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BY
SILVER SILLAK

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AALBORG UNIVERSITY
DENMARK

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by

Silver Sillak

AALBORG UNIVERSITY
DENMARK

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PhD supervisor: Associate Prof. Kristian Borch
Aalborg University

Assistant PhD supervisor: Associate Prof. Karl Sperling
Aalborg University

PhD committee: Associate Professor Daniel Galland (chairman)
Aalborg University, Denmark

Associate Professor Mark Wiering
Radboud University Nijmegen, The Netherlands

Associate Professor Annika Agger
Roskilde University, Denmark

PhD Series: Technical Faculty of IT and Design, Aalborg University

Department: Department of Planning

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ENGLISH SUMMARY

The new long term strategy of the European Union is to become climate neutral and powered by mostly renewable energy by 2050. The transition to a near or fully renewable energy system is a very complex process that relies on distributed energy production, the integration of electricity, thermal, and gas grids through energy conversion and storage technologies, as well as demand side flexibility and energy saving. Regional and municipal governments have a key role in governing the transition because they are the smallest political units in most countries, they have a considerable degree of autonomy in their jurisdiction, and they are close to the actors who actually have to implement the changes.

Currently, regions and municipalities are failing to live up to the task and would need to roughly double their ambitions. However, they are facing both technical, political and administrative challenges when it comes to designing and implementing strategic energy plans. The technical challenge is: how to choose which specific energy sources and technologies to rely on in which sectors?. The political challenge is: how to increase the acceptability and legitimacy of the transition among politicians, businesses and local communities?. The administrative challenge is: how to coordinate all the changes in the different subsectors and how to mobilize the necessary resources for that?

Co-creation is an emerging governance strategy that occurs when government agencies, businesses, non-governmental organizations, and unorganized communities work together to define common problems and design and implement innovative solutions. The author proposes that co-creation could provide a useful alternative to market- or government-led strategies for governing the renewable energy transition. The aim of this thesis is to study whether the challenges that regions and municipalities face could be overcome by the co-design and co-implementation of strategic energy plans. As such, it is one of the first studies that applies the proliferating knowledge about co-creation in political science to the energy sector.

So far, co-creation in the energy sector has been insufficiently conceptualized; existing empirical studies have focused mainly on the co-creation of energy plans but not their implementation; there are no good examples of the institutionalization of co-creation in new governance bodies; and the feasibility of co-creation outside Western Europe is largely unknown. This thesis contributes to filling these knowledge gaps by conducting a literature review and analyzing three empirical cases: the co-design of a regional energy plan

in Ida-Virumaa in Estonia, and the co-implementation of municipal energy plans in Ringkøbing-Skjern and Sønderborg in Denmark.

The results show that co-creation as a governance strategy for renewable energy transitions can be divided into: 1) collaborative process, 2) institutional design and leadership, 3) outputs and outcomes and 4) antecedent conditions. The thesis offers new contributions in all of these categories. First, the collaborative process relies on expectation alignment, learning and evaluation, resource mobilization, and involves role changes between sectors. Second, co-creation can be institutionalized in a municipality-led network or a network administrative organization, with different consequences for the energy transition. Third, co-creation can produce outputs and outcomes that go beyond plans or policies such as new collaborative networks, joint projects, wider institutional changes and increased legitimacy of the transition. Fourth, antecedent conditions like natural resources, industrial specialization, existing institutions and policies, capacity of non-governmental sectors and history of collaboration heavily influence the effectiveness of co-creation.

DANSK RESUME

Den nye langsigtede strategi for EU er at blive klimaneutral og forsynet med overvejende vedvarende energi (VE) i 2050. Overgangen til et næsten eller fuldt udbygget VE-system er en meget kompleks proces, der er baseret på en decentral energiproduktion, integration af elvarme- og gasnet gennem energikonverterings- og lagringsteknologier samt fleksibel efterspørgsel og energibesparelser. Regionale og kommunale myndigheder har en nøglerolle i styringen af overgangen, fordi de er de mindste politiske enheder i de fleste lande, de har en betydelig grad af autonomi i deres jurisdiktion, og de er tæt på de aktører, der faktisk skal implementere ændringerne.

På nuværende tidspunkt formår regioner og kommuner ikke at leve op til opgaven og burde groft sagt fordoble deres ambitioner. Men de står over for både tekniske, politiske og administrative udfordringer, når det kommer til at designe og implementere strategiske energiplaner. Den tekniske udfordring er: hvordan vælger man hvilke specifikke energikilder og teknologier man kan stole på og i hvilke sektorer? Den politiske udfordring er: hvordan øger man accepten og legitimiteten af omstillingen blandt politikere, virksomheder og lokalsamfund? Den administrative udfordring er: hvordan koordinerer man ændringer i de forskellige delsektorer, og hvordan mobiliserer man de nødvendige ressourcer hertil?

Co-creation (samskabelse) er en ny styringsstrategi, der opstår, når statslige organer, virksomheder, ikke-statslige organisationer (NGO'er) og løst organiserede lokalsamfund arbejder sammen om at definere fælles problemer og designe og implementere innovative løsninger. Forfatteren foreslår, at co-creation kunne udgøre et nyttigt alternativ til markeds- eller regerings-ledede strategier til styring af overgangen til VE. Formålet med denne afhandling er at undersøge, om de udfordringer, som regioner og kommuner står over for, kan overvindes ved co-design og co-implementering af strategiske energiplaner. Som sådan er det en af de første undersøgelser, der anvender den voksende viden om co-creation i statskundskab til energisektoren.

Indtil videre har co-creation i energisektoren været utilstrækkeligt konceptualiseret, fordi eksisterende empiriske undersøgelser har hovedsageligt fokuseret på samskabelse af energiplaner, men ikke deres gennemførelse. Samtidig er der er ingen gode eksempler på institutionalisering af co-creation i nye styringsorganer, og endelig er erfaringer med co-creation uden for Vesteuropa meget begrænset. Dette Ph.d.-projekt bidrager til at udfylde disse videnshuller ved at gennemføre en litteraturgennemgang og analysere tre empiriske cases: co-design af en regional energiplan i Ida-Virumaa i Estland, og co-implementering af

kommunale energiplaner i de to danske kommuner Ringkøbing-Skjern og Sønderborg.

Resultaterne viser, at co-creation som en styringsstrategi for vedvarende energiomstillinger kan opdeles i: 1) samarbejdsproces, 2) institutionelt design og ledelse, 3) output og resultater og 4) forudgående forhold. Ph.d.-projektet byder på nye bidrag inden for alle disse kategorier. For det første er samarbejdsprocessen afhængig af forventningsafstemning, læring og evaluering, ressourcemobilisering og involverer rolleskift mellem sektorer. For det andet kan selve institutionalisering af co-creation i et kommunestyret netværk eller en netværksorganisation have forskellige konsekvenser for energiomstillingen. For det tredje kan co-creation producere resultater, der går ud over planer eller politikker, såsom nye samarbejdsnetværk, fælles projekter, bredere institutionelle ændringer og øget legitimitet af overgangen. For det fjerde har forudgående forhold som naturressourcer, industriel specialisering, eksisterende institutioner og politikker, kapacitet i ikke-statslige sektorer og historie med samarbejde i høj grad indflydelse på effektiviteten af co-creation.

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Many thanks go out to my colleagues at the Estonian Green Movement who welcomed me to their organization with open arms and provided me with an opportunity to get invaluable insights into how climate and energy policy is made on regional, national and international scales. Without this experience from the field I could not have completed this PhD thesis.

I also want to thank my friends in the Institute of Education and the Institute of Social Studies at the University of Tartu with whom I have had many enriching conversations on a variety of topics including the climate crisis, science, technology, education and social and personal change.

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Appendix B. Sillak, S. & Vasser, M. (2022). How might we co-design energy transition policy in old industrial regions? *Environmental Policy and Governance.* https://doi.org/10.1002/eet.2007.

Appendix C. Sillak, S. (2022). All talk, and (no) action? Collaborative implementation of the energy transition in two frontrunner municipalities in Denmark. *Energy Strategy Reviews,* under review.

Let's raise the stakes on the bet that we made,
let's decide to be the architects, the masters of our fate.

Rise Against, “Architects”

CHAPTER 1. RESEARCH PROBLEM AND QUESTIONS

1.1. CLIMATE EMERGENCY AND OUR OUTLOOK

The world is facing an unprecedented environmental crisis. According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) published in 2022, it is now very likely that global warming will soon reach or exceed 1.5°C compared to pre-industrial levels, even in the case of the very low emissions reduction scenario that relies on the roll-out of highly optimistic technological ”fixes” (IPCC, 2022). Other studies indicate that we might soon face a point of no return that will lock us into the “Hothouse Earth” scenario where further warming becomes uncontrollable even if emissions are reduced, and can exceed 5°C by the end of the century (Steffen et al., 2018). This is because of previously underestimated reinforcing feedback loops triggered by the global dimming effect (Andreae et al., 2005), the dangerous levels of emissions of pollutants other than carbon dioxide such as methane, nitrous oxide and chlorofluorocarbons (Montzka et al., 2011), and emissions originating from new sources such as the melting of Arctic permafrost (Miner et al., 2022). As a result of global warming by 1.5°C, up to 14% of species in terrestrial ecosystems will face a very high risk of extinction, and up to 48% of species are very likely to go extinct by 5°C warming (IPCC, 2022).

The danger of global warming has been known and politically acknowledged for decades. The IPCC was established in 1988 and published its First Assessment Report in 1990. In 1992, hundreds of countries joined the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty for cooperation to combat climate change. Paradoxically, statistics show that more carbon dioxide has been emitted into the atmosphere from industrial activity in the 30 years since the publication of the first IPCC Assessment Report than in the rest of human history before that (IEEP, 2020).

In 2015, at the 21st annual meeting of the Conference of the Parties of the UNFCCC in Paris, history was made. For the first time, 196 countries signed the Paris Agreement to limit global warming to ”well below 2°C” compared to pre-industrial levels (UNFCCC, 2022b). In 2020, the European Union submitted its long-term strategy to the UNFCCC, with the aim to become climate neutral by 2050. This means that no more carbon dioxide and other greenhouse gases are emitted than are captured through natural or technological processes (European Commission, 2022a). The transition to

climate neutrality presents an enormous and unprecedented change for the EU and will require a significant contribution from every sector in every region and municipality in every Member State. Consequently, regional and municipal governments will need to rethink their governance strategies in order to legitimize, implement and institutionalize these changes. The aim of this thesis is to investigate whether and how a new form of governance – co-creation – could help do that.

1.2. TRANSITION TO 100% RENEWABLE ENERGY

The road towards carbon neutrality relies heavily on increasing energy efficiency and replacing fossil fuels with renewable energy in all sectors, including electricity, heating, transport, manufacturing and agriculture. Studies indicate that it is technically possible and economically feasible to build a climate neutral and (near) 100% renewable energy system globally (International Energy Agency, 2021; Jacobson et al., 2017) and in Europe (Child et al., 2019; Connolly et al., 2016). More detailed analyses show how this can be achieved on the country level, including Denmark (H. Lund & Mathiesen, 2009; Maya-Drysdale et al., 2022a) and Estonia (Maya-Drysdale et al., 2022b; Rohetiiger & TalTech, 2022), and on the municipal level (Drysdale et al., 2019; Thellufsen et al., 2020).

However, the renewable energy transition is an extremely complex challenge. Although wind turbines and solar photovoltaic systems are already mature technologies, they need to be supplemented with dispatchable power or energy conversion and storage options. While biomass has been increasingly relied upon to provide dispatchable generation, there are serious concerns over whether woody biomass should be classified as a renewable or sustainable energy source (Simon, 2022). There is also uncertainty around the competitiveness and scalability of some of the technologies that could provide storage options such as power-to-X. Moreover, power-to-X and other storage technologies rely on the integration of electricity, thermal, and gas grids to a significantly larger extent than they are now (Henrik Lund et al., 2017; Mathiesen et al., 2015).

