PlanEnergi

Organisational Structures in the Danish District Heating Sector

CoLab KWP-Deliverable D

3. June 2024

NORDJYLLAND
Jyllandsgade 1
9520 Skørping

MIDTJYLLAND
Vestergade 48 H, 3.
8000 Aarhus C

SJÆLLAND
Nørregade 13, 1.
1165 København K

☎ +45 9682 0400
VAT: DK-7403 8212

Fehler! Linkreferenz ungültig.

Subject:	CoLab KWP-Deliverable D
Short description:	Organisational structures in the Danish district heating sector-ownership and organisation of district heating in Denmark as one of the four main topics that were identified by the German Energy Agency (dena) as relevant for German district heating stakeholders.
Release date:	3. June 2024
Project no.:	23-024
Prepared by:	Tara Sabbagh Amirkhizi, Max Gunnar Ansas Guddat (Planenergi)
Quality-assured by:	Per Alex Sørensen
Document no.:	01
Version:	1.1

Prepared for:

Deutsche Energie-Agentur (dena)

Deutsche Energie-Agentur GmbH (dena)

Chausseestraße 128a
10115 Berlin
Tel: +49 30 66 777 - 0
Fax: +49 30 66 777 - 699
info(at)dena.de

Table of contents

1 Introduction

Denmark has one of the world's highest district heating shares. Almost 66 percent of all private households in Denmark use district heating for both space and water heating[1]. The expansion of the district heating system, along with a significant portion of heat cogeneration with electricity in CHP plants, has played a pivotal role in increasing energy efficiency in Denmark and contributed to a sustained reduction in carbon emissions over the last decades [1].

Denmark has six major central district heating zones that collectively distribute around 67 petajoules (PJ) of heat annually[2]. These areas are strategically situated around key cities and urban centres. Furthermore, there are approximately 350 smaller decentralized district heating areas across the country, contributing to an annual heat production of approx. 53 PJ.

In this report we are describing organisational structures and processes in the Danish district heating sector, and thereby answering questions that many German municipalities have about setting up a district heating company or organising district heating though existing municipally owned utilities (like Stadtwerke). Since most district heating in Denmark is either municipally owned or owned directly by consumers, Denmark has a lot of experience to offer on these ownership structures.

The report is a deliverable within the CoLab KWP project. The objective of the report is to clarify ownership and organisation of District Heating especially in Denmark as one of the four main topics that were identified by the German Energy Agency (dena) as relevant for German district heating stakeholders.

In the first part, we set the scene by highlighting the framework conditions that have led to the uptake of district heating in Denmark, with a focus on the most distinguishing factors of the Danish energy policy and society such as the high trust level, heat planning, the not-for-profit principle, and the policy tools and regulation that have framed the district heating sector in Denmark since the 1970s. It is important to be aware of the differences in the regulatory ecosystem between Denmark and other countries, in order to understand why certain organisational structures have been successful and some not. Afterwards, we elaborate on different ownership models for district heating systems and how these ownership models are being implemented and affect the day-to-day business of DH companies. In the third part, the report highlights the financial aspects of district heating in Denmark.

[1] https://danskfjernvarme.dk/

[2] However, it is the 16 central power plants in these areas and not the resulting 6 areas that are specified in the executive order on authorisation for the construction and modification of electricity production plants and electricity production from onshore plants.

2 Regulatory and Societal Framework Conditions

The success of the Danish district heating industry is a result of the historical development of the energy system, local policymaking, and the societal structures in Denmark. There are five principles that have contributed to improving the framework conditions for the uptake of district heating grids in Denmark. These principles are listed as:

a. High Trust in systemic structures and organisations
b. Heat planning track record since the 1970's
c. Not-for-profit model
d. Taxation for shifting consumer choice
e. Transparency and close to market regulatory agencies.

The following segments, elaborate on each of these principles.

2.1 High Trust in systemic structures and organisations

Denmark has a 150-year-old tradition of cooperative organisations in farming and agriculture. This kind of organisation is well-known in the Danish society, especially in smaller municipalities where informal processes based on trust and collaboration are the norm. This makes the establishment of local projects very efficient since bureaucratic work is kept at the minimum amount necessary. The approach to establish partnerships and collaborations is applied to larger and more complex district heating systems as well, as the case of the greater Copenhagen area shows.

2.2 Heat planning track record since 1970s

The Heat Supply Act of 1979 governed the Danish district heating sector during its growth, granting municipalities significant authority in local heat planning, energy infrastructure decisions, and resource prioritization. The heat supply act ensures that the heat supply price is set according to the heat production cost, and later (in the 1990's) due to an interest of the utilization of Danish North Sea gas fields, makes the use of combined power and heating plants mandatory where possible.

