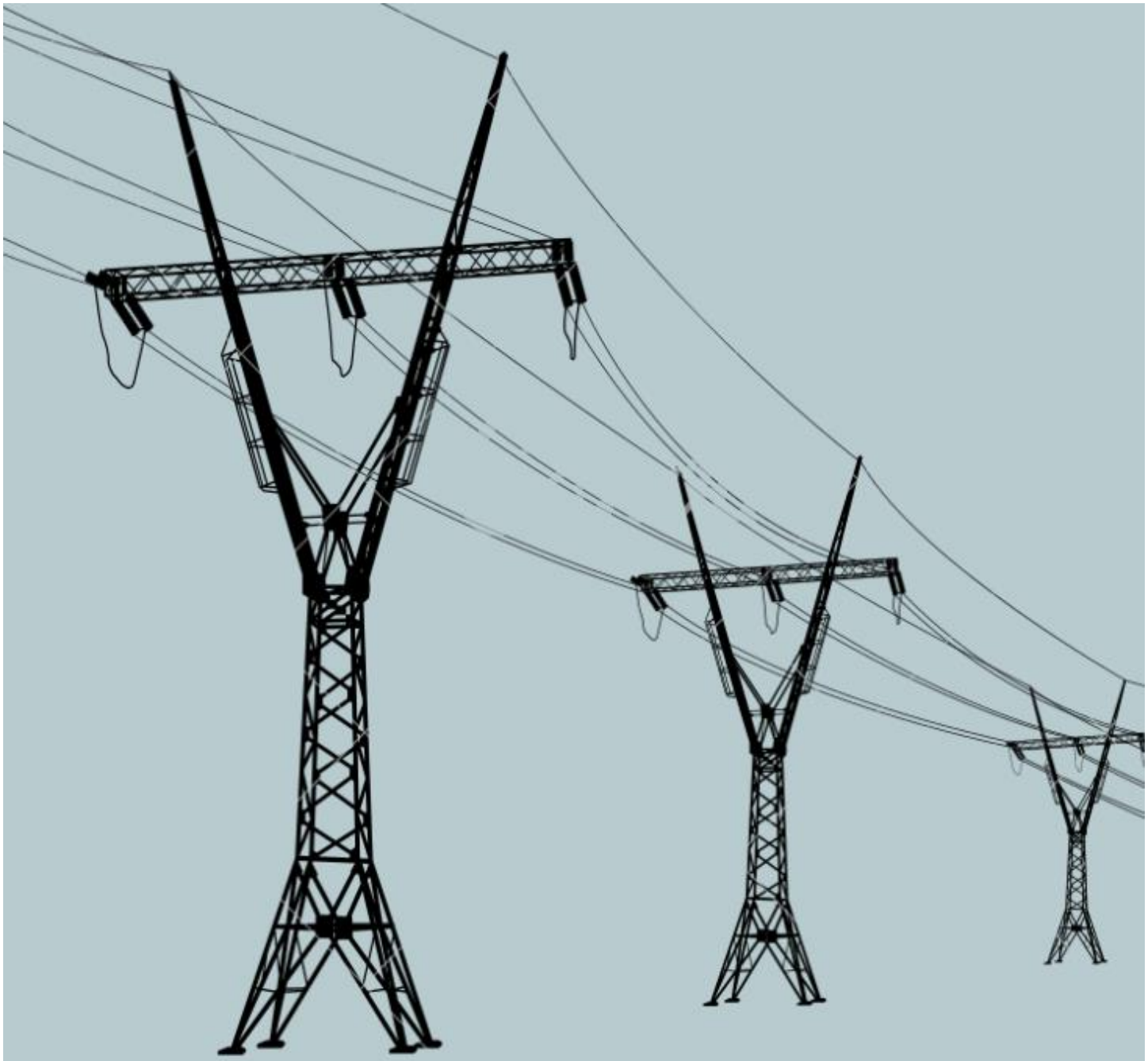

Master's Thesis

Evolving Energy Conditions and Their Impact on Municipal Energy Planning and Grid Development with a case of Aarhus and Thisted

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Abstract

This thesis explores how evolving structural conditions have shaped the role of municipal energy planning in Denmark, with a case of Aarhus- and Thisted Municipality. It examines how strategic energy planning (SEP) approaches can account for electricity grid development, and how institutional and regulatory frameworks influence local planning practices.

A historical analysis of Aarhus Municipality's planning practices reveals a path dependency shaped by structural conditions, leading to institutional path dependency, and a misalignment between municipal energy planning and electricity grid expansion. Fragmented governance and regulatory inertia limit municipalities' ability to coordinate with electricity grid infrastructure actors, and plan holistically. Through a comparative analysis, Thisted Municipality demonstrates how local adaptation of SEP practice, with tools such as spatial zoning, and early stakeholder involvement, can support integration of energy infrastructure. However, differences in local conditions, and the voluntary nature of SEP, mean such approaches are not directly transferable.

The thesis concludes that enabling municipalities to act as strategic actors in the energy transition requires improved coordination, clarified institutional roles, and adequate resources, alongside broader governance reforms.

Summary

The central problem addressed in this thesis is the lack of integration of electricity grid considerations in municipal energy planning. This issue persists despite a national ambition to empower municipalities through the introduction of Strategic Energy Planning (SEP) back in 2012. However, the voluntary nature of SEP has limited its impact. NEKST, a politically appointed working group, has also highlighted municipal shortcomings and recommended stronger collaboration with grid operators. The problem analysis identifies weaknesses in the legislative framework and insufficient collaboration between municipalities and Distribution System Operators (DSOs) as key contributing factors.

To explore the issues, the thesis first examines how evolving structural conditions have shaped the role of municipal energy planning in Denmark, with the case of Aarhus Municipality. This is followed by an analysis of Thisted Municipality, who have strategic planning as a more integrated part of their planning. This aims to assess how different municipal approaches support or hinder coordination with electricity grid development. The research question is as follows:
How has the role of municipal energy planning in Aarhus Municipality been influenced by the conditions for energy through time, and how do the strategic energy planning approaches of Danish municipalities, as seen in Aarhus and Thisted, accommodate for electricity grid development?

To address the first part of the question, a historical analysis of Aarhus Municipality's energy planning is conducted through a document analysis, based on official planning documents on a national- and municipal level, as well as the legislative framework that has governed energy planning over various time periods. This is complemented by preliminary interviews with DSOs as well as a planner in Aarhus Municipality. This analysis reveals the path dependency grounded in early structural conditions, leading to regulatory inertia and a misalignment between municipal energy planning and electricity grid expansion. The previously set legislative structures remain an influence on today's planning in Aarhus Municipality, resulting in fragmented governance and limited capacity to coordinate strategically with electricity grid operators.

This institutional rigidity hinders holistic planning, despite municipalities' crucial role in achieving national energy transition objectives.

For answering the second part of the research question, a comparative study of Thisted- and Aarhus Municipality is carried out. This includes a document analysis and two interviews—one with the director of Thisted's DSO and another with an AAU researcher who developed a SEP framework. This section aims to understand the relation, or lack thereof, between Thisted Municipality and its DSO and how local adaptations of SEP practices, and citizen engagement can support the integration of electricity infrastructure. In contrast to Aarhus Municipality, Thisted Municipality exemplifies how tailored local approaches, such as the Thy-model that includes spatial zoning and early stakeholder involvement, can overcome regulatory constraints and enhance cross-sector coordination. However, differences in local conditions and the voluntary nature of SEP limit the direct transferability of Thisted's methods to Aarhus.

The thesis concludes that enabling municipalities to act as strategic actors in the green transition requires more than improved planning tools and regulatory adjustments. It also demands sufficient resources to support municipalities in adapting to the expanded scope of energy planning. The study highlights several strategic priorities including enhancing cross-sector coordination, clarifying institutional roles, and providing the necessary financial and human resources to integrate electricity grid considerations effectively into municipal planning. These reforms are essential for aligning local planning efforts with national energy ambitions and ensuring a more coherent and proactive energy transition at the municipal level.

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Abbreviations

HI: Historical institutionalism

RE: Renewable energy

RES: Renewable energy sources

NUP: Network development plan

LUP: Long-term development plan

TSO: Transmission system operator

DSO: Distribution system operator

SEP: Strategic energy planning

PV: Photovoltaics

CHP: Combined heat and power

KAT: Climate Alliance Thy

NEKST: National energy crisis staff

1. Introduction

In June 2020, the Danish Government adopted the Climate Act, pledging to cut CO_2-emissions by 70% in 2030, and set an additional goal, in the Foundation of Government, of reaching carbon neutrality by 2045 (KEFM, 2021, p. 6). This requires a comprehensive transition of all sectors, but especially the energy sector is fundamental, as electrification of other sectors is a stepping stone by out-phasing fossil fuels (KEFM, 2021, p. 6). Electricity from renewable energy sources (RES) are the key substitute to fossil fuels in all sectors, including transportation, households, industries, and the heating sector. The Danish Energy Agency estimates the reduction potential of the total Danish emissions, from a full electrification, to be 60 %, corresponding to 28 mio. tonnes CO_2 (KEFM, 2021, p. 8).

To secure the transition, both production, transportation, and the use of electricity from RES must grow rapidly and simultaneously, leading to a higher necessity for electricity grid expansion. Currently, several parts of the transmission lines have reached their maximum capacity, due to the demand increasing very rapidly over just a few years (Energinet, 2024, p. 6). The Danish transmission system operator (TSO), Energinet, estimates that there is a need to expand the transmission lines with 2,700 km in 2030, and an additional 3,000-4,000 km towards 2050, which is a respectively 33% and 37-49% increase (Energinet, n.d., A).
However, the expansion of the electricity grid is not happening at the necessary speed and is currently one of the biggest barriers for a full electrification (Energinet, 2024, p. 6). In 2025, 98 out of the 174 planned expansion of the electricity grid are delayed due to the long process of expansion, with an average of 1.3 years extra (Green Power Denmark, 2025). This threatens the politically binding national Climate Act, and thereby the mitigation of climate change.

Due to the need of rapidly implementing and expanding the electricity grid, the Danish Government established the National Energy Crisis Staff (NEKST) in 2023, an expert group with actors from across the value chain in the energy sector, to identify barriers and present their recommendations to the Danish Government (KEFM, 2023). They are working with the overarching interest of how to ensure that electrification won't be halted by the barriers in the existing structures and planning processes (KEFM, 2023).

The expert group came out with their first recommendations, for a faster expansion of the electricity grid, in December 2024, which contains three focus areas (NEKST, 2024, p. 17). These focus areas include streamlining and shortening application processes, closer collaboration between actors, and reducing pressure on the electricity grid, through flexibility and efficiency optimization (NEKST, 2024, p. 17). The three focus areas have a wide spread of perspectives, emphasizing the complexity of the task to secure the necessary electricity grid capacity (NEKST, 2024, p. 18). Of the three focus areas, NEKST highlights collaboration as essential. Not only as a value in itself, but also as a prerequisite for the success of the other two focus areas. In each step of the process, actors are required to contribute and put an effort into enabling other actors to complete their task efficiently (NEKST, 2024, p. 18). NEKST suggests that municipalities and DSOs should communicate more effectively and share information to support municipal planning of the electricity grid (NEKST, 2024, p. 44). According to NEKST, municipalities should consider electricity grid infrastructure early in their spatial planning, so a necessity for areas will be clarified early on and won't be a hindrance later for realizing energy projects. This will also result in a better understanding among municipalities, on what their role in the expansion of the electricity grid is (NEKST, 2024, p. 44). Currently, the municipalities interpret their responsibility differently, leading to incoherent planning of electricity grid infrastructure between municipalities (NEKST, 2024 p. 23).

Actors have different roles and considerations to take, leaving a possibility of conflicts of interest, therefore making collaboration essential (NEKST, 2024, p. 18). In the current state of planning, NEKST have identified this as a lacking parameter amongst actors as the transparency of the process and awareness of individual needs are unclear. The consequences of silo planning are that the factual demand isn't covered sufficiently ahead of time due to a lack of dialogue, and knowledge sharing across the value chain (NEKST, 2024, p. 18). The reasons behind the communication issues are ambiguous, and must be researched through actors' different roles, purposes, and the current legislation on planning related to the electricity grid.

2. Problem Analysis

The issues of ensuring the electricity grid's expansion were illuminated at an expert meeting at the Parliament on the 7th of November 2024, where three experts were invited (KEF, 2024). The meeting was arranged in continuation of the political desire to accelerate the expansion of the electricity grid. There were, an energy planner from Aalborg University and board member at NEKST, a representative from Energinet, and a representative from Erhvervshus Nord, presenting the issue from different perspectives. According to the energy planner, municipalities are key actors in energy planning, but there is considerable planning-related uncertainty within them (KEF, 2024). They do not have clear knowledge of the existing electricity grid capacity, yet they are responsible for creating energy plans and ensuring their implementation. Consequently, they are making plans without aligning capacity and supply, which poses a significant challenge for coordination in long-term planning (KEF, 2024). Furthermore, municipalities that are not dimensioned with the necessary transmission lines risk being disconnected from the green transition. The same challenge applies to the industry, which is dependent on whether they can be supplied with sufficient energy.

Currently, there are no prospects for clear national guidelines regarding the available electricity grid capacity at the municipal level (KEF, 2024). This lack of clarity can weaken municipal planning, which is simultaneously constrained by its own legally binding climate, energy, and land-use objectives. As a result, this may lead to discrepancies between municipal priorities and national energy planning goals.

2.1 Media Coverage of Electricity Grid Expansion

Besides NEKST, the Danish media have covered the issue of expanding the electricity grid within the necessary timeframe. With a point of departure in the media coverage of electricity grid expansion in Denmark, a literature review has been conducted for an overview of how the issue has been addressed and to what extent. To do so, a comprehensive search was performed across all Danish news media, using the keyword "elnet" translated to electricity grid.

Based on the articles with relevance to the scope of the thesis, five main themes were identified as common challenges for the electricity grid expansion: 1) Economic pressure, 2) Regulation and legislation, 3) Collaboration and communication, 4) Market and industry, and 5) Technological advances. The literature review can be found in Appendix F.

In the figure below, the occurrence of the five main themes is illustrated:

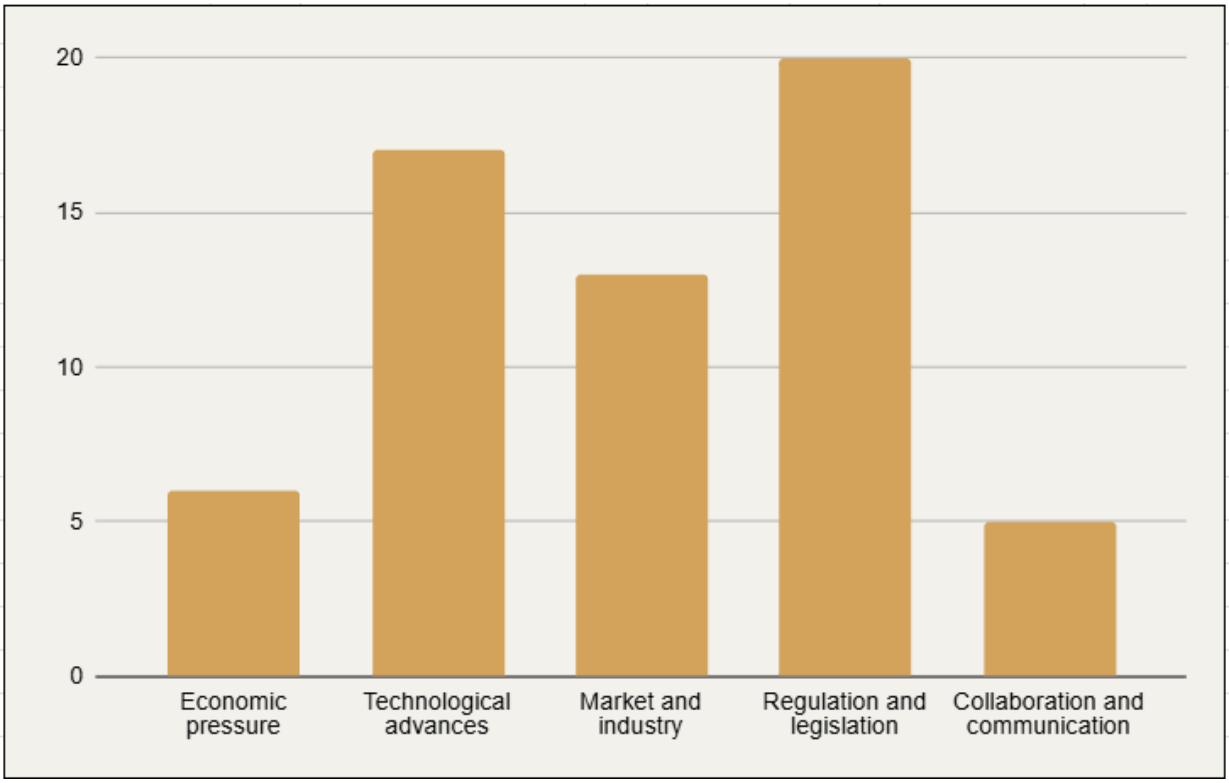

Figure 1: Occurrence of mentioned challenges regarding electricity grid infrastructure in Danish media (own figure).

From the categorization of the challenges, it is evident that the current legislative framework is the most prevalent obstacle mentioned in the Danish media. Following that is the technological advances. A prominent voice in the Danish media is actors in the industry, pushing for a political focus on the issue of investors being reluctant to invest in the energy system, as nothing seems clear for investors of whether or not a return is secured (Appendix, F). Additionally, the current infrastructure and legislative framework do not ensure favorable conditions for investors in energy projects. From a market perspective, there is a need for a guarantee before investments can be made.

These challenges are therefore addressed from a standpoint of needing more transparency for actors who are interested in investing in energy sources, or want to start industries, and in turn, create a higher supply or demand, in which they will be dependent on electricity grid expansion.

The perspective of collaboration and communication is not prevalent, in spite of being a key aspect that the NEKST-group identified as being necessary to strengthen when ensuring a sufficient expansion of the electricity grid. Furthermore, the perspective of collaboration and communication is solely presented by directors of DSOs, who emphases how the actors who perform the different municipal and national energy goals, are in need of some better collaboration with DSOs to realize what is expected of them long-term. They highlight that there is a lack of knowledge of the long-term prospects of the electricity grid, which is emphasized in the way that it is written about, where the mentioning of the electricity grid is followed by an uncertainty about whether or not electricity grid expansion plans will be realized (Appendix F). The lack of different actors mentioning collaboration and communication in the articles, also emphasis the lack of awareness of what the NEKST-group recommends. Furthermore, the way challenges for the electricity grid expansion are covered in Danish media doesn't point towards a clear actor to overcome these challenges. Due to the main obstacle identified in Danish media being the current regulations and legislation, it is relevant to look into what the current framework is for energy planning in the municipalities.

2.2 Municipalities' Role in Securing Electricity Grid Expansion

Municipalities can ensure electricity grid expansion by ensuring efficient case processing and coordination through its different roles (Green Power Denmark, 2025, p. 6). The first one is with the role of a landowner. Electricity grid infrastructure requires space with both laying new cables and building new transformer stations. These are often crossing municipal owned land, and cooperation of municipalities are determining for how quickly infrastructure is built and new energy facilities are connected (Green Power Denmark, 2025 , p. 6). Besides this, municipalities can secure space for future electricity grid infrastructure ahead of time, which requires new power installations and electricity grid expansion (Green Power Denmark,2025 , p. 7).

When planning new residential or business areas, combined with a rising consumption of electricity from e.g. EV and heat pumps, it is essential to allocate space for the required electricity grid infrastructure. An important planning element to ensure this is local plans. Early dialogue with the local DSOs can help clarify land needs, allowing this to be included in local development plans. Electricity grid expansion may require a new transformer station, typically needing a minimum of 15 m^2 (Green Power Denmark, 2025, p. 7). A municipality can relieve pressure on the electricity grid, through energy efficiency measures on public buildings (Energistyrelsen, 2013, p. 33).

A municipality also has the role as a public authority with the responsibility of processing the application of various energy projects, as well as making assessments of the project based on their own municipal guidelines, and legal framework for the spatial planning (Green Power Denmark, 2025, p. 11). This also includes making environmental assessment, if the project requires it.

The last role consists of acting as a cohesive actor that can take on a facilitating role to strengthen collaboration between actors (Green Power Denmark, 2025, p. 10). Municipalities are equipped with knowledge of planning, which can be crucial for the DSOs to know of. Therefore, the role of the municipalities also lies in securing information sharing, with relevant actors. An early dialogue about the expected supply and demand to come could strengthen the DSOs' work with expanding the electricity grid (Green Power Denmark, 2025, p. 10).

To further explore the municipal role in energy planning in action, the case of Aarhus Municipality is introduced. From a planning perspective, Aarhus Municipality is currently in the works of forming several new long-term plans for framing the development of energy. This makes exploring their planning practices during a long time span interesting, as these are essential to ensure an electrification of their territory. Here, electricity grid expansion is a determining factor, as the motion of the increasing energy demand and supply will depend on it. As NEKST have pointed towards municipalities to be the collaborative facilitator, it is interesting to examine whether Aarhus Municipality is aware of their responsibility in ensuring proper electricity grid infrastructure.

This will be done through an analysis of their upcoming climate strategy, an interview with a municipal planner involved in the energy and climate plans, and interviews with the local DSOs in Aarhus Municipality, who are working to realize the political energy goals. Coordination and communication are therefore unfolding in real time during this research, providing favorable conditions for their exploration.

2.3 Aarhus Municipality as a Case Study

In April 2024, The City Council in Aarhus adopted a climate strategy for Aarhus 2025-2030, reaffirming its 2008 commitment of making Aarhus Municipality CO_2-neutral by 2030 (Aarhus Kommune, 2025, p. 4). A central aspect of the plan is the energy sector, where the municipality aims to transition to RES and reduce dependence on biomass (Aarhus Kommune, 2025). To ensure a stable energy supply, Aarhus Municipality will significantly expand solar and wind power capacity. The ambition is that 1,600 hectares of solar panels (PV) and an additional 8 wind turbines, will be established (Aarhus Kommune, 2025, p. 21).
With this timing of an electrification strategy taking point of departure in the conditions today, it is relevant to look at from a planning perspective. While Aarhus Municipality set the framework for achieving climate neutrality, it will only be possible through joint efforts between actors across the energy sector.
In continuation of this, Aarhus Municipality has initiated a separate plan for the energy sector spanning from 2025-2045. By 2030, a major transformation of Aarhus Municipality's energy supply must take place, as the Studstrup CHP-plant is set to close after many years of production, which has been a significant energy source for Aarhus (Sørensen, Appendix A, p. 2). The set goal of reaching climate neutrality already in 2030, as opposed to the national goal in 2045, means that the timeline for an electricity grid expansion is shorter. The transition means a higher demand for electricity, with a total expected demand in 2030 to be 2,900 GWh, compared to the 1,700 GWh demand in 2022 (Aarhus Kommune, 2024 April, p. 5). Within the municipalities' boundaries, there is therefore a need to increase energy production, as well as expand the electricity grid to follow the consumption. As their Energy Plan spans from 2025 all the way to 2045, it would require cooperation with DSOs, to take into consideration the recommendation from NEKST.

