



ASSESSMENT OF HUMAN RESOURCE UTILIZATION IN THE EXPANSION OF THE DANISH DISTRICT HEATING SECTOR

How many human resources were needed to create the district heating growth from the adoption of the first heat law in 1979 until 1989

APPROX. 45 FTEs WERE UTILIZED DURING THE DH-SECTOR EXPANSION

Main results

The interview and literature studies shows that at national level approximately 45 FTEs were involved in creating the transition in Danish district heating in the period from 1979 – 1989. During that time the district heating share of the heat demand for heating buildings increased from 30% to 50%.

In each municipality it is estimated that 1 – 2 FTEs were involved. In Denmark, a lot of the project work was done in the existing district heating companies. For the smaller companies it was around 0.3 FET, the medium sized 2 FTEs and for the larger 8 FTEs.

How? – Methodology of this report

The report's findings are based on interviews with 21 experienced individuals involved in district heating projects from 1979–1989, supplemented by existing literature. Due to the lack of detailed records from that era, the analysis relies on interviewees' recollections, cross-referenced for accuracy, and supported by the author's expertise and peer reviews. The focus is on resource allocation for sector growth rather than comprehensive workforce data.

Why is this report important?

District heating in Denmark today covers more nearly 70% of the space heating demand. District heating is a corner stone in the transition to a renewable heat supply. Denmark has established an industry environment that support the green heat transition – other can find inspiration to their own endeavors here.

Who is this report targeted towards?

The report is targeted towards national, regional and local authorities working to establish a framework condition and establish district heating networks. In this report they get input to one way of organizing institution, companies and authorities that will make it possible to



INTRODUCTION

This chapter contains the following:

- Introduction to the topic: The growth and expansion of district heating in Denmark
- Overview on the scope of the study
- Outline of the report design and contents
- Explanation of the data collection process

INTRODUCTION TO THE TOPIC

Introduction:

In Denmark, energy policy gained importance during the 1970s, spurred by the oil crisis of 1973 and again in 1979. At the time, heating was primarily reliant on oil. However, elevated oil prices and supply shortages demanded a fundamental reassessment of the country's energy system. This period marked the establishment of ambitious goals and frameworks for the future of collective heat supply, which included a significant expansion of district heating based on CHPs as well as the development of a new natural gas infrastructure.

District heating had already gained greater adoption in Denmark compared to many other European nations. However, the oil crisis underscored the significance of enhancing energy security and reducing dependencies on oil. Consequently, district heating expansion became a strategic priority, not only to reduce reliance on imported energy but also to utilize Denmark's domestic natural gas resources. This vision culminated in the adoption of the Heat Supply Act of 1979, a groundbreaking and long-term policy framework that profoundly transformed Denmark's district heating landscape.

The Heat Supply Act set the stage for significant growth in district heating systems across the country, outpacing developments in many other European countries. Simultaneously, the act sought to create a market for Denmark's newly established natural gas project. This dual focus introduced a competitive dynamic between district heating and natural gas networks in the heat planning process.

Scope of the study

This report examines the 10-year period following the adoption of the Heat Supply Act, a transformative decade (1979-1989) marked by substantial expansion of Denmark's district heating system. This expansion naturally required significant personnel resources across various entities, including state agencies, municipalities, and district heating company¹. The aim of this presentation is to provide an overview of the human resource efforts involved in this expansion—a subject of considerable interest internationally, where inquiries are frequently made about the staffing resources required for such an ambitious project. The study does not compare to the resources needed in other countries.

Since no official statistics or comprehensive data sources exist for this purpose, the overview has been prepared based on interviews with individuals active in Denmark's district heating sector during this period. While the data carries a degree of uncertainty due to the reliance on recollections from events over 40 years ago, the findings offer valuable insights into the human resource allocation for this transformative effort. A full list of interviewees is provided at the end of the report.

¹ | District heating company is the chosen terminology for the entity that delivers district heating. A district heating plant is used for the heat producing entity.

REPORT DESIGN AND CONTENT

Contents of the report

The report outlines tasks carried out across various organizations within the Danish district heating sector, including:

- The Danish Energy Agency
- The Gas and Heat Price Committee (Today the Energy Regulator)
- The Danish District Heating Association
- The Danish Municipal Bank - KommuneKredit
- Municipalities
- District heating companies.

Additionally, consulting engineering firms, primarily staffed by technicians, were instrumental in handling many of the tasks during this period. This report focuses specifically on planning and preparation efforts for the expansion of district heating systems. It does not include resource utilization related to the construction, operation, or administration of district heating systems. The 24 counties in Denmark played only a minimal role and has therefore not been a part of this study.