According to the heat supply act, each municipality[3] was mandated to perform a heat plan, determining where to prioritise which heating system. These plans led to the development of several district heating plants and the extension of existing ones, following primarily the heat demand density, and using natural gas (CHP and boilers) as the primary source of heat.

The first heating supply act introduced "zoning" that gave municipalities the mandate to determine which areas were to be supplied by district heating (highest density), natural gas (intermediary density) or individual heating (typically oil boilers at the time. The purpose was to

[3] at that time approx. the size of a German "Gemeinde"

establish efficient, low-emission energy systems in different areas, and to prevent overinvestments in infrastructure by investing only in those areas that were most viable for infrastructure development. The zoning regulation was accompanied by comprehensive customer protection [2]. During the market liberalisation trend in the 2000's the mandate of defining new zones and mandatory connection to a given district heating grid[4] in the zones was abolished. However, within the previously defined zones, new buildings could still be obligated to connect to the previously determined heat supply [3]. Mandatory connections and payment of fixed costs was abolished 2019. However, no consumer has ever been obliged to consume heat from the grid he/she was connected to before that either.

Since the 1990s, new projects along the heat plan that included a change of the heat supply or heat production were planned on a case-by-case basis and presented to the municipal council in project proposals. Project proposals could cover distribution or production of district heating and must include an analysis of alternatives as well. These analyses can for example, evaluate project proposals in relation to other local planning documents (does this fit with the planning interests?) and the socioeconomic performance of the project (is there a gain for the socio-economy and not only the plant operator?), following standard methods [4]. Throughout the years, the municipal heat (and energy) plans have been updated. The revised law in 2007, following the new climate agenda, established new heat plans as part of the strategic energy planning process [2].

Following the new climate law from 2022. after the Russian, the Danish state decided to accelerate the phase-out of gas boilers in residential heating. For this purpose, the new energy agreement improved the conditions for the roll-out of district heating grids, for example, by making heat planning mandatory in Danish municipalities again to determine where district heating is the optimal heating solution in an area.

2.3 Not-for-profit model

Similar to electricity and gas grids, District heating systems are natural monopolies. However, unlike electricity and gas they are not affected by the EU unbundling rules. Thus, there are different ownership, pricing, and benchmarking structures possible in this sector.

One major characteristic of the Danish district heating model is that any district heating grid (regardless of the ownership structure) is operated on a not-for-profit principle. Based on this principle, the district heating company's surplus or deficit from one year is reflected in the district heating price of the next year. District heating companies determine the district heating price for consumers based on the total and cumulated costs of heat production and provision (heat generation infrastructure, the total cost of fuels and fuel transport, heat distribution

[4] Mandatory connections and payment of fixed costs was a tool until 2019. However, no consumer has ever been obliged to consume heat from the grid he/she was connected to.

networks and storage facilities, investments, maintenance, operations and management, service, workspace and offices, and legal advice and consulting) [4]. Danish district heating prices are published on https://fjernvarmepriser.dk/.

2.4 Transparency and close to market regulatory agencies

The Danish Energy Agency sets the framework for municipal heat planning and the processing of heating projects. However, it is the municipal councils that make the final decision on how heat planning and expansion of heat supply should take place in the municipality. Municipal councils can approve district heating systems within a centralised policy framework provided at a national level. The rules are set out in the Executive Order on the Approval of Projects for Collective Heat Supply Systems, also known as the Project Executive Order. The Heat supply law provides a framework for project approval, mandate transitions to environmentally friendly fuels, and ensure the use of surplus heat, all while considering societal interests and ensuring transparency and accountability in heat supply management.

The monopoly-like nature of district heating grids is highly regulated to ensure consumer protection. The Supply Authority ("Forsyningstilsynet") oversees Danish district heating companies. The supply authority has the permission and ability to inspect, analyse, and regulate district heating companies, and ensure that the necessary information and compliance measures are in place to facilitate effective supervision and accountability.[5]

In practice, not all municipalities had the same level of involvement in the district heating projects. After the Russian war in 2022, the involvement of municipalities in developing the heating infrastructure in cities increased since the climate agreement mandated them to phase out gas from the residential heating sector by 2030.

[5] Chapter 4a of the heat supply law: https://www.retsinformation.dk/eli/lta/2021/2068#id5179c561-176c-4f8a-bbe4-1c6495faea72

2.5 Taxation for shifting consumer choices

The oil crisis in the 1970s led to a sudden increase in imported fuel prices. After the fuel prices dropped to their initial level in the 1980s, the Danish state decided to implement taxes for fossil fuels used in heat generation. After already experiencing high fuel prices during the oil crisis, the consumers had an easier time accepting the tax increase. This ensured that consumers continued to be motivated to use environmentally friendly energy sources and to save energy. Biomass and biogas were exempted from taxes.