2.3.1 Electricity Grid Expansion: Roles and Responsibilities

Expansion of the electricity grid depends on several actors. This includes actors on the national level, with the Ministry of City, Land, and Church, and the Ministry of Climate, Energy, and Supply setting the overarching regulatory framework for planning on a municipal level. Additionally, the planning is dependent on actors on a regional and local level, with different responsibility areas. These actors range from having a direct influence on the development of the municipal plan, e.g. the consultancy firm NIRAS, who collaborated on Aarhus Municipality's current municipal plan, to actors who are affected by municipal planning, e.g. energy consumers (Aarhus Kommune, 2017). In the figure below, the actors involved in energy planning from the case of Aarhus Municipality are illustrated together with their interconnected relations:

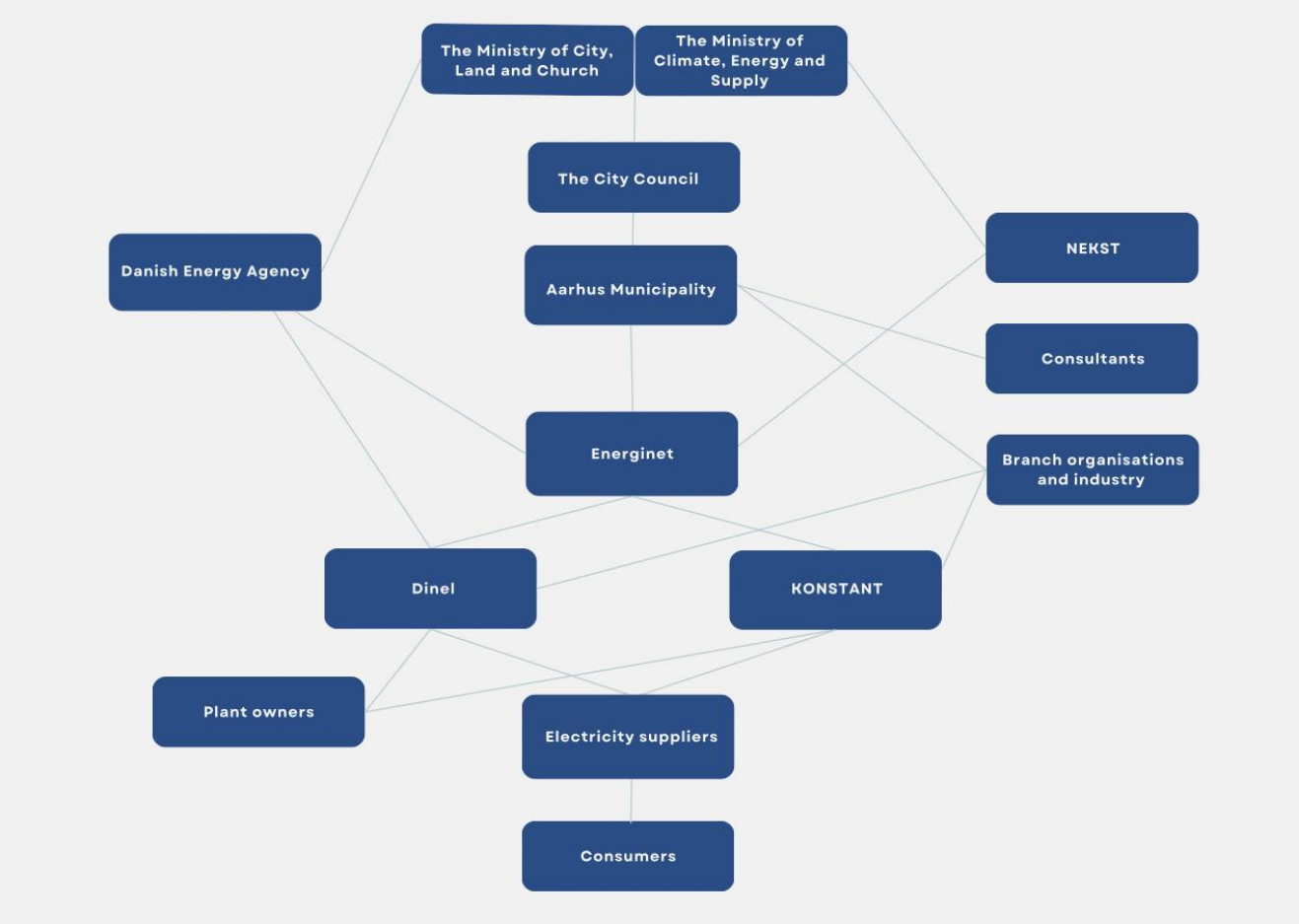

Figure 2: Overview of actors related to grid infrastructure and their interconnections (own figure).

2.3.1.1 Transmission Operator

The actor responsible for the physical part of the transmission grid is the national Transmission System Operator, Energinet, who owns the transmission lines and is responsible for securing the supply of electricity (Energinet, n.d., B). Their role regarding securing the national supply of energy is prescribed in the Electricity Supply Act (Elforsyningsloven, 2023). Regarding Energinet's role in planning the electricity grid infrastructure, this regulation sets the frame they are operating within. They are obliged to secure the necessary reconstruction and expansion of the transmission lines in accordance with transmission network planning (Elforsyningsloven, 2023, §12 stk. 2). Energinet must be separated in terms of ownership from production and trading activities (Elforsyningsloven, 2023, § 19 a). This limits their role in electrification, as they aren't allowed to operate any plants. Furthermore, their long-term planning of the electricity grid is formulated in the Danish System Responsibility Act with the requirement of publishing a long-term development plan (LUP) every second year for the expected electricity grid capacity needed to secure supply (Systemansvarsbekendtgørelsen, 2023, §12 stk. 12). The LUP describes the necessary expansion and maintenance projects for the electricity grid in a 20-year perspective and is a central element in the long-term investments in the transmission lines (Energinet, 2024).

2.3.1.2 Distribution Operators

A DSO, also called a network company, owns and manages the distribution lines that connect the transmission infrastructure to the consumer (Energinet, n.d., B). The DSOs operating in Denmark have, according to the Electricity Supply Act, a monopoly on the distribution system in their respective geographical area with a 20-year time frame (Elforsyningsloven, 2023, § 19 stk. 2). The Act also prescribes that the planning of the transmission network must happen transparently through publication of a network development plan every second year (NUP) (Elforsyningsloven, 2023, § 22, stk. 1). At the national level, 35 DSOs operate across different regions (Forsyningstilsynet, 2024). In Aarhus Municipality, the distribution lines are operated by two DSOs as seen in figure 3 on the next page.

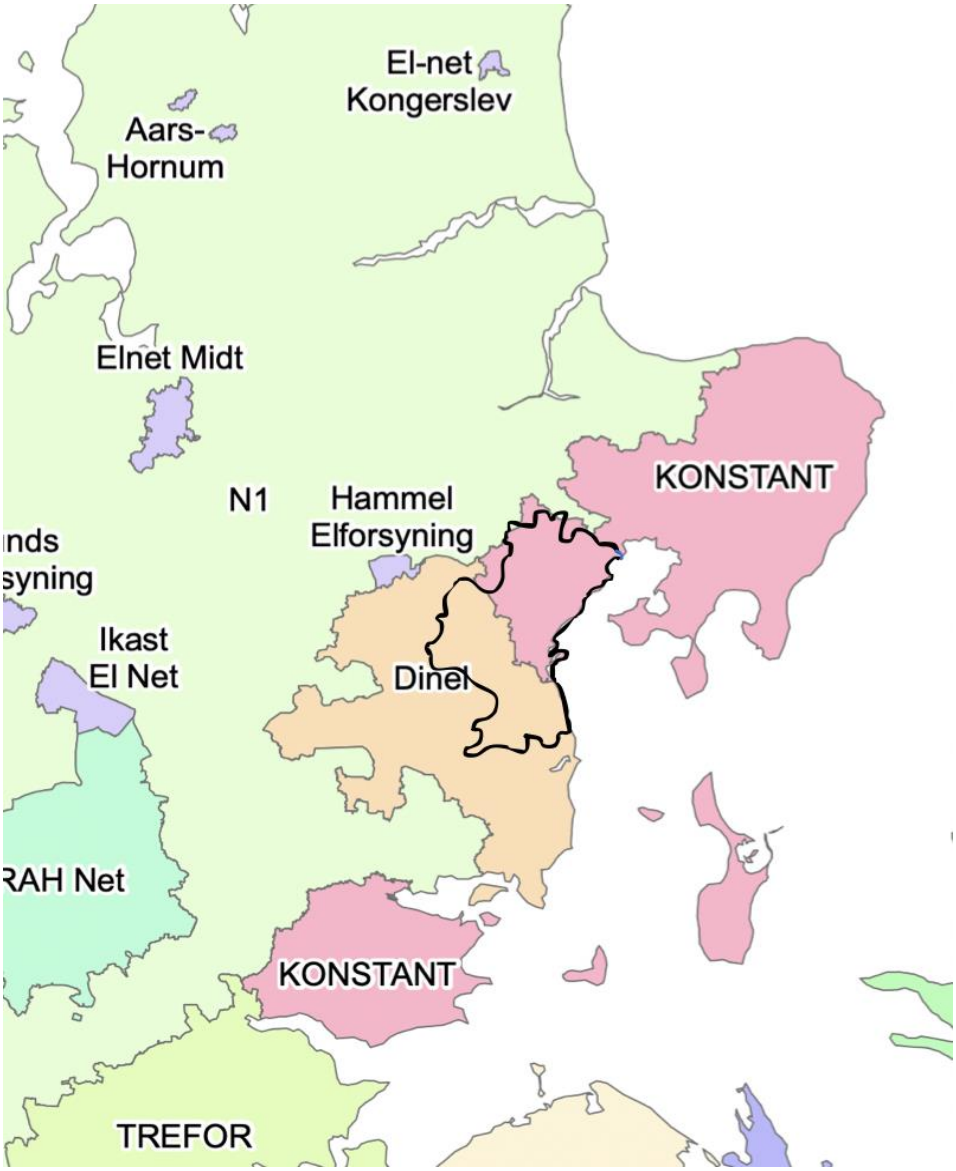

Figure 3: Overview of the two DSOs with monopoly in Aarhus Municipality, marked by the black outline (Energistyrelsen, 2022).

KONSTANT is the DSO operating in the northerly part of Aarhus Municipality, and Dinel is responsible for the southern part.

2.3.1.3 Developers

There are approximately 100,000 energy plants in Denmark, producing electricity, and these are plant owners responsible for (Energinet, n.d., C, p. 3). DSOs are the connecting link between the TSO, the plant owners, and the electricity supplier to consumers. Planning of electricity grid expansions involves all of the actors introduced above, who are in need of different knowledge at different times for their own needs and processes (NEKST, 2024, p. 4).

2.4 The Legal Framework

With a drastically elevated need for electricity grid capacity, energy planners need to combat bottlenecks prolonging the process.
To understand why the collaboration among the actors hasn't been sufficient in pushing for the necessary expansion of the electricity grid, the legal frames for planning are essential to explore.

For spatial planning in Denmark, the Planning Act determines the legal frames for how municipalities can use and manage their planning (Planloven, 2024). Furthermore, municipalities must follow the Planning Act's regulations for the municipal plans for how they plan the area's purposes. Municipalities must have a municipal plan, which covers a 12-year timeframe, stating the overall vision of its development and a main structure, illustrating the municipality's future construction (Planloven, 2024, § 11). With this, area reservations and municipal plans are politically determining what should happen within the energy sector and consequently the ambitions for energy facilities and capacity (Sørensen, Appendix A, p. 6).

The City Council is also regulated by the Planning Act, which states that they need to publish their 4-year strategy plan, within the first 2 years of their election period (Planloven, 2024, § 23 a). The strategy plan can constitute a partial revision of the existing municipal plan or a re-adoption of it, provided the election period falls within the original 12-year validity of the municipal plan. If changes are required that are not addressed by the existing municipal plan, a municipal plan supplement can be prepared to amend the framework regulations for a specific area, while still remaining within the scope of the overall municipal plan (Planloven, 2024, § 11). Furthermore, a local development plan must be adopted before any major construction, infrastructure projects, or changes in land use can be carried out, if such developments are not already in accordance with existing local planning regulations. A local plan ensures legal clarity and binds property owners to specific land use and development guidelines within a defined area (Planloven, 2024, § 13).

The organization within municipalities is determined by The Danish Local Government Act (Kommunestyrelsesloven, 2019, § 2). The law gives Danish municipalities the authority to decide their own administrative structure. The law does not mandate specific departments or their names. Municipalities are free to organize their administration as they see fit as long as they fulfill their legal obligations (Kommunestyrelsesloven, 2019, § 2).

2.5 The Current Planning Landscape

As mentioned in the recommendations in NEKST, it is a challenge for actors to know when information sharing may be relevant for other actors, as it is not clear what the individual actor needs information on. To strengthen the information sharing, the purpose of the NUP is as follows:
"Electricity grid development plans can also serve as a dialogue tool to support the coordination of electricity grid expansion at both the distribution and transmission levels, thereby contributing to a socio-economically sound development of the electricity supply network in Denmark." (Energistyrelsen, 2024, p. 6, translated from Danish).

The NUP does so by creating clarity for development needs of electricity grid infrastructure for other actors than the DSO, and the need for creating more flexibility in the system (Energistyrelsen, 2024). The data basis of the NUP is determined by the Danish Energy Agency, who makes annual analytical assumptions about the expected national energy consumption towards 2050. This data is the data, the plans must be based on (Elforsyningsloven, 2023, § 22, stk. 1). On top of that, the DSO can apply its own local knowledge of upcoming energy production to make a more precise estimation of the needed electricity grid expansion in their monopoly area.

In the figure below, the long-term plans from both Energinet, the local DSOs, and Aarhus Municipality that are directly related to or influencing the expansion of the electricity grid are illustrated.

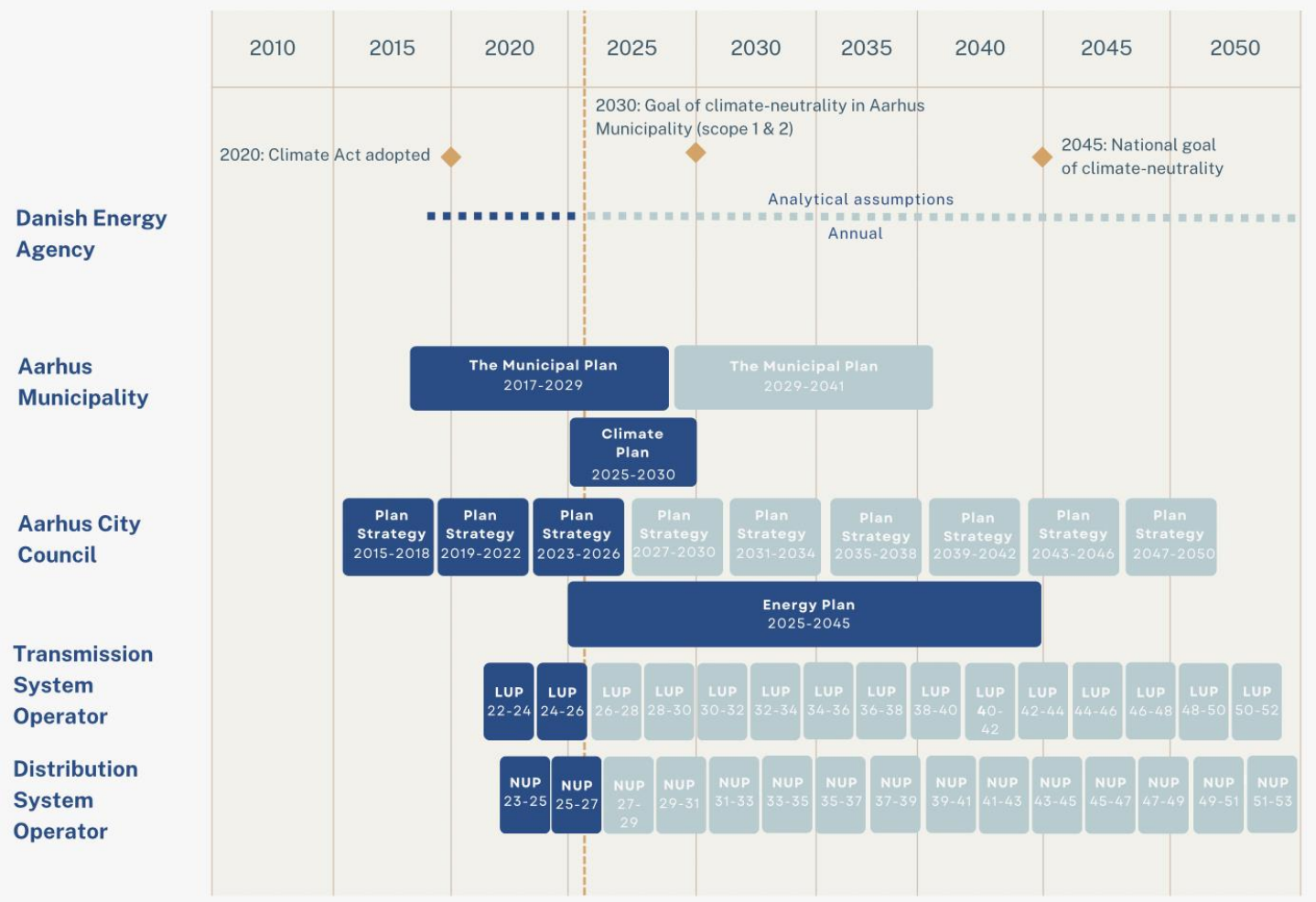

Figure 4: Timeline of publication of plans by relevant actors (own figure).

Through the publication of long-term plans from the municipality, Energinet, and local DSOs, it is possible to get insight into the alignment of their plans. Municipal plans define the overall target for the spatial division and its specific purposes. Municipal plans consist of both agreed energy projects and more unknown content. These are relevant for both DSOs, Energinet, and developers, which all are influenced by the municipalities' plans, as well as the plans depend on their contribution to realizing them. On the other hand, both plans by Energinet and the DSOs are relevant to the municipality as their long-term planning of the electricity grid gives insight into where the existing electricity grid infrastructure is placed and where they expect capacity challenges. Therefore, coordination between each actor becomes crucial for the long-term planning of electricity grid expansion.

As seen in figure 4, the publication timelines of the DSOs' plans and Aarhus Municipality's current planning strategy are not aligned with respect to the municipal energy plan, which depends on both. As seen in figure 4, the publication of the plans by the DSOs and Aarhus Municipality's current plan strategy are not aligned in regard to the municipal energy plan, which depends on them.

Through interviews with the Head of Department at KONSTANT and a senior specialist at Dinel, valuable insights into the planning practices for the electricity grid expansion and the collaborative efforts within the area of Aarhus Municipality are provided. Through the interviews, it became clear how there is an unfilled potential between the publication of plans and the actual involvement and coordination (Rørby, Appendix B, p. 8;Birch, Appendix C, p. 2).

From the perspective of the municipality, there is a planning dilemma in deciding on energy projects ahead of time when DSOs only are allowed to plan for expansions when there has been initiated a contract for a project, cf. the Electricity Supply Act (Sørensen, Appendix A, p. 5). Sørensen calls it a disparity that the municipality has the opportunity to coordinate their future projects with the DSOs ahead of time but the DSOs can't integrate it in their planning (Sørensen, Appendix A, p. 5). At the same time, the DSO also calls for better timing for the coordination and exchanging of information to each other. If the DSOs are to deliver the necessary electricity grid, the municipality has to contemplate them in time ahead (Birch, Appendix C, p. 2). Today, the DSOs are mostly involved in the process when there is a need for a new transformer station. Understanding each other's needs and the amount of time they need to plan for is essential when planning a complex system like the electricity grid (Rørby, Appendix B, p. 4).

The planning framework is a result of years of policy- and technological developments that have shaped how it is done today. Energy planning in a Danish context emerged back in the 1970's due to the oil crisis in 1973, with the first Danish energy plan in 1976, and has since then transitioned from an oil dependent energy system to ambitious goals of a renewable energy system (Energiministeriet, 1982, p. 2).

Through this development, the political, economic, and societal conditions have changed, leading to the need for the rearrangement of responsibilities and roles among actors in energy planning. From the interview with Sørensen, it was made clear that the frames of municipal planning have changed, since the 80's and 90's (Sørensen, Appendix A, p. 6). Therefore, the institutional framework defined by legislation is important to examine to understand current energy planning practices. While the legal framework guides the formal responsibilities of municipalities, the planning culture in each municipality plays a key role in shaping how the planning practices actually unfold. This leads to an investigation of the current planning practices and how this shapes the conditions for planning of the electricity grid.

2.5.1 Current Understanding of Energy Planning in Municipalities

The mentioned dilemma of a lack of collaboration puts into question whether the current practices for energy planning in Danish municipalities are favorable for supporting electrification. In 2012, there was a political focus on strengthening the collaboration among municipalities, regional-, and national planning (Energistyrelsen, 2012). Therefore, the Danish Government presented strategic energy planning (SEP) as the favorable planning practice in Denmark, for thinking more holistically (Jensen & Sperling, 2019). Following this, a project period from 2013-2015 with a funding of 19 mio. DKK was initiated by the government (Energistyrelsen, 2012). Part of the funding was to support and strengthen the cooperation between the municipalities on a national and regional level, as well as horizontally, with a focus on local businesses, industries, energy developers, and citizens.

The evaluation of the projects showed that participants in the project got a nuanced and more in-depth insight into other actors' roles and needs (Energistyrelsen, 2016, p. 12). Furthermore, it also strengthened the knowledge of each actor's options to act with an overview of the overall energy system (Energistyrelsen, 2016, p. 12).
Even though the projects showed positive results, it did not become an obligatory task for municipalities, and it is today purely up to the municipalities if they want to take on a strategic approach in their energy planning (Energistyrelsen, 2016, p. 5). It is therefore interesting to look into whether or not the usage of SEP has been implemented in the Danish municipalities.

A study done by Louise Krog Jensen and Karl Sperling in 2019, set out to explore the use of SEP in Danish municipalities, as well as how it is understood. The first academic papers in Denmark mentioned SEP in 2011 (Jensen & Sperling, 2019, p. 89). Due to the voluntary aspect, SEP was in the literature review shown not to be a widespread phenomenon in municipal planning (Jensen & Sperling, 2019, p. 85). Part of the literature review also looked into the Danish usage of SEP in planning documents to seek an overarching understanding of the term (Jensen & Sperling, 2019, p. 89). The literature review showed that the understanding of SEP by Danish municipalities is limited compared to an international literature investigation. The Danish understanding and use of SEP is narrowed to a focus on the technical aspect of energy planning through implementing tools for achieving efficiency and flexibility.

Additionally, four specific problems for the Danish municipal implementation of SEP were identified as being: financial resources, cultural norms, skills, and political will. The usage of SEP in the papers explored in the study by Jensen & Sperling, is solely focusing on meeting energy demands by technical optimization. As collaboration is a prerequisite for electricity grid expansion to finalize the plans for energy, it is important that this aspect is considered in SEP. Jensen & Sperling (2019) points towards coordination as a necessity across sectors, plans and climate strategies. A municipality, which has taken on a facilitating role in energy planning, is Thisted Municipality. Due to the legislative frames being the same for all municipalities, it is relevant to look into how they operationalize their municipal role in energy planning.

2.6 Thisted Municipality

Thisted Municipality is one out of two municipalities visited in the programme at UN's COP15, which was held in Denmark in 2009 (KAT, 2021, p. 7). Since then, the municipality has actively positioned itself as Denmark's leading municipality in climate action. This is driven by a political effort to strengthen the sustainable development of the area.

As a part of this effort, Thisted Municipality introduced their own “Thy model”, which offers several tools to strengthen the spatial considerations for energy planning, as well as supporting local engagement in energy projects (Thisted Kommune, n.d., A). The organization of the responsible department for energy planning in both municipalities is shown in the figure below:

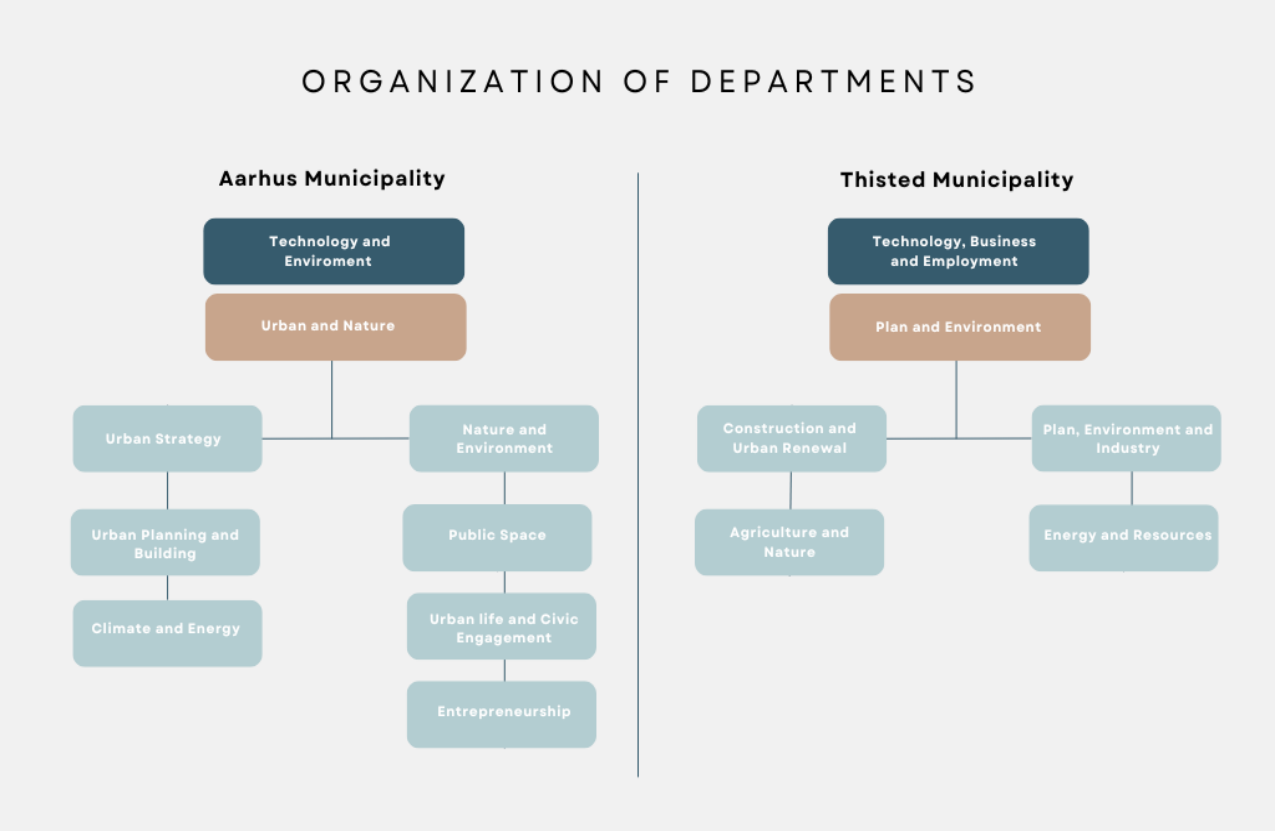

Figure 5: Overview of the organization of the departments responsible for energy planning in Aarhus- and Thisted Municipality (own figure based on Thisted Kommune, 2023; Aarhus Kommune, 2025 April).

