Coordinated planning for renewable smart energy systems

How strategic energy planning could help meet local and national goals

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– HOW STRATEGIC ENERGY PLANNING COULD HELP MEET LOCAL AND NATIONAL GOALS

BY
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AALBORG UNIVERSITY
DENMARK

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CV

Louise Krog Jensen earned her bachelor's degree in Urban, Environmental and Energy Planning from Aalborg University in 2012 and a master's of science in Sustainable Energy Planning and Management fromAalborg University in 2014. Louise worked as an energy planner in Hjørring Municipality from November 2014 to October 2015. In October 2015, Louise began as a research assistant at the Department of Planning at Aalborg University and in March 2016 she began her PhD project at Aalborg University within the CITIES project (Centre for IT-Intelligent Energy Systems in Cites) supported by Innovation Found Denmark.

Papers included in the thesis:

- L. Krog, K. Sperling, and H. Lund, "Barriers and recommendations to innovative ownership models for wind power," *Energies*, vol. 11, no. 10, p. 2602, Sep. 2018.
- L. Krog and K. Sperling, "A comprehensive framework for strategic energy planning based on Danish and international insights," *Energy Strateg. Rev.*, vol. 24, no. April, pp. 83–93, 2019.
- L. Krog, "How municipalities act under the new paradigm for energy planning," *Sustain. Cities Soc.*, vol. 47, 2019

Other publications and presentations by the author

- P. Wokuri and L. Krog, "'Community' renewable energy projects: A David versus Goliath battle? Insights from two initiatives in Denmark and France". Conference paper presented at XIX ISA World congress of sociology, Toronto, Canada, July 15-21, 2018. (presented by P. Wokuri).
- L. K. Jensen and K. Sperling, "Kystnære vindmøller – en folkesag?". Popular scientific article published in NyFOKUS, March 2018.
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- L. K. Jensen (2017). Local Ownership Models as an Implementation Tool in Strategic Energy Planning. Poster presented at CITIES Consortium Meeting, Denmark, 2017.
- L. K. Jensen (2018), How municipalities act under the new paradigm for energy planning. Poster presented at CITIES Consortium Meeting, Denmark, 2018.
- L. Krog (2018), Biomasse i fremtidige 100% vedvarende energisystemer. Presentation in Hjørring Municipality, Hjørring, 2018.

ENGLISH SUMMARY

The topic of this PhD project is the role of Danish municipalities in the strategic energy planning of the Danish energy system. Denmark is in the middle of a transition towards a 100% renewable energy system, and strategic energy planning was introduced by Danish politicians in 2012. Policy makers and officials have described strategic energy planning as a task for the Danish municipalities, but this has not been made a mandatory task with allocated funding. This has led to scattered energy planning in Denmark, wherein some municipalities have chosen to develop strategic energy plans while others have chosen not to. Furthermore, earlier studies have identified a large variety in the quality of local strategic energy plans. To investigate how strategic energy planning can be improved to ensure the green transition of the energy system, the following main research question is addressed in this work.

What coordination needs emerge within the paradigm shift towards a 100% renewable energy system and how should local strategic energy planning develop to meet these coordination needs?

The research process was guided by three sub-questions related to the main research question. The PhD project was designed as a case study of a Danish municipality (Hjørring Municipality) to investigate in detail the different processes of local strategic energy planning.

The theoretical perspective in the thesis is inspired by multi-level governance, innovative democracy and choice awareness theory. The choice awareness theory is extended to include an organisational dimension developed in the PhD project to meet societal needs within the planning of an energy system. The theoretical perspective identifies two approaches in the Danish energy planning that challenge each other, namely a centralised approach and a decentralised approach. Even though the centralised approach currently seems to be dominating at the national level, municipalities and other actors are starting to challenge it, stating that 100% renewable energy systems require a more decentralised planning approach. Based on the challenges found in the planning of the Danish energy system today, the thesis' theoretical framework highlights two coordination issues that influence current local strategic energy planning, namely coordination between the *national* and *local levels* and coordination between *technical solutions* and *societal needs*.

To outline the context of the case study and to frame the concept of strategic energy planning applied in the analyses, a theoretical analytical framework for strategic energy planning in the Danish context has been developed to guide the analyses of

local strategic energy planning. The methodological choices for data collection in the thesis include a mix of methods, namely a literature review, document analyses, interviews and participant observations.

The case study includes two analyses. The first investigates Hjørring Municipality's first strategic energy plan which began in 2012 and focuses on the implementation process of the strategic energy plan. The fact that Hjørring Municipality had an existing strategic energy plan starting in 2012 made it possible to analyse both the content of the plan and how the plan was used and implemented between 2012 - 2016 when the analysis was conducted.

The second analysis concerns the development process of a new strategic energy plan in Hjørring Municipality, which began in 2017 and is currently ongoing. During this analysis, it was possible to gain access to and follow the specific planning processes of the development of the new plan in Hjørring Municipality. In particular, the municipal employees and their interactions with local and other actors, which could be observed during the strategic energy planning process.

The combined outcome of the two analyses is an insight into how local strategic energy planning is carried out in a Danish municipality today. The analyses show that there is interest and commitment, in the municipality as well as among local actors, to conduct local strategic energy planning and that Hjørring Municipality even in 2012 included implementation strategies in its strategic energy plan. However, poor national framework conditions for strategic energy planning have created uncertainty in the municipality regarding its role and responsibilities in strategic energy planning. Moreover, local actors' willingness to invest in activities that support the implementation of the local strategic energy plan is also highly influenced by the national framework conditions. Frequently, changes in tax and support schemes have caused local actors to hesitate when investing in new technologies.

The analyses identify a list of barriers connected to the two identified coordination issues in strategic energy planning. The main coordination issue identified through the study is a lack of coordination between the national level and the municipalities.

The thesis develops suggestions for how to address and eliminate the identified barriers at the national and municipal levels as well as improve the conditions for successful local strategic energy planning in Denmark to secure the implementation of a 100% renewable smart energy system. However, the most pressing issue is the lack of coordination between the national and local levels in strategic energy planning. If strategic energy planning is to support the transition to a 100% renewable smart energy system, it is important that the national and local levels coordinate with each other to develop strong framework conditions that secure the overall planning of the Danish energy system while at the same time meeting local needs and possibilities.

The results from this PhD project contribute to scientific theoretical approaches by extending the existing choice awareness theory to connect it to an organisational dimension. Furthermore, the thesis develops the concept of strategic energy planning and provides an analytical framework for Danish strategic energy planning. Moreover, the PhD project presents a practical contribution that could be implemented in Denmark to strengthen strategic energy planning, namely the analytical framework for strategic energy planning to facilitate a uniform approach to strategic energy planning in Danish municipalities. Furthermore, suggestions are presented for how to overcome the barriers in strategic energy planning and create more coordinated strategic energy planning in Denmark.

DANSK RESUME

Emnet i dette Ph.d.-projekt er danske kommuners rolle i strategisk energiplanlægning for det danske energisystem. Danmark er midt i en omstilling til et 100 % vedvarende energisystem. Strategisk energiplanlægning blev for første gange introduceret i 2012 af danske politikere. Politiske beslutningstagere og embedsmænd har beskrevet strategisk energiplanlægning som en kommunal opgave, dog uden at dette at gøre det til en obligatorisk opgave med medfølgende finansielle midler til at opnå disse forventninger. Dette har ledt til en sporadisk energiplanlægning i Danmark, hvor nogle kommuner har valgt at udvikle strategiske energiplaner mens andre kommuner ikke har. Endvidere, er der, gennem tidligere studier, identificeret en stor forskellighed i kvaliteten af de lokale strategiske energiplaner. For at undersøge hvordan strategisk energiplanlægning kan forbedres for at sikre den grønne omstilling af energisystemet, er det følgende hovedforskningsspørgsmålet analyseret;

Hvad er koordineringsbehovene der opstår i paradigmeskiftet mod et 100 % vedvarende energisystem? Og hvordan skal lokal strategisk energiplanlægning udvikles til at kunne imødekomme disse koordineringsbehov?

Forskningsprocessen var guidet af tre underspørgsmål relateret til hovedforskningsspørgsmålet. Yderligere, var Ph.d.-projektet designet som et casestudie af en dansk kommune (Hjørring Kommune), hvor forskellige processer af lokal strategisk energiplanlægning er undersøgt i detaljer.

Det teoretiske perspektiv i afhandlingen er udviklet med inspiration fra Multi-level Governance, Innovative Democracy og Choice Awareness teori. Den eksisterende Choice Awareness teori er udbygget med en organisatorisk dimension, udviklet i Ph.d. projektet for at møde samfundsmæssige behov i planlægningen af energisystemet. Det teoretiske perspektiv identificerer to tilgange i dansk energiplanlægning i dag, en centraliseret tilgang and en decentraliseret tilgang. Selvom den centraliserede tilgang synes at være dominerende på det nationale niveau lige nu, begynder kommuner og andre aktører at udfordre denne tilgang og argumentere for at et 100 % vedvarende energisystem behøver en mere decentraliseret planlægnings tilgang. Med udgangspunkt i de udfordringer der ses i planlægningen af det danske energisystem i dag, fremhæver den teoretiske ramme to identificerede koordineringsudfordringer, som har indflydelse på den lokale strategiske energiplanlægning i dag. Disse to koordineringsudfordringer er, koordinering mellem de *nationale og lokale niveauer* samt, koordineringen mellem *tekniske løsninger og samfundsmæssige behov*.

For at opstille konteksten for casestudiet og klargøre konceptet strategisk energiplanlægning, som anvendes i analyserne, blev en teoretisk analytisk ramme for strategisk energiplanlægning, i en dansk kontekst, udviklet til at guide analyserne af strategisk energiplanlægning. De metodiske valg truffet i forbindelse med dataindsamlingen inkluderer et mix af metoder; litteratur studie, dokumentanalyse, interview og deltagende observation.

Casestudiet inkluderer to analyser. Den første analyse undersøger Hjørring kommunes første strategiske energiplan fra 2012 og har et stort fokus på implementeringsprocessen af den strategiske energiplan. Det at Hjørring Kommune havde en eksisterende strategisk energiplan fra 2012 gjorde det muligt både at analysere indholdet i planen, men også at analysere hvordan planen er blevet anvendt og implementeret fra 2012 indtil 2016 hvor analysen er lavet.

Den anden analyse udarbejdet i casestudiet var af udarbejdelsesprocessen af en ny strategisk energiplan i Hjørring Kommune. Processen startede i 2017 og er stadig igangværende. Igennem analysen var det muligt at få adgang til og følge den specifikke planlægningsproces til udviklingen af den ny plan i Hjørring Kommune. Særligt både de kommunale medarbejdere og deres interaktion med lokale aktører, kunne observeres gennem den strategiske energiplanlægningsproces.

Det samlede resultat af de to analyser er en indsigt ind i hvordan strategisk energiplanlægning udføres i en dansk kommune i dag. Analyserne viser at det er en interesse og engagement fra kommunens side, men også blandt de lokale aktører for at arbejde med lokal strategisk energiplanlægning, samt at Hjørring Kommune allerede i 2012 inkluderede implementeringsstrategier i deres strategiske energiplan. Det viser sig dog, at dårlige nationale rammebestemmelser for strategisk energiplanlægning skaber en usikkerhed i kommunen i forhold til deres rolle and ansvar i den strategiske energiplanlægning. Yderligere er villigheden blandt lokale aktører, til at investerer i aktiviteter der støtter op om implementeringen af den lokale strategiske energiplan, ligeledes påvirket af de nationale rammebestemmelser. Hyppige ændringer in skatte- og tilskudsordninger leder til at aktører tøver med at investere i nye teknologier.

Gennem analyserne er en liste med barriere relateret til de to koordineringsudfordringer i strategisk energiplanlægning identificeret. Den største udfordring er identificeret til at være manglen på koordinering mellem det nationale niveau og kommunerne.

Afhandlingen udvikler forslag til hvordan de identificerede barrierer kan adresseres og elimineres på det nationale og kommunale niveau, for at forbedre vilkårene for succesfuld lokal strategisk energiplanlægning i Danmark, som kan sikre en implementering af et 100 % vedvarende energisystem. Den vigtigste udfordring at adressere hurtigt er manglen på koordinering mellem det nationale og lokale niveau i

strategisk energiplanlægning. Hvis strategisk energiplanlægning skal understøtte omstilling til 100 % vedvarende smarte energisystemer, er det vigtigt at de nationale og lokale niveauer koordinere med hinanden, om at udvikle stærke rammebestemmelser, som sikre den overordnede planlægning af det danske energisystem og som på samme tid møder lokale behov og muligheder.

Resultaterne fra Ph.d.-projektet bidrager til videnskabelig teoretiske tilgange gennem en udvidelse af den eksisterende Choice Awareness teori, med en organisatorisk dimension. Yderligere udvikler afhandlingen konceptet for strategisk energiplanlægning og levere en analytisk ramme for strategisk energiplanlægning. Ph.d.-projektet fremkommer ligeledes med nogle praktiske bidrag som kan implementeres i praksis i Danmark for at styrke strategisk energiplanlægning. Disse praktiske bidrag er den analytiske ramme for strategisk energiplanlægning, som kan anvendes til at skabe en mere ensartet tilgang til strategisk energiplanlægning i danske kommuner. Yderligere kan anbefalingerne til hvordan barriererne i strategisk energiplanlægning kan elimineres, være med til at fjerne de identificerede barrierer og skabe en mere koordineret strategisk energiplanlægning i Danmark.

PREFACE AND ACKNOWLEDGEMENTS

This PhD thesis is part of the Centre for IT-Intelligent Energy Systems in Cities (CITIES) research project funded by Innovation Fund Denmark. I would also like to thank the partners involved in the project.

I would furthermore like to extend my gratitude to the employees of Hjørring Municipality for participating in the interviews and letting me attend and observe their meetings in relation to my data collection.

In addition, I would like to thank my supervisors Karl Sperling and Frede Hvelplund for their guidance and support throughout the project. Also, thanks to my colleagues at Aalborg University.

Motivation and inspiration for the PhD project

This PhD project was very much motivated by my earlier experience of working in and with Danish municipalities prior to my employment at Aalborg University.

Just before the start of the PhD project, I was employed at Hjørring Municipality in Northern Jutland, mainly working with tasks related to strategic energy planning locally within the municipality, but I was also part of a cross-municipal project on strategic energy planning in Northern Jutland. Experiencing the challenges connected to the development of strategic energy planning in practice has been one of the main drivers behind the work in this PhD thesis.

Aalborg, May 2019
Louise Krog Jensen

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CHAPTER 1. INTRODUCTION

Energy production is a major factor that impacts climate change due to CO_2 emissions from the extraction and utilisation of fossil fuels. Over the last decade, there have been ongoing technical discussions that aim at finding the best technologies to secure renewable energy production in the future. Numerous technical energy strategies and scenarios for future energy systems have been developed and presented at different institutional levels (national, regional, local)[1]–[3], while actions have been taken to implement renewable energy technologies all over the world, with some countries being more successful than others. Different approaches to the energy system can be found, and what is included in the definition of an energy system varies from country to country. So far, an energy system has been considered as being part of different sectors without any major connections (for example electricity, heating, gas and transport), and some countries primarily talk about a smart grid, focusing on the electricity sector in relation to the green transition. However, some countries, including Denmark, are starting to focus on smart energy systems[4].

The concept of a **smart energy systems** has been developed in recent years. It combines the whole energy sector and highlights important synergies in the energy system.

> *Smart energy systems are defined as an approach in which smart electricity, thermal, and gas grids are combined and coordinated to identify synergies between them in order to achieve an optimal solution for each individual sector as well as for the overall energy system*.[[5], p. 139]

Technical scenarios and solutions showing that a green transition is possible have been developed by governments, NGOs, researchers etc. [1], [6]–[8]. What is often lacking in these scenarios is the relationship between the energy system to the environment and society of which it is part. While technologies have been developed to utilise renewable energy sources in the most energy-efficient way, these must be implemented in societies where people are not accustomed to having energy production in their "backyard"[9].

In the planning and implementation of a smart energy system, it is important to create a balance between the technical possibilities and what is locally possible. This means that we must find a way to move on from merely talking about the combination of different renewable energy technologies to also focusing on how to implement these technologies appropriately so that they are accepted by society, enabling the creation of a balanced 100% renewable smart energy system. Such an increased focus could also help to increase the efficiency of the energy system and ease the implementation of fluctuating renewable energy sources[10]. One example of can be found in the

Danish town Hvide Sande where a project of three wind turbines where developed and implemented by using a 100% local ownership model. The project was carried out without local resistance and resulted in 400 local shareholders and a local fund for business development owning the turbines.[11]

Developing and implementing smart energy systems requires political will and energy planning on multiple levels. Many countries have already begun to develop long-term goals for their energy systems to be renewable and CO_2 free; in order to fulfil these goals, different energy planning approaches have been introduced internationally, such as integrated energy planning[12], centralised and decentralised energy planning[13], community energy planning[14] and strategic energy planning[15], [16]. Strategic energy planning is the planning approach chosen by the Danish Government and this was reinforced in the Energy Agreement of March 2012 with the aim of reaching the current (2019) Danish long-term goal of becoming a low-carbon society independent of fossil fuels by 2050 [17], [18]. With strategic energy planning, the Danish Government has allocated more responsibility for the development of the energy system to the municipalities at the local level. Many Danish municipalities are already conducting energy planning locally by setting up the goal of being self-sufficient and CO2-neutral with renewable energy [19]–[21]. However, energy planning has a long history in Denmark, starting even before the concept of strategic energy planning was introduced, and it is important to recognise this history in order to fully understand how it has contributed to the shaping of strategic energy planning in Denmark and to see whether the energy planning development is moving towards smart energy systems.

1.1 STRATEGIC ENERGY PLANNING IN THE POLITICAL ARENA IN DENMARK

Energy planning has hitherto been dominated by sector thinking in Denmark, whereby the responsibility for the different energy sectors has been divided between different authorities. With the Heat Planning Act in 1979, the municipalities became responsible for developing heat plans that mapped current energy demands, heating methods and energy use along with estimating future heating demands and methods. The 1979 Heat Planning Act also made city councils in the municipalities responsible for the local development of the heat planning and approval of heating projects [22], while the responsibility for regulating the electricity sector is placed directly with the Danish Energy Agency [23].

Since the oil crisis in the 1970s, Denmark has had different energy policies. The first was introduced in 1976 with the purpose of securing the Danish energy system against future energy crises [24]. Since the first energy policy, the government has published a number of energy policies with different content and purposes. In 2006, Danish Prime Minister Anders Fogh Rasmussen stated that Denmark should have the long-term goal of being independent of fossil fuels and instead be self-sufficient with

environmentally friendly energy[25]. This statement laid the foundation for the subsequent development of politics and technical solutions in the Danish energy system and led to the current national goal for Denmark to be independent of fossil fuels (coal, oil and gas) by 2050[26]. The long-term time horizon of 2050 has since served as the deadline in the later planning and development of the Danish energy system. Furthermore, the statement from the Prime Minister in 2006 has been a breeding ground for a more sector-integrated approach to understanding and planning the energy system in a direction towards smart energy systems.

Several actions from the national political level (The Danish Government and supporting agencies such as the Danish Energy Agency) have been introduced since 2006 to promote strategic energy planning in the municipalities. The actions and documents found to be most central to this development are presented in Figure 1.

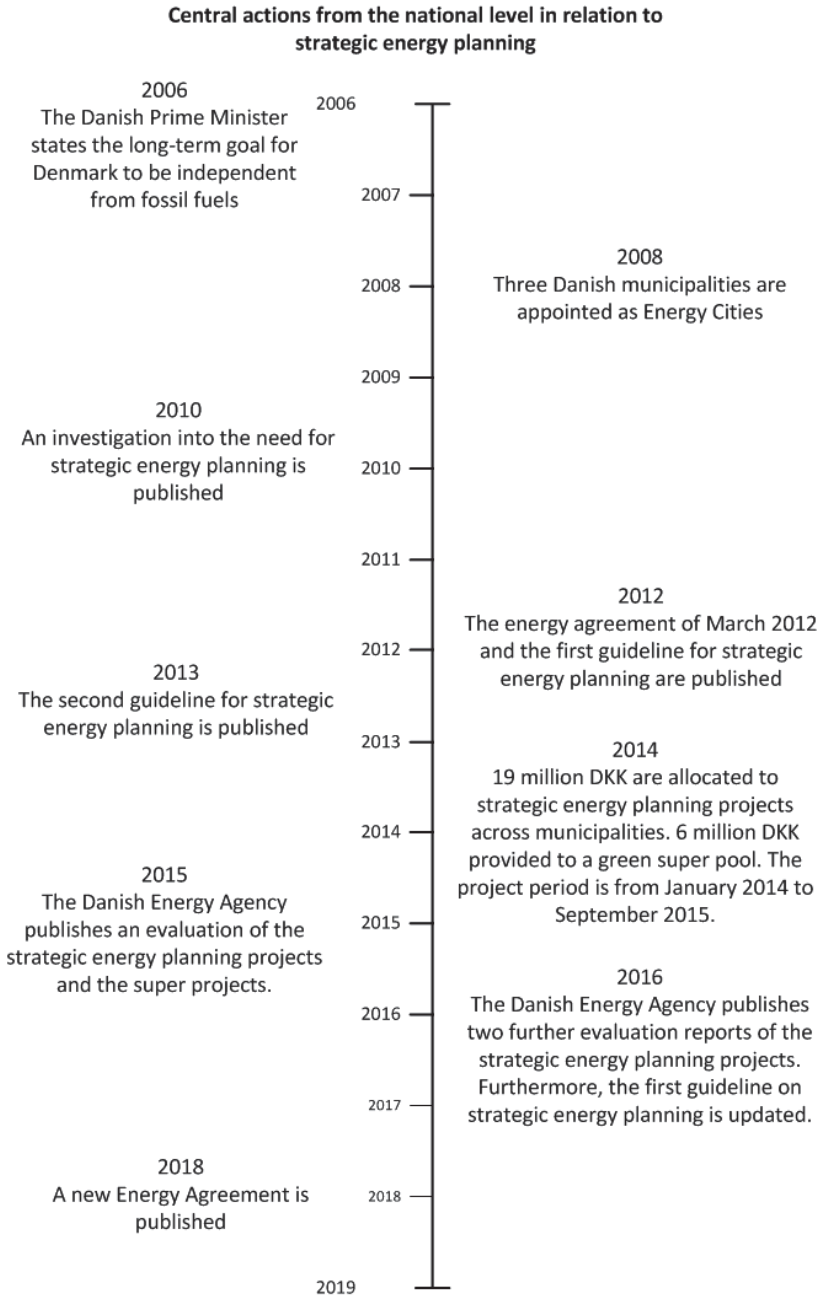

Figure 1: Timeline of the most central actions and documents in relation to the development of strategic energy planning in Denmark

In 2008, three Danish municipalities (Skive, Kolding and Copenhagen) were appointed as Energy Cities by the climate and energy minister. The Energy Cities were seen as frontrunners within climate and energy [27]. The Energy City initiative was seen as one of the starting points in the political agenda towards the strategic energy planning approach in Denmark even though strategic energy planning was not on the political agenda in 2008.

Municipal strategic energy planning was first introduced in the Danish national political context in 2010 by a workgroup with the purpose of describing the municipalities' possibilities within energy planning in relation to initiating projects that would increase the use of renewable energy and lower the energy consumption[28]. The workgroup consisted of the Danish Energy Agency, Local Government Denmark and two Danish municipalities. The workgroup suggested strategic energy planning as a way of securing local energy planning in the municipalities, and they emphasised that strategic energy planning differs from the current heat planning as it is a more holistic approach that combines the energy demand and supply side, including all aspects of supply (heating, cooling and electricity)[28].

This led to the inclusion of strategic energy planning in the Danish Energy Agreement of March 22, 2012. The Energy Agreement states that funds of 19 million DKK should be allocated to projects based on partnerships that promote strategic energy planning across municipalities, energy companies and local businesses. The projects should also improve the cooperation between the national, regional and municipal levels as well as support municipal planning with citizen-close initiatives. [18]

The Energy Agreement was followed by two guidelines for strategic energy planning in the municipalities, in 2012[29] and 2013[30], in which the Danish Energy Agency defines the purpose of strategic energy planning:

> *Strategic energy planning in municipalities (SEP) is about long-term thinking. The municipality can through the strategic energy planning add to a long-term development towards a fossil-free energy supply and other municipal and national climate and energy goals. SEP includes all types of energy use and energy supply in all sectors (households, municipal and other public services, private service, industry, transport).*[[30], p. 7] [Translated from Danish]

The Danish Energy Agency uses the guidelines to set the framework for strategic energy planning, and they are primarily directed at the municipalities as the main actor in the planning approach. However, at the same time, it is clearly stated that strategic energy planning is a voluntary task that interested municipalities may choose to do. [29], [30] The fact that it is voluntary also implies that the government does not allocate any fixed funding for local strategic energy planning, leaving the municipalities to find the financial means within their existing budgets.

In 2013, the funds allocated in the Energy Agreement for projects promoting strategic energy planning were put into action. The 19 million DKK were divided between 12 projects on both smaller or larger scales with a project period running from 2013 to 2015. [31] In addition to the 12 projects, another two projects were funded through a super pool, which has the purpose of supporting municipalities that wish to be frontrunners in the green transition [32]. Each of the projects is a collaboration between several actors in the energy field, such as municipalities, regions, energy companies and local companies. An assessment of the projects shows that 96 out of a total of 98 municipalities in Denmark participate, on either a smaller or larger scale, in the strategic energy planning projects [31], [33]–[37]. Aalborg and Læsø municipalities have shown to be the only ones not represented in any of the projects.

