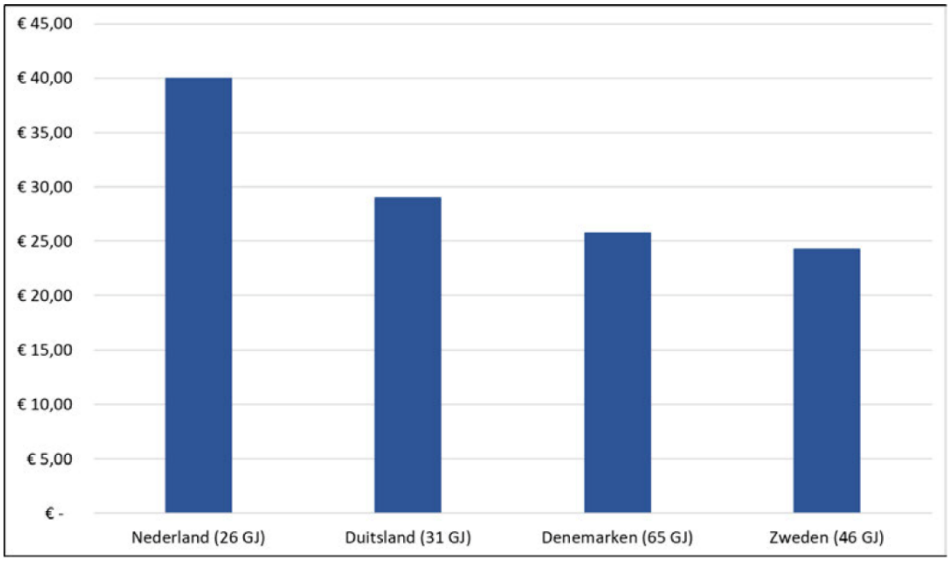


Table 3: Integral tariffs for district heating [38]

According to TNO, the explanation for the price difference maybe differences in the market structure and in regulation. In the Netherlands district heating is relatively concentrated as well as the industries supplying services to district heating companies. Quote: "*The government can help here by properly monitoring the playing field and by removing any barriers to entry the market, for example for district heating cooperatives, for whom entering the market is very difficult.*" Another explanation given is the system of maximum prices which no other country has. Moreover, in other countries there are tariff structures that reduce the costs of district heating systems like peak tariffs, capacity tariffs and tariffs based on the delta T between in outgoing and return temperature. Those incentives to reduce costs are not present in the Netherlands. [39]

Financing of development costs

In the Netherlands, there does not exist a financing structure for cooperative district heating projects yet. Every initiative is looking for funding to get started with an initiation phase. Funding in most cases has the form of subsidies. The funding sources are governmental: municipalities and provinces and sometimes a private foundation. When the initiatives are entering the development phase and projects are becoming more concrete, some municipalities are providing loans or bank guarantees to an initiative, the ministry of Internal Affairs has financed several projects as Test Beds for Natural Gas-free Districts. With the prospect of some projects reaching the construction phase, commercial banks are starting to get involved. In 2020 Energie Samen implemented a project on the establishment of financing mechanisms for cooperative district heating projects with TNO, the Rabobank and ASN bank (a subsidiary of Volksbank) and four pioneering cooperatives. The project has clarified the requirements and conditions of these commercial banks for financing of cooperative district heating projects. The

[37] TNO rapport Vergelijking tarieven collectieve warmtesystemen in Nederland met tarieven in Zweden, Denemarken en Duitsland.
[38] https://www.acm.nl/nl/publicaties/tarievenbesluit-warmteleveranciers-2022
[39] TNO rapport Vergelijking tarieven collectieve warmtesystemen in Nederland met tarieven in Zweden, Denemarken en Duitsland.

project not only aimed at financing of the construction and exploitation phase, but also aimed at financing of the risky development phase. [40] Energie Samen is involved in the management of a development fund for cooperative energy projects, which after years of preparation got started in the spring of 2021 in four of the twelve provinces. The Ministry of Economic Affairs and the four provinces have invested 25 million Euro in the development fund with the aim that the fund has a revolving character. The priority for the development fund is projects for the development of renewable energy (wind and solar) because their risk profile is well established. In a later stage also funding for district heating projects is foreseen. In the past years, financing of the development phase has been regarded as too risky for the development fund. District heating projects are generally considered as not competitive to maintaining heating with natural gas. The main reason is that the existing infrastructure for natural gas is paid off, and costs for maintaining the gas infrastructure is distributed over the country while the costs of new district heating infrastructure must be carried fully by the users of that infrastructure. Since Russia started a war in Ukraine, prices of natural gas have increased so sharply that the assessment might be different now. And the sense of urgency has increased for the substitution of natural gas with a sustainable heat source. But so far, the lack of competitiveness implied that initiatives are spending many hours without remuneration, or with a lack of funding. Pioneering initiatives are often willing to accept this till the end of the initiation phase, but when there is no sufficient funding at the start of the development phase, projects will start to stagnate. Project development of a cooperative district heating project requires professional expertise and substantial funding. Governments have been providing seed money for the initiation phase but are reluctant to invest more substantial amounts of money in the development phase. The first pioneering cooperative projects that had access to funding each have spent more than 1 million Euro in the development phase. The expectation is that the development costs will go down when the development processes are standardized and have been repeated several times. In this stage the high costs for project development should to a large extent be considered as learning costs.

The lack of competitiveness of district heating projects with a sustainable heat source compared to natural gas counts for all projects, whether they are commercial, governmental or cooperative. The Dutch natural gas distribution infrastructure has developed since the 1960s and is now at the end of the economic lifespan. The investment costs have taken place in the past and only the costs for maintenance of the local grids remain to keep them technically operational. Bits and pieces of the gas infrastructure are being renovated but the actual question to be answered in the municipal Transition Visions Heat is if they should be renovated or phased out and removed. District heating grids have difficulties to compete because the investment costs are high and will be counted in the heat prices of each project, while the costs for the gas infrastructure are substantially lower and evened out over the whole of the Netherlands. The distribution tariffs for electricity and gas are not reflecting the real costs in an area but are socialized, which means that everybody in the Netherlands pays the same transport fees. As a result, most heat projects have a deficit in the business case compared to natural gas. A subsidy is needed to fill the gap.

To give the development of district heating projects a boost, the Ministry of Economic Affairs together with all the district heating companies, some municipalities, project developers, and including Energie Samen, have prepared a plan NieuweWarmteNu! (New Heat Now!). The plan has been approved and is meant to subsidize the deficit in the business case of 12 heat projects and 6 innovative demonstration projects that are in the pipeline, and which are planned for implementation in the period 2023-2025. The selection process of the projects that will be

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https://energiesamen.nu/media/uploads/FINAL%20Handleiding%20financieringsaanvraag%20co%C3%B6peratieve%20warmte%20_DEFVersie.pdf

included in the first tranche of 'the basket' has taken place in the fall of 2021. Two cooperative district heating projects will be financed in this plan, in Heeg and Groningen. The 200 million funding for this plan comes from the National Growth[41]

In the Netherlands the pension fund PGGM has bought an 80% share in Ennatuurlijk one of the five big district heating companies in the Netherlands, with grids in 40 municipalities spread over the country. The pension fund has a long-term perspective on the heat market in the Netherlands and aims to be a player in the expansion of district heating in the coming decades. For the pension fund the profitability of district heating is a condition to invest in new district heating projects. Ennatuurlijk and Energie Samen have investigated the conditions for cooperation in the development of cooperative district heating projects. The talks about cooperation started from the common ground that the breakthrough in heat transition is likely to come from organising the demand side in the built environment. The result of the talks was that Ennatuurlijk started to invest in an approach to be a partner in cooperative district heating projects. Ennatuurlijk developed and tested a toolbox for a district in Utrecht that was thinking about substitution of natural gas with a sustainable heat source and prepared a service menu for a cooperative district heating project in Muiderberg that was selecting a partner in the development process. So far Ennatuurlijk did not reach the development phase with a first cooperative initiative yet.

Municipal guaranteed loans

A municipality in the Netherlands can provide a loan guarantee for financing the capital investment or operational activities. For example, in 2009 Thermo Bello received a 100% municipal guaranteed loan when it bought the assets to establish a cooperative district heating company. Recently a cooperative district heating project in Haarlem got a municipal guarantee on a small part of the CAPEX investment that was not covered in the project plan. However, in 2015 the Dutch municipalities have been put under severe financial stress by the national government in a process that is referred to as decentralisation of (youth) care. Many Dutch municipalities are not financially healthy anymore and have limited or no capacity to provide municipal guaranteed loans. To get long term financing for a district heating project the municipality can apply for funding at the Bank Nederlandse Gemeenten (BNG) or the Waterschapsbank (WSB), that is able to finance projects under the condition that a municipality provides a loan guarantee. Because of the bad financial situation of many municipalities the access to cheap loans from the BNG is decreased. And district heating cooperatives do not have direct access to the BNG. Therefor a national guarantee fund seems more logical in the Dutch situation to provide access to cheap CAPEX funding for cooperative district heating projects.

[41] Persbericht NWN! Final version

Discussion of differences and similarities of the financial issues

Table 4: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Tariff structure	Defined by the non-profit principle.	Defined by the NMDA principle stating that the costs should not surpass the average costs for heating with natural gas.
Financial support structure in the development and exploitation phase	Construction credit loans with larger deposits through KommuneKredit.	In the development phase there is no financial support structure yet. Sometimes subsidies are available, but they have the characteristic of a lottery. In the exploitation phase commercial banks are prepared to provide loans under the condition that the cash flow is sufficiently stable.
Financial support structure in the final phase of a district heating project.	Municipal guaranteed loan through KommuneKredit.	Municipal guaranteed loan through BNG or WSB. The financial health of many municipalities is too weak for this. A national guarantee fund is a more likely to work in the Dutch situation.
District heating pricing	Lower because of financial support structure.	High because of new network, high heat rates (dependent on gas rate), electricity rate and material costs.
Transparency of prices	Fully transparent. The Danish Utility regulator develops benchmarking reports of the district heating companies.	Transparency is lacking; commercial district heating companies set one consumer price for all their district heating systems, and the profits or losses of individual district heating systems are hidden. And district heating companies tend to demand prices close to the maximum prices allowed by the ACM = no competition

Remarks

- In Denmark, the non-profit regulation has proven to be very efficient in protecting consumers, because the surplus is repaid to consumers in the form of lower consumer prices the next year. It is not possible for district heating companies to make a profit on producing and supplying heat in Denmark, because of the non-profit regulation.[42] In the Netherlands it is questionable if the regulation of maximum prices has been effective to protect consumers because the prices levels are 38% to 65% higher in the Netherlands compared to Denmark, Germany and Sweden.[43]
- The Danish regulation strengthens the positions of district heating cooperatives because commercial actors are not interested in a market, where there is no profit. District heating cooperatives are not motivated by profit, but by keeping the heating price as low as possible, because the board of directors in the cooperatives are local consumers themselves. The non-profit regulation ensures that the Danish district heating sector is not dominated by big private companies that act on behalf of maximization of profit. On contrary, the regulation enables the existence of different and local ownership types in the district heating sector that act on behalf of consumers interests. In the Netherlands district heating cooperatives have the same objectives and motives as in Denmark but new regulation proposed in Heat Act 2.0 is putting them in the position to compete with profit-oriented district heating companies who are also willing to develop a project in their district.
- In addition, to incentivize keeping a lower heat price, the Danish Utility Regulator benchmark each year the heating prices for each company in a public report. The district heating companies put an honour in having a low heating price, because it symbolizes that everything is under control. Based on the price control accountancy in September, the Danish Utility Regulator also controls whether each district heating company charges the consumers with the correct heat price. In the Netherlands there is a lack of incentives to lower the heat price[44]. The ACM in the Netherlands set the maximum price and control if the tariffs of district heating companies are lower than or equal to the maximum price. Transparency is lacking and there is no public benchmarking of heat prices.
- The non-profit regulation of Danish electricity companies has been replaced by a model based on commercial incentives. The new regulation allows the electricity companies to make a profit on their monopoly activities. The profits are used, among other things, for the acquisition of companies and for other activities such as expanding the fiber-optic. The result of the acquisitions of companies has been that the electricity market in Denmark is centralized in bigger companies without local connection with the consumers.[45] In the Netherlands the existing concentration in the heat market is one of the explanations of the fact that heat prices are much higher compared to Germany, Denmark and Sweden. [46]

[42] https://www.danskfjernvarme.dk/maerkesager/oekonomisk-regulering/udspil/den-fremtidige-regulering-af-fjernvarmeselskaberne

[44] TNO rapport Vergelijking tarieven collectieve warmtesystemen in Nederland met tarieven in Zweden, Denemarken en Duitsland.
[45] https://www.danskfjernvarme.dk/maerkesager/oekonomisk-regulering/udspil/den-fremtidige-regulering-af-fjernvarmeselskaberne

[46] TNO rapport Vergelijking tarieven collectieve warmtesystemen in Nederland met tarieven in Zweden, Denemarken en Duitsland.