Regarding their plans, both Thisted- and Aarhus Municipality have published a climate plan. This is a voluntary task emerging from the DK2020 project with the ambition of a local climate action plan following the ambitions of the Paris Agreement (Realdania, n.d.). An independent energy plan is not an obligatory task, but the municipality is responsible for envisioning spatial planning and local development through their municipal plan. From this, the municipal plan must outline the framework for technical facilities, locating wind turbines, PV, and district heating, cf. the Planning Act (Planloven, 2024, § 11).

This master's thesis explores how current planning practices for the long-term development of the electricity grid in Denmark have been shaped by historical energy planning on a municipal level, looking into Aarhus Municipality as a case. The challenge of timely electricity grid expansion in Denmark highlights how unclear municipal roles, fragmented planning, and the current legal conditions lack the coordination needed for energy planning.

Furthermore, it investigates how SEP has been conducted in Thisted Municipality and what their experiences have been with it, to understand how SEP as a tool can emerge in long-term energy planning in municipalities. This research is done to answer the research question presented on the next page.

3. Research Question

The problem analysis has led to the following research question:
How has the role of municipal energy planning in Aarhus Municipality been influenced by the conditions for energy through time, and how do the strategic energy planning approaches of Danish municipalities, as seen in Aarhus and Thisted, accommodate for electricity grid development?

Sub-question 1: How have the energy planning conditions in Aarhus Municipality evolved over time, and how do these conditions influence the current planning conditions for the electricity grid?

Sub-question 2: How do the strategic energy planning practices of Aarhus Municipality compare to those of Thisted Municipality, and how do differences influence planning outcomes?

Sub-question 3: What opportunities and challenges emerge when municipalities aim to integrate strategic energy planning into electricity grid development, based on the cases of Aarhus- and Thisted Municipality?

3.1 Research Design

The following research design outlines the overall structure of the thesis. The theories and methods in which we seek to answer each sub-questions are illustrated in accordance with when they will be applied.

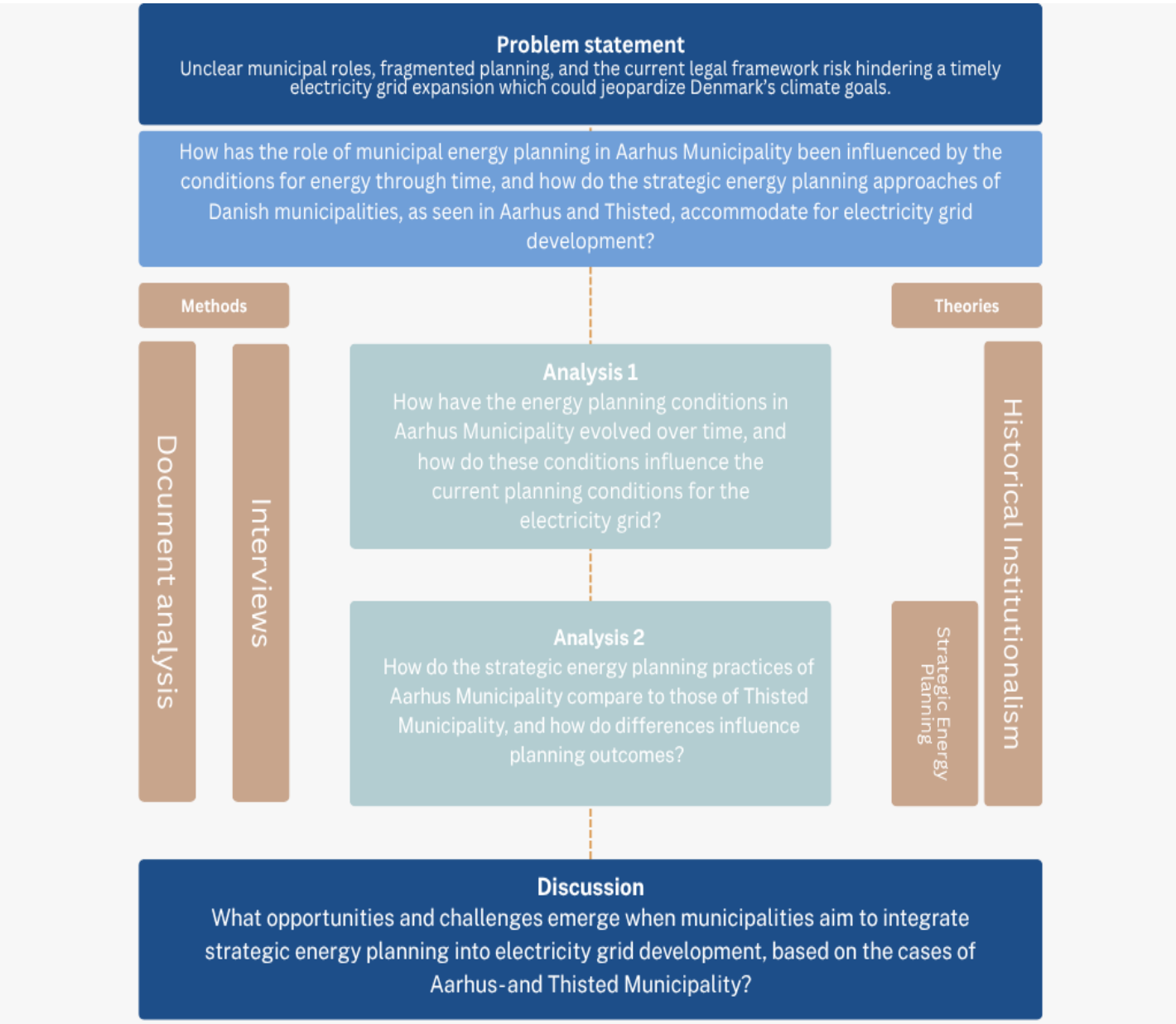

Figure 6: The research design for the thesis (own figure).

4. Theory

This chapter outlines the theoretical framework guiding the analysis. The first section introduces historical institutionalism (HI), which explores the role of institutions in energy planning, to understand how planning practices relate to the electricity grid and the broader energy system. The second section presents the concept of SEP, which offers a comprehensive approach to managing energy transitions towards a climate-neutral energy system.

4.1 Historical Institutionalism

Historical institutionalism, grounded in new Institutionalism, is used to understand the historical development in energy planning practices and how structural dynamics have their outcomes. HI is grounded in new institutionalism, which represents an attempt to illuminate how political struggles are embedded in the institutional settings it occurs within (Lockwood et al., 2016, p. 314). It is centered on how institutions are formed, why changes occur, as well as when they don't (Lockwood et al., 2016, p. 314).

Planning institutions are in a historical context *"collectively enforced expectations with respect to the creation, management, and use of urban space"* (Sorensen, 2015, p. 20). This definition puts attention to the shared norms and formal rules that shape action in social, political and economic processes, and determine structural outcomes (Sorensen, 2015, p. 18). According to HI's ontology, these structures are historically shaped by past decisions and institutions. HI's epistemology is grounded in causality, where understanding structures requires investigating them in their historical context, through the examination of the interplay of institutions and broader structural forces (Sorensen, 2015, p. 19).

HI provides an analytical framework for understanding continuity and change in public policy by examining the formation, persistence, and evolution of institutions over time (Sorensen, 2015, p. 18). HI consists of several key concepts, including path dependency, critical junctures, incremental change and positive feedback effects to analyze the processes of change (Sorensen, 2015, p. 18).

4.1.1 Path Dependency

Path dependency is an explanation of why certain institutions withhold their power and are difficult to change over time (Sorensen, 2015, p. 20). Therefore, the early phase of planning can impose substantial impacts in a long-term perspective. With this understanding of path dependent institutions, diving into planning events is essential from a HI approach to get insight into what causes the continuity or the formation of new institutions (Sorensen, 2015, p. 21). To explain why certain institutions become path dependent, the argument is that the dominance of specific practices limit emergence of others (Sorensen, 2015, p. 21). The dominant practice creates a self-reinforcing effect through positive feedback effects, where each decision in a particular direction makes it likely to continue the progression in the same direction. That makes reversals unattractive, because actors make investments and form relationships based on the existing institutions. An example of this presented by Sorensen, related to planning, is the transition towards combined sewers in many cities during the 19th century (Sorensen, 2015, p. 21). The initial incentive to construct this system were cost savings, but this sewer system has now continued to dominate due to the costs of transforming the whole system into separate pipes, even though this is the most optimal solution. The costs of changing the system now, with a big network of combined sewers, is in many cases an economic obstacle (Sorensen, 2015, p. 21).

In this and other cases, it becomes more difficult to change processes over time, as they become more embedded in the planning approach (Sorensen, 2015, p. 21). When researching planning history, an analysis should pay attention to the events where new policies or approaches are introduced (Sorensen, 2015, p. 24). Identifying these are essential to discover which institutions have shown a tendency toward path dependence, and the actors who played a key role in institutional decisions (Sorensen, 2015, p. 24).

4.1.2 Critical Junctures

When a path dependency is brought to an end and new institutions are established, it is triggered by a critical juncture (Sorensen, 2015, p. 25). When such major changes occur, other actors get the opportunity to play a role in establishing new institutions and influencing the future outcomes (Sorensen, 2015, p. 25).

The specific context surrounding the establishment of institutions plays a crucial role in shaping the compromises made and the institutions that dominate (Sorensen, 2015, p. 26). Regarding the difficulty of reforming institutions, the initial context of their establishment becomes crucial for understanding the long-term patterns of urban governance and planning (Sorensen, 2015, p. 26).

4.1.3 Incremental Change

In most instances, institutional change is more gradual and nuanced rather than as radical as critical junctures, following a pattern of path dependency (Sorensen, 2015, p. 28). In fact, the critical junctures are not the most common; more often, institutional stability or incremental changes is seen (Sorensen, 2015, p. 28). When incremental change occurs, it is still influenced by past decisions, institutional structures, and the opportunities available to key actors to either drive or block institutional change. Institutions are therefore not completely locked-in by path dependencies but are a result of the continuation of power processes by those who are in advantage of the institution and try to withhold this (Sorensen, 2015, p. 28).

Changes can also occur within the existing rules due to a variety in enforcement of rules, with many rules needing to be interpreted in specific situations (Sorensen, 2015, p. 29). When rules allow for interpretation, institutional change can occur without formal revision, but through changes in how the rules are applied and how compliance is enforced (Sorensen, 2015, p. 29).

The central element of HI is the influence of institutions, and for the development of energy planning, it is relevant to look at what kind of institutions that is determining and how (Lockwood et al., 2016, p. 315). Multiple actors across sectors are engaged in energy planning, including municipalities, energy providers, system operators, policy makers, and the consumers of energy. Through the conceptualization of HI, the processes of change in energy planning are explored to illuminate the planning processes in municipalities and its influence on the electricity grid.

4.2 Strategic Energy Planning

This section will explore the term SEP, in which we seek to conceptualize how it can be understood and applied in the perspective of this thesis. Due to the variation in the understanding of SEP, the purpose of SEP as well as different understandings will be explored, leading to four significant dimensions that are used as our framework for SEP.
The Danish energy system is undergoing a major transition from a centralized, fossil-based foundation to a more decentralized and integrated system based on RE, with new infrastructure and charging stations increasingly located closer to consumers. Yet, energy planning has so far tended to treat the different sectors of the energy system as mostly separate from each other (Jensen & Sperling, 2019, p. 83). To secure an efficient transition of the energy system towards 100% RE, municipalities are recognized as a central planning actor (Jensen & Sperling, 2019, p. 84). In 2010, it was therefore recommended by the Danish Government for municipalities to use a SEP approach to achieve a climate-neutral energy system (Jensen & Sperling, 2019, p. 84).

There are multiple definitions of the concept of SEP, both in a Danish and international context (Sperling & Jensen, 2019, p. 87). The definition from the Danish Energy Agency has been the official definition in Danish energy planning since 2013. The definition is based on a more technologically anchored understanding, in which planners must incorporate flexibility, efficiency, and savings in the system based on RE, while also considering socioeconomics (Energistyrelsen, 2016, p. 5). This general definition aligns more closely with smart energy systems, which are isolated to the technological aspect, focusing on synergies and coordination between thermal, electricity, and gas (Sperling & Jensen, 2019, p. 84). According to Sperling & Jensen, the concept of SEP is broader than that and must include climate planning, to consider the energy system together with climate goals (Sperling & Jensen, 2019, p. 85). SEP is also a broad concept, as it is a framework that consists of a range of tools.

Therefore, it is not a one-size-fits-all solution, but instead must be adapted to the individual municipalities, based on how their local energy system, organization, culture, etc., are (Sperling, Appendix D, 2025, p. 12). However, Sperling & Jensen also frame how SEP is applied, based on their literature review conducted in 2013, as described in the problem analysis:

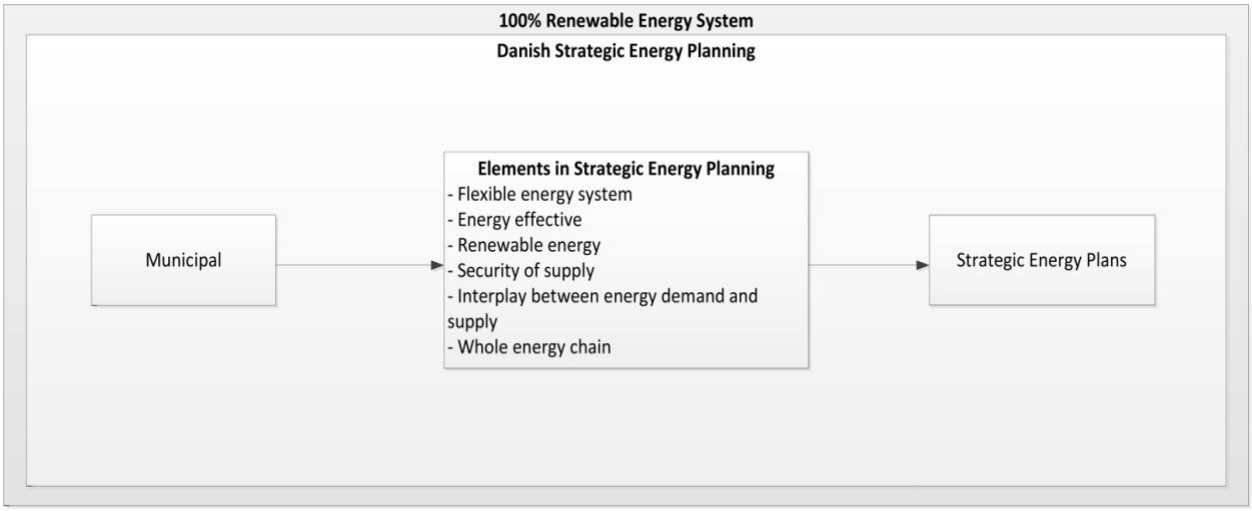

Figure 7: Elements in SEP as understood in Denmark (Sperling & Jensen, 2019, p. 86).

The elements in the figure are also centered around the energy system's technical abilities, but don't consider other dimensions in planning. The existing infrastructure, industries, resources etc., needs to be considered with the existing local resources for a proper implementation (Sperling, Appendix D, p. 12).
The second part of Jensen & Sperling's literature study broadened the study to international planning documents and identified the occurrence of different aspects in the SEP documents, with these terms being the most prominent: long-term, short-term, holistic, and stakeholder involvement (Sperling & Jensen, 2019, p. 87). Additionally, the recommendations from NEKST, a lack of collaboration is considered as a hindrance for SEP and must therefore be an integrated part of the framework (NEKST, 2024, p. 17).

Considering these aspects, the following four dimensions are the criteria's for aligning a strategic planning approach with electricity grid expansion. These will be applied in analysis 2 to assess the strategic scope of SEP used by Thisted Municipality.

4.2.1 Temporal Planning

SEP must incorporate both short-term and long-term perspectives to ensure a coherent transition of the energy system. Although temporal dimensions are acknowledged in planning documents, they are not yet fully integrated into the conceptual framework of SEP in Denmark (Sperling & Jensen, 2019, p. 87). Addressing both immediate and future needs is essential for aligning infrastructure development with RE integration to achieve climate goals.

4.2.2 Collaboration

Collaboration is a key element in SEP due to the presence of multiple actors with different roles and responsibilities, which can lead to fragmented planning (NEKST, 2024, p. 17). Municipalities are expected to act as facilitators, promoting transparency and ensuring stakeholder involvement across sectors (Energistyrelsen, 2013). The lack of structured collaboration has been identified as a major challenge for electricity grid expansion by NEKST, causing delays. Therefore, closer collaboration is essential for integrating strategic frameworks for future energy planning (NEKST, 2024, p. 17).

4.2.3 Local Resources

When using SEP, local conditions and assets of each municipality must be considered. This includes existing infrastructure, industrial profiles, local energy resources, and organizational structures (Sperling, Appendix D, p. 12). Since SEP is not a one-size-fits-all tool, effective planning depends on the municipality's ability to adapt strategies to their unique local context, which includes the existing electricity infrastructure.

4.2.4 Inclusion and Awareness

A central challenge in SEP is ensuring that the interests and needs of various stakeholders are understood and reflected in the planning process. This includes developers, DSOs and citizens, all of whom are equipped with local knowledge, valuable in local energy planning. Current practices lack transparency and do not sufficiently acknowledge the individual concerns of stakeholders involved (NEKST, 2024, p. 18). Creating awareness of these interests is essential to facilitate coordination, prevent conflicts, and enable integrated decision-making across sectors.

5. Methodology

The methodology for this thesis is outlined in the following chapter. To address the first analysis and understand the historical development of energy planning in municipalities, a document analysis is conducted, as it sheds light on transitions in planning through official planning documents. This analysis is complemented by semi-structured interviews and preliminary exploratory interviews. The second analysis involves a comparative study of Thisted- and Aarhus Municipality, employing an additional document analysis, alongside further interviews examining the practices of Thisted Municipality.

5.1 Literature Review

Before conducting the two analyses, a literature review was carried out to understand how the issue of electricity grid expansion is currently addressed in Danish public discourse. To do so, a comprehensive search was performed across all Danish news media using the keyword "elnet" (electricity grid). The purpose was to identify all addressed challenges related to the electricity grid.

A total of 2,168 articles were identified containing the word “elnet”, with a time perspective from 2020-2025. The content of the articles was screened based on their title and introduction. This initial search led towards a broader understanding of how the electricity grid expansion is discussed, with particular attention to recurring themes and dominant perspectives. The literature reviewed was narrowed down to articles focusing on the electricity grid, proposing what bottlenecks or challenges hinder the expansion of it. Therefore, articles that highlight the lack of expansion of the electricity grid as an obstacle for other things, such as tendering for offshore wind, were not included, as that aspect has been illuminated in the introduction. Based on the literature review, five main themes were identified as common challenges for the electricity grid expansion presented in Danish media. These were as follows: 1) Economic pressure, 2) Regulation and legislation, 3) Collaboration and communication, 4) Market and industry, and 5) Technological advances. The literature review can be found in Appendix F. The common aspect of all included articles was that they provided insights into perspectives and debates that are not always explicitly outlined in policy documents or official reports.

5.2 Interviews

The primary purpose of the interviews was to gain insights into processes and challenges that are not accessible through document analysis alone. The interviewees, as practitioners and experts, possess valuable knowledge about where barriers and bottlenecks arise in energy planning. Therefore, we conducted three preliminary interviews, which allowed the participants to guide the conversation within the overall framework of planning.

5.2.1 Preliminary Interviews

Initially, three preliminary interviews were conducted to illuminate possible problems that emerged between different actors, when planning a long-term transition of the energy sector. They were done with a focus on collaboration, to further understand the planning practices of the whole energy system.
To gain insight into the energy planning in Aarhus Municipality, a preliminary interview with one of the municipal planners, Sørensen, was conducted. At this stage, an exploratory approach was taken to understand the municipality's responsibilities in energy planning and how this relates to planning for the electricity grid. The transcription of this interview can be found in Appendix A.
Prior to the interview with Sørensen, four themes were identified as being specifically interesting for exploring planning practices in Aarhus Municipality regarding energy and relevant to electricity grid development. They arose from the problem analysis and the overall focus on identifying planning challenges for electricity grid development. They were as follows: 1) Collaboration in the municipality and stakeholder involvement, 2) Internal coordination across the different interests within Aarhus Municipality, 3) Spatial planning, and 4) Long-term planning, where we inquired how the municipality plans e.g. the municipal plan, which spans a period of 12 years.

The preliminary interview with Sørensen led to the theme of collaboration among actors, as this was identified as being one of the main issues that Aarhus Municipality experienced when working with the facilitation of energy planning.

The theme of collaboration was further explored in the following two interviews with Rørby and Birch, who are working in the DSOs Dinel and KONSTANT, which administer the distribution in Aarhus and other cities. The interviews had a heightened focus on their respective collaboration with the municipalities, as well as other actors. The interview with Rørby from Dinel and Birch from KONSTANT can be found in Appendices B and C. The preliminary interviews gave insight into the energy planning practices in the case of Aarhus Municipality.

5.2.2 Semi-structured Interviews

To make a comparison with Thisted Municipality, an interview with the director of the DSO in that area was conducted later in the process. To gain insight into the planning practices of key actors in Thisted Municipality and compare them with Aarhus Municipality, a semi-structured interview was conducted. Through a semi-structured interview, the aim is to obtain descriptions of the interviewee's perspective to interpret the meaning of the described experiences (Kvale & Brinkmann, 2009, p. 144). To get insight into the use of SEP practices in Thisted Municipality, both the municipality and the DSO were contacted. Unfortunately, planners in Thisted Municipality were unable to participate in an interview as they did not have the resources and had to decline our inquiry as well as other students'. An interview with the director of the DSO, Netselskabet Elværk, in Thisted Municipality was conducted. The transcription can be found in Appendix E, with the director referred to as Lasson. Furthermore, an interview with Sperling, Associate Professor at Aalborg University, was conducted. His research on the topic of SEP goes back more than a decade and, through his multiple publications on SEP, he is an expert on the development. The transcription of the interview can be found in Appendix D.

The purpose of this interview was to gain knowledge of how Sperling assesses the conditions for using SEP in municipalities in Denmark. Before the interview, several themes, along with suggested questions should be prepared (Kvale & Brinkmann, 2009, p. 144). At the same time, the questions must be openly phrased, with the possibility of follow-up questions based on the answers provided.

The interview questions should be formulated regarding both thematic and dynamic dimensions (Kvale & Brinkmann, 2009, p. 151). The thematic dimension should relate to the theoretical understanding of the research topic and the subsequent analysis of the interview (Kvale & Brinkmann, 2009, p. 151). The interview guide with Lasson was structured around the four theoretical elements of SEP to get insight into the different planning practices related to SEP. In the interview with Sperling, the overall theme was reduced to the understanding of SEP and its use in municipalities' energy planning.

To avoid presuming prior knowledge, the language used in the interviews was kept flexible and adaptive (Kvale & Brinkmann, 2009, p. 151). This is particularly relevant in the case of SEP, as its definitions are varied. Therefore, the definition of the term was chosen as a theme in the interview with Sperling and was explicitly not used in the interview with Lasson, as the concept is ambiguous and complex.

5.3 Document Analysis

Urban development, such as energy planning, can be understood within the broader context of development dynamics (Moulaert et. al., 2016, p. 167). To support this understanding, the ASID model, developed by Moulaert, Jessop and Mehmood, offers a theoretical framework for analyzing the interactions between agency, structure, institutions, and discourse within spatial development processes (Moulaert et. al., 2016, p. 167). They argue that urban development processes must be understood as the outcome of dynamic interactions among institutional frameworks, agency, structural constraints, and discursive practices aligning with the perspective of HI (Moulaert et. al., 2016, p. 178).
Starting with the introduction of energy planning, spanning back to the 1970's, an historical overview is relevant to trace the emergence of different approaches to doing energy planning, which in turn have led to the current landscape for energy planning in Aarhus Municipality today. This is to seek out the historically conditioned context that has created the path, and in turn possible path dependencies, that may be responsible for the lack of accommodation of the electricity grid when performing energy planning.