Lastly, the report describes key energy policy measures implemented during the period, providing context for the transformative changes that shaped Denmark's district heating sector between 1979 and 1989.

Inclusion of contemporary case studies

To provide a modern perspective and establish a basis for comparison, the report also includes two contemporary case studies:

- Holbæk Municipality: This case highlights the employee resources and tasks required for heat planning in a municipality about to establish a heat network in a medium sized town using gas today.
- Bjæverskov District Heating: This case describes the establishment of a new district heating system in a former natural gas area, including the creation of a new cooperative district heating company.

These two cases demonstrate how district heating projects are planned and executed today, offering valuable insights into how processes and resource allocation have evolved since the 1980s.

DATA OVERVIEW

Data collection

The findings presented in this report are primarily based on interviews conducted with individuals who were actively involved in the establishment and expansion of district heating systems during the period 1979–1989. In total, 21 individuals were interviewed, all of whom had significant experience working on district heating projects during this pivotal decade. Additionally, the existing literature from that period was assessed to supplement the interview data.

Challenges in data availability

It is important to note that the period in question occurred more than 40 years ago, and detailed statistical data from that time is either limited or entirely unavailable. For instance:

- District heating plant and network investments during the period lack comprehensive records.
- The number of employees engaged in the establishment and expansion of district heating is not well-documented.

This report specifically focuses on the resources allocated to sector growth and development rather than the total workforce involved. As a result, the findings rely heavily on interviewees' recollections and estimations.

Validation of findings

To ensure the quality and relevance of the data:

- The methodology and numerical estimations were validated by cross-referencing information provided by multiple interviewees. Where there was agreement among several individuals, the data was deemed reliable.
- The author has drawn on personal experience in the field and incorporated insights from an ongoing peer review process to enhance the accuracy of the findings.



DATA: PEOPLE ON THE INTERVIEW LIST

All are people who have been involved during the specified period or have knowledge of it. Every effort has been made to find people from different organizations and backgrounds. Interviews, data collection and report drafting was done by Astrid Birnbaum, former Københavns Energi (now HOFOR) and Høje Taastrup Fjernvarme.

Thanks to:

Name	Company	Name	Company
Anders Dyrelund	Rambøll	Lars Gullev	VEKS
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Else Bernsen	former COWI	Morten Abildgaard	Viborg Fjernvarme
Erik Wolff	Sønderborg Fjernvarme	Nils-Aage Gregersen	former Aalborg Varmeforsyning
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Jacob Worm	PlanEnergi	Thorkild Kjærsgaard	former Skanderborg Fjernvarme
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Jane Stampe	former Aalborg Kommune	And others...	
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CONTEXT

This chapter contains the following:

- Exploration of the Danish district heating expansion from 1903 - 1989
- Understanding of the development of district heating before 1979
- Presentation of the key events in 1979 that reshaped Denmark's energy landscape

THE START OF DISTRICT HEATING IN DENMARK

District heating development in Denmark (1903 – 1989)

District heating in Denmark began as early as 1903. In urban areas, district heating gained popularity from the 1920s onward. Heat sources was mainly surplus heat from electricity production and waste incineration, supplemented by oil and coal. This development was mainly in the large cities.

Until the 1960s the industry saw smaller growth. Thereafter a significant growth in number of companies in the smaller cities occurred due to the availability of inexpensive bunker oil on the global market, leading to lower heat prices. By the 1970s, approximately 300 district heating companies were operating across Denmark.

The larger district heating systems were primarily integrated into the municipal organization, e.g . The utility company. The vast majority of the district heating companies were cooperatively owned by consumers.



Picture: Frederiksberg Utility, the first district heating plant in Denmark.



DANMARK AND THE EXPANSION OF DISTRICT HEATING

Population and structure in Denmark (1979)

In 1979, Denmark had an approximate population of 5 million. At this time, the country was divided into 24 counties and 271 municipalities.

Heat sources

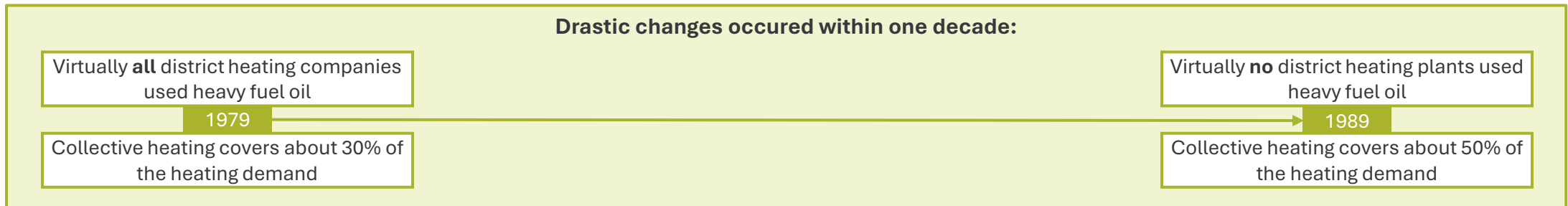
The choice of fuel for district heating companies was driven largely by cost. For cooperatively owned plants, cost competition with alternatives was significant. Although environmental and import factors began to play a role, cost remained the primary driver for the end consumers.