After the end of the project period, the Danish Energy Agency and Local Government Denmark had a consultancy company conduct an evaluation of the 14 strategic energy planning projects [38]. The evaluation showed that all project partnerships had gained positive experiences from the projects and that many of the partnerships expected to continue some form of the project or network after the projects had finished. At the same time, the partnerships also emphasised that it is important that the Danish Energy Agency follows up on the momentum established through the projects if they wish to continue promoting strategic energy planning in Denmark. The overall conclusion in relation to strategic energy planning in the document is:

> *Strategic energy planning is necessary for Denmark to realise its ambitions of a cost-effective green transition. A municipal/regional corporation around SEP is a precondition for this transition and is necessary to secure local political support to the transition. 'It is the concrete projects in the single municipality that can realise a significant part of the green growth potential for citizens and companies.'* [[38], p. 104] [Translated from Danish]

The evaluation is primarily focused on the regional and municipal actors, whereby the role of the national level is only briefly touched upon as a facilitator for knowledge sharing between the different actors within the project period. It is not clear how the government or Danish Energy Agency see their role in strategic energy planning in the future.

The evaluation of the projects offers several conclusions. These show a number of positive outcomes of the projects, but they also reveal a number of areas that should be improved in order to further promote strategic energy planning in the future. Table 1 presents the most important conclusions from the evaluation. The positive effects are written in black, while the aspects needing improvement are written in red.

Table 1: Significant results extracted from the evaluation of the strategic energy planning projects financially supported by the government[38].

Conclusions from the evaluation report

- **Some themes, e.g. the transport sector, seem to have been difficult to manage and have therefore apparently been given less priority in some of the projects.**
- **To a great extent are common knowledge and increased understanding of the complete energy system were created.**
- **There is frustration over what they [the project partnerships] consider a contradiction between Denmark's approved development goals and the current legislative framework.**
- **The projects have led to a more nuanced and deeper insight into the different actors' interests and competences.**
- **The projects would like to cooperate with the national level, and this cooperation can still be improved and concretised.**
- **The political [local political] ownership of SEP has been, according to the project's own evaluations, strengthened through the project work.**
- **The municipalities ask for a clearer definition of their role in SEP, e.g. whether SEP should be made a municipal responsibility, as well as for energy political goals of the work.**
- **The municipalities generally lack the time and resources to address the task of SEP.**
- **There is a lack of legislation that supports the green transition on a number of parameters.**
- **The projects would like the Danish Energy Agency to take a more active role, preferably in a cooperation, regarding the development of a better and more uniform common data foundation.**

The different statements are extracted and directly translated from [38]

From the conclusions highlighted in Table 1, it is clear that there is a common denominator for the conclusions showing areas for improvement. One of the keywords is coordination, concerning both the successes and the lack of coordination in some areas. For instance, the project participants call for improved coordination between them and the national level, but focusing on the goals should also arise between the national development goals and the legislative framework.

Furthermore, the evaluation of the financially supported strategic energy planning emphasises that there is good momentum for strategic energy planning and that it is important to support this if it is to continue. Therefore, it is surprising that the Danish national political level has not taken any action in relation to securing local strategic energy planning since 2015.

In June of 2018, the Danish Government, in cooperation with several other political parties, (Socialdemokrtiet, Dansk Folkeparti, Enhedslisten, Alternativet, Radikale Venstre og Socialistisk Folkeparti), published a new energy agreement covering the 2020–2024 period. Surprisingly, the new energy agreement does not mention strategic energy planning. It does, however, state that the Danish Energy Agency, in cooperation with the energy industry, will formulate a proposal for a trust that can promote municipal incentives to expand renewable energy production [39]. This could be an opening to encourage municipalities to obtain financing for strategic energy planning initiatives. However, this is still not specifically formulated, and there is no mention of the amount such a fund should contain.

Based on the history of strategic energy planning, it is clear that the national level expects the municipalities to conduct strategic energy planning; however, the national level does not allocate funds or coordinate how or which actions the municipalities should prioritise.

1.2 STRATEGIC ENERGY PLANNING – A MUNICIPAL TASK IN DENMARK

The paper “A comprehensive framework for strategic energy planning based on Danish and international insights” [40] (in Appendix B) illustrates what Danish strategic energy planning looks like today based on the Danish Energy Agency’s definition as well as prior studies of strategic energy planning in Denmark [16], [41], [42]; see Figure 2.

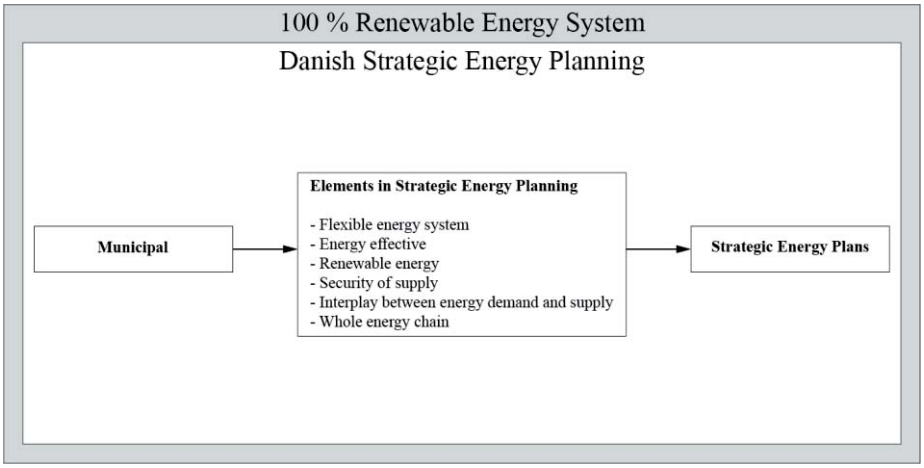

Figure 2: Danish strategic energy planning based on the Danish Energy Agency's definition [40].

In [40] three main elements in Danish strategic energy planning were identified as **the development of plans**, **a municipal task** and **the inclusion of the whole energy chain**. What is important about strategic energy planning being seen as a municipal task is that it is formulated as a voluntary task and that no funding is provided from the national level to fulfil local strategic energy planning.

Another point in strategic energy planning is that it is seen as a tool to help achieve national energy policy goals. However, the national role is only briefly considered in the national documents regarding strategic energy planning. It can be argued that this is not optimal since the national level could be considered important in order to set the framework conditions for strategic energy planning as well as in the coordination of local initiatives to avoid a sub-optimisation that could harm the development of the overall Danish energy system. [3]

Despite the weak framework conditions and the voluntary nature of strategic energy planning, many Danish municipalities have chosen to develop local energy plans. Petersen (2018) [43] found that 49 out of a total of 98 municipalities in Denmark have chosen to develop strategic energy plans since 2010. Even though there is a lack of national support for strategic energy planning, it is possible that some non-governmental initiatives, such as the Covenant of Mayors [44], [45] and the Climate Municipality Agreement[16], [42], [46], whereby the municipalities obligate themselves to take actions, have an influence on the motivation for the municipalities to develop local energy plans or strategies [42], [47].

However, studies of strategic energy planning in Denmark point to a need for improved coordination between the different institutional levels. Furthermore, the

voluntariness has been mentioned as a challenge that leads to a variation in the quality of the developed strategic energy plans due to the differences in the prioritising of resources and competences within the municipalities [16], [21], [41], [42].

1.3 THE IMPORTANCE OF LOCAL ENERGY PLANNING

It is important to recognise that energy planning on the local level is not only important because the Danish Government states that it should be a municipal task. The current energy planning task involves finding a balance between the technical strategies and society's aspects and needs. Public support and involvement in the green transition are crucial if the national goals are to be reached by 2050. Moreover, Mattes et al. [48] state that neglecting citizens in the planning process most will likely create local resistance. For example, there is growing resistance among local citizens towards wind projects in Denmark, where four projects (with a total of 305 MW) were rejected in 2018 due to local resistance [49]. Getting the public more involved in the transition of the energy system will require the involvement of several relatively new actors, such as private consumers, and here thinking from the social sciences might help technical researchers. Brüscher and Sumpf (2015) argue that trust and confidence are vital for getting consumers and other actors onboard in the transition of the energy system [50]. If consumers and other local actors are to be successfully involved in the transition of the energy system, the municipalities, as mentioned earlier, are an important actor because they are placed close to the local actors and possess valuable local knowledge that cannot be obtained at a national level. However, local energy planning cannot stand alone in the transition of the energy system. Thellufsen [51] describes the importance of considering the local energy systems from the perspective of the whole national energy system.

Mattes et al. [52] state that if the municipalities are to be able to be this important actor in the transition of the energy system, there is a need for good communication and coordination between the national and local levels. It is becoming widely acknowledged that actors within strategic energy planning face a number of challenges in the transition, and from an overall perspective, it seems that many municipalities have taken action in terms of initiatives to develop local energy plans. However, little is known in detail about how the local authorities work with and coordinate these processes.

Implementing smart energy systems implies sectors integrate all aspects of the energy system, on both the supply and the demand side. The coordination tasks of this integration are much closer to the consumers than the fossil fuel production and transportation it replaces. Local strategic energy planning is thus important since the sector integration will require more decentral energy production and system coordination to take advantage of the synergies between the supply and demand side in the energy system. The focus in this PhD thesis lies therefore on developing a realm of understanding of strategic energy planning and the coordination issues occurring

in relation to it. Furthermore, the aim is to investigate how local authorities in Danish municipalities are tackling the coordination issues between the optimal technical solutions and the societal aspects in the strategic energy planning within the current nationally provided framework conditions as well as in relation to the developed understanding of strategic energy planning in this PhD study.

1.4 RESEARCH QUESTION

Based on the issues described above, this thesis sets out to answer the following research question.

What coordination needs emerge within the paradigm shift towards a 100% renewable energy system? And how should local strategic energy planning develop to meet these coordination needs?

- How should strategic energy planning be understood to support more coordinated local energy planning processes in Denmark?
- How does a Danish municipality act within the framework of strategic energy planning and what kind of coordination is present in current local strategic energy planning?
- What are the current barriers in local strategic energy planning and how could these barriers be eliminated to better support coordinated strategic energy planning?

The three sub-questions are answered through the three papers written in relation to the PhD study as well as in the following chapters in this thesis. Section 1.5 presents the structure of the thesis and the connections between the different parts of the thesis, the sub-questions and the papers described.

1.5 STRUCTURE

The thesis comprises five different parts with different purposes, as is illustrated in Figure 3.

The first part of the thesis is the introduction (Chapter 1), where the overall problem is introduced, and the context within local strategic energy planning is introduced along with the research question.

The second part consists of the theoretical and analytical framework (Chapter 2) and the research design and methodology (Chapter 3). Chapter 2 presents the theoretical framework of the PhD thesis by tying together the theoretical perspectives from the three papers under the common denominator “coordination”, as seen in the research

question in part one. The first and second papers (Appendixes A and B) both contribute to the development of the theoretical framework "worldview" that guide the analyses conducted in the third part of the thesis. The development of the theoretical and analytical framework is also used to address the first sub-question "How should strategic energy planning be understood to support more coordinated local energy planning processes in Denmark?". The, in Chapter 2, developed analytical framework for strategic energy planning are used in analysing the case study in Chapter 4. Furthermore, this part of the thesis includes the research design and methodology presented in Chapter 3.

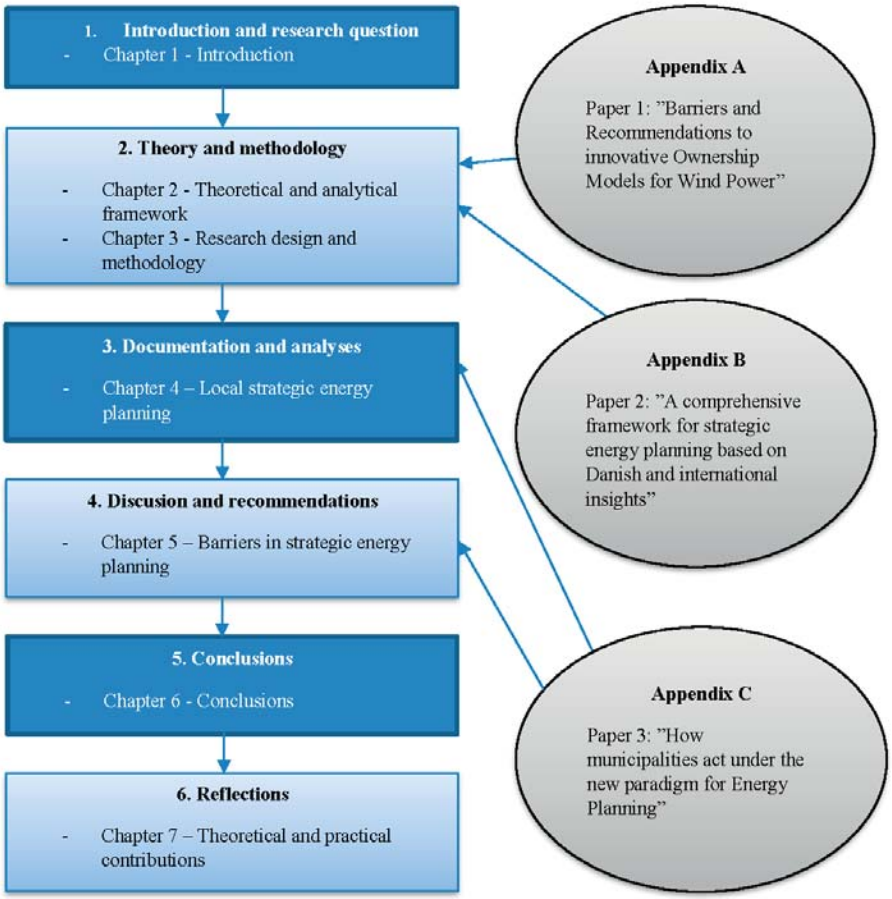

Figure 3: Structure of the PhD thesis and how the papers relate to the different parts of it.

The third part, in Chapter 4, documents and analyses the case study of Hjørring Municipality. This part addresses the research question's second sub-question of "How does a Danish municipality act within the framework of strategic energy planning and what kind of coordination is present in current local strategic energy planning?". Chapter 4 consists of two separate analyses made within the case study of Hjørring Municipality. The first analysis, consisting of the current strategic energy plan in Hjørring Municipality, takes place in the third paper (Appendix C) and is only summarised in Chapter 4. The second analysis of the municipality's process of developing a new strategic energy plan is presented in its full length Chapter 4 in the thesis.

The fourth part of the thesis addresses the third sub-question "What are the barriers in local strategic energy planning today and how could these barriers be eliminated to support a better coordinated strategic energy planning?". This is done in Chapter 5 through a discussion of the results from the analyses that conclude with suggestions to how barriers in relation to the coordination issues in strategic energy planning can be eliminated. The word "barriers" is used in a broad sense and covers aspects that can be understood as challenges to strategic energy planning in Denmark.

In the fifth part of the thesis, the overall conclusions in relation to the PhD study's research question are presented (Chapter 6). Furthermore, this part also includes reflections and suggestions for further research. The final part of the thesis, part seven (Chapter 7), includes reflections on the theoretical and practical contributions of the PhD study.

CHAPTER 2. THEORETICAL AND ANALYTICAL FRAMEWORK

In this chapter, the overall theoretical approach and the analytical framework for the PhD thesis are presented. The theoretical approach sets the frame for the study and the reflections made throughout the thesis. The thesis builds upon three scientific papers [40], [53], [54] and each of the papers has its own theoretical framework; these are not described in this chapter but can be found in the different papers given in Appendixes A, B and C, respectively.

The theoretical framework in the thesis ties together the theoretical frameworks used and developed in the three papers under the common denominator "coordination". The theoretical framework in the thesis builds upon the theoretical frameworks presented in the three papers, but it is further inspired by the theory of innovative democracy, multi-level governance theory and choice awareness theory, including the author's own extension of choice awareness theory. Each of the included theories contributes to the thesis with either input that helps to understand current Danish energy planning or with a theory that helps to identify solutions to the challenges found in local strategic energy planning to reach national goals in the transition of the energy system.

Furthermore, the theoretical perspective aims to answer the first sub-question "How should strategic energy planning be understood to support more coordinated local energy planning processes in Denmark?" through the development of the analytical framework for strategic energy planning. The analytical framework is developed in the paper "A comprehensive framework for strategic energy planning based on Danish and international insights" [40], found in Appendix B, and is used as the analytical framework for the analyses made of strategic energy planning in the case study within the PhD project.

2.1 CHANGES IN DANISH ENERGY PLANNING

The recognition of climate change within society and science has led to a change not only in academia but also in society. The change has led, among others, to a large amount of research in sustainability, renewable energy, environment etc. Especially within the energy sector, research has been directed towards renewable energy production technologies and the combination thereof. The change is seen in society in the media and political agendas through a wide recognition of climate change and the need for renewable energy.

The beginning of the change in the energy sector in Denmark can be dated back to 1975 when renewable energy technologies were starting to become a supplement to fossil fuel-based energy systems [55]. The radical shift towards renewable energy is not just a matter of changing the technologies, as such as technological changes in the energy system also leads to radical changes in the political setup and market structures [55].

In 1984, Müller et al. [56] defined technology as consisting of four different elements, namely **knowledge**, **organisation**, **technic** and **product**. In 2005, Hvelplund[57] introduced the term radical technology change, whereby he added a fifth element, **profit**, to the definition of technology. Each of the five elements can be changed. Some changes might not have large impacts on technology and can easily be implemented, while others require fundamental changes to be implemented. Hvelplund[57] talks of two types of technological changes, radical technology change and technological renewal.

A radical technology change is characterised by "*a change in more than one of the technology's five dimensions"*[57] [Translated from Danish]. In contrast, changes can be described as a technological renewal if four or five elements are changed[57].

To understand today's shift in Danish energy planning, it is crucial to consider the historical perspective. Hvelplund and Sperling[58] have identified three phases in Danish energy planning within the shift towards renewable energy:

> *"Phase 1: Renewable energy and energy conservation as a supplement in a mainly fossil fuel based energy system (1975–2002) […]*
>
> *Phase 2: Renewable energy as a major supplier in a system when fossil fuel systems become backup systems (2002–2016)*
>
> *Phase 3: Preparing for 100% renewable energy in 2050 [2020–2050)]."* [[58], p. 338]

With the oil crises in the early 1970s, a change in Danish energy planning started to occur. At the time the energy consumption was primarily supplied by imported oil. The crises, therefore, made the government focus more on the energy supply and demand in Denmark.

In 1976, the Danish Ministry of Trade published *Energipolitik 1976*. The first energy plan's primary focus was on the security of the energy supply through a decrease in the dependency of oil, in addition to a focus on energy savings[24]. A result of the new Danish energy policy, the first Heat Supply Act was implemented in 1979[28]. Through the Heat Supply Act the municipalities were made responsible for actions related to local energy planning, through e.g. the development of local heat plans, which included mapping the heat demand, heating methods and heating possibilities.

Furthermore, the city councils were made responsible for approving project proposals within the collective heat supply[28].

In the first phase, the development of a new generation of wind turbines also started to occur. This occurred through pilot projects, where publicly supported projects proved that it is possible to put up locally owned renewable energy production technologies. Furthermore, there was a strong development within energy NGOs working in the renewable energy field. The combination of strong local support and NGOs was the main reason for the political support for local ownership of the energy system in the first phase [58]. Another development seen in this period was a change from investing in mainly centralised CHPs (combined heat and power plants) to investing in a large amount of consumer-owned CHPs.

A change in the political setup towards the end of 2001 implies that renewable energy was degraded in the national political agenda[58]. However, in 2006, the Danish prime minister changed his attitude towards renewable energy and made it a long-term national goal for Danish society to be independent and based on environmentally friendly energy[25], [58]. It was also during this second phase of energy planning in Denmark that the foundations for the centralised energy system approach were established. The electricity transmission system was nationalised, and the large power plants was sold to state-owned companies (DONG and Vattenfall). Furthermore, the electricity market was turned into a competitive market, "The Nordpool power market", with an additionally economically supported renewable energy capacity market [58].

Currently, we are in what Hvelplund and Sperling[58] define as the third phase. The national goal from 2006 is still alive and the common aim is now to have a 100% renewable energy system by 2050[6]. However, there is an ongoing discussion of how the goal of a 100% renewable energy system should be fulfilled. It can be argued that there is a lack of a clear message from the central level in Denmark, in terms of how the development of the energy system should be organised and coordinated. Based on the Danish energy agreement of 2012[18], it seems that municipal strategic energy planning is a preferred approach. In the energy agreement, projects were based on partnerships/networks for strategic energy planning, financially supported over a three-year period. However, after the end of the three years of financial support, strategic energy planning has almost not been addressed at the national level.

CENTRAL VS. DECENTRAL ENERGY PLANNING

Instead, the current tendency within the Danish Government seems to be towards the centralised energy system approach, where the development of large offshore wind turbine parks, the expansion of transmissions lines and the interconnection with neighbour countries are the focus[59].

As we are following the centralised energy system approach, it will be possible to manage the majority of energy planning from the central level. However, this approach will most likely result in an energy system with a large amount of fluctuating energy and very little energy system integration capacity to balance this fluctuating energy production. In particular, the large amount of fluctuating energy from wind and solar makes it important to take a holistic approach when planning for the energy system in order to balance the fluctuating supply through flexible demand[60]. This holistic energy planning approach is referred to in this thesis as a decentralised energy system approach and takes its point of departure in smart energy systems, as the desired system design approach for the Danish energy system.

The decentralised approach to the green transition of the energy system can especially be found within different organisations and lobbyists, such as universities, regions, municipalities, industry associations and different NGOs working to improve conditions for local energy planning.[1], [3], [61]

Even though tendencies towards two energy planning approaches are identified in the shift towards a renewable energy system in Denmark, there is a broad agreement on the main goal for the Danish energy system to be based on 100% renewable energy by 2050[6], [62]. However, tendencies towards the two approaches are seen to be competing against each other. The two approaches in this thesis are presented as two extremes in energy planning and are roughly outlined in Figure 4.

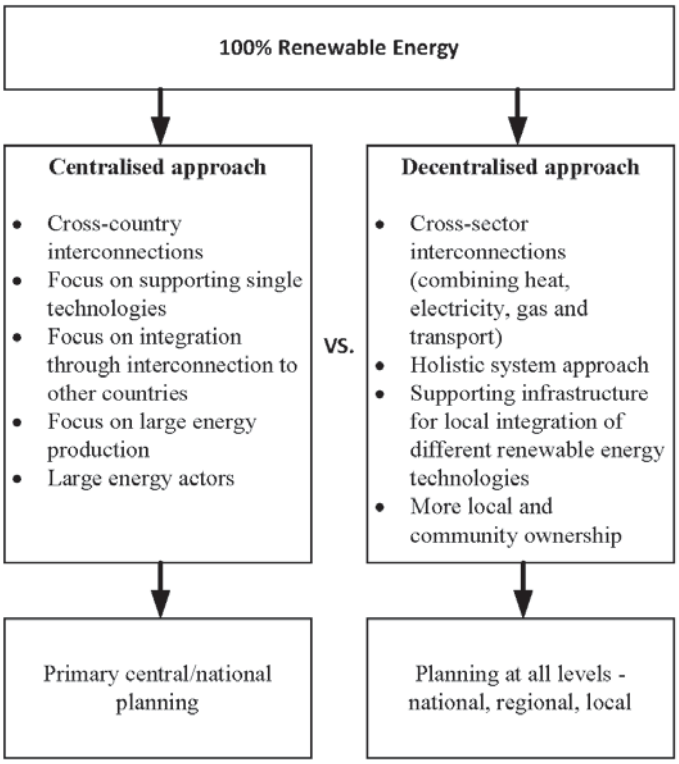

Figure 4: Competing energy system approaches within Danish energy planning

In reality, it is not possible to completely separate the two approaches from each other as Danish energy planning combines the two to some extent, regardless of which approach is being advocated. The most crucial difference between the two approaches is the question of integration into the energy system. In the centralised approach, integration mainly handled through large international interconnections, whereas the decentralised approach focuses on integration at the national level through local distribution grids[61]. The decentralised approach will to a greater extent require strong coordination, both of technical solutions but also between the institutional levels involved in Danish energy planning.

Outwardly, it can seem that there is a broad agreement across actors (the Danish Government, universities, NGOs etc.) to follow the more holistic decentralised approach in going towards a smart energy system. This is based on, e.g., announcements from the national political level stating the importance of energy savings, electrification and the integration of the energy system. Also, the Danish

Society of Engineers (IDA) in collaboration with Aalborg University have developed an alternative energy strategy that advocates the decentralised smart energy system approach, and where it is emphasised that the existing infrastructure is sufficient for the green transition of the Danish energy system[1].

An example of a national political announcement towards the decentralised approach is found in the new Danish Energy Agreement from 2018, where one of the main goals is for Denmark to have

> *The most integrated, market based and flexible energy system in Europe with efficient utilisation of the energy across the power, heat and gas sectors and with continuing high security of supply.* [[39], p. 13].

However, in practice the tendency at the national level appears to be toward the central planning approach, where the perception seems to be that the first move in the transition should begin by expanding large electric transmissions lines and building large offshore wind parks to cover the increasing electricity consumption in Denmark[63], [64]. This is supported by the Danish TSO (transmission system operator), who has developed analyses recommending the government expands the large electricity transmission lines in Denmark to integrate with interconnections to other countries[59]. At the same time, a tendency to neglect local energy planning has been identified through the national statements, among others in the new energy agreement from 2018[39], as described in the introduction in Chapter 1.