Changes in energy supply need to be complemented by the improvement of energy savings and flexible consumption on the demand side (Creutzig et al., 2016; Kuzemko et al., 2017). As the future energy system becomes more distributed and more reliant on intermittent sources, citizens and consumers will need to take an increasingly active role by contributing to the co-production of energy projects and services through, for instance, citizen energy communities that can provide more flexible electricity and heat generation, energy efficient renovation, and load shifting. According to the new EU regulation, energy communities enable citizens to team up with

governmental organizations and market players and jointly invest in energy assets (European Commission, 2022b).

1.3. ROLE OF REGIONS AND MUNICIPALITIES

Energy transitions are processes that are governed across multiple geographical scales and political-administrative levels. Although the Paris Agreement has been adopted globally, it is implemented through nationally determined contributions (NDC) that embody efforts by each country to reduce national emissions (UNFCCC, 2022a). Similarly, the achievement of climate neutrality in the EU depends on the member states who are required to develop national energy and climate plans (NECP) on how they plan to achieve the necessary emissions reductions (European Commission, 2022a).

In turn, member states have to make sure that regional and municipal activities are in line with national and international goals. Regions and municipalities have arguably the most important role because they are the smallest political units in most countries, they have a considerable degree of autonomy in their jurisdiction, and they are close to the actors who actually have to implement the changes. This is why transnational networks such as the EU Covenant of Mayors for Climate & Energy are encouraging and supporting the creation of local sustainable energy and climate action plans (SECAP) that describe the steps towards emissions reduction targets by 2020 or 2030 on the regional or municipal level (Covenant of Mayors, 2022). Some municipalities have also developed more detailed strategic energy plans in order to accelerate the transition to a renewable and integrated energy system (Krog, 2019).

Currently, regional and municipal governments are failing to live up to the task. Although energy and climate plans are being developed, they are often unambitious or are simply “shelved” (Petersen, 2018). Recent research shows that European cities need to roughly double their ambitions and efforts to be on track to reach the target of the Paris Agreement (Salvia et al., 2021). Even in the case where ambitious plans are in place, there is a large gap between the commitment to rapid emission reduction in the plan and the practical steps towards fulfilling this commitment. Massive upscaling of climate action on municipal and regional levels is therefore needed (Fuhr et al., 2018).

1.4. CHALLENGES FOR REGIONS AND MUNICIPALITIES

I propose that the challenges that regions and municipalities face with regard to the transition can broadly be divided into 1) scientific or technical, 2) strategic or political and 3) institutional or administrative . First, the scientific or technical complexity of the task lies in figuring out which technologies

should be relied on to achieve the climate neutrality goal. The lack of knowledge about the technical and economic feasibility of new technologies can be ameliorated partly by research such as energy system modelling, economic analysis and environmental impact assessment. However, research cannot do away with the contested nature of the social and political assumptions that underlie scientific and technical "facts". For instance, Åkerman and Peltola (2006) show how the way economic costs are calculated can become the main source of conflict over the choice of fuel even in a small district heating system.

This brings us to the second set of problems which I call strategic or political. These have to do with which problems, goals and solutions are deemed as legitimate or acceptable and whether and how an agreement can be reached. The social acceptability (or in other words, legitimacy[1]) of the transition is fragile all over Europe and it is feared that social resistance to renewable energy can ultimately jeopardize the whole process. I define "social acceptability" as the degree to which the renewable energy transition is recognized and accepted as lawful, right and just by relevant interest groups. It can be reflected in the willingness of industries and other market actors to invest in, produce and consume renewable energy (market legitimacy); public opinion and political attitudes towards renewable energy and renewable energy policies (political legitimacy); or the agreement with specific renewable energy development projects by local residents, communities and authorities (community legitimacy) (Wüstenhagen et al., 2007).

For instance, recent studies show that the development of power-to-X is currently stalled not so much by technological barriers but by unfavorable policies and market conditions (Skov et al., 2021). Companies are not likely to make large investments if there is no agreement on a favorable long-term regulatory environment. However, political leaders are afraid of committing to any radical policy changes if there is no "sense of urgency" or political demand from key stakeholders or citizens to take action (Petersen, 2018). The lack of political demand from citizens is often not caused by insufficient awareness of the dangers of the climate crisis but rather due to uncertainty over how the local community can benefit from the changes. For instance, regions that host a large energy industry are commonly overtaken by fears of decreasing energy security or increasing energy poverty and unemployment due to the destabilization of the existing industry (Sillak & Kanger, 2020).

The third set of issues can be characterized by institutional or administrative complexity. Provided that we can agree on the solutions and create legitimacy for the transition, who should contribute to providing the solutions and is there

[1] Hereon I use the terms "acceptability" and "legitimacy" as synonyms.

actually capacity to do it? For most municipal governments, energy and climate are relatively new topics and as such, they lack the necessary knowledge, finances and administrative staff for designing and implementing climate and energy plans (Petersen, 2018). Moreover, the plans need to be integrated with other sectoral development strategies but there seems to be a lack of clarity over the terms and requirements and no consistent approach of doing so has yet developed (Cajot et al., 2017). There is a need for institutionalized coordination as well as the mobilization of extra resources from outside the public sector but municipal administrators are not used to facilitating such extensive horizontal collaboration (Mosannenzadeh et al., 2017).

1.5. NEED FOR A NEW TYPE OF GOVERNANCE

The aforementioned evidence shows that the renewable energy transition is a socio-technical process that involves cultural clashes, political conflicts and administrative struggles (F. W. Geels et al., 2020; Frank W. Geels et al., 2017). While alternative energy system models and feasibility analyses that show that it is technically and economically possible are needed, the transition also depends on the design of new policies that are acceptable to a wide variety of actors and new governance practices that enable their design and coordinate their implementation (Lund, 2014). So far, governance in the energy sector in most countries has been limited to a small number of large energy companies usually representing the incumbent fossil fuel industry.

These companies have in turn tended to use their power to resist change and lobby for regulations that would uphold the *status quo* (see e.g. Bonneuil et al., 2021; Supran & Oreskes, 2021). Even in cases where fossil fuel companies have begun reorienting towards renewables, they have often maintained centralized energy production in large-scale industrialized wind farms and therefore also the concentration of power in the energy market in the hands of the few. The low social acceptability of the transition is hence reproduced not only by the technological lock-in to fossil based energy production, but also by the political lock-in to existing institutional arrangements (Wolsink, 2018, 2019).

The new type of governance has to reduce the political power of “old lobbyists” who depend on the continuation of the fossil fuel market as it is, and open up space for participation for “new lobbyists” who favour the expansion and democratization of the renewable energy market. These include renewable energy companies as well as groups with no direct economic interest such as researchers, consultants and advocates of environmental protection and community rights (Hvelplund, 2011; Hvelplund & Djørup, 2017). Changes in the mode of governance can in turn be the key to initiating the development

of alternative energy systems models and feasibility studies, and to the adoption of new policies (Lund, 2014). As such, a new type of governance can be seen as the foundation of the renewable energy transition (Figure 1).

Figure 1. Prerequisites of the renewable energy transition (adapted from Lund (2014)).

Recently, "co-creation" has been hailed as a strategy for reinvigorating public governance. Co-creation occurs when two or more public and private actors collaborate to define common problems and design and implement innovative solutions (Chris Ansell & Torfing, 2021). There has also been growing interest in using co-creation for strategic energy planning (Gjørtler Elkjær et al., 2021; Itten et al., 2021). This is a continuation of the interest in collaborative approaches that started with the rise of "collaborative planning" in European cities in the 1990s and was scaled up to regional, national and international scales as "cross-sector collaboration" or "collaborative governance" experiments in the 2000s. Co-creation can thus be viewed as a further development of cross-sector collaboration and collaborative governance that emphasizes 1) the inclusion of unorganized lay citizens, 2) distributed leadership and responsibility and 3) public value creation through innovation (Chris Ansell & Torfing, 2021; Torfing et al., 2021).

This PhD thesis is an attempt to apply and adapt the proliferating knowledge about co-creation among governance scholars to strategic energy planning. I think that co-creation falls on a very fertile ground in the energy sector but there are significant gaps in knowledge that need to be filled in order for co-creation to be usefully applied. I have identified the following gaps:

1. Co-creation has been conceptualized in rather general terms and there are few guidelines on how to organize and integrate it in strategic energy planning, as well as assess its usefulness. In addition, existing studies have focused primarily on a limited co-creation strategy with industrial stakeholders without much attention

to third sector, local communities or ordinary citizens (Hendriks, 2008, 2009).

2. Most analyses have focused on the early phases where visions are developed, targets are set and plans are designed (see e.g. Hofstad et al., 2022; Sørensen & Torfing, 2022), while knowledge about the implementation phase where the plans are actually implemented is largely lacking. Exemplary cases are nowhere to be found because this requires not only a one-time attempt at co-creation but continued leadership and an institutionalized governance network. In other words, we do not know how to proceed from the collaborative design of strategic energy plans to the collaborative implementation of these plans through the institutionalization of collaboration.
3. Due to insufficient studies of the implementation phase, there is a lack of evidence about the benefits of co-creation beyond involvement for involvements' sake. For instance, it is unclear whether co-creation has actually improved the effectiveness and efficiency of the implementation of strategic energy plans or the legitimacy of new development projects. In fact, a common criticism has been the lack of legitimacy even in co-creation processes due to the involvement of mainly industrial actors (Hendriks, 2008, 2009).
4. Most studies on co-creation have been conducted in Western Europe while the feasibility of similar approaches elsewhere is largely unknown. As different regions and municipalities vary vastly in their degree of lock-in to fossil fuels and their renewable energy potentials as well as the tradition of democracy, experience of cross-sector collaboration and socio-economic conditions, it is uncertain whether co-creation would be an effective choice for governing renewable energy transitions in all regions and municipalities.

1.6. RESEARCH QUESTIONS AND STRUCTURE OF THE THESIS

The aim of this PhD thesis is to fill the aforementioned gaps by answering the following questions:

1. How can co-creation as a governance strategy of renewable energy transitions be conceptualized and assessed?;
2. How can co-created networks be institutionalized as new governance bodies?;
3. What is the effect of institutionalized co-creation on the implementation of regional and municipal energy plans?;
4. What is the effect of antecedent regional or municipal conditions on co-creation and its implementation?.

In the course of the PhD, I have written three research papers, two of which have been published in academic journals and one is currently under review.

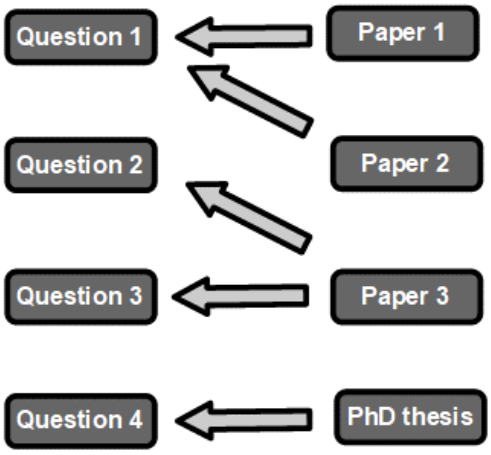

Figure 2. Relationship between research questions, papers and thesis.

The relationship between the research questions and the papers is the following (Figure 2). The first and second paper provide an answer to the first question. The third paper addresses the second and third questions. Finally, the thesis answers the fourth question by drawing on data from the second and third paper.

The thesis is structured as follows. Chapter 2 gives an overview of the research design, methodological choices and limitations. Chapter 3 presents the main findings of the research conducted for this thesis. Chapter 4 summarizes the contributions to existing knowledge and gives further recommendations for policymakers and researchers. The full texts of the three papers are included in the appendices.