Organizational structure of the district heating company

Denmark

Statutes

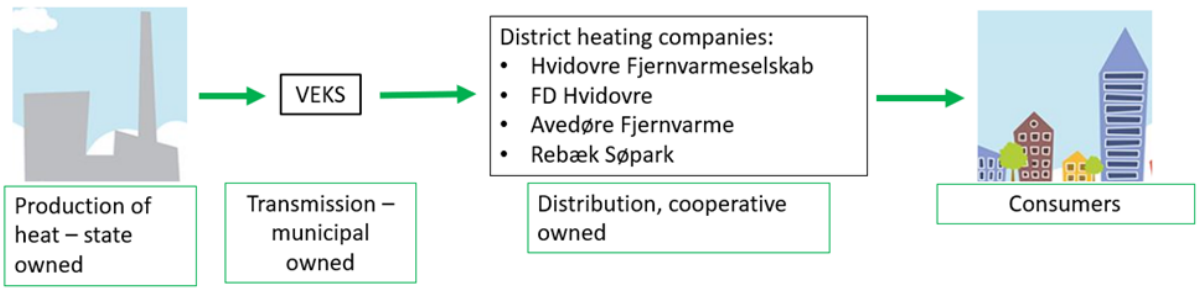
The Heat Supply Act has minor regulations concerning the organizational structure of district heating cooperative. Therefore, the district heating cooperative is organized on the principles in the agreement between all members/consumers – i.e. "the statutes".

When the statutes are settled and the district heating grid is implemented, the next step is to develop general regulations for the cooperative members to ensure that everybody is treated the same way, but also to ensure that the installations at the cooperative members/consumers fulfil minimum technical criteria - one bad functioning installation can affect the effectiveness of the whole district heating grid. Therefore, the district heating cooperative must develop "ordinary regulations" and "technical regulations". The "ordinary regulations" explains the general guidelines for the establishment and change of the district heating supply, the operation and maintenance of the installation, the tariffs and payment, the metering set-up, and the measurement of the meter. The "technical regulations" explains the technical details concerning the installation of the district heating supply, the dimensions of the heat service line, the type of district heating unit that is allowed to be installed, the installation of the meter, the insulation, and it entails a guideline for how a new district heating unit should be checked before it is put into operation. It is also described how the district heating unit should be maintained to ensure a well-functioning delivery of district heating.

Case of district heating cooperative FD Hvidovre

FD Hvidovre is an example of a how a district heating cooperative is organized. It is important to mention that there exist Danish cooperatives that are organized differently.

FD Hvidovre is a distribution company located in Hvidovre, a suburb near Copenhagen. The company is connected to a large transmission grid, wherefrom the heat is being delivered. The supply chain is illustrated in the next picture. Danish district heating cooperatives often own the whole chain from production to distribution, but in some cases it is different. The cooperatives located near the bigger cities are often connected to a larger transmission grid, where the production of heat occurs in multiple places – it can be at different CHP-plants or incineration plants. In these cases, the district heating cooperative only owns the distribution grid.



An example of a district heating cooperative that only owns the distribution grid

The main objective of FD Hvidovre is to establish and to operate a collective district heating supply in Hvidovre. All consumers connected to the distribution grid of FD Hvidovre can become

active cooperative members of the company. The only criteria is that the consumer has a heating meter installed owned by FD Hvidovre, and that their household is located within the supply area of FD Hvidovre. It is not obligatory to become an active cooperative member. All consumers - active or not - are treated the same way and have the same heat delivery terms.

To become an active cooperative member, the consumer must pay a small amount determined by the board of representatives. The consumer is solely liable for the amount they have paid. They are not personally liable for the commitments of FD Hvidovre. Every active cooperative member has suffrage and can be chosen as board member or deputy.

The board of representatives is the supreme authority of the company and consists of the active cooperative members. The role of the board is to ensure an appropriate composition in the board of directors. Moreover, the board has to supervise and decide the strategic direction for the district heating company. Maximum 5 months after the end of the financial year, a yearly meeting of the board of representatives is being held.

The board of representatives in FD Hvidovre is divided into 6 groups: 1. the municipality, 2. larger housing associations, 3. smaller housing associations, 4. larger private properties, 5. businesses, and 6. the households. Decision making is accomplished through a majority of votes. Every cooperative member has several votes based on the registered properties/business/leasing agreements connected to the district heating grid. The board of directors are elected at the meeting of the representatives.

The board of directors in FD Hvidovre consists of 11 members - each group from the board of representatives is represented in the board. The board is responsible for making decisions regarding operation, investments, and other cases that exceed the day-to-day operation. They have to perform strategic leadership by taking active part in the overall strategic direction of the company and its goals. At the same time, they have to act as sparring partners and control the daily leadership of the company. It is the responsibility of the board of directors to support the board of representatives in the supervision role by providing relevant information. Therefore, it is extremely important that the board of directors is characterized by openness and transparency, which is essential to ensure legitimacy in the district heating cooperative structure.

Each year the board of directors meet 4 times during a year.

- The first meeting takes place in the 1. quarter of the year, where the main objective is to go through the economic results from the last year. Then the meeting of representatives occurs, where the representatives approve the yearly report and elect the members to the board of directors.
- The second meeting is a constitutional meeting of the board of directors.
- The third meeting is an up-date meeting that occurs in the 3. quarter of the year, and
- The fourth meeting is a budget meeting for the following year that occurs in the 4. quarter of the year.

The tasks and responsibilities of the board of directors

One of the most important roles of the board of directors is to develop and enhance the activeness of the cooperative members. It is among others ensured by transparency, ongoing communication, and by making it as easy as possible for the cooperative members to practice their ownership. The yearly general assembly in the board of representatives is the primary tool to practice the ownership of the cooperative members, because this is where the board of

directors is elected and where the overall strategic direction of the company is discussed. Therefore, it is important that the board of directors put a lot of effort into communicating that the general assembly is held in order to ensure that as many as possible will participate. In addition, it is important that communication is not too technical and easy to understand for everybody. However, the communication should be ongoing and more than once a year. It can for example be efficient to be visible at different local events, arranging open house events, and so on. In general, the board of directors is also responsible for leading the company, the strategic development, the economic planning, the supervision with the daily leadership, and risk management.

The interests of the existing and future consumers should be the core of the company's actions in the short- and long term. Therefore, the board of directors should discuss the overall and long-term development of the company. At the same time, they should ensure ongoing notification and decision making related to finances and capital resources, and that appropriate guidelines for procurement and tendering are followed.

EBO Consult – a support structure for district heating cooperatives

The day-to-day operation of FD Hvidovre and three other district heating cooperatives in Hvidovre are managed by EBO Consult. The district heating cooperative can choose to be fully managed by EBO Consult or partly. If it is fully managed, then EBO Consult performs every task for the cooperative. It can be administrative, financial, operational, communicative, and project tasks.[47] If the district heating cooperative only wishes to be partly managed, then EBO Consult helps with single tasks.

EBO Consult functions as the link between the board of directors and the consumers. The planning of the strategic direction and the general decision-making of the cooperative occurs in the board of directors, but it is EBO Consult that realize it. This collaboration set-up replaces the traditional district heating cooperative with its own employees. It enables the board of directors to outsource tasks related to staff responsibility and to focus on the overall strategic direction. A few years ago, there was a new requirement regarding digitalization of the district heating grid. When the cooperatives are fully managed by EBO Consult, it is the responsibility of EBO Consult to make sure that the cooperatives are fully informed and complies with all requirements and regulations. In other words, the cooperative did not have to hire new employees or acquire new competencies to comply with the new digitalization requirement, because it was taken care by EBO Consult.

EBO Consult has all the technical equipment, competencies, and IT-programs to run district heating cooperatives. When several district heating cooperatives are managed in one place, it follows that some cost can be lower. The cost for a website platform is for example shared by some of the cooperatives that EBO Consult manages.

Therefore, EBO Consult helps district heating cooperatives to be more efficient, to lowering the costs, to stay local, and to focus on important matters such as the strategic direction of the cooperative.

[47] www.eboconsult.dk

The Netherlands

Statutes and cooperative regulations

The statutes of district heating cooperatives are not standardized yet, nor are specific criteria imposed on the statutes of district heating cooperatives. However, cooperatives are active in other sectors in the Dutch economy (e.g. agriculture, banking, insurance) and there is a tradition of more than 100 years with this legal form. A distinctive quality of a cooperative compared to an association can be found in the objectives of all cooperative statutes and that is: that a cooperative provides for the material needs of its members. The members of a cooperative organize themselves in a company to produce a good or a service that serves the material interests of the members. In case of district heating, it is obvious that the material need is heat. According to legislation regarding cooperatives there is a lot of flexibility to distinguish between voting rights for different categories of members. The rule one man one vote applied in the cooperative sector in the Netherlands refers to the democratic notion that voting rights should be independent from the amount of money put in the cooperative.

To ensure reliable administrative and technical processes a district heating cooperative publishes ordinary regulations as well as technical regulations.

Case of district heating cooperative Thermo Bello

Energy company Thermo Bello Ltd is located in Culemborg. The company is producing, distributing and delivering low temperature heat (maximum 50°C) to 230 houses, and 2 large office buildings and 2 large school buildings of a secondary school in the district EVA-Lanxmeer. The total annual heat production is around 9000 GJ. The annual turn-over below 300.000 Euro. The main objective is to provide reliable district heating at affordable prices to the end-users.

All inhabitants of the district EVA-Lanxmeer can become active cooperative members of the cooperative that owns 100% of the shares of the limited company. The cooperative Thermo Bello has no other activities than holding the shares of the limited company. The cooperative has two membership categories: A) direct membership of natural persons living in the district EVA-Lanxmeer B) indirect membership of all households in the district through a legal entity: the association of inhabitants of EVA-Lanxmeer. Membership in category A is voluntary and open for everybody living in the district whether a client of Thermo Bello or not. In practice only clients of Thermo Bello apply for membership. To become a member in category A, persons must invest a minimum of 250 Euro to buy a membership certificate, that is linked to the capital (nominal value of 42.750 Euro) that is invested in the shares of the company. The association is a legal entity, with a very high percentage of households in the district being a member. Thus, although a resident of the area can be a client without being a member, in practice through the membership of the association almost everybody is indirectly linked to Thermo Bello. The general assembly of the association voted for its membership in the cooperative. With the membership certificates the members in both categories capitalize the company with risk capital, and the members of the cooperative are only liable for the value of the certificates. A member is not personally liable for the commitments of the company.

The director of the company is responsible for the activities of the company and is supervised by the board of the cooperative. The board consists of representatives of the two membership categories and a third member. The board members do not necessarily have to live in the district, but in practice they do. Every active cooperative member of category A has suffrage

and can choose its board member. The association of inhabitants appoints the board member of category B. The board members themselves appoint the chairman.[48]

The board of the cooperative forms the general assembly and is the supreme authority of the company. Every year two general assemblies are being held. Maximum 5 months after the end of the financial year, a meeting is being held on the financial results of the previous year. That is the moment when members decide on approval of the financial statements and the policy of the board. The active members of the cooperative can participate in the general assembly and use their suffrage towards the board. A second general assembly is being held at the end of the year, to present the progress on the budget and the expectation for the coming year.

Partnership with social housing corporations

Dutch housing corporations are not allowed to become a member in the board of a district heating cooperative. This is an undesirable legal constraint for district heating cooperatives that would like to benefit from the expertise of housing corporations to develop and operate a district heating company to keep energy prices low for the homeowners as well as for tenants of the housing corporations.

According to the Dutch Housing Act: *"Housing corporations and their affiliates and joint ventures are exclusively active in the field of public housing. The area of public housing only includes the provision by the authorized institution or by an enterprise affiliated with it to residential accommodation intended for permanent residence and to members of housing cooperatives to which it has alienated such residential accommodation, of services directly related to the occupation"*[49] And *"services as referred to in Article 45 second paragraph under c of the Act do not include services that can be provided by utility companies, insofar as that delivery is not made using a facility present in or near the residence."* [50]

Partnership with affiliates of DSOs

In the Netherlands three DSOs have established affiliates to develop distribution grids for district heating. According to Dutch law that split the energy sector in transport and delivery, the DSOs are not allowed to deliver energy. This law applies to natural gas and electricity, but it also applies to district heating. The know how that the DSOs possess in the development and maintenance of underground infrastructures can only be applied to the expanding market for district heating if they can partner with district heating companies producing and delivering heat. The existing (big) district heating companies have no interest in cooperation with the DSOs and lobbied against market access of the DSOs to the heat market. But for the district heating cooperatives it can be attractive to cooperate with these affiliates. Across the Netherlands, in Amsterdam, Den Haag, Zutphen and Nijmegen district heating cooperatives are partnering with the DSO affiliates to develop and operate district heating projects.[51] Therefore, Energie Samen joined a lobby for access to the heat market in the framework of Heat Act 2.0.