One example supporting the tendency toward a central energy system approach at the national level can be found within the heat sector, where district heat consumers have been obligated to connect to and stay on the district heat grid in district heating areas[65]. With the new Danish Energy Agreement from 2018, this requirement was dropped in smaller district heating areas from January 2019[39]. This can have consequences for integration in the heating sector. Integration of, e.g., surplus heat requires large long-term investment in the existing district heat grid and insecurity in relation to the customer base will most likely lead to the district heating companies investing in less efficient and cheaper short-term technologies.

Another example found in the new energy agreement is the government's goal of reducing the number of onshore wind turbines in Denmark[39]. This does not support local development within the green transition. It might remove some local resistance towards wind turbines, but at the same time, it also removes the possibilities for local actors to invest in these projects.

The Danish Government and the Danish Energy Agency introduced the importance of local strategic energy planning in municipalities in 2012[18], [28]. Furthermore, the government financially supported projects based on partnerships for strategic energy planning in the period 2014–2015[18], [38]. However, since then strategic energy planning has disappeared from the national level in discussions on the future

energy system. Moreover, the tendency towards a central approach to the Danish energy system does not support the advantage of utilising local synergies in the energy system. With a smart energy system approach, these synergies become more apparent and a more integrated renewable energy system can be achieved. By using a holistic approach to consider the energy system, it is possible to find solutions that combine the different energy sectors within the overall energy system, which can lead to a better balance between societal needs and interests and technical solutions. However, this approach requires significantly more local integration and implementation of energy technologies. Even though the decentralisation of the Danish energy system has been a central element in the development of district heating and onshore wind turbines in Denmark, the current system is increasingly moving away from this approach. If the smart energy system approach is to be implemented, it is necessary to discuss how energy planning should be organised and at what level it should be implemented. Therefore, from this point on it is the smart energy system design that is in focus when addressing strategic energy planning in Denmark in this thesis.

To identify what should be changed in current Danish strategic energy planning to promote a change in the energy planning paradigm towards a smart energy system, it is necessary to explore the elements that are influencing local energy planning.

2.2 PLANNING FOR SMART ENERGY SYSTEMS IN SOCIETY

Planning for a decentralised smart energy system means that the task of planning is moved into local societies/communities, which are forced to interact with the energy system (and energy technologies) in ways they are not accustomed to. When planning in society, a great variety of actors are influenced by the planning and policy decisions, for example through connections between different sectors (environment, healthcare, schools, transport, energy etc.). Therefore, it is also becoming more important to involve more actors in the processes[66], [67]. However, the more actors that are involved in the process, the more complex the planning or policy-making becomes, especially if the actors have different rights that need to be met [67].

Energy systems can be defined as complex systems which are influenced by political, social and physical processes[68]. Energy planning and policy-making at all levels are influenced and developed based on organisational, economic and legal conditions[58]. Furthermore, policies and planning decisions influence the physical choices of technologies and integration of infrastructure.

Energy planning becomes more complex in the context of the smart energy system approach, where the holistic approach to the energy system requires a long-term strategic approach to foresee how actions in terms of energy savings, expansion of infrastructure and implementation of energy conversion technologies should be implemented in society. The decentralised energy system approach also implies that more actors are involved with the implementation of a 100% renewable energy system

or are impacted by it. It is therefore important that these actors are acknowledged and included in the planning processes. It is important to notice that planning and policies have consequences that go beyond "the subject of planning". The consequences can be both positive or negative, but in order to avoid socially negative impacts, it is necessary to coordinate between actors at the different institutional levels[69].

It can be argued that implementing a decentralised smart energy system approach in Danish energy planning will require more technical and societal coordination in terms of finding the right balance between the implementation of energy technologies and infrastructures and avoiding a negative impact on society. Furthermore, such coordination requires a strong definition of the institutional level's responsibilities within strategic energy planning.

To understand the institutional setup around strategic energy planning and to develop suggestions to improve strategic energy planning processes in Danish municipalities, three different theories related to political governance are introduced in this section; multilevel governance, innovative democracy and choice awareness theory.

MULTI-LEVEL GOVERNANCE

Multi-level governance refers to the coordination between the different planning levels and the involved actors. In multi-level governance theory, it is recognised that planning and policy-making are coordinated through interactions between different government levels and different actors (governmental and non-governmental)[70]. Furthermore, multi-level governance distinguishes between two dimensions, namely horizontal and vertical. In the vertical dimension, coordination between levels of government (e.g. national, regional, municipal) occurs[71], whereas the coordination within the horizontal dimension can be between, e.g., different policy areas, sectors, non-state actors, state actors and local authorities[70]. Thompson et al. [72] outline the modes of coordination that occur between actors, namely market, hierarchical and network.

- Market: coordination by the "buyers" and "sellers"
- Hierarchical: coordination/steering by one or more actors that have the authority to make decisions through control and command.
- Network: coordination through non-hierarchical actor constellations.

Networks or partnerships are often described as a better way to influence and coordinate policy-making[70]. It makes sense to consider energy policy-making and planning from a network perspective due to the fact that energy systems consist of a broad number of actors (generators, producers, suppliers and end-users) [68].

National governments should provide general guidance and frameworks and raise awareness in relation to adaption policies, such as climate change, environmental and

energy policies. Sub-national entities, including municipalities, are important actors in detailed planning and the implementation of adaption policies[70].

Through multi-level governance, Corfee-Morlot et al. [73] have identified three types of institutional models that influence policy actions with reference to climate change:

> ***Nationally led or top-down enabling frameworks*** *with predominant influence moving from national to local action. This uses national policy to steer local or regional authorities to take climate change into account at the local level. Frameworks can include national mandates the leave wide latitude for local authorities to shape policies on climate change to fit local contexts.*
>
> ***Locally led or bottom-up action*** *that influences national action. In this model, learning and experience acquired through autonomously initiated successful local programmes inform and steer policymaking at higher levels of government.*
>
> ***Hybrid models*** *showing features of both. In this approach, national governments may provide enabling frameworks but give local governments a certain amount of discretion to tailor local initiatives. Also the private sector may be a central actor, e.g. through international or national carbon markets. Successful examples may be replicated through initiatives led at higher levels of government.* [[73], p. 10]

Currently, both top-down and bottom-up actions can be seen in Danish energy planning, through the centralised and decentralised approaches. However, this does not rule out a balanced hybrid model with a combination of top-down and bottom-up actions. Instead, it seems that a lack of coordination between the national and municipal/local levels in strategic energy planning has led to an uncoordinated implementation of actions in the green transition of the Danish energy system. Therefore, it is important to start looking into how the coordination between the institutional levels involved in the planning of the energy system can be improved.

INNOVATIVE DEMOCRACY

Hvelplund[55] introduced the concept of innovative democracy into the theories of political economy approaches. Innovative democracy acknowledges that market rules are a product of political processes, and the approach is based upon an equal possibility for dependent and independent lobbyists to influence the political process. Hereby, a dependent lobbyist is defined as an actor with a direct economic interest in a specific technology, and an independent lobbyist is defined as an actor with no economic interest in specific technologies. Hvelplund's model for describing innovative democracy and energy policy-making is shown in Figure 5.

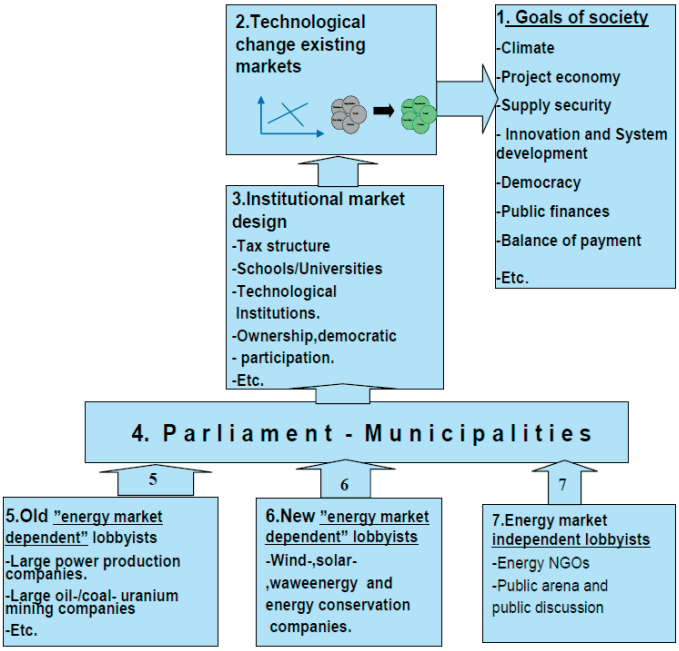

Figure 5: Energy policy and innovative democracy [55].

Figure 5 illustrates how societal goals should be met through a bottom-up process where different groups of lobbyists (boxes 5, 6 and 7) should be able to provide equal information into the political institutions (box 4), which can influence the institutional market design (box 3). Changes in the institutional market design can create changes in the discourse of technical scenarios (box 2), which can again lead to technological changes that can meet the goals of society (box 1).

Hvelplund developed the innovative democracy approach in relation to a radical technology change within the Danish energy system going from an energy system based on fossil fuels to one based on renewable energy resources. As things currently stand, a 100% renewable energy system is still the main political goal. However, it can be argued that there has been a change in the competing actors, the lobbyists and the 'point of contention'. Considering the issue through the theory of radical technological change, the discussion has moved away from a large focus on the technic element, characterised by a competition between fossil fuel technologies and renewable energy technologies, and an overall agreement has been reached that renewable energy technologies should be implemented in the energy system.

The discussion is instead beginning to address the organisation and profit elements. This implies a discussion of how renewable energy technologies should be implemented and integrated into the energy system and concerns the balance between

the centralised and decentralised approaches in energy planning. The fact that decentralised smart energy systems bring renewable energy technologies closer to local communities and the consumers entails that a wide range of new local actors' have an interest – in or are forced to play a role in – the implementation and integration of renewable energy technologies (this can both be positive interests but also interests that hamper the implementation of technologies). This development strengthens the importance of local strategic energy planning in the municipalities. The municipalities act within the local communities and are therefore in a position where they have knowledge that makes it possible for them to take local conditions and actors into consideration in the strategic energy planning process. This also implies that the lobbyists in boxes 5, 6 and 7 in Figure 5 need to change in order to strengthen the voices of local actors working towards the implementation of new smart energy system infrastructure that can manage large amounts of fluctuating electricity in the energy system.

CHOICE AWARENESS

Choice awareness theory was developed by Henrik Lund[5] to create an understanding and awareness of choices always exist even though it may not always seem so. Choice awareness theory has two main theses. The first offers an understanding of how incumbent actors act to protect existing technologies on the market through the use of choice-eliminating mechanisms[5]. The second thesis is related to how to tackle situations where the choice-eliminating mechanisms described in the first thesis are used[5].

As mentioned earlier, the focus in the debate has started to shift from which renewable energy technologies to include in the energy system towards a discussion of organisation and profit in the implementation of the technologies. Choice awareness theory does not ignore this more societal part of the green transition of the energy system; however, the two main theses of the theory and the choice-eliminating mechanisms are primarily related to the technical implementation of renewable energy technologies[53].

Therefore, this PhD project has chosen to develop the existing choice awareness theory further by adding an organisational dimension to the choice-eliminating mechanisms. This is done through the case study carried out in the paper "Barriers and recommendations to innovative ownership models for wind power"[53] (in Appendix A). The case study is described in depth in the paper, and a full description is therefore not included in this thesis.

With a departure point in the existing choice awareness theory, three choice-eliminating mechanisms for the organisational dimension are identified and formulated based on the case study of a Danish tender for nearshore wind turbines.

The three choice-eliminating mechanisms for the organisational dimension are[[53], p. 10]:

a. *Exclusion of actors from the debate and decision-making arenas.*

b. *Design of framework conditions that only make it feasible for some actors to participate.*

c. *Design of feasibility studies in such a way that radically new organisational, financing and ownership models are assessed as not being economically feasible to society.*

The first societal choice-eliminating mechanism is related to the exclusion of specific actors, social groups and interests that seek to promote radical changes in the financing, organisational and ownership models within renewable energy systems[53]. The second and third societal eliminating-mechanisms are related to how the authorities design framework conditions in a way that leads to the exclusion of certain actors and interests[53]. These elimination mechanisms are manifested in the case study of the tender for nearshore wind turbines, where both a municipality and a project based on 100% popular ownership tried to gain access to bid for the tender (see paper [53] in Appendix A). However, the tender conditions, set at the national level, intentionally excluded such smaller actors in favour of large energy actors[53], [74].

The case study is also an example of how the national level currently considers municipalities and local actors, whereby the original case study of the nearshore wind tender clearly identifies a focus at the national level to promote the central planning approach rather than a decentralised energy planning approach. At the same time, the case study has also highlighted an interest and willingness among municipalities and local actors to participate in the transition of the energy system [74]. These findings show conflicting interests among the actors in the green transition of the energy system, which stresses the importance of changes in the current energy planning approach in Denmark.

Based on the results of the case study in the paper [53] in Appendix A, the following suggestions for how to eliminate the choice-eliminating mechanisms related to the organisational dimension of choice awareness theory are developed in this thesis.

- A broad variety of actors influenced by policies and framework conditions should be invited to join an open and transparent dialogue concerning these at the early development stage.
- Policies and framework conditions should be developed so as not to exclude potential important and interested actors from the process.

- Feasibility studies should be designed in such a way that they remain open towards new approaches to how to implement technical solutions in the energy system (e.g. new ownership models).

The organisational dimension of choice awareness theory can help to identify the conflicts of interest and create an awareness of the impacts of the changes in the organisation and profit elements in the radical change of the energy system.

The three theories described in this chapter are, together with the three papers, used in the following sections to develop the theoretical perspective for the thesis. The theories are not directly referred to throughout the thesis, but they are indirectly used in the discussion of identified barriers in relation to local strategic energy planning in Chapter 5.

2.3 FRAMING THE PERSPECTIVE AND ANALYTICAL FRAMEWORK OF THE THESIS

The shift towards a 100% renewable energy system in Denmark has been in the pipeline since the first Danish energy policy in 1976. However, there are uncertainties regarding the desired approach to the energy system at the national level. The current tendency in actions at the national level point in the direction of a centralised energy system approach with limited focus on local strategic energy planning.

However, if a smart energy system is the desired way to realise a 100% renewable energy system in Denmark, it is necessary to find a balance between the centralised and decentralised approaches with a greater focus on developing decentralised smart energy systems that can benefit Danish society in the most optimal way.

With a point of departure in Hvelplund's theory of radical technology change, a 100% renewable energy system is defined as the desired "technology" of the Danish energy system; see Figure 6.

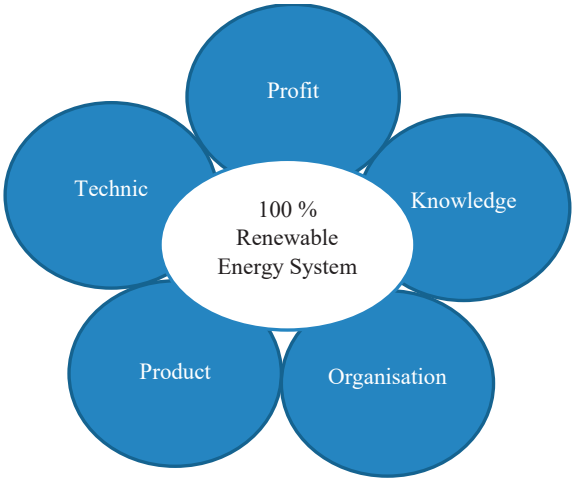

Figure 6: The five dimensions of technology in relation to a 100% renewable energy system, inspired by Hvelplund, 2005[57].

Depending on which approach to the energy system is chosen, the elements of technology will change differently. Thus far in the discussion of the transition of the energy system, the focus has been primarily on technique and knowledge regarding how to implement renewable energy technologies in the energy system. However, in the current state of the transition of the energy system, we are in a position where it is necessary to start focusing more on the discussion of other elements of the technology. Table 2 presents the five elements of technology related to a 100% renewable energy system for both the decentralised energy system and the centralised energy system approaches.

Table 2: The five dimensions of technology in relation to a 100% renewable energy system for the decentralised and centralised energy system approaches.

	Decentralised approach	**Centralised approach**
Product	Renewable energy	Renewable energy
Technic	Primarily local integrable renewable energy production technologies	Primary large renewable energy production technologies accommodating interconnections with surrounding countries.
Profit	User and community profit.	Shareholder profit (large and often distant shareholders)
Knowledge	Technical knowledge of how renewable energy technologies and energy efficiency measures can be combined in the energy system. Knowledge of society and local conditions in communities where the elements of the energy system are implemented. Knowledge of how to integrate the energy system locally.	Knowledge of how to build and integrate large energy production units and infrastructures in the energy system that support the interconnections in the electricity grid between countries.
Organisation	Framework conditions supporting local strategic energy planning in the planning of a 100% renewable smart energy system. Bottom-up organisation with local planning processes and local participation.	Framework conditions supporting the development of a centrally steered energy system. Top-down organisation with centrally steered planning processes and project implementation.

The government is, as mentioned, showing a tendency towards the central approach, e.g. through the energy agreement from 2018. However, as mentioned in the introduction in Chapter 1, an increasing number of municipalities are starting to conduct local strategic energy planning, even though the national level is giving mixed signals in their different publications and announcements. The municipalities' initiatives within strategic energy planning are challenging the national tendency. In pace with local strategic energy planning implemented within the municipalities, the focus on the elements is starting to shift pari passu with the implementation of energy production technologies that are moving closer to the consumers and as the consumers are forced to take more conscious decisions regarding investing in green alternatives (e.g. electric cars, individual heat pumps, energy restoration of houses). Therefore, local strategic energy planning is becoming increasingly important in order to challenge and start a discussion of the current perceptions in the profit and organisations elements. As mentioned earlier, the transition of the energy system will require a mix of the centralised and decentralised approaches if the transition is to happen successfully. It is, therefore, a question of finding the right balance between the two approaches. Currently, the decentralised approach, with its focus on local integration, is not prioritised in the framework conditions and analyses for the future energy system. The consequence is that the "optimal" balance between the decentralised and centralised approaches will not appear in the planning for the energy system. Therefore, there is a need for stronger framework conditions outlining how strategic energy planning should contribute to the transition of the energy system to create the coordination between the centralised and decentralised actions that a 100% renewable smart energy system requires.

COORDINATION ISSUES IN THE STRATEGIC ENERGY PLANNING

Based on the theory, two coordination issues that should be addressed within local strategic energy planning are defined. These are:

1. National level vs. local level
2. Technical solutions vs. societal needs

The first coordination issue concerns finding the right balance between the national and local levels in energy planning. The question is how much of the energy planning should be steered from the national and local levels, respectively, in order to reach the overall national goals. This is referred to as vertical coordination. Another dimension of the coordination between the national and local levels is the horizontal coordination at the two levels. Figure 7 illustrates the overall coordination flows in strategic energy planning. The thesis approaches strategic energy planning at the local level, thus the horizontal coordination at the national level is left out in Figure 7.

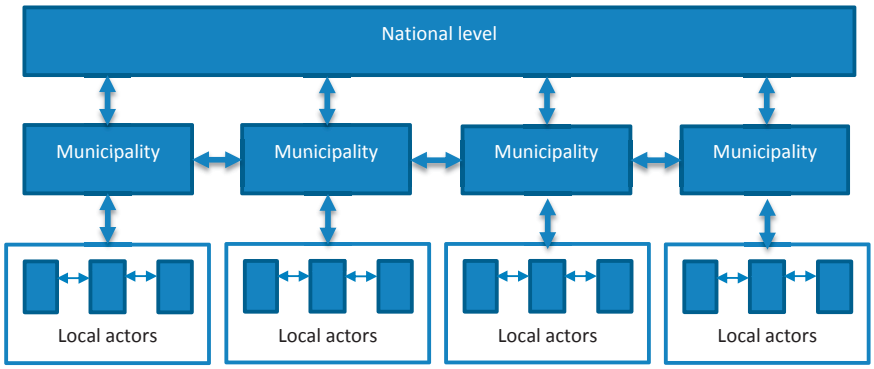

Figure 7: Overall coordination flow in strategic energy planning.

The second coordination issue considers the balance between technical solutions and the needs of the society in which they are implemented. The best technical solution might not be the one that best fits the local society. How then should the balance between optimal technical solutions and societal needs be balanced in a smart energy system?

In Denmark, energy planning is conducted at different institutional levels, whereby the national and municipal levels are the most distinctive. Local integration of energy infrastructures and energy conversion technologies is important in implementing a 100% renewable smart energy system in Denmark, and this implies interaction with energy consumers, local energy producers and other sectors such as road infrastructures for transporting energy resources (e.g. liquid manure and biomass to biogas plants). It is crucial to recognise these local connections. Municipalities are the authorities placed close enough to the consumers and local producers to collect and manage knowledge of local possibilities and synergies between resources, local interests and geographical challenges. Therefore, in this thesis, it is chosen to focus on local strategic energy planning in Danish municipalities.

In order to investigate the research questions stated in Chapter 1, it is necessary to look deeper into the definition of strategic energy planning and what it should contain to coordinate the right balance between the centralised and decentralised elements in the energy system. Therefore, an analytical framework for strategic energy planning is developed in the following section to guide the analyses made through the PhD project.

ANALYTICAL FRAMEWORK FOR STRATEGIC ENERGY PLANNING

Based on the definition of strategic energy planning identified through the Danish Energy Agency and the scientific literature regarding strategic energy planning in a Danish context, as presented in the introduction in Chapter 1, it is clear that strategic

energy planning is not a very well-defined concept. An international literature review was therefore conducted in the paper "A comprehensive framework for strategic energy planning based on Danish and international insights"[40] (Appendix B) to investigate how the concept is used and defined from the international perspective. On the basis of the theoretical perspective presented in this chapter, the Danish definition of strategic energy planning and the international review form the analytical framework for strategic energy planning developed in this section.

The literature review reveals a general use of the concept of strategic energy planning as a name for an energy planning approach, without specifying a definition or going deeper into the content of the approach. Different studies connect different keywords to the concept of strategic energy planning, which leads to a broad variety of elements included in the understanding of strategic energy planning. Based on the literature, it is not possible to identify one generally used definition of strategic energy planning. Krog and Sperling[40] sum up the findings of their literature review in [40] in terms of keywords, tools/methods, institutional levels and stakeholders. The findings are collected in Table 3, where each term is followed by a number in brackets indicating the number of papers where it has been identified in relation to strategic energy planning.

One of the authors' main findings was that strategic planning is mainly mentioned in relation to technical solutions for energy systems, and only a few keywords are identified within more social aspects of the energy system (improving welfare, community goals and stakeholder involvement) [40]. This is a crucial finding since it is argued in this thesis that strategic energy planning should be conducted to secure the development and implementation of smart energy systems, as emphasised in the introduction in Chapter 1. It is therefore important that strategic energy planning balances the societal and technical aspects of the energy system. The strategic energy planning process should, therefore, include tools that tackle the technical aspects, but also tools that address the social aspects related to the green transition of the energy system. It is, therefore, important to conduct strong technical scenarios based on the specific societal and geographical conditions within the municipalities.

Table 3: Based on findings in[40], this table shows the identified keywords, tools/methods, institutional levels and stakeholders in relation to the use of strategic energy planning in the scientific literature. Numbers in brackets indicate the number of papers using each term.

Keywords Short-term (5), Mid-term (1), Long-term (20), Holistic (5), Sustainable (7), Strategy document (strategic energy plan) (33), Reduce end-use energy demand (1), Community goals (1), Renewable energy sources (1), Stakeholder involvement (6), Efficiency (2), Improving welfare (1), Reliability (1), Integrated system thinking (1), Energy supply and demand (2), Resiliency and security of energy infrastructures (1), Cost structure of energy, production (1), Comprehensive energy system (1), Land-use (1), Smart Energy Systems (4)
Tools/methods GIS-based analyses (1), Scenario analyses (4), SWOT analyses (1), System dynamic modelling (1), Optimisation models (1)
Institutional levels Cities (urban planning) (6), Municipalities (local) (4), Regional (2), Central (national) (3)
Stakeholder Municipalities (11), Utilities (1), Citizens (6), State/government (8)

Figure 8 shows how the analytical framework for strategic energy planning is defined in this thesis. It should be seen as a theoretical analytical framework for strategic energy planning that can be used to analyse current strategic energy planning activities or in the development of future strategic energy planning processes. The analytical framework in this thesis is used in the identification of coordination issues in current strategic energy planning. This is done through the case study carried out in the paper "How municipalities act under the new paradigm for energy planning"[54](in Appendix C) in Chapter 4 and Chapter 5 in this thesis. By applying the framework to a specific case study, it is possible to obtain new and detailed practical knowledge of where to act to improve current strategic energy planning processes in Denmark.