The Danish state subsidises district heating technologies mainly during the innovation and technology development stage. Denmark had nearly no subsidy schemes for heat planning or for establishing or operating district heating. This approach enabled an incentive for the green transition in the heating sector with little bureaucracy. The market-based approach, not being dependent on subsidy schemes, makes it much safer for utilities to invest, as the business case is not dependent of the outcome of a given subsidy scheme, which can (and often does) lead to stop-and-go in the project development and leads to uncertainty about the boundary conditions that will develop within one or two years. Instead, project evaluations depended on the socio-economic feasibility, where taxes would determine the choice between natural gas, biomass or heat pumps.

3 Ownership structures of Danish district heating companies

To meet the goal of climate neutrality in the heating sector in Denmark, the increase of district heating is crucial. Either existing district heating companies must expand their grids, or residents must establish completely new companies. Else, municipalities must implement district heating grids within the framework of a municipal owned company. Thus, district heating companies can be organized in one of three main ownership models:

- Consumer owned (" cooperative model"- partially or fully)
- Municipality owned
- Owned by commercial organisation

Currently out of 354 district heating grids in Denmark, 58 are owned by municipal companies, and 286 are consumer owned. Only 10 district heating companies are owned by commercial actors. However, the grids that are owned by municipal companies mostly belong to larger cities and thus, deliver more heat than the 286 consumer owned grids. The ownership structure is important both for investors and consumers[6]. In the following sections we elaborate on consumer-owned district heating grids ("the cooperative model") and municipal-owned district heating systems. We will not focus on district heating systems owned by commercial organisations, since their setup is similar in different countries, and they are not very prominent in Denmark.

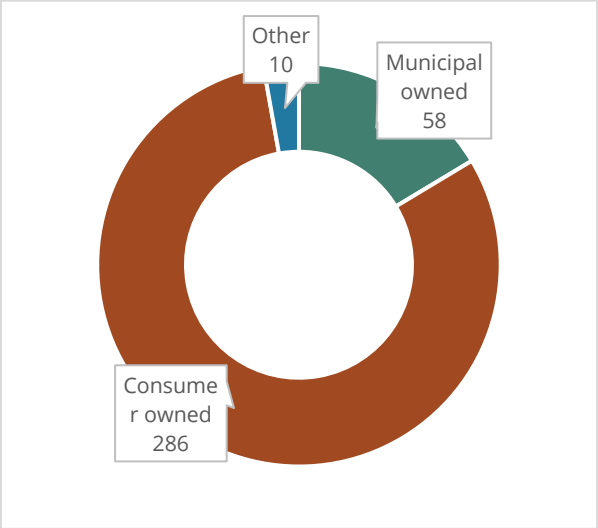

Figure 1: Ownership of District Heating Companies

[6] https://dbdh.dk/dh-in-greater-copenhagen-history-and-status-2023/

Regardless of the ownership structure, district heating companies in Denmark are organised in a classic company structure with different roles that are involved in the decision-making processes within the district heating company. These roles are listed in table 1.

Table 1: Roles and actions within district heating companies in Denmark

	Municipality-owned	**Consumer-owned**
Political (Municipal Council/City council)	**Assigns the board**	Can be represented in the board (not in their political role)
Consumer	Can be represented in the board	**Assigns the board**
Board of the district heating company	Makes decisions, hires professional staff	Makes decisions, hires professional staff
Professional staff	Day to day operation and administration	Day to day operation and administration

While the board of a consumer-owned district heating company mainly consists of consumer representatives, municipality-owned district heating companies might have a consumer representative as a member of the company's board. However, this is not mandatory. On the other hand, there is always a member of the municipal council involved in the board of a municipality owned district heating company. The role of political actors in the board of a district heating company is independent from their political activities.

The daily operations are managed by the professional staff, paid by the district heating company through the heating costs. The size of the district heating system and its complexity determines the staff necessary for operating and maintaining the district heating grid[7].

3.1 Consumer-owned ("cooperative model")

In consumer owned district heating companies (the "cooperative model"), the consumers own the district heating company as a cooperative, following the example of farming cooperatives. A district heating company is usually established as an "andelsselskab med begrensede ansvar-a.m.b.a.", which is a limited liability cooperative (equivalent to the German "Genossenschaft- eG"), a cooperative where the owners' liability is limited to the share of capital they have contributed.

[7] For example, general manager, technical staff, customer service, and accounting.

At the yearly general assembly, the consumers appoint the board and decide on major developments. This is where the main decisions on investment, pricing etc. can be taken. The general assembly elects a board of typically 5-11 people, usually consisting of different profiles that can contribute to the evolution of the district energy system of their community[8].