CHAPTER 2. RESEARCH DESIGN, CASES AND METHODS

2.1. CASE STUDY AS RESEARCH DESIGN

The research conducted for this PhD thesis relies on three case studies. Case studies are in-depth, detailed examinations of a single phenomenon (or a small number of similar phenomena) within a real-world context. They are a preferred approach when the research focuses on a relatively new phenomenon that has not widely diffused in society nor been fully theorized yet; when the researcher has little control over the studied phenomena; and when the research questions start with “how”, i.e. are aimed at producing know-how for practical interventions (Yin, 2018). Since co-creation fits all the aforementioned criteria, I deemed the case study approach as the best for the purpose.

The PhD research is part of the MISTRAL (Multi-sectoral approaches to Innovative Skills Training for Renewable energy & sociAL acceptance) project funded from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions. The objective of the research as presented to the EU in the project proposal was to “explore new collaborative ways in which local values and interests can become part of the negotiation process in planning procedures, creating a space for influence and local empowerment” (Queen’s University Belfast, 2022). The initial idea was to follow co-creation between a wind farm developer, a local community and municipal government around one of the currently planned wind farms in Denmark. However, while doing the literature review, it became clear to me that co-creation is practiced also in strategic planning and spatial planning, not just in project development. This realization significantly broadened my choice of empirical evidence as I began mapping possible cases on all the different spatial scales and levels of planning in which I could study co-creation. Table 1 provides an overview of the cases that I mapped with the help of my supervisors.

Table 1. All possible cases considered during the PhD and eventually selected cases (marked with dark gray).

Spatial scale	Type of planning	Possible case
Regional	**Strategic energy plan**	**Ida-Virumaa**
	Citizens’ climate and energy assembly	Ida-Virumaa or Tartu

Municipal	**Strategic energy plan**	**Sønderborg or Ringkøbing-Skjern**
	District heating policy	Tartu
Community	Wind farm development	Sønderborg or Ringkøbing-Skjern
	Energy efficient building renovation	Sønderborg or Tartu

2.2. CASE SELECTION

The cases that I actually ended up studying were selected on the basis of both strategic and pragmatic reasons. As the first case, I decided to follow the co-design of a regional renewable energy and energy efficiency plan in Ida-Virumaa, Estonia. A range of circumstances pushed me towards choosing this case. First, there was another PhD student in my office at the Technical University of Denmark who had begun studying co-creation in a wind farm development process just before me (see Gjørtler Elkjær, 2022). As I wished to complement rather than copy what she was already doing, I decided to focus on co-creation in strategic planning on the regional scale instead of co-creation in project development on the community scale. Second, my previous research on the history of the energy transition in Estonia (Sillak & Kanger, 2020) meant that the strategic level was more familiar to me than the community level. From my previous work I also had a hunch that several aspects of co-creation in strategic planning had not been fully explored yet and needed to be studied further.

Third, six months into my PhD, the COVID-19 pandemic started and I moved temporarily back from Denmark to Estonia. I decided to use this unexpected disruption of my work as an opportunity to do my external stay at the Estonian Green Movement (Friends of the Earth Estonia). Coincidentally, the Estonian Green Movement was just about to initiate the co-design process in Ida-Virumaa and it provided a perfect case for my research (see below). Lastly, I was already relatively familiar with the context of Ida-Virumaa because of my previous research and the new case also happened to be a perfect continuation of my last research paper in which I recommended the local government in Ida-Virumaa to develop a regional energy transition plan. Strategically, the case also fit the purpose because it was a crucial (Gerring, 2007) or critical (Flyvbjerg, 2006) case, meaning that the context did not provide especially favorable conditions for co-creation (see more below). The reasoning behind the case selection was that if co-creation can be shown to be successful in the case where it is least likely to, it will probably also succeed in other contexts.

In 2021, the COVID-19 restrictions were finally lifted and I could return to Denmark on a more permanent basis. This enabled me to turn my attention

to some Danish cases the exploration of which I had postponed because of COVID. After having studied the co-design of an energy plan in Ida-Virumaa, my focus turned more to the implementation phase. As the second case, I therefore decided to choose the co-implementation of a municipal climate neutrality plan in Sønderborg, Denmark. This case was provided to me by my supervisor who had arranged for the local NGO ProjectZero to be a partner in the MISTRAL project. However, as I had already done one single-case study and was well aware of its limitations, I wanted the second case study to be a multiple-case one.

Therefore, my supervisors helped me brainstorm other successful municipalities in Denmark that I could compare with Sønderborg, and we quickly came up with Ringkøbing-Skjern. The two cases fit well with the purpose of my research: first, because they are both revelatory cases (Yin, 2018), revealing success stories of co-creation being used to implement renewable energy and energy efficiency and significantly reduce CO_2 emissions on a municipal scale; and second, because they are most similar cases, being similar on nearly all aspects except for those I as a researcher was interested in studying (Gerring, 2006; Seawright & Gerring, 2008). Specifically, I wanted to see how, despite a fairly similar context and level of success, the differences in the institutional design and leadership of co-creation in the two municipalities had influenced the implementation of their strategic energy plans and the renewable energy transition as a whole.

2.3. CASES IN CONTEXT

One of the key reasons behind studying one case from Estonia and two cases from Denmark was also to explore how the differences in the national context between the two countries as well as the regional context within Denmark influence co-creation. Previous studies have shown that the development of energy systems is a highly path dependent process and is affected by the availability of local natural resources and raw materials, existing technological specialization and expertise, investment capacity and the financial commitment from industry, and local cultural narratives (Hansen et al., 2017; Karnøe & Garud, 2012; S. Sillak & Kanger, 2020; Simmie, 2012; Simmie et al., 2014). In addition, researchers of cross-sector collaboration have found that collaboration is heavily molded by antecedent conditions such as sector failure, the interdependence between stakeholders, existence of resources in non-governmental sectors to solve the issue, power and resource imbalances between stakeholders, prehistory of collaboration or conflict, the lure of alternative venues to proceed unilaterally, and a window of political opportunity to collaborate (Chris Ansell & Gash, 2008; Bryson et al., 2015; Bryson & Crosby, 2006; Thomson & Perry, 2006). Table 2 provides a short

comparison of some of the most significant differences in antecedent conditions between the three cases.

2.3.1. NATURAL RESOURCES AND INDUSTRIAL SPECIALIZATION

Since the beginning of the 20th century, Estonia's energy system has been centered around oil shale, a local fossil resource almost all of which is extracted and processed in the Ida-Virumaa region. Consequently, the country has become heavily reliant on the oil shale industry for energy security, while the region desperately needs the employment opportunities and tax revenue that the industry provides (Holmberg, 2008; Silver Sillak & Kanger, 2020). Although Ida-Virumaa is also rich in renewable resources such as biomass and wind, the development of wind farms has been forbidden in a large part of the region by the Ministry of Defense, because wind turbines would obstruct the functioning of aerial surveillance radars and other national defense systems (Whyte, 2022).

The three oil shale companies Eesti Energia, Viru Keemia Grupp, and Kiviõli Keemiatööstus have for decades been the backbone of the regional economy in Ida-Virumaa. The main fields of activity of the companies are oil shale mining and the production of electricity, heat, oil and chemicals. Following the adoption of the EU's climate neutrality strategy, the companies have had to make changes to their business strategies. However, oil shale as a resource will likely not be abandoned as production will just be reoriented towards the market of fine chemicals. For instance, Eesti Energia plans to stop producing electricity, heat and oil from oil shale by 2040, but at the same time significantly expand the production of oil shale based raw materials for the chemical industry (Eesti Energia, 2022).

Table 2. Comparison of antecedent conditions in Ida-Virumaa, Ringkøbing-Skjern and Sønderborg.

	Ida-Virumaa	**Ringkøbing-Skjern**	**Sønderborg**
Natural resources	Oil shale, onshore wind, (forest and non-forest) biomass	Onshore and offshore wind, (non-forest) biomass	Onshore and offshore wind, (non-forest) biomass
Industrial specialization	Oil shale mining; electricity, heat, oil and chemical	Wind turbine manufacturing (Vestas, Siemens Gamesa)	Industrial machinery and electronics manufacturing (Danfoss)

		production (Eesti Energia, Viru Keemia Grupp, Kiviõli Keemiatööstus)		
Political visions and goals	**National**	40% renewable electricity and 42% renewable energy by 2030	100% renewable electricity and 55% renewable energy by 2030; 100% renewable energy by 2050	
	Regional, municipal	No specific energy vision	100% renewable energy by 2020; fossil free by 2040	Climate neutral by 2029
GDP per capita	**National**	20 184 €	52 000 €	
	Regional	11 665 € (Ida-Virumaa)	46 020 € (Southern Denmark)	47 710 € (Central Denmark)
History of stakeholder collaboration in the energy sector		Disrupted by Soviet era and uncommon nowadays	Traditional and common in electricity and heat supply sectors	

The Danish energy system has historically relied on imported fuels, but after the energy crisis of the 1970s, Danish energy policy shifted towards the exploration of local oil and gas in the North Sea as well as the utilization of local renewable resources like wind and biomass (Hvelplund, 2011; Rüdiger, 2019). Denmark is currently the largest oil producer in the EU, although production has been in decline for the past 15 years and will be stopped altogether by 2050 at latest (see below). Large segments of the Danish oil and gas industry are highly concentrated around the cities of Esbjerg and Fredericia in Southern Denmark (Sperling et al., 2021). Rural and coastal municipalities like Ringkøbing-Skjern or Sønderborg, on the other hand, are abundant in wind and biomass resources, as wind energy can be generated there both onshore and offshore, and biogas can be produced from agricultural residues.

The lack of an existing local fossil fuel industry in Ringkøbing-Skjern and Sønderborg also creates more favorable conditions for the development of an alternative energy system than in Ida-Virumaa. The largest industrial enterprise in Ringkøbing-Skjern is Vestas, which has grown from a small steel company into the largest and most sustainable wind turbine manufacturer in the world. The second largest wind turbine manufacturer, Siemens Gamesa,

is also situated in the municipality. At the heart of Sønderborg's industry is Danfoss, a manufacturer of industrial machinery and electronics whose primary focus now is on providing more energy efficient technologies for other manufacturing industries as well as residential customers.

2.3.2. POLITICAL VISIONS AND GOALS

Political visions and goals on the national and regional scales are another key factor. According to the Estonian National Energy and Climate Plan (NECP) submitted to the European Commission in 2019, Estonia aims to achieve a 42% share of renewable energy in total final energy consumption and a 40% share of renewable electricity in electricity consumption by 2030 (Ministry of Economics Affairs and Communications of Estonia, 2019). There is no specific national target beyond that although the Estonian government has endorsed the EU's goal of climate neutrality by 2050 (Wright, 2019). In Ida-Virumaa, there is no regional vision for the energy industry or energy system at all, although the need for a vision has been regularly expressed in the media (Postimees, 2016).

In comparison, Denmark's NECP targets that 55% of the total final energy consumption will be produced from renewable energy by 2030, with renewable electricity providing more than 100% of electricity consumption by that time (Danish Ministry of Climate Energy and Utilities, 2019). In addition, a political decision to achieve 100% renewable energy supply in all sectors by 2050 was made in Denmark already back in 2012. This trajectory is further supported by the recent decision to stop all exploration for oil and gas in the Danish part of the North Sea by 2050 (Murray, 2020). The municipal vision in Ringkøbing-Skjern is to become 100% fossil free in all sectors already by 2040, which is even more ambitious than the national target. The vision in Sønderborg is to achieve CO_2-neutrality by 2029.