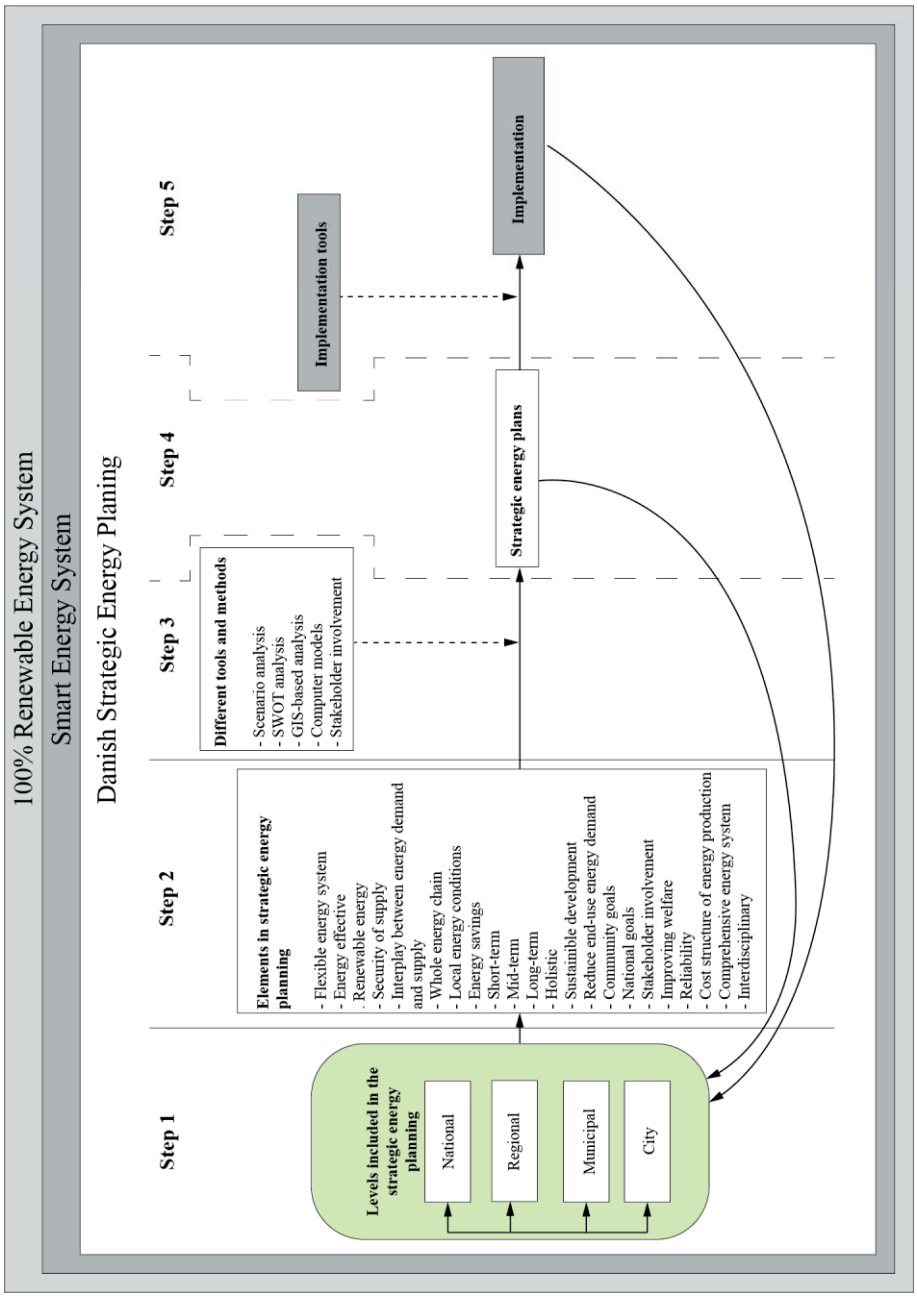

Figure 8: Analytical framework for strategic energy planning.

The analytical framework can be considered from both a macro and a micro perspective. The macro perspective is identified through the overall process of strategic energy planning as presented through the steps in Figure 8. Each of the five steps in the figure includes one or several micro perspectives.

Step 1 represents the institutional arena for strategic energy planning. From a macro perspective, the coordination between the different institutional levels in strategic energy planning is considered. This includes how the national level presents and communicates the overall national framework conditions for strategic energy planning and the green transition of the energy system. Furthermore, this step also includes how the municipalities act within the national framework conditions and how they communicate their experiences back to the national level.

From a micro perspective, step 1 includes several smaller systems that influence the overall macro perspective. Each of the different levels acting within strategic energy planning has its own dynamics and processes that shape the overall outcome. For example, the national level consists of several ministries and agencies that are all involved in the development of the national framework conditions for the green transition of the energy system. The local/municipal level consists of administrative employees, local politicians, several local actors etc., who all somehow influence the shaping of the local strategic energy planning processes.

Step 2 concerns finding the balance between the national and local goals and visions for the future energy system. This step contains the main elements (technologies, time horizon, actors to be involved in the further process etc.) to include in the further strategic energy planning process identified, based on the coordination between the different levels in step 1. From a macro perspective, the final list of elements are considered but from a micro perspective, the processes in relation to the selection of the elements are considered.

Step 3 represents the tools and methods used to analyse and develop the physical strategic energy planning document based on the chosen elements in step 2. From a macro perspective, this step includes a number of methods to use, or to be used in a specific situation, based on the choices made in the specific municipality. However, from a macro perspective, this includes examining the details of the different tools and models in order to select the best-suited ones.

Step 4 is a strategic energy plan that is the physical outcome of the processes in steps 1-3.

Step 5 represents the implementation phase of the strategic energy plan. This step includes the implementation tools and methods but also the actual implementation in terms of energy projects carried out in the municipalities. From a macro perspective, this step is very much about identifying the specific actions implemented or to be

implemented in order to fulfil the goals set in the strategic energy plan. However, from a micro perspective, this step consists of a number of processes, such as the selection process for which implementation tools to include as well as the coordination process between the municipality and the project developers implementing the actions from the strategic energy plan.

Even though the process is divided into five different steps, it should not be considered a completely linear process. The knowledge obtained in the different steps is most likely to lead to new considerations and changes in earlier steps. Therefore, strategic energy planning should rather be considered a dynamic process where changes in the knowledge of technologies, local conditions etc. should lead to a consideration of going back and changing the strategic energy plan to fit the new conditions arising for the transition of the energy system.

2.4 DELIMITATION

As presented above in Section 2.3, strategic energy planning becomes more and more complex the deeper we move into the micro-processes of the concept of strategic energy planning. This thesis can therefore only embrace a small part of strategic energy planning, and thus chooses to focus on local strategic energy planning and the municipalities' role in this. It is important to note that by limiting the thesis to only consider local strategic energy planning, a number of the micro-processes in strategic energy planning are deselected. Nevertheless, the thesis still touches on a lot of these elements, since all elements are interconnected and cannot be considered individually. With a point of departure in the analytical framework for strategic energy planning in Figure 8, the delimitations made in the PhD study are presented in this section.

Actions at the national level

Strategic energy planning in Danish municipalities is very much dependent on actions and decisions coming from the national level, allowing them to navigate the development of local energy systems. This is because the national level decides what to include on the national agenda (e.g. in policies), and this influences the directions and content of local strategic energy plans. The most crucial elements coming from the national level are:

- Policies, visions and goals for the future energy system in Denmark
- Legislative framework conditions, tax and support schemes
- Market conditions for renewable energy
- Intended target groups for national policy and planning

In the macro-structure for strategic energy planning, a 100% renewable energy system and smart energy systems are mentioned as the underlying premises or goals for Danish strategic energy planning. The 100% renewable energy system goal is set on the national level along with the rules and regulation measures. The market structures

are to some extent also steered from the national level. The research project "Innovative re-making of markets and business models for a renewable energy system based upon wind power" (IREMB)[75] refers to the market design for renewable energy, and therefore in this thesis it is chosen to not look deeper into market design or how the market should be designed to support the green transition.

Even though the national framework conditions are crucial for how the municipalities can conduct strategic energy planning locally, this thesis does not investigate how the national goals, legislative measures and market conditions have been developed at the national level. This would have required deep analyses of the relations between the different ministries, agencies and lobbyists acting at the national level. Furthermore, it would be interesting to investigate how the national budget is prioritised between the different sectors. Such analyses would provide valuable knowledge of how the overall framework conditions for the green transition of the energy system – and thereby also for strategic energy planning – are developed. However, the PhD study takes its point of departure from the existing framework conditions and investigates which coordination issues and barriers are visible in the municipalities' current strategic energy planning.

In the development of the theoretical development of the existing choice awareness theory, the paper "Barriers and recommendations to innovative ownership models for wind power"[53](Appendix A) did a case study of the tender for nearshore wind turbines in Denmark, indicating that that national policy and planning actions are focused in a way that benefits large energy actors. The paper suggests how to expand the target groups for these large tenders for renewable energy production, e.g. through new tender models [53]. Although this provides an insight into the perception at the national level, it is not addressed further in this thesis.

The technical composition of the energy system

In the development of smart energy systems, it is important to make scenario analyses to select the *"optimal solution for each individual sector as well as for the overall energy system."* [[5]p. 11]. Scenario analyses should be conducted on both the national and local levels. At the national level, scenario analyses would provide an overview of the possible outcome of the different decisions made in the national policies and legislative actions. At the local level, scenario analyses could give the municipalities and local actors insights into the consequences of different combinations of renewable energy technologies and energy saving initiatives. Therefore, scenario analyses could be useful tools to support the decisions made in the final strategic energy plan.

This thesis recognises the importance of a technical scenario analysis to show possible solutions for the future smart energy systems both at national, regional and local levels but does not go into the discussion of which models should be used for this purpose. There are already several studies of scenario analyses on how future energy systems

should be constructed based on the use of different scenario modelling tools. The modelling tools used in such studies include EnergyPlan [3], [76], Balmorel [77], [78] and EnergyPro [79]. However, it is important to recognise that scenario analyses are dependent on the worldview of the actors using the modelling tool to develop scenarios. Therefore, technical scenario modelling is closely connected to the societal aspects of energy planning, although technical scenarios are only useful in local strategic energy planning if the local authorities know how to use the scenarios in their planning processes. Currently, consultancy companies are often used by the municipalities to conduct these analyses[21]; consequently, the local municipal employees most likely do not fully understand the argumentation behind the different scenarios and the synergies identified through the scenarios. This is not further explored in this thesis, but it is a subject that should be investigated further to strengthen local strategic energy planning.

Furthermore, the technical models fall short when it comes to the implementation of scenarios within society. They cannot consider, e.g., whether local resistance will occur when certain technologies are introduced into the local communities. It is therefore chosen not to investigate which model should be used in the Danish context or what the technical composition of the local energy system should be in the studied case. Instead, the thesis focuses on the overall coordination in the process of the development of a strategic energy plan (in Chapter 4) and on in the implementation of an already existing strategic energy plan (in the paper "How municipalities act under the new paradigm for energy planning[54] (in Appendix C).

CHAPTER 3. RESEARCH DESIGN AND METHODOLOGY

In this chapter, the research design and methodology used in this PhD thesis are presented. Through the application of different data collection methods within the two case studies, it is possible to construct a study that comes very close and enters deep into local strategic energy planning, especially with reference to how national political framework conditions influence local strategic energy planning. Prior studies of strategic energy planning primary have had a more overall perspective on the energy planning processes[16], [21]. The thesis's focus on two specific case studies has made it possible to identify elements that have not previously been observed in other studies with a more overall perspective on the energy planning processes.

The PhD project is primarily conducted as a qualitative study. This approach is used to describe, understand and interpret mechanisms in the energy planning processes in Denmark [80]. In the qualitative research process, the researcher brings in their own sets of beliefs and worldviews[81]. The worldview of the thesis is described through the theoretical framework presented in Chapter 2.

3.1 RESEARCH DESIGN

The research design for the PhD study is developed with inspiration from phronetic planning research. The purpose of phronetic planning research is not to develop universal methodologies or theories but rather to add a deeper knowledge of practice into the research to gain deeper understandings of the values and power relations in planning[82]. Phronetic planning research goes beyond scientific knowledge and technical know-how and knowledge and places a value on practical knowledge gained through case studies and narratives. Flyvbjerg (2004)[82] summarised the point of departure for phronetic planning in four questions;

> *(1)Where are we going?*
> *(2) Who gains and who loses, and by which mechanisms of power?*
> *(3) Is the development desirable?*
> *(4) What, if anything, should we do about it?* [[82], p. 289–290]

The research question in this PhD project is not specifically designed to follow the four questions in phronetic planning research; however, the sub-questions used to answer the overall research question (see Table 4) do touch upon these four questions. Furthermore, it is not the purpose of this PhD project to develop a uniform methodology for strategic energy planning; rather, the purpose is to understand the coordination issues occurring in the context of Danish local strategic energy planning

today and to point to solutions that could improve local strategic energy planning processes in the future.

Flyvbjerg [83] argues that there are limits to how far we can reach in a learning process by only considering a theoretical perspective; therefore, it is important to add practical knowledge obtained through practical case studies to develop and support the theoretical knowledge. Based on the history of energy planning in Denmark and the coordination issues assumed to limit successful local strategic energy planning today, the case study was chosen as the main research design to investigate and understand how strategic energy planning is actually conducted in practice today, rather than only considering the more or less ambitious visions expressed in (vocal) statements or written documents. The research design is therefore constructed to answer the overall research question, which is done through three sub-questions that are formulated to guide the research process; see Table 4.

Table 4: Research design.

What coordination needs emerge within the paradigm shift towards a 100% renewable energy system? And how can local strategic energy planning meet these coordination needs?			
Sub-questions	***Data collection methods***	***Used data***	***Chapter***
How should strategic energy planning be understood to support more coordinated local energy planning processes in Denmark?	Literature review and document analysis, nearshore wind case	Literature on the different theories (multilevel governance, innovative democracy, choice awareness theory); Existing dataset for the nearshore wind case	2
How does a Danish municipality act within the framework of strategic energy planning and what kind of coordination is present current in local strategic energy planning?	Case study of Hjørring Municipality, interviews, participant observation	Hjørring Municipality's current strategic energy plan; Transcriptions from one focus group interview, four single person interviews and one two-person interview; Observation notes from three meetings; E-mail correspondence	4
What are the current barriers in local strategic energy planning and how could these barriers be eliminated to better support coordinated strategic energy planning?	Case study of Hjørring Municipality, interviews, participant observation	Results from analyses made in Chapter 4; Transcriptions from one focus group interview, five single person interviews and one two-person interview; Observation notes from three meetings	5

CASE STUDIES

Two case studies form the basis of this study. Firstly, a case study of a tender for nearshore wind turbines in Denmark is investigated. Secondly, a case study of strategic energy planning in Hjørring Municipality is used as the case municipality.

The case study is chosen as the primary research methodology since this is a good way to obtain insight into real-life practice, providing a practical dimension that adds to the theoretical research studies[83]. The case study research approach is based on an investigation of one or multiple bounded systems over a period of time[81]. When designing a case study, it is necessary to examine the intent of the study, whereby three types of intent exist: the intrinsic case study, the collective case study and the single instrumental case study. The intrinsic case study focuses on the case itself, whereas the collective and single instrumental case studies use the case to illustrate or investigate a concern or issue [81].

It this PhD project, the main purpose is to investigate both how strategic energy planning is carried out within the current framework conditions as well as the coordination issues occurring in relation to the strategic energy planning process. Therefore, the intrinsic case study is not relevant for this study, although the single instrumental case study and the collective case study could be used. One of the benefits of choosing the collective case study is the fact that the issues can be studied from several perspectives or could simply be replicated to develop a generalisation based on the different cases [81]. However, one of the issues when choosing the collective case study design is that the more cases are included in the study, the less the depth can be applied in the individual cases. Selecting a single instrumental case study makes it possible to get closer to the case and explore details that would otherwise remain hidden.

Earlier studies of strategic energy planning in Denmark have been on a more overall level, where the concept is studied through comparisons between the strategic energy plans in the municipalities[16], [21], [42]. These studies highlight different issues in strategic energy planning. To complement the findings of earlier studies, a single instrumental case study is chosen to go deeper into the obtained knowledge and to explore details that are more varied and not visible at the more overall level. One example is that prior studies indicate that local authorities do not relate to the national level in strategic energy planning[16], [42]. Through the case study in this thesis has it been possible to go deep into the content of the strategic energy plan and the processes of developing and implementing the strategic energy plans. This is necessary if a detailed understanding of coordination in strategic energy planning is to be obtained. The case study makes it possible to investigate the reasons behind the missing relations to the national level in the local planning. Furthermore, the case study makes it possible to investigate, e.g., how the individual project initiatives fit into the specific strategic energy plan or how the communication between the

involved actors takes place. However, this approach can also result in some overall details in the planning being missed in the study, such as the connections across municipalities and relations between the different municipal strategic energy plans.

Besides the main case study of Hjørring Municipality, a second single instrumental case study has been carried out in the PhD project with the purpose of developing the existing choice awareness theory, presented in Chapter 2.

Flyvbjerg (1991) (2006) [83], [84] defines four types of case study, namely extreme cases, maximum variation cases, critical cases and paradigmatic cases. Both case studies carried out in the PhD thesis are critical cases. Flyvbjerg defines the purpose of a critical case as:

> *To achieve information that permits logical deductions of the type, 'if this is (not) valid for this case, then it applies to all (no) cases'* [[84], p. 230]

The specific choices made in relation to defining the type of case used in the two case studies are presented in further detail below and in the two papers "How municipalities act under the new paradigm for Energy Planning"[54] (Appendix C) and "Barriers and recommendations to innovative ownership models for wind power"[53] (Appendix A).

Hjørring Municipality

Hjørring Municipality is the primary case in this study in relation to answering the second and third sub-questions. The purpose of this case is to not only investigate how strategic energy planning is currently carried out but also to investigate what barriers occur when municipalities conduct local strategic energy planning.

Hjørring Municipality was chosen as a critical case when this PhD project started in 2016 for several reasons.

1. Hjørring Municipality has already been working with strategic energy planning and has had an existing strategic energy plan since 2012.
2. At the time, Hjørring Municipality was about to start developing a new strategic energy plan for the municipality.
3. Energy and strategic energy planning are a political priority in Hjørring Municipality and are prioritised in the municipal budget.
4. The author of this PhD thesis was earlier employed in Hjørring Municipality and therefore has exhaustive knowledge of the work in the municipality as well as easier access to important information since the relations between the author and the administrative employees in the municipality already existed.

Besides the strategic energy planning from 2012, Hjørring Municipality has also been the driving force behind the combined strategic energy planning project in Northern Jutland "Et Energisk Nordjylland" under the national fund for strategic energy

planning in 2014–2015. Based on the author's knowledge of strategic energy planning in Danish municipalities today, Hjørring Municipality is among the frontrunner municipalities where strategic energy planning has been prioritised as an important task in the municipality. Hjørring Municipality is not the only municipality that could have been used as a critical case in relation to strategic energy planning in Denmark, as municipalities such as Sønderborg or Skive could also have been potential critical cases due to large engagement through ProjectZero in Sønderborg[85] and Energibyen (Energy City) in Skive[86]. However, due to the author's knowledge of ease of access to information, Hjørring Municipality was chosen as the case for investigation. Furthermore, Hjørring Municipality was about to start the development process for a new strategic energy plan, which made it possible for the author to be a participant observer during this process. A more thorough description of the case can be found in Chapter 4 and in the paper "How municipalities act under the new paradigm for energy planning"[54] (Appendix C).

Nearshore wind tender

The tender for nearshore wind turbines in Denmark has been chosen as the second critical case in the PhD study. The purpose of this case study is to provide knowledge of how national framework conditions impact actors' possibilities to act within the green transition of the energy system for the development of the theoretical framework in Chapter 2.

The case study of the nearshore wind turbines tender is based on an earlier study[74] by the Danish grassroots organisation WindPeople in developing the project Wind & Welfare; the dataset from this study is used and analysed in a new context of choice awareness and temporary space theory. The dataset and knowledge are also used here to develop choice awareness theory to include an organisational dimension of choice-eliminating mechanisms. The thesis presents of only the results of the analysis included in the theoretical framework in Chapter 2, and the full analysis can be found in the paper "Barriers and recommendations to innovative ownership models for wind power"[53] in Appendix A.

The original case study was designed as a narrative study[81], whereby the Wind & Welfare project was studied based on direct information from representatives of the non-profit organisation Wind People, who organised the Wind & Welfare project[74]. The dataset in this thesis is referred to as secondary data and is described further in the "Secondary Data" section.

3.2 DATA COLLECTION

The data collection for the case studies consists of a mixed-method approach, where the primary and secondary data complement each other and eliminate some of the weaknesses in the different methods. The primary data are collected through interviews and participant observation at workshops and meetings. The secondary

data are collected through a literature review and document analysis of different documents. The following includes descriptions of the used data collection methods.

SECONDARY DATA

Literature review and document analysis

Throughout the study, both the literature review and document analysis are an ongoing process.

The literature review and document analysis were the key methods used to identify the already known information about general and strategic energy planning in Denmark. Different types of literature and documents were analysed in the study:

- Scientific papers
- National policy documents
- Municipal documents related to their strategic energy plan
- E-mails

These documents were used to gain an in-depth knowledge of the strategic energy planning approach in order to develop the analytical framework for analysing strategic energy planning in Chapter 2, which builds upon the paper "A comprehensive framework for strategic energy planning based on Danish and international insights"[40], presented in Appendix B, where the specific methodology of the paper is also described. Furthermore, the literature was used to reach an understanding and insight into the case studies in Chapter 2, Chapter 4 and Chapter 5.

Use of an existing dataset

As described above, the case study of the nearshore wind tender is based on an existing dataset (developed by the author of the PhD thesis) from the case study presented in the report "Who should own the nearshore wind turbines? A case study of the Wind & Welfare project"[74]. Table 5 presents the data used in the case study.

Table 5: Overview of the dataset available from the existing case study.

Type of data	Content
Written report	"Who should own the nearshore wind turbines"[74]
Diary recordings	13 spoken diary recordings from one representative of the NGO WindPeople
Interviews (narrative interviews)	Three single-person narrative interviews with two representatives from the NGO WindPeople.
E-mail correspondences	Access to e-mail correspondence between WindPeople and other actors involved in the project.

PRIMARY DATA

Interviews

Qualitative interviews are a part of the data collection for the analyses in the thesis. The interviews conducted through the PhD project were all conducted in relation to the case of Hjørring Municipality. The conducted interviews are one focus group interview, four individual interviews and one two-person interview. An overview of the interviews can be found in Table 6.

The interview is a method of seeking to gain access to people's experiences of a phenomenon in their lifeworld[80]. It is a method that can contribute new insights to a research field through close interactions with people in a specific situation, and it gives the researcher the possibility to understand situations from the point of view of the involved persons. One thing to consider when choosing the interview as the research method is that it is difficult to conduct an interview without influencing the interviewed person through the asked questions and interactions between interviewer in interviewee[80]. This is also one of the critiqued points against interviews as a scientific research method[87]. Brinkmann[87] argues against this perception and emphasises that qualitative research such as interviews investigates how things work, unlike quantitative research, which investigates what is working. He argues that the two research approaches complement each other rather than being not related at all[87].

Focus group interview

Focus group interviews are often flexible, and the interviewer's role is more to steer the discussions in the desired direction rather than ask delimited questions[87]. The focus group interview has the advantage that the respondents can supplement each other, and therefore very detailed information can be gained through the interview[88].

The focus group interview was chosen in the initial phase of the case study of Hjørring Municipality; see Table 6. This was chosen to obtain an overview of the different actions in the municipality related to strategic energy planning and especially the current strategic energy plan for the municipality. The interview was conducted with the four employees who had the greatest connection to strategic energy planning in the municipality. These employees were identified by contacting one of the employees by email, asking who should be included in an interview regarding the strategic energy plan and energy planning projects in the municipality.

Single-person interview

Single-person interviews were used to understand the different energy projects and actions in Hjørring Municipality and the context in which they occur. The single-person interview has some advantages compared to the focus group interview. Firstly, it makes it easier to maintain focus in the interview as well as to go in depth with some questions. Furthermore, people are likely to express views and feelings towards a subject that they would not comfortably share with a larger audience[87].

Four single-person interviews were conducted in relation to the case study of Hjørring Municipality. The purpose was to gain a deeper knowledge of the different energy projects and actions identified in relation to the current local strategic energy plan during the focus group interview. The single-person interview was conducted with the same respondents who were interviewed in the focus group interview, whereby each respondent was interviewed in relation to the projects and actions for which they indicated they had knowledge.

Two-person interview

One two-person interview was conducted in the final stage of the data generation. The purpose of this interview was to follow up on the information on the municipality's new strategic energy plan that was gathered through participant observation (described below). The respondents for the interview were chosen as these two administrative employees in Hjørring Municipality were responsible for the work with the new strategic energy plan.

Table 6: Overview of the conducted interviews.

	Focus group interview	**Single-person interview**	**Two-person interview**
Purpose	To identify energy projects in the municipality and the responsible employees	To gain comparable knowledge of the different energy projects and the strategic energy planning process in the municipality	To follow up and get confirmation of information and observations in relation to the process of the second strategic energy plan
Interview type	Semi-structured	Structured	Semi-structured/unstructured
Number and type of people interviewed	Four persons: one team leader and three administrative employees, all representing Hjørring Municipality	Four different single-person interviews: one team leader and three administrative employees, all representing Hjørring Municipality	Two persons: two administrative employees representing Hjørring Municipality
Date of interview	October 19th, 2016	October 7th and 10th, 2016	November 21st, 2018
Interview guides	Appendix D	Appendix D	Appendix E
Reference	[89]	[90]–[93]	[94]

Participation observation

Part of the data collection was done through observation, which to a great extent was participant observation. The author was asked to participate and make presentations on a number of meeting and workshops in relation to the development of a new strategic energy plan in Hjørring Municipality. These workshops and meetings formed the basis for the participant observation made throughout the PhD project. An overview of the observations is found in Table 7.

The participant observation method was chosen because it makes it possible to get very close to the case and its processes, and thereby to go deeply into the details and learn things that would not appear through, e.g., interviews, where people have more time to reflect upon the process before answering the questions. Through observations, it is possible for the observer to see and hear what the actors do spontaneously in the situation and not what they say they did once they have had time to reflect upon the situation[88].

The participant observation method has two purposes:

- To see how the municipality coordinates and interacts with local actors (including which actors they include).
- To obtain knowledge of how the second strategic energy planning process is structured.