3.1.1 Starting a "cooperative" district heating company

There are two important partners in establishing a new (consumer-owned) district heating company: existing district heating companies in the area and the municipality. The existing district heating company has valuable knowledge about the heat potentials in the area, as well as whether there have been previous attempts to establish a district heating system, and if so, why they failed. The district heating company also has extensive knowledge about the operation of district heating and the possibilities and limitations of the Heat Supply Act. The municipality is crucial as they are the authority responsible for heat planning and approving new district heating projects.

The Danish District Heating association ("dansk fjernvarme") has prepared a guide on how to establish your own district heating company (see figure 2). In the following segments, we elaborate on the different steps towards a consumer-owned district heating company. The material is available at the link: https://danskfjernvarme.dk/medlemsfordele/lav-dit-eget-fjernvarmeselskab [5].

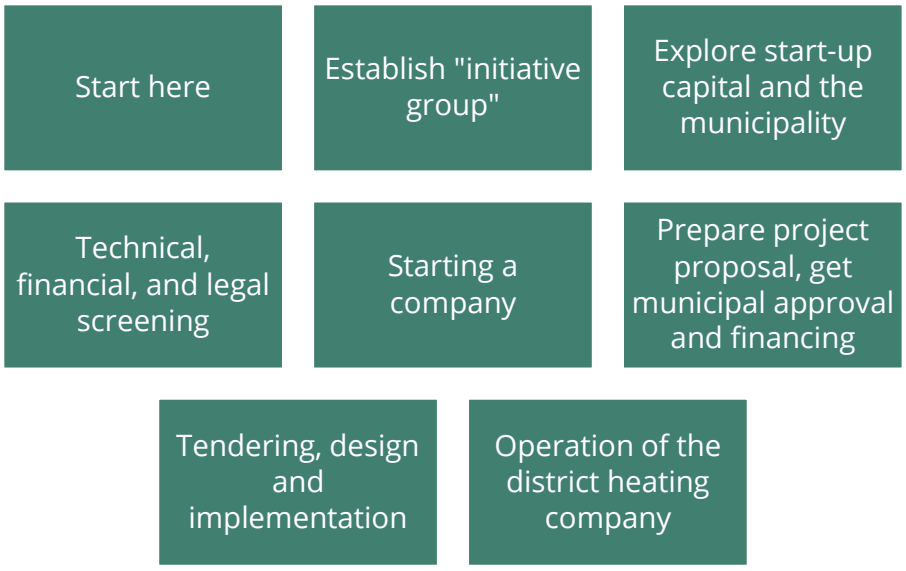

Figure 2: 8 steps towards a "cooperative" district heating company

[8] E.g. lawyer, economist, engineer

3.1.1.1 Start here

First and foremost, establishing a district heating company following the “cooperative model” requires the backing of most citizens in the area. The Danish District Heating Association recommends existing district heating companies to be always involved in starting-up new district heating grids. The existing companies have experience and can provide sparring to the new district heating companies. In the long term, it may be even possible to enter joint operations or other strategic partnerships. A good start for citizen groups who want district heating is to approach:

- Existing district heating companies (contact the nearest local company)
- The municipality- to gather information about heat planning
- Public registers and analyses about district heating potentials.

District heating companies in the area will have knowledge about whether there were previous attempts to start a district heating system and if yes, what went wrong. Sometimes the local media and even Facebook groups can also give information about previous attempts to start a new district heating company.

Establishing district heating from scratch requires many resources. This means a lot of volunteer hours from local enthusiasts to, for example, ring doorbells and have dialogue with advisors and the municipality. Preparing a project proposal will require funds of about 75,000-100,000 DKK (10,000-14,000 EUR) depending on size and complexity of the project. In addition, there's another DKK 100,000-125,000 (14,000-17,000 EUR) for technical, legal and financial screening and preparatory work if there is no existing screening analysis or strategic heating plan. Additionally, planning and rolling out collective heat supply is time intensive. For example, for establishing a new district heating area, processing times in the municipality, excavation work, etc. can easily take more than 2 years.

3.1.1.2 Start the “initiative group”

In practice, when a group of enthusiasts decide to establish district heating in an area, they should contact the nearest district heating companies (even the small ones) and find out if they have plans to supply district heating to the area. It may be that district heating will be available in 2, 3 or 5 years. If this is not the case, it's also a good idea to do an initial screening for the potential for collective supply. first it must be investigated whether the area is suitable for district heating. Are the properties reasonably close together, how many people might want district heating, etc. The municipality is usually a good partner for this information as well. If there is a basis for a company, the "initiative group" can convene a general meeting for initiation and elect a board of directors.

It also helps to have an initial dialogue with major heat consumers such as industry/business, municipal buildings, owners' associations, housing associations, etc. as well as initial considerations about potential heat sources/heat production, for example, the possibility of surplus

heat from industry, data centres, wastewater, water purification, and local production of biogas.