For this thesis, the ASID framework is based on the operationalization developed by Johannes Suitner to periodize Vienna's urban planning history. The ASID model is used to analyze the historical development of structural conditions for energy planning to illustrate when, how and why different planning practices have developed in response to institutional conditions (Suitner, 2021, p. 882). Furthermore, it can illuminate how energy planning and energy development are interconnected. Through the theory, we take a systematic approach to periodize the history of planning practices with a focus on municipalities' responsibilities in energy planning.

The agency, structure, institutions and discourse heuristic (ASID) is a framework in which four dimensions can be used to analyze the development of planning. In the figure below, the four dimensions and key elements applied in the analysis are illustrated:

Agency	Structure	Institutions	Discourse
Key planning actors	Political economy	Formal Institutions	Planning imaginaries
Decision-makers	Economic regime	Legal rules and binding	Planning objectives
		Plans	Modes of 'good planning'
	Energy demand	Informal Institutions	Idealized energy model
	Demographic	Embedding of planning	Concepts of energy
	Choice of energy sources	Planning culture	

Figure 8: Model for application of ASID dimensions (own figure with inspiration from Suitner, 2021, p. 886).

Agency includes all key actors who do and influence planning through behavior, individual or collective (Moulaert et. al., 2016, p. 169). Structure is the material conditions for planning, such as urban size and the governmental system. The understanding of institutions comes from the theory and refers to the arrangement of formalized rules and plans, together with embedded norms and practices that influence planning and thereby includes formal and informal institutions.

The last dimension is discourse, which is aimed at making meaning about what actors perceive as important to them in the context of planning (Moulaert et al., 2016, p. 169).

As the original framework by Moulaert et al. was adapted for urban planning, it was necessary to align our model to fit the historical development of energy planning, in which relevant aspects of the four dimensions were revised. The framework is applied to the case of Aarhus Municipality with the illustrated key elements, as they fit the practices of energy planning.
A systemic document analysis has been done, where planning documents and policies were gathered and analyzed across a timeline from the 1970's to the present. The documents include all available published municipal plans containing main structures and land-use plans, local energy plans, and climate strategies by Aarhus Municipality. On a national level, it includes the available national energy plans and strategies, starting from the energy plans back in the 1980's. Additionally, relevant laws and policies framing municipal energy planning and grid obligations are used to understand the influence of the legal framework.

Due to limitations in accessibility, one must account for some documents not being archived or available, and therefore not interpreted. The documents that were available, either online or in physical form, were analyzed in chronological order to interpret their historical context and to capture the development of municipal planning practices. Through this, it became possible to detect gradual shifts and periods of stability within the historical evolution of energy planning, resulting in an ability to understand the current landscape in Aarhus Municipality, explored in analysis 2. The notion of path dependency was a guiding concept in this regard, as the analysis aimed to uncover how dynamics shape present-day practices and imaginaries.

To evaluate the current planning practice in Aarhus, it is crucial to have a case to compare the planning approach to. For this, Thisted Municipality is chosen as they aim to be the leading municipality in the green transition, as well as currently being the leading municipality regarding green energy solutions (Thisted Kommune, 2023).

This ambition places Thisted Municipality amid considering strategies and tools to reach these ambitions. Following the document analysis of the Aarhus Municipality case, an additional document analysis of the currently valid planning documents and strategies available has been conducted. For the best conditions for a comparative analysis of the two cases, the ASID framework is applied to the current planning landscape in Thisted Municipality. According to Sperling, the concept of SEP will be applied differently in each municipality (Sperling, 2025). Therefore, the applications of SEP will be evaluated based on the understanding of SEP in this thesis, to evaluate the different tools used to transition each municipality's energy sector, based on the four themes identified in the theory of SEP.

As presented by Suitner, it can be discussed whether historiographies like this one, oversimplify planning history, leaving out key historical facts and causal relations, and therefore, periodization should therefore be seen as a heuristic device (Suitner, 2021, p. 896). Despite its simplifications, it remains a valuable tool in this thesis for understanding the historical developments in energy planning and making sense of the conditions for changes in planning practices. It allows for the identification of broader trends and shifts, offering a starting point for deeper inquiry.

6. Analysis 1

This chapter examines the historical development of planning in Denmark to the present, with a point of departure in HI. This is done through the case of Aarhus Municipality, focusing particularly on how critical junctures, institutional changes, and evolving governance structures have shaped planning practices over time, which are explored in analysis part 1. This is followed by a further assessment of the determining conditions for each period's planning in part 2.

6.1 Analysis part 1

Through a document analysis of national- and municipal plans, and investigation of the legal framework, the study traces the transformation of Denmark's energy landscape across five distinct periods.
By mapping the developments, the analysis highlights patterns of institutional changes, path dependency, agency, and coordination challenges that continue to influence contemporary energy planning, especially in the context of electricity grid infrastructure planning and general electrification. Special attention is given to how planning practices within municipal responsibilities either accommodate or overlook the needs of electricity grid infrastructure.

6.1.1 Crisis-Induced State-Led Energy Planning (1973-1987)

During the 1960's, Danish society advanced with technological development, making it more dependent on energy-heavy activities (Energiministeriet, 1982, p. 2). Within a decade, energy consumption doubled, and this occurred without economic burden, as the price of oil was cheap. In 1972, the demand for electricity was met by 80% oil and 20% coal (Energiministeriet, 1982, p. 5). In 1973, the oil crisis caused a significant increase in the price, and through the 1970's, there was a 20-fold increase. This led to an economic crisis, with a sudden need to find alternative energy sources and reduce energy use (Energiministeriet, 1982, p. 5).
In response, the 1976 Act on Energy Policy Measures established the institutional foundation for a more coherent and state-directed energy policy.

For the first time, energy policy was integrated into the legislative framework, thereby formalizing the state's role in energy governance and as described in §1 the purpose was:
"(...) to create the basis for reducing the country's dependence on imported oil through improved utilization and application of energy, and by accelerating the use of other energy sources." (Lov om energipolitiske foranstaltninger, 1976, § 1).

This meant specifically that there had to be an assessment of energy demand and the energy sources available, targets and plans for an efficient exploitation of sources, and programs for energy research (Lov om energipolitiske foranstaltninger, 1976, §1). Furthermore, this law introduced the establishment of the Danish Energy Agency to monitor developments in production, supply, consumption, and research in the energy field. This resulted in the publication of the first Danish energy political plan the same year, aimed to protect Denmark against supply crises such as the oil crisis in 1973 (Miljø- og Energiministeriet, 1996, p. 9).

In 1970, a municipal reform reduced the number of municipalities from more than 1300 to 275 (Indenrigs- og Sundhedsministeriet, 2005, p. 5). With this new division, the responsibility of societal tasks was assigned to the municipalities, given their larger sizes and thereby larger economy to manage (Indenrigs- og Sundhedsministeriet, 2005, p. 5). Thereby, a larger economy created an incremental change in the planning scope for the municipalities, as they had more to administer as well as a greater capital with which to do so.

Based on the Danish Parliament's energy policy, Aarhus Municipality developed its first heating plan for Aarhus Municipality in 1978 (Aarhus Kommune, 1978, p. 10). At that time, heating was the municipality's sole responsibility in terms of energy consumption, making it the only energy planning initiative the municipality undertook. This was still influenced by the oil crisis, with its main objective being to secure a sufficient use of the available energy sources and implementation of energy consumption savings in Denmark in general and thereby minimize the dependency on the oil supply (Aarhus Kommune, 1978, p. 10).

As a result of the rising oil prices, the main national goal became to phase out oil and substitute it with natural gas and coal (Energiministeriet, 1982, p. 5). After the oil crisis in 1973, it only took eight years, before the energy supply turned around with coal covering 81% of the electricity supply and oil only covering 19%. Simultaneously, the electricity consumption increased from 22% in 1972 to 32% in 1980, with the same total consumption. It was possible to make this transition fast due to the political goal of securing supply (Energiministeriet, 1982, p. 5).

This development of the energy system created a demand for more administration, and therefore the Danish Energy Ministry was established in 1979. At this time, the most important things in energy planning were security of supply and the societal costs. In a publication from the Danish Energy Ministry in 1982, the role of energy planning was described as balancing supply with planned consumption, avoiding indiscriminate purchasing, and ensuring stable energy supplies during future crises (Energiministeriet, 1982, p. 6).

These objectives were formulated in the context of the oil crisis, as these were the main challenges to overcome at that time, with a focus on energy savings for the consumers through e.g., subsidies. Supply security was a priority for the Danish Energy Ministry and had to be considered in relation to other public tasks, due to investments in the energy sector being so demanding that they could only be made responsibly with an overview of all societal needs (Energiministeriet, 1982, p. 3). Within this planning document, an overview of the transmission lines nationally was included, in the chapter for prospected energy demand, illustrating how there was a national awareness of the transmission lines as a part of energy planning.

As a result of this, energy planning by the public was introduced, and a new planning landscape began. This includes both political goals and means of actions to shape energy sources and the consumption of energy. The national energy plans emphasize the importance of energy as a vital resource for the nation and point out that securing and distributing energy to various sectors is not just a technical or economic task, but a comprehensive societal responsibility. This reflects a planning culture where energy issues must be considered in relation to societal needs.

Furthermore, the importance of long-term planning is highlighted as investments in facilities are expensive and take a long time to build, and therefore must be usable for many years (Energiministeriet, 1982, p. 38). The Danish Energy Ministry acknowledged the uncertainty associated with predicting future energy needs, yet it emphasizes that such forecasts were crucial for planning. This reflected a planning culture that valued data-driven predictions, but also recognized the inherent uncertainty in long-term projections, suggesting that planners had to balance careful predictions with flexibility and adaptability due to the evolving energy supply and demand.

In this period, municipalities' role in energy planning was only concentrated on heat supply and district heating, with the transition from individual heating by oil burner to the shared district heating network (Energiministeriet, 1982, p. 22). This became more financially profitable as areas became more dense and piped energy supply reduced the energy price. At this time, the CHP-plant Studstrup was one of the biggest electricity producers in Aarhus, and supplied almost all its own citizens (Energiministeriet, 1982, p. 22).

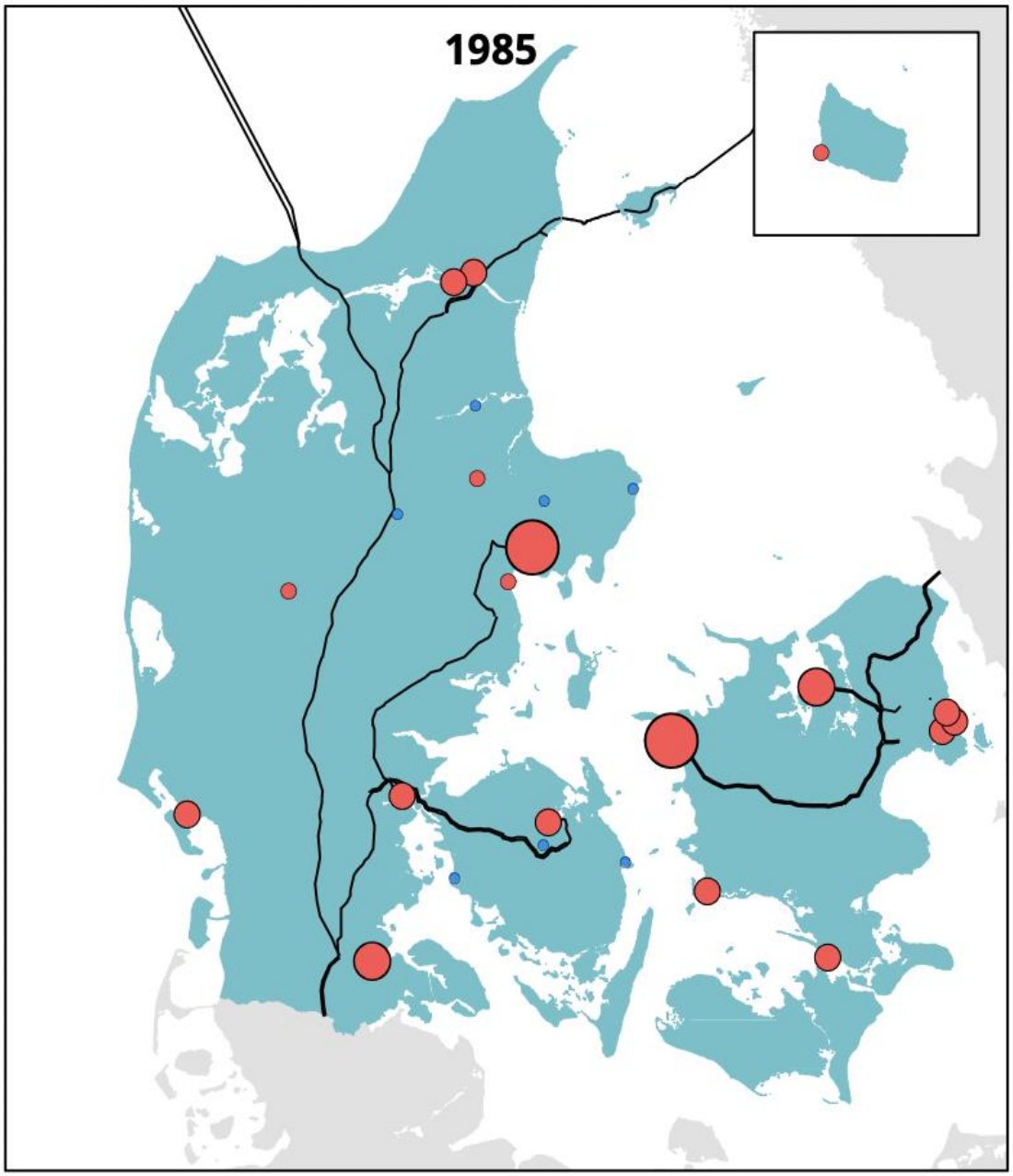

Figure 9: Danish transmission lines in 1985 with central plants (red) and decentralized plants (blue circles) (Energistyrelsen, 2017).

The figure above shows the Danish electricity grid infrastructure in 1985, with the red circles illustrating the placement and capacity of central power plants and the blue representing decentralized power plants (Energistyrelsen, 2017). At the time, West- and East Denmark were not interconnected, and therefore the transmission lines were owned by two different companies (Energistyrelsen, p. 15.). Elsam in West Denmark and Elkraft in East Denmark. From the figure, it is evident that the decentralized energy supply at this time was only beginning to emerge.

6.1.2 Sustainable Energy Planning (1988-2000)

The 1988 Municipal plan for Aarhus, spanning the next 8 years, was published, consisting of visions and guidelines, including expansion of housing, business, green areas and the road network (Aarhus Kommune, 1990, p. 1). In this period, urban development and growth was the main focus, shaping the planning of supply around this (Aarhus Kommune, 1990, p. 4). When looking into the different categories of purposes of divided areas, there was no reserved area for energy production.
In 1989, Aarhus Municipality published its first long-term energy plan, describing the economic and technical conditions for future decisions regarding the transition of energy planning. The time period for the vision predicts the development in energy consumption towards 2001. The plan referred to both electricity- and heat supply with the goal of composing a long-term vision for how the largest reduction of fossil fuels in relation to electricity- and heat production could happen within the municipality (Aarhus Kommune, 1989, p. 2). In these years, a focus on environmental impact emerged with knowledge of the cause from burning of fossil fuels. It was formulated in this plan that the vision must consist of an environmentally friendly energy supply and should meet the recommendations by the Brundtland Commission from their report in 1987 (Aarhus Kommune, 1989, p. 2).

To meet the recommendations, the municipality outlined three initiatives: Reduction in energy consumption, transition towards RE, and effective supply systems (Aarhus Kommune, 1989, p. 5). At this time, electricity produced by wind power was more expensive than electricity from coal-supplied CHP-plants. In general, the content of the plan focused on the economic aspect of energy planning, including the investment costs in district heating and the potential of reducing private households' energy consumption for a better economy (Aarhus Kommune, 1989, p. 5). The electricity grid infrastructure did not occur as a part of this long-term plan, but there was a focus on establishing energy facilities and ensuring that energy production corresponded to the expected demand from a temporal perspective. This reflects that the planning conditions at that time did not face challenges regarding spatial availability, complex energy distribution, and legislative framework, therefore it was not a hindrance for energy plans.

In 1991, the Planning Act was adopted with the main objective to secure a coherent planning that balances societal interests, protects nature and the environment, and supports sustainable development and economic growth across the country (Planloven, 2024, §1). As part of this, municipalities were required to develop a municipal plan with a 12-year perspective, revised every fourth year, responding to the selection of a new City Council (Planloven, 2024, §1). This incremental change in the planning frames for municipalities, positioned them as the appointed key planner in ensuring a vision for the spatial development in their respective areas, while prolonging the time frame for municipal plans.

Following the Brundtland Report, the environment also became the center of attention on a national level, with the launch of the third energy plan, *Energy 2000* – Action Plan for Sustainable Development in 1990 (Miljø- og Energiministeriet, 1996, p. 9). After a period characterized by large infrastructure projects, and the development of markets for natural gas and CHP-plants, the plan introduced the goal of a sustainable development of the energy sector (Miljø- og Energiministeriet, 1996, p. 9). Thus, with a majority in the Danish Parliament, Denmark adopted its first legally binding climate target in 1990: a 20% reduction in CO_2-emissions by 2005 (Green Power Denmark, 2020). This was also the first climate target ever adopted by any nation at the time (Green Power Denmark, 2020).

This marked the beginning of a national commitment to climate action, reflecting an incremental change within the institutional framework. The climate agenda gradually gained influence through political strategies and planning documents, increasing focus on renewable energy, energy efficiency, and carbon reduction.
In 1995, the UN's Climate Panel stated that industrialized countries should cut their CO_2-emission by half in 2030 compared to 1990, to mitigate severe climate change (Miljø- og Energiministeriet, 1996, p. 3). In the governmental plan 'Energi 21', published in 1996, it is stated that this recommendation will shape the future Danish energy planning. On a national level, the focus was to keep developing the Danish energy system, but RE had to be further developed to become a viable technological and economic alternative to fossil fuels. Energy efficiency had to be improved across society, and future energy imports minimized (Miljø- og Energiministeriet, 1996, p. 3).

In the action plan from 1996, it was highlighted that there was a need for reshaping the institutional framework of the electricity and heat sector in response to global energy trends, market liberalization in the EU, and negative environmental impacts (Miljø- og Energiministeriet, 1996, p. 27). The reform called for better conditions for the growing number of energy actors, including producers of electricity from wind, CHP-plants, and district heating systems (Miljø- og Energiministeriet, 1996, p. 28). This also implied that the framework should encourage utility companies to increase integration between energy supply types and functions at the distribution level. The option to operate as a CHP-company, combined with operating RE, should be able to coexist (Miljø- og Energiministeriet, 1996, p. 29).

From a governmental perspective, it was recognized how the local level had to be institutionally reimagined, as the division of the public responsibilities and commercial interests was undefined (Miljø- og Energiministeriet, 1996, p. 29). This broadened the scope of municipal planning from a single-sector (electricity) to cross-sectoral coordination (electricity, heat, gas). The government aimed to redefine the responsibilities, with a shared governance between public and private actors. Municipalities were positioned as key stakeholders, but within a multi-actor governance system, it required more complex coordination. It reflected a growing expectation that municipalities would integrate local knowledge and cross-sector dynamics into their spatial- and energy planning (Miljø- og Energiministeriet, 1996, p. 29).

As a response to the EU's directive on the liberalization of the electricity market, and to secure sustainable development, the Electricity Supply Act was reformed in 1999 (Elforsyningsloven, 1999). Before this reform, electricity companies owned the entire value chain, resulting in production, transmission, and distribution, operating as monopolies. The reform separated the production and distribution of electricity between different companies (Elforsyningsloven, 1999). Companies responsible for the transmission- and distribution grid were separated from production companies, but ownership remained with consumers or municipalities (Elforsyningsloven, 1999).

For municipalities, this also introduced a requirement for corporate separation between the municipality and its energy facilities producing both heat and electricity (Elforsyningsloven, 1999). This reform represented a critical juncture in the governance of electricity infrastructure. Municipalities lost their direct influence in grid planning, while DSOs retained local monopolies, but now operated independently. This institutional shift created a path dependency, where municipal energy planning became disconnected from electricity infrastructure development, which is a division that persists today.

6.1.3 Fastly Expanding Energy Planning (2001-2011)

Back in 2001, a politically set agenda to create a more market-oriented approach for national energy planning was introduced (Nielsen, 2012). According to the prime minister at the time, this was to secure greater competitive strength on the Danish energy market. This led to a halt in national energy plans, and instead led the development to be market driven, as the then-current government was against a planned economy for Denmark (Nielsen, 2012).

The establishment of Energinet was adopted in 2004, as a means to center the agency of the transmission lines in a singular actor, which would be a publicly owned independent company (Lov om Energinet, 2004). The purpose was to ensure an effective and coordinated development of this vital infrastructure. This new law led to the fusion of the grid companies Eltra, Elkraft Transmission, Elkraft System and Gastra. The whole transmission line system was now centered within the same company, which the law specified to sustain the national plans. The law allowed Energinet to own subsidiaries, which in 2005 were Eltransmission.dk A/S and Gastransmission.dk A/S, who administered the electricity- and gas grid (Energinet, 2004, § 2).

In this period, there was an additional focus on renewables, which had emerged from the Brundtland Report back in 1987, emphasizing the need for planning sustainably (WCED, 1987). This led to a change in the demand for renewables to cut carbon emissions. The prices for renewables also turned more favorable, making it a priority in policymaking. In the main structure from Aarhus Municipality' Municipal Plan 2001-2013, it was presented as being a necessity for reaching the political goals of the City Council (Aarhus Kommune, 2001).

The overarching goal for Aarhus Municipality back in 2001 was to secure the physical development of Aarhus to follow the urbanization (Aarhus Kommune, 2001). These developments led to a more closely planned city, making holistic planning across sectors more essential for the administration of Aarhus Municipality to still reach the overarching goal, while securing economic considerations and Aarhus as a competitive city (Aarhus Kommune, 2001).

Looking at it from a spatial planning perspective, the division of the geographical areas of Aarhus Municipality showcased how the prioritization of area reservation for energy was lacking. With this lack of spatial planning, the electricity grid was also not an integrated part of the planning landscape of Aarhus Municipality. Instead, the spatial planning was prioritized with the following themes, in the main structure from 2001: businesses, housing, retail, nature, and recreation, culture and leisure, traffic, and technical facilities. As a new part, the illustration of the transmission grid was integrated in a geographical illustration by the municipality as seen in the figure on the next page:

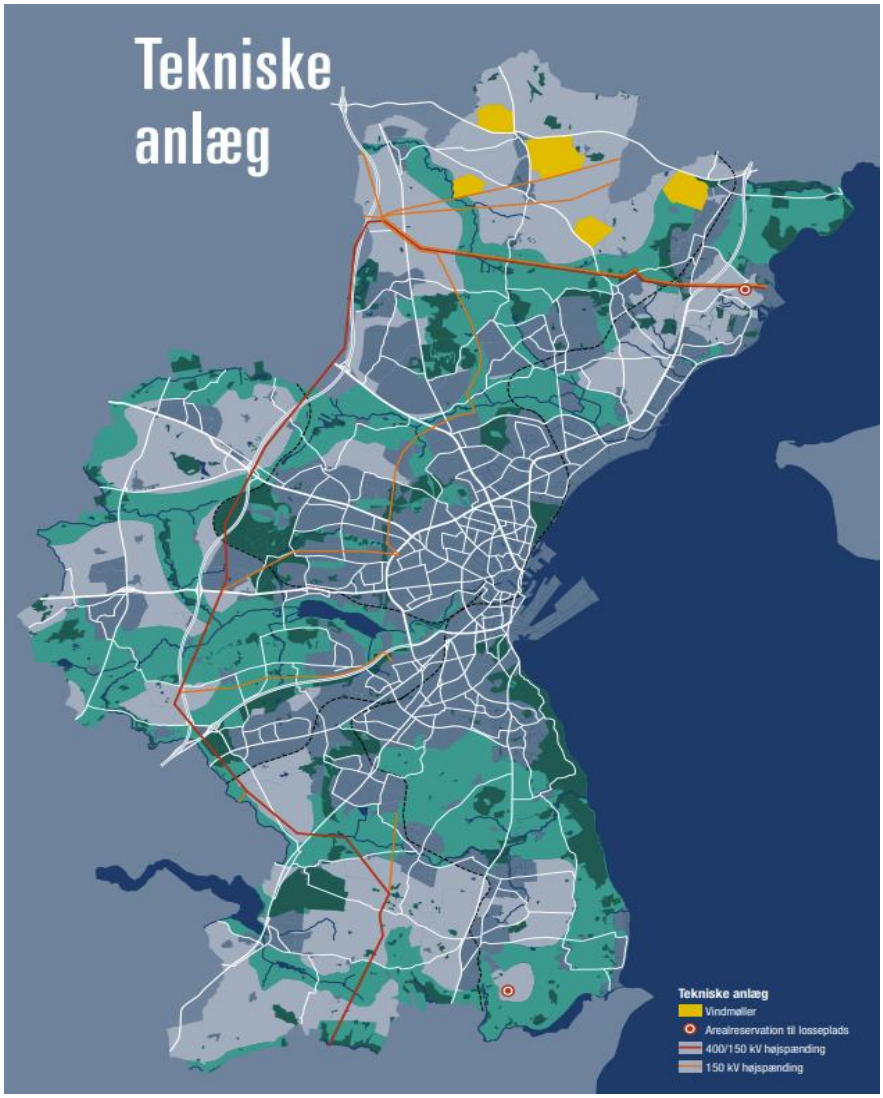

Figure 10: Overview of technical facilities in the main structure of the 2001 Municipal Plan including the transmission grid (red and orange lines) and placement of wind turbines (yellow markings) (Aarhus Kommune, 2001, p. 96).