The participant observation proved to be effective in identifying the coordination between the municipality and local energy actors, and specifically in identifying the actors' positions towards the local strategic energy planning.

There are also some issues related to using observation as a research method, due to the role of the observer; these issues can be to remember to take field notes, getting overwhelmed at the site due to the amount of information, and knowing when to be a participant or nonparticipant[81]. These issues also emerged in this study. One of the challenges in this study was the dilemma between being a participant and being an observer. On the one hand, it was desired to merely observe how the municipality runs the process within the strategic energy plan, but on the other hand, this was difficult since the author was also a part of the advisory board and wanted to share knowledge for the municipality to achieve the best possible result. The choice was made to participate and share knowledge with the municipality while recognising that this most likely influenced the process in some ways.

Another relevant issue is the challenges of participating in the process and at the same time taking good field notes. In this study, handwritten notes were taken during the meetings and workshops, and then a summary was written shortly after the meeting, while it was still in the memory. It can be seen as a weakness that no sound or video

recordings were made during the observation process since this would have made it possible to go back and examine details that were missed in the situation. However, it can also be considered a strength that no recordings were made. If the participants knew they were being recorded during the workshop or meeting, they would have been more likely to make more reflections before they spoke. Therefore, the approach chosen in this PhD study is more likely to show natural reactions and interactions between the participating actors.

Table 7: Overview of observation situations during the PhD study.

Observation situations	***The author's role in the situation***	***People present***	***Date***	***Reference***
Themed meeting about biomass in the future energy system	Presenter and observer	Representatives from Hjørring Municipality, local heat plants, biogas plants and the northern farmer association	May 28th, 2018	[95]
Public meeting about the municipality's new strategic energy plan	Observer and participant in workshop	Representatives from Hjørring Municipality, Aalborg University, Several Danish Municipalities, local heat plants, local biogas producers, the northern farmer association, the Danish Wind Energy Association, House of Energy, Region Northern Jutland, North Sea Science Park, HMN Natural Gas, European Energy.	June 20th, 2018	[96]
Advisory board meeting in relation to the development of the strategic energy plan in Hjørring Municipality	Observer and participant on the advisory board	1st meeting – 14 participants (5 employees from the municipality, 9 external actors (the northern farmer association, local district heating companies, Northern Jutland Transport Company (NT), Hirtshals Harbour, local biogas companies, Aalborg University, Solutions4innovation and North Sea Science Park)	September 11th, 2018	[97]

3.3 REFLECTIONS ON THE VALIDITY AND RELIABILITY OF THE STUDY

The question of validity is a core element when it comes to scientific research. Especially the question of generalisability is often highlighted in relation to the validity of qualitative research and case studies[84], [88]. Flyvbjerg argues that it is possible to generalise from case studies and even single cases if the cases are selected strategically[84].

In this PhD study, the aim of the case study is to obtain as much information as possible about local strategic energy planning and the coordination issues that arise in relation to strategic energy planning. In this situation, Flyvbjerg argues that a randomly selected case or a representative case is not the most appropriate selections, because they often do not provide the richest information. In contrast, more extreme cases provide more information due to the fact that they are more active in relation to the problem studied [84]. In this study, a critical case has been selected on the basis of the philosophy that Hjørring Municipality is a "most likely" case to succeed with local strategic energy planning; therefore, it is assumed that many of the issues identified through the case study can be generalised to cover strategic energy planning in Denmark in general. However, the awareness remains that all case studies are context dependent[81], [82]. Choosing multiple cases for investigation could have provided a greater foundation for the generalisation of the findings in the study.

Another issue raised in relation to case studies is that it can be fraught if the researcher is placed too close to the investigated case. In cases where the researcher is personally related to the case, it can be difficult to maintain an objective approach to the object being studied. Flyvbjerg again argues against this position and states that if the researcher places themselves within the context being studied, they are a better position to understand the case[84]. Furthermore, it is highlighted that intense observations like case studies reveal more details and discoveries than statistics based on large groups. With that in mind, it can be argued that the author's former employment in Hjørring Municipality is an advantage for the investigation made in the PhD study. The author is, of course, biased due to her relation to the case, and it is possible that she has unknowingly been following without questioning some assumptions she made based on her knowledge and time employed in the municipality. However, this is something she has been very conscious of during the study, and she has tried to take a step back to take an objective perspective of the process in the organisation in relation to strategic energy planning. However, at the same time, it can be argued that it has also been of great advantage to have a deep preceding knowledge of the processes and actions within the case study.

In addition, the mixed-method approach has been chosen in the data collection to secure information from different sources that supplement each other and, in that way, contribute to the validity of the study. The data collection methods are a literature

study and interview and participant observation. The methods complement each other. The information collected through interviews can be defined as narratives of events and actions based on memories that can be influenced by the respondent's personal stance, while participant observations can help to validate and support the knowledge obtained in the interviews through direct access to social life through events and actions to observe how the different actors act in different situations [80]. Furthermore, the data were collected over a period of time, which made it possible to validate the obtained knowledge by presenting the findings from the observations to the employees in Hjørring Municipality and question them about their views of the findings. The interview data were documented through the development of interview guides prior to each interview as well as voice recordings of interviews followed by transcriptions. Observations were documented through notes during the meetings; these were then used to write up minutes from each meeting. As the author also participated in the meetings it would have been beneficial to have used video or voice recordings to document the meetings, since some information may have been lost as the author had a double role (participant and observer) at the meetings. However, to validate the observations, Hjørring Municipality's own minutes were compared to the author's to see if any information was missed in the field notes.

Based on the reflections made in this section, it is argued that the PhD study provides valid input into the ongoing discussions about strategic energy planning.

CHAPTER 4. LOCAL STRATEGIC ENERGY PLANNING

This chapter aims to answer the second sub-question "How does a Danish municipality act within the framework of strategic energy planning and what kind of coordination is present in current local strategic energy planning?".

Municipal strategic energy planning is investigated through the case study of Hjørring Municipality. The first part of the chapter is a summary of the paper "How municipalities act under the new paradigm for energy planning"[54] (Appendix C), examining the first strategic energy plan in Hjørring Municipality from 2012 in relation to the analytical framework for strategic energy planning presented in Chapter 2. Furthermore, the first part includes an analysis of the first strategic energy planning process analysed in relation to the two coordination issues identified in the theoretical framework in Chapter 2.

The second part of this chapter comprises an analysis of Hjørring Municipality's second strategic energy planning process (begun in 2017) done in relation to the analytical framework for strategic energy planning and the identified coordination issues. The analysis of the second strategic energy plan process is based on data from interviews, e-mail correspondence, and participation on an advisory board and in meetings in relation to the development of the second strategic energy plan in the municipality.

4.1 HJØRRING MUNICIPALITY'S FIRST STRATEGIC ENERGY PLANNING PROCESS

In the paper "How municipalities act under the new paradigm for energy planning"[54] in Appendix C, Hjørring Municipality's first strategic energy plan is analysed. Strategic energy planning has started to become a part of the perception in Danish municipalities since it was introduced by the Danish Government in 2010. Petersen[21] identified that in 2018, 49 of 98 municipalities had developed strategic energy plans, while 13 municipalities stated that they were in a phase of developing local strategic energy plans. However, how much effort in terms of financial resources and competent personnel the municipalities put into strategic energy planning varies significantly across municipalities[16]. With point of departure in the theoretical analytical framework for strategic energy planning outlined in Chapter 2, Hjørring Municipality's strategic energy plan is analysed to exemplify how far Danish municipalities take strategic energy planning today.

Based on the findings in [54], Figure 9 summarises how the municipality frames and uses strategic energy planning. Figure 9 differs from the framework developed in Chapter 2 (Figure 8) in mainly two aspects. Firstly, the strategic energy plan does not outline the energy system as a smart energy system based on the integration of different energy sectors; the different sectors and technologies are instead addressed separately. Secondly, a new box, implementation strategies, is added to the analytical framework under step 4. The strategic energy plan includes a list of 33 different actions (implementation strategies) that should be implemented to reach the local goals and visions outlined in the plan.

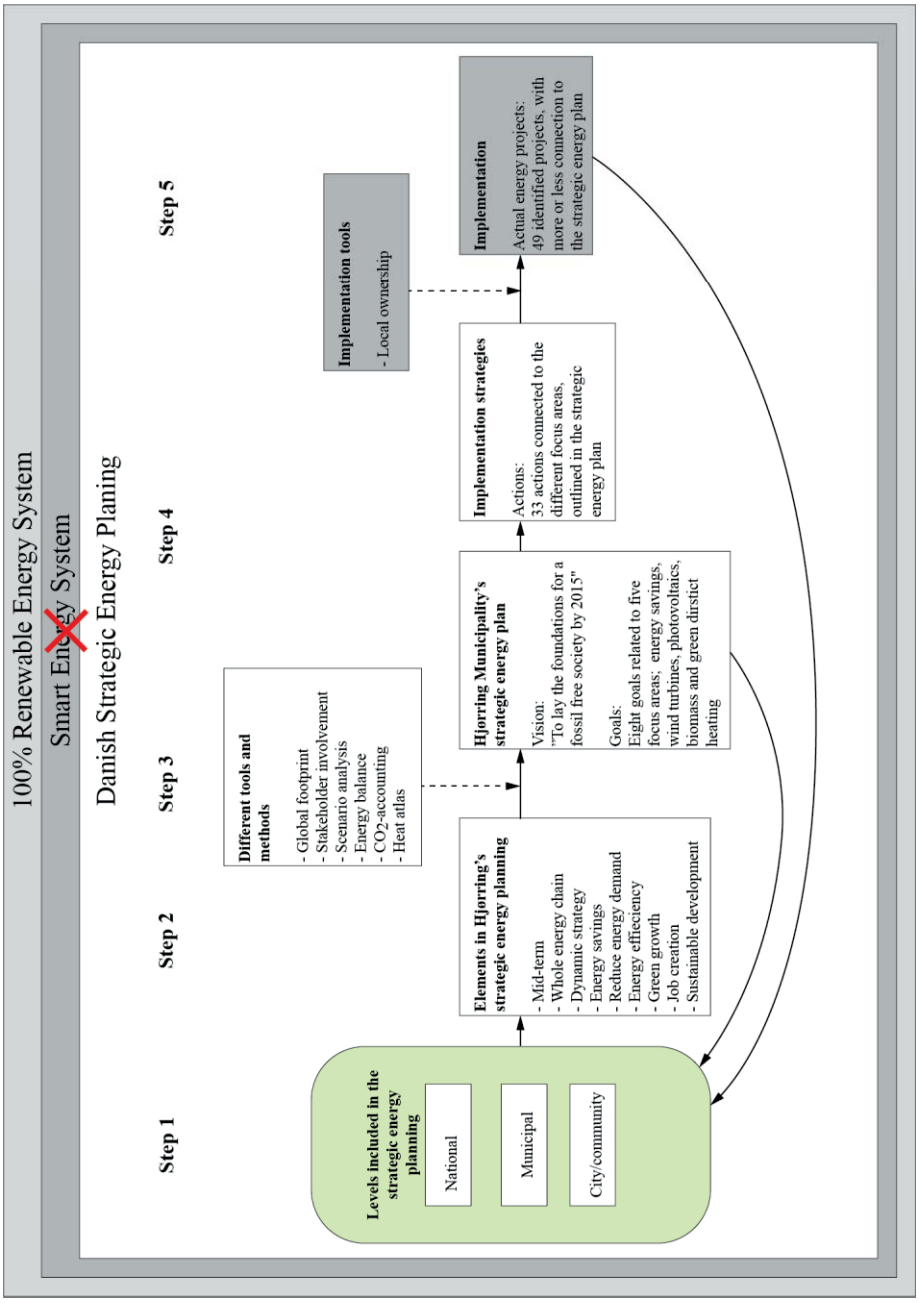

Figure 9: Hjørring municipality's current strategic energy plan from 2012 and the ongoing implementation process of the strategic energy plan.

The levels included in the strategic energy planning under Step 1 in Figure 9 are addressed under national and local coordination later on in this section.

Step 2 includes the elements that have been identified in the strategic energy plan. Since it was not possible to analyse the process of the development of the first strategic energy plan from 2012, it is assumed from the mentioning of these elements in the plan that the municipality considers it strategically important to include these in the strategic energy plan to develop local visions and goals that meet the national energy system goal.

Step 3 highlights the methods used in the development of the strategic energy plan (identified through the strategic energy plan and interviews); however, the line connecting the tools and methods to the process is dotted as it is not completely clear when and how these methods were used in the process.

Step 4 includes the physical strategic energy plan document, including implementations strategies. Hjørring Municipality set their overall goal for the strategy as being "*to lay the foundation for a fossil fuel free society in 2025*"[54], [98]. This is put into practice through eight separate goals related to different sectors in the energy system. Two goals related to energy savings, one to wind turbines, one to photovoltaics, one to biomass and three related to green district heating[98]. In order to realise these goals, the municipality has developed 33 actions connected to the goals.

Lastly, Step 5 combines implementation tools and implementation. Only one implementation tool could be identified through the strategic energy plan, and the dotted line connecting the implementation tools box to the process line indicates that local ownership does not appear to have been established through the realisation of the plan. Step 5 also includes implementation, and through interviews, it has been possible to identify 49 energy-related projects that are more or less connected to the realisation of the strategic energy plan[54].

It is difficult to identify how the specific goals for the technologies have been settled, hampers the assessment of whether these goals are ambitious enough in relation to the potential in the municipality. The elements identified in the plan show that they are aware of the importance of including the whole energy system from production to consumption. However, they do not entirely address this in the strategic energy plan; for example, they leave out the whole transport sector, despite knowing this is a sector with a large fossil energy consumption.

MOTIVATION BEHIND LOCAL STRATEGIC ENERGY PLANNING

Hjørring Municipality developed its first strategic energy plan in 2012. The process was motivated by three elements[54]:

- Looking towards other organisations working with strategic energy planning
- Desire to obtain an overview of the local energy balance
- The political expectation that strategic energy planning could help solve placement issues for green energy technologies

At the time where Hjørring Municipality decided to develop their first strategic energy plan, Local Government Denmark and Randers Municipality were in particular actively working with strategic energy planning, and Hjørring Municipality was inspired by their work[99]. Furthermore, internally within the municipality, there was a desire to obtain an overview of the energy balance in the municipality and to establish a framework that could set the basis for actions within the energy sector in the municipality. Lastly, the strategic energy plan was motived by political expectations that strategic energy planning could solve issues related to the placement of wind turbines and biogas plants.

COORDINATION ISSUES IN THE FIRST STRATEGIC ENERGY PLANNING PROCESS

National and local coordination

The strategic energy plan is based on the national goal of a 100% renewable energy system by 2050, which is the steering element in the overall goal setting in the local strategic energy plan[98]. However, the strategic energy plan, supplemented by interviews with employees in the municipality, reveals that there have been no other coordination or communication between the national and local levels in the work related to it; this is the reason for the stippled line between the national and local levels in Figure 9.

On the other hand, the strategic energy plan reveals an attempt to coordinate at the local vertical level. In relation to the development of the strategic energy plan. Hjørring Municipality held a number of meetings with local energy actors to obtain knowledge of their plans and intentions for the future[54], [98]. No coordination has been identified in the strategic energy plan on the horizontal level between municipalities.

Technical and societal coordination

Generally seen, it seems that the technical considerations outweigh the societal dimension in the strategic energy plan. However, during the interviews, it became clear that the strategic energy plan functions as a guideline for the development in the municipality, whereby the municipality tries to support project proposals that fit into the 33 actions described in the strategic energy plan.

> *Well, generally seen we do often take a point of departure in the strategic energy plan. And it is about the projects we give birth to ourselves or get in. How does that fit into the energy plan? […] But we also try to follow*

> *or support those who do something already. In other words, most of the time, it is an application or a group or association that wants to do something and we do support it in the way we can. It can be through time or "kroner" [money], or entrance to the municipality or something like that. We try to support the things that are there already and make it fit in.*
>
> *You can say, another thing we try to do, it is a bit related to supporting what is already present, it is to involve those who get affected by it. Be careful not to have a clear attitude or decision of what the goal should be.* [Translated from Danish] (Administrative employee, Hjørring Municipality [91])

Hence, this can be considered as vertical coordination between the municipality and actors at the city/community level in the municipality. The municipality can act in a facilitating role to coordinate the overall technical and societal goals in the municipality. The plan also includes a societal dimension in terms of a driver, namely that the green transition is an opportunity to create local growth and jobs in the municipality. Moreover, the plan mentions local ownership as a way to create local support for the implementation of the strategic energy plan.

The municipality is aware of the importance of creating a balance between the societal and technical dimensions in the energy planning; however, local ownership was not mentioned once during the interviews where actual energy projects in the municipality were identified. Also, it is not clear to what extent there has been job creation in the municipality due to actions within the green transition.

LEARNINGS FROM THE FIRST STRATEGIC ENERGY PLAN

Some important findings from the analysis of the first strategic energy plan (in this chapter and in the paper "How municipalities act under the new paradigm for energy planning"[54]) emphasise the importance of coordination at different levels in the planning processes. Through the interviews, it has become clear that the municipalities do not have the authority to use much force in connection to the implementation of their strategic energy plan. With the strategic energy plan, the municipality can build a framework for local actors to act upon. The municipality is very much dependent on the local actors when acting and implementing solutions.[54] The most central learning points from the first strategic energy plan that should be addressed in current and future work with strategic energy planning are:

- National statements and actions have a large influence on the local realisation of strategic energy plans.
- There are not many actions that the municipality can realise by itself.
- It is important for the implementation of the strategic energy plan that local actors support the development.

The analysis of the first strategic energy plan has, furthermore, resulted in the identification of a number of barriers to successful local strategic energy planning. These barriers are presented in the paper "How municipalities act under the new paradigm for energy planning"[54] in Appendix C. The barriers are addressed further in the thesis in Chapter 5.

The following section investigates among other things if and how these learning points are addressed in the development of the second strategic energy plan in Hjørring Municipality. This is done to see if the municipality uses its experiences to develop and strengthen local strategic energy planning.

4.2 THE SECOND ROUND OF STRATEGIC ENERGY PLANS

The first strategic energy plan in Hjørring Municipality was developed in 2012 and has not been updated since. The analysis of the first strategic energy plan provides great knowledge of how Hjørring Municipality has worked with the implementation of the strategic energy plan; however, it does not provide any information on the process of the development of the strategic energy plan and considerations behind it. This process is interesting because in this phase it is important that the municipality finds the right balance between national and local interests in order to develop a strategic energy plan that supports the overall national goals, while also fitting the local interests and gaining support from local actors. Therefore, it is interesting to add to the results in Appendix C[54] by examining the development process of the second strategic energy plan in Hjørring Municipality.

In this section, the process of the development of a new local strategic energy plan in Hjørring Municipality is outlined and analysed. This plan is, at the time of writing, still in the process of being developed and has therefore not yet been turned into a physical document. This means that the analysis primarily includes information from Steps 1, 2 and 3 in Figure 8 in Chapter 2.

THE NEW STRATEGIC ENERGY PLAN

From spring 2017 until the beginning of 2019, Hjørring Municipality worked on developing a new local strategic energy plan for the municipality[94]. In relation to this development, the city council granted 400.000 DKK plus work hours for two employees[94]. With the new strategic energy plan, the municipality wishes to shift focus from energy production units towards a combined renewable energy system [96]. Furthermore, there is an increased focus on collaboration. In the municipality's presentation of their thoughts on and visions for the new strategic energy plan, they state that it is not possible for a single municipality to achieve the goals alone[100]. This is reflected in their presentation of the visions for the plan:

- Hjørring Municipality should be self-sufficient with renewable energy.

- Creation of synergy effects between the green transition and business development, which is a part of creating growth and development in the municipality.
- Cooperation across all actors – including regional, national and international.

Even though the vision is to be self-sufficient with renewable energy in the municipality, they have set the short-term goal of Hjørring Municipality's energy consumption being covered by a minimum of 77% renewable energy by 2025[100].

The three visions should be realised through four overall and five cross-disciplinary themes, which form the basis for goals and actions within the strategic energy plan. The general themes are[101]:

- A future coherent energy system
- Future energy producers
- Future energy users
- Future green transport

Furthermore, the cross-disciplinary themes[101] are:

- Knowledge and innovation
- Settlement and business development
- Business possibilities and circular economy
- Collaboration and resources
- Hjørring Municipality's roles and ambitions

In the first strategic energy plan, Hjørring Municipality formulated specific goals in 2025 for the capacity of wind (1.000 TJ), photovoltaic (170 TJ), and biogas (1.200 TJ) energy as well as for the integration of renewable energy in district heating (≈80%)[101]. The status for the realisation of these goals in 2018 was wind (1.089 TJ), photovoltaic (33 TJ), and biogas (1.820 TJ) energy as well as the integration of renewable energy in the district heating (≈ 60%)[101]. The municipality has, thus, already achieved the goals for wind and biomass with the actions made since 2012. Only little action has happened within solar, which is due to a change in regulations that occurred just after the first strategic energy plan was published[54].

The new strategic energy plan includes new goals for 2025 and 2050, which lie above the goals in the previous strategic energy plan. The goals were developed from the perception that the municipality should be energy self-sufficient by 2050[97]. However, since the strategic energy plan has still not finally published, there may still be changes to these numbers. The currently estimated goals for 2025 and 2050 are presented in Table 8.

Table 8: Current situation and estimated goals in the new strategic energy plan in Hjørring Municipality[101].

	Wind	**Biogas**	**Photovoltaic**	**District heat**	**Renewable energy**
2018 (status quo)	1.089 TJ	1.820 TJ	33 TJ	≈60%	64%
2025	1.500 TJ	2000 TJ	300 TJ	≈80%	82%
2050	2.050 TJ	2.730 TJ	410 TJ	≈80%	≈100%

MOTIVATION AND PROCESS

Event through strategic energy planning is a voluntary assignment for the municipalities, the local politicians in Hjørring Municipality have chosen to prioritise the development of a second strategic energy plan. The political decision has been supported by the administrative employees in the municipality, who have provided information to the technical and environmental committee in order to persuade them to prioritise the development of a new strategic energy plan[94]. The motivation behind the employees' wish to develop a second strategic energy plan stems from a recognition that the first strategic energy plan is outdated due to the current fast pace of development within the energy sector. Furthermore, the employees can see new needs within the local energy planning. While the first strategic energy plan had a large focus on individual renewable energy technologies and creating an overview of the local energy system, they now see a need to combine these technologies in a coherent and flexible energy system. At the same time, they have become aware of the fact that the energy system and energy planning have a larger interface with other sectors not directly dealing with energy[94].

> *[…] I think that we are starting to have a good overview now and have had it for many years and can now see that it is connected to another development and see that it has a greater interface than energy only. We believe that there can be job creation – that is through sustainable and green energy.* [Translated from Danish] *(*Administrative employee, Hjørring Municipality [94])

In the new strategic energy plan, the municipality has a larger focus on a flexible and integrated energy system and the involvement of local actors. In order to anchor this into the plan, their approach in the process has been to hold a number of meetings with political committees, internal meetings in the municipality, themed meetings with external actors, and a large public meeting with a broad variety of energy actors, and they have also set an advisory board that follows and comments on the work. The

process with the strategic energy plan is illustrated in Figure 10 and can be divided into actions within the four themes of political involvement, the involvement of external actors, internal involvement of specialist teams in the municipal organisation, and involvement of consultancy companies. Each of the themes is described in this section.

Political involvement

Political support is crucial for the administrative employees for them to be able to develop the strategic energy plan. Therefore, the first step in the process was to organise meetings with the political committee for technology and environment. At the beginning of the process in spring 2017 (box 1 in Figure 10), the team leader from the sustainable development team attended meetings with the technical and environmental committee, wherein the committee was told about the status of the first strategic energy plan. Furthermore, they were introduced to the idea of a coherent and flexible energy system as well as the administrative employee's thoughts about the new strategic energy plan[94].

The political committee was positive toward the ideas for the new strategic energy plan. However, the work was put on hold during fall 2017 due to local elections (box 2 in Figure 10), which changed the political setup in the municipality, including the members of the technical and environmental committee. In spring 2018 (box 3 in Figure 10), the new technical and environmental committee was presented with the recommendations from the old committee, which supported the development of a second strategic energy plan. The new committee was also positive toward the development of the strategic energy plan, and the process has moved forward since then [94].

Therefore, politicians were not involved directly in the process until fall 2018 (box 9 in Figure 10), when the technical and environmental committee was presented with the suggested goals that emerged from the administrative employee's work with the strategic energy plan[94].

The next political involvement in the process occurred at the beginning of 2019 (box 12 in Figure 10) when the almost finalised strategic energy plan was presented for the technical and environmental committee for them to approve or reject sending the strategic energy plan for an eight-week hearing. The final approval of the strategic energy plan after the hearing is also given by the politicians and is expected to be in spring 2019 (box 15 in Figure 10)[94].

Alongside the political process for the strategic energy plan, there have been different project applications for energy projects through the municipality in order to obtain political approval. These projects of course also have some influence on the strategic energy plan, since the experiences from the specific projects influence the politicians' position towards specific actions within the strategic energy plan [94].