By 1979, nearly all district heating companies relied on heavy fuel oil as their main fuel due to its low cost. However, over the next decade, this reliance on heavy fuel oil shifted dramatically. By 1989, heavy fuel oil had been nearly eliminated, with district heating plants transitioning to other fuel sources mainly waste and coal and later in the period straw and natural gas.

Rollout and expansion of district heating

District heating saw steady growth since its inception in 1903, with an accelerated expansion in the 1960s. By 1979, district heating and other collective heating solutions covered about 30% of the heating demand for buildings in Denmark.

The following decade saw the enactment of a new heating act, which spurred further growth. By 1989, collective heating, which included district heating and some use of natural gas, accounted for 50% of the total heat demand in buildings. This conversion largely replaced individual oil boilers, and the overall heat demand continued to rise during this period.



DISTRICT HEATING IN DENMARK: PRE-1979 DEVELOPMENTS

The energy landscape before 1979

The period leading up to 1979 was marked by two significant global oil crises, which had profound implications on energy supply and necessitated a fundamental shift in Denmark's energy infrastructure. Oil shortages and rising prices highlighted the urgent need for reliant energy solutions. A key focus during this time was to drastically reduce dependency on imported energy especially oil, both for district heating production, for individual heating systems and for general use.

Policy and strategic initiatives

The primary policy objectives aimed at ensuring energy independence from oil, securing supply stability, and integrating Danish natural gas into the national energy mix. To achieve these goals, Denmark began the development of a multi-tiered energy supply system, which included both expanding existing district heating networks and building new natural gas infrastructure to meet increasing demand.

A series of crucial energy policy measures were introduced prior to 1979, laying the groundwork for these transformations:

- Establishment of the Danish Energy Agency: In 1976, the Danish Energy Agency was created to coordinate the country's energy policy and initiatives. This marked a significant step in managing the country's transition towards more reliant energy solutions.
- Electricity Supply Act of 1976: This legislation mandated that all new power plants be designed as CHPs. Existing plants were required to convert to CHP operations, utilizing surplus heat from electricity production to support district heating networks. This move aimed to leverage heat more efficiently for urban areas.
- Preparatory work for District Heating Expansion: Significant efforts were undertaken to prepare for the effective use of surplus heat from central CHP plants, both existing and newly constructed. New district heating transmission systems were planned and developed in larger urban centers, to ensure widespread and efficient heat supply.
- Preparation of Heat Supply Act: The Heat Supply Act set forth specific objectives and frameworks for the nation's energy system, aiming to create a robust and reliant energy framework. These efforts were supported by collaborations between the Danish Energy Agency, municipal authorities, energy companies, and the district heating sector. Experts and consultants played an essential role in these collaborative discussions, focusing on integrating Danish natural gas into the broader energy system effectively.

In addition, in 1979, Denmark made a decisive policy resolution to exclude nuclear power from its future energy strategy. This move reaffirmed the country's commitment to reliant, independent energy sources, reinforcing its transition towards alternative energy solutions. This foundational work laid the groundwork for the comprehensive district heating system Denmark expansion in the subsequent decades, shaping a resilient energy future for the country.

KEY EVENTS IN 1979: SHAPING DENMARKS ENERGY LANDSCAPE

In 1979, Denmark's energy policy became a central focus, driven by growing political interest in the regulation and oversight of the energy sector, particularly district heating. This marked a significant turning point toward increased government intervention, with the goal of ensuring stability and long-term resilient in energy supply.

Major policy changes and initiatives in 1979

- **Creation of the Ministry of Energy:** The Danish government established the Ministry of Energy, signifying a dedicated focus on energy policy. The Danish Energy Agency, which was initially part of the Ministry of Trade, was relocated to the new Ministry of Energy. Denmark became the first country in Europe to appoint a dedicated energy minister, demonstrating the country's commitment to tackling energy challenges through specialized leadership.