However, the development of the electricity grid, in contrast to the wind turbines and other technical facilities, was not a perspective that Aarhus Municipality could plan for. Instead, it was a status for the current electricity grid and the location of it. This only included transmission lines and did not include distribution lines. Besides the figure, there were no mentions of the electricity grid in the text. However, this points towards a new focus on including the electricity grid infrastructure. The change in the scope of energy planning, however, did not mean that the municipal planning encompassed all the technical components that existed within the energy system.

Furthermore, the scope of planning was very much focused around heating and less about electrification. The way energy was presented in the Climate Heat Plan, showed a clear focus on new technologies emerging, such as RE.

The Climate Heat Plan from 2009 was in direct continuation of the City Council's decision in 2008, to implement a goal of reaching climate neutrality in 2030 (Aarhus Kommune, 2009). In the Climate Heat Plan, a topic of discussion was the technological prospects of different energy sources to start planning for (Aarhus Kommune, 2009). Whether it should be the safer path of combustion of biofuels, or whether it should be a more innovative path by investing more into renewable sources. Part of the Climate Heat Plan from 2009 called into question what the role of the municipality should be regarding the construction and operation of new heat and electricity generating plants, and whether it should be Aarhus Municipality or district heating companies being responsible (Aarhus Kommune, 2009). The discussion of expanding on the roles of planning and delegating tasks was prevalent for the time period, likely due to the expansion of the energy planning scope.
The emergence and consideration for renewables and, in turn, a complicated energy mix, increased the responsibility of Aarhus Municipality, leading to a delegation of roles.

6.1.4 Enhanced Strategic Planning (2012-2025)

As aforementioned, a political focus on supporting partnerships in municipalities in 2012 led to a funding of 19 mio. DKK (Energistyrelsen, 2012). Despite this, the planning practice was not made obligatory and still remains voluntary today. Aarhus Municipality's Municipal Plan 2017, which is also the current one, does not reflect these priorities. Instead, the plan focuses on urban growth, livability, and preparing for metropolitan life (Aarhus Kommune, 2017). Looking into the main structure and visions of the Municipal Plan 2017, these desires are not an integrated part of the visions for the municipality, which instead showcases other priorities such as developing the city, enhancing the livability in the city, and preparing for metropolitan life (Aarhus Kommune, 2017).

Looking into the physical landscape of the time, the figure below illustrates the distribution of energy sources in 2015, showing the progress of the decentralization of energy across Denmark (Energistyrelsen, 2017):

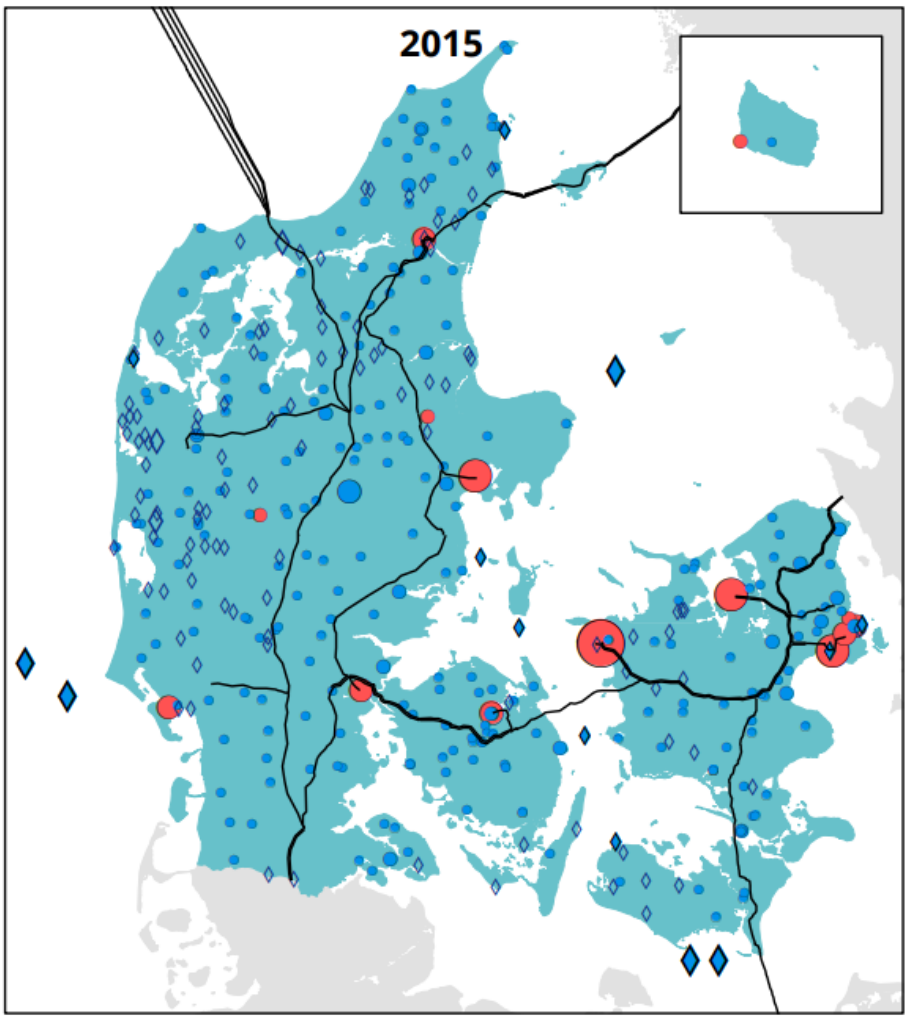

Figure 11: Danish transmission lines in 2015 with central plants (red circles), decentralized plants (blue circles) and wind turbine parks (squares) (Energistyrelsen, 2017).

The change in energy sources becoming decentralized, in turn, means a higher demand for expanding the distribution lines, to reach a wide set of energy sources, rather than fewer plants driving the production.

In 2015, the Paris Agreement was signed by 195 countries, including Denmark, to make sure that the global temperature rise would not exceed 2 degrees Celsius, and aimed for no more than 1.5 degrees Celsius compared to 1990 (Realdania, n.d.). Following this, DK2020 was established in 2016, by Realdania, which is a private firm (Realdania, n.d.).

The purpose of establishing DK2020 was to ensure that municipalities were properly advised on shaping their climate plans and making sure that they have the proper tools to secure compliance with the Paris Agreement (Realdania, n.d.). This represented an incremental change at the time, by ensuring municipalities were adapted for change, while keeping it voluntarily. Furthermore, due to the increased focus on substantial CO_2-reductions, the extensive electrification has led to higher electricity grid demand.

Two years after the Paris Agreement, Aarhus Municipality published their municipal plan, spanning until 2029, and which is for the first time a fully virtual one, with the physical planning illustrated through an interactive GIS map.
The main structure focuses on three values for the city: 1) growth, 2) livability, and 3) preparing for a bigger city, within which the mapping of energy facilities, and infrastructures is included in the third value. Energy planning is further elaborated in a supplement to the main structure from 2020, where Aarhus Municipality adopted a supplement no. 54 to the Municipal Plan 2017 regarding RE facilities (Aarhus Kommune, 2020 December). The supplement is dedicated to the planning of new renewables, and also offers the physical landscape of facilities and the electricity grid, as seen in the figure on the next page.

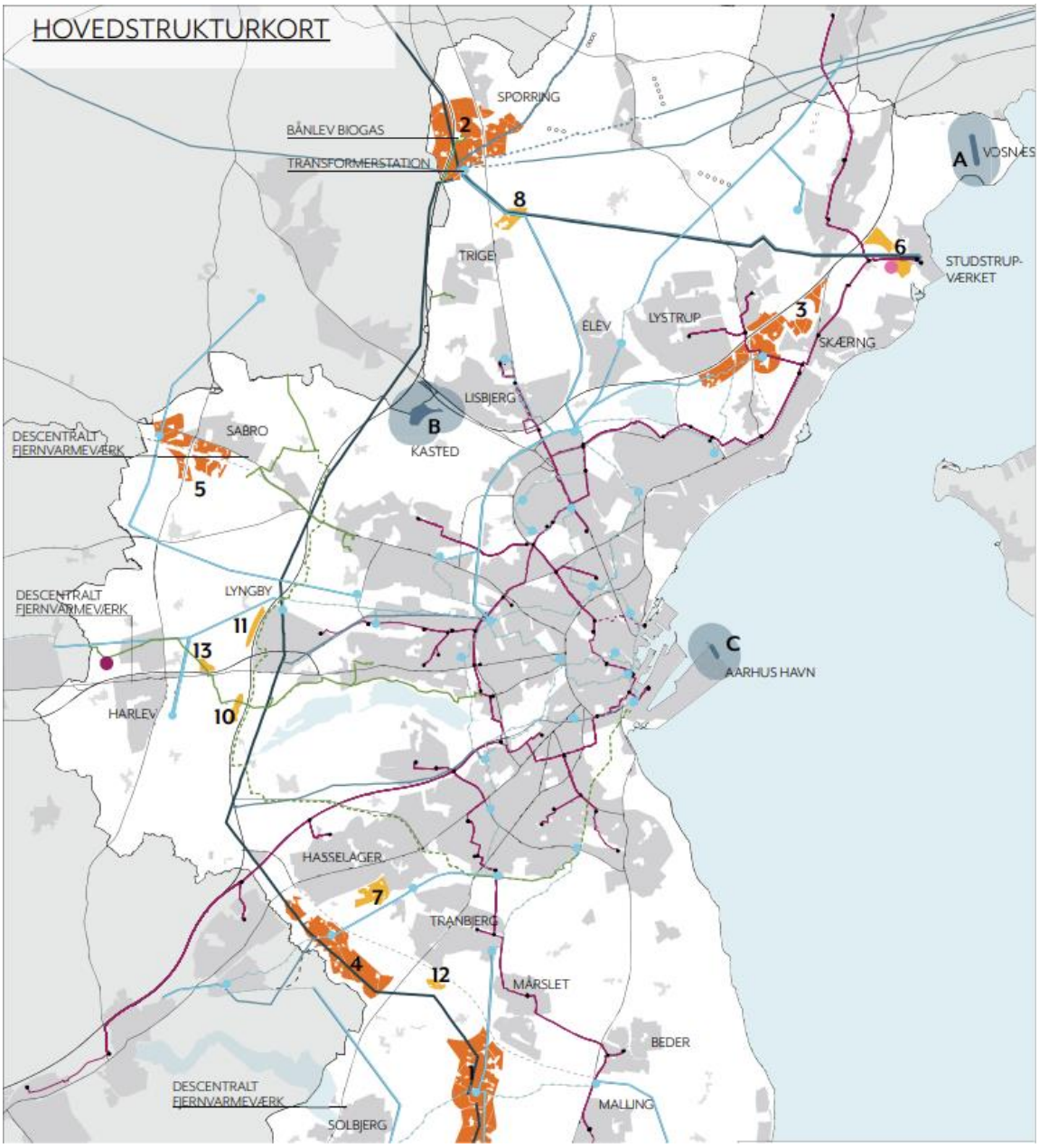

Figure 12: The placements of spatial reservation for technical facilities and grid infrastructure (Aarhus Kommune, 2020 December, p. 6).

Compared to the main structure in figure 10 from 2001, the details of the map have been elevated as it now includes both the transmission and distribution lines. The mapping creates an incremental change in the municipal planning, by now also consisting of areas that are relevant for technical facilities, such as wind turbines and PV. The areas are being marked as buffer zones and categorized as places that are eligible for possible wind turbine parks.

A significant shift in the planning tools used is visible in the implementation of GIS-based systems that allow the overlay of multiple spatial layers, including facility infrastructure such as pipelines and energy networks (Aarhus Kommune, 2017). This technological advancement can be argued to be an incremental change in how municipalities are able to plan holistically. By integrating physical infrastructure into digital planning interfaces, municipalities are theoretically better equipped to align land-use with strategic energy considerations.

As part of Aarhus Municipality's planning efforts to meet the ambitious climate goals adopted by the EU in 2019, the municipality issued supplement no. 81. This supplement focuses on the newly adopted 2030 target of a 100% reduction in emissions and reflects a broader, more integrated approach to energy infrastructure planning (Aarhus Kommune, 2020 June, p. 12). As seen in the figure below, a mapping that consists of possible areas for future technical facilities, including transformer stations, is illustrated for the first time:

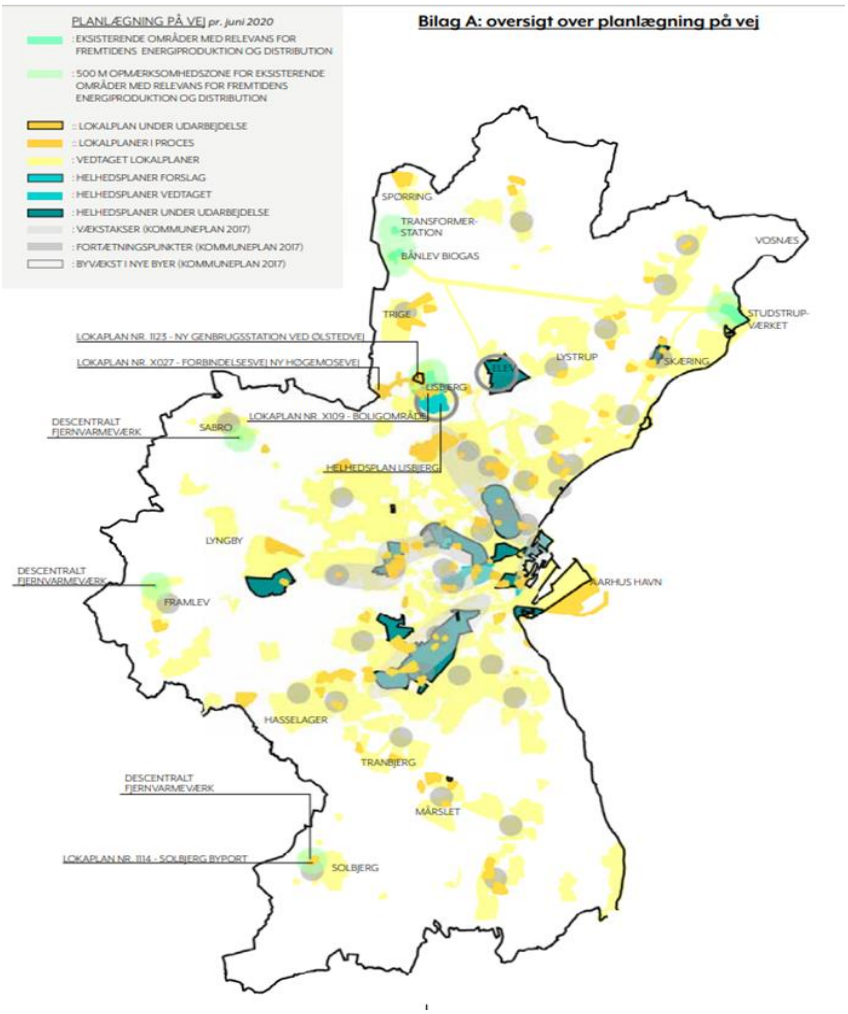

Figure 13: Overview of decided planning projects in Aarhus Municipality in 2020 (Aarhus Kommune, 2020 June, p. 17).

The intention behind the area reservations is to ensure that lack of physical space does not hinder the future energy production and distribution systems, including facilities such as charging stations, batteries, heat pumps, and thermal storage (Aarhus Kommune, 2020 June, p. 14). In supplement no. 81 of transition to green energy, it is stated that the municipality must ensure that specific needs are considered early in the process and in close dialogue with utility companies (Aarhus Kommune, 2020 June, p. 16). These considerations should be part of the process early enough to allow for reasonable adjustments to the project's economy, taking into account both physical space requirements and technical needs as stated by the municipality (Aarhus Kommune, 2020, p. 16). This is the first time the importance of the electricity grid infrastructure and the need for coordination between actors have been mentioned in a publication by Aarhus Municipality.
Aarhus Municipality defines SEP in their supplement no. 81, as a planning tool, with the integration of the following 5 categories: 1) dialogue, 2) overview, 3) coordination, 4) strategic frame, and 5) innovation (Aarhus Kommune, 2020 June, p. 5). This is the first time SEP is being mentioned in Aarhus Municipality's plans or strategies, creating an incremental change in the scope of the planning of energy within Aarhus Municipality. Furthermore, SEP as a concept is mentioned in the supplement as the framework they will embed in their planning of the energy system as the link between supply and spatial planning is essential for supporting a RE system.

On a national level, the prioritization of RE became more evident in 2022, when the Government, with broad support from other parties in the Danish Parliament, determined that the RE production on land should be quadrupled in 2030, to ensure Danish independence from Russian gas (Regeringen et. al., 2022). In the agreement text, it states that municipalities carry the main responsibility for the adoption of new local plans, which will realize the implementation of more wind turbines and solar (Regeringen et. al., 2022). This calls for extensive spatial planning in the municipalities to be able to realize these nationally set goals (Regeringen et. al., 2022). This, in turn, inevitably puts pressure on area reservations made in the municipalities, especially in dense municipalities such as Aarhus Municipality.

6.1.5 Toward Electrification Through Coordinated Planning (2025 - future)

In 2025, Aarhus Municipality is releasing both their Climate Plan 2025-2030 and their Energy Plan 2025-2045. The Climate Plan has been through its hearing phase, while the proposed Energy Plan is yet to be published. These plans set the outline for the long-term initiatives taken by the municipality to reach its climate target and, therefore, also its strategy in energy planning.

Diving into the proposed Climate Plan, it consists of initiatives that contribute to a sustainable city and their climate goal of being CO_2-neutral in 2030 (Aarhus Kommune, 2025, p. 4). The municipality actively positions itself as an actor of change, outlining its multifaceted role as a company, authority, energy supply owner, and facilitator (Aarhus Kommune, 2025, p. 13). The Climate Plan includes 8 action areas with energy as one of them. The upcoming energy plan is also a part of the energy action area, and its purpose is to provide an overview of all existing and planned energy conditions in the municipality. It is also stated that this overview will make it possible to point out the potential need for land reservation for necessary infrastructure facilities (Aarhus Kommune, 2025, p. 21).

Today, 82% of Aarhus Municipality's energy supply comes from renewables, with biomass covering 63% of this (Aarhus Kommune, 2025, p. 20). 17% of the energy still comes from fossil fuels. The City Council will phase out both fossil fuels and biomass (Aarhus Kommune, 2025, p. 21). Regarding the expansion of RE, the City Council has currently decided on up to 1,600 hectares of PV and 8 new wind turbines towards 2030. To supply its citizens with rising energy consumption, the goal is to establish enough energy to supply its citizens with 65% of the consumption (Aarhus Kommune, 2024, p. 7). Aarhus Municipality is struggling with difficulties in finding available space with the appropriate distance to residents (Aarhus Municipality, 2024, p. 3). The figure below shows the areas in Aarhus Municipality available for more wind turbines with a height of 150 meters.

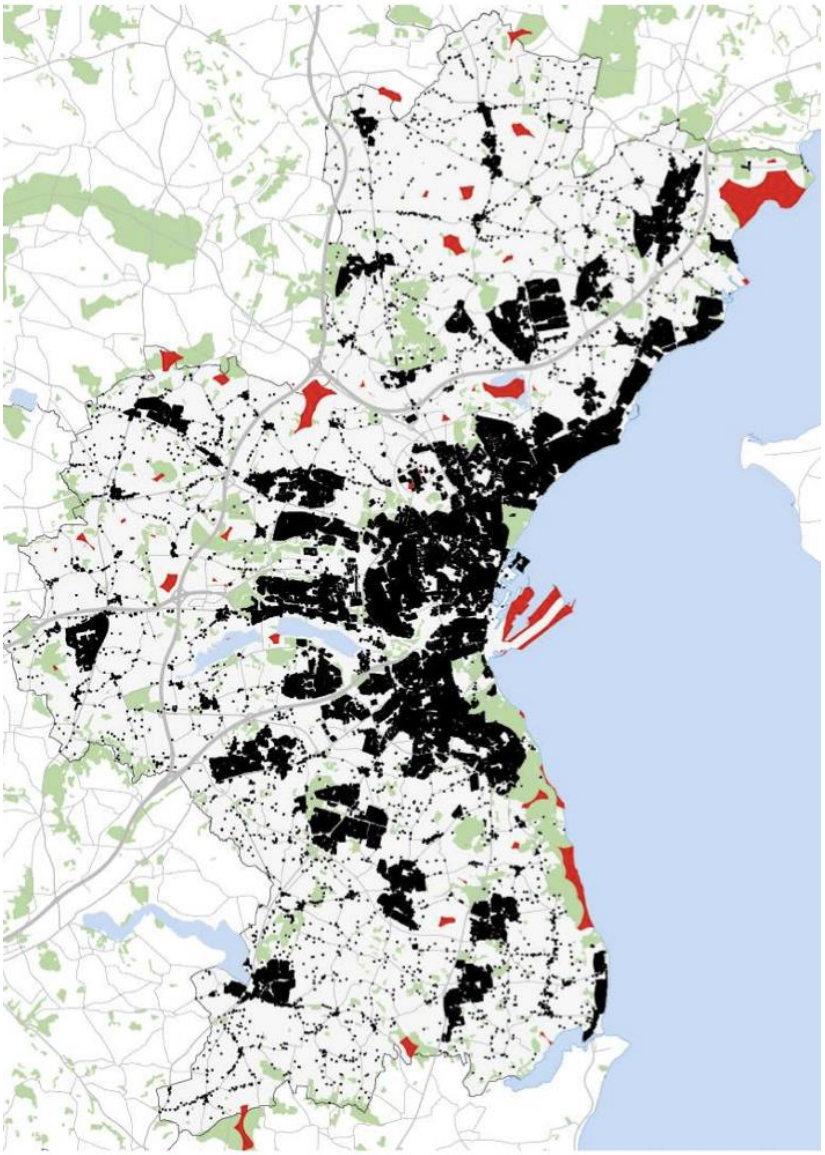

Figure 14: Overview of places where it is known possible to place wind turbines with 150 meters in height (red areas) (Aarhus Kommune, 2024, p. 3).

Aarhus Municipality is both struggling with difficulties in finding available space with the appropriate distance to residents and the persistence of opposition by local citizens (Aarhus Kommune, 2024, p. 3). To achieve the municipality's climate goal, the implementation of a new planning model for RE is argued for in the upcoming Climate Plan (Aarhus Kommune, 2025, p. 21). Such a model should enable faster and more flexible local planning, ensure earlier involvement of local stakeholders and energy developers in the planning process, and strengthen citizen engagement (Aarhus Kommune, 2025, p. 21). Energy infrastructure is not mentioned in relation to this nor in other sections of the strategy. The municipality emphasizes the expansion of RE, yet the plan does not address how electricity will flow, where capacity needs to be expanded, and how systems need to be integrated.

This lack of focus on grid infrastructure reflects a broader structural challenge, as municipalities are structurally excluded from electricity grid infrastructure planning, due to the Electricity Supply Act. Municipalities are therefore not given any influence on the planning of the electricity grid at all. Furthermore, the DSOs are also bound by the reformed Electricity Supply Act from 1999. Rørby from Dinel underscores this constraint, explaining that even when early dialogue with municipalities occurs, they are legally prohibited from initiating expansions until a formal demand materializes (Rørby, Appendix B, p. 4). This regulatory framework not only restricts DSOs' ability to act proactively but also creates coordination mismatches with municipal planning processes, which operate under a fundamentally different logic.

Municipal planning, as Sørensen from Aarhus Municipality points out, follows an anticipatory model, where municipalities are allowed and even expected to initiate local plans in advance of concrete projects. This leads to a structural misalignment between the two domains: while municipalities prepare for future urban development and include other actors early in the process, their plans are not aligned with the capacity or timing of electricity grid infrastructure, which remains legally and procedurally reactive. Sørensen highlights the dilemma, pointing out that while public sector planning can begin even without a building application, the same is not possible for electricity planning. This misalignment contributes to delays in the process. Without coordinated planning procedures, the dialogue between municipalities and DSOs remains unstructured and heavily reliant on local initiatives.