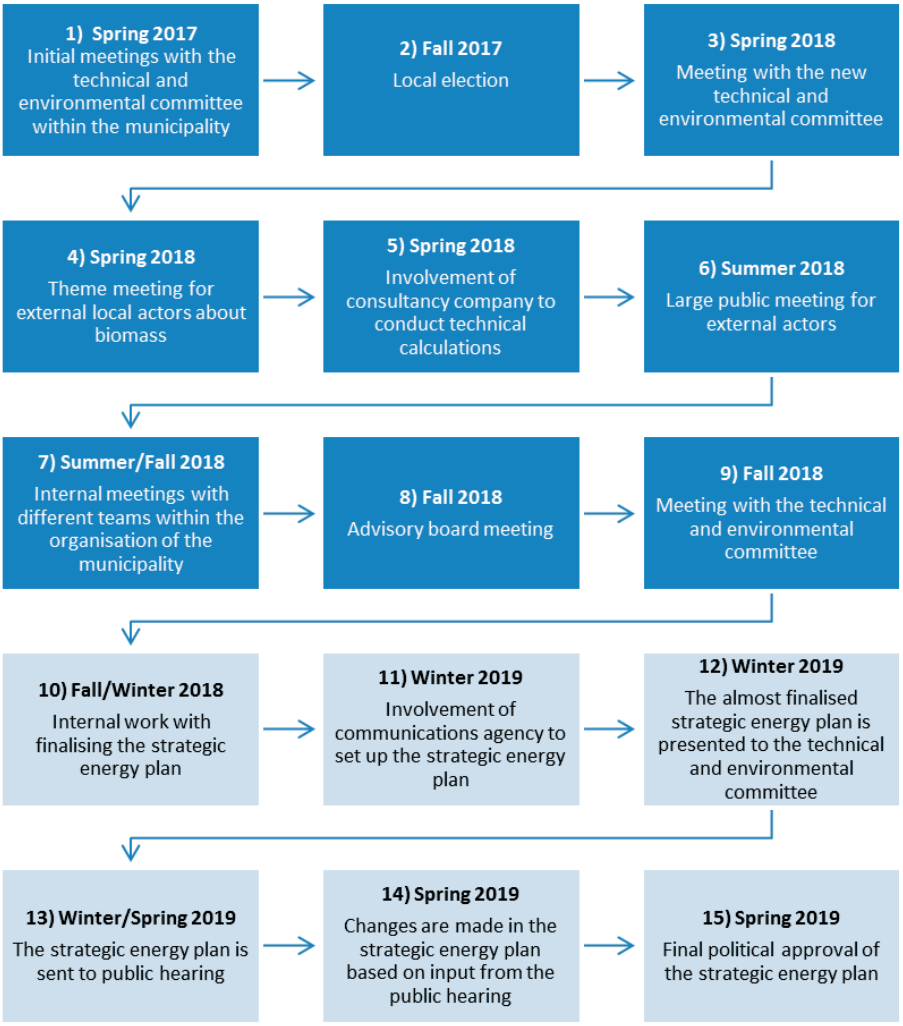

Figure 10: Process of the second strategic energy plan in Hjørring Municipality. The figure shows the specific steps Hjørring Municipality has taken during the process of developing the second strategic energy plan (dark blue boxes). The light blue boxes show the planned steps that have not yet been carried out.

Involvement of external actors

External actors are involved in the process of the strategic energy plan on several occasions.

The first time external actors are involved is in spring 2018 (box 4 in Figure 10) when the municipality invites specific actors that have a connection to biomass to attend a theme meeting about biomass in the future energy system[95]. The actors at the meeting were representatives from local biogas plants, district heating plants and the industry association LandboNord. Furthermore, representatives from a consultancy company and Aalborg University gave presentations[95]. The outcome of the meeting is further discussed later in this chapter.

In summer 2018 (box 6 in Figure 10), the municipality invited external actors to participate in a large public meeting regarding the new strategic energy plan. At this meeting, the municipality invited a large variety of actors, not only local actors. This included participation by representatives from local district heating companies, biogas plants, other municipalities, different sections/teams within Hjørring Municipality, industry associations, research institutions, the region, and other energy-related companies and associations [96]. The outcome of the meeting is further discussed later in this chapter.

At the large public meeting regarding the new strategic energy plan, the municipality asked interested actors to volunteer to participate in an advisory board for the strategic energy plan[96]. The purpose of the advisory board is for the administrative employees to obtain input for the strategic energy plan and that the advisory board should also provide an overall societal perspective on the strategic energy plan[97]. The administrative employees emphasised that they cannot make promises to the external actors and that the advisory board cannot make any decisions in relation to the strategic energy plan as all decisions are made at the political level[94].

The first advisory board meeting was held in fall 2018 (box 8 in Figure 10). Here, the municipality presented the strategic energy plan and their suggested goals in the plan as an introduction to the discussions by the advisory board[97].

The next time external actors are involved in the process is through the public hearing of the strategic energy plan in winter or spring 2019 (box 13 in Figure 10). During the public hearing, the municipality plans to arrange a meeting in the advisory board with the purpose of the advisory board developing with a united contribution of recommendations to the local politicians as a response to the strategic energy plan. This is because a united response from a board would receive more attention from the local politicians than if the actors were to individually comment on the strategic energy plan [94]. Furthermore, the municipality will make an active effort to involve local citizens in the public hearing period[94]. The citizens were not involved in the process earlier on.

Even though the citizens have not been directly involved in the development process of the new strategic energy plan, the municipality still emphasises the importance of citizens and other local actors for the realisation of the strategic energy plan. When asked why they consider the involvement of citizens and actors to be important, one employee said:

> *It is because we cannot realise and conduct the actions in the strategic energy plan by ourselves. It is simply because we need others to lift the task, or we, at least, need to lift it together. And it is therefore important that you get a sense of belonging to it and can see yourself in it. That is, so it is not only us [the municipality], that defines what that actions should be and then expect others to lift the task.* (Administrative employee, Hjørring Municipality [94]) [Translated from Danish]

Involvement of internal teams within the municipal organisation

The employees responsible for the development of the strategic energy plan have made an effort to involve other teams within the municipal organisation during the summer and fall of 2018 (box 7 in Figure 10). This was done to activate the existing knowledge present in the organisation and to obtain input and more specific knowledge of the actors and technical conditions that should be included in the strategic energy plan[94]. One employee describes the aim of these meetings:

> *The fact that we have some colleagues that possess great knowledge, a very specific knowledge because they sit and conduct case handling within these areas. They have daily contact with the biogas plants, or the wind turbine planners or with the citizens. So, they were to make us equipped and we to make them equipped in order to create an energy plan that is linked together of all our knowledge within the municipality [the municipal organisation]. […] They possess a large amount of knowledge that we do not have, where we have the overall knowledge do they really have it down in the details.* (Administrative employee, Hjørring Municipality[94]) [Translated from Danish]

Involvement of consultancy companies

Hjørring Municipality is using two types of consultancy companies in the development of the strategic energy plan. A consulting engineering company was brought into the process in spring 2018 (box 5 in Figure 10) with the purpose of making calculations for the local energy system in Hjørring Municipality based on the different goals provided by the municipality. The consulting engineering company has been involved over a longer period that has run parallel with some of the other actions mapped in the process in Figure 10[94].

The second consultancy company to be involved in the process is a communication company. The communication company is to be included in the process in spring 2019 when the strategic energy plan is finalised for publishing (box 14 in Figure 10). The

purpose of involving a communication company is to ensure that the strategic plan is designed to be visually welcoming to make it interesting for the actors to read[94].

OUTCOME OF INVOLVING DIFFERENT ACTORS

The most dominant change in the process between the first and the second strategic energy plan is the involvement of actors. In the current process involved with the second strategic energy plan, the interaction with different actors has been a key activity. It is therefore chosen to look deeper into the outcome of this involvement. Through observations and participation in the theme meeting, workshops and advisory board for the strategic energy plan, a number of different expectations from local energy actors have been identified in relation to their expectations of the municipality's role in strategic energy planning. Furthermore, a number of barriers in strategic energy planning have been identified from the perspective of the local energy actors.

Expectations

In the dialogue between the municipality and the different energy actors involved in the process, one of the questions asked repeatedly concerns the actors' expectations of the municipality. What role should the municipality have in strategic energy planning after the development of the plan? The municipality seems unsure of their own role in the strategic energy planning and when asked why, they point out that strategic energy planning is a voluntary task, leaving the municipality with few resources; therefore, they consider it important that they use their resources where it makes the most sense. As one employee stated:

> *It is also because, as mentioned, it is not a 'must-do'-task, so we are forced to make definitions ourselves. So, we think it is fine also to have a dialogue with the actors, to know what they are thinking. It is not always, we can fulfil, what they want us to do. But that we define the role in collaboration with them and are in a dialogue with them.* (Administrative employee, Hjørring Municipality [94]) [Translated from Danish]

Based on observations from the three meetings (theme meeting about biomass, large public meeting about the strategic energy plan and first advisory board meeting) the following expectations are identified [95]–[97];

- The municipality should collect information from the theme meeting and translate it into something concrete[95].
- The municipality should have a large overview and should point out potential synergies in the local energy system and between local actors[95][96].
- There is a need for "good histories" in order to get inspiration and knowledge[95].
- The municipality should be more ambitious[95].
- The municipality should be a frontrunner[96].

- It should describe the possibilities in the green transition and make it clear why different actions are needed[97].
- The advisory board created for the strategic energy planning process should be maintained, even after the plan has been published [96].

The actors do have quite high expectations of the role of the municipality, but at the same time, they express an understanding of the pressure the local politicians are under[94]. However, the actors emphasise that the municipality and local politicians should be careful not to drag the case handling too far since this can result in the actors losing their trust in the municipality[97]. Another point from the local actors is that it is important that the existing knowledge of the local energy actors is brought into action in the strategic energy planning process in order to find the best solutions and that the strategic energy plan can be dynamic to crease space for changes[96].

Barriers

Through the observation and participation in the meetings, it has been possible to identify barriers experienced by the actors when they operate within the energy system. It is primarily local actors who should implement actions that fulfil the visions and goals in the strategic energy plan, and it is therefore important to explore the barriers that hamper their development and actions. The identified barriers are:

- Processes being put on hold because local politicians are afraid to make a decision [95],[97]
- Politicians become paralysed when an election approaches[97]
- Rapid changes in rules and regulations (e.g. tax schemes) [96]
- Lack of a national statement concerning which way to go [96]
- Confusing legislation[96]

Especially rapid changes to rules and regulations are mentioned by several actors as being a barrier that makes it difficult for them to make investment decisions for the future. Furthermore, the political decision process is mentioned several times as a barrier to local development. It is pointed out that the local political decision-making processes often are very long when it comes to approving project proposals (especially wind-related), and this is a problem because it leads to actors losing faith in the system.

The barriers identified through the involved actors are further discussed in Chapter 5, where all barriers identified through the first strategic energy plan and the process of developing the second strategic energy plan are presented and discussed.

COORDINATION ISSUES IN STRATEGIC ENERGY PLANNING

National and local coordination

Even though the municipality indicates that it is not possible for a single municipality to reach the goals set within the green transition alone, it is difficult to identify active vertical coordination between the municipality and the national level in their work with the development of the new strategic energy plan. When confronted with this observation, an employee's answer was:

> *It is actually a weakness and sort of an insufficiency. You can say, at the time where we had the SEP projects [SEP projects financially supported by the Danish Energy Agency] a couple of years ago, we had more dialogue with them [the Danish Energy Agency], also through KL [Local Government Denmark] and so on. But after the end of them [SEP projects] the discussion and contact are completely diapered again.* [Translated from Danish] (Administrative employee, Hjørring Municipality [94])

The municipality sees that lack of coordination between them and the national level as a problem; however, at the same time, they also state that they have not done anything to start a dialogue with the national level[94]. This is also seen at the advisory board meeting, where transport is raised as an area where it is difficult for the municipalities to act alone. When asked if the municipality has been in dialogue with the national level regarding this issue, they answer that they have not been good at starting a dialogue with the national level and that they have approached the framework conditions as they are. However, they add that they know other municipalities that have succeeded in creating a dialogue with the national level [97]. Instead, the municipality takes its point of departure in the written goals and visions developed at the national and EU levels.

The municipality highlights the importance of collaboration and coordination between all levels in energy planning and especially between municipalities if the green transition is to be successful. Currently, there is nothing indicating that the municipality is looking towards coordination with other municipalities when considering that they have developed their goals for various energy technologies from the point of view that the municipality should be self-sufficient with 100% renewable energy. However, the municipality is currently working as the main driver together with Mariagerfjord Municipality in a project to develop a strategic energy plan covering the whole of Northern Jutland. This shows that even though the municipality aims at self-sufficiency, they are still prioritising the collaboration between the municipalities.

Within the municipality, the employees have made an effort to strengthen local vertical coordination, both internally in the municipal organisation and externally by involving local actors in the process of developing the new strategic energy plan. Internally in the organisation, the involvement of other specialised teams within the

organisation has led to a broader knowledge base for the development of the strategic energy plan as well as a greater knowledge of the local actors due to the fact that the more specialised teams interact daily with the local actors[94].

Furthermore, the municipality has strengthened the local vertical coordination by inviting a broad variety of local and general energy actors into a dialogue about the development of the new strategic energy plan. These are the industry association for agriculture in North Jutland, local district heating companies, local biogas producers, universities, other municipalities, wind turbine association, the combined municipal owned general partnership HMN natural gas, consultancy companies, larger energy companies (European Energy), NT (North Jutland's traffic company) and the North Denmark Region.

However, based on the observation at the meetings in relation to the development of the new strategic energy plan, it still seems that there is space for improvements in relation to which actors are involved in the process and when. An example can be found in the first advisory board meeting. The municipality presented numbers for their goals in relation to specific technologies in the municipality, which resulted in puzzlement among the biogas producers. These stated that they know they will produce significantly more energy than as stated by the municipality[97]. Based on this, it seems that the municipality does not involve local actors in the technical analyses, nor does it match their expectations with the local energy producers in the development of the specific goals in the strategic energy plan. The local actors are instead involved through dialogue on a more overall level. When asked why they do not speak to the local actors individually to balance the goals in the strategic energy plan with the actors' expectations for the future, they answer that they would like to do so but simply do not have the time resources to do it and have therefore chosen to have the dialogue with the actors in a broader forum[94].

Technical and societal coordination

The involvement of the different actors can be seen as an attempt by the municipality to create a stronger balance between the technical and societal dimensions of energy planning. However, when observing the meetings and especially the advisory board for the strategic energy plan, it becomes clear that it is primary actors with a technical interest and agenda who participate. This is also seen in the discussion, where it is obvious that the different actor groups try to advance their interests, even though the advisory board was told to take an objective approach and consider the presentation of the strategic energy plan from an overall perspective of what would be the best solution for the municipality[97]. It is, therefore, necessary for the municipality to see past the different agendas and balance the different inputs from the actors so that the optimal local energy system can be realised.

One actor group that was not involved in the dialogue are local communities and citizens. When asked about the involvement of citizens, the answer from the

municipality is that they will not be involved before the actual hearing phase. However, the municipality will try to actively involve the citizens in that phase because citizens are important actors who easily can stop projects if they begin to resist against them[94].

4.3 SUMMARY

The chapter aimed to answer the second sub-question in relation to the main research question "How does a Danish municipality act within the framework of strategic energy planning and what kind of coordination is present in current strategic energy planning?".

The two analyses of strategic energy planning in Hjørring Municipality (the first and second strategic energy planning processes) show a tendency to follow the framework conditions (policies, legislation, and tax and support schemes) provided by the national level in relation to strategic energy planning. The municipality does not challenge the national level when it experiences barriers in the framework conditions. Rather, they work around the barriers, e.g. by leaving out transport in their first strategic energy plan from 2012. However, at the same time, the analyses show that Hjørring Municipality goes beyond the Danish Energy Agency's definition of strategic energy planning. Using the theoretical analytical framework for strategic energy planning developed in Chapter 2 to analyse Hjørring Municipality's first strategic energy plan and the process of developing the second strategic energy plan, it becomes clear that Hjørring Municipality has focused on the implementation of the strategic energy plan by developing implementation strategies. However, at the same time, it is clear that the municipality has very little influence on the actual realisation of the plan as the implementation is dependent on local actors showing a willingness to support and invest in actions that support the strategic energy plan. Furthermore, actions at the national level (political discussions and statements and changes in tax and support schemes) have a significant influence on the willingness among local actors to invest in local energy technologies.

The analyses show that there has been a development in the planning approach between the first and second strategic energy plans. This becomes particularly clear by looking into the two coordination issues, namely national vs. local and technical vs. societal. Investigating the balance between national and local coordination shows that there is no vertical coordination between the national and local levels, in both strategic energy plan processes, besides the written national framework conditions. However, the analysis shows that the municipality has increased its focus on the involvement of actors in the strategic energy planning process, from the first to the second strategic energy plan. The process of the second strategic energy plan to a great extent consists of the involvement of different local and general actors working within the energy sector. Therefore, the municipality has a more transparent dialogue with the local actors. However, it is also clear that the municipality has made some selections regarding which local actors to involve in the process. It seems that local

citizens have been eliminated from the design process of the second strategic energy plan, even though the municipality themselves state the importance of involving them. They do, however, state that the citizens will be actively involved in the hearing process of the strategic energy plan.

In the process of the new strategic energy plan, the municipality emphasises that strategic energy planning is not a task that can be handled by the individual municipalities; rather, it has to be handled across different institutional levels (municipal, regional, national). However, in analysing the process of the development of the second strategic energy plan, almost no coordination with other institutional levels can be identified. At the same time, a project involving a combined strategic energy plan for all municipalities in Northern Jutland has been identified. However, it is not clear how this should fit into the local strategic energy plan, where the aim is for the municipality to be self-sufficient with renewable energy. Nevertheless, it is proof that the municipality is looking at possibilities to work across municipal borders in the local transition of the energy system.

When analysing the technical vs. societal coordination issues, the analyses reveal that the coordination in strategic energy planning today is very much limited to local coordination within the municipal organisation itself and to dialogue with local energy actors. However, in the specific target setting, it seems that the local goals for the different technologies are defined from a theoretical point of view by considering the energy balances rather than by talking to the different energy actors to include their views on their future production.

If local strategic energy planning is to be successful in promoting the development and implementation of a 100% renewable smart energy system in Denmark, is important that the coordination between the institutional levels is improved. In order to make suggestions for improvements to the strategic energy planning, the following chapter, Chapter 5, collects all the barriers identified in relation to local strategic energy planning in this PhD project.

CHAPTER 5. BARRIERS IN STRATEGIC ENERGY PLANNING TODAY

The aim of this chapter is to answer the third sub-question "What are the current barriers in local strategic energy planning and how could these barriers be eliminated to better support coordinated strategic energy planning?" as well as to introduce suggestions on how to overcome these barriers in strategic energy planning.

The barriers presented in this chapter have been identified through the different analyses made in relation to the PhD study.

Firstly, five barriers were identified in the introduction in Chapter 1 through the evaluation of the strategic energy planning projects financially supported by the Danish Energy Agency. These barriers are presented in Table 9 in the column called "Evaluation of financial supported SEP projects 2015". Secondly, six barriers were identified through the development of the theoretical analytical framework for strategic energy planning in the paper "A comprehensive framework for strategic energy planning based on Danish and international insights"[40] (Appendix B). These barriers are identified through the literature review of the scientific and non-scientific literature of Danish strategic energy planning. These barriers are found in Table 9 in the column "Literature review". Thirdly, eight barriers were identified through the analysis of Hjørring Municipality's first strategic energy plan in the paper "How municipalities act under the new paradigm for energy planning"[54] (Appendix C). These barriers are discussed in the paper along with suggestions on how to overcome the barriers. This chapter presents the identified barriers presented in Table 9 in the column named "Hjørring Plan 2012". Moreover, suggestions on how to overcome the barriers are used in the discussion for each of the identified barriers in this chapter. Lastly, fourteen barriers were identified through the analysis of the development process of Hjørring Municipality's second strategic energy plan in Chapter 4. These barriers were primarily identified through observations of the municipality's interactions with local actors and therefore highly represent the barriers seen by the actors. Furthermore, barriers were also identified through an interview with two administrative employees representing Hjørring Municipality. The identified barriers from the second strategic energy planning process are presented in the column called "Hjørring Process 2018" in Table 9.

All the identified barriers are presented in Table 9, where they are divided into the two groups of strategic barriers and practical barriers.

> *Strategic barriers are barriers that come from the national level and in general, limit municipalities in their options (e.g. legislation, tax, funding, national politics) and practical barriers are locally anchored barriers(e.g. local geography, resistance, local politics) and these barriers can only be understood through local knowledge of the individual municipalities.* [[54], p. 2]

The fact that different barriers have been identified during the different processes does not necessarily mean that these were not present during other strategic energy planning processes. It is only an expression of the fact that they were not identified from the perspective of this thesis. Moreover, the list of barriers in the thesis should not be seen as a definitive list, and other barriers are likely to be identified in the investigation of other cases.

Sections 5.1 and 5.2 discuss the strategic and practical barriers with the purpose of developing suggestions on how to overcome the barriers identified in Table 9. In the following, the barriers are collected and discussed in groups with similar barriers that are all related to an overall coordination issue. The barriers are grouped in Table 9 by colour, with related barriers having the same colour.

Table 9: Overview of the identified barriers based on conclusions from the evaluation report of the financial strategic energy planning projects (evaluation of financial supported SEP projects 2015)[38] in chapter 4, results from the analysis in [54](Hjørring Plan 2012) and the analysis of the process of the second strategic energy plan in Hjørring Municipality in this chapter (Hjørring process 2018).

Barriers	**Literature review**	**Hjørring Plan 2012**	**Evaluation of financial supported SEP projects 2015**	**Hjørring Process 2018**
Strategic barriers				
1. Lack of coordination between the national and local levels	+	+	+	+
2. Rapid changes in rules and regulations		+	+	+
3. Strategic energy planning as a voluntary task	+	+		+
4. The municipalities are unsure about their role in strategic energy planning			+	+
5. Some themes are difficult to address in the individual municipalities		+	+	+
6. High divergence in targets and quality in the local strategic energy plans	+			
7. No clear and concrete framework conditions and guidelines for the energy system (and strategic energy planning)	+			+
Practical barriers				
8. Lack of clearly defined long-term and ambitious goals		+		+

9. Municipalities primarily focus on local targets rather than the combined national targets	+			+
10. Timing in relation to local political agendas		+		
11. The long time between the revisions of the strategic energy plan		+		+
12. Mistrust in local politicians when decision-making is dragged out				+
13. Lack of time and resources in the municipality to conduct strategic energy planning			+	+
14. Implementation of strategic energy plans is deeply dependent on citizens and other actors		+		+
15. Mismatch between goals developed by the municipality and local actors' expectations				+
16. No use or wrong use of local and general actors				+
17. Lack of implementation strategies in local strategic energy plans	+			

5.1 STRATEGIC BARRIERS

The strategic barriers are related to the national level, and it can be argued that the barriers here refer to the coordination issue between the national and local levels. Barriers 1 to 7 in Table 9 are identified as strategic barriers. In this section, the strategic barriers are discussed; even though the barriers are outlined individually in Table 9, some of them are highly related to each other and are therefore grouped together in three different groups of barriers, namely lack of coordination between institutional levels, rapid changes in rules and regulations, and national and local responsibilities.

LACK OF COORDINATION BETWEEN INSTITUTIONAL LEVELS

The strategic barriers 1, 3, 4, 6 and 7 (blue in Table 9) are connected to the coordination between the national and local levels, which are especially expressed through the uncertainty found in the municipality regarding its role in the strategic energy planning (barrier 4). It is possible that such uncertainty concerning the role leads to a standstill in the strategic energy planning because the municipality does not know where or how to use its resources. An indication of this is seen in the case study, where local actors pointed out that they think Hjørring Municipality has been too defensive, and they asked the municipality to be more proactive and facilitate more actions in the municipality[97].

Barrier 1 "Lack of coordination between the national and local levels" refers to the missing communication between the institutional levels in the strategic energy planning. This barrier is identified in all four processes. It is clear that the municipality does not feel that the Danish Energy Agency has an interest in communicating with them, as the current framework conditions do not include strategic energy planning. When asked about the communication, one employee said:

> *[…] It is difficult with the Danish Energy Agency, there is nothing written about strategic energy planning in the new energy agreement and the municipalities are generally speaking not mentioned either.* [Translated from Danish] (Administrative employee, Hjørring Municipality [94])

It is, however, not only the national level that is not communicating with the local level. The municipality is not communicating with the national level either when it runs into problems whereby the framework conditions are not aligned with the local reality [94], [97]. This might be one of the reasons behind barrier 6 "High divergence in targets and quality in the local strategic energy plans" since a lack of coordination means that the municipalities act primarily in their own interests when planning for their future energy systems.

The municipality also feels that the lacking communication (barrier 1), current framework conditions (barrier 7) and the fact that strategic energy planning is a voluntary task (barrier 3) all together make them unsure of their role in the strategic energy planning (barrier 4). Currently, the administrative employees working with strategic energy planning are dependent on the local city council to prioritise funds for strategic energy planning in the municipality's budget. In Hjørring Municipality, the employees feel lucky at the moment as strategic energy planning is a prioritised task in the municipality; however, they also emphasise that they do not know for how long this local political support will continue[94]:

> *It is political support we have in the municipality, that they will do it [strategic energy planning]. But we cannot know if it [the political support] is still here in three years. We are luckily in a good development*

> *where the politicians want to do it and there is wide support to do it [strategic energy planning] because they to see the area in a wider perspective and also the local development is clear. However, it is not a 'must-do' task and we can therefore not know if they [local politicians] will prioritise it just as much at the next election.* [Translated from Danish] (Administrative employee, Hjørring Municipality [94])

RAPID CHANGES IN RULES AND REGULATIONS

The second strategic barrier is the "Rapid changes in rules and regulations" (green in Table 9). It was identified in the first strategic energy planning process, but it has been underpinned as a barrier in the evaluation of the financially supported strategic energy planning projects and the process of developing the second strategic energy plan. In the process of developing Hjørring Municipality's second strategic energy plan, several actors directly pointed out that these rapid changes are a barrier, causing uncertainty and making it difficult for them to make long-term investment decisions.