Cooperative shared service organisation

In the context of the ambitions in the Dutch Climate Agreement to expand district heating in the Netherlands, the open Coalition Cooperative District heating has published the ambition to have at least 1000 district heating cooperatives in the Netherlands by 2030. It is unlikely that this ambition will be realised only with commercial service organisations that are entering the

[48] http://www.thermobello.nl/component/docman/cat_view/9-pdf-organisatie?orderby=dmdate_published&ascdesc=DESC
[49] Woningwet artikel 45 lid 1 and lid 2 aanhef sub c.
[50] Art 47 van het Besluit toegelaten instellingen volkshuisvesting 2015 (BTIV 2015) and nota van toelichting p106-107.
[51] Watergraafsmeer Amsterdam, Vrichtenbuurt Den Haag, Helbergen Zutphen, Hengstdal Nijmegen.

market to support district heating initiatives to develop and operate a district heating project. Therefore, Energie Samen together with several member cooperatives and partners has started the development of a cooperative shared service organisation. The first step will be getting a licence from the ACM for the delivery of district heating, and the second step will be to support citizen initiatives in the development phase of a district heating project. The support in the development phase will also be linked to the cooperative development fund for district heating that is being prepared by Energie Samen in cooperation with the Ministry of Economic Affairs. [52]

Discussion of differences and similarities of the organizational structure

Table 5: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Organizational structure	Established with the cooperative as juridical form.	Pioneering phase with the cooperative combined with one or more other legal entities.
Cooperative statutes and regulations	Statutes and ordinary and technical regulations are standardized but allow enough flexibility for each cooperative.	Statutes and regulations are not yet standardized.
Definition "Consumer"	End user, i.e., all private persons, companies and housing associations that have a connection to the district heating grid.	End user, i.e., all private persons and companies that have a connection to the district heating grid.
Housing/tenants democracy	Exist. Tenants elect board of directors, whereas one is appointed to represent them in the district heating cooperative.	Does not exist. Tenants represent themselves.
Housing corporations	Representative from the social housing corporation participate in the board of directors.	Social housing corporations are not allowed to participate in cooperative
DSOs	Have no role in district heating	Are active in development of district heating projects in cooperation with district heating cooperatives
Supply chain	District heating cooperatives can own	District heating cooperatives vary in what they own.

[52] A feasibility study on the expansion of the cooperative development fund for wind and solar parks with district heating will be published in October 2022

	the whole supply chain or only own the distribution grid.	Sometimes the whole supply chain, sometimes shared ownership with the municipality, and/or with commercial partners.
Shared service organisation	Commercial service organisations partnering with cooperatives are established and generally stay out of the ownership structure of the cooperatives	Commercial service organisations partnering with cooperatives are entering the market and take a share in the ownership structure. District heating cooperatives have started to develop a cooperative shared service organisation in order to keep the assets in cooperative ownership.

Remarks

- In Denmark, the cooperative legal structure is the dominant form in which the activities are structured. There are no other legal entities involved in the ownership structure, because the cooperation with different partners in the cooperative structure is settled by a distribution of voting rights in the cooperative itself. In the Netherlands the cooperative is often one of the legal forms involved in the organisational set-up. In many cases the assets of the cooperative are structured in a limited company owned partly or for the full 100% by the cooperative. This is also due to the lack of a financing mechanism for cooperative district heating, which forces cooperatives into an ownership structure with municipalities, commercial service organisations or DSO affiliates. The different partners distribute the shares in the limited company. It needs to be seen how stable these structures will be.
- In Denmark a district heating cooperative is in business when the statutes and regulations are submitted. These formal documents that govern the cooperative are standardised but leave enough flexibility for each cooperative to define how they want to operate technically and financially. In the Netherlands there are a few district heating cooperatives at the point that they need to (re)think about the statutes and the regulations in order to effectively operate a district heating project. It is not standardized yet.
- The appropriate scale for an economically viable district heating cooperative is of course dependent on several factors, including the heat source, the density of houses and the average use of heat. The district heating cooperatives in Hvidovre are currently working on expanding district heating with local heating production plants, so-called island projects, and one of them is economically viable with a heat demand of 3250 MWh.
- In order to contribute substantially to the Climate Agreement with a rapid expansion of district heating in cooperative ownership of the residents, district heating cooperatives develop a cooperative shared service organisation for the development and the operation of cooperative district heating projects. EBO Consult has been the source of inspiration for this shared service organisation.

- In the Netherlands, the social housing corporations are not allowed to become a member in the board of a district heating cooperative. This is an undesirable legal constraint for the Dutch district heating cooperatives that would like to benefit from the expertise of social housing corporations to develop and operate a district heating company to keep energy prices low for the homeowners as well as for tenants of the social housing corporations. In Denmark, it is nationally regulated that social housing corporations are allowed to participate in the district heating cooperative. The social housing corporations are important to involve, because they often represent a large part of the heat demand and sometimes the renters form the majority of citizens living in a city.
- In the Netherlands the chapter about market regulation in the Heat Act 2.0 is under discussion because not only cooperatives but also affiliates of DSOs are knocking on the door of the Ministry of Economic Affairs for market access. In many cases district heating cooperatives and affiliates of DSOs are establishing partnerships for the development and operation of district heating projects. In Denmark DSOs do not play a role in the heat market.

Municipal involvement

Denmark

In Denmark, the municipalities can take on different roles that accelerate the expansion of district heating and the green transition. The roles that the municipality can take on is as a company, as an authority, as an owner of the district heating cooperative, and as a facilitator of the district heating.[53]

The municipality as a company

The municipality can choose to request new and green solutions, items, and services. The municipality is often a big energy consumer and can affect the market through green behaviour and purchase. Therefore, the municipality can function as a front figure when investing in energy renovations, choosing green energy to its buildings, and expanding the local district heating grid.

The municipality as an authority

In 1979, municipal heat plans were required by national law. It paved the way for the municipal involvement in local heat planning. According to the Heat Supply Act, it is the responsibility of the municipality to make a district heat plan. Actually, the municipality can demand that a local heat plan shall be made by the district heating company.

The requirement of a local heat plan has created a political and regulatory framework supporting the development of district heating. In fact, it appears that the presence of a stable heat plan fosters long-term confidence in district heating systems.[54] To mention a concrete example, the cooperative of Hvidovre Fjernvarmeselskab has developed a district heating expansion plan for the areas in Hvidovre that does not have district heating. At the same time, they have made it possible for future consumers in these areas to sign up for district heating.

[53] https://www.danskfjernvarme.dk/maerkesager/for-kommuner-subsection/kommunens-roller
[54] Chittum,A.,Østergaard,P.A.,HowDanishcommunalheatplanningempowersmunicipalitiesandbenefits individual consumers.EnergyPolicy(2014), http://dx.doi.org/10.1016/j.enpol.2014.08.001i

Despite some areas having to wait 10 years for district heating, future consumers are still signing up for district heating.

The national law of municipal heat plans demonstrates that Danish energy policy tends to decentralize the power to local decision-making processes when it comes to the development and planning of district heating systems. However, the local power relies on a centralized political and regulatory framework that is supervised from a national level. For example, in order to realize district heating projects, it is obligatory to calculate the societal costs. Only projects showing the best net benefit to society are prioritized. This contrasts with normal cost-benefit analyses, where the focus is on whether the project is economically interesting to the individual company. It is the Danish Energy Agency on the Danish National level that provides the framework for calculating the socio-economic calculations by providing forecasts for future energy prices, energy use etc. Therefore, there are different power levels that contribute to the Danish heat planning structure, which among others ensure that the municipalities can fulfil their role as effectively local regulators of the development of district heating. This is illustrated in the following model.

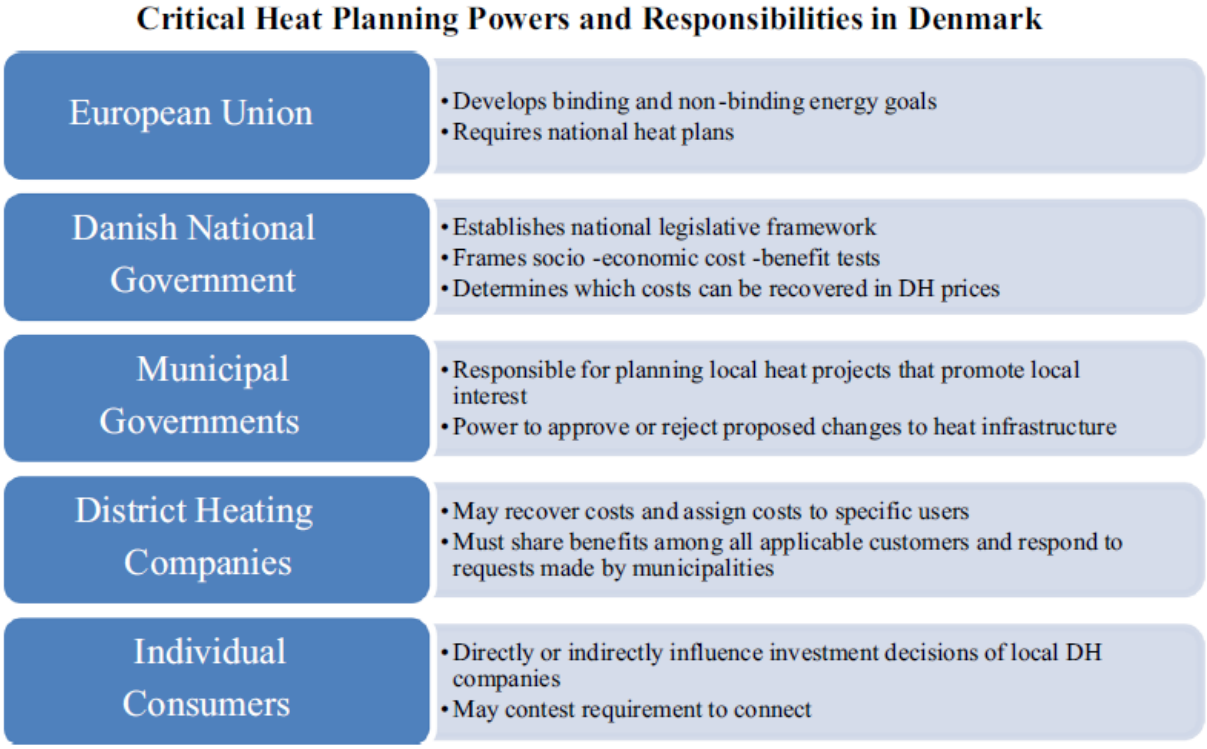


Figure 2: Powers and responsibilities held by different levels of government and heat system users in Danish heat planning ***Fout! Bladwijzer niet gedefinieerd.***

Beside from ensuring that only district heating projects with the highest socio-economic gains are approved, the municipality can also decide which heating sources should be prohibited and in the past, the municipality could also demand citizens living in a district heating area to be connected to the district heating grid or oblige them to stay connected. The municipalities powers are granted with an expectation that the local interest will be pursued. Therefore, the municipality can select the energy solution that they think are appropriate for their citizens, but they may not choose a technology that could result in unnecessarily high prices.

The municipality as a "company owner"

Representatives from the municipalities sometimes sit on the board of directors participating in the development of the district heating company. In Hvidovre, 1 or 2 representatives from the municipalities sit in the board of directors, because the district heating cooperative has municipal guaranteed loans. The participation in the board of directors enables the municipality to have direct influence on the day-to-day operation and the long-term strategic plan. Anders Liltorp, which is a municipal representative and chairman in the district heating cooperative called Hvidovre Fjernvarmeselskab says "w*e don't bring our political agendas when we are having meetings in the board of directors. In the district heating cooperative, we work for a common cause which is to ensure a cheap and sustainable heat to our fellow citizens despite our political disagreements. Of course, politicians have agendas and ambitions – that's only natural, but if we do not respect the task at hand, we lose the opportunity to help secure both the citizens need for a green, sustainable, payable and secure supply of heat and also the direct influence on the strategic long term and coherent planning of district heating from local to regional and national level".*

The municipality as a facilitator

The municipality can also function as a facilitator by implementing information campaigns or by facilitating partnerships through their day to day talk with citizens and business. In Hvidovre, the municipality is an excellent facilitator of district heating. They arrange info meetings, they recommend the citizens to install or wait for district heating, and they support the development of district heating.

The Netherlands

The roles of municipalities in the development of district heating in the Netherlands are changing since the signature of the Climate Agreement.

Most of municipalities do not have district heating yet. And are defining their roles now.

Before 2019 the role of municipalities in the development of district heating was focused on new urban areas, while after the Climate Agreement municipalities are increasingly having a role in the existing built environment. Municipalities have a coordinating role in the phase out of natural gas in the built environment. What the coordinating role exactly means is being discovered by the municipalities, but it includes a new element and that is the development of municipal heat plans. As mentioned before all Dutch municipalities must make Transition Visions for Heat that establishes a realistic time schedule within which to transition away from natural gas. For the districts in which the transition is scheduled before 2030, the Transition Vision for Heat describes the new energy infrastructures (all-electric, heat network or green gas) to be developed. The next step will be that municipalities will make a Heat implementation plan per district (WUP: wijkuitvoeringsplan). That is an implementation plan comparable to the instrument in the Environment and Planning Act. As mentioned before the new Heat Act will further define the role of the municipality with regard to the definition of heat parcels and the designation of heat companies on a heat parcel.