Legislation passed

- **The Heat Supply Act:** This pivotal piece of legislation laid the groundwork for the future development and regulation of district heating systems, promoting a more organized and standardized approach to collective heating.
- **The Construction Act for Natural Gas Supply:** This law established the framework for the development of natural gas networks across Denmark, marking the formal entry of natural gas into the country's energy mix. It also led to the creation of four regional gas companies tasked with the distribution of natural gas for residential heating.

Transition from oil-based heating: Public support for transitioning away from oil-based heating systems became widespread. This move was driven by concerns over supply security and the desire for more stable and predictable heating prices.

Development of CHPs: In 1986, a political agreement led to the creation of several decentralized CHPs, aimed at addressing the growing demand for electricity while simultaneously expanding district heating networks. These plants primarily utilized natural gas, along with renewable sources such as straw and waste, aligning with Denmark's environmental objectives and reducing fossil fuel dependency.

This pivotal year laid the groundwork for a more resilient and integrated energy system in Denmark, emphasizing energy independence, security of supply, and a transition toward renewable and alternative energy sources.

THE FIRST HEAT SUPPLY ACT FROM 1979

The Heat Supply Act

The Heat Supply Act, passed in 1979, established a comprehensive framework aimed at optimizing the socio-economic use of energy for heating and hot water supply in buildings, with a particular emphasis on reducing the energy supply's dependence on imported fuels, especially oil. The primary objective of the law was to ensure that energy resources were used efficiently, promoting resiliency and cost-effectiveness in the delivery of heating services.

A key provision of the Heat Supply Act was the principle that district heating and natural gas pipelines should not be installed within the same street or area. To avoid conflicting energy systems, the law required a division of areas, with socio-economic factors determining whether a given area would be supplied by district heating or natural gas. Typically, densely populated areas were designated for district heating, while detached house areas were allocated to natural gas supply. Areas with very low heat density were excluded from collective heating systems altogether.

The Act mandated that municipalities prepare detailed heating plans, which included an assessment of the heat demand, and a mapping of the heating methods employed in different areas within the municipality. These plans were subject to approval by the Danish Energy Agency, ensuring alignment with national energy policy objectives.

Under the Heat Supply Act, district heating supply was designated as a monopoly, meaning that no profit could be made from or extracted through the provision of district heating services. Furthermore, the law stipulated that district heating companies should be owned by the consumers who use the service, either through municipal ownership or through cooperative structures where consumers directly participated in ownership.

Municipalities were given the responsibility of overseeing heat planning within their jurisdiction, serving as the heat planning authority. In addition, municipalities were required to provide a guarantee for district heating plants' borrowing related to investments in infrastructure. This support was aimed at ensuring the long-term nature of district heating projects.

The Act also allowed municipalities the option to introduce a connection and “stay-on” obligation for district heating, further ensuring the stability and reliability of heat supply to residents within designated district heating areas.



ENTITIES INVOLVED

This chapter contains the following:

- Presentation of all the involved entities during the expansion of district heating: Danish Energy Agency, Energy Complaints Board, Danish District Heating Association, KommuneKredit, Municipalities, District heating companies, Transmission systems
- Explanation of the respective tasks and resources that were needed for the expansion

OVERVIEW: HOW MANY FTEs¹ WERE NEEDED DURING THE EXPANSION OF THE DISTRICT HEATING SECTOR

General comments

Based on the interviews we matched the knowledge of our interviewees with the available insights and data. The following table shows an overview of how the different entities used human resources during the time of expansion of the district heating sector in Denmark. The estimations have been cross-referenced and checked against the information provided by multiple interviewees. Details can be found in the following pages.

Entity	FTEs Internal	FTEs External
Danish Energy Agency	30	NR
Energy Complaints Board	1-2	<1
Danish District Heating Industry Association	11	-
KommuneKredit	<1	-
Municipalities	<1	<1
District Heating Companies (small/ medium/ large)	0.3 2 8	2 3 4
Transmission companies	few	24-63

¹ | FTEs (full time equivalent) refers to a full-time employee at that time

ENTITIES INVOLVED

THE DANISH ENERGY AGENCY

Tasks and responsibilities:

The Danish Energy Agency was tasked with a range of responsibilities to support the Ministry of Energy in the implementation and regulation of energy policy, particularly in relation to the Heat Supply Act. One of its primary roles was to assist in the development of legislation and prepare guidelines based on the provisions outlined in the Heat Supply Act. These guidelines were essential in ensuring consistent and effective implementation of the law across the country.

A significant responsibility of the agency was to assess the heating plans submitted by municipalities. This involved engaging in a collaborative dialogue with local authorities to evaluate the proposed plans and provide recommendations for their approval by the Minister of Energy. The agency's role in this process ensured that the plans adhered to the legal framework and aligned with national energy objectives.