2.3.3. FINANCIAL CAPACITY OF NON-GOVERNMENTAL SECTORS

While political agreements provide a clarity for investors about the long-term direction of the economy, businesses and households in Denmark also have a relatively high capacity to actually invest in alternative technologies. This is indicated by an average gross national product (GDP) per capita of 52 000 €. The indicator's value does not fall much short of the national average in the Central Denmark region (where the Ringkøbing-Skjern municipality is located) and in the Southern Denmark region (which includes the Sønderborg municipality), amounting to slightly below 48 000 € and slightly above 46 000 € respectively (StatBank Denmark, 2022). In comparison, the average GDP per capita in Estonia is around 20 000 € and in the Ida-Virumaa region it is only a little over 11 000 €, which is only 57,8% of the national average

(Statistics Estonia, 2022). This puts a significant limit on what the private stakeholders can invest in the market, but also on what they can contribute in financial resources to co-creation, as the latter depends to a large extent on resource mobilization from outside the public sector.

2.3.4. HISTORY OF STAKEHOLDER COLLABORATION

Lastly, Danish municipalities can boast with a long history of collaboration between diverse stakeholders in the energy market. During the past 50 years, the Danish wind energy sector has grown from a few locally operated cooperatives to a large-scale and heavily regulated industry that nevertheless tries to maintain decentralized production and engage local communities (Gorroño-Albizu et al., 2019; Kirch Kirkegaard et al., 2020). In the heating sector, most district heating suppliers in Denmark are non-profit municipal companies or consumer owned cooperatives that prioritize an efficient heat supply at the lowest possible price for its owners. Collaboration has an even longer tradition in other sectors: for instance, Danish farmers were one of the first ones in Europe to form agricultural cooperatives. The active engagement of Danish citizens in decision making processes around a wide array of technical issues and the use of open debate and negotiation to achieve consensus have therefore become integral to the Danish culture (Joss, 1998).

There were also examples of cooperative electricity production and consumption in Estonia before World War II, but the Soviet era disrupted this tradition as voluntary cooperation was replaced with state-controlled collectivization. Since the fall of the Soviet Union, the energy sector in Estonia has remained centralized and monopolistic, with the state-owned Eesti Energia acting as the main producer of electricity and a limited amount of private companies dominating the heating market. Collaboration between government organizations and private developers has often been rocky. For instance, Eleon, the developer of the potentially largest new wind farm in Ida-Virumaa, has for years been engaged in a court battle with the government over the right to build the wind farm (Pulk, 2022). The largest existing platform of collaboration for stakeholders in the energy sector in Ida-Virumaa is the Ida-Viru Investment Agency (IVIA) that owns and develops five industrial and business parks in Ida-Virumaa. The collaboration in these parks has mostly revolved around utilizing the by-products of the oil shale industry such as mining residues, ash and, more recently, CO_2 through carbon capture and utilization.

2.4. DATA AND METHODS

The theoretical part of my research is primarily based on a critical narrative review presented in paper 1. A critical review goes beyond a mere description

of the literature and includes conceptual synthesis and innovation, often resulting in a new theoretical framework, model or a set of hypothesis (Grant & Booth, 2009). In this case, the review produced initial categories for a new theory of co-creation as well as a set of questions to guide further research and practice of co-creation (see Section 3.1.). The advantage of this review method is that it allows the reviewer more flexibility in choosing the literature and in interpreting and synthesizing the existing theories. This means that the reviewer needs to have an extensive and in-depth overview of the field as well as other related fields of work, and a well-developed skill of theoretical thinking, which is why this type of review is often performed by more established scholars. The main disadvantage of a critical narrative review is the relative lack of formal criteria for the search and synthesis of the literature that can resulted in a biased review. The specific reasons for choosing this review method are explained in Section 2.5.

The empirical research relied on qualitative methods due to the small quantity of the units of analysis (cases). I used a mix of qualitative methods and data that allowed for triangulation. Triangulation is the combination of methods for studying the same phenomenon with the purpose of increasing the validity of the research (Denzin, 2007). The first case study relied on participant observation as a primary source of data and semi-structured interviews as a secondary source. The advantage of participant observation is that it allows the researcher to get a real-life experience of the researched phenomenon and its context (Yin, 2018). The disadvantage is that it takes a lot of effort to write down what was observed and that observation can be very selective and open to subjective interpretation.

The second case study used semi-structured interviews as a primary source of data and publicly available documents (municipal energy plans and websites) as a secondary source. The advantage of documents is that they contain exact data and that they have not been created as a result of the case study, making them less prone to obtrusion from the researcher. The disadvantage is that the researcher is limited to the data that is contained in the documents and cannot obtain additional insights. The advantage of interviews, on the other hand, is that they are targeted and can provide specific insights that the researcher craves for, including thoughts and feelings that were not observed or written in documents.

The disadvantage of interview data is that it can suffer from poorly constructed questions and unprofessional interviewing technique. The emergent nature of a semi-structure intervew decreases the chances that other researchers could get the same information from a similar interview and therefore makes the data less reliable. This risk was minimized by carefully adhering to the interview plan and asking some questions multiple times if a satisfactory

answer had not been given. Interviews can also contain socially desired responses which reflect the impression that the interviewee wishes to communicate rather than what he or she actually thinks or feels, and therefore makes the data less valid. This risk was minimized by interviewing multiple people from different sectors and with different perspectives, and comparing the interview data with what was written in the documents.

2.5. LIMITATIONS

The research has several limitations. I will start with the limitations of the literature review and then move on to the case studies. As for the literature review, the decision to do a review that allowed a lot of flexibility in choosing the literature and included a large degree of conceptual synthesis was a bold choice and a demanding task for an early stage researcher. As a result, the review suffers from two weaknesses. First, my focus in the review was not solely on co-creation but on "collaborative approaches", which in hindsight was clearly too broad. I collected a rather diverse set of papers on co-creation, co-production, co-design, open innovation, grassroots innovation and social innovation with different empirical focuses ranging from renewable energy installation to building renovation and behavioural change programs and lumped them all together under the umbrella of "co-creation of the energy transition". By doing so, I probably consolidated the perception of co-creation as a "fuzzy" concept (Dudau et al., 2019). Part of the reason for doing so was that there was not much existing academic literature on co-creation at that time yet. However, I could have also included the large amount of non-academic "grey literature" on co-creation in the review. This would have been helpful as co-creation is a concept that has been invented and developed by practitioners.

Second, I might have overestimated my grasp of the existing literature as well as my skills for theory development. At the same time as I was doing my research, the theory of co-creation in the political sciences was growing very fast and new papers with important conclusions were being published constantly. This work was led by more experienced and knowledgeable scholars than me (e.g. Chris Ansell & Torfing, 2021). I did my best to keep up with their work throughout the three years and to integrate the initial theoretical building blocks that I came up with in paper 1 with the theoretical development done by other scholars. This synthesis is presented in Section 4.1 and it is up to the reader to judge whether I succeeded in the job or not.

The conclusions of the case studies are also limited. In the first case study I acted as a participant-as-observer: I was involved in the process both as an expert of Estonian Green Movement, providing input to the policy proposals, as well as a researcher of Aalborg University, making observations for the

case study. The dual role meant that I was deeply immersed in the case and it was therefore immensely difficult to distance myself from the research while writing paper 2. It was even more difficult to take a critical stance because some of the people who were facilitating the process or who were involved in it were my good colleagues or acquaintances. However, because I had a good relationship with them, we were able to have a fairly open conversation about the process and my research. One of the goals of the process was also to produce a report that summarized the lessons learned and suggestions for similar processes in the future. The facilitators were quite reflexive and self-critical while writing the report and gave a fairly honest judgement of the process which enabled me to reuse parts of the report in paper 2.

Another bias of the first case study resulted from the single case approach and the lack of comparative perspective which made it very difficult for me to judge the success of the process. This was part of the reason why I opted for a comparative perspective in the second case study. Contrary to the first case study, the main limitation of the second case study was the difficulty to gain an insider's perspective of the case. This was due to the selected method (interviews) and a lack of contextual knowledge as I was a foreigner. I selected interviews as the primary source of data because my time for doing another round of observational field work was very limited and also because there was no clearly delineated process to observe: the focus of the study was more on institutional change over a lengthy period of time. I was lucky to have two supervisors who had knowledge about the local context and who could inform me of the things that I had not understood or had misunderstood during our regular discussions about the two cases.

CHAPTER 3. FINDINGS AND DISCUSSION

3.1. TOWARDS A CONCEPTUAL MODEL FOR GUIDING AND ASSESSING CO-CREATION

Co-creation has been defined as a collaboration between two or more public and private actors to agree on common problems and design and implement innovative solutions (Chris Ansell & Torfing, 2021). Due to a lack of existing theory on co-creation at the time of starting the PhD, in the first two papers I focused on answering the question:

- how can co-creation as a governance strategy of renewable energy transitions be conceptualized and assessed?.

In Paper 1 (Appendix A), I reviewed the existing studies on co-creation and similar collaborative approaches in energy transitions research order to arrive at an understanding of how co-creation has been understood in strategic energy planning so far. Based on the review, I summarized preliminary findings about the phases of co-creation, the involvement of actors, the activities it includes, and its outputs and outcomes. The findings can be used to generate new questions for research or questions for guiding and assessing co-creation processes in practice (Boxes 1-3).

3.1.1. INVOLVEMENT OF ACTORS AND THEIR ROLES

Co-creation can involve state, market, third sector and community actors. They can be distinguished on the basis of whether they are formal or informal, private or public, for-profit or non-profit (Avelino & Wittmayer, 2016). Governmental actors are formal, (usually) non-profit, and public organizations; market actors are for-profit and private; third sector actors are non-profit and can be both public and private; and community actors are also non-profit but often informal (unorganized). In between these four categories lie a variety of combined organizational forms like public-private partnerships, state-owned businesses and social enterprises. It is useful to distinguish between these four “sectors” based on the three variables because the actors differ in their access to planning processes, their motivation to participate, and their power to influence outcomes. For instance, previous studies on energy transition governance have documented the inclusion of formal state and market actors (such as the “triple helix” of industrial, governmental and academic

organizations) at the expense of informal and non-profit actors (such as ordinary citizens from local communities).

Co-creation also changes the entrenched role division between actors. Public planning processes commonly convened, led and facilitated by politicians or public administrators can, in the context of co-creation, be initiated and led by private or third sector organizations. This can make a lot of sense in cases where the private or third sector has more motivation to initiate a process or holds better skills to facilitate it. In addition, unorganized or marginalized citizens and communities might feel more comfortable joining or following a co-creation process led and facilitated by actors from other sectors in cases where the government does not enjoy high legitimacy within the community. The public sector may choose to join the process as active co-creators (Chris Ansell & Torfing, 2021) or as encouragers or sponsors who provide the necessary (financial, organizational, moral or other) resources to support collaboration (Bryson & Crosby, 2006; Scott & Thomas, 2017). The changes in roles break down and flatten existing power relations by turning “governors” and “subjects” into strategic partners.

Box 1. Questions to guide and assess the involvement of actors in co-creation.

Which actors have been involved in which phases and in which roles?
To what extent have entrenched roles and power relations changed?

3.1.2. PHASES OF CO-CREATION

Co-creation is usually divided into the initiation, design, and implementation phases. In other sectors, co-creation has become most popular in the implementation phase where citizens have often been engaged as co-producers of services (Voorberg, Bekkers, and Tummers 2015). For instance, customers of waste management service providers are responsible for sorting their own waste and thereby contributing to recycling. In the energy sector, a reverse trend is apparent. Various stakeholders and citizens are more and more involved in the early phases of building energy visions and creating energy plans, while the implementation of the particular projects and services in these plans has largely remained the responsibility of governments or private developers. However, in the smart energy system citizens will need to take on a more active role as co-implementers of energy services and projects.