Municipalities do not have the right to switch off districts from natural gas, but a new law is being prepared for that purpose.

There are big questions regarding the capacity of municipalities to make implementation plans that will effectively be implemented. In 2020 Klimaatverbond Nederland, an association of municipalities, provinces and water boards, took the initiative for a 'think tank' around the

implementation plans per district. Energie Samen is one of the partners in the think tank. The first output of the think tank was a white paper on an 'energy service organization' published in the spring of 2021. The white paper argues that municipalities are not able to do it alone, nor can they leave the implementation to market parties. They need to cooperate with the residents and with market parties in a public-civil-private energy service organization that takes responsibility for the implementation. The scope of the municipal plans, biased towards technical solutions and business cases, needs to be broadened with appropriate organizational structures to ensure that the transition projects of a district will reach the exploitation phase and that all households in a district are able to join the transition.[55]

The next step proposed in the whitepaper is to develop regional pilots with 4 to 5 municipalities per region, who share the wish to develop an energy service organization in their region. In 2022 pilots started in 4 regions.

Partnership with municipalities

The district heating cooperatives that emerge in the Netherlands are dependent on the support of their municipality for the development a project proposal, for the financing of the development expenditures, for construction licences and potentially also for a municipal guaranteed loan. For the financing of development expenditures, some cooperatives got access to the funding for the Test Beds for Natural Gas-free Districts that the Ministry had channelled to the municipalities. Three municipalities that received funding for a test bed are making different choices in how they want to relate to the district heating cooperative in their municipality. In Wageningen the municipality established a joint venture with cooperative Warmtenet Oost-Wageningen, and the joint venture owns 67% of the shares of the district heating company. A commercial company involved owns 33% of the shares. In Groningen, the municipality has decided that the district heating networks should be publicly owned, and that the cooperative Grunneger Power could play a role in the development and operation of the production facilities and in delivering heat to customers. The municipality already has established a public district heating company called Warmtestad, and this implies for Grunneger Power that are developing a district heating project together with the municipality of Groningen and Warmtestad. In Amsterdam the cooperative Ketelhuis WG is developing the district heating company on its own with 100% of the shares owned by the cooperative. Ketelhuis WG is developing the district heating project with a consortium of two companies, that will also provide operational services to the company when the project is built. The municipality of Amsterdam will not have formal role in the district heating company.

[55] https://klimaatverbond.nl/wp-content/uploads/2021/03/Klimaatverbond-Nederland.-2021.-Van-klimaatakkoord-naar-keukentafel.pdf

Discussion of differences and similarities of the municipal involvement

Table 6: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Role municipality	Established. Central and important role related to heat planning – they function as a company, authority, company "owner", and facilitator.	Municipalities have a coordinating role in the transition and in heat planning and many have not decided yet what role(s) to play.
Approval of district heating projects	The municipality approves or rejects district heating proposal. It relies on a centralized political and regulatory framework that is supervised from the national level.	The heat market is not regulated yet, and municipalities are free to establish a district heating company themselves, or to cooperate with a commercial district heating company or with a cooperative. Heat Act 2.0 will structure the approval process.
Municipality and cooperative	Characterized by a collaboration. Representative from the municipality can participate in the board of directors in the district heating cooperative.	Collaboration is in the pioneering phase. Sometimes cooperatives are treated as partner and sometimes not.

Remarks

- The municipalities and the district heating cooperatives in Denmark are dependent on one another. In Hvidovre, the district heating cooperatives are responsible for developing project proposals, while the municipality is responsible for the approval. Therefore, it is extremely important that the two actors collaborate and have aligned ambitions. In Hvidovre, the municipality is excellent as a facilitator and front figure of the district heating cooperative. They arrange info meetings, they recommend the citizens to install or wait for district heating, and they support the development of district heating.
- In the bigger cities of Denmark, it is often municipal owned district heating companies. Here, the municipal is solely responsible for developing and approving district heating.
- The Dutch government has put responsibility on municipalities to direct the heating transition. The first step has been to make heating transition visions for the whole municipality. This had to be done before the end of 2021. The next step is that heating

plans must be made for all districts in the municipalities, starting with the districts that are planned to be disconnected from natural gas before 2030. Most municipalities do not have the resources nor the staff nor the knowledge to carry out this task. The new government that was formed after the elections for parliament in spring 2021, has reserved a budget of €800 million to provide municipalities with the financial resources to expand to carry out this task. [56]

- In the absence of supportive national political frameworks there are municipalities such as Wageningen that started cooperation with energy communities based on the expectation that district heating cooperatives will contribute to the acceptance of district heating. The Dutch Climate Agreement stresses the importance of participation of residents in the transition of the built environment and based on that vision municipalities have started up cooperation with residents that are organized in energy communities and cooperatives. This vision is strengthened with the evaluation of the Test Beds for Natural Gas-free Districts in June 2021 that showed more satisfaction of residents in projects with a cooperative. [57] But there are also municipalities who prefer to do business with established commercial district heating companies. This can have several reasons:
    - 1. There are previously made contracts for the neighbourhood that binds the municipal to a district heating company
    - 2. they do not believe district heating cooperatives have the knowledge and capacity to develop a district heating project.
    - And finally, there are also municipalities who are waiting and prefer to watch what is happening in other municipalities first and what the new district heating law prescribes. Every energy community or district heating cooperative must negotiate its position as developer and future owner of a district heating project with its municipality. [58]
- In the context of sharply increasing prices for natural gas and electricity, all the municipalities are confronted with a growing number of residents who are getting in financial trouble. They are looking for solutions short term and long term. The primary concern now are models that establish a stable heat supply for reasonable prices. If the cooperative organizational structure contributes to these objectives, they are likely to be interested.

Technologies

Denmark

This section will focus on some of the heating sources and production technologies in Denmark.

Today, more than 1,8 million households have district heating. In 2021, 31.442 became district heating consumers.[59] The district heating sector accounts for over 22.300 full-time jobs in Denmark, and the sector contributed to GDP with 17,7 billion kr. in 2019.[60] About 62 % of the district heating production is based on renewable energy. It is particularly the conversions to biomass, but also the expansion of solar heating and heat pumps that contribute to the green

[56] https://www.parlement.com/9291000/d/pdfs/coalitieakkoord-2021-2025.pdf
[57] Bewonerstevredenheid Proeftuinen aardgasvrije wijken 2021
https://www.aardgasvrijewijken.nl/nieuws/1994784.aspx?t=Onderzoek-bewonerstevredenheid-in-proeftuinen-
[58] Participatiecoalitie april 2022. De zoektocht naar volwaardig samenwerken in de warmtetransitie. Succesfactoren en uitdagingen van 70 bewonersinitiatieven en hun gemeenten.
[59] https://www.danskfjernvarme.dk/aktuelt/nyheder/arkiv/2021/210423-nye-forbrugere-str%c3%b8mmede-i-rekordstort-antal-til-fjernvarmen-i-2020
[60] Fjernvarmesektorens betydning for Danmark, 2020, Dansk Fjernvarme

conversion. In the future years, the percentage of renewables will increase as natural gas and coal will be phased out. In 2030, the district heating sector is going to be CO_2-neutral.

The co-production of heat and power (CHP) has played a vital role in the Danish expansion of district heating. Today, there exist about 860 CHP plants in Denmark with an electricity capacity of 8.000 MW and a heat capacity of 9.800 MW. 34 are central CHP plants with an electricity capacity of 5.530 MW and a heat capacity of 5.950 MW. In addition, there exist decentralized plants with an electricity capacity of 1.160 MW and a heat capacity of 2.240 MW. Moreover, there are 348 other CHP plants such as waste incineration plants, industrial plants, purification plants, plants at institutions and private plants with an electricity capacity at 690 MW and heat capacity at 1.525 MW.[61] However, there is a growing part of the electricity production coming from wind and solar. It follows that the role of CHP is decreasing to peak and backup supplies to both electricity and heat systems. Today, Denmark is moving ahead with an electrification strategy for the energy sector. It follows that the production of district heating in the future will be based on low-temperature district heating, heat pumps, Power-to-X, wind, solar, surplus heat and so on.

Different generations of district heating

In the future, buildings are expected to become more energy-efficient which means that there will be a lower heat demand per square meter. Meanwhile, the demand for space and comfort is increasing. Therefore, efficient low-temperature district heating solutions will play an increasing role. In Denmark, we are therefore working with different generations of district heating, where the district heating temperature is becoming even lower, which increases the energy efficiency. In addition, the focus is on integrating all available renewable energy sources such as solar heating and PVT panels, heat pumps, and ATES storage. The aim is to electrify the district heating system so that we move towards significantly lower temperatures in the heating system.

Solar heating

Large-scale solar thermal installations have worked as a heat production facility in many district heating companies. It is a production technology that is expected to increase in the coming years, because of the ambition of the 70 % CO2 reduction. The sun is one of the cleanest energy sources, it generates the lowest heating costs, it makes no noise, and it does not smell. One of the disadvantages is that most of the heat is produced during the summer, where the demand for heat is the lowest. To solve this problem, it is necessary to combine the large-scale solar thermal installation with seasonal thermal energy storage, which is typically a water basin with an insulated lid that works like a thermos flask, allowing the energy to be stored from summer to winter. An example of this type of installation is at Dronninglund, where a 37.573 m2 solar thermal installation is placed combined with a 62.000 m3 thermal energy storage. The combination covers 40 - 50 per cent of the annual heat demand with solar thermal energy. The heat supply is supplemented with natural gas and bio-oil.[62] Another disadvantage with large-scale solar thermal installation is that it typically creates a lot of dissatisfaction to the neighbours, because their view is no longer a green field, but solar thermal installations. A way to handle the dissatisfaction is the cooperative way, where local citizens are allowed to participate in the decision-making processes.

[61] https://www.danskfjernvarme.dk/viden-og-v%c3%a6rkt%c3%b8jer/produktion-og-br%c3%a6ndsler/kraftvarme
[62] https://dbdh.dk/wp-content/uploads/2020/09/SoG_WhitePaper_DistrictEnergy_210x297_V22_WEB.pdf

Heat pumps

Large scale heat pumps are expected to play a key role integrating large amounts of renewable energy into district heating systems. Common for all heat pumps is that they use a low temperature heat source which they convert into a higher temperature. Heat pumps can be a particularly good option in combination with low temperature district heating.[63] In Hvidovre, heat pumps play a vital role in the plans of the district heating cooperatives. The expansion of district heating is expected to be accomplished through so-called islands projects, where each expansion area has its own heat production plant. The production plant in the first island project is expected to consist of an air to water heat pump and a biogas boiler as a peak and load base. The capacity of the heat pump is going to be 700-750 kW and the capacity of the biogas boiler is going to be 1 MW. The heat demand in the expansion area is about 5.222 MWh, divided between 113 consumers.

Electric boilers

An electric boiler works as the ones we use in our kitchens. An electric boiler has a low investment cost and a fast reaction time, which makes it an excellent supplementary heat source. Typically, heat pumps have higher investment costs, longer start-up time, but also higher efficiency. The electric boiler can be used whenever it is windy and the wind turbines generate more electricity than required, which means that the electricity prices are low.[64] Therefore, electric boilers in district heating systems are specifically interesting from a flexibility point of view, because electric boilers can help reduce price variations in the electricity spot market.[65]

Heat storages

Heating storages are commonly used to optimize the heating production. When the heat production excesses the heat demand, the heating can simply be stored. Contrary, when heat demand is higher than heat production, heat energy from the storage can be used.[66]

Power to X - PtX

One of the hot technology topics in Denmark that relates to the green transition and district heating is PtX. PtX is electrolyse processes that convert electricity into hydrogen, which can be converted into liquid fuels that can e.g. be used in the transport sector. The conversion process creates a lot of surplus heat which can be used in district heating systems, ultimately decreasing the costs of producing green hydrogen. Therefore, PtX might be one of the major green heating sources in future district heating systems.

The Netherlands

In the Netherlands, district heating is a rather unknown concept among inhabitants. However, there are already a handful of district heating networks in operation for several decades. Currently, the built environment demands 22 PJ of heat from district heating, split between 12 PJ for households and 10 PJ for utility buildings[67]. 4.6% of the total heat demand in the Dutch built environment is covered by district heating heat (as opposed to 84.7% by natural gas for house level boilers). From 2013 to 2019 district heating demand increased by 1 PJ per year, corresponding to an annual increase of 5%.

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[63] https://ens.dk/sites/ens.dk/files/contents/material/file/regulation_and_planning_of_district_heating_in_denmark.pdf

64 https://www.danskfjernvarme.dk/-/media/danskfjernvarme/viden/publikationer/faktaark/faktaark_heat_generation_in_denmark.pdf

[65] https://ens.dk/sites/ens.dk/files/contents/material/file/regulation_and_planning_of_district_heating_in_denmark.pdf

[66] https://ens.dk/sites/ens.dk/files/contents/material/file/regulation_and_planning_of_district_heating_in_denmark.pdf

The next sections elaborate on currently operated district heating networks and new, renewable projects.