The agency also maintained an ongoing dialogue with municipalities to clarify the requirements for planning and to provide guidance on the content and structure of heating plans. This support aimed to assist municipalities in preparing their heating plans in compliance with the Heat Supply Act. To facilitate this process, three heating offices were established, each covering a specific geographical area. These offices operated as "travel teams," traveling across the regions to offer direct, on-the-ground assistance and advice to local authorities.

In addition to its work with municipalities, the Danish Energy Agency continued to collaborate with various stakeholders, including electricity companies, gas providers, and district heating companies, through the Heat Plan Committee. This committee played a crucial role in coordinating efforts related to the utilization of (CHPs and the establishment of district heating transmission networks, further supporting the expansion and optimization of Denmark's collective heating infrastructure.

Resources:

To carry out these tasks, the Danish Energy Agency allocated approximately 30 FTEs per year, drawing on its staff of employees to provide the necessary expertise and resources for effective implementation and oversight.

FTE's / year:

30

ENTITIES INVOLVED

ENERGY COMPLAINTS BOARD

Tasks and responsibilities:

In 1982, the establishment of the Gas and Heat Price Committee marked an important development in Denmark's energy regulation. This body, which later evolved into the Energy Regulator or Utility Regulator, was tasked with resolving disputes related to the supply of district heating and natural gas. Its primary responsibility was to protect consumer interests within the utility sector, ensuring fair practices and transparency in pricing.

One of the key functions of the Committee was to monitor heat prices, compiling relevant statistics to track and analyze price trends across the sector. This provided a basis for evaluating pricing structures and ensuring that they remained equitable for consumers.

Due to the structure of the district heating sector, where all heating plants were either municipally or consumer-owned, regulatory supervision was somewhat limited. The sector was considered "self-regulating," with the goal of maintaining as low heat prices as possible. This ownership model, which emphasized local control and accountability, was viewed as a means to ensure that the industry operated with a focus on the long-term interests of consumers, fostering a self-reliant and efficient system.

Resources:

The Committee operated with a relatively small secretariat, consisting of 1-2 FTEs per year. A "board" of seven members was established, and these members convened several times a year to review and address specific cases brought before the Committee. Their role was to oversee any issues related to pricing or service provision, offering resolutions to disputes as they arose.

FTE's / year

1-2

THE DISTRICT HEATING INDUSTRY ASSOCIATION

Task and responsibilities:

The Danish District Heating Industry Association played a vital role in the development and coordination of the district heating sector in Denmark. Its primary purpose was to safeguard the interests of Danish district heating companies and to facilitate cooperation between these, fostering a unified approach to industry challenges and opportunities.

Timeline:

- 1957 The trade association, initially known as the District Heating Association, was founded with the participation of 10 district heating companies. The Association's core objective was to disseminate and gather information on technical and economic matters of mutual interest to its members.
- 1964 By this time, the association had grown significantly, including 100 district heating plants. It began formal cooperation with state authorities and expanded its scope to include international collaboration, further elevating the association's role in shaping the future of district heating in Denmark.
- 1974 The association was renamed the Danish District Heating Plants Association (DFF). At this stage, the association broadened its responsibilities taking on a more proactive role in influencing energy policy. With the appointment of a new chairman, a new director, and a secretariat, the DFF became more focused on setting the energy policy agenda. It played a pivotal role in the "heating method committee," a body appointed by the ministry to promote and support district heating.
- 1979-89 During this period, the DFF became increasingly involved in ministerial coordination groups related to heat planning. The association's focus shifted toward being a more politically active interest organization, advocating for the position of district heating within the broader energy landscape, particularly in relation to the growing natural gas project. The chairman of the DFF emerged as a prominent figure in the Danish energy policy debate, representing the interests of the district heating sector. During this time, virtually all district heating companies in Denmark became members of the DFF. The secretariat expanded to 11 employees.
- 2005 The association underwent a rebranding and changed its name to "Dansk Fjernvarme", reflecting the continued evolution of the organization and its mission to represent and advance the interests of Denmark's district heating sector.

FTE's / year:
11

KOMMUNEKREDIT – THE DANISH MUNICIPALITY BANK

Tasks and responsibilities

KommuneKredit is the Danish municipal bank providing loans to public investments. The bank was well-established with its regulatory framework in place and has existed for 100+ years . The bank does not do any credit evaluation as it relies solely on a bank guarantee issued by the municipalities.

After a municipality has approved a project proposal made by the district heating company, the municipality also extends a loan guarantee. The loan guarantee allows KommuneKredit to issue the loan.