3.1.1.3 Explore start-up capital and co-operation with the municipality

If there is no district heating planned for a specific area, the “initiative group” should contact the municipality and get insight into the local heating plans. It's a good idea to involve the municipality from the beginning if consumers are considering setting up their own district heating company. The municipality can help with several things, such as inviting to public meetings.

A challenge in the start-up phase is often financing. The Danish District Heating Association recommends 360° advice - technical, financial and legal. But a group of volunteers rarely have the financial resources to pay for expert advice. At this stage, in some cases, the municipality will provide support for counselling and preparation of project proposals in connection with the municipal heat planning task.

3.1.1.4 Technical, financial, and legal screening

It is important that collective heat supply (district heating) is only introduced where it is economically and environmentally feasible in the long term. There is currently a lot of pressure to switch from natural gas to other heat sources, while at the same time energy prices are volatile and there is a lot of pressure on resources both in terms of materials (pipes, meters etc.) and personnel (contractors, blacksmiths, planners etc.). This makes it even more important to carry out a thorough technical, financial and legal screening of district heating projects. The Danish District Heating Association's advice is:

- Get a competent advisor who can provide 360° guidance
- Beware of "no-cure, no-pay" consultancy. The setup to get paid only in the case of the implementation of the project can incentivise the establishment of district heating projects that are not viable in the long term
- Create technical sensitivity analyses/scenarios
- Check heat density and calculate heat losses in the pipes
- Utilise existing boilers (nurseries, schools) or waste heat (industry, wastewater, seawater, seawater) and investigate the location of technical facilities
- Consider security of supply, robustness and peak load
- Consider organisation and operation in the long term
- Make budget estimates
- Check competitiveness (price mix)
- Calculate the budgeted heating price per consumer based on estimated production and administrative costs
- Calculate the necessary and probable connection rate (check the prior interest of the covered properties)
- Sensitivity analysis: How many properties can you "afford to lose" because they would rather have an individual heat pump? What about interest rates on loans? What about

the cost of installing the pipework and heat production? As it can take several years from initial budgets and estimates to actual prices being realised, it is important to calculate sensitivity and recalculate if necessary.

The "initiator group" is usually in close dialogue with the municipality's departments for climate, heat planning authority, property management (major public consumption that can be connected) and land use/local planning (location of technical facilities). It is the same municipality that must subsequently approve project proposals and decide on municipal guarantees behind loans, so a close dialogue will be an advantage.

3.1.1.5 Starting a company

As mentioned earlier, district heating companies are usually established as limited liability cooperatives. Customers share loans and other obligations but are only liable for the paid-in share of the capital. An association can borrow money from a bank, mortgage or through "KommuneKredit" and obtain municipal guarantees. "KommuneKredit" is an organisation whose purpose is to provide loans to municipalities and regions and to companies/institutions with 100% municipal guarantee.[9]The KommuneKredit is further elaborated in chapter 5.

3.1.1.6 Prepare project proposal, get municipal approval and financing

The project proposal (prepared in accordance with the Project Executive Order) forms the basis for the municipal approval of the project under the Heat Supply Act. The municipality must approve the project before the construction work begins.

The project proposal is usually prepared by a consulting firm either commissioned by the district heating company, or by the municipality. If the municipality has the project proposal or environmental assessment, building application etc. prepared, the municipality should ensure that another impartial consultant assists in the regulatory processing of the project proposal. This is to avoid disqualification during this process.

Once the project has been approved, a loan must be taken out for financing. Loans via KommuneKredit with a municipal guarantee are based on an approved project proposal. However, district heating companies can also choose private banks, mortgage institutions or leasing companies as an alternative to KommuneKredit. Here, however, the company will often only be able to finance 80 % of the project, unlike KommuneKredit, which can finance 100 % of the project.

3.1.1.7 Tendering, design and implementation

After the project proposal has been approved, district heating can be established if there are enough customers (sufficient connection rate) to make the project economically viable. The district heating company should consider marketing and communication with citizens as an integral part of the project, as the project depends on the number of sign-ups. Therefore, it is

[9] https://www.kommunekredit.com/

also important that the company has decided on how to offer district heating before starting the actual communication.

As a general rule, the task of establishing a pipe network and heat production must be put out to tender. This is also where the district heating company can ensure a competitive price, or realise that the budget was not enough, in which case they must go back and look at options for dividing the project into phases, etc.

3.1.1.8 Operation of the district heating company

As mentioned earlier, many district heating companies in Denmark were started on a local initiative. This is important and good in the start-up phase. But in the long term, establishing joint operations or joint rosters can provide major financial benefits.

It can be expensive to employ dedicated staff for 24-hour shifts and have employees with knowledge of all conditions. Collaboration with a neighbouring company can provide both cheaper and better solutions. It is therefore a good idea from the start of the project to consider whether a local district heating company can operate the system in the long term, since these companies have the resources, expertise and experience to operate district heating systems. Several smaller district heating companies can also establish joint operations to save costs.