On one hand, research from other sectors suggests that active participation in the implementation of services is strongly linked to the ability to have a say in the design of these services (Christopher Ansell et al., 2017; Sørensen &

Torfing, 2021). In other words, if collaborative implementation is to succeed then it should start already with collaboration in the design (or possibly even initiation) phase. On the other hand, existing research also shows that the move from the co-design of energy plans to their co-implementation can prove to be very tricky because of "the stakeholders' diverging motivation, cultural background and methods of (co-)operation, unequal degrees of power, the lack of well-defined bureaucratic rules and procedures for collaboration, an unclear division of roles, distributional conflicts about who pays the costs and who reaps the benefits, struggles with assigning responsibility and holding to account, and difficulties with measurement and evaluation in ambiguous contexts" (Sillak & Vasser, 2022).

3.1.3. ACTIVITIES DURING THE PROCESS

In paper 1, I found that there are activities that can help alleviate some of these problems and that co-creation enables to perform. Among these activities are the articulation and alignment of expectations, social learning, resource mobilization, and developmental evaluation. In paper 2, I used data from an empirical case study and combined it with additional insights from sociological literature to describe these activities more in detail and to assess their usefulness.

Box 2. Questions to guide and assess the activities done during co-creation.

To what extent have participants articulated their expectations, and (how) has alignment been reached?
To what extent has single-, double- and triple-loop learning taken place?
To what extent and how have collective resources been mobilized?
To what extent and how has development been evaluated and supported?
To what extent and how has accountability been established?

Expectations can be defined as beliefs or hopes about the future (van Lente, 2012). They can include expectations for the process and its facilitation as well as for its short-term outputs and long-term outcomes. Expectations for outputs and outcomes can be more or less general, ranging from specific expectations about the feasibility of certain technologies or projects in particular areas, to generalized expectations about the scalability of a technology or a technological system or the function that it can fulfil in the local community or society (also called socio-technical visions or frames) (Ruef & Markard, 2010). Furthermore, expectations can be categorized according to their priority: there are things that must necessarily happen, that will probably happen, that should hopefully happen, and that could ideally happen (Olkkonen & Luoma-aho, 2014). The trick is that expectations are very difficult

to be managed, aligned and realized unless the participants are allowed and encouraged to clearly express them in the process.

Social learning is defined as a change in understanding that occurs through social interaction and goes beyond the individuals involved to become situated within wider groups or institutions within society (Reed et al., 2010). Learning can range from “surface level knowledge of alternative solutions to the same problem (single-loop learning), to the re-framing of a problem and its context (double-loop learning) or even the reconsideration of what is understood as valuable knowledge (triple-loop learning)” (Sillak & Vasser, 2022). Learning is supported by developmental evaluation in which the evaluator becomes part of the design team from the start, intervenes with evaluative questions and data, and facilitates discussion about how to simultaneously develop and evaluate the outputs and outcomes (Patton, 2011; Patton et al., 2016). This is helpful in settings where the process, goals, outputs and outcomes are emergent and changing rather than predetermined and fixed.

Resource mobilization occurs when assets that could contribute to solving public problems, but that are dispersed in different sectors, are pooled into collective ones with a greater effect than before. Five types of resources can be mobilized: material, human, organizational, cultural and moral resources (Edwards et al., 2019; Edwards & McCarthy, 2004). These resources can be mobilized in four different ways: self-production, aggregation, co-optation and patronage (Edwards et al., 2019; Edwards & McCarthy, 2004). By mobilizing the experiences, ideas, skills and funds of involved stakeholders, co-creation tends to enhance public value (Chris Ansell & Torfing, 2021).

The findings from paper 3 revealed another activity that is essential, especially in the implementation phase: establishing social accountability. It refers to forums of process participants, stakeholders and citizens who have access to information about the process, are able to scrutinize it, establish incentives or sanctions, and call for more action. Incentives for participants can include the opportunity to increase local benefits for their organization or the community, or simply the joy of collaboration, deliberation and learning. Sanctions can include “naming and shaming”, the replacement of participants, the change of leadership roles or even the termination of the whole co-creation process. Holding the participants to account enables to avoid the implementation of bad decisions and correct mistakes or enforce the implementation of good decisions and accelerate progress.

Box 3. Questions to guide and assess the outputs and outcomes of co-creation.

To what extent have existing plans or policies been improved? To what extent has the implementation of projects or services improved? Has the process been more time or cost efficient? Have new relationships and networks emerged or the existing ones strengthened? Has there been a change in existing institutions? Has the acceptability (legitimacy) of the process and its outcomes been improved in the eyes of political and market stakeholders or communities?

3.1.4. OUTPUTS AND OUTCOMES

Co-creation of strategic energy plans can result in more ambitious plans and policies; more effectively and efficiently implemented projects; stronger relationships and networks built during the process; and improved acceptability (legitimacy) of the plans, projects, and the renewable energy transition as a whole. It is useful to be aware of the range of possible goals and the different outputs and outcomes that these might lead to in order to organize the process more strategically.

In paper 2 (Appendix B), I followed a renewable energy and energy efficiency policy co-design experiment in the region of Ida-Virumaa in Estonia historically dominated by the oil shale industry, and assessed it based on the aforementioned criteria. I present the findings from this case study in Section 3.2. In addition to confirming the findings already presented in paper 1, I also discovered that the institutionalization and leadership of co-creation (or the lack of these) as well as antecedent regional conditions can have a big influence on the effectiveness of co-creation, especially in the implementation phase. The role of these factors will be discussed in Sections 3.3 and 3.4 of this thesis (which in turn draw on paper 3 in Appendix C). The findings from the three papers as well as additional research that was published by established scholars of co-creation during my PhD were synthesized into a model of co-creation that I present in Section 4.

3.2. CO-DESIGN OF AN ENERGY PLAN: INVOLVEMENT, ACTIVITIES, OUTPUTS AND OUTCOMES IN IDA-VIRUMAA

As mentioned above, in paper 2 I focused on how the initiation and design phases of one specific co-creation process in a specific setting were organized and executed. In particular, I studied how actors were recruited and involved in the policy co-design[2] experiment; how expectation alignment, social

[2] Hereon I use the term ”co-design” to refer to the initiation and design phases of the co-creation process.

learning, resource mobilization, and developmental evaluation were facilitated; and how this influenced the outputs and outcomes.

3.2.1. ROLES OF GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS, BUSINESSES AND THE COMMUNITY

The co-design experiment involved 10 nongovernmental organizations (including environmental organizations and energy and clean-tech consultancies), 11 governmental organizations (including municipal governments, national ministries, and universities), 15 private enterprises (including renewable energy companies and their associations), and 27 non-organized local community members. The participants were carefully chosen so that all of the aforementioned actor segments would be more or less equally represented while also prioritizing actors with the most interest in and influence on the renewable energy transition in the region. Most of the actors were present throughout the initiation (introductory meeting and vision-building workshops) and design (two policy design workshops and two extended network meetings) phases (Table 3).

As for roles, there was a shake-up of the conventional role division. The Association of Ida-Virumaa Municipalities (IVOL) and the Ida-Viru Enterprise Center (IVEK) who are usually responsible for creating regional development plans decided this time to delegate the creation of the renewable energy and energy efficiency policy proposals (also called the “green plan” or “plan G”) to a consortium of three environmental organizations (Estonian Fund for Nature, Estonian Green Movement, and Environmental Law Center). They in turn commissioned a consortium of social enterprises (DD StratLab, Social Innovation Lab and Institute of Baltic Studies) to facilitate the process. On one hand, these moves elevated the aforementioned third sector organizations from ones that are simply consulted with to (almost) equal partners. On the other hand, some of the municipal, regional and national government organizations did not interpret this as an opportunity for themselves to participate as co-creators in the process but instead decided to maintain a distance or opt out completely. Similarly, the large oil shale companies in the region who are used to advocate and lobby for their goals through different avenues were absent from the main part of the process. The evidence therefore shows that some actors embraced the change of roles more easily than others.

Table 3. Number of different organizations involved in the co-design experiment in Ida-Virumaa.

	Whole process	Introductory meeting	Vision-building workshop	Policy design workshops	Extended network meetings[3]
Third sector	10	9	7	7	9
State	11	6	5	5	10
Market	15	11	8	7	9
Total	36	26	20	19	28

3.2.2. THE (UNUSED) POTENTIAL OF EXPECTATION ALIGNMENT AND RESOURCE MOBILIZATION

The articulation and alignment of expectations and the mobilization of diverse resources were the activities that contributed most to the co-design process. In the introductory meeting, the facilitators invited the participants to share their expectations (and doubts or fears) for the co-creation process, for its outputs and outcomes, and for the role of the facilitators (Table 4). The expectations ranged from what must necessarily happen and what will likely happen to what could ideally happen. This provided an indication for the facilitators about to what extent they should try to change the preconceived arrangements or try to persuade the participants to alter their expectations. It was agreed the expectation that must be fulfilled (i.e. the bare minimum) was the delivery of the policy proposals in a timely manner. However, the expectation that was interpreted as most likely to happen and not previously foreseen by the facilitators was that the time schedule was too demanding (the meetings were too long) and would probably lead to a fallout of participants and hence jeopardize the whole process. The facilitators therefore decided to significantly shorten the meetings in the co-creation process, meaning of course that some activities had to be cut and some other expectations about what could ideally happen would not be fulfilled. Among the latter were the development of a sustained collaboration network between participants that would enable to deliver more than just proposals and demands for government policies but to some “hands-on” results such as new joint projects.

Table 4. Expectations of actors for the co-design experiment in Ida-Virumaa.

[3] In addition, 27 non-organized local community members were involved in the extended network meetings.

	Expectations for process	Expectations for outputs and outcomes	Expectations for leadership and facilitation
Necessary (must happen)	Useful new contacts	Ambitious and optimistic policy proposals delivered in time	Time efficient schedule
	Engagement of local stakeholders		Burden of facilitation not placed on participants
Probable (will happen)	Too demanding time schedule, leading to a fallout of participants	Additional advocacy needed to communicate proposals to decision makers	Flexible facilitation due to unforeseen changes to time schedule and activities
	Influential local stakeholders underrepresented		
	Excessive consensus, no challenging disagreements		
Hopeful (should happen)	Fruitful disagreement and debate	Policy or project proposals that would actually be implemented	Coordination with other ongoing planning processes
	Co-creation of new knowledge		
Ideal (could happen)	Sustained collaboration between participants	"Hands-on" results (more than just proposals)	Development of a network with clear leadership roles

Sector-specific visions of actors for the region were another type of expectations the articulation and alignment of which was facilitated during the co-creation process. This was done in the vision-building workshop in which the participants were asked what they would like to have happened in Ida-Virumaa by 2030 as a result of the green plan (Figure 3). In other words, the visions can be seen as the long-term outcomes that the outputs of the process, i.e. the proposals in the green plan, should or could ideally lead to. The visions included ideas for the development of specific technologies or projects as well as for the wider role of these technologies and technological systems in the local communities: "(1) world-class renewable energy research and education; (2) systemic policy instruments for households in transition; (3) greater local energy security; (4) green laboratories; (5) no electricity generation from oil shale; (6) improved social and ecological well-being; (7) green and successful communities; (8) green transformation of local

government; (9) green transformation of industry; and (10) a new narrative for Ida-Virumaa" (Sillak & Vasser, 2022).

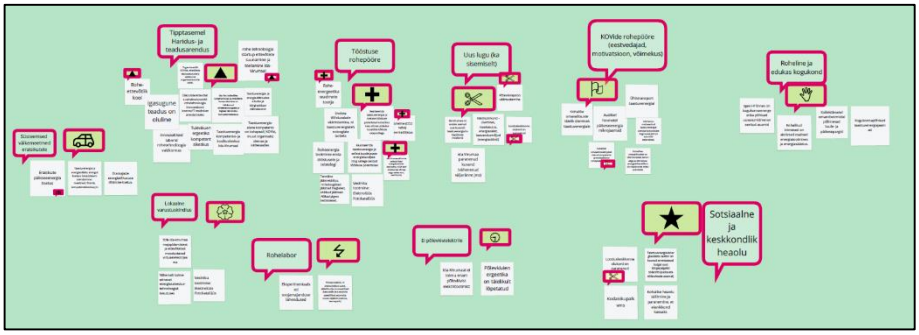

Figure 3. Collective vision of actors for the Ida-Virumaa region by 2030.