Existing district heating networks

In 2019 the Netherlands accounts for 15 5,000+ connection district heating networks[67]. With some exceptions, all of them are owned by a select group of private heat suppliers, using gas-based CHP as main source of heat. Table 7 shows the 5 largest district heating networks in the Netherlands, based on number of connected buildings.

Table 7: 5 largest district heating network in the Netherlands

District heating	Main heat source	Generation
Utrecht	CHP (natural gas)	3rd
Almere	CHP (natural gas)	3rd
Breda/Tilburg	CHP (biomass)	3rd
Purmerend	BWI (biomass)	3rd
Rotterdam	Waste incineration	3rd

In addition to these 'large' district heating networks, there are between 100 and 200 'small' district heating networks, with a total of 64,000 connections in 2018[67]. Currently, 5.9% of the Dutch residences is connected to district heating, corresponding to 425,000 houses.[67]

Recent developments on privately owned district heating networks

There are several developments in the landscape of existing district heating networks. The most noteworthy developments are described in the next sections.

WarmtelinQ

The district heating network of Rotterdam will be extended to, among others, the cities of Delft, The Hague and possibly Leiden[68]. WarmtelinQ is the main transport pipeline to which local distribution networks can be connected[69]. With this expansion, residual heat from industry and waste incineration from the port of Rotterdam is utilized instead of emitted. The project has been criticized because of the use of fossil heat sources. WarmtelinQ will therefore feed local distribution networks that will be open to additional sustainable heat sources.

Mijnwater

The first fifth-generation district heating network in the Netherlands has been installed in the Heerlen agglomeration[70]. The low-temperature district heating network supplies 30°C heat for heating and cooling to homes and utility buildings. The heat network contains several heat sources and uses old mine galleries at different depths as heat and cold buffers. Particularly new buildings are being connected to this network.

New-generation district heating projects

New district heating projects focus on heat sources that are in line with the sustainability goals of the country. Energy cooperatives in particular are working on new-generation district heating networks, in which innovative heat sources are key. Research and pilot studies are

[67] https://www.cbs.nl/nl-nl/achtergrond/2020/35/warmtemonitor-2019
[68] https://warmtenetwerk.nl/nieuws/item/den-haag-tekent-toch-voor-hoofdtransportleiding-warmtelinq/
[69] https://www.warmtelinq.nl/project
[70] https://warmtenetwerk.nl/warmteproject/mijnwater-heerlen/

being conducted on (deep) geothermal energy, thermal energy from surface water, heat extraction from asphalt, heat from ice, storage in basalt, Ecovat, and more. Table 8 shows an overview of pilot projects per heat source[71].

Table 8: Researched heat sources for new district heating networks

Heat source (technology)	Project	Project owner
Deep geothermal energy	Traais Warmtenetwerk	Citizen cooperative Traais Energie Collectief
'Bodemwarmte' to max 500 meter depth	Meent Aardgasvrij	
Deep bodemwarmte between 400-800 depth	Pilot Assen	Housing corporation Actium
Thermal energy from surface water	Local district heating network	Energy cooperative Ketelhuis WG
Thermal energy from drinking water production	Warmtenet EVA-Lanxmeer	Energiebedrijf Thermo Bello
Thermal Energy from waste water treatment	Check website network aquathermie	
Heat from asphalt	Vijverstaete Avenhorn	Zorgcentrum Vijverstaete Koggenland
Heat from water to ice	Solareis Westerschans - Goes	Beveland Wonen
Storage in basalt	Cesar heatbattery with tubes in basalt	Ecodorp Boekel
Storage in Ecovat	Warmte | Koude-net Panningen	Coöperatie Peel Energie
Storage is HoCoSto	Kernvariant Nagele	Energiek Nagele
Ground-coupled heat exchanger		
Modular neighbourhood heat pump	Hengstdal Nijmegen	
Hydrogen gas	Stad aan het Haringvliet	
Mine water	30°C district heating network	Mijnwater BV

[71] https://www.hieropgewekt.nl/lokale-energie-monitor#downloadslem2021

Energy cooperatives select a heat source technology by means of comparative research on feasible technologies. The selected technology strongly depends on local geographics and demographics. These projects are all in pilot phase, financially depending on grants.

Discussion of differences and similarities of technologies

Table 9: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
How widespread is district heating?	More than 1,8 million households have district heating	425.000 households (5,9%) have district heating
CHP	CHP has played a vital role in the development of district heating, but the role of CHP is decreasing to peak and backup supplies to both electricity and heat systems.	Gas-based CH still is the main heat source
Biomass	Certified biomass is seen as a green heating source	Biomass covers 3.7% of total heat consumption in the built environment
Low temperature district heating	It begins to be more widespread.	In pilot phase by cooperatives
Electrification of district heating	Heat pumps, electric boilers and so on are beginning to be a more common and widespread heating sources.	In pilot phase by cooperatives
Solar heating	Common and widespread.	One project in Almere (Vattenfall)
Surplus heat from industry	Common and widespread. The new development here is PtX.	In development WarmteLinQ
Geothermal energy	Not common	Not common but some pilot projects
Cooperative model vs commercial model	The cooperative model involves residents in the decision-making process resulting in more acceptance on spatial impact of new heating technology compared to top-down approach.	

Remarks

- In Denmark, there is no restriction on the use of technologies and energy sources except from fossil fuels such as natural gas and oil. However, the selection of technologies and energy sources depend on the project proposal, where the municipality must approve the project with the most socio-economic, user-economic, company-financial, and environmental benefits.
- In the Netherlands there are also no restrictions on the heat source technology. All kinds of technologies are being researched in pilot projects. These projects still depend on testbed subsidies by the national government (PAW).
- Certified biomass is seen as a green energy source in Denmark, but also as a temporary heating source which will be replaced in the future. When the biomass is certified, it follows that it fulfils 8 criteria and therefore can be used for producing energy, because it is produced in a sustainable way and is CO2-neutral. The 8 criteria are settled in an agreement between the Danish district heating association and the energy industry. The criteria are: 1) The biomass have been harvested legally, 2) The ecosystem of the forest is protected, 3) The size of the forest is preserved and increased, 4) The forest is healthy and well-functioning, 5) The biodiversity of the forest is protected, 6) The forest socio-economic functions is preserved, 7) It is only allowed to use biomass where the total CO2 footprint used in the making and transporting phase are minimized, 8) Fulfilment of requirements of targeting the carbon cycle etc.[72] Suppliers of biomass must guarantee that the biomass is certified. Through inspections the biomass is checked and approved by an independent inspector, who has experience in certifying biomass.[73]
- In the Netherlands, many district heating projects use cold and heat storage. Two commercial companies are specialised in this technology and own a few hundred district heating networks.
- When introducing new technologies and energy sources, it can sometimes result in different concerns and worries from citizens. For example, in the Avedøre Green City project[74] where the district heating network is going to be extended to Avedøre Landsby, there have been concerns about the installation of a local common heat pump that will produce district heating to the area. They worry about the noise, the size, and low temperature district heating. In order to minimize the worries, the district heating cooperative in Avedøre arranged an info meeting in the local school. Most of the citizens living in Avedøre Landsby attended, which witness a local engagement. It was local citizens from the district heating cooperative that were informing about the project and in that way acting as local ambassadors. It strengthens the credibility of the project, when it is local citizens that talk positively about the project. The reason why they can inform and talk positively about the project is because they have been part of the decision-making process enabled by the district heating cooperative structure. After the meeting, several citizens signed up for district heating.
- In the cooperative pilot projects in the Netherlands, the cooperatives build an organisation of local inhabitants to develop the project and communicate towards the citizens. Like in Denmark, this results in roles such as working groups, street ambassadors, and energy coaches, to enhance local engagement.

[72] https://www.danskfjernvarme.dk/viden-og-v%C3%A6rkt%C3%B8jer/udgivelser/folder-om-b%C3%A6redygtig-biomasse
[73] https://www.danskenergi.dk/fakta-fokus/baeredygtig-biomasse
[74] https://www.xn--avedregreencity-8tb.dk/

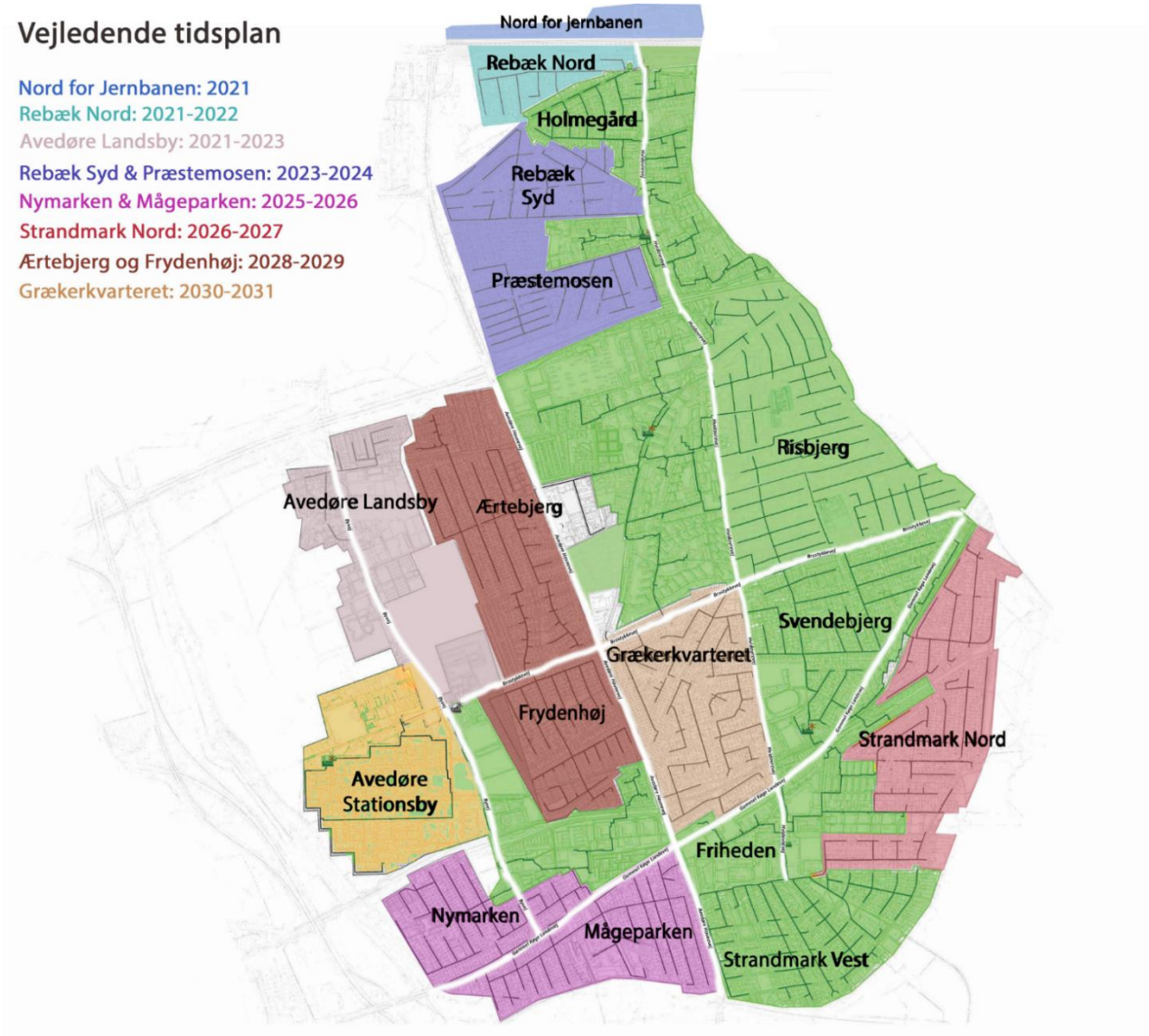


Figure 3: District heating expansion plan of Hvidovre municipality. The green areas are district heating areas while the rest of the areas are potential district heating expansion projects.

Citizen demand for connecting to district heating

Denmark

It is important that the Danish district heating cooperatives have the competencies to communicate about district heating in a way that is understandable and appealing to consumers, and also have competitive products and services. Especially, because the district heating cooperative often has to convince people to wait for district heating. In the district heating cooperative, Hvidovre Fjernvarmeselskab, it is among others managed by developing an expansion heat plan, a sign-up list for district heating, and a bunch of communicative work stressing the advantages of district heating. Today, there are over 2000 households signed up for district heating in the expansion areas. Hvidovre Fjernvarmeselskab are also working closely together with the municipality that communicates to the citizens of Hvidovre that they prefer district heating, because of the many neighbour complaints they receive about noisy heat pumps.

What motivates people to choose district heating?