3.1.2 Example of Hadsund district heating

One example of the cooperative model is the Hadsund District heating company. The company was founded in 1959 by the town's local egg wholesaler, Carlo Jensen. He took the initiative to start the district heating company to connect the first 315 customers at that time. Today, 2000 households in Hadsund are connected to the district heating system of Hadsund. The wood chip plant is the primary source of heat production, and a solar thermal plant provides 14% of the annual energy production. The heating plant has kept up with the times and is today a 100% carbon-neutral heat supply, serving consumers with heat from renewable sources.

All the board members of the company are consumer-elected and do not have a direct working relationship with the district heating company besides their membership in the board. Board members receive a basic monthly compensation of 571 DKK/76 € (board member) to 5711 DKK/765 € (chairman of the board), and additional 1000 DKK/134 € for each meeting they participate in.

3.2 Municipal ownership

The heat supply law ("Varmeforsyningsloven") clarifies the role of the municipality in overseeing the district heating company of a town, regardless of who owns the district heating grid in a municipality. The city council can mandate an existing collective heat supply facility to implement an approved project within a specific deadline. If a private heat supply facility cannot

meet the mandate, it can require the municipality to take over the facility. However, this has never occurred and is more a last resort tool provided to the municipalities by the law. For combined heat and power facilities, the facility must allow others to establish and operate the facility and provide the necessary infrastructure.

The framework conditions and rules for municipalities to own district heating companies is also set out in the heat supply law. A municipally owned district heating company and its board must act as a commercial company independent of the municipality, following the "Company law" ("selskabslovet").

Municipalities can independently or jointly with other municipalities or private companies manage business activities related to heat supply. Some examples of these activities are the ownership and operation of biogas plants and geothermal energy plants. According to the heat supply law, Municipalities may utilize capital returns and include profits when managing businesses.Activities directly related to heat supply are not subject to this since they are operated on a not-for-profit base.

The municipalities can extend their heating services to other municipalities provided there is a physical connection and regulatory approval for the expansion, ensuring integrated and regulated heat supply systems.

3.3 Example of Brønderslev Forsyning

Brønderslev Forsyning A/S is a 100% municipally owned holding company. The company's board of directors consists of representatives from the municipal council and employees, while the board of the subsidiaries consist of city council politicians and consumer representatives.

The organisation functions as a municipal multi-utility and has divided its responsibilities into three subsidiaries: Brønderslev Vand A/S (fresh water), Brønderslev Spildevand A/S (wastewater), and Brønderslev Varme A/S (district heating). Each subsidiary has its own board, and there can be overlaps in the board members of the different companies (see figure 3).

Brønderslev Vand and Brønderslev Spildevand handle the water and wastewater treatment and distribution in the whole municipality, and Brønderslev Varme is responsible for heating 5,350 properties in the city of Brønderslev. These properties are connected to the heating network operated by the company. To ensure reliability, the company has established two backup plants in Brønderslev and one in Øster Bronderslev, which can be activated in case of emergencies. Furthermore, the company employs smart meters for monitoring and managing energy consumption.

All employees are employed by the holding company. Today, there are approximately 34 employees who professionally manage the operation, administration, and development of the companies.