Birch mentions Aarhus Municipality as a best-case example, as there are some municipalities within their operation area they aren't even in dialogue with because they have never heard from them (Birch, Appendix A, p. 5). Birch points out a significant issue, being the degree of municipal involvement is highly uneven across the country (Birch, Appendix A, p. 5). Aarhus Municipality with Sørensen, shows the willingness to coordinate but without corresponding legal or institutional reforms to formalize its role, it points toward institutional mismatches that exist between municipal planning logics and the operational logic of DSOs and Energinet.

6.2 Analysis part 2

Looking at the historical development, energy planning can be categorized into different periods, leading up to the current municipal planning tasks and practices prevalent today. The different periods will be analyzed further, with the most prevalent external factors, and what have shaped the periods, with a focus on the conditions for electricity grid planning. The distinct periods, and the characteristics shaping the peri0d, are interpreted in this part of the analysis. These will be explored to identify what critical junctures and path dependencies have emerged. To offer a systematic overview of the different periods, a table has been made, based on the framework in figure 8.

6.2.1 Crisis-Induced State-Led Energy Planning (1973-1987)

The 1973 oil crisis marked a critical juncture that disrupted the status quo and revealed vulnerabilities in Denmark's energy system. Before the crisis, Danish energy policy was underdeveloped, with a heavy reliance on imported oil and a lack of long-term planning. The crisis forced policymakers to confront the risks associated with import dependency, and the lack of energy diversification. As HI suggests, such shocks often open up a window of opportunity for institutional reconstruction. With the Act on Energy Policy Measures in 1976, energy policy became more coherent and state-directed, with an administrative structure in the energy sector, and the Danish Energy Agency to monitor developments in production, supply, consumption and, research in the energy field. This can be seen as a case of institutional layering, where new structures were added to the existing governance framework, to handle emerging challenges.

This reorientation at the national level also triggered changes at the municipal level. In 1978, Aarhus Municipality developed its first heating plan. This was a result of institutional changes at the national level, introduced through Danish energy policy in the 1970s following the oil crisis. These changes shaped institutional norms and created structural incentives that enabled municipalities to engage in formal energy planning for the first time. This marks the beginning of a path dependency which would influence local energy planning for decades to come.

In the 1970's, the energy supply went through a significant change, and the workload of planning and operating the system grew, resulting in a new ministry responsible for energy planning. In the national energy report of 1982, it is emphasized that the national energy supply requires a long-term planning perspective with an overview of the overall needs of society to secure the appropriate investments. Here, a critical juncture occurred, as it was recognized by the government how energy planning must be developed and controlled by the public sector. Despite this critical juncture, the electricity grid was not addressed in any of the municipal planning documents.

6.2.2 Sustainable Energy Planning (1988-2000)

The publication of the Brundtland Report in 1987 created a focus on the negative impact of human activity on the environment. As a result of this report and national climate targets, it became clear that the Danish energy sector had to meet the energy demand in a sustainable way. This marked a change in informal institutions, as a national CO_2-reduction goal was adopted on the basis of the report, illustrating how external conditions can trigger institutional change.

A shift toward sustainable energy was needed, and this involved addressing the governance system by creating an institutional reconstruction, as emphasized in the national long-term energy plan from 1996. By stressing these arguments, it became evident that integrating RE required not just new technologies but also a reconfiguration of planning structures. This shift also implied a move from a more traditional top-down structure of the energy system, and redefined institutional roles. Municipalities have always played a key role in energy supply regarding district heating systems and local power plant, but now the energy system would become complex with both the decentralization of energy sources and the division of ownership as a result of the Electricity Supply Act.

This shift in agency, with a liberalization of the electricity market, marked a critical juncture. There was a break from a centralized, state-driven energy model toward a more decentralized structure involving new actors and an altered ownership structure. This significantly complicated municipal planning, challenging their ability to plan holistically across sectors and actors.

Aarhus Municipality illustrates how local governments began engaging in long-term energy planning during this period. In 1989, the municipality published its first long-term energy plan, with a focus on reducing fossil fuel dependency through district heating, energy efficiency, and local renewable resources (Aarhus Kommune, 1989, p. 5). The Studstrup facility was, at the time, one of the largest electricity facilities built and remained central during this period of energy planning.

While municipalities are increasingly expected to act as local coordinators, this role is being layered onto existing structures of planning practices. This points toward a path dependency, where municipalities are expected to coordinate energy planning, yet operate within institutional structures that were not designed for integrated, cross-sectoral action. The lack of authority over energy facilities and electricity grid infrastructure reinforces a path dependency, making local planning reactive to external, often private, initiatives rather than proactive and strategic.

6.2.3 Fastly Expanding Energy Planning (2001-2011)

Urbanization took off in Aarhus Municipality around the millennium, shaping the built environment to accommodate the growing population. In turn, this created a new demand that shaped the prioritization within municipal planning, with the planning imaginary being to secure Aarhus as an attractive city for newcomers. Part of the embedding of this imaginary was to secure enough energy that was also cost-efficient. New energy sources emerged; however, they were not going to become an integral part of the energy planning, due to the planning imaginary at the time focusing on sustaining the upsurge in housing and rapid industrialization.

Area reservations for energy facilities were minimized to accommodate the growing urbanization. But for Aarhus Municipality, temporal planning focused on securing that the energy sector could follow the demand. The emergence of new technologies didn't influence or change the overall planning practices of the municipality, and the practice was more of a status-quo, where instead the higher ambitions for development were the overarching theme for the period.

6.2.4 Enhanced Strategic Planning (2012-2025)

Energy planning has been broadened to more than just the technical facilities, and the concept of urbanity was broadened to integrate different desires for the energy system in the planning. In continuation of this, in 2019, the EU adopted the climate goal of reaching a 70-pct. reduction, ultimately putting pressure on municipalities to follow the goals and subsequently reduce carbon emissions faster.

In Aarhus Municipality, a more ambitious climate target from the plan strategy in 2008 shaped the municipal planning. This is seen in the supplement no. 84 to the Municipal Plan 2017, changing the scope for what the municipality should plan for. There was a heightened focus on including more than establishing energy facilities within the energy planning. Furthermore, the technical development of the main structure, now being shaped through GIS, changed the planning instruments for Aarhus Municipality, as this allows for more cross-sectoral planning when doing the spatial division of its area. The expansion of the electricity grid can be seen as a prerequisite for reaching the climate goals and needed electrification, however it is not an integrated part of energy planning, in spite of a heightened focus on thinking more strategically.

6.2.5 Toward Electrification Through Coordinated Planning (2025 - future)

The municipality's role in achieving climate initiatives has become increasingly complex. As RES demand more space and integration with existing spatial purposes, municipalities are the key actors responsible to make spatial division, yet with limited influence over electricity grid infrastructure that is essential for electrification. This dynamic reflects institutional misalignment, shaped by historical processes that have left energy infrastructure and spatial planning operating in parallel rather than in coordination.

Both Aarhus Municipality and the DSOs' experience challenges in coordinating their planning of future energy projects with the needed electricity grid despite long-term plans like municipal energy- and climate plans, together with the NUP, being embedded in the planning process.

This points toward a path dependency of planning, where initial decision-making, such as the liberalization of the energy sector, has created path dependent structures that separate responsibilities for energy facilities and energy infrastructure planning.

While municipalities have the responsibility to ensure the RE supply and grant permits for physical installations, they lack influence over electricity grid development, which remains the legal responsibility of the DSOs. This is even though the municipalities responsible for the energy supply are expected to develop plans to reach their own and the national climate goals. This creates a division of responsibilities related to energy planning, resulting in institutionally siloed governance, where infrastructure and land-use planning are evolving in parallel, shaping the prerequisite for planning.

The planning practices surrounding electricity infrastructure in Denmark are shaped by the legislative framework, which still poses significant challenges for planning between municipalities and DSOs. Although some DSOs now seek earlier dialogue with municipalities and vice versa, these efforts represent only incremental change within an institutional framework that reinforces fragmented planning. As long as this division of authority persists, the planning and implementation of electrification will continue to face risks of delays due to coordination barriers.

In the following table, the significant conditions for each period are illuminated within each of the four dimensions.

	Agency **a. Key Planning Actors**	**Structure** **b. Political economy** **c. Energy demand**	**Institutions** **d. Formal Institutions** **e. Informal Institutions**	**Discourse** **f. Planning Imaginary** **g. Idealized Energy Model**
Crisis-induced State-Led Energy Planning	a. Danish Parliament, Danish Energy Agency, Danish Energy Ministry, Aarhus Municipality.	b. Economic priorities post-crisis emphasizing cost-efficiency and national energy independence. c. Heat supply planning became a part of the municipality's tasks due to the need for infrastructure investments and supply security.	d. Establishment of Danish Energy Agency (1976) to centralize monitoring and coordination of energy policy. Act on Energy Policy Measures (1976) to establish legal and policy frameworks for reducing oil dependency. e. Introduction of national energy plans to establish long-term planning and socio-economic security.	f. Energy is emerging as a critical resource. g. Cities visioned as self-sufficient supported by centralized planning and public investment.
Sustainable Energy Planning	a. The EU, Danish Parliament, Danish Energy Agency, Danish Energy Ministry, Aarhus Municipality and private energy companies.	b. Energy transition driven by national climate targets and liberalization of the energy market. c. More demanding energy capacity to follow the urban expansion with housing and businesses.	c. Electricity Supply Act (1999) liberalizing the energy sector. Planning Act (1990). First national goal af reducing emissions by 20% in 2050. d. Growing environmental awareness influences planning. Municipal plans are spanning longer.	f. Meet the recommendations in the Brundtland Report. g. Prioritization of RES to support an environmentally friendly energy system.
Fastly Expanding Planning	a. The EU, Danish Parliament, Danish Energy Agency, Danish Energy Ministry, and Aarhus Municipality and private energy companies.	b. Securing competitiveness with other municipalities and Aarhus in the position of a growth driver. c. Growing urbanization and demand for energy.	d. Establishment of Energinet (2004). The City Council adopts a goal of reaching climate neutrality in 2030. e. Further focus on sustainability and RE. Reduction of previous energy facility area reservation for urban purposes.	f. Positioning Aarhus as a rapidly growing city. g. Energy production that can sustain urbanization.
Enhanced Strategic Planning	a. The EU, Danish Parliament, Danish Energy Agency, Danish Energy Ministry and private energy companies.	b. The competitiveness has increased from a national to an international scale. c. Existing energy production is being transitioned towards CO2-neutral energy sources as well as growing demand from electrification of society.	d. The EU set a binding climate goal in 2019 of reaching 70 % carbon reduction in 2030. Establishment of DK2020. e. Strengthening community and development of the city, through more communication in relation to projects.	f. Securing that the necessary technical facilities to support a green transition will be implemented. g. The energy system needs to consider non-technical elements.
Comprehensive Energy Planning	a. The EU, Danish Parliament, Danish Energy Agency, Danish Energy Ministry, Aarhus Municipality and private energy companies.	b. Green growth. c. RES that accommodates the transition towards 2030.	d. Proposed Climate Plan 2025-2030 and upcoming Energy Plan 2025-2045. e. Top-down planning: Technical facilities and capacities are proposed and determined by the City Council.	f. A climate-neutral city is only achieved through a joint effort. g. Need of new planning model to accommodate for flexible local planning.

6.3 Summary

Through this analysis, a periodization of the development in energy planning focused on the municipalities' practices and illuminated by the case of Aarhus Municipality, has been done.

In the figure below, the five different periods are illustrated with the determining structures that have partially framed the conditions for the energy planning in municipalities. Additionally, the national plans that, in turn, shaped municipal energy planning are illustrated at the bottom.

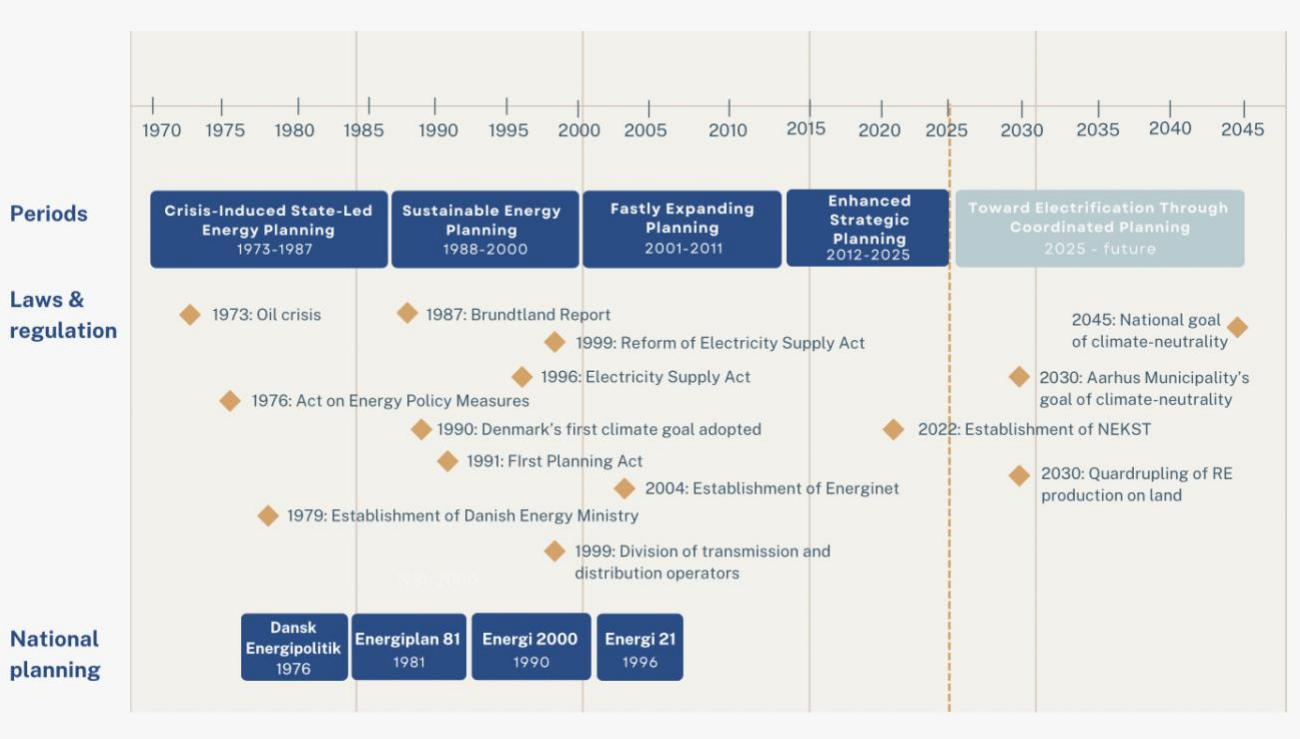

Figure 15: The historical structural conditions shaping energy planning in Aarhus Municipality (own figure).

Based on the historical overview of the planning periods for energy planning in Aarhus Municipality, it can be concluded how energy planning and energy development are interconnected. Starting from the 1970's the conditions for planning allowed for a complete transition of the energy sector without bottlenecks, due to the legislative framework as well as spatial planning. This, in turn, meant that the electricity grid could act as 'invisible' infrastructure in planning documents.

Throughout the historical development, however, obstacles have emerged due to changes in supply, demand, and technical conditions, while the legislative framework for the electricity grid has remained somewhat unchanged since 1999. Regulatory frameworks have created path dependency in planning practices, locking them into outdated logics and a fragmented division of responsibilities between energy planning, system operation, and infrastructure providers.

The energy transition and urban development have created new demands for cross-sectoral coordination. This has led to challenges in expanding the electricity grid, as the actors responsible for planning are not the ones executing the plans. As a result of the current regulatory framework, energy planning today cannot account for developments that have led to a complex energy system, which requires an actor capable of holistic and long-term planning. Furthermore, municipalities plan in advance and expect both energy facilities and infrastructure to follow, while DSOs must wait for formal demand signals before initiating any action. The result is a coordination gap, which, unless addressed through institutional reform, threatens to stall both local development and national decarbonization efforts.

External circumstances have shaped energy planning rather than by municipal strategies. While municipalities' responsibilities have increased, they remain institutionally constrained by outdated governance structures and market-driven frameworks that do not promote strategic planning. Therefore, grid infrastructure still does not appear in Aarhus Municipality’s energy planning practices.
These historically determined misalignments still exist, and the ambitions for sustainable urban and energy transitions outpace the adaptability of the regulatory framework. Going forward, addressing these structural barriers will be crucial to ensure the energy system's capacity to support a carbon-neutral transition.

7. Analysis 2

This analysis examines the planning approaches in Thisted Municipality, with a focus on integrating the electricity grid into local energy planning. Through the first part of the analysis, an investigation of Thisted Municipality's current energy planning and its strategic features is emphasized with a point of departure in the ASID model. The second analysis investigates if Aarhus Municipality could benefit from adopting a strategic practice to better align energy planning with infrastructure needs, comparing their current practices with those of Thisted Municipality. Insights on Thisted Municipality's planning practices related to electricity grid infrastructure are based on their current plans and strategies, combined with an interview with the director of the local DSO in Thisted Municipality.

7.1 Analysis part 1: Thisted Municipality as a Strategic Energy Planner

The first part of the analysis introduces Thisted Municipality's conditions for municipal energy planning and investigates how Thisted has taken on the role of a key energy planner. The ASID framework, shown in figure 8, is used to operationalize Thisted Municipality's approach to SEP, with a focus on the current conditions shaping their practices. Furthermore, the inclusion of the electricity grid in the two municipalities, or the lack thereof, will be explored.
The current municipal plan for Thisted spans from 2021 to 2033, after the City Council adopted a revision to the previous municipal plan (Thisted Kommune, 2021). The current main structure is divided into five different themes, with one of them being climate, energy, and infrastructure.

To follow up on the theme, the City Council in Thisted Municipality adopted its strategy for a sustainable transition, 'Grøn Fremtid Thy', across its organization in 2022 (Thisted Kommune, 2023, p.7). It includes three policies across its organization for the period of 2023-2026. With the political interest in ensuring the greatest possible climate benefits while securing as little negative impact on local communities, it lays the foundation for the conditions of energy planning (Thisted Kommune, 2024).

As new energy facilities are still unknown, it is politically prioritized to make sure they contribute to the local development, so citizens and businesses gain from this.

In regard to their specific climate targets, they aim for achieving CO_2-neutrality for scope 1 and 2 in 2035 and extending this to include scope 3 by 2045. The strategy includes an action plan with concrete initiatives for how to achieve its ambitions. The action plan consists of 8 main initiatives, and relevant in this context are the category *Electrification* and *Energy Zones* (Thisted Kommune, 2023, p. 6).

7.1.1 Strategic Energy Planning: Lessons from Thisted Municipality

To achieve the climate ambition of being a climate neutral municipality in 2035, a model for the expansion of RE has been adopted, called The Thy Model (Thisted Kommune, n.d., A). It consists of a division of the geographical area, with themes as indicators for priorities when the City Council decides on new energy projects (Thisted Kommune, n.d., A).

The initiative, implemented in 2023, is a tripartite screening of its areas for energy facilities, which divides areas into, negative, neutral, and positive zones (Thisted Kommune, n.d., A). In figure 17 below, the division of the municipality into the three planning zones can be seen. Furthermore, the transmission line is illustrated with brown and the natural gas lines with orange.

Figure 16: Categorization of Thisted Municipality in the three planning zones: negative (green), neutral (orange) and positive zones (red) (Thisted Kommune, 2025 January).

The three planning zones determine the opportunity of establishing energy facilities (Thisted Kommune, n.d., A). In the negative zones, it will not be possible to establish facilities which cover about ⅔ of the municipality's geographical area. This is due to protection of nature and other protected areas, such as churches, as prescribed by the law. In the neutral areas, it will be possible to establish energy facilities, but with local engagement (Thisted Kommune, n.d., A). Part of the initiative is to support local energy associations, by including, hearing, and involving them in the process of establishing new energy facilities. This area is around ⅓ of the geographical area. Lastly, the positive zone, also called energy zones, sets the frame for eligible placements for space-intensive energy facilities, such as PtX-facilities and wind turbines. These are strategically placed in proximity to urban zones. Infrastructure plays a key role, so the zones are positioned to take advantage of existing electricity grid, gas network, and district heating systems. The idea behind the zoning is to make sure that facilities can exploit synergies among each other, by limiting the distance between facilities that require each other, and to ensure local green business development (Thisted Kommune, n.d., A).
In April 2024, the Municipal Council agreed on the first two energy zones, Hanstholm and Midtthy (Thisted Kommune, n.d., A). Both are strategically placed for optimal usage of, e.g. electricity grid, agricultural industry, and development opportunities. Hanstholm is located close to the coastlines to support facilities and industries that have a high water demand (Thisted Kommune, n.d., A). This is an example of strategic spatial planning that allows for consideration of existing infrastructure.

7.1.1. Local Engagement

Thisted Municipality aims to engage citizens through dialogue and have previously sent out questionnaires as a way to include citizens early on in the establishment of the energy zones (Sperling, Appendix D, p. 6). The questionnaire got 4,000 replies, showing interest from the community. Through the questionnaire, five themes were chosen as the most valuable to the citizens: 1) Local ownership, 2) Compensation of neighbors, 3) Forest, nature and recreational facilities, 4) Landscape and 5) Local support. The themes are used as a guide in local policy making, to ensure the interest of the public is being properly managed (Sperling, Appendix D, p. 6).

Thisted Municipality defines their own role as being a sparring partner for the local energy associations. They contribute by advising on how to establish an energy association, as well as by calling for meetings with citizens (Thisted Kommune, n.d., B). Participants in the energy associations include the public, along with additional participants from businesses, district heating companies, and other supply companies. An energy association effectively represents local interests and streamlines negotiations on behalf of Thisted Municipality. This way, local knowledge becomes a fundamental part of the municipality's planning approach (Thisted Kommune, n.d., B). Consequently, energy associations serve as a valuable channel for enhancing communication between Thisted Municipality, its citizens, businesses, and supply companies.

Regarding the municipality's criterion of local ownership, they aim for at least 50% of new RE facilities to be owned locally. Moreover, they prioritize projects where a significant share of the ownership is held by the local associations rather than private developers (Thisted Kommune, n.d., B). In this way, the municipality overcomes the challenge with a market-driven energy development, where local interests are often overlooked.

Additionally, the municipality places greater weight on the interests of citizens compared to the typical developer-driven model, which allows private actors to independently decide on the best locations for technical facilities. Private developers often tend to avoid democratic engagement with the community, which results in the exclusion of local knowledge and opinions from the planning process.
Although the structural planning in municipalities is top-down, due to the Municipal Council setting the frames based on a nationally set budget, Thisted Municipality has succeeded in introducing a bottom-up approach locally through citizen engagement. The energy associations, as a tool, motivate locals to partake in the planning of new technical facilities.

7.1.2 Zoning as a Planning Tool

Within Energy Zones, the goal is to identify and plan energy zones for future renewable technologies (Thisted Kommune, 2023, p. 14). The purpose is to create the most optimal conditions for new technologies. As part of this process, land area assessments are conducted to estimate the expected space requirements.
As described by the municipality, the identification of energy zones is the first step in securing the best conditions for implementing energy technologies to create synergies with the existing industry and local energy infrastructure. Another goal in the main initiative, Energy Zones, is the development of holistic energy infrastructure, including the electricity grid.
It is described how the municipality must: *"Ensures that awareness of plans within the relevant infrastructure is made public, and that the relevant partners are informed about the opportunities"* (Thisted Kommune, 2023, p. 15, translated from Danish). This is assigned to Team Energy and Resources, together with Evida, Thy-Mors Energi, Biogas Thy, Energinet and their local district heating companies (Thisted Kommune, 2023, p. 15).

The plan of the energy zones is prepared by the Climate Alliance Thy (KAT), designated by the municipality due to its scope of professional and local knowledge (Thisted Kommune, 2025 February). This consists of assessing a potential energy zone for the best match between existing local energy context, demand conditions and potential types of energy facilities. KAT is an association of local organizations across various projects and sectors, all working towards the sustainable development of the area. It was established in 2020 and consists of Thy Erhvervsforum, Fjordland, Thisted Kommune, Thy-Mors Energi, Thy Forsyning, Thisted Varmeforsyning, Dansk Industri, Thy/Mors og Hanstholm Havn — representing local businesses, the municipality, and owners of technical facilities and supply. Furthermore, Thy-Mors Energi is a partner company to the local DSO, Netselskabet Elværk, and indirectly represents them as well (Thisted Kommune, February 2025).

7.1.3 The Current Planning Landscape

In the following sections, the current planning period in Thisted Municipality will be analyzed using the ASID model, with its dimensions serving to illuminate the prevailing planning conditions.

7.1.3.1 Agency

Due to the responsibility for spatial planning, municipalities are a key planner for the long-term development and land use. However, regarding energy planning, the exact responsibilities of the key planning actors remain more undefined.
In Thisted Municipality, energy companies, suppliers, and the municipality have come together in KAT to create a common foundation for the work to reduce the municipality's CO_2-emissions. In relation to the model with energy zones in the municipality, KAT has been asked to prepare a vision plan for the Energy Zone in Midtthy (Thisted Kommune, 2025 February). While the municipality does not control specific projects, by planning these areas in advance, they have found a model that accommodates unknown energy projects through the strategic designation of available space.