Resources

Kommunekredit did not have a dedicated district heating team (also the case today). Loans to district heating companies was handled by the general loan team (today staffed with less than 10 FTEs). There is no indication that the boom in district heating in the 80'ies was followed by a mentionable increase in the numbers of people involved in the loan handling. The number given below has not been confirmed by KommuneKredit and is an estimation based on the experience from that time.

FTE's / year

1?

MUNICIPALITIES (1 / 2)

Key tasks:

Under the Heat Supply Act, the municipal council or city council was designated as the heat planning authority, bearing primary responsibility for ensuring the most socio-economically efficient use of heat supply within the municipality. The key tasks and responsibilities of the municipal authority included:

- *Socio-economic heat supply optimization:* Ensuring that the heat supply system in the municipality was utilized in the most socio-economically beneficial manner, balancing costs, efficiency, and environmental considerations.
- *Mapping of heating needs and methods:* The municipality was required to create a heating plan that included a mapping of heating needs within the area, alongside an identification of the heating methods employed.
- *Coordination with regional authorities:* The municipality was responsible for ensuring coordination with the relevant county or region to align local heating strategies with broader regional plans. This coordination aimed to ensure that heating solutions across municipal borders were consistent and efficient.
- *Approval of district heating project proposals:* The municipal council was tasked with approving project proposals submitted by district heating plants for the establishment of new networks or plants.
- *Guarantee for district heating company borrowing:* The municipality was also required to provide a municipal guarantee for district heating plants' borrowing needs, ensuring financial stability for infrastructure projects based on the approved project proposal.

Administrative responsibilities:

The administrative responsibilities of the municipality (often carried out by the municipal administration) included:

- *Preparation of heating plans:* The municipality had to prepare a heating plan, determining the appropriate division of areas for district heating, natural gas supply, and areas with individual heating based on socio-economic considerations.
- *Submission of heating plans for coordination:* Once completed, the heating plan needed to be submitted to the county for regional coordination, ensuring that heating plans were integrated into broader regional strategies.
- *Socio-economic viability of district heating projects:* The municipality was responsible for ensuring that any project proposals for new district heating networks or significant changes to existing were socio-economically sound, in accordance with the heating plan. This included evaluating the financial viability of projects, ensuring the municipal guarantee was in place, and ensuring that heating prices for consumers were competitive compared to alternative heating options.



MUNICIPALITIES (2 / 2)

Resources

Municipalities typically did not have dedicated employees for these tasks. Instead, responsibilities were often assigned to existing staff handling building permits, environmental matters, or other administrative functions. As a result, municipalities often enlisted consulting engineering firms to assist with the preparation of heating plans.

The time required for preparing a heating plan and the other task varied by municipality size, ranging from 0.1 to 0.5 FTEs per year, with the assistance of external consultants. During the 1980s, heating plans were prepared over several years, and by 1989, virtually all municipalities had completed their plans.

Administrative Work: The administrative tasks associated with being the heat planning authority, including preparing recommendations for the municipal council and city council, required approximately 0.05 to 0.1 FTEs per year. These tasks were ongoing and involved regular coordination and updates to ensure compliance with the Heat Supply Act.

FTE's / year
0.1 + 0.5

DISTRICT HEATING COMPANIES (1/2)

Tasks at district heating companies:

This slide outlines the comprehensive tasks involved in the expansion of district heating, from the initial planning phase through to the final execution of the project. This process represents a comprehensive and coordinated effort to expand district heating systems, ensuring both technical feasibility and economic sustainability while meeting the needs of consumers and complying with regulatory requirements.

1. *Contribution to municipal heating plan:* Collaborating with the municipality to prepare a heating plan, ensuring alignment with regional heat supply strategies and socio-economic objectives as outlined in the Heat Supply Act.
2. *Planning for district heating expansion:* Developing a detailed plan for the expansion of district heating infrastructure, including identifying areas for coverage and establishing the scope of the project based on current and future heating needs.
3. *Dimensioning of district heating networks and organization of production:* Determining the appropriate size and capacity for district heating networks, as well as organizing the production facilities to meet the required demand efficiently.
4. *Project proposals and economic evaluation:* Preparing comprehensive project proposals, which include a thorough economic analysis. This evaluation assesses the financial viability of the district heating project from three perspectives: societal benefits, company profitability, and the impact on consumer heating costs.
5. *Obtaining approvals and regulatory permits:* Securing the necessary approvals and regulatory permits from relevant authorities, ensuring compliance with local, regional, and national regulations governing the establishment and operation of district heating systems.
6. *Approval and guarantee from the heat planning authority:* Submitting the project proposals to the heat planning authority (municipality) for approval in accordance with the Heat Supply Act. The municipality is also required to provide a guarantee for the project's financial support, particularly for the borrowing process.
7. *Financing through loans:* Taking out loans to fund the district heating project, typically through Kommunekredit, ensuring capital for the project.
8. *Design phase:* Finalizing the technical design of the district heating infrastructure, including detailed technical specifications for construction, layout, and integration into existing systems.
9. *Tendering and contracting:* Initiating the tendering process to select contractors and suppliers for the construction and implementation of the district heating project. This includes negotiating contracts, establishing timelines, and agreeing on terms of service.
10. *District heating agreements with consumers:* Establishing formal agreements with consumers, outlining the terms of district heating services, including pricing, delivery schedules, and customer obligations. At that time marketing and promotion was done only limited.