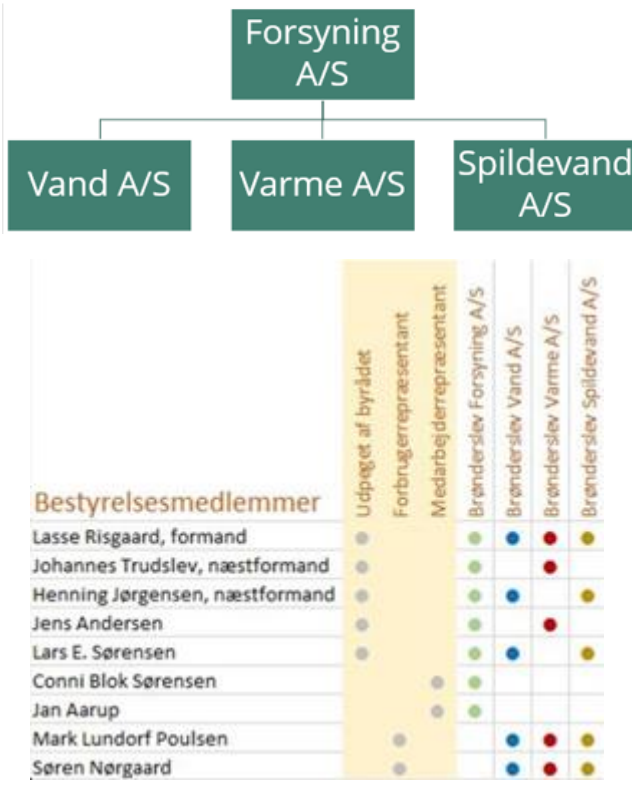

Figure 3: Organisation of Bronderslev Forsyning

3.4 Other ownership structures-Greater Copenhagen Area

The district heating system in the greater Copenhagen area demonstrates a special case of district heating organisation, for a system that is consisting of many municipalities. Due to the large number of market actors and stakeholders involved in the operation of the district heating system, the greater Copenhagen area shows more complexity than other district heating systems in Denmark. A part of the district heating transmission grid is operated by CTR (capital area) and VEKS (western outskirts of the capital region). These companies are founded by 20 local district heating distribution companies who entered a partnership in 1984 with the purpose of facilitating the transmission of heat from the newly established large CHP units to the growing distribution networks in their respective areas.

The district heating company of Copenhagen, HOFOR, and local heating companies have a longstanding tradition of collaboration, which extends to both long-term planning and the

day-to-day management of heat supply operations. CTR, VEKS, HOFOR and other heat transmission companies co-own a shared load management unit known as “Varmelast.dk.” This unit plays a crucial role in optimising heat production across the region, working closely with plant owners to ensure efficient operations [5]. Production plants are owned by private companies, for example Ørsted, or by municipal/cooperative owned utility companies. Some distribution companies within the partnership such as Høje Taastrup also have their own production and storage units. Figure 4 visualises the district heating system of the greater Copenhagen area.

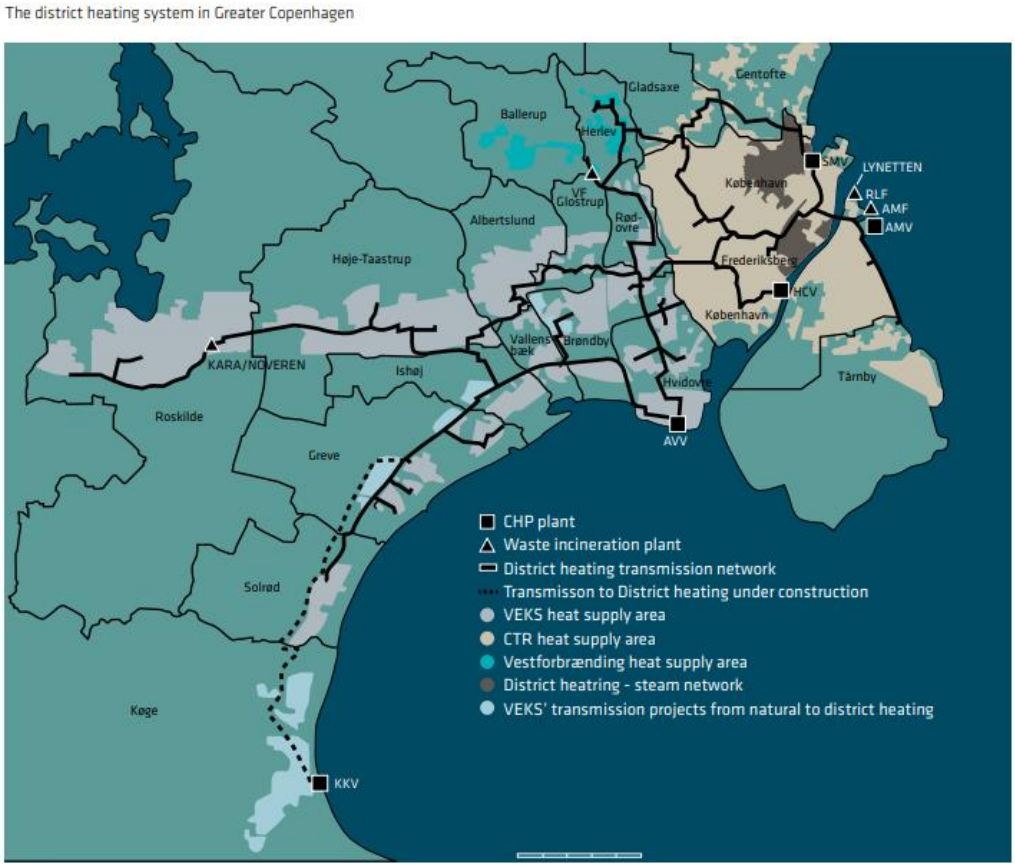

Figure 4: The district heating system in greater Copenhagen[5]

4 Investment Decisions

Large scale infrastructure such as district heating networks require large sums of investment. These investments should be low risk and have favourable conditions, due to the not-for-profit nature of the Danish district heating model.