Based on the process of the second strategic energy plan, it appears that the process of development can be surprisingly long (see Figure 10 in Chapter 4). The specific process in Hjørring is expected to take around two years from the initial meeting with the political committee until the final plan is published. If changes in rules and regulations are made too often, this can result in the strategic energy plans already being almost outdated even before they are published. An example of this has been found in Hjørring Municipality. In the first strategic energy plan, Hjørring Municipality included goals for a large amount of photovoltaic energy because the national support schemes indicated that this was desired at the national level. However, just after the strategic energy plan was published, the government removed the support scheme, and the municipality was suddenly unable to reach the goals in the strategic energy plan because it was no longer beneficial for local actors to invest in the technology[90], [94].

Rapid changes in the framework conditions can make it difficult for the municipalities to conduct long-term planning and goals. However, it is crucial for the green transition that local long-term plans are developed, and thus the municipalities must, therefore, develop long-term strategic energy plans under the framework conditions existing at the time the plan is developed, while also leaving room for adjustments when changes in the framework conditions occur.

NATIONAL AND LOCAL RESPONSIBILITIES

Barrier 5 (yellow in Table 9) "Some themes are difficult to address in the individual municipalities" points to an uncertainty about what tasks should be fulfilled at the

local level and what is a transversal issue that must be addressed at the overall national level. Transportation was mentioned in the three processes as an example of such a transversal area that is difficult for the municipalities to handle individually [38], [94], [98].

Hjørring Municipality chose to include transportation as a focus area in the new strategic energy plan, even though they do not yet know how to address this area[96]. The municipality emphasises that it is important that they determine what they as a municipality can do in the area and what is decided upon from a national level in order for them to make strategic decisions in the municipality that can have an impact on the green transition[94]. This is also one of the main challenges highlighted in the evaluation of the financially supported strategic energy planning projects, namely that some important themes in strategic energy planning go beyond the individual municipality and require decision-making at the national level (e.g. transport and infrastructure for green transportation)[38]. However, it is currently not clear who should address these cross-municipal issues, and therefore it is difficult for the municipalities to take responsibility.

5.2 PRACTICAL BARRIERS

The practical barriers 8 to 17 in Table 9 are related to local barriers within the geographical and institutional borders of the municipality. The practical barriers are all related to coordination issues, but they can be roughly divided into two groups: practical barriers related to local politics and practical barriers related to coordination with local actors.

COORDINATION WITH LOCAL POLITICIANS

The barriers connected to local politics are barriers 8 to13 (orange in Table 9). Barrier 8 “Lack of clearly defined long-term goals” are highly connected to the strategic barriers. A lack of clear and long-term statements from the government makes it difficult to define long-term goals at the local level. At the same time, a lack of local long-term and ambitious goals becomes a problem if the municipality wants local actors to participate and invest in the local green transition. The interviews reveal that the administrative employees in the municipality have to balance local politicians’ caution on one side and local actors; desire for ambitious goals on the other:

> *You can say that our politicians are very cautious, in any rate when it concerns the very large facilities such as wind turbines, biogas plants and large photovoltaic plants. They are very cautious not just to let loose.” […]” We have been in dialogue with our politicians in different ways to see if we can push up the goals. But again, it is a fine balance because we risk that the politicians would say completely stop if we came with something too ambitious. So, it is all the time about finding the level where*

> *the actors and project developers can take action, but at the same time not get the politicians to stop the whole thing.* [Translated from Danish] (Administrative employee, Hjørring Municipality [94])

The local politicians are cautious when they have to make decisions that could face local resistance among the local citizens. For example, politicians might hesitate to make decisions that would make them unpopular in an upcoming election. Therefore, the early involvement of local actors and citizens is important in strategic energy planning, since local politicians would be more agreeable to making decisions on things that are already locally supported.[102]

The politicians' caution and the fact that political decisions often take time are related to barrier 12 "Mistrust in local politicians when decision-making is dragged out". Local actors emphasise how long political decisions can be a problem since a long political process can result in investors losing interest in a project. As a consequence, project developers can lose their investors before a project is approved by the city council[97].

Barrier 10 "Timing in relation to local political agendas" underlines the importance of employees in the municipality knowing when to bring suggestions to the politicians in order for them to have interest in it; otherwise, the proposal might be turned down or the process can be length[91]. The process of the second strategic energy plan in Hjørring Municipality is an example of the effect of timing. An election in the middle of the process resulted in a new political committee, which subsequently had to get all the information that the previous committee members had received a year before, as shown in Figure 10 in Chapter 4.

Barrier 13 "Lack of time and resources in the municipality to conduct strategic energy planning" is very much connected to the fact that the resources for strategic energy planning are allocated by the local politicians in the individual municipalities. The employees in Hjørring Municipality feel fortunate in that strategic energy planning is prioritised by the local politicians, but they never know when this support will disappear again[94]. Even though this is a prioritised task in Hjørring Municipality and a budget of 400.000 DKK and man-hours from two employees have been allocated to develop the new strategic energy plan, they still experience that there are insufficient resources undertake the actions necessary to develop the best possible strategic energy plan for the municipality[94]. This is also highly connected to barrier 11 "The long time between the revisions of the strategic energy plan" because the process is dependent on local politicians prioritising it in the local budget, where the funds are balanced between all the responsibilities in the municipality. Almost all public sectors are under pressure to make cost reductions, and therefore it is understandable if the city council finds it hard to allocate a large amount of resources to a voluntary task.

COORDINATION WITH LOCAL ACTORS

Barriers related to the coordination with local actors are barriers 14 to 16 in Table 9 (light grey in Table 9). Barrier 14 is present in both the first strategic energy plan and the process of the second strategic energy plan and is an expression of the municipality's narrow possibilities to take action in relation to implementing the strategic energy plans. The municipalities are dependent on local actors and developers to take action and implement projects that support the strategic energy plan. This is another reason that the involvement of local actors is important in the process to obtain local interest and support for the plan. In relation to this, barriers 15 and 16 are identified through the involved actors. These barriers are significantly related to each other and emphasise the mismatch between the municipality's goals and the actors' own expectations of their future energy production as well as the lack of or wrong use of actors.

Finally, barrier 17 "Lack of implementation strategies in local strategic energy plans" (dark grey in Table 9), identified through the literature review in [40], did not emerge in the case of Hjørring Municipality, where the strategic energy plan as described in Chapter 4 included a list of 33 activities that can be defined as implementation strategies. However, even though Hjørring Municipality includes implementation strategies in its strategic energy plan, this study does not investigate whether this is the case in other municipalities; therefore, a lack of implementation strategies may be missing in many Danish municipalities' strategic energy plans.

5.3 HOW TO OVERCOME BARRIERS IN DANISH STRATEGIC ENERGY PLANNING

The majority of the barriers are related to the fact the strategic energy planning is developed based on political decisions, both at the national and local levels. Furthermore, most of the barriers are related to other barriers, and therefore there is little sense in trying to eliminate the barriers one by one. In the following, the identified barriers are discussed in relation to the theoretical framework in Chapter 2 with the aim of offering suggestions on how to eliminate barriers in local strategic energy planning.

COORDINATIONS BETWEEN NATIONAL AND LOCAL INSTITUTIONAL LEVELS

In the theoretical framework in Chapter 2, the centralised and decentralised approaches to the Danish energy system are described as two competing approaches in the Danish context. Even though this thesis primarily sees the decentralised smart energy system approach as the right way to reach the national goal of a 100% renewable energy system by 2050, it is also recognised that this transition will, in reality, require a mix of the two approaches.

The theoretical framework in Chapter 2 presents three models of multilevel governance that influence policy actions within the context of climate change (top-down, bottom-up and hybrid). Currently, the government has published two guidelines for strategic energy planning in the municipalities, wherein they state that strategic energy planning is a municipal task. The latest update of these guidelines is from 2016[103], after which strategic energy planning is not mentioned at the national level. The guidelines suggest a large number of methodical actions, but at the same time, they emphasise that strategic energy planning is a voluntary task for the municipalities. The national level does, to some extent, employ a top-down approach to implement local strategic energy planning by stating that it is a municipal task. However, the national level does not provide any financial support for local strategic energy planning. Furthermore, local strategic energy planning and references to the municipalities' role in the green transition have disappeared from national statements and policies during the recent years, leading to uncertainty in the municipalities regarding their role in the green transition[94].

Despite the lack of support from the national level, 50% of Danish municipalities have chosen to develop local strategic energy plans and the trend is increasing[21]. This offers evidence that not only Hjørring Municipality considers local strategic energy planning important for the green transition. However, this case study also shows that Hjørring Municipality does not actively communicate or coordinate with the national level to initiate a dialogue about adjusting the national framework conditions for strategic energy planning to fit the local conditions in the municipalities.

In order to secure the best possible conditions for the implementation of a smart energy system in Denmark, it is important that the national and local institutional levels start to coordinate and share knowledge with each other. A successful green transition of the energy system requires a united effort of the entire society. It is important for the government to clearly define the desired direction for the development of the Danish energy system and the roles of the different actors.

Furthermore, guidelines for strategic energy planning can help to develop a more uniform and comparable strategic energy planning in the municipalities, which would make it easier for them to compare and cooperate across municipal borders. It is, however, important that such guidelines leave room for municipalities to adjust to local conditions (available energy resources, built-up area etc.) to secure the best possible overall development in the Danish energy system. The national guidelines for strategic energy planning in the municipalities should, therefore, be developed to reflect the minimum resources available in the municipalities in terms of time and financial means. The thesis contains only limited discussion of how decisions are currently made internally at the national level. Furthermore, it assumed that the municipalities play an important role in the transition towards a 100% renewable smart energy system, thus strategic energy planning is presumed to be a is part of the current and future green transition of the energy system.

With inspiration from the theory of innovative democracy, multilevel governance and choice awareness, it can be argued that there is a need for a hybrid model in the national energy policy making in Denmark. There is also a need for a strong national framework that sets the overall direction for the transition of the energy system while giving local politicians a stronger mandate to conduct strategic energy planning that develops ambitious local initiatives tailored to fit local conditions.

Choice awareness theory emphasises the importance of an open and transparent dialogue that offers insights into the different actor's discourses and interests if changes to the existing system are to be implemented successfully. Combining this with Hvelplund's[55] theory of innovative democracy, it can be argued that there should be an analysis of the current setup of the actors (described as lobbyists in Hvelplund's theory) influencing the national energy policy-making and that changes should be made to secure the presence of actors representing the interests of municipalities. This is because it is important for local knowledge to be brought into the dialogue if the national framework conditions for strategic energy planning are to be tailored to respect local conditions instead of only considering the overall lines of the energy system. The municipalities should find a way to organise themselves to ensure that they are present in the dialogue when the national policies and framework conditions are developed. This thesis does not investigate what form such a set-up should take; however, these could include looking into Local Government Denmark, a task force consisting of representatives from the municipalities or regions to participate in the dialogue among the municipalities. It is important that the final constellation reflects the actual positions in the municipalities; therefore, it is crucial to create a forum in which the municipalities can discuss both local issues and political announcements to coordinate with the national level.

Another barrier highlighted in Table 9 is the rapid changes in rules and regulation. As mentioned earlier, rapid changes make it difficult for municipalities to develop long-term strategic energy plans. It is therefore important that the national level ensures that the rules and regulations reflect the role they expect the municipalities to fulfil, thereby strengthening the willingness among local politicians in the municipalities to make long-term decisions. However, a level of flexibility remains necessary in the local strategic energy plans to continuously adapt the local energy system to new knowledge and development of energy technologies as well as the rules and regulation related to this development.

Recommendations for the national level:

- **Transparent dialogue:** The government or Danish Energy Agency should start an open and transparent dialogue concerning how the Danish energy system should be developed to reach the goal of a 100% renewable energy system.

- **Clearly defined roles:** The municipalities' role in strategic energy planning should be clarified alongside a decision regarding how the energy system should be developed.
- **Mandatory task:** When the municipalities' role in the strategic energy planning is defined, it should be made a mandatory task accompanied by the financial means for the purpose.
- **Rules and regulations:** The rules and regulations should reflect the role that the municipalities are to fulfil in the transition of the energy system.

Recommendations for the municipalities:

- **Communicate experiences:** The municipalities should be better at communicating their experiences to the national framework conditions (positive and negative), including how the framework conditions influence work in the municipalities and local actors.
- **Present a united front:** The municipalities should organise themselves to enable them to communicate and coordinate with the national level through one strong voice. (This could be through Local Government Denmark (KL), a task force of representatives from the municipalities or the regions etc.).

LOCAL POLITICAL DILEMMAS

Many of the practical barriers in relation to local political decisions (barriers 10, 11, 12, 13 and 17) could be eliminated in the municipalities if strategic energy planning is prioritised from the national level. However, as long as no financial means are allocated from the national level, local development is dependent on the local politicians to ensure strategic energy planning is prioritised and a suitable amount of financial resources are allocated for the purpose. This creates, as Sperling et al.[16] and Petersen[21] write, a great variety in the quality of the local strategic energy plans in the Danish municipalities.

As the individual city councils are the ones to prioritise strategic energy planning, it is important for the administrative employees advocating local strategic energy planning to know the political "game", allowing them to determine when best to approach the city council to ensure a fit with the political agenda[54]. Furthermore, the administrative employees working with strategic energy planning prosses should have competences that reflect the tasks within strategic energy planning as defined by the national level, while also possessing the ability to engage the local political level at the right time and with the right argumentation.

Another way to obtain local political support for actions within strategic energy planning can be for municipalities to apply for external funding, e.g. through EU funding programmes such as Horizon 2020[104]. This is tendency is already seen within Danish municipalities with projects such as Skive Municipality[105], [106],

Hjørring Municipality[107] and Sønderborg Municipality[108]. Hjørring Municipality looks towards external funding for energy projects, and three externally funded projects have been identified through the interviews mapping energy projects in the municipality[90]–[92]. Budget cuts in the municipalities mean that local politicians have less funding to allocate to the different sectors in the municipality, and as strategic energy planning is a voluntary task it not guaranteed that finances are allocated for the purpose. However, employees in Hjørring Municipality pointed out that chasing external funding might not be the best solution for the overall energy planning. This is because reliance on external funding means that local energy planning would be controlled by the fund for specific purposes, which might not fit into the overall local or national goals for the Danish energy system. Furthermore, one of the employees emphasises:

> *We have experienced that we will use more time on one action or one act instead of seeing the overall perspective and I can be worried that it could be a problem. That is, if we have a three-year energy project that relates to one or two actions, out of 30, then there is a long road ahead of us.* Translated from Danish] (Administrative employee, Hjørring Municipality [94])

External funding is, therefore, a dilemma for local politicians and administrative employees since there can be both positive and negative effects on the overall implementation process of the local strategic energy plan. The municipalities should, therefore, be aware of these possible consequences when applying for external funding for projects in strategic energy planning.

Recommendations for the municipalities:

- **Knowledge of the political "game":** Employees in the municipalities should have extensive knowledge of the local political "game" and structure to know when to enter the political dialogue in order to gain positive feedback.
- **Develop the right competences:** Municipalities should hire employees with competences that reflect the different aspects of the municipalities' role in strategic energy planning.
- **Keep a focus on the overall energy system:** Municipalities can strengthen their local actions by applying for external funding while maintaining a focus on the overall purpose of their local energy goals.

COORDINATION BETWEEN MUNICIPALITIES AND LOCAL ACTORS AND CITIZENS

Two of the practical barriers that could be eliminated if the right amount of funding were allocated to conduct strategic energy planning in the municipalities are barriers 12 and 13 in Table 9. Currently, it is clear that the coordination between the

municipality and local actors is not optimal in the development of the strategic energy plan, even though the municipality has focused significantly on involving actors in the process of the second strategic energy plan. It is therefore important to find ways to strengthen the local democracy, and it is clear that the municipality has already started to integrate this into its strategic energy planning process. Hjørring Municipality's initiative with an advisory board following the development of the strategic energy plan could help strengthen local democracy, especially if the advisory board continues after the strategic energy plan is finalised. This would secure a communication forum between local actors and the municipality and the local politicians. From the observations made in Hjørring Municipality[97], it seems that both the administrative employees and the local actors are positive about the discussions and knowledge sharing for which the advisory board meetings form the basis. The actors even emphasise that the municipality should make the advisory board permanent[96]. Having a permanent advisory board for strategic energy planning in the municipality could ensure that strategic energy planning remains a dynamic process because the close interaction with the local actors would provide valuable knowledge to the municipality. Based on the interaction with local actors, it is possible for the municipality to keep track of the implementation of the strategic energy plan and to identify where they might have to make changes along the way.

Currently, it is not very clear how the municipality has made decisions concerning the specific goals included in the strategic energy plan. The interview with two employees from Hjørring Municipality[94] gives an insight into how the administrative employees try to create and balance goals that can satisfy both cautious politicians' and ambitious actors' beliefs of the future. In order to create a more transparent process of strategic energy planning, it would make sense to derive inspiration from choice awareness theory. The second thesis of choice awareness theory advocates that awareness should be created through the presentation of different technological alternatives[5]. This is done, for example, in Sønderborg Municipality, where technical scenarios have been illustrated to show how different decisions can lead to different results for the future energy system[109]. Furthermore, the development of feasibility studies would show the local feasibility of the different technical alternatives and different constructions of ownership models (as described in Chapter 2 and the paper [53] in Appendix A). This would feed into a local discussion of how the local energy system should be organised so that local support is leading in the strategic energy planning because all involved actors are able to see their role the energy system. This is especially important because the municipalities do not have the means to realise the implementation of the strategic energy plan by themselves. Instead, they are highly dependent on local actors and project developers to engage in the transition through project proposals supporting the fulfilment of the goals in the strategic energy plan[90].

Another barrier linked to local political conditions is the time period between the revisions of the local strategic energy plans. If the municipalities were to regularly

follow up on their strategic energy plans, they would be able to continually feed into the national level regarding the local impact of the nationally developed framework conditions[54]. However, revising the strategic energy plan more often also requires the right amount of financial resources and personnel with the right competences to be allocated to the task.

Recommendations for the municipalities:

- **Technical scenarios:** The municipality should develop different technical 100% renewable energy scenarios for the future energy system and create feasibility studies showing the consequences of the different scenarios as a basis for an open and transparent dialogue with the actors involved in the local transition of the energy system.
- **Involvement of local actors:** The municipalities should talk to local energy producers and citizens to include their perspectives on the future when designing strategic energy plans.
- **Point out synergies:** The municipality should focus on pointing out the potential synergies between local actors to motivate them to act.
- **Facilitate ongoing dialogue:** The municipalities should facilitate an advisory board for strategic energy planning in the municipality to keep it a dynamic process.
- **Revise the plan regularly:** The municipalities should make sure to revise the strategic energy plan regularly.

5.4 SUMMARY AND REFLECTIONS IN RELATION TO THE NECESSARY PROCESS

The aim of this chapter is to provide an answer to the third sub-question "What are the current barriers in local strategic energy planning and how could these barriers be eliminated to better support energy planning?". The identified barriers for local strategic energy planning in Denmark today are in this thesis connected to the coordination of strategic energy planning at different levels. As introduced earlier, the barriers are divided between strategic and practical barriers. The processing of the identified barriers has shown that the primary barriers are the strategic barriers, in Table 9, connected to the coordination between the national and local levels. However, there is also a strong connection between the strategic and practical barriers, and some of the identified practical barriers would disappear if the strategic barriers were eliminated.

For example, the poor framework conditions for strategic energy planning and the lack of communication and coordination between the national and local levels lead to uncertainty in the municipality regarding their role in strategic energy planning. This again leads to mistrust from the local actors and citizens towards the municipalities' willingness to take the right responsibility in local energy planning. This identified bad spiral of barriers to successful local strategic energy planning is illustrated in Figure 11. It should be noted that the spiral in Figure 11 is a rough illustration of how the barriers can reinforce each other based on the tendencies identified through the analyses made in this study. It should not be understood as the municipality not making any positive actions within strategic energy planning today.

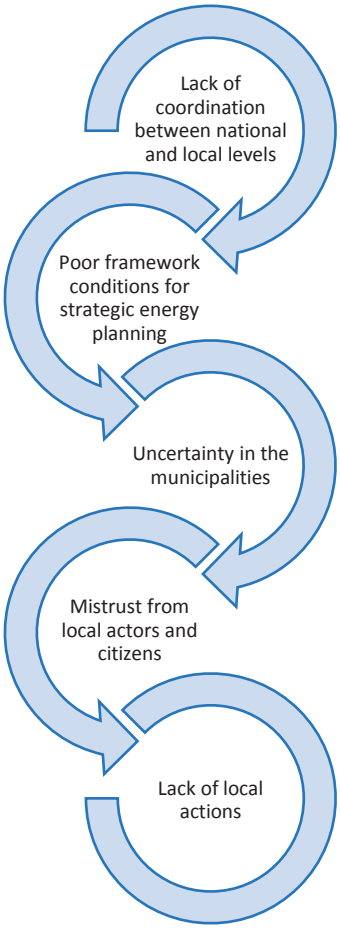

Figure 11: Example of a bad spiral based on identified barriers in Danish strategic energy planning.

To stop the bad spiral of barriers in local strategic energy planning and to secure a better and more uniform local strategic energy planning in Denmark, a number of suggestions for how to overcome the identified barriers are presented in Section 5.3. These suggestions are divided between the national level and the municipalities. The chapter does not discuss the order in which the actions/suggestions should be addressed. However, as described above, the findings in the analyses indicate that the coordination issues at the national level as well as the poor framework conditions have a negative impact on the local work within strategic energy planning. Based on this, the overall suggestion in this thesis is that the national and local levels should start to coordinate as soon as possible. It is also crucial that there is a democratic dialogue of how strategic energy planning should be structured in Denmark and that the roles of different actors are defined if smart energy systems are to be successfully implemented in Denmark.

CHAPTER 6. CONCLUSIONS

This thesis has examined the coordination needs within local strategic energy planning in Denmark today.

What coordination needs emerge within the paradigm shift towards a 100% renewable energy system? And how can local strategic energy planning meet these coordination needs?

In the following sections 6.1, 6.2 and 6.3, the three sub-questions to the main research question are answered. Subsequently, the main research question is answered in section 6.4. Finally, the chapter provides reflections for further research that could add to the findings in this study.

6.1 FRAMEWORK FOR STRATEGIC ENERGY PLANNING

The first sub-question addressed in the thesis concerns the definition and understanding of strategic energy planning in Denmark.

"How should strategic energy planning be understood to support more coordinated local energy processes in Denmark?"

It is found that the Danish Energy Agency's current definition and framework conditions for strategic energy planning are not adequate if local strategic energy planning is to play a significant role in the implementation of smart energy systems in Denmark.

Through an examination of the national framework conditions for strategic energy planning as well as the political statements, it is found that the national level in the last decade has provided mixed signals in relation to the expectations of the municipalities' role in the green transition of the energy system. On one hand, the national level expects the Danish municipalities to conduct strategic energy planning and take a large part of the responsibility for the green transition (through the energy agreement of 2012 and the guidelines for strategic energy planning). However, lately, it seems that strategic energy planning and the role of the municipalities have disappeared from the national perception (e.g. the new energy agreement from 2018, where neither strategic energy planning nor the municipalities' role/responsibilities are mentioned). Despite these mixed signals, many Danish municipalities have chosen to develop local strategic energy plans[21]. This attests to conflicting intentions and a lack of coordination in the planning and implementation of a 100% renewable energy

system in Denmark. Therefore, in this PhD project it is found necessary to look deeper into the coordination needs and issues present in strategic energy planning in Denmark today as well as how strategic energy planning should be framed to support the green transition of the energy system.

In the theoretical framework for the thesis in Chapter 2, the two coordination issues ("*national vs. local level*" and "*technical solutions vs. societal needs*") are identified as being crucial to balance if strategic energy planning is to support the development and implementation of smart energy systems in Denmark. Based on the current Danish definition and framework for strategic energy planning as well as the literature review in [40], a theoretical analytical framework for strategic energy planning is developed and presented in Figure 8 in Chapter 2. The framework in Figure 8 is used in the analyses conducted within the case study of Hjørring Municipality to investigate how strategic energy planning is currently carried out.

The analysis of Hjørring Municipality has provided an insight into how the municipality is currently approaching strategic energy planning. Using the analytical framework, it has been shown that Hjørring Municipality had already in 2012 included implementation strategic/action plans in their strategic energy plan. This is considered a significant part of strategic energy planning and, therefore, the term "implementation strategies" has been added to the framework in Step 4 "strategic energy plans"; see Figure 12. Furthermore, the study has shown that the early involvement of actors impacted by strategic energy planning has created a positive dialogue in Hjørring Municipality, where actors are interested in being involved in the strategic energy planning process. The local actors have a great knowledge of the local societies and what is possible on the local level. In addition, it is the local actors who are expected to fulfil most of the goals in the strategic energy plan and, therefore, they should be included in the development process of strategic energy planning to match expectations early on in the process. This is illustrated in Figure 12, where "local actors" are added to the levels included in strategic energy planning in Step 1.