DISTRICT HEATING PLANTS (2/2)

Resources in district heating companies:

The expansion of district heating systems, encompassing the stages from initial planning to project readiness for execution, involves significant resource allocation. It is important to note that the resource consumption figures discussed herein exclude the costs associated with the establishment, operation, and administration of district heating systems. The scale and potential for district heating expansion varied considerably across individual district heating plants. These differences were influenced by factors such as the extent of the conversion of oil-heated buildings to district heating and the timing of project initiation.

Resources varying on size of district heat company:

1. Small DH-companies:

Lacking internal staff for expansion projects, smaller plants outsourced all tasks to external consultants. Many of these companies, along with medium-sized ones, did not commence district heating expansion until the late 1980s or early 1990s. This delay coincided with regulatory requirements mandating the development of decentralized CHP plants.

2. Medium-sized DH-companies

These plants maintained smaller teams for district heating expansion and consequently also relied on consultants for nearly all project activities.

3. Large DH-companies:

Large companies, such as the 10 municipal district heating plants supplied by central CHP's, initiated system expansions in the early 1980s. These plants typically employed dedicated teams, including planners, project managers, and technical experts. Despite having in-house expertise, external consultants, primarily technicians from engineering firms, were engaged to handle specialized tasks.

Post-1990, over 100 new consumer-owned district heating plants were established - small, decentralized CHP systems powered by natural gas.

The table below categorizes the 300 district heating companies into three groups, providing general estimates of annual resource consumption (internal and consultant-based) required for district heating system expansion at the initiation phase.

Table 1. Overview of FTE per year depending on the size of district heating-company

District heating company	Small	Medium	Large
Own employees:	0-0,3	1-2	5-10
Advisers:	1-2	2-3	3-6

ESTABLISHMENT OF DISTRICT HEATING TRANSMISSION COMPANIES

Establishment of transmission systems:

During the period 1982–1984, four transmission companies were established in Greater Copenhagen (CTR and VEKS), the Aarhus region, and the Fredericia area (TVIS). These companies, owned by multiple municipalities, contributed to creating some of the largest transmission systems in Europe.

The transmission infrastructure included pipelines, exchanger stations, and pumping stations, facilitating the expansion of district heating generated by central CHPs and waste incineration facilities. This system supplied district heating across more than 30 municipalities, where local district heating plants distributed the heat to end consumers.

The establishment of these transmission systems involved significant investments and marked a critical milestone in the widespread adoption of district heating based on CHP. The projects, executed following the approval of heating plans in the early 1980s, were a cornerstone for district heating expansion during the 1979–1989 period.

Investment and infrastructure overview:

The table below outlines the investment and infrastructure scale for the four transmission companies:

Table 2. Investment and infrastructure scale of four transmission companies

Company	Investment (in DKK)	Pipeline Length (in km)
Aarhus	2.0 bn	100
TVIS	1.4 bn	70
CTR	3.0 bn	54
VEKS	2.4 bn	100

Resource consumption

Resource allocation for the planning and execution readiness of these projects is estimated based on investment size, consultation with experts, and interviews with professionals involved at the time. Key insights include:

- Estimated FTE's: Total resource use ranged between 24–63 FTEs per year over a three-year design period, varying by project scale.
- Consultant involvement: Approximately 10–15% of the total investment was allocated to external advisors, with 4–5% dedicated to project planning and design.
- Hourly rates and effort: Consultant services were billed at an hourly rate of DKK 500, with a typical workload of 1,600 hours annually per consultant over the three-year project timeline.

Observations: At the time, transmission companies had limited internal staffing for these projects, relying extensively on consulting engineering firms for design and technical tasks. This outsourcing was pivotal to completing these large-scale infrastructure investments efficiently.