Importantly, through the energy zones, the municipality facilitates local ownership, giving citizens and local stakeholders meaningful agency in the energy transition. This model empowers local actors to actively participate in shaping energy development in their communities, thereby strengthening democratic involvement and support for sustainable initiatives.
At the national level, as well as locally in Thisted Municipality, the DSO is bound by the Electricity Supply Act. They cannot expand the electricity grid without a developer's application to connect to the distribution grid and approval from the municipality. This legal framework places limits on long-term proactive planning, as the DSO acts not as a planning actor but as an executor of plans by constructing the necessary infrastructure.

7.1.3.2 Structure

Thisted Municipality operates under the economic model of "green growth", where the transition towards CO_2-neutral energy sources is viewed as essential to sustaining continuous economic growth within the municipality. This political economy is grounded in the Municipal Council's decision to invest in a transition towards a sustainable municipality.

This political prioritization is also reflected in the planning approach for RE, where Thisted employs extensive spatial planning to categorize areas eligible for the placement of RES. Additionally, the eligible areas are further categorized as a tool to account for local resources, in accordance with the KAT report. The energy zoning also takes into consideration constraints related to the electricity grid, strategically locating demand and supply close to each other.

7.1.3.3 Institutions

Thisted Municipality has established its identity as a front-runner in the green transition, considering itself a pioneering 'climate municipality.' This is integrated in their spatial and climate planning, highlighting the transition of the energy system as a core part of local governance.

A second key feature of their practice is a strong emphasis on actor collaboration. The municipality relies heavily on other actors in their planning processes with both energy associations and the KAT. These partnerships are established without a formal regulation and have become essential for the municipality for reaching their ambitions of using local resources, ensuring local engagement and implementation of complex energy initiatives such as energy zones. Collaboration is a key element in SEP, as local stakeholders must be involved to balance different interests and mitigate conflicts. With this collaborative approach, Thisted also embeds a bottom-up governance in planning, with citizens and businesses actively participating in energy planning. In practice, this is seen in the division of energy areas and the model for screening these, as they are done by energy actors through KAT. Furthermore, the neutral energy zones position citizens in the role of proposing energy projects.

Another tool is questionnaires and hearings, where citizens are brought into the process of consideration to prioritize when identifying energy zones. The aim for Thisted is to adopt a democratic planning approach. With this planning approach, Thisted Municipality illustrates that local energy planning can depend on the ability to take on a strategic planning approach.

7.1.3.4 Discourse

Thisted aims to ensure thorough inclusion of stakeholders in the early stages of planning to gain insights into demand and local conditions that are otherwise unknown to the municipality. They diverge from the typically developer-driven planning by adopting a more strategic approach that actively engages local stakeholders in the spatial planning of energy facilities. Through this, Thisted Municipality pursues a democratic planning approach that safeguards the interests of citizens and local businesses (Sperling, Appendix D, p. 4). This way, Thisted effectively captures what locals value most in the planning process and adapts its plans accordingly. The ideal energy model for Thisted is one where technical facilities are considered collectively to ensure synergies between facilities and industries, thereby enabling full electrification of the energy system. Additionally, the strategic use of local resources promotes a tailored approach that takes specific energy conditions into account.

The municipality also has its own area of authority where its competencies are most effective and should be maintained. However, Lasson notes that planners can sometimes be cautious about whom they include in the planning process, possibly due to legal interpretations of planning responsibilities (Lasson, Appendix E, p. 9). The DSO's experience is that there is a hesitance to involve supply companies in planning, which conflicts with Thisted Municipality's planning vision. Ideally, Thisted wants to include all relevant actors early in the planning process rather than after decisions are made. Nevertheless, it can be argued that dialogue and collaboration with the DSO remain limited, resulting in a lack of mutual awareness between the DSO and the municipality.

Based on this investigation of Thisted Municipality's current planning practices, the table below illustrates its characteristics based on the four dimensions. For proper comparison, both the current practices for Thisted- and Aarhus Municipality are showcased in the table, which will be compared in the second part of the analysis.

	Agency **a. Key Planning Actors**	**Structure** **b. Political economy** **c. Energy demand**	**Institutions** **d. Formal Institutions** **e. Informal Institutions**	**Discourse** **f. Planning Imaginary** **g. Idealized Energy Model**
Aarhus Municipality	a. The EU, Danish Parliament, Danish Energy Agency, Danish Energy Ministry, Aarhus Municipality and private energy companies.	b. Green growth. c. RES that accommodates the transition towards 2030.	d. Proposed Climate Plan 2025-2030 and upcoming Energy Plan 2025-2045. e. Top-down planning: Technical facilities and capacities are proposed and determined by the City Council.	f. A climate-neutral city is only achieved through a joint effort. g. Need of new planning model to accommodate for flexible local planning.
Thisted Municipality	a. The EU, Danish Parliament, Danish Energy Agency, Danish Energy Ministry, Aarhus Municipality and Energinet (TSO).	b. Green growth. c. RES that accommodates the transition towards 2035.	d. 'Grøn Fremtid Thy', setting the strategy for reaching climate neutrality in 2035. e. Supporting energy associations and implementing strategic energy zoning.	f. Energy planning is democratic. g. Local ownership- and engagement.

7.2 Analysis part 2: Comparison of Planning Practices in Thisted and Aarhus Municipality

Building on the first part's investigation of Thisted Municipality's planning practices, this part illuminates the distinction between the two municipalities' practices and their ability to plan strategically. Furthermore, it explores how electricity grid infrastructure is embedded in planning of both Thisted- and Aarhus Municipality. The comparison is divided into the four dimensions from the ASID model to illuminate planning.

7.2.1 Agency

Comparing the constellation of actors in Aarhus Municipality and Thisted Municipality, the energy actors in Aarhus Municipality have not yet gathered in the same form and scale yet. There also exists a climate alliance in Aarhus Municipality with a task force within energy (Aarhus Kommune, 2025 January).

Although, it is currently in its initial phase, still figuring out what to focus on and what actors to be involved. The group will be working with some central questions, including how to balance climate and land-use priorities with the interests of citizens and businesses, and what energy companies can achieve together. The alliance in Thisted Municipality have been working together for years and have gained a significant role in ensuring planning is done in an efficient way. In comparison to this, the alliance in Aarhus Municipality is just beginning to look at the challenges Aarhus Municipality is facing, and is not as evolved (Aarhus Kommune, 2025 January). The strength of implementing a climate alliance is that it allows for a dispersion of agency among actors within the alliance, instead of solely relying on the municipality. This shared agency enables a more inclusive approach where local knowledge, interests, and capacities are mobilized, potentially increasing the legitimacy and effectiveness of energy planning and implementation.

In relation to reaching its climate targets, the City Council in Aarhus has decided on reserving 1,200 hectares to establish PV and establish 10 more wind turbines (Aarhus Kommune, 2024 April, p. 6). However, the majority of these installations have not been assigned specific locations yet, and the establishment of the energy sources remains politically determined rather than coordinated. This top-down approach has led to recurring challenges during the implementation phase of such energy projects. When the municipalities are deciding on these ambitions to achieve their long-term transitioning of their energy consumption it often causes problems with local resistance in the hearing-phase (Sperling, Appendix D, p. 2). This approach demonstrates the path-dependent nature of Aarhus Municipality's energy transition process. Long-term energy plans are created without inclusive coordination, limiting the emergence of agency among diverse actors in decision-making. This practice creates a self-reinforcing challenge where municipalities are trying to operate strategically by publishing long-term energy plans, but the actual projects are not decided in an inclusive practice (Sperling, Appendix D, p. 2).
This is an example of a positive feedback effect, where Aarhus takes a direction of top-down decision-making, such as reserving land for PV and wind turbines without detailed local input, increasing the likelihood that future decisions will follow the same approach. In Aarhus, this could pose a challenge during the implementation of their upcoming energy plan.

Actor involvement is not coordinated to the same extent as in the Thisted energy zone model, which increases the risk of local resistance and delays due to fragmented planning between actors. Currently, the agency in spatial planning has remained solely in Aarhus Municipality's custody.
Given the path-dependent nature of long-term energy plans and the self-reinforcing dynamics, it is likely that Aarhus Municipality will continue to face challenges in meeting its climate targets unless it actively incorporates more inclusive practices into the planning phases of these energy projects.

In the Climate Strategy 2025-2030 by Aarhus Municipality, this challenge is also explicitly acknowledged, as the political parties have asked the department of Technology and Environment to explore the opportunities for creating a new model for planning of RE. The goal is to reduce the complexity of spatial planning processes and to better integrate these with existing land use considerations (Aarhus Kommune, 2024 April, p. 7). This initiative signals a recognition of the need for more strategic, cross-sectoral coordination and potentially a shift toward a more facilitative and integrated planning framework. In spite of both municipalities being constrained by the same legislative framework that hinders formal influence on the electricity grid, the DSO in Thisted is still aware of their own contribution in creating collaboration to accommodate the electricity grid (Lasson, Appendix E, p. 3) Furthermore, they are using initial meetings as a tool to strengthen their own planning and expectations long-term (Lasson, Appendix E, p. 10).

Sperling acknowledges the gathering of actors in the private sector as a part of SEP, as it plays a key role in securing a broad support from actors and maintaining a long-term perspective in planning (Sperling, Appendix D, p. 5). By having this collaboration between actors in Thisted, it prevents a project-oriented type of development, where developers are the driving force in new projects without a holistic perspective. It is a municipal task to ensure a democratic process, as they are the ones able to have a holistic perspective and take the necessary considerations (Sperling, Appendix D, p. 10). By doing this, Thisted Municipality ensures that the temporal aspect of SEP is being secured through the collaboration. This happens only when municipalities like Thisted Municipality take on this role actively.

7.2.2 Structure

Looking into the difference in the structure between Aarhus- and Thisted Municipality, it is evident that both municipalities share the same ideal economic model of 'green growth', that also shapes the transition for the energy sector. This influences the choice of energy sources e.g., which favors RE. The energy transitions of both municipalities are therefore technologically aligned.
The tools for a transition that supports green growth differ in the two municipalities, however, although they are still based on an awareness of the role of spatial planning in energy planning. In Thisted, the concept of spatial planning is grounded in a democratic planning approach, allowing for utilizing the local knowledge of actors including energy associations and industries, ultimately considering more than the technological aspect in planning technical facilities. For it to be considered strategic spatial planning, reservations must include a temporal perspective in which different interests are included and regarded. In Aarhus, the municipality uses area reservations as a means to secure and localize available space for the technical facilities.

Aarhus Municipality's use of spatial reservations as a planning tool lacks a strategic and holistic perspective. Rather than integrating long-term local interests, resources, and infrastructure, the approach appears primarily shaped by legislative requirements and space availability. By failing to include relevant actors such as citizens and industries early in the process, the planning risks overlooking potential conflicts of interest and technical considerations within the energy system. Although the reservation of space could be seen as a temporal measure, it is not sufficiently connected to a broader, adaptive planning strategy.
Thisted Municipality's model for energy zones has the potential for a municipality to fully illuminate the different local interests and promote local ownership through strategic planning. However, the conditions for the individual municipality might not make it a feasible tool for all, therefore it cannot be concluded whether or not Aarhus Municipality would be able to adopt the tool in their planning.
Both of the municipalities, however, lack an inclusion of the electricity grid as a part of the area reservations. Currently, this has not created an issue for the DSOs to realize the plans, however this is also due to the projected plans for RE stalling (Lasson, appendix E, p. 11).

Considering the exponential development in the energy transition expected awareness of each other's needs and responsibilities becomes crucial to combat delays and ensure that the electricity grid can continuously support the growing demand.

7.2.3 Institutions

The strategic embedding of planning differs in Aarhus- and Thisted Municipality specially regarding the strategic dimension. In Thisted Municipality, the planning of energy is not limited to the tasks formed by national regulations and is centered on local engagement. A central partnership is KAT and its strategic and coordinating role, ensuring that plans for energy zones consider the existing energy conditions combined with the future demand. This collaboration allows actors to engage early and collectively in a planning process when identifying where infrastructure expansion is needed and enables knowledge-sharing between actors who might otherwise plan separately.

In Aarhus Municipality, a similar structure could help ensure that the municipality strengthens a strategic collaboration. In a dense area like Aarhus, this becomes even more essential due to the shortage of available space in general and the gap between energy planning and the capacity of the electricity grid, making it more critical to correlate the planning. For Aarhus Municipality, collaboration through citizen engagement would also bring local knowledge forward and create a strategic approach to facility placement that makes sense from both a technical and social perspective. In this also lies an opportunity to include DSOs into energy planning as it would be considered as a component in a strategic approach.

Sperling also highlights this pre-project phase as a core element of SEP, as it is not the implementation phase that is important but rather the process of developing an area and unfolding the project by engaging local citizens and business (Sperling, Appendix D, p. 16). The importance of considering the temporal dimension in planning is further supported by Rørby from Dinel and Birch from KONSTANT. As Rørby from Dinel points out, a coherent energy system cannot be delivered on demand but must be founded on a coordinated supply chain.

The establishment of regular dialogue with Aarhus Municipality has already improved mutual understanding and created a shared planning culture, which both Rørby and Birch view as a strength in accelerating electricity grid expansion (Rørby, Appendix B, p. 4; Birch, Appendix C, p. 4).

7.2.4 Discourse

Applicable to both Thisted- and Aarhus Municipality is the understanding that planning is a joint effort, meaning that there is not solely one actor, including municipalities, who can achieve the desired outcome regarding the ensuring of climate goals being met. Also emphasized by Sperling & Jensen, who argues for a sustainable transition to be an integrated part of SEP (2019, p. 89).
Thisted Municipality's planning imaginary built on top of the aim of including climate regards in energy planning by stating that it is also necessary that the green transition is in line with the local development. This means that existing infrastructure and local resources are also being considered.

This approach also reflects Sperling's point that modern energy planning has moved beyond system optimization to encompass a broader climate agenda, bringing in sectors such as agriculture that are traditionally excluded from energy system considerations (Sperling, Appendix D, p. 3). Thisted Municipality embraces this broader discursive framing by integrating energy, land use, and environmental values early in the planning process. Their planning framework acknowledges the importance of synergies, especially between technical facilities and local industries, to promote spatial constellations that enhance energy efficiency and reduce conflicts. Importantly, Thisted Municipality's use of strategic stakeholder involvement has enabled the municipality to adapt its planning to the local context.

In contrast, Aarhus Municipality recognizes the importance of stakeholder inclusion and system integration in principle, yet its current planning practices fall short of realizing this ambition. As outlined in its forthcoming Climate Plan 2025–2030 and Energy Plan 2025–2045, Aarhus Municipality sets out comprehensive goals for achieving CO_2-neutrality and drastically scaling RE production. However, despite its ambitions, Aarhus Municipality hasn't integrated tools or mechanisms that allow for the same level of strategic planning as Thisted Municipality.

From Thisted Municipality's holistic approach, Aarhus Municipality can draw important lessons. Firstly, by moving beyond technical energy system optimization and instead adopting a broader climate and territorial perspective, in which Aarhus Municipality can create planning processes that are better aligned with local conditions. Secondly, Aarhus Municipality could benefit from a more strategic inclusion of stakeholders early in the planning process. To not only inform of their planning but to allow for a more thorough inclusion. Lastly, adopting a clearer facilitation role, as Thisted Municipality does, could help Aarhus Municipality navigate the structural limitations posed by national legislation on electricity grid development.

7.3 Summary

Both Aarhus- and Thisted Municipality follow a green growth model and use spatial planning as a tool in their energy transitions. Despite sharing the same economic model and both using spatial planning in their plans, their energy planning approaches differ significantly.
Thisted Municipality has applied a strategic and inclusive energy zoning model that involves local stakeholders early in the process, allowing for the integration of local knowledge and interests. This model enables planning processes that are more flexible, inclusive, and responsive to local conditions, reflecting a SEP approach.
Aarhus Municipality relies more on technical and legal criteria for spatial reservations, focusing on availability rather than collaboration. Neither municipality integrates the electricity grid directly into spatial planning, despite its central role in enabling the energy transition. Aarhus Municipality, despite ambitious climate and energy goals, lacks planning tools for early and meaningful local stakeholder inclusion. By embedding the planning practices from Thisted Municipality, Aarhus Municipality could ensure stronger collaboration across actors, aligning energy planning with energy development, and support the achievement of its long-term climate goals.

The two municipalities differ in how they approach their role as energy planners. Thisted Municipality has taken a proactive role by engaging directly with energy actors through KAT and even delegating parts of the site assessment for energy facilities to these stakeholders, enabling cross-sector coordination. Aarhus Municipality has yet to adopt such a model, which contributes to ongoing coordination challenges and potential delays in electricity grid infrastructure. SEP requires municipalities to act not only as regulators but also as facilitators, aligning spatial and energy planning through early engagement with infrastructure providers. By adopting this role more intentionally, Aarhus Municipality could improve project timelines and better integrate strategic planning in their planning.
However, these tools in Thisted Municipality might not be applicable to Aarhus Municipality. This is due to SEP being an approach that should be adapted to the local conditions. Therefore, the result of implementing the zoning tool from Thisted Municipality, might differ due to differences in local conditions.

8. Discussion

In this chapter, current conditions for integrating SEP by municipalities are discussed. This includes exploring both the opportunities that emerge when municipalities take on a SEP approach, and also the challenges they face. Through experiences from Thisted- and Aarhus Municipality, the operationalization of temporal planning, collaboration, local resources, and inclusion and awareness are discussed against the structural barriers in a Danish context.

8.1 Local Inclusion in Energy Planning

When it comes to specific energy projects, municipalities often underestimate the value of local knowledge (Sperling, Appendix D, p. 6). Energy plans are often introduced to energy operators and DSOs in a local area after decisions have been made, and these actors are therefore excluded from the initial planning phase. This planning process eliminates the ability to exploit local competencies and knowledge, ultimately not resulting in the most optimal energy conditions for local businesses and citizens.

To counteract these challenges, strategic tools can be used for inclusion to incorporate local knowledge in energy planning (Sperling, Appendix D, p. 4). One example is found in Thisted Municipality, where the energy zone model enables local associations to take part in defining the prerequisites for new energy zones. Thisted Municipality uses this as a proactive tool to reduce local resistance, increase legitimacy, and support local ownership. Additionally, Sperling underscores that if local residents eventually reject the project, it is still considered part of the SEP process, due to the project misaligning with the local conditions (Sperling, Appendix D, p. 16). The initial stages of local energy project planning, such as site assessment, are typically handled by private developers who focus on project delivery and cannot be expected to take a strategic approach that accounts for the realization of other plans (Sperling, Appendix D, p. 6).

A challenge for integrating a planning approach with inclusion of energy associations and ensuring local acceptance is the limited resources available to municipalities.

Although some municipalities, such as Thisted, have taken a proactive and strategic approach, this is not a common practice (Sperling, Appendix D, p. 4). Local inclusion often requires significant resources and is time-consuming. In most cases, only a small proportion of the municipality's budget is allocated to energy planning activities. This is due to the structural restriction within the budget, as SEP isn't legally mandated. As a result of this energy planning depends on surplus funds, which are unstable and not guaranteed in the long-term (Sperling, Appendix D, p. 4). This means that initiatives often depend on priorities from the local politicians and City Council (Sperling, Appendix D, p. 4).

While some municipalities are allocating resources for energy planning, inclusive and locally owned energy solutions remain dependent on these extra allocated funds and thus remain a niche. This makes the City Council an important actor, as it is responsible for the municipality's budget, and the inclusion of SEP is therefore determined by its political ambition. Furthermore, the allocation of resources for energy planning does not necessarily go to employees who can facilitate the municipal plans. Rather, municipal planning in Aarhus Municipality, as in other municipalities, is dependent on consultancy firms to create the plans. This is evident in the current municipal plans for both Aarhus and Thisted Municipality, which were prepared by Niras (Aarhus Kommune, 2017; Thisted Kommune, 2021). The planning is pushed outside the organization of the municipalities, as they do not have the human resources or competencies themselves. This could pose an issue, as Niras is not equipped with the same local knowledge as the municipalities for which they are preparing the plans, and they are also not responsible for the implementation of those plans.

This raises the question of whether the current model of municipal financial governance is well-suited to ensure the development of strong and locally grounded energy planning. In 2022, a national goal of quadrupling energy production from RES was adopted, with municipalities assigned the key responsibility of identifying and promoting new areas for RE development (Regeringen et al., 2022). Electricity grid infrastructure is a prerequisite for realizing the expansion of RE. However, ensuring this requires not only local engagement, but also coordination with energy operators, the TSO, and DSOs to ensure that proposed projects are feasible.

In the financial outline of the agreement from 2022, it is not indicated that funding will be allocated for administration at the municipal level. Instead, the funds are directed towards processing applications. As a result, there is a lack of human resources to drive the desired development forward strategically.

Even though it was concluded back in 2016 that there was a need for additional funding and national guidance to achieve the significant gains by integrating SEP in municipalities, it has still not become an obligatory task for municipalities. Due to the 2022 agreement of quadrupling RE on land, additional applications for RE could result in an unstructured approval of applications, not accounting for strategic placement and interplay between the existing infrastructure, if the necessary resources are not provided. The lack of resources is evident when looking at the number of employees in Thisted and Aarhus Municipality dedicated to energy planning. In Aarhus Municipality, the Department of Climate and Energy employs 53 people. Within the energy and heating domain, there are only about three full-time equivalent positions. In Thisted Municipality, the Department of Planning and Environment employs 19 people, of whom six full-time equivalents are engaged in energy planning tasks. These limited human resources reduce the municipality's ability to engage consistently with local citizens and energy associations, which is a necessary component of strategic and inclusive planning.

Despite these limited resources, Thisted Municipality demonstrates how a more participatory approach can be implemented in SEP. Thisted Municipality illustrates how strategic inclusion can be operationalized through its extensive survey sent to all residents, asking them to identify what they value in relation to local energy development (Thisted Kommune, n.d., C). Furthermore, Thisted Municipality's energy zone model addresses the complexity of integrating both citizen and energy operator engagement in the early mapping and planning phases.

By allocating resources to this, Sperling highlights Thisted Municipality's planning approach as an example of strategic inclusion rather than project inclusion (Sperling, Appendix D, p. 6). Although such processes are time-consuming and require significant administrative resources, they offer valuable insight into local conditions.

However, as long as municipalities lack dedicated and stable resources for energy planning, it remains challenging to implement this type of model nationally. It also raises the question of whether funding should be allocated to administrative energy planners to ensure alignment between infrastructure and the energy ambitions set by the government.

8.2 The Importance of Collaboration

DSOs are only allowed to expand their electricity grid when they receive an application for a specific energy project. This mismatches the municipal way of planning, where they make the energy plans and strategies first, without concrete project applications for the DSOs to act on. DSOs have experienced that there has been a lack of awareness by municipalities of what it takes to create new electricity grid infrastructure (Rørby, Appendix B, p. 4; Lasson, Appendix E, p. 7). It is a long process to establish new lines, due to obtaining permissions and a long supply chain (Rørby, Appendix B, p. 4). If municipal planning and approval processes are run with no overlap in the time period of the electricity grid connection process, instead of simultaneously, the time perspective is significantly prolonged (Lasson, Appendix E, p. 5). Both take one to three years, resulting in a project potentially taking twice as long (Lasson, Appendix E, p. 5). This is also one of the main reasons for delays in new projects (Sørensen, Appendix A, p. 6).

Municipalities are just starting to realize that electricity grid expansion requires proper planning (Rørby, Appendix D, p. 4). The importance of awareness of each other's plans is highlighted by Birch, who describes that a dialogue in relation to the municipality's making of plans has given awareness of how the electricity grid affects these (Birch, Appendix C, p. 4). Through these learnings, Kredsløb, the municipally owned heating company in Aarhus, has realized they need to act early if they want to ensure the electricity grid capacity the DSOs must accommodate for (Birch, Appendix C, p. 4). Alternatively, the municipality would only realize their capacity needs for an energy facility at a late stage, ultimately resulting in delays of multiple years (Birch, Appendix C, p. 4). This led to a collaboration between these two actors, with monthly meetings following up on the plans (Birch, Appendix C, p. 4).

This example of improved collaboration between Aarhus Municipality and their local DSOs highlights a key element in SEP with an early awareness through a cross-sectoral dialogue. If municipalities only recognize the electricity grid infrastructure's capacity for future energy needs, after they publish their strategies, the DSOs' response time starts late and can delay both municipal and private development plans by years. With a strategic and collaborative approach, facilitated through meetings in the project planning phase and exchange of knowledge between municipalities and DSOs, challenges with delays and silo thinking can be mitigated. When municipalities are aware of the long planning horizon for electricity grid expansion, they are more likely to initiate conversations, which underscores the need for coordinated efforts to facilitate this dialogue, ultimately supporting the need to secure the electricity grid capacity needed to support the growing electrification.

While these perspectives from the DSOs in Aarhus- and Thisted Municipality demonstrate the benefits of early inclusion and continuous collaboration between them and municipalities, it also raises the question of whether municipalities are in the position to take the lead in SEP within the current conditions for planning.