In order to encourage homeowners to choose district heating, EBO Consult has developed a package deal together with the district heating cooperatives in Hvidovre. The package deal follows that the cooperative takes care of the whole conversion process from natural gas or oil to district heating. Everybody that signs up gets a visit of the account manager of EBO Consult. This person explains all the details on how, when, and where the installations will be installed. This account manager communicates with the builders and construction workers, and the consumer only needs to do two things: 1) sign a district heating contract, and 2) open their house for the installation. The package deal is cheaper than a normal district heating installation, and during a marketing campaign the price is regulated to a higher price in order to incentivise people to choose district heating in the beginning of the campaign. The package deal is especially attractive to the group of people that values comfort and convenience, and who doesn't have the time nor desire to understand technical details. This is in line with the result from the questionnaires that were sent to new district heating consumers in Hvidovre[75], where the majority expressed that the reason for why they wanted to convert into district heating was because they considered district heating as an easy, stable, secure, green, and cheap heating source. Another reason was related to timing - it depends on the end date for their existing heating source. However, since Russia started the war in Ukraine, the citizen demand for connecting to district heating has exploded, and the primary reason for choosing district heating in 2022 is the price.

There is also a group of citizens that prefer to take care of the installation process. In order to target a wider group, it can therefore be a good idea to offer a second option. Citizens are not forced to choose the package deal, they can also choose that the district heating cooperative only takes care of the heat service line installation, where the rest is managed and coordinated by the future consumer.[76]

The experience from the package deal is also that it is important to create great customer experiences. One way is to make sure that citizens can get their questions answered or get help when calling the district heating cooperative. Another way is to invest time visiting citizens, talking with them about their options, and advise them about what is most beneficial in relation

[75] Result from the questionnaire sent to 130 new district heating consumers
[76] https://ens.dk/sites/ens.dk/files/Energibesparelser/6_brugerundersoegelse_af_demonstrationsprojekter_for_ve-baserede_opvarmningsformer.pdf

to their household. It is important that technical specialists from the district heating cooperative take their time to understand the needs and concerns of citizens and that they are able to communicate about district heating in a simple language.

District heating marketing

A district heating campaign begins when the board of directors in Hvidovre Fjernvarmeselskab decides to offer the package deal in the existing district heating areas or decides to expand district heating in a new area, and the project proposal is approved, then different marketing initiatives start. What is important to be aware of in the development of the marketing campaign is to use both formal and informal communication channels.[77] In the formal communication channel, it is mostly citizens that search for information. Therefore, the formal channel cannot stand alone, it is also necessary to be proactive and to reach out for the citizens. The formal communication channels are info meetings, websites, articles, signs, advertisements in the local newspaper, flyers, videos, etc. The informal communication channels are talking with housing associations, local ambassadors such as real estate agencies, existing consumers, and the municipality. It is also to have meetings in the households of the citizens, and to encourage the cooperative members of the district heating cooperative to talk with their neighbours about their opportunities, etc.

The advantages that are highlighted in the marketing campaign about district heating are among others:

- It is an easy installation
- There is a free service included
- The district heating unit is automotive
- The district heating unit has a long lifetime
- The district heating unit is quiet and odourless
- It is easy to have district heating
- District heating is stable and reliable
- District heating is a green heating source
- District heating is cooperative owned

It is a conscious choice that prices are not highlighted as an advantage. Firstly, because the district heating price has not always been competitive to prices on natural gas and electricity. Secondly, because it can create a bad customer experience if the consumer has based their decision converting into district heating on price, and their price expectations are not fulfilled. Because of the rebound effect, it can occur that new district heating consumers will tend to relax and not think about their consumption, especially if district heating has been sold as a price saving and consumption saving heating source. Ultimately, it can result in a higher district heating consumption, and therefore a higher price than expected. In other words, unsatisfied consumers that feel cheated.

The Netherlands

In the Netherlands, financing of cooperative heat projects depends on the bank, which requires signatures from residents for security of financing. For this reason, energy cooperative Warmtenet Wageningen-Oost and energy cooperative KetelhuisWG have set up a neighbourhood campaign to collect signatures in order to get the loan. These campaigns have

77 https://www.teknologisk.dk/_/media/70550_FRESMIR%20Antropologisk%20rapport.pdf

shown that various motives can be reasons to whether or not to connect to a heat network to be developed. These motives are described in the following sections.

Motives in favour of connecting to a district heating network

As mentioned in Chapter Technology, district heating is a relatively unknown concept among residents. Residents often have no opinion or motive with regard to (connection to) a district heating network. Residents develop opinions when it concerns the person oneself. The mentioned initiatives have already experienced residents' motives during neighbourhood campaigns. These campaigns show that motives for connecting to a district heating network differ greatly per resident segment: innovators, early majority, late majority, and laggards.[78] The group of innovators considers sustainability as the main motivation for participating in a neighbourhood district heating network, while early and late majority consider the cost of induction stove and cooking vessels as an obstacle.

Another important segmentation is homeowners and tenants.[78] Homeowners quickly foresee the personal benefits a district heating network provides. Tenants, on the other hand, are highly dependent on the landlord, and may be suspicious of the landlord due to historical/current incidents (e.g., overdue maintenance). In addition, tenants are afraid of increased housing costs due to the in-home implementation of the heat exchanger.

Motives for not connecting to a district heating network

The campaigns lead to questions or concerns from residents, who demand information about the new energy system before they are willing to sign the contract.[79] This is mainly about security of supply, connection costs, aesthetics of the connection, individual nuisance, inexpensive 'old' energy contract and alternative energy systems (i.e., heat pumps). However, because information about these matters was obtained at an early stage in the project, residents have been informed on these matters. Therefore, these issues did not lead to rejection of signing.

However, variety of reasons can prevent residents from connecting to district heating.[78] This is especially true for tenants. Unknown landlords or landlords living abroad may be unreachable, while tenants are not authorized to make decisions. In addition, the language barrier of tenants can cause misunderstanding. Finally, there are those who are sceptical about sustainability, see no benefits in a district heating network, or do not like major changes. These laggards are open for discussion during the neighbourhood campaign, but decide not to join.

Subsidy stimulation

A description of the subsidy provided by the national government can be found in Section Agreements for the Built Environment.

[78] Interview with Laura van Baasbank, consultant on communication and participation
[79] Report Warmtetransitie in de Benedenbuurt: geleerde lessen van de campagne

Discussion of differences and similarities of the demand for district heating

Table 10: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Image of DH	Positive because non-profit principle, cooperative ownership, and it is cheap.	Neutral or negative because it is generally regarded as too expensive.
Extra investments when installing district heating that are not related to household heating	It is often not necessary with extra investments.	Additional investment in induction stove and cooking vessels.
Motives in favour of connecting to district heating	Easy, stable, secure, green, and cheap heating source. End date of current heating source of resident.	General sustainability motive among innovators Cooperatives promise that new heating tariffs will be equal to or less than the current tariffs for natural gas.
Marketing strategy	Formal communication: info meetings, websites, articles, signs, ads in the local newspaper, flyers, videos, etc. Informal communication: talking with housing associations, local ambassadors such as real estate agencies and existing consumers, the municipality, in-house customer meetings, encourage the district heating cooperative members to talk with their neighbours about their opportunities, etc.	Marketing carried out by street ambassadors (literal neighbours) is far more effective than marketing carried out by organisations, whether commercial or cooperative, because of trust level.
Marketing benefits	Easiness of installation and system, free service, lifetime, noise/odour, reliable,	Sustainable, cooperative ownership, heat cost equal to or lower than current gas cost.

	green, owned by cooperative	

Remarks

- The main difference between Denmark and the Netherlands is the image of district heating. District heating has existed in Denmark for a long time. It is common and widespread. It follows that there exist a lot of great examples and best practices throughout the country. In general, it makes district heating a "normal" choice which consumers trust. The trust is also enhanced by the non-profit regulation and the cooperative model. It is highlighted by the fact that 70 % of the Danish people thinks that it is important to keep cooperatives and non-profit in the district heating sector.[80] In addition, the Danish heating association also develops marketing campaigns nationally to strengthen the image of district heating, while local district heating cooperatives and companies develops marketing campaigns locally. A lot of efforts are, therefore, put into developing a positive image of district heating. In the Netherlands, homeowners often have no image at all because it is unknown to them. And in the cities with district heating the image is often negative, because it is regarded as too expensive. Sometimes distrust of commercial district heating companies also plays a role because they feel they are connected to a monopoly without transparency about the price. The result is that there is little motivation for connecting to district heating.
- For Dutch citizens the price for heating is most important. Natural gas has been a cheap commodity in the Netherlands and alternative heat sources were more expensive. District heating is interesting when it is cheaper than natural gas. Other motives are the space needed for the installation, the environmental impact, the nuisance during installation and extra costs related to induction stove and cooking vessel. Cooperative district heating projects connect to another set of motives of citizens in the energy transition such as are better solutions through more careful processes in the neighbourhood, positive social impacts and increased local democracy.
- In Denmark, EBO Consult offers a package deal to cooperatives, ensuring minimum nuisance during realisation. The package deal is part of the marketing campaign via formal and informal channels. In the Netherlands, in the first semester of 2022 two district heating cooperatives in Amsterdam and Wageningen have implemented a marketing campaign to get residents to sign for connecting to district heating. Both campaigns were successful as a result of gradual built up of support for district heating by the cooperatives over a period of years. Residents in both districts trust the work and effort that the cooperative has been putting in the district heating project. And the sharp increase of prices for natural gas has given extra motivation to sign for district heating.

[80] https://www.danskfjernvarme.dk/maerkesager/oekonomisk-regulering/udspil/den-fremtidige-regulering-af-fjernvarmeselskaberne

Tendering

Denmark

In a district heating expansion project, it is necessary that a certain percentage of the heat demand accept district heating before the tendering and construction phase can begin. It is due to the economic perspective of the project. Therefore, the marketing phase is often prior to the tendering phase. When the percentage is obtained, the tendering phase can begin.

Tendering refers to the process where vendors are invited to submit an offer for a large project within a finite deadline. The process consists of an opening, evaluation, and final selection of the vendor. In our case, the vendors are consulting firms, technical experts, and contractors. This description will focus on tendering material to contractors.

Before the tendering process, it is a critical project step to develop the tendering material. The contractors will base their offers on the tendering material, and it is therefore important that the material is thoroughly analysed and described. In that way, it is more likely that the contractor gives a realistic price of the project from the beginning. It can also diminish misunderstandings, confrontations, and unpleasant surprises during the project.

The tendering documents

The tendering material varies depending on the type of project. The description of the tendering material in this section is related to district heating expansion projects where the tendering is regulated under the EU-directive.

The project proposal and the tendering material is not the same. The project proposal is an overall analysis which is based on the national regulatory framework, and it is developed in the feasibility phase. The tendering material is developed in the implementation phase, where the project proposal has been approved by the municipality. The tendering material entails a detailed description of the project in relation to the technical details of the work that is carried out, but also working conditions, communication skills, security and so on. In Denmark, there exists a construction act that provides general terms and conditions for work and delivery in the construction sector. The act is often used in the tendering material as a reference, which follows that the work that is carried out is obliged to follow the construction act.

In the tendering material, it is first of all important to clarify:

1. The scope of the project
2. The technical details of the grid
3. The tendering conditions
4. The working conditions
5. The different roles of the partners in the project
6. The timeline
7. The way the offers will be evaluated
8. Extra work

The next step in the tendering material is to describe the special conditions related to the district heating expansion project. It can for example be a special offer to the new district heating consumers that is developed and designed by the district heating cooperative. In the case of Hvidovre Fjernvarmeselskab, it is often that citizens are offered a package deal in relation to district heating expansion projects. Therefore, it is described how the contractor and

the plumbing work should be executed in the tendering material with reference to the "technical regulations" of the district heating cooperative. But that is not the only thing, it is also described how the contractor should communicate with customers. The contractor represents the district heating cooperative, because they have a lot of face-to-face interaction and communication with consumers, when district heating is going to be installed. If the contractor can't handle the communication or is not able to give the customer a good experience, it will backfire the image of the district heating cooperative. Therefore, EBO Consult has developed a "The Customer Journey" which describes all steps and milestones for the contractor and the customer. The description of "The Customer Journey" includes all necessary documents for the tendering and the agreements with the customer, where we focus on communication and information towards the customer. Thus, the upcoming contractor has to prove specific capabilities in communicating and must appoint experienced and dedicated staff for that purpose, before the contract is signed.

Other special conditions in a district heating expansion project that is worthwhile taking into account:

- The existing district heating grid
- Entrances to the area - are there areas, where the grid cannot pass (river, railway and so on)
- Flow direction
- Soil conditions
- Construction site

The above mentioned is only a selection of the subjects in the tendering material. The material is wide in scope and describe how the contractor should relate to other conditions such as:

- The working process
- Unknown grid
- Pipe trench
- Connection to the existing grid and households
- Wells

In addition, it is also important to include a description of the excavation work. In Denmark, it is normal procedure that the soil, which is in surplus, is investigated and classified into pollution categories before it is removed. If the soil is polluted it should be treated like garbage and removed to a plant that can clean the soil. This treatment can be quite costly. How the contractor should treat the soil in surplus is described in the tendering material. What is also important to include is a description of the pipe work and how it should be executed.