FTE's / year
24-63



CASE STUDIES

This chapter contains the following cases from today:

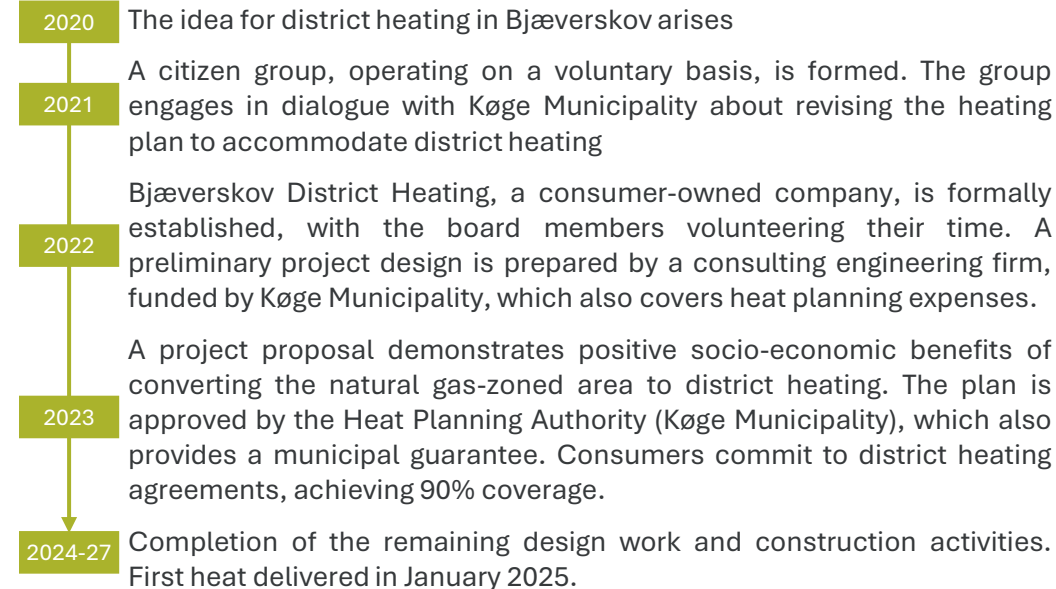
- Bjæverskov Fjernvarme a.m.b.a. - new district heating company
- Holbæk Municipality

CASE 1: BJÆVERSKOV FJERNVARME A.M.B.A. - NEW DISTRICT HEATING COMPANY

Establishment of Bjæverskov District Heating Company

This case outlines the timeline and resource consumption associated with the establishment of a newly formed consumer-owned district heating company in Bjæverskov, a town with approximately 1,000 homes under Køge Municipality. The project aimed to transition the area from natural gas, as designated by the heating plan, to district heating generated from surplus heat (from the transformer station), an air-water heat pump, and an electric boiler.

Timeline of events



Resources allocation

1. Formation of the Company:
 - Accountant and legal services: ~50 hours.
2. Planning and Desing:
 - Consultant involvement to date: ~1.5 FTEs per year over 2.5 years.
 - Estimated additional resources for the remaining design phase: ~1.5 FTEs per years.

Key observations

- The project benefited from strong community engagement, with substantial voluntary contributions from the citizen group and company board members.
- Financial and technical support from Køge Municipality was critical to the project's progress, including heat planning, project funding, and providing a municipal guarantee.
- The high consumer commitment (90% coverage) highlights the community's positive reception and willingness to transition to a more resilient heating solution.

FTE's / year
2

CASE 2: HOLBÆK

Initiation of Holbæk's district heating

Today, virtually all municipalities in Denmark have areas zoned for district heating according to their heating plan. Holbæk municipality (approx. 75,000 inhabitants) is one of the few municipalities in Denmark that does not have district heating company in its largest town.

In accordance with the political goal of phasing out natural gas for residential heating, Holbæk Municipality has in 2022 updated their heating plan and recalculated the socio-economic consequences, with the result that there has been a changed area delimitation between district heating and natural gas, so that part of the municipality is now zoned for district heating. However, this has only been possible by the introduction of a new framework for socio-economic calculations in 2021 there the alternative heat source is now individual heat pumps.

The design, layout, technical specifications etc has been handed over to the local utility company. The FTEs used by them to make the project ready for implementation is not included in the FTE numbers.

Resources

Heating plan update: 0.5 FTEs for one year.

Consultant: 0.1 FTEs for one year.

FTE's / year

0,5 - 1

The report shows the tasks of different organizations, and the people resources used for the transformation in Danish district heating in period from the first heat law in 1979 to 1989.

It is important to emphasize that the numbers are very much influenced by Danish framework conditions and the stage of development found in the industry at that time. Denmark already had 30% heating from district heating, an established municipal bank etc., but had to establish the Danish Energy Agency and other institutions. It is therefore important to understand the background and situation in Denmark prior to making any comparisons to the developments seen in other countries today.

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