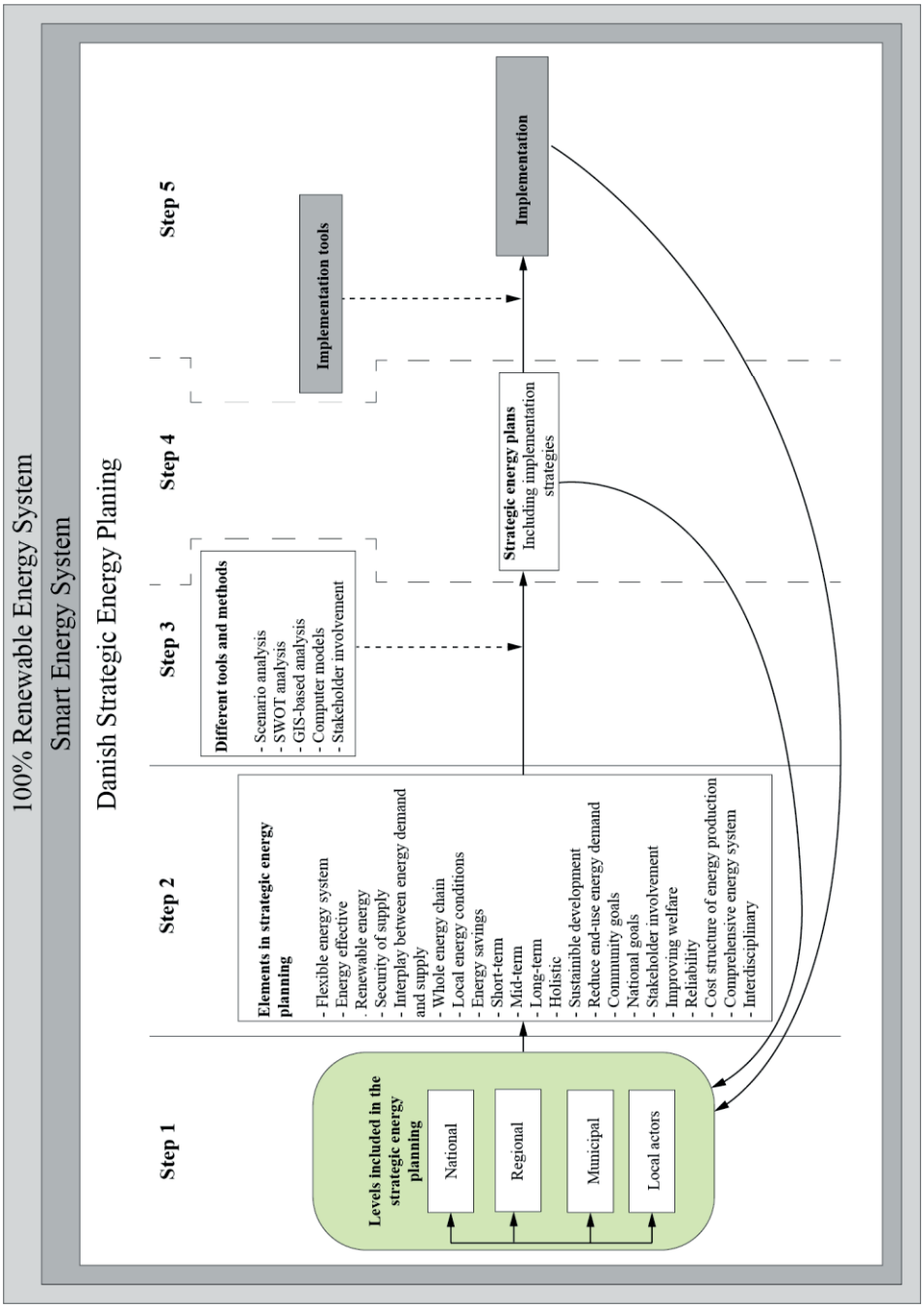

Figure 12: Analytical framework for strategic energy planning

6.2 COORDINATION ISSUES IN STRATEGIC ENERGY PLANNING

The second sub-question in this thesis is used to identify how municipalities currently work with strategic energy planning and to examine if and how the theoretical identified coordination issues are present in local strategic energy planning:

"How does a Danish municipality act within the framework of strategic energy planning and what kind of coordination is present in current local strategic energy planning?"

With a point of departure in the developed analytical framework for strategic energy planning (presented in Chapter 2), two analyses of the case study have been carried out. These analyses support each other since they focus on two different parts (sub-processes) of strategic energy planning, and therefore provide a detailed picture of how the municipality works with strategic energy planning. The first analysis primarily focuses on the content and implementation process of the first strategic energy plan from 2012 until today. Meanwhile, the second analysis focuses on the development process of the second strategic energy plan yet does not cover any of the implementation as the strategic energy plan is not yet finalised and published.

The case study shows that the municipality does not make any active attempts to start a dialogue with the national level concerning the barriers they meet in strategic energy planning. Instead, the municipality works with the framework conditions in their present form. However, at the same time, it is also clear that the municipality thinks they have a responsibility in the energy planning, and thus in their 2012 strategic energy plan, they go beyond goal setting and include 33 implementation strategies. During the analysis of Hjørring Municipality's first strategic energy plan from 2012, it becomes clear that the municipality's own options to implement the actions included in the plan are limited. The municipality is very dependent on the local actors' interest and willingness to carry out projects supporting the goals of the strategic energy plan. The municipality is aware of this issue and in the process of developing the second strategic energy plan, they included local energy actors in a dialogue of the strategic energy planning process from an early stage.

The analyses made within the case study identify an increased focus on horizontal coordination among the municipality and energy actors within the geographic borders of the municipality. However, one of the largest local actor groups are the citizens, and they have not been included in the development process of the new strategic energy plan. According to choice awareness theory and innovative democracy theory in Chapter 2, this could be a mistake, because it is difficult – if not impossible – to coordinate the interests of actors if they are not included in the process.

The technical decisions regarding goals for the different technological solutions in the strategic energy plan were set internally in the municipal organisation in collaboration with a consultancy company. The different goals were then presented to the local energy actors, who commented on the goals regarding their own expectations for the future. However, it has not been identified whether or not the comments from local actors have resulted in changes to the goals set by the municipality, although since the process is not yet finalised, it is not possible to conclude the state of the final goals. The identified coordination issues in relation to strategic energy planning in Hjørring Municipality are summed up in Table 10.

Table 10: Identified coordination and coordination issues in relation to strategic energy planning in Hjørring Municipality.

Coordination at the national and local levels	**Coordination between the technical and societal aspects of strategic energy planning**
- No active coordination between the national level and the municipality. - Local horizontal coordination between the municipality and local energy actors (primarily in relation to the municipality's role in strategic energy planning). - Exclusion of local citizens in the development phase of the strategic energy plan.	- Technical solutions/goals are primarily suggested by an external consultancy company and from analyses of potential resources within the municipality. - Actors (local society) have not been included in the initial goal setting.

6.3 BARRIERS IN LOCAL STRATEGIC ENERGY PLANNING

The third sub-question discuss how barriers identified in relation to the coordination issues in local strategic energy planning can be eliminated to strengthen the overall strategic energy planning in Denmark.

"What are the current barriers in local strategic energy planning and how could these barriers be eliminated to better support coordinated strategic energy planning?"

Several barriers in relation to local strategic energy planning have been identified through the analyses conducted during the case study. These barriers both confirm and add to previously identified barriers in strategic energy planning in Denmark. The identified barriers are divided into two groups namely, "strategic barriers", which are barriers anchored within the national level, and "practical barriers", which in theory can be handled at the local level within the current framework conditions. The identified barriers are presented in Table 9 in Chapter 5. Furthermore,

recommendations to eliminate the barriers in strategic energy planning are made in Chapter 5. These recommendations are developed for both the national level and the municipalities and are presented in Table 11.

Table 11: Recommendations for the national level and municipalities on how to eliminate barriers and strengthen strategic energy planning in Denmark.

Recommendations for the national level
Transparent dialogue: The government or Danish Energy Agency should start an open and transparent dialogue concerning how the Danish energy system should be developed to reach the goal of a 100% renewable energy system. **Clearly defined roles:** The municipalities' role in strategic energy planning should be clarified alongside a decision regarding how the energy system should be developed. **Mandatory task:** When the municipalities' role in the strategic energy planning is defined, it should be made a mandatory task accompanied by the financial means for the purpose. **Rules and regulations:** The rules and regulations should reflect the role that the municipalities are to fulfil in the transition of the energy system.
Recommendations for the municipalities
Communicate experiences: The municipalities should be better at communicating their experiences to the national framework conditions (positive and negative), including how the framework conditions influence work in the municipalities and local actors. **Present a united front:** The municipalities should organise themselves to enable them to communicate and coordinate with the national level through one strong voice. (This could be through Local Government Denmark (KL), a task force of representatives from the municipalities or the regions etc.) **Knowledge of the political "game":** Employees in the municipalities should have extensive knowledge of the local political "game" and structure to know when to enter the political dialogue in order to gain positive feedback. **Develop the right competences:** Municipalities should hire employees with competences that reflect the different aspects of the municipalities' role in strategic energy planning. **Keep a focus on the overall energy system:** Municipalities can strengthen their local actions by applying for external funding while maintaining a focus on the overall purpose of their local energy goals. **Technical scenarios:** The municipality should develop different technical 100% renewable energy scenarios for the future energy system and create feasibility studies showing the consequences of the

different scenarios as a basis for an open and transparent dialogue with the actors involved in the local transition of the energy system.

Involvement of local actors: The municipalities should talk to local energy producers and citizens to include their perspectives on the future when designing strategic energy plans.

Point out synergies: The municipality should focus on pointing out the potential synergies between local actors to motivate them to act.

Facilitate ongoing dialogue: The municipalities should facilitate an advisory board for strategic energy planning in the municipality to keep it a dynamic process.

Revise the plan regularly: The municipalities should make sure to revise the strategic energy plan regularly.

6.4 HOW TO MEET THE COORDINATION NEEDS OF DANISH STRATEGIC ENERGY PLANNING

This section collects the findings from the analyses conducted to answer the three sub-questions to answer the main research question presented at the beginning of the chapter and hereby conclude the PhD thesis.

In the transition to a 100% renewable smart energy system in Denmark, this PhD study finds an interest not only from the municipalities toward conducting strategic energy planning but also from the local actors toward participating in the processes. At the same time, the activities related to local strategic energy planning at the national level have been decreasing over recent years. This has led to a scattered energy planning in Denmark, whereby municipalities develop strategic energy plans that primarily focus on meeting local needs instead of reaching a balance between the national and local goals for the future energy system. The case study of Hjørring Municipality shows that the municipalities would like to do even more within the strategic energy planning, but due to a lack of resources, they are forced to prioritise their actions and only implement those they consider most important in the development of the strategic energy plan. This is despite the fact that Hjørring Municipality is a municipality where strategic energy planning has a relatively high political prioritisation and where financial resources are allocated to the strategic energy planning process. This emphasises that there is a need to address the coordination between the *national and local levels* in strategic energy planning.

Furthermore, a coordination need has been identified in that there should be better coordination be the *technical solutions and societal needs* in strategic energy planning. This refers to the technical scenario combinations made at the overall national level for the complete Danish energy system but also to the smaller local

energy systems in the municipalities, whereby it is important to start including implementation strategies that are coordinated with the local authorities, actors and communities to gain local support for the implementation of decentralised energy production constellations.

The PhD study identified several strategic and practical barriers related to the two identified coordination issues in Chapter 5. The analysis of the barriers shows that most of the barriers can be related to the lack of coordination between the institutional levels and the current poor framework conditions for strategic energy planning in Denmark. It is therefore important to address the national barriers first so that the framework conditions that define different actors' role in strategic energy planning are made clear. However, this will require transparent coordination between the national and local levels, and this coordination could also be initiated by the municipalities as much as it could the national level. One way the coordination could be secured would be through the organisational dimension of choice awareness theory developed in this PhD study, namely to ensure that the right actors are included in the dialogue on strategic energy planning to develop framework conditions that meet both national and local needs. Although it is important to address the barriers at the national level to ensure better conditions for the municipalities and a more uniform approach to strategic energy planning, it is equally important that local strategic energy planning does not come to a halt in the time it takes to develop the right framework conditions. Therefore, the municipalities should still address the local barriers through the recommendations made to the municipalities in Table 11 while actively communicating and coordinating with the national level.

6.5 FURTHER RESEARCH

The PhD thesis has focused on the coordination issues found to be important for the success of strategic energy planning today. The study has primarily investigated the coordination issues through a local perspective through the case study of a single Danish municipality. The barriers in strategic energy planning have therefore primarily been identified through the eyes of the municipality and local actors involved in the specific strategic energy planning process. This has been chosen because it is the municipalities that are expected to carry out strategic energy planning in Denmark. However, since many barriers identified in local strategic energy planning are significantly connected to the national framework conditions for strategic energy planning, it would have been interesting to investigate how the national level sees the development of strategic energy planning in Denmark. Furthermore, an additional dimension would have been added to the PhD study if, for example, the interviews with the Danish Energy Agency had been carried out with the aim of obtaining their responses to the barriers identified through the case study of Hjørring Municipality.

Moreover, it would be interesting to investigate the national level further to gain an understanding of why strategic energy planning has disappeared from the national political statements and publications over recent years. Therefore, further research should be conducted in relation to local strategic energy planning to investigate how the Danish government views the municipalities' role in the transition to a 100% renewable energy system in Denmark in the long run.

At the local level, it would be interesting to investigate more municipalities to explore any differences in the way they approach strategic energy planning. It would also be interesting to investigate how the municipalities that do communicate with the national level are doing so and to examine what they gain from communicating with the national level. One way to investigate strategic energy planning on a more general level in Denmark would be to develop a questionnaire based on the findings in this PhD study and send it to all Danish municipalities. This could validate and support the findings in the PhD study and could be useful in relation to obtaining a deeper understanding of the challenges and opportunities of local strategic energy planning, but also of how different challenges are handled differently in different municipalities.

CHAPTER 7. THEORETICAL AND PRACTICAL CONTRIBUTIONS

This final chapter presents and discusses what contributions can be drawn from this PhD study in relation to the theoretical approaches in strategic energy planning as well as practical contributions gained from the study that could be used in Danish strategic energy planning in practice.

7.1 THEORETICAL CONTRIBUTIONS

The theoretical contributions of the PhD study can be divided into two main groups:

- Adding an organisational dimension to choice awareness theory.
- Developing the concept of local strategic energy planning and creating an analytical framework for strategic energy planning in Denmark.

The thesis contributes to scientific research in different ways. Research within the transition towards 100% renewable smart energy systems has largely focused on the development of technical scenarios that show how it is possible to construct smart energy systems. However, these studies often do not include considerations of how these smart energy systems can be implemented successfully in society. Choice awareness theory, developed by Henrik Lund[5], advocates transparency in the development of technical solutions and scenarios and highlights different choice eliminating mechanisms in relation to the technical solutions used by actors in the green transition[53]. In this PhD study, it was found that choice awareness theory is useful when tackling the complex task of planning for the transition of the energy system. However, choice awareness theory seems to fall short when the focus is moved towards “organisation” and “profit” in the elements of technology (described in Chapter 2). The organisation and profit elements require more coordination between the technical solutions and societal needs as well as between the institutional levels if more decentralised smart energy systems are to be successfully implemented. So far, the focus in Danish energy planning has primarily been on the technical composition of the energy system and its implementation in local societies has been largely overlooked. However, smart energy systems require local integration of the energy system and therefore it is important that this is recognised when planning for the implementation of smart energy systems. Therefore, the case study of the tender for nearshore wind turbines in Denmark has been used to identify and develop the organisational dimension of choice-eliminating mechanisms, which adds to the current choice awareness theory, outlined in Chapter 2.

Secondly, the PhD thesis contributes to ongoing research within energy planning approaches and the implementation of renewable energy systems. Through the investigation of the concept of strategic energy planning, both in a Danish context as well as in the international scientific literature, this PhD project has developed the concept of strategic energy planning. This concept suggests forming a new framework for strategic energy planning that includes all processes from the development of the overall national framework conditions to the local development of strategic energy plans and even to the implementation of local strategies. The new framework for strategic energy planning is not intended to be used as a strict model for how and what to include in Danish strategic energy planning. Rather, it should be used as a tool for understanding the overall process of strategic energy planning, including the sub-processes that are present in the different steps of strategic energy planning. Strategic energy planning is still under development and the framework developed in this thesis can add to the ongoing discussions on how the planning and implementation of renewable smart energy systems should be carried out.

7.2 PRACTICAL CONTRIBUTIONS

The practical outcomes of this PhD study can be presented as two contributions:

- An analytical framework for strategic energy planning.
- Suggestions on how to overcome barriers in local strategic energy planning.

The theoretical analytical framework for strategic energy planning can be used directly in the discussion of how strategic energy planning should be part of the green transition of the energy system in the future. The framework highlights the strategic energy planning process/processes and can be used in practice as a tool to secure a more uniform approach to strategic energy planning while ensuring sufficient space for individual local authorities to include case-specific relevant elements.

The suggestions on how to overcome barriers in local strategic energy planning can be used in combination with the framework for strategic energy planning as a common starting point for municipality and central authorities to develop an awareness when working with local strategic energy planning. Furthermore, the suggestions on how to overcome barriers to strategic energy planning create a basis for dialogue and coordination between the national level and the local municipalities.

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APPENDIXES

Appendix A:
Barriers and Recommendations to innovative Ownership Models for Wind Power

Appendix B:
A comprehensive framework for strategic energy planning based on Danish and international insights

Appendix C:
How municipalities act under the new paradigm for Energy Planning

Appendix D:
Interview guide – Interviewforløb med Hjørring Kommune angående nuværende (strategisk) energiplanlægning
(Interview guide - Interview process with Hjørring Municipality regarding current (strategic) energy planning)

Appendix E:
Interview guide – Opfølgende interview med to medarbejdere fra Hjørring Kommune d. 20.11.2018
(Interview guide – follow up interview with two employees from Hjørring Municipality, date: 20.11.2018)

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(Interview guide – Interview process with Hjørring Municipality regarding current (strategic) energy planning)

Interviewforløb med Hjørring Kommune angående nuværende (strategisk) energiplanlægning

Forskningsspørgsmål:

Hvordan arbejder danske kommuner med lokalt strategisk energiplanlægning i dag og hvilke barrierer opleves der i arbejdet?

- *Hvordan opstår energirelaterede projekter i kommunen? (på baggrund af en strategisk energiplan?)*
- *Er der sket en udvikling i den måde kommunerne arbejder med (strategisk) energiplanlægning, siden kommunesammenlægningen i 2007?*
- *Er de rammer regeringen opsætter, gennem nationale planer, strategier og scenarieanalyser, nok til at kommunerne føler de kan lave lokal energiplanlægning, som hænger sammen med de nationale målsætninger?*

Tredelt interview:

1. Interview med leder ang. udviklingen af energiplanlægningstilgangen i kommunen
2. Fokusgruppe, semistruktureret interview med kommunale (energi)medarbejder, med henblik på identificering af energiprojekter i kommunen
3. Individuelle Interviews med kommunale medarbejdere(projektansvarlige), med henblik på at indhente informationer om de enkelte projekter.

Første del – Interview guide:
Semistruktureret interview, med formål at finde ud af, hvordan kommunen selv oplever deres arbejde med energiplanlægning. – Udføres med Teamleder.

- Hvordan arbejder I med energiplanlægningen i kommunen i dag?
    - Arbejder I struktureret med nogle målsætninger eller er det mere flydende?
- Hvordan forholder I jer, til jeres energiplan efter udarbejdelsen af denne?
- Er der sket en ændring i den måde i planlægger på siden kommunesammenlægningen i 2007?
    - Hvordan kan I mærke dette?
    - Hvordan konkret? (samarbejde med andre, fokus på andre ting - adfærd?)
- Har SEP-puljen/projektet har en indflydelse på den måde I tænker planlægningen i fremtiden?

- Når I arbejder med at opsætte mål og tiltag i jeres strategiske energiplan og i jeres generelle arbejde med energiplanlægningen i kommunen – oplever I så at de rammer der er udstedt af regeringen er tilstrækkelige til at I føler I kan lave energiplanlægning der hænger sammen med de nationale målsætninger? (nationale planer, målsætninger, strategier, scenarioanalyser mv.)
    - Har I adgang til de informationer I føler I har brug for?
    - Er de redskaber I har behov for tilgængelige for jer?
    - Oplever I nogle konkrete barrierer i forhold til jeres arbejdsmuligheder?
- Hvor meget betyder de nationale rammer/planer, når I planlægger for kommunen?
- Oplever I nogle barrierer i forhold udførelsen af strategisk energiplanlægning på det kommunale niveau? (involvering af aktører, handlefrihed, midler m.v.)
    - Ideer til mulige løsninger?
- Når jeg hører jer tale om projekterne i kommunen, lyder det for mig, til at i opstiller nogle rammer som gør det muligt for aktører at handle indenfor disse?
    - Hvor afhængige er I af, at de "rigtige" (initiativrige) aktører/borgere bor i kommunen? Eller agere i kommunen?
    - Prøver I at presse borgerne/aktørerne i den ønskede retning – kommunikativt eller skal de komme af sig selv?

Anden del – Interviewguide:
Fokusgruppe interview med henblik på at identificere energiprojekter i kommunen samt de medarbejdere der er tilknyttet projekterne. Eksplorativt interview – åbent interview.

- Hvilke projekter har i, i gang på nuværende tidspunkt i kommunen?
    - Vindmøller, biogasanlæg, interne projekter (kommunale bygninger), tværkommunale projekter, mv.
- Har I nogle energiprojekter der allerede er afsluttet på nuværende tidspunkt?
    - Vindmøller, biogasanlæg, interne projekter (kommunale bygninger), tværkommunale projekter, mv.

Tredje del – Interviewguide:
Struktureret interview med de enkelte medarbejdere med henblik på at indsamle viden om de enkelte energiprojekter i kommunen. Gentages for hvert enkelt projekt.

- Projektets titel?

- Hvad er projektets fokusområde?
- Hvad er projektets løbe periode?
- Hvad er kommunens rolle i projektet?
- Hvordan er projektets geografiske afgrænsning?
    - Dækker det hele kommunen eller er det et afgrænset projekt?
- Hvordan er projektet opstået?
    - Er det kommunen der har taget initiativ til projektet? – hvorfor?
    - Er projektet kommet ind udefra?
    - Er det afledt af mål i den strategiske energiplan?
- Kan give en kort beskrivelse af projektet?
    - Hvad er formålet?
    - Hvad handler det om?
- Hvilke aktører er involveret i projektet?
    - Virksomheder, borgere, forbrugere, andre kommuner, energiselskaber, mv.?
    - Andre afdelinger internt i kommunen?
- Kan du sige noget om, hvad I har lært gennem projektperioden?
    - Er I stødt på nogle barrierer, som har betydning for projektet?
    - Har i haft nogle succesoplevelser, som I kan tage med videre til andre projekter?

Appendix E: Interview guide – Opfølgende interview med to medarbejdere fra Hjørring Kommune d. 20.11.2018

(Interview guide – follow up interview with two employees from Hjørring Municipality, date: 20.11.2018)

Interview guide – Opfølgende interview med to medarbejdere fra Hjørring Kommune d. 20.11.2018

Formål med interviewet er at samle op på nogle spørgsmål, der er opstået på baggrund af tidligere interviews, samt observeringer under workshops og møder. Yderligere, er det meningen af interviewet skal anvendes til at validere, den kortlagte proces omkring udarbejdelsen af den nye strategiske energiplan i Hjørring Kommune.

1) Hvad er jeres motivation til at udarbejde en ny strategisk energiplan for kommunen?

    a. I har tidligere sagt, at motivationen bag den første plan, var politisk forankret i et ønske om et overblik over energibalancen i kommunen. Derudover, at i var inspireret til at lave en strategisk energiplan, af det arbejde der fandt sted i Randers kommune med en strategisk energiplan.

2) Er der noget som I tænker ikke fungerede i den første plan, som I har ændret i processen med den anden strategiske energiplan?

3) Hvordan er den strategiske energiplanlægning finansieret i kommunen?
    i. Politisk finansieret – gennem det kommunale budget?
    ii. Eksterne midler? – hvilke?
    iii.

    b. Tror I, at I som kommuner skal til at satse mere på eksterne midler (EU-midler), for at kunne opnå finansiering til at kunne realisere de ting I gerne vil indenfor den grønne omstilling?

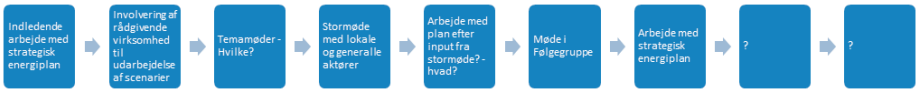
    c. Hvor stort er budgettet til strategisk energiplanlægning i kommunen (finansielle midler og personale)?
        i. Ved I, hvordan det er i forhold til andre kommuner?

4) Kortlægning af mål og ressourcer – Hvordan er I kommet frem til;
    i. Potentialet for de forskellige ressourcer?
    ii. Jeres målsætninger (tal)

    b. Hvordan har I arbejdet sammen med PlanEnergi om dette? Og Udviklingen af scenarier?

5) Kortlægning af processen omkring udviklingen af den strategiske energiplan!
    a. Hvornår og hvordan har I involveret lokale politikere?

    b. Har I været i dialog med de enkelte aktører i forhold til at tage hensyn til deres fremtidsplaner? (hvem og hvornår i processen)
6) Selve processen?
    a. Jeg har forsøgt at kortlægge de aktiviteter, jeg har identificeret gennem observationer til møder og workshops.



- Hvornår og hvordan har I involveret lokale politikere?

- Har I været i dialog med de enkelte aktører i forhold til at tage hensyn til deres fremtidsplaner? (hvem og hvornår i processen)

- Hvornår begyndte i Processen og hvordan gik I, igang?

- Har I afholdt flere temamøder? Hvilke og hvornår?

7) Temamøder og workshops.
    a. Hvorfor har I valgt denne tilgang med temamøder og workshops?
        i. Hvad har I fået ud af dette?

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