Firstly, SEP is voluntary for municipalities to integrate into their planning approach. Consequently, the level of awareness surrounding electricity grid infrastructure among municipalities can vary significantly on a national scale. As the continuous dialogue between DSOs and municipalities is an emerging constellation, some municipalities will run into obstacles due to not yet having an established dialogue. This lack of communication can result in a disconnection between municipal energy planning and electricity grid infrastructure, leading to the challenges highlighted by Rørby, Birch, and Lasson, with delays in the process of expanding the electricity grid infrastructure. From this perspective, it becomes clear that municipalities may not currently have the technical knowledge or adequate mandate to take the lead in securing SEP.

This raises the question of whether other actors should be more responsible for some of the planning tasks, including private actors such as the energy associations. By involving energy associations more actively in the planning processes, for example throughout the energy zone model as in Thisted Municipality, there is a greater potential to align local energy planning with electricity grid capacity requirements. Furthermore, the unknown variables are reduced, as areas are divided into zones with predefined locations for energy facilities. These actors have the understanding of the technical requirements for energy projects, as they are the ones operating them, and therefore in a position to align future energy projects with the local electricity grid infrastructure.

A second solution could be making SEP mandatory in municipal planning, to ensure a consistent and structured approach to incorporate consideration of electricity grid infrastructure in energy plans. Integrating SEP could reduce fragmentation by requiring municipalities to collaborate with DSOs and consider the infrastructure with plans that are technically feasible and aligned with local conditions. This would involve investigating how the optimal governance model for implementing SEP can be designed to embed collaborative practices into municipal tasks and ensure awareness across the entire energy supply chain, including the electricity grid.

Whether this is through giving responsibility to energy associations or creating a stronger mandate for municipalities through a legal framework, a more united and inclusive approach is vital to ensure that the electricity grid has the necessary capacity for future energy demand.

8.3 Fragmented Planning

Looking at energy planning on a national scale, the practice has changed due to historically evolving conditions. Before 2001, the practice was characterized by a planned economy, with national policymakers having a more holistic overview of energy planning. This changed with the government at the time, which put a stop to the national energy plans (Nielsen, 2012). It was replaced by a national policymaking approach that has become more fragmented, with energy planning carried out through different political agreements, each addressing singular aspects of energy planning, e.g., PtX or district heating.

This could also be a natural transition due to the changing scope of energy planning caused by the emergence of new energy technologies and a more technically complex system. Looking at the Ministry of Climate, Energy, and Utilities' overview of agreements within the current governmental period, which started in 2022, so far 16 different agreements have been created (KEFM, 2025). These include a wide range of administrative areas, such as setting the economic framework for hydrogen infrastructure, agreements on the framework for tendering offshore wind farms, and regulations for energy crops in biogas production, which emphasize the complexity of the energy system. This raises the question of whether returning to a planned economy would be feasible given the current scope.

The lack of a national energy plan, however, can create obstacles in coordination between municipalities and the national level, since municipalities must follow national guidelines. Without an energy plan that also considers the distribution of energy facilities from a local perspective, municipalities face difficulties knowing what to plan for, as was also mentioned at the expert meeting in Parliament in November (KEF, 2024).

At the municipal level, planning has become more fragmented, partly as a result of the legislative framework liberalizing the electricity market. Moreover, municipal planning consists of several planning documents that are not aligned with each other. Part of the intention behind the Electricity Supply Act was to ensure economic security for consumers, preventing companies from exploiting the system for economic gain (Elforsyningsloven, 2023). This framework still protects consumers today, and despite contributing to more fragmented planning among actors responsible for grid expansion, it would not be socioeconomically responsible to remove the current legislative framework.

8.4 Aligning Long-Term Municipal and Network Planning

Currently, the strongest tool bridging the gap between the municipalities and DSOs energy planning is the NUP, which was introduced in 2023 (Elforsyningsloven, 2023, § 22, stk. 1). The NUP is made from an economic point of view, as it sets out to map the expected investment needs.

This is more in the interest of the DSO to know. By including the investments, respectively, for the coming 5 and 10 years, the NUP is a tool that allows temporal planning and enables the municipalities to become aware of the DSOs' assessment of the future expansion needs. The NUP is also meant as a dialogue tool for all energy planners to create a common understanding of the development of infrastructure.

However, this is not what is experienced in practice, as mentioned by the interviewed DSOs. They experience being somewhat overlooked actors in SEP, even though the NUP is an obligatory tool that external actors can act on and "*for example, supporting interaction and coordination with municipal heat and energy planning*." (Energistyrelsen, 2024, p. 6, translated from Danish).
Of the 35 DSOs, only 10 of them received input or comments during the hearing period from the relevant municipalities in the publications of 2024 (Appendix F). In practice, this otherwise strong foundation for a dialogue between the municipalities and DSOs is not being used as intended, as also underlined in the interviews with the interviewees from KONSTANT, Dinel, and Netselskabet Elværk. Instead, it is mainly used internally to gather their own plans and get an overview of investment needs (Lasson, Appendix E, p. 14). On the other hand, it also creates concern for DSOs that the NUP is pseudo-work, due to not receiving any responses to it, which is the sole purpose of the NUP (Lasson, Appendix E, p. 13). It begs the question of whether or not the NUP is the correct tool to bridge the gap or if the circumstances around it are adverse.

The NUP is still a new tool, with the 2024 publications being the second year in which it has been legally obligatory. As mentioned by Sørensen, Aarhus Municipality made comments in the hearing-phase already at the first publication of NUPs, which was a surprise to the DSOs and not a common practice for all municipalities (Sørensen, Appendix A, p. 4). This resulted in more awareness of each other's needs, which could be argued to emerge from making of the NUP. In Aarhus Municipality, they still don't implement the NUP in planning, however, and the purpose of the NUP is therefore up for debate. On the other hand, it could also be due to NUP being a new tool, and it will take some years for the municipalities to transition and become more aware of their opportunity to get insight into the expertise knowledge of DSOs and their long-term investments.

As mentioned by Rørby, another issue with the NUP is that it offers a here-and-now overview of the electricity grid, and he argues that as soon as the NUP is published, it is already outdated due to new projects and applications happening right away, leaving the NUP no longer to be a reflection of the current situation (Rørby, Appendix B, p. 7).

The format for creating the NUP could also explain why it is not being used as intended. On the Danish Energy Agency's website, it is explained how the hearing process works, and it is clear that it happens after the preparation of the NUP, and is therefore isolated to the voluntary hearing, which has been lacking. Due to it being a voluntary tool to use, the hearing might then be limited to municipalities who see a purpose for the NUP as a tool or are more proactive municipalities with proper resources for it. It could also be argued that it would take some technological knowledge to understand the NUP and to understand what to learn from it in any way. Looking into the hearings from the 2024 publications of NUPs, the comments differ a lot, with some just simply sending a link to their municipal plan, which indicates that planners in municipalities are not aware of how to use the tool in planning or shows the lack of time investments. On the other hand, as argued by Sperling, the mapping of the electricity grid could be a very useful tool, as it aligns with the structuring of a main structure through GIS-mapping (Sperling, Appendix D, p. 12). However, due to the NUP having more of an economic focus, it weakens the link between the NUP and how the municipality plans ahead for technical facilities and infrastructure.

Another perspective, which is quite crucial when considering SEP, is its temporal dimension. With that, it is not only a question of whether or not planning is long-term, but it also needs to consider short-term planning to accommodate for the ongoing expansion of the electricity grid to support the exponential electrification. Here, the timing of the NUP is based on the LUP made by Energinet, so the transmission- and distribution companies' publications are aligned. However, in practice, the publication of the NUP is not aligned with how the municipalities are making their plans, as the NUP has a very strict deadline across all DSOs to be publicized at the same time.

For a municipality to implement the NUP in their planning, it would be difficult to make it temporally relevant due to the NUP possibly being outdated when the municipality is making their energy, climate, or municipal plan. The municipality would then need to plan around the legally set deadline of the NUP.

It leaves the question of what it can offer to bridge the planning gap between municipalities and DSOs. Based on the experiences of Aarhus- and Thisted Municipality, the NUP does not solve the lack of collaboration between the municipality and DSOs, but with proper use could have led to dialogue and a strengthened relationship between the two actors. KONSTANT experienced different amounts of involvement from the different municipalities, but it is not clear what motivates some municipalities to act on the NUP and for others not. This creates an uncertainty of the effect of NUP as a tool for dialogue. With the responsibility for the DSOs to follow the electrification of society, the NUP might be too weak a tool to promote a dialogue and collaboration to ensure that the electricity grid can follow the municipal goals. What it offers in terms of opportunities for municipalities to strengthen their planning of the energy sector remains to be further investigated.

Through this discussion, it has been emphasized that a key challenge in integrating SEP is the voluntariness of municipalities to incorporate it in their planning practices. This reinforces the poor communication between them and DSOs and thereby continues to maintain a planning practice where new infrastructure is not accommodated for. Furthermore, municipalities often lack resources to implement and operate such a model due to the lack of funding for SEP. Therefore, it can be questioned whether the current planning structure and division of responsibility are optimal considering the lack of resources, especially considering how the budget restricts the municipality from taking on a facilitating role in SEP, which is a prerequisite to implement a strategic approach.

9. Conclusion

This thesis has examined how the role of municipal energy planning has been influenced by evolving energy conditions over time, and how SEP approaches account for electricity grid development based on the case of the two Danish municipalities, Aarhus and Thisted.

Historically, energy planning in Aarhus Municipality has been shaped by structural conditions rather than by proactive local strategies. Based on the periodization of Aarhus Municipality's planning history, it can be concluded that the early dynamics of the conditions have led to a path dependency in the current planning landscape. This has resulted in a misalignment between energy planning in Aarhus Municipality and planning of electricity grid expansion. This is due to regulatory inertia, which has resulted in a fragmented planning structure. Municipalities lack the prerequisites to plan holistically for electricity grid expansion, reinforcing collaboration gaps between municipalities and infrastructure providers. Although municipalities are a determining actor in realizing national energy ambitions due to their responsibility of administering spatial purposes, they are institutionally constrained by these legacy structures. With a lack of obligation to involve local stakeholders in energy planning, Aarhus Municipality continues to rely on realizing political ambitions without a strategic approach. Despite sharing the same national framework and energy ambitions, the two municipalities, Aarhus and Thisted, diverge in their planning practices regarding SEP. Thisted Municipality demonstrates how local adaptation of tools for SEP can enhance collaboration and inclusion through its Thy-model, involving early stakeholder engagement and cross-sector coordination that adapts energy planning to the local conditions. Through their zoning tool, they account for energy infrastructure in their spatial and temporal planning, overcoming the constraints in the nationally set planning structure. However, transferring Thisted Municipality's zoning approach directly to Aarhus Municipality may not yield identical results due to differences in physical and institutional settings. Due to the voluntary nature of SEP, the implementation is therefore determined by the individual municipality's capability to adopt a strategic approach and align energy planning with electricity grid expansion. Strengthening cross-sectoral coordination, clarifying roles, and ensuring adequate resourcing are essential steps to ensure the municipalities can fulfill their role and act strategically in energy planning to realize national energy goals. This underscores the need for not only improved local planning models but also broader governance reforms.

10. References

Aarhus Kommune (1978). *Varmeplan for Århus*. Aarhus Kommune. Magistraten 5. Afdeling Det Kgl. Bibliotek.

Aarhus Kommune (1989). *Langsigtet energiplan Århus. Aarhus Kommune. Magistratens 5. Afdeling Det Kgl. Bibliotek.*

Aarhus Kommune (1990). *Hovedstruktur Århus Kommune - Kommuneplan 1988-96. Aarhus Kommune Magistratens 5. Afdeling Det Kgl. Bibliotek.*

Aarhus Kommune (2001). *Kommuneplan 2001*. Aarhus Kommune. Det Kgl. Bibliotek.

Aarhus Kommune (2009). *Oplæg til klimavarmeplan - Varmeplan Århus og Århus Kommune*. Århus Kommune : Driftsrådet for Varmeplan Århus. Det Kgl. Bibliotek.

Aarhus Kommune (2017). *Velkommen til Aarhus kommuneplan*. Available at: Velkommen - Kommuneplan 2017 - Aarhus Kommune. Located 27/3 2025.

Aarhus Kommune (2020 December). *Tillæg nr. 54 til Kommuneplan 2017 TEMAPLAN OM VEDVARENDE ENERGIANLÆG*. Available at: VE_Temaplan_som vedtaget af byrådet_25_november_2020.indd. Located 24/4 2025.

Aarhus Kommune (2020 June). *Forslag til TEMAPLAN FOR OMSTILLING TIL GRØN ENERGI - Tillæg nr. 81 til Kommuneplan 2017*. Available at: Temaplan_Omstilling til grøn energi_tillæg nr 81_8_oktober_2020.pdf. Located 24/4 2025.

Aarhus Kommune (2024). *Klimaindsatser*. Available at: https://aarhus.dk/media/rotcrowe/klimamateriale-samlet.pdf. Located 23/4 2025.

Aarhus Kommune (2024 April). *AFTALE OM KLIMASTRATEGI 2025-2030*. Available at: https://aarhus.dk/media/xxpgrrj0/samlet-klimaaftale-underskrevet.pdf. Located 23/4 2025.

Aarhus Kommune (2025). *Proposal of Climate Plan 2025-2030*. Available at: https://deltag.aarhus.dk/sites/default/files/documents/Forslag%20Klimaplan%202025-2030_0.pdf. Located 29/4 2025.

Aarhus Kommune (2025 April). *Teknik og Miljø som arbejdsplads*. Available at: https://aarhus.dk/om-kommunen/teknik-og-miljoe/teknik-og-miljoe-som-arbejdsplads. Located 13/5 2025.

Aarhus Kommune (2025 January). *Klimaalliancen Aarhus*. Available at: https://aarhuskommuneerhverv.dk/partnerskaber/klimaalliancen-aarhus. Located 24/4 2025.

By- og Landskabsstyrelsen (2008). Vejledning om kommuneplanlægning. Available at: https://www.plst.dk/Media/638270762132678490/vejledning_kommuneplan08.pdf. Located 15/3 2025.

Elforsyningsloven (2023, LBK nr 1248 af 24/10/2023). *Bekendtgørelse af lov om elforsyning*. Klima-, Energi- og Forsyningsministeriet. Available at: https://www.retsinformation.dk/eli/lta/2023/1248.

Elforsyningsloven (1999, LOV nr 375 af 02/06/1999). *Lov om elforsyning*. Klima-, Energi- og Forsyningsministeriet. Available at: Elforsyningsloven.

Energiministeriet (1982). *Energi og Danmark - nu og i fremtiden*. Bonde's Bogtryk.

Energinet (2024). *Langsigtet udviklingsplan 2024*. Available at: rapport-lup-web-2-1.pdf. Located 14/2 2025.

Energinet (n.d., A). *Eltransmissionsnettet i dag*. Available at: https://energinet.dk/el/eltransmissionsnettet/elnettet-i-dag/. Located 20/2 2025.

Energinet (n.d., B). *Roller og opgaver på elmarkedet*. Available at: https://energinet.dk/el/elmarkedet/roller-pa-elmarkedet/. Located 20/3 2025.

Energinet (n.d., C). *Player in the electricity market - how does it work, and who does what?*. Available at: https://en.energinet.dk/media/se3lwlrw/participant-in-the-electricity-market.pdf. Located 22/4 2025.

Energistyrelsen (2012). *Ny pulje om strategisk energiplanlægning starter til foråret*. Available at: Ny pulje om strategisk energiplanlægning starter til foråret. Located 18/3 2025.

Energistyrelsen (2013). *Strategisk energiplanlægning i kommunerne*. Available at: https://www.ea-energianalyse.dk/wp-content/uploads/2020/02/1263_vejledning_sep_oktober.pdf. Located 18/3 2025.

Energistyrelsen (2016). *Strategisk energiplanlægning på kommunalt og regionalt niveau*. Available at: 1414_strategisk_energiplanlaegning_danmark.pdf. Located 18/3 2025.

Energistyrelsen (2017). *Fra central til decentral elproduktion*. Availbale at: https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://ens.dk/media/3655/download&ved=2ahUKEwiQgfX5qf-MAxWf1gIHHQ5dPcsQFnoECBoQAQ&usg=AOvVaw0qG55A96uFQ4xEMJaOtiZC. Located 3/3 2025.

Energistyrelsen (2020). *Liberalisation of the Danish power sector 1995-2020 - An international perspective on lessons learned*. Available at: Liberalisation of the Danish power sector, 1995-2020. Located 12/3 2025.

Energistyrelsen (2022). *Elnetselskaber*. Available at: https://ens.dk/sites/ens.dk/files/Statistik/elnetgraenser.pdf. Located 4/2 2025.

Green Power Denmark (2020). *Sådan fik Danmark verdens første klimamål*. Available at: https://greenpowerdenmark.dk/nyheder/saadan-fik-danmark-verdens-foerste-klimamaal. Located 14/3 2025.

Forsyningstilsynet (2024). *Elnetvirksomhedernes netudviklingsplaner 2025*. Available at: https://forsyningstilsynet.dk/vejledning-og-indberetning/udmeldinger/2024/netudviklingsplaner-2025. Located 7/2 2025.

Green Power Denmark (2025). *Sammen finder vi plads til fremtidens elnet*. Available at: https://elnet.dk/files/media/document/Sammen%20finder%20vi%20plads%20til%20fremtidens%20elnet_0.pdf. Located 30/4 2025.

Indenrigs- og Sundhedsministeriet (2005). *Kommunalreformen - kort fortalt*. Available at: https://www.ism.dk/Media/638159624452010296/kommunalreformen-kort-fortalt.pdf. Located 7/5 2025.

Jensen & Sperling (2019). *A comprehensive framework for strategic energy planning based on Danish and international insights*. A comprehensive framework for strategic energy planning based on Danish and international insights - Aalborg Universitets forskningsportal. Located 14/3 2025.

KAT (Klimaalliancen Thy) (2021). *Klimavisioner i Thy - Vejen til en bæredygtig fremtid*. *Available at:* https://www.epaper.dk/thymors/rapport-klimaalliancenthy_u-skaeremaerker/. Located 21/4 2025.

KEFM (Klima-, Energi og Forsyningsministeriet) (2021). *Elektrificering af samfundet - Vejen mod et mere elektrificeret Danmark*. Available at: https://www.kefm.dk/Media/637605500518146072/Elektrificering%20af%20samfundet.pdf. Located 11/2 2025.

KEFM (Klima-, Energi- og Forsyningsministeriet) (2023). *Regeringen etablerer national energikrisestab*. Available at: Regeringen etablerer national energikrisestab. Located 11/2 2025.

KEFM (Klima-, Energi- og Forsyningsministeriet) (2025). *Aftaler*. Available at: https://www.kefm.dk/aftaler. Located 13/2 2025.

KEF (Klima-, energi- og forsyningsudvalget (2024). *Åbent ekspertmøde*. (Tv fra Klima-, Energi- og Forsyningsudvalgets møder / Folketinget. Located 3/2 2025.

Kommunestyrelsesloven (2024, LBK nr 69 af 23/01/2024). *Bekendtgørelse af lov om kommunernes styrelse*. Indenrigs- og Sundhedsministeriet. Kommunestyrelsesloven

Energistyrelsen (2024). *Elnetvirksomhedernes netudviklingsplaner 2025*. Downloaded at: https://ens.dk/forsyning-og-forbrug/netudviklingsplaner. Located 7/2 2025.

Kvale, S., & Brinkmann, S. (2009). *Interview: Introduktion til et håndværk*. (2 ed., chapter 7) Hans Reitzels Forlag.

Land- og Distriktsstyrelsen (n.d.). *Kommuneplantillæg*. Available at: Kommuneplantillæg | Plan- og Landdistrikts Styrelsen. Located 7/3 2025.

Lockwood, M., Kuzemko, C., Mitchell, C., & Hoggett, R. (2017). Historical institutionalism and the politics of sustainable energy transitions: A research agenda. *Environment and Planning C: Government and Policy*, *35* (2), 312-333. https://doi.org/10.1177/0263774X16660561

Lov om Energinet (2004, LOV nr 1384 af 20/12/2004). *Lov om Energinet Danmark*. Klima-, Energi- og Forsyningsministeriet. Lov om Energinet Danmark.

Lov om energipolitiske foranstaltninger (1976, LOV nr 194 af 28/04/1976). *Lov om energipolitiske foranstaltninger*. Klima-, Energi- og Forsyningsministeriet. https://www.retsinformation.dk/eli/lta/2023/1248

Miljø- og Energiministeriet (1996). *Energi 21 - Regeringens energihandlingsplan 1996*.

Moulaert, F. Jessop, B. & Mehmood, A. (2016). *Agency, structure, institutions, discourse (ASID) in urban and regional development*. INTERNATIONAL JOURNAL OF URBAN SCIENCE, VOL. 20, NO. 2, 167–187 Agency, structure, institutions, discourse (ASID) in urban and regional development

NEKST (2024). *Hurtigere udbygning af elnettet - Afrapportering fra NEKST-arbejdsgruppen*. Available at: https://www.kefm.dk/Media/638687206136506042/Nekst_Hurtigere%20udbygning%20af%20elnettet.pdf. Located 4/2 2025.

Nielsen, J. S. (2012). *Martin Lidegaard genintroducerer energiplaner*. Information. Available at: Martin Lidegaard genintroducerer energiplaner | Information. Located 13/5 2025.

Planloven (2024, LBK nr 572 af 29/05/2024). *Bekendtgørelse af lov om planlægning*. *By-, Land- og Kirkeministeriet*. Planloven

Realdania (n.d.). *DK2020*. Available at: https://realdania.dk/projekter/dk2020. Located 17/4 2025.

Regeringen et. al. (2022). *Klimaaftale om grøn strøm og varme 2022 - Et grønnere og sikrere Danmark*. Available at: Klimaaftale om grøn strøm og varme 2022.pdf. Located 21/4 2025.

Sorensen, A. (2014). *Taking path dependence seriously: an historical institutionalist research agenda in planning history*. *Planning Perspectives, 30(1), 17–38*. *https://doi.org/10.1080/02665433.2013.874299*

Suitner, J. (2021). Vienna's planning history: periodizing stable phases of regulating urban development, 1820–2020. Planning Perspectives, 36(5), 881–902. https://doi.org/10.1080/02665433.2020.1862700

Systemansvarsbekendtgørelsen (2023, BEK nr 1358 af 24/11/2023). *Bekendtgørelse om systemansvarlig virksomhed og anvendelse af eltransmissionsnettet m.v.* https://www.retsinformation.dk/eli/lta/2023/1358

Thisted Kommune (2021). *Kommuneplan 2021-2033*. Available at: VELKOMMEN - Kommuneplan 2021 - 2033 - Thisted Kommune. Located 1/5 2025.

Thisted Kommune (2023). *Organisationsdiagrammer*. Available at: Organisationsdiagrammer. Located 5/5 2025.

Thisted Kommune (2023). *Den grønne omstilling - handleplan 2023*. Available at: https://www.thisted.dk/Media/638235455214589411/28062023_Handleplan2023_grønomstilling_stemplet.pdf. Located 28/4 2025.

Thisted Kommune (2024). *Energiplan 2024*. Available at: https://thisted.viewer.dkplan.niras.dk/plan/103#/44769. Located 30/4 2025.

Thisted Kommune (2025 January). *Proces, planer og perspektiver*. Available at: https://admin.thisted.dk/Media/638743602052383039/Borgermøde_29012025_Gisselbæk.pdf. Located 30/4 2025.

Thisted Kommune (2025 February). *KAT skal lave visionen for energizoner*. Available at: https://www.thisted.dk/nyheder/2025/februar/vision-for-energizoner. Located 30/4 2025.

Thisted Kommune (n.d. A). *Vedvarende energi i Thy*. Available at: https://www.thisted.dk/politik-demokrati-and-indflydelse/thy-til-groen-omstilling/vedvarende-energi. Located 30/4 2025.

Thisted Kommune (n.d. B). *Energiforeninger*. Available at: Energiforeninger. Located 30/4 2025.

Thisted Kommune (n.d., C). *Vedvarende energi i Thy*. Available at: https://www.thisted.dk/politik-demokrati-and-indflydelse/thy-til-groen-omstilling/vedvarende-energi. Located 30/4 2025.

WDEP (1987). *Brundtland rapporten*. Available at:

sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf.

Located 22/4 2025.

11. Appendices

Appendix A: Interview with Sørensen from Aarhus Municipality conducted on the 10th of February 2025

Appendix B: Appendix B: Interview with Rørby from DINEL conducted on the 19th of February 2025

Appendix C: Interview with Birch from Konstant conducted on the 7th of March 2025

Appendix D: Interview with Sperling from Aalborg University conducted on the 30th of April 2025

Appendix E: Interview with Lasson from Netselskabet Elværk conducted on the 13th of May 2025

Appendix F: Literature review and hearing results for the NUPs