The mobilization of dispersed and untapped resources is a key advantage of co-creation in comparison to conventional policy processes. In this regard, the process succeeded in the aggregation of human, organizational and moral resources (expertise, relationships, legitimacy), and the initiators were also fortunate to receive material, organizational and moral patronage (financial grant, political authority) from some influential stakeholders. Still, the process fell short of producing new resources other than the creation of ideas for policies and the promotion of a new narrative for the region (Table 5). Additional financial assets are yet to be unlocked, nor have any significant organizational or institutional changes occurred as a result of the process. We found two reasons for this shortfall. One of the reasons can be traced back to expectation management, during which it was decided to focus on delivering the proposals at the expense of producing more "hands-on" results. The other reason is the shortage of local resources such as investment capacity, renewable energy expertise, and motivated community leaders in the region. The facilitators tried to alleviate the issue by mobilizing outside experts, which resulted in there being more non-local than local people involved in the process. While this solution helped bring on board additional expertise, it did not solve the problem of local leadership.

Table 5. Resource mobilization in the co-design experiment in Ida-Virumaa.

	Self-production	Aggregation	Co-optation	Patronage
Material				Using grant money from European Climate Initiative to hire facilitators
Human	Creating new knowledge about policies and projects that could be implemented	Mobilizing a diverse set of expertise from all sectors		
Organizational		Building a network and establishing new ties	Using the organizations with most existing ties to recruit others	Integrating the results into the regional development plan by IVOL and IVEK
Cultural	Promoting renewable energy as a new narrative for Ida-Virumaa			Drawing on the belief of environmental organizations and renewable energy companies in accelerating the transition in Ida-Virumaa
Moral		Increasing the legitimacy of and optimism towards the renewable energy transition		Receiving the authority and encouragement from IVEL and IVOK to organize and carry out the co-design experiment

In addition, I looked at whether and how social learning and developmental evaluation were organized. I found that learning and evaluation went hand in hand: evaluation tools and questions were used to facilitate learning among the participants which in turn helped develop the outcomes of the process. In the first policy design workshop, an initial set of policy proposals was brainstormed and selected. The facilitators then prepared a worksheet for the participants to preliminarily evaluate the expected impacts of their proposals. In the second policy design workshop, the filled worksheets were discussed and reviewed one by one. The facilitators guided the discussion with questions like “what exactly is being developed here?”, “in what settings has it already been implemented and tested?”, “what kind of indicators would be appropriate for evaluating its impact?”, “is there any evidence of its effectiveness and is it transferable?”. In other words, the evaluation worksheets and questions were used as tools for mobilizing the participants' knowledge and for organizing learning in the group.

3.2.3. AMBITIOUS PLAN, BUT IS THAT IT?

Table 6 provides an overview of the main outputs of the process: the developed proposals to be included in the green plan, categorized according to the themes of the parallel policy design workshops (columns) and the types of outputs (rows). Proposals for policies to be implemented by national or municipal governments were by far the most popular ones, while ideas for wider institutional changes or joint projects directly involving more than the public sector were relatively few. The evidence confirms that although the policy co-design experiment generated new ideas, it did not succeed in fully transforming the existing role division between the public sector (as policy implementers) and the other sectors (as simply advocates or consultants), nor did it succeed in creating a sustained collaboration between participants that would continue in the co-implementation of the proposals. The reason again lies in the fact that the development of new roles and institutional arrangements was deprioritized due to time restrictions.

Table 6. Overview of developed proposals for the green plan in Ida-Virumaa.

	Wind energy	Solar energy	Energy efficiency	Energy storage	General

<table>
<tr><td rowspan="4">Policies</td><td>Introducing a subsidy for creating citizens' energy co-ops</td><td>Introducing state-guaranteed financial instruments for SMEs and local governments to invest in solar energy projects</td><td rowspan="4">Changing the building policy by redirecting renovation grants to Ida-Virumaa and simplifying the grant application process</td><td rowspan="4">Introducing a subsidy for commercial energy storage projects (TRL 9) and accelerating the authorization of these projects</td><td>Making climate objectives binding for governments on all levels</td></tr>
<tr><td>Introducing a community benefit scheme for wind farms</td><td>Improving access to capital for households and communities to start solar energy projects</td><td rowspan="3">Developing a retraining program for former middle managers and technical laborers from the oil shale sector for moving into the renewable energy sector</td></tr>
<tr><td>Removing "phantom" grid connections</td><td rowspan="2">Promoting multi-functional land use through agrivoltaics</td></tr>
<tr><td>Making new areas available for wind energy production</td></tr>
<tr><td>Institutional changes</td><td></td><td></td><td></td><td rowspan="2">Launching consortia that include stakeholders from the whole value chain for carrying out energy storage pilot projects (TRL 6–8)</td><td>Establishing a renewable energy and green transition research center</td></tr>
<tr><td>Technology projects</td><td></td><td></td><td>Developing a residential district as an energy efficiency demonstration area</td><td>Establishing a regional energy agency</td></tr>
</table>

			Implementing 4th generation district heating		
Other					Promoting renewable energy as a new narrative for Ida-Virumaa

3.3. FROM CO-DESIGN TO CO-IMPLEMENTATION: INSTITUTIONALIZED LEADERSHIP IN RINGKØBING-SKJERN AND SØNDERBORG

In paper 2 I show that it is relatively easy to co-design energy policy and operationalize it as a strategic energy plan. However, "it is much more challenging to co-create a strong network of committed actors with clear roles in the implementation of these policies and plans" (Sillak & Vasser, 2022). It became apparent that the co-design of energy plans does not guarantee a swift implementation unless the collaboration is institutionalized in the organizational structure.

This finding pointed towards the importance of institutional design and leadership of co-creation and opened up new research questions for paper 3:

- how can co-created networks be institutionalized as new governance bodies?;
- what is the effect of institutionalized co-creation on the implementation of regional and municipal energy plans?.

I define institutional design as the establishment of permanent rules, procedures, and organizational structures that create the space for co-creation to be initiated, developed and sustained (Ansell & Torfing, 2021). I define leadership in this context as the distribution and enactment of roles between individuals or organizations who initiate, develop and sustain co-creation (Ansell & Torfing, 2021).

3.3.1. THREE TYPES OF INSTITUTIONAL DESIGN AND LEADERSHIP

In the co-design experiment in paper 2, three avenues for institutionalizing the network that co-designed the green plan were briefly discussed (although the question ultimately remained unsolved): 1) continuation of collaboration in a project-based or *ad hoc* manner; 2) delegation of leadership and coordination

responsibility to one of the participants or another existing organization; 3) institutionalization of the network as a new governance body based on a partnership agreement between the participants. These options roughly correspond to the three most popular ways of institutionalizing governance networks described in the existing literature: 1) participant governed networks in which the actors collectively steer the implementation with no separate and unique governance entity, 2) lead organization governed networks in which implementation is coordinated through and by a single participating actor (e.g. municipal administration), acting as a lead organization, and 3) network administrative organizations in which a separate administrative entity is set up specifically to steer implementation (Provan & Kenis, 2008).

Paper 2 already showed that the first option of an unbrokered and fully participant governed network is unlikely to be effective in the implementation phase because of the excessive fluidity of roles, lack of motivation or capacity to take the leadership role, and the sheer technical and organizational complexity of the tasks at hand. Hence for paper 3 I selected two cases which could illuminate the potential of the other two types of institutional design, with Ringkøbing-Skjern hosting a municipality-led network and Sønderborg having established a separate network administrative organization. The participants in the networks share the responsibility for co-producing the outputs of the strategic energy plans that they have collectively designed.

The Ringkøbing-Skjern municipal council established a network called the Energy Council (recently renamed to Climate Council) to help with the implementation of the Energi2020 vision. It consists of 25 members, including representatives of local energy and utility companies, local businesses, housing associations and non-governmental organizations, that have an interest in the energy transition and are able to contribute with unique expertise. The Climate Council is chaired by a member of the Ringkøbing-Skjern municipal council and the daily work is facilitated and coordinated by a department of the municipal administration called the Energy Secretariat (recently renamed to Climate Secretariat).

In Sønderborg, a public-private partnership called ProjectZero was established between the Sønderborg municipal government, local manufacturing and utility companies, and private foundations investing in regional development. It consists of the ProjectZero Foundation that sets the vision, lays out the key strategic issues and funds the daily operation of the ProjectZero A/S, a joint-stock company that employs the ProjectZero CEO and a Secretariat of five to ten people who are responsible for turning strategy into activities and following up on progress.

3.3.2. MUNICIPAL-LED NETWORK AND NETWORK ADMINISTRATIVE ORGANIZATION

My analysis in paper 3 showed that there are significant differences in the institutional design in the two municipalities (Table 7). First, the Energi2020 network in Ringkøbing-Skjern is not a legal entity but an informal council led by the municipal administration, meaning that its institutional design is quite flexible (Sillak, 2022). The network administrative organization in Sønderborg, on the other hand, consists of two new legal entities, the ProjectZero Foundation and ProjectZero A/S, and this makes its organizational structure more rigid. Second, the network administrative organization in Sønderborg is less prone to avert from its direction due to political change because it is not directly controlled by the municipal council. In Sønderborg, the network would provide a platform for arguing and making joint decisions over private sector investments even in the case of an unfavorable political environment, while the municipality-led network in Ringkøbing-Skjern could be terminated if the political direction of the municipal council should change.

Table 7. Comparison of the institutional design of governance networks in Ringkøbing-Skjern and Sønderborg (Sillak, 2022).

	Ringkøbing-Skjern	**Sønderborg**
Led by	Municipal administration	Network administrative organization
Legal status	None	Non-profit foundation and joint stock company
Institutional design	Flexible and informal	Rigid and formal
Political control	Controlled by municipal council	Controlled by network members
Funding	Excluding private donations	Including private donations
Access to non-financial municipal resources	Not limited	Limited

The differences in institutional design and in the role of the municipal government in the two networks also affect their ability to mobilize resources (Sillak, 2022). The municipality-led network in Ringkøbing-Skjern is able to draw on municipal resources such as financial means as well as the expertise of the administrative staff, but it cannot accept private donations to finance its activities (Table 7). The network administrative organization is able to attract private funding, as ProjectZero does by relying on regular contributions from its large stakeholders, but has less access to municipal know-how.

Interestingly, institutional design is also reflected in the energy plans (see Appendix C). In Ringkøbing-Skjern, the energy plan represents general expectations of the participants for the local energy system in the future and does not rely on detailed technical analysis (Sillak, 2022). In this way, it is more similar to the green plan in Ida-Virumaa than the energy plan in Sønderborg. The latter is a rather detailed step-by-step roadmap based on a technical energy system model by Drysdale et al. (2019) and additional calculations done by the Boston Consulting Group (ProjectZero, 2021b). Consequently, there is a lot of flexibility inscribed in the energy plan in Ringkøbing-Skjern and the outputs (specific projects) are co-produced emergently in the implementation phase. In Sønderborg, most of the large projects are pre-decided upon in the design phase of the plan and significant changes can be made only through the re-design of the plan.