Selection of the contractor

In the tendering material, it is described how the offers from the contractors will be evaluated, determining which contractor will be selected. In EBO Consult, we have selected 6 criterias which are valorized differently:

- The price
- References
- Service and technic
- Environment
- Quality Assurance

- Execution timeline

The contractor with the highest score will be selected.

The Netherlands

Like in Denmark a minimum number of participants are needed in order to be able to have a solid business case. Once this threshold as achieved the tendering can begin.

In order to separate interests, risks and accountability it's advised that the energy cooperation creates a project company (a Ltd, a "B.V." in Dutch) to mitigate these risks and to keep the cooperation clear.

In this section the heating district of Muiderberg is used as an example of the tendering process. The local energy cooperation is WattNu and it has created the project company called "Warmtebedrijf Muiderberg B.V." (District heating company Muiderberg Ltd.) This company has then started a tendering procedure to acquire five contractors for the following work packages:

- Technical installation (TEO, Heat Cold Storage, central heatpumps, back-up heating, technical space);
- Heating district (underground infrastructure up to and including heat exchanger in houses;
- Strategic partner to support the district heating company with investments and knowledge support on technical, financial and legal matters;
- Operation (administration); and
- Installations inside the houses (plumbing works, starting at heat exchanger).

For each of these working packages a separate tendering process will be started. Of course, during earlier design phases of the project some research and preliminary studies have been performed, so a quite detailed design of the heating district is available.

Tendering documents

This detailed technical design and other knowledge acquired during the concept and preliminary design phase is shared with the contractors. This package includes:

- Planning;
- Technical design (concept design and preliminary design) consisting of heating district route and its performance, underground infrastructure already present with identification of possible problems, number of customers, amount of heat (peak power and energy during the year) delivered and source specification (primary source and possible heat storage);
- Summary of the business case; and
- Form to indicate reference projects.

The tendering process

This detailed technical design, together with accompanying information and mission statement of the heating company is shared with the tendering process. Furthermore, a detailed planning and the summary of the business case are shared.

As it's in Denmark the case also in the Netherlands some special points of attention are valid during the tendering process. The scope of the project the tendering conditions, the working

conditions, the different roles of the partners in the project, the way the offers will be evaluated and the way additional work is dealt with.

However, any input from contractors in the tendering process is appreciated, therefore there are several moments included in this process to talk with contractors and to interchange information. This could possibly lead to improvements in the design of the heating district. These additional changes are then communicated to all contractors in the tendering phase by means of a "Nota van Inlichten" (note with additional information).

The tendering process itself looks like the following:

- Release of tender documents
- Introduction meeting with contractors (individual)
- Additional (technical) meetings if required
- First offer
- Questions from district heating company towards contractor
- Presentation of first offer
- Preliminary selection of contractor
- Signing of Letter of Intent
- Collaboration sessions to fine tune agreement
- Signing Agreement.

Selection of contractor

Contractors which submit their offer during the tender phase will be judged on the following topics:

- Check on completeness of offer;
    - Security of supply
    - Influence of district heating company
    - Well supported business case
    - Flexibility and quick startup
    - Durability
- Drive and ability to collaborate with a cooperative company;
- Relevant experience; and
- Proposed financial collaboration.

After the contractor is selected a final proposal can be made towards the participants as at that point in time all necessary information and pricing is available.

Discussion of differences and similarities of tendering

Table 11: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Heating district	Expansion of operational heating district close-by	Stand-alone heating district
Tendering applied to source vendors or constructors	Yes	Yes
Services tendered	Similar.	

Tender process	Similar.	
Tender documents	Similar documents, based on description above.	
Selection of contractor	Similar.	
Interaction with consumers	Setup of a Customer Journey	Not mentioned in project plan, but might be performed by the cooperation.

Remarks

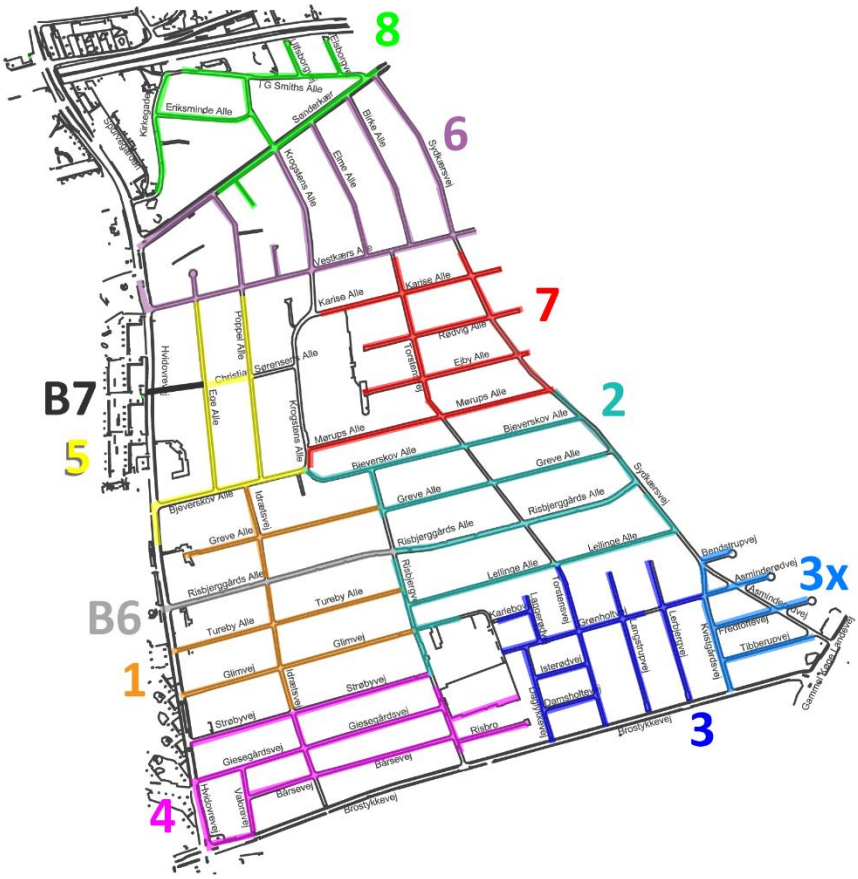
- In general, the tendering process in the Netherlands and Denmark is similar because both countries are under EU regulation. In Denmark, EBO Consult has a lot of experience with tendering, while district heating cooperatives in the Netherlands are beginning to learn how to do it.

Construction

Denmark

In Denmark, there exist several contractors specialized in district heating. When tendering a district heating project, there are, therefore, often several contractors competing. When the contractor is selected, the execution of the district heating project can begin. The contractor is obliged to follow the construction act that provides general terms and conditions for the work that is carried out. According to the act, it is for example the contractor that has the primary responsibility for the work. If something goes wrong, it is also the contractor that have the responsibility to fix it.

When the construction phase begins, it is important to inform about the contractor schedule to the people living in the area. It can be done with signs illustrating the time schedule placed in the area. Depending on the size of the project, it can sometimes be necessary to separate the area into stages. The stages are put into a chronological order, which is based on where from the area is supplied with district heating. It enables an ongoing process where the consumers can be connected to the grid, supplied with heat, and where the installations are completely finalized before the next stage begins. In addition, it is also important to be aware of whether the municipality or other companies, e.g. a water supply company, is planning to do some work in the area. In the expansion project illustrated in the picture below, a waste water company was going to optimize the sewer in a part of the area. Therefore, it was important to coordinate the work with the company - also to minimize the inconveniences for the people living in the area.



District heating expansion area divided into stages

When the contractor begins the expansion project, it is important to keep a close dialogue with the contractor and daily supervision of the work that is carried out. Weekly meetings and detailed minutes of the meetings are ways to handle it.

Legislation

It is legally required to register the new district heating grid in the national grid owner register, which is managed by the agency for data supply and efficiency. The purpose of the register is to minimize grid damage and to find information about owners of the grid. In addition, the register enables contact between the owners and those who wish to dig or seek grid information.[81]

Another legal principle concerning the grid is the so-called "guest - principle". The grid is established in an area, owned by another actor, e.g. the municipality. It follows that the district heating cooperative is the guest in the area and, therefore, the "guest - principle" is relevant. The principle implies that the owner of the area maintains the right to change the use of the area even though it means that the grid has to be moved to another location. If the "guest - principle" is relevant between the actors, it is the guest that has to pay for the costs related to moving the grid even though the relocation is caused by the owner of the area.[82] The principle is relevant in public and private areas, but it is only relevant in situations where there are no agreements between the grid owner and the area owner. Therefore, the district heating

[81] https://ler.dk/Portal/P.1.Forside.aspx
[82] https://www.danva.dk/media/2840/2016_05_04_vejledning_om_gaesteprincippet.pdf

cooperatives have signed agreements concerning the location of the heat service line with each household connected to district heating.

The Netherlands

The construction of district heating grids requires a construction permit from the municipality and often a water extraction permit from the water board. This is because in some parts of the Netherlands the groundwater is close to the ground level, and active drainage is needed to pump groundwater out of the pipe trench. Sometimes archaeological sites need to be protected and that may require directional drilling of pipes. In 2010, Thermo Bello had that experience with a directional drilling under an archaeological mound covering findings of the roman period.

Often the expansion of a district heating grid is requested because of the construction of new buildings in a district or because of a renovation project. In both cases the planning of the grid constructors must be aligned with the planning of other constructors in or around the houses. In the Netherlands there usually is coordination between public infrastructure providers such as DSOs for electricity, drinking water companies for water, and optical fibre companies for internet and TV. District heating companies align the planning of the grid construction works with these companies and with the contractor of the houses of course.

In the Netherlands the constructor is responsible until their work is finished and the district heating company signs for the work done. But during the work the clients of district heating will hold the district heating company liable, and not the contractor.

Legislation

It is legally required to register the new district heating grid in the public registers of the Land Register and the KLIC Register which purpose is to minimize grid damage. In addition, the register enables contact between the owners and those who wish to dig or seek grid information. Before digging with a machine, a contractor is legally required to check the register (KLIC notification). Municipalities are managing the underground of the public space by requiring the district heating companies to make use of a national online MOOR Platform® that improves control, transparency, efficiency and cooperation in the cables and pipes chain. The MOOR Platform® is the standard in the Netherlands for supporting all processes related to planning, permitting, executing and administrative handling of work on the underground infrastructure.

To ensure the use of the underground for the district heating most district heating companies opt for the juridical form of a limited real right of superficies, laid down in title 8 of book 5 of the Dutch Civil Code. Establishing a right of superficies creates a horizontal division of a plot, between the bare ownership of the landowner and the superficies of the pipe installer. A right of superficies is legally established by having a notarial deed drawn up and registering it in the public registers of the Land Register. Another option is the juridical form of an easement that is also established with a notarial deed. When Thermo Bello was established, the grid was taken over from the drinking water company, and the notary had to investigate the ownership structure of every parcel in which the pipes are laying, and the notary changed the contracts with all the landowners.

Discussion of differences and similarities in construction

Table 12: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Number of qualified construction companies	several	few
Competition level	At least 5 companies are competing for a tender	There are a few constructors in the market willing to take part in a tender
Public licences for construction	Similar	
Construction registration	Similar	
Responsibility of the work carried out during the project	Similar. It is the contractor that is responsible for the work carried out during the project.	

Remarks

- In Denmark, district heating has existed for decades. It is an ongoing sector with continuously work and development. It follows that there also exist a market for contractors specialized in district heating. When tendering, there are soften five to seven contractors competing about the tasks. In the Netherlands, the district heating market is smaller than in Denmark and there is less competition among construction companies. This is one of the reasons why heat prices are 38% to 65% higher in the Netherlands compared to Germany, Denmark and Sweden.

Maintenance

Denmark

Maintenance is a basic element of asset management. Because FD Hvidovre is a part of a larger grid, the cooperative is not responsible for producing heat, but is responsible for distributing heat to the consumers and functioning as a heat reserve storage. It follows that most of the maintenance work revolves around the distribution grid.

The way the district heating grid is maintained is crucial for a well-organized asset management.