As mentioned in chapter 3, it is possible to finance district heating investments by means of municipality-guaranteed loans (KommuneKredit) at the same conditions as e.g. the financing of public nursing homes or cultural centres. Since municipalities approve project proposals, they are already involved in some degree in the district heating projects and can offer their guarantee for the loans based on their insight on project risks. Additionally, due to the consumer prices cover increased costs of district heating projects, the risk of these projects is relatively low. There have been only 2 cases in Denmark, where the actual project costs exceeded the calculated costs in the project proposal (which was approved by the municipality) substantially. In one of these cases, the district heating company fusioned with another company and realised the project, and in the other case the project stopped, and the municipality had to cover the loss. For the municipal guarantee, municipalities usually charge a loan fee, which varies from municipality to municipality [4].

KommuneKredit offers comparably low interest rates (normally approx. 1-2 %-points lower than banks) and long payback periods (20-30 years). There is no fixed limit for the payback period of the loans, because district heating projects usually have long depreciation periods, which affects the payback period of the loans. For example, in the case of a solar district heating project in Dronninglund the payback period was set on 25 years.

Using the KommuneKredit is not mandatory and given more favourable conditions, district heating grids are also being financed by private bank loans (typically still at 20-25 years payback).

While the core financing tool for district heating in the long-term perspective is through the described financing schemes, initial investment support schemes do exist. A support scheme in the Danish district heating sector, particularly for transition projects, is the “district heating pool”, which was established within the Danish energy agreement in 2020. It aims to contribute to reducing CO_2 emissions from oil and gas boilers in the residential heating sector. District heating companies can receive grants from the pool for projects where energy-efficient district heating networks are rolled out in new areas and where individual oil and gas boilers are converted to district heating. The subsidy is a fixed amount of up to DKK 20,000 per converted oil and gas boiler for the number that constitutes the minimum connection. The minimum connection is defined as the number of conversions in the project area that, including subsidies from the district heating pool, results in a balance in the discounted corporate economic income and expenses over the lifetime of the conversion project's investments. The economic performance of the projects is calculated upfront using the average

consumption data and costs derived from the technology catalogue.10There have been a couple of cases where planned district heating systems have been cancelled because of too high calculated heat prices (for example in Randers and Års).

After the Russian full-scale invasion of Ukraine in 2022, the Danish state decided to accelerate the phase-out of gas boilers within residential heating. In addition to the district heating pool, the agreement lays out additional favourable conditions for district heating investments. According to the agreement, the depreciation period for investments must reflect the expected lifetime of the investments, which enables a longer depreciation period.

The district heating pool was initially at 148 million DKK (19,8 million EUR). And was topped up with 265 million DKK (35,5 million EUR) in 2024, whilst applications accumulated to 409 million DKK. The pool was later expanded to match the applications that were sent according to the deadline etc. However, this led to a stop-and-go and delayed several projects. Also, district heating plants may be more cautious about investigating expansions when funding for these is linked to risks.

[10] https://ens.dk/service/tilskuds-stoetteordninger/fjernvarmepuljen

5 Conclusion

The development of district heating has contributed to the decarbonisation of the heating sector, especially because since the 1970s, the focus within district heating has been set on increasing efficiency and using local energy resources. Policies supporting the development of the district heating system and the availability of municipal loans, have improved the financial viability of district heating projects and are a major contributor to the further evolvement of district heating grids and their decarbonisation.

This report evaluated the framework conditions and organisational structures within district heating in Denmark. The Danish Heat Supply Act, known as "Varmeforsyningsloven", serves as the primary legal framework governing the planning, establishment, and operation of district heating systems in Denmark. It sets out the rules on cost-based pricing and the project approval, independent of the organisational structure of the district heating company.

While there are major differences in the initial set-up of different organisational structures in Denmark, the acceptance of the consumer in the organisation is very strong in the cooperative model. Consumer-owned district heating companies is highly dependent on initiatives from the consumers to take the contact with the municipality and other district heating companies and raise awareness and information on district heating in the area.

In larger cities, municipal ownership of district heating grids is more common. In these cases, district heating companies operate as independent companies with the possibility to acquire loans and separate accounting from the municipality. Both primary models operate within the same framework – the not-for-profit principle and the management and practical work in the organisations are rather similar.

6 References

[1] A.-S. Knud Erik Nielsen *et al.*, “DISTRICT ENERGY Energy Efficiency for Urban Areas,” 2018.

[2] “The Danish Model for Organising and Financing of District Heating.”

[3] “Regulation and planning of district heating in Denmark Contents.”

[4] K. Johansen and S. Werner, “Something is sustainable in the state of Denmark: A review of the Danish district heating sector,” *Renewable and Sustainable Energy Reviews*, vol. 158. Elsevier Ltd, Apr. 01, 2022. doi: 10.1016/j.rser.2022.112117.

[5] L. Gullev, “How to Start.” [Online].

[6] “DISTRICT HEATING IN COPENHAGEN: ENERGY-EFFICIENT, LOW-CARBON, AND COST-EFFECTIVE 2.”