3.3.3. DIFFERENT WAYS TO LEGITIMIZE THE TRANSITION

The feasibility of the renewable energy transition depends also to a large extent on its acceptability or legitimacy in the eyes of local businesses and industries, politicians, local communities and the general public. While the legitimacy of individual renewable energy projects such as wind farms has been thoroughly analyzed for several decades, the full transformation on energy systems is yet to become an object of research (Wolsink, 2019). This is why I started writing another paper as a spin-off of paper 3 with the aim of focusing specifically on how the transition has been legitimized in Ringkøbing-Skjern and Sønderborg. The writing of the paper is still in progress and I cannot offer a full analysis here yet, but I can draw some preliminary conclusions as the topic is relevant. For instance, it is already clear that the legitimization of the two networks and subsequently of the energy transition as a whole has been approached differently in the two municipalities.

In Ringkøbing-Skjern, legitimacy is created through the flexibility of the network and the energy plan, which leave room for new participants to be included and a wide range of alternatives to be pursued and negotiated. This makes the network more responsive to the expressed wishes of stakeholders and citizens and increases legitimacy in the eyes of the wider community. In addition, political legitimacy is established by the municipal government's leadership role in the network as they have been granted a mandate by the citizens in the elections to decide over the long term development of the municipality.

In Sønderborg, leadership of the network by private businesses such as Danfoss creates legitimacy among other market stakeholders, evidenced by the private funding behind ProjectZero. However, it can erode political and community legitimacy as a network led by business stakeholders might not be

regarded as legitimate in the eyes of the political parties or the wider community. The problem is exacerbated by the rigid nature of the network and the energy plan which means that when compromises around the implementation of specific projects have to be negotiated with the local community, the network is limited in its responsiveness to their wishes by the pre-defined scope.

3.3.4. IMPLEMENTATION OF ENERGY ACTIONS IN THE TWO MUNICIPALITIES

The diverging institutional designs together with the different antecedent conditions (See also Section 2.3 and 3.4) have pushed the energy transition in the two municipalities in two different, although relatively successful paths (Sillak, 2022). Ringkøbing-Skjern has been more successful in increasing renewable energy capacity (especially wind farms and biogas production facilities) and has achieved a 71% share of renewables in the local energy mix. The installation of wind farms has been driven primarily by the local companies Vestas and Siemens Gamesa. At the same time, energy consumption has also increased by 19% as renewable energy production has added to instead of replacing fossil fuel consumption (Figure 4). Still, CO_2 emissions in Ringkøbing-Skjern have decreased by 82% since 2007.

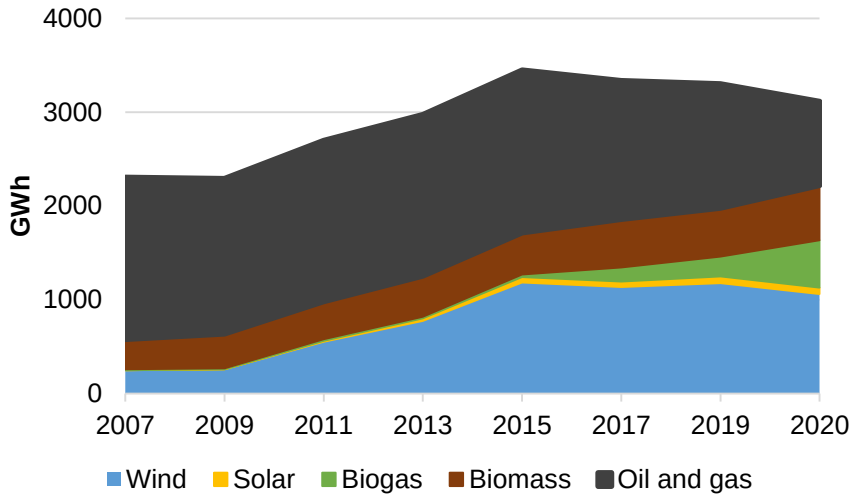

Figure 4. Development of annual energy consumption in Ringkøbing-Skjern. **Source:** (Ringkøbing-Skjern Kommune, 2020).

Sønderborg, on the contrary, has been significantly more successful in improving energy efficiency in buildings and in industry, and through sector coupling, which has resulted in a 17% decrease in energy consumption since

2007. The technologies for increasing energy efficiency have largely been provided by the local company Danfoss. However, renewable energy installation is lagging behind in with a share of 17% renewables in the local energy mix. The main reason for this has been the resistance from the local community to wind farms and biogas plants which can partly be traced back to the business-oriented and rigid setup of the governance network and the energy plan. Consequently, CO_2 emissions in Sønderborg have decreased by 52% since 2007.

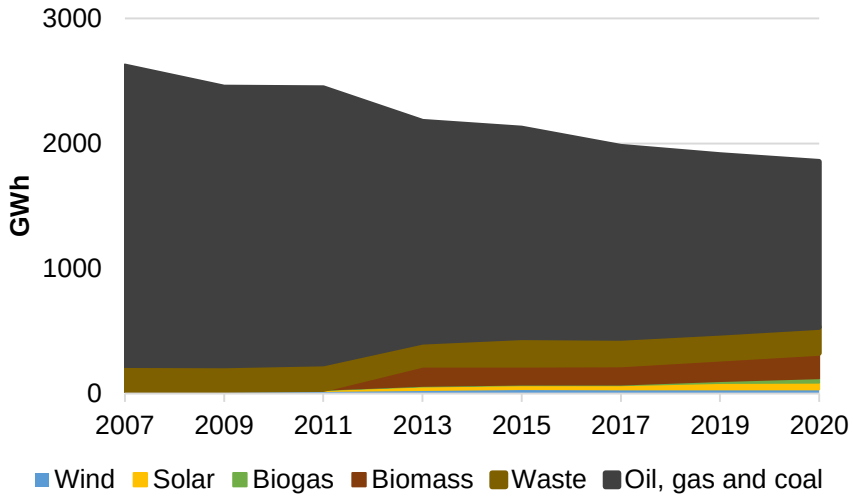

Figure 5. Development of annual energy consumption in Sønderborg. **Source:** (ProjectZero, 2021a).

Since the transition to a future smart energy system depends on the roll-out of renewable energy as well as the improvement of energy efficiency and sector coupling, the approaches of the two municipalities should be combined in order to achieve the transition (Sillak, 2022). I suggest that Ringkøbing-Skjern start focusing more on energy efficiency in the local industry based on technical and economic analysis and improved co-creation with the business stakeholders. I also suggest that Sønderborg start addressing more the engagement of local residents and communities living in the vicinity of future wind farms and biogas production facilities in order to increase the legitimacy of their erection.

3.4. THE CURSE OF ANTECEDENT CONDITIONS: PATH DEPENDENCE IN IDA-VIRUMAA, RINGKØBING-SKJERN AND SØNDERBORG

The cases of Ringkøbing-Skjern and Sønderborg allow for a good comparison with Ida-Virumaa. On one hand, the design of strategic energy plans in all three cases was a collaborative effort involving 50–100 people. On the other hand, many of the same people that were involved in the design of the plans in Ringkøbing-Skjern and Sønderborg were later also involved in their implementation through the institutionalized governance networks, while this does not seem to be the case in Ida-Virumaa (at least according to early evidence). This difference in the outcomes of similar processes begs the question: why did co-design lead to co-implementation and institutionalized collaboration in Ringkøbing-Skjern and Sønderborg, but not yet in Ida-Virumaa? Although some of it can be explained by the set-up of the co-creation process described in Section 3.2., there is also reason to believe that part of the answer lies in antecedent regional and municipal conditions. The question can therefore be rephrased in more general terms:

- what is the effect of antecedent regional or municipal conditions on co-creation and its implementation?.

Diverse antecedent conditions have influenced co-creation in the three cases. These conditions include the availability of local natural resources, industrial specialization, political visions and goals, capacity of non-governmental sectors and history of collaboration (see Section 2.3). In Ringkøbing-Skjern and Sønderborg, there has been no oil or gas extraction that would contribute significantly to the local economy, while renewable energy offers significant opportunities for economic development. In addition, the Danish government has provided a political opportunity for these resources to be utilized by setting a long-term target of 100% renewable energy supply by 2050. For Ringkøbing-Skjern, this has provided an opportunity to build on the already existing local wind energy industry, which hosts two of the largest wind turbine manufacturers in the world: Vestas and Siemens Gamesa. Hence, the technology, labour and expertise needed for the energy transition is locally supplied, which is a major advantage for the municipality.

In Sønderborg, there was no wind turbine industry, but there was a large local manufacturing company Danfoss who provided machinery and equipment for other industries. The opening of the political window provided by the government with the 2050 target was seized as an opportunity by Danfoss to reinvent itself and diversify towards a new market by focusing on producing machinery and electronics for organizations interested in decarbonization and electrification. In addition, Danfoss is a major funder of ProjectZero in

Sønderborg by providing yearly donations through the Bitten & Mads Clausen Foundation. The Bitten & Mads Clausen Foundation was established by the founders of Danfoss to support local communities and neighbourhoods and the regional development of Sønderborg, as well as projects within renewable energy and energy efficiency that advance the Danfoss vision. Thus, in both Ringkøbing-Skjern and Sønderborg, local companies have acted as major sponsors and encouragers of co-creation, either through direct or indirect financial support.

In Ida-Virumaa, the opportunities for the exploration of onshore and offshore wind are more limited, and the unavailability of wind resources along with the institutional lock-in to oil shale have significantly hampered the development of an alternative energy system and economy in the region. There has also been no significant support from the national or regional governments in terms of political visions or targets, and the lack of a vision for the regional energy system and energy industry has allowed the large oil shale companies Eesti Energia and Viru Keemia Grupp to influence regional development unilaterally. So far, the companies have primarily focused on expanding oil and chemical production instead of renewable energy production, with Eesti Energia starting the construction of a new oil factory that would use oil shale as feedstock for plastics and fine chemicals (ERR, 2021a), and Viru Keemia Grupp exploring the idea of building a pulp factory that would enable the chemical enhancement of woody biomass (ERR, 2021b). The local governments have in turn refrained from intervening because they are heavily dependent on the industries for tax revenue.

The results therefore indicate a significant dependence in all cases on the existing technological, institutional and cultural paths (Seto et al., 2016). I suggest that the dependence on these antecedent paths can partly explain why the energy transition has been successfully governed through institutionalized co-creation in Denmark but not in Estonia. In Denmark, co-creation was used to harness the local natural resources, the expertise of existing industries, the political will and the cultural incline towards collaboration, while there were no such resources to build on in Estonia. At the same time, it has to be kept in mind that the institutionalization of co-creation is in any case a slow process that has also taken some time to achieve in the two Danish cases and will certainly take more time than the few months that were available in the Estonian case.

CHAPTER 4. CONTRIBUTIONS AND SUGGESTIONS FOR FURTHER RESEARCH

4.1. CONTRIBUTIONS TO EXISTING KNOWLEDGE

This thesis emerged from the realization that co-creation as a strategy for governing the transition from fossil fuels to renewable energy systems has been insufficiently conceptualized and studied in previous research. Especially worrying was the lack of focus on the implementation and institutionalization of energy plans after they were created; and the lack of attention to antecedent conditions that influence the applicability of co-creation in areas beyond Western Europe. With this thesis, I have focused on filling these knowledge gaps. Based on the findings presented so far, I now propose a holistic model of co-creation as a governance strategy for renewable energy transitions. The model is divided into four categories: 1) antecedent conditions, 2) collaborative process, 3) institutional design and leadership, 4) and outputs and outcomes (Figure 6). I conclude by emphasizing how my research has contributed to each of these four categories.

Contribution 1: Co-creation involves expectation alignment, learning and evaluation, resource mobilization and role changes between sectors. Co-creation is the collaboration of government, business and third sector organizations, and unorganized local community groups with the aim to agree on common problems and design and implement innovative solutions. I propose that the main advantage of co-creation for politicians and public administrators in comparison to government intervention or market-based development lies in the possibility to implement policies and projects more effectively and efficiently through the mobilization of resources from outside the public sector. However, this requires a change in the participants' role perception so that they start to see each other as strategic partners that share the responsibility of designing as well as implementing solutions. This change can be facilitated through the articulation and alignment of participants' expectations, collective learning about and evaluation of possibilities, and increased accountability on behalf of the participants' for their action.