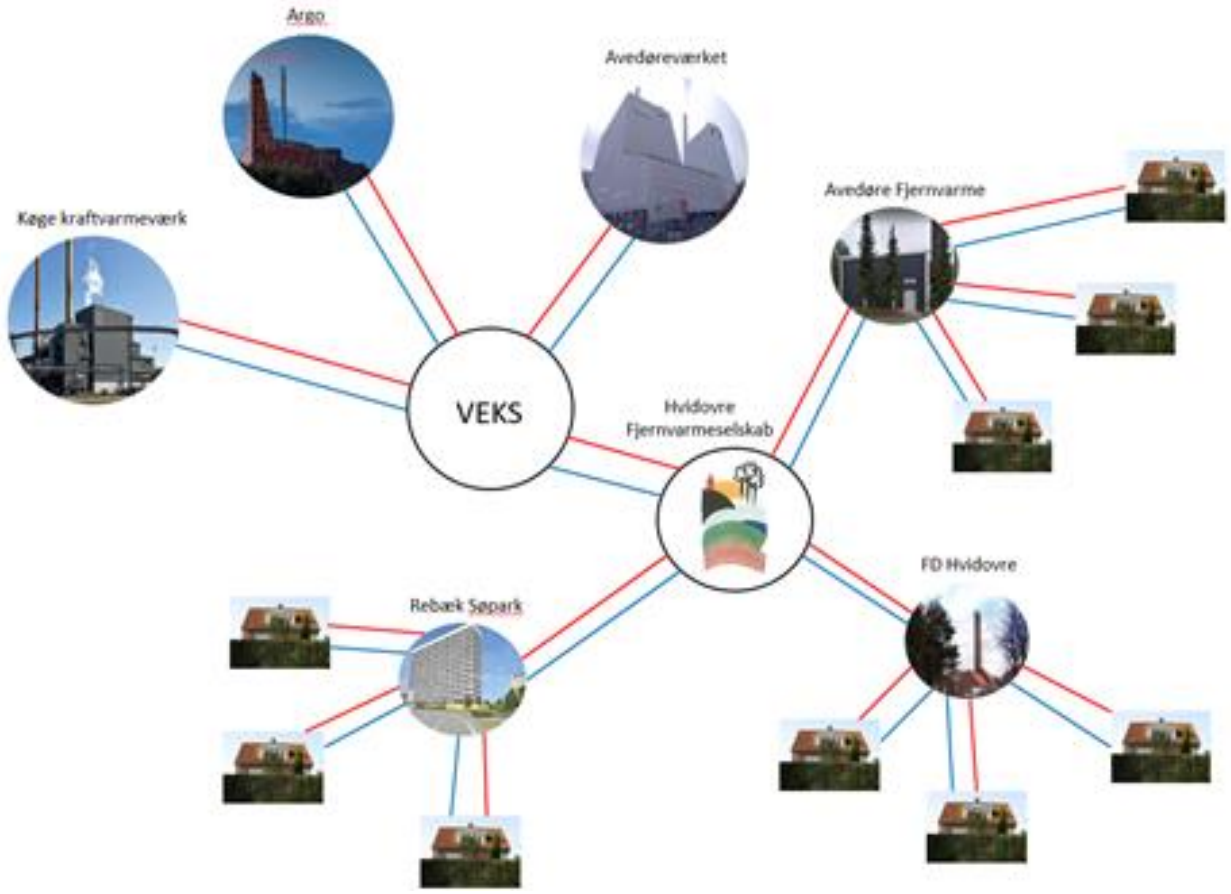


Figure 4: The picture illustrates the district heating grid connected to FD Hvidovre.
The maintenance work of FD Hvidovre revolves around the consumers

Expertise among the employees and surveillance tools are also important values for the day-to-day operation. A system regulation and surveillance program enables a constant overview of the distribution grid. The program keeps an eye on the grid, and it sends alarms to employees whenever there is something wrong with the pressure or temperatures. In that way, employees can react quickly to errors, which in the end ensures a high security of heat supply.

EBO Consult has developed and implemented an operation and maintenance strategy where all tasks are described in detail (e.g. manhours and single tasks) in an operation plan for a year. Every day the operational staff members receive a calendar reminder about "today's tasks" and they know exactly what to do and how to do, since every task is described in detail.

The operation and maintenance strategy focuses on

- qualified service and how to do it,
- proactive initiatives to secure further operation of the system,
- staff members' competences and behaviour
- development of customer relations and evaluation of employees' performance and
- communication among staff members and towards customers.

In district heating cooperatives it is experienced that consumers with a high energy consumption make agreements with the district heating cooperative to organize and administer the surveillance of the internal heat distribution. It is considered as a help to the single

consumer and the caretaker of the buildings and makes it possible for the district heating cooperative to optimize the flow in the overall heating system.

Further, it is the experience that consumers with many internal heat meters make agreements with the district heating cooperative about optimization the heat meters, where heat meters are directly controlled and monitored by the district heating staff members. Housing associations are especially looking for optimization of their internal heat system and they are seeking assistance from the district heating cooperative. The result is mainly energy savings which lower the tenants' heat invoices and an optimized heating system.

Maintenance is key to having a distribution grid that works. If there is a leek, it is important that the valves can close. It is also important to have service contracts established with plumbers that are specialized in repairing leakages. Today, there exist leakage detection systems that can detect the leeks which makes it easier to find the leeks. In the technical regulation[83] of the district heating cooperatives in Hvidovre, it says that the consumers must accept that it is sometimes necessary to close the heat supply in order to maintain the district heating grid.

EBO Consult has developed a specific maintenance program where the life span of installations, installation costs and energy savings by exchanging e.g. pipes are integrated. All figures are based on long-time experiences including construction works. You can choose different parameters in your selection of maintenance wishes. For the board of directors in district heating entities it is a very important tool to economize the lifetime operation of the heating system, and it is fundamental for the implementation of a long-term strategy for the entire system.

Technical service

What is also important when considering maintenance is service. The district heating cooperative and EBO Consult help the consumers by offering a technical service for free. The service is a check of the consumers heating installations every second year:

The first check is a check of their district heating unit and a thorough energy analysis of their houses, i.e. how the consumer can save energy in their house. After the check, the consumer receives an energy report of their house. In the report, the consumer is informed on whether their heating consumption is below or above the average consumption and it entails guidelines for what the consumer can do to optimize the energy efficiency of their house. This type of check is repeated every sixth year.

Two years after the first check, a maintenance check of the district heating unit is performed in order to adjust the unit in the most energy efficient and energy saving way. This type of check happens every second year.

When multiple consumers accept the service, it follows that the cooling in the whole district heating system improves, which ultimately benefits the consumers. It is due to the fact that the distribution company buys heat from the transmission company. The transmission company needs cold water to cool the electricity turbines in a CHP plant. Therefore, the transmission company has implemented a cooling tariff on the return water from the district heating system. One heating degree costs 26.889 euros. It follows that the cooler the return water is, the less

[83] The regulation is explained in detail in the chapter about the organizational structure of the district heating cooperative

the distribution company has to pay in cooling tariff. If the cooling in the whole district heating system is improved, it, therefore, reduces the production costs, which ultimately decreases the consumer's heating bill.

The technical service is performed by plumbers. In order to perform the service, the plumbers must finalize an education called Fjernvarmens Serviceordning. The education is developed in a collaboration between the Danish Heating Association and TEKNIQ employer. The aim of the education is to improve the operation of the district heating units and to ensure that the technical service of the district heating units is executed in the same way and with a high quality. It is also a criterion in EBO Consult that the plumbers that perform the technical service in Hvidovre also go through a workshop where they are informed about the ordinary regulations and technical regulation of the district heating cooperative.[84] Another important criterion is that the plumbers know how to communicate and educate consumers about their district heating unit. In the end, the plumbers represent the district heating cooperative when they perform the technical service, and, therefore, it is important what they tell the consumers are in line with the standards set by the operational staff in EBO Consult.

The Netherlands

In the Netherlands Thermo Bello is the only district heating cooperative having experience with operation and maintenance of district heating installations. Thermo Bello has activities in the production of heat, in the distribution, and in the delivery of heat. Thermo Bello has one part-time staff member who is responsible for the daily operation and coordination of maintenance, and a group of three volunteers that contribute to the operation and maintenance activities. Together they form a technical team that has a weekly meeting chaired by the director of Thermo Bello. The director is accountable for the work of the technical team and for the contracts with suppliers. The operation and maintenance strategy of the heat production installation is focused on 5 key performance indicators:

-Reliability of district heating

-Coefficient of Performance (COP) of the heat pump

-Overall electric consumption of the heat pump and surrounding pumps

-Use of natural gas

-Number of start-stops of the heat pump

These KPIs have been optimized with data management combined with fine tuning of the regulation strategy of the heat production software programme PRIVA. And recently also with replacement investments. Because the heat exchanger and the heat pump, as well as the natural gas installation (for back-up and production peaks) reached the end of their technical lifespan, Thermo Bello replaced the entire heat production installation. For the replacement a heat pump and natural gas installation were selected with a higher production capacity to be prepared for expansion of the number of households connected to district heating. And the new heat pump has a better COP and will further reduce the use of electricity.

With regards to the distribution network operation and maintenance activities include leakage detection checks on the pipes at four measurement points in the district. There are also two valves in the field that are inspected every year. The leakage detection system only covers the

[84] The regulations are explained in the chapter about the organizational structure of the district heating company.

main distribution pipes and not the smaller distribution pipes in the district. In case of a leakage somewhere in the smaller pipes the location of the leak is difficult to find. A small leakage may lead to continuous suppletion of new medium water. When a leak becomes so big that the suppletion water production unit cannot follow it, and the pressure in the grid drops, the leak needs to be found and repaired. According to the Heat Law the clients of district heating need to be compensated financially for not receiving heat, if the delivery of heat is interrupted for more than 8 hours. The clients are entitled to a compensation of 35 Euro for an interruption of 8 hours and for every extra 4 hours 20 Euro extra compensation. Thus, for an interruption of 24 hours the costs amount to 115 Euro per client, and 25.300 Euro for 220 clients. Thermo Bello is too small to have a service contract with a specialised company that repairs leaks and is dependent on the availability of one of the specialised companies when it has a leak to be repaired urgently. Having a leak repaired within 8 hours can be very challenging. Fortunately, there are number of specialised companies in the Netherlands that can repair leakages.

Operation and maintenance activities in the delivery of heat are restricted to the replacement of the heat meter every 15 years. Thermo Bello receives meter data every day, and the clients can also access the meter data at an online platform. The district heating unit does not include a heat exchanger because Thermo Bello delivers heat of maximum 50 degrees Celsius for heating houses and that is not suitable to produce hot water for sanitary use. Some 30 houses in de district have a booster heat pump to produce hot water for sanitary use with the medium water for district heating as heat source. In the district there are other hot water heating systems installed such as solar boilers, heat pump boilers, electric boilers and burners of natural gas.

Not everywhere in the Netherlands there are local plumbers that are skilled in the maintenance of district heating units or in house district heating installations. For example in Culemborg, clients of Thermo Bello are having trouble to find a skilled plumber if they need one. Future expansion of district heating to small cities and towns needs to be accompanied by training of local plumbers. In Purmerend the municipal district heating company Stadsverwarming Purmerend established a trainings programme 'Certified Local Installer' that is being implemented by Techniek Nederland. Techniek Nederland is the association for the Installation Branche and the technical retail sector representing more than 6000 companies in the Netherlands. Only certified local installers are allowed to work on district heating units owned by Stadverwarming Purmerend.

The annual check of the functionality of the valves in the houses is being done by the inhabitants themselves. Thermo Bello replaced the valves in houses where they were subject to corrosion and installed the new valves in a dry place above the ground.

Thermo Bello does not offer a technical service to its clients except from one apartment complex. The return temperature of the houses can hardly be influenced because the regulation of the heating installations cannot be changed. The houses and office and school buildings are heated with low temperature heat (30 to 50 degrees Celsius) and use low temperature heating systems in the wall or floor that are per definition very low. The potential economic benefits of a lower return temperature are unknown. Clients sometimes ask questions regarding their heating installation and then a volunteer from the technical team visits the house to investigate the need for a plumber. When a group of homeowners want to replace their installations, they can also invite the technical team of Thermo Bello to be involved for advice. In the process to get the whole district free from natural gas, old installations for the production of hot water for sanitary use are replaced by new installations.

Discussion of differences and similarities in the maintenance

Table 13: The main similarities and differences in Denmark and the Netherlands

	Denmark	**The Netherlands**
Compensation payments	None in Hvidovre	35 Euros for an interruption of 8 hours and for every extra 4 hours 20 Euros extra compensation
Spare parts	Easy access	Not easy access
Certified plumbers	4.736 plumbers that have finalized a specialized district heating education offered by Fjernvarmens Serviceordning	Techniek Nederland has a specialized trainings programme for district heating
Surveillance system	Similar	
Production of hot water	Co-production of heat and hot water for sanitary use	Production of heat and hot water for sanitary use is separated in Thermo bello
Organizational structure of maintenance	Employees working in EBO Consult	Service companies do the maintenance. In Thermo bello partly only staff and partly volunteers

Remarks

- According to the Dutch heating law, the consumers must be compensated financially when there is an interruption in the heat supply. It costs 35 Euros for an interruption of 8 hours and for every extra 4 hours there are 20 Euros extra compensation. In Denmark, it is not regulated on a national level, but on a local level. In Hvidovre, it is regulated under the technical regulations of the district heating cooperative, where it says that the consumers must accept that it is sometimes necessary to close the heat supply to maintain the district heating grid.
- In Denmark, the plumbers can be certified in district heating when finalizing an education called Fjernvarmens Serviceordning. The aim of the education is to improve the operation of the district heating units and to ensure that the technical service of the district heating units is executed in the same way and with a high quality. In the Netherlands, Techniek Nederland has a specialized training programme for plumbers, but there is a lack of plumbers specialized in district heating.

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