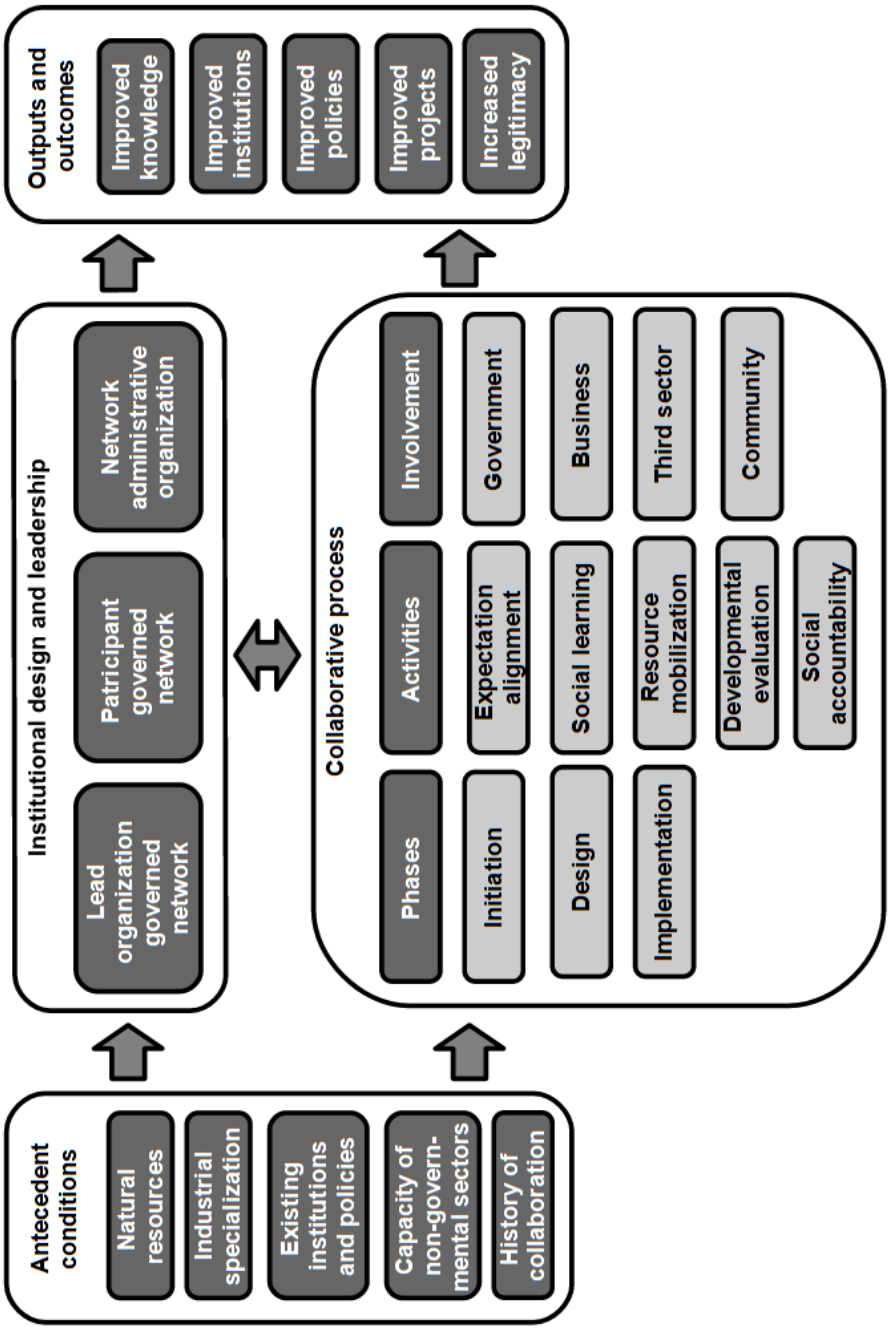

Figure 6. Co-creation as a governance strategy of the renewable energy transition (based on Ansell & Torfing, 2021; Sillak, 2022; Sillak et al., 2021; Sillak & Vasser, 2022)

Contribution 2: Co-creation can produce outputs and outcomes that go beyond plans or policies. A common output of co-creation is a municipal or regional strategic energy plan. However, co-creation should be seen as more than just the collaborative design of an improved plan or policy as it has the potential to lead to more transformative outcomes such as new collaborative networks, joint projects and wider organizational and institutional changes. I found that an extensive focus on delivering a plan might draw away attention from creating a sustained collaboration and can therefore undermine the implementation of the plan.

Contribution 3: Co-creation can be institutionalized in a municipality-led network or a network administrative organization. The municipalities that have been successful in implementing their co-created strategic energy plans have done so through institutionalizing the emerging network of participants as a new permanent cross-sectoral governance body. These institutionalized networks can be led either by the municipal administration or a separate network administrative organization. Municipality-led networks (such as the one in Ringkøbing-Skjern) can build on municipal resources and enjoy more legitimacy within the community, but are also politically controlled and cannot mobilize private funding. Network administrative organizations (such as the one in Sønderborg) can more easily attract resources from the private sector and are less vulnerable to political change, but have less access to municipal know-how and are also less legitimate in the eyes of the public. These institutional differences also affect the design and implementation of energy plans, and ultimately the entire energy transition.

Contribution 4: Antecedent conditions lead to different outcomes of co-creation in frontrunner and traditional regions. Some of the most important antecedent conditions are natural resources, industrial specialization, institutions and policies, capacity of non-governmental sectors and history of collaboration. In the energy sector, the effect of technological factors related to the availability of local natural resources and local industrial specialization on co-creation is at least as important as the effect of existing institutions and policies or previous experience with collaboration. In Ringkøbing-Skjern and Sønderborg, co-creation builds on a tradition of collaboration between the public and private sector and the local community as well as the large potential of wind and solar energy and biogas production and an existing industry that can contribute to the energy transition. In Ida-Virumaa, the wind energy resources are somewhat limited and so is the expertise, investment capacity and willingness to cooperate between sectors, which altogether have created uncertainty around whether and to what extent the co-created energy plan will be implemented.

4.2. POLICY RECOMMENDATIONS

Traditionally, researchers are expected to give recommendations for new policies. However, it is somewhat difficult to make policy recommendations here because the whole aim of co-creation is to move beyond the unrealistic expectation for government policies to solve all problems towards a system where every sector contributes to the fulfilment of collective goals. Still, some recommendations can be made based on the research presented in this thesis:

- local politicians and energy planners should view themselves as facilitators of co-creation rather than as sovereign governors or the promoters of the “free market”;
- facilitation of co-creation should focus on the principles “align, learn, mobilize, evaluate, hold to account”;
- professional facilitators or trainers should be commissioned, if needed, to help choose the appropriate tools for applying these principles;
- co-creation should be adjusted to the existing regional or municipal conditions;
- co-creation should aim at building sustained cross-sector partnerships, not just delivering a plan;
- in order for it to sustain, co-creation should be institutionalized in new governance networks and bodies;
- network design should be based on a deliberate choice and role attribution.

4.3. SUGGESTIONS FOR FURTHER RESEARCH

While it was stated in the beginning that energy system models and feasibility analyses are important prerequisites of the energy transition, the thesis did not specifically address the role of energy system models in co-creation. In the Ida-Virumaa case it became apparent that the regional planning process would have benefited from an energy system analysis but no resources had been allocated for that in the beginning nor could the necessary resources have been mobilized on such short notice. Further research could therefore focus in more detail on how to integrate energy system modelling and co-creation in strategic energy planning. Here I can only provide some hints of an answer. As the energy system is extremely technical and complex system where the production and consumption of electricity have to be balanced at all times, all plans and changes need to rely on solid technical and economic calculations. This becomes even more important as we move towards a 100% renewable energy system which relies on higher demand-side flexibility and sector integration, and therefore also increases the risks related to system

operation. It means that the co-creation of energy plans has to be more attuned to technical expertise than similar exercises in other sectors.

At the same time, co-creation relies on the inclusion and mobilization of knowledge from all interest groups and the marginalization of "lay knowledge" will likely be detrimental to the legitimacy of co-creation and the energy transition (Aitken, 2009). Previous research has suggested that it is therefore preferable to prioritize the co-creation of a broad vision for the future energy system between stakeholders and then utilize models as exploratory tools for assessing the technical and economic options for realizing the vision (Sgouridis et al., 2022). In addition, models can also be used as "boundary objects" that enable to connect different interest groups in co-creation (Taylor et al., 2014). Research and practice show that modellers can meaningfully engage stakeholders at every step of the way from task definition to fine-tuning the detailed design of the model (Lammers & Arentsen, 2017). Further studies could test how and to what extent would it be actually possible to involve a broader set of actors in model building.

Due to reasons stated in Section 2.2, the thesis did not really delve into the co-creation on the level of specific development projects such as wind farms. This has been done in another recently published PhD thesis which shows how local actors can position themselves as active co-creators and thereby significantly shape wind power projects (more specifically a shared ownership model) (Gjørtler Elkjær, 2022). However, experience has shown that there is often a discrepancy between co-creation on the strategic and project levels, meaning that the specific projects that are co-created do not necessarily align with what has been agreed on in the strategic energy plans or what would be optimal from an energy system perspective. Further research is needed in order to learn how to bring together the strategic and project perspectives of co-creation.

Another potential avenue for future research is the role of contestation in addition to or instead of collaboration. The problem with co-creation and other collaborative approaches is that it tends to somewhat exclude radical groups or heavily critical voices because they are difficult to negotiate with. At the same time, the option for radical criticism needs to be available: first because it is a cornerstone of democracy, second because the renewable energy transition would have never started without activists that were critical towards the existing system, and third because the EU climate neutrality target for 2050 might still not be ambitious enough in order to prevent a climate catastrophe, and even more radical action may therefore be needed. On the basis of the Danish cases studied in this thesis, I propose that the strengthening of social accountability might provide a way for critical voices to be heard while at the same time maintaining a spirit of fruitful co-creation. This

way, the critics would become part of the “extended network” and would be offered a platform in which they could express their concerns while the members of the “core network” would be obligated to consider these and make the necessary adjustments in governance.

Finally, an important question that arises with case study research is: to what extent are the results generalizable? Having done case studies before, I was well aware of the difficulty of drawing general theoretical conclusions from case studies. Hence, I put a lot of consideration into case selection and all the cases in this PhD thesis have been selected based on their potential for offering generalizable knowledge (see Section 2.2). The cases include revelatory cases that show what can ideally be achieved, as well as a critical or crucial case that enables to test what can be done in more difficult circumstances. However, there are also limits to the generalizability of the research. Since all the cases are drawn from a European context, it is unclear whether the model of co-creation developed in this thesis applies in the Global South, for instance. At the same time, the model of co-creation presented in Section 4.1 is quite general and therefore rather easily allows for further research in this direction as well. For example, further studies could illuminate the antecedent conditions in new regional contexts such as the Global South and explore what influence the conditions there have on the co-creation process, institutional design and leadership, and output and outcomes.

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APPENDICES

The following appendices include the three academic papers that this thesis is based on.

Appendix A. Sillak, S., Borch, K., & Sperling, K. (2021). Assessing co-creation in strategic planning for urban energy transitions. *Energy Research & Social Science*, *74*. https://doi.org/10.1016/j.erss.2021.101952.

Appendix B. Sillak, S. & Vasser, M. (2022). How might we co-design energy transition policy in old industrial regions? *Environmental Policy and Governance.* https://doi.org/10.1002/eet.2007.

Appendix C. Sillak, S. (2022). All talk, and (no) action? Collaborative implementation of the energy transition in two frontrunner municipalities in Denmark. *Energy Strategy Reviews,* under review.

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