RAIN IN THE CITY

– a study of strategic navigation in climate adaptation projects

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Abstract

The effects of climate change are showing more often still. In Denmark, this is particularly observed with heavier and more frequent cloudbursts. These lead to flooded basements, waste water backup, and discharge of polluted water into natural water bodies; and they can cause expensive damage. To combat this, climate adaptation is a growing necessity in most urban areas of Denmark, and has increasingly become a central focus during the last few decades.

For accommodating larger amounts of rain water, the traditional approach would be to expand sewers. But this is an expensive solution, and it does not bring about other possibilities for other improvements of the urban areas. Another and increasingly popular approach is sustainable urban drainage systems (SUDS). These are surface solutions handling water visibly and locally. These solutions are usually cheaper than the underground alternative, and they are beneficial as they can be combined with other foci to create additional values; including aesthetic, recreational, environmental, social, and economic values.

But SUDS are not necessarily easy to implement. As climate adaptation is a relatively new field, limited experience and knowledge exist. Further, the current legislative framework is not geared for such climate adaptation measures; possibilities are lacking, legislation is not coordinated, and rules and responsibilities are in some cases limited to certain actors. And moreover, as SUDS are placed on the surface, they are subject to a wide range of sometimes conflicting interests, compared to underground sewers that are primarily managed by technicians. This necessitates broad involvement and multisectoral cooperation.

All these challenges must be tackled by the municipal planners working with climate adaptation projects. They must navigate in the different conditions, factors, and possibilities present, to find solutions that fit their given contexts. On top of this, planning for climate adaptation projects often has transformative ambitions: it is attempted not just to solve the pressing problem of rain, but also to achieve additional values, embrace new ways of working, reconfigure actor relations, and ultimately, change the conceptions of climate adaptation and all it entails.

This makes climate adaptation projects a complex field. To succeed in implementing such projects and obtain additional values and transformative qualities, planners must work strategically and navigate in a variety of aspects. This is what this thesis studies through the research question: *how can planners in Danish municipalities navigate strategically in the implementation of large climate adaptation projects related to rainwater – that include a focus on creating additional values – in order to address challenges and complexities of such projects, and realize their transformative ambitions?*

This is examined through literature studies and particularly case studies of three large climate adaptation projects, namely Trekroner East, Kokkedal Climate Adaptation, and Middelfart – The Climate City. By

studying these projects, their processes, and their implementation, their planning strategies and strategic navigation are described. These are further studied and discussed in order to arrive at common drivers for climate adaptation projects, conditions that are decisive for necessary strategic navigation, and finally, five recommendations for municipal planners embarking on climate adaptation projects. Specifically, it is recommended that they should work actively with strategic planning and navigation; use the existing conditions as a point of departure; navigate in the existing legal frameworks; create common directions and shared priorities through collaborative networks; and pursue stakeholder involvement with outreach. With these aspects in mind, individual climate adaptation projects can contribute to creating general systemic transformations, benefitting all work with climate adaptation.

Summary in Danish

Klimaforandringernes effekt viser sig stadigt oftere. I Danmark kommer dette især til udtryk ved kraftigere og mere hyppige skybrud. Disse medfører oversvømmede kældre, opstuvning af spildevand og udledning af forurenet vand til naturlige vandområder. Dette kan hurtigt blive en omkostningstung affære. For at forhindre dette er klimatilpasning et voksende behov i de fleste byområder i Danmark, og over de sidste par årtier har klimatilpasningsprojekter fået øget opmærksomhed.

Traditionelt ville man udvide kloakkerne for at rumme de stigende vandmasser. Men denne løsning er dyr, og den medfører ikke muligheder for øvrige forbedringer af byområderne. En anden og stadigt mere populær tilgang er lokal afledning af regnvand (LAR); overfladeløsninger, der håndterer vand synligt og lokalt. Disse løsninger er som regel billigere en de underjordiske alternativer, og de er fordelagtige, da de kan kombineres med andre indsatser, hvormed merværdier kan skabes. Disse inkluderer æstetiske, rekreative, miljømæssige, sociale og økonomiske værdier.

LAR er dog ikke altid nemt at implementere. Da klimatilpasning er et forholdsvist nyt felt, findes der kun begrænset viden og erfaring. Desuden er de nuværende lovmæssige rammer ikke indrettet til den slags klimatilpasningsløsninger. Der mangler muligheder, love er ikke koordinerede, og fordelinger af roller og ansvar er i nogle tilfælde begrænset til bestemte aktører. Derudover er LAR, som jo er placeret på overfladen, underlagt langt flere og nogen gange modstridende interesser end de underjordiske kloakløsninger, som det mest er teknikere, der interesserer sig for. Dette fordrer bred inddragelse og tværsektorielt samarbejde.

Alle disse udfordringer skal håndteres af kommunale planlæggere, der arbejder med klimatilpasningsprojekter. De skal navigere i de forskellige eksisterende forudsætninger, faktorer og muligheder, for at finde løsninger, som passer ind i deres givne kontekster. Derudover har planlægning af klimatilpasningsprojekter ofte også transformative ambitioner; der forsøges ikke kun at finde løsninger på den foreliggende udfordring med regn, men samtidig at opnå merværdier, imødegå nye måder at arbejde på, omkalfatre eksisterende relationer mellem aktører samt i yderste konsekvens at ændre forestillingerne om klimatilpasning og alt, det medfører.

Dette gør klimatilpasning til et komplekst område. For at lykkes med implementeringen af sådanne projekter, og samtidig opnå merværdier og transformative kvaliteter, bliver planlæggerne nødt til at arbejde strategisk og navigere i et væld af anliggender. Det er, hvad dette speciale fokuserer på, med spørgsmålet: *Hvordan kan planlæggere i danske kommuner navigere strategisk i implementeringen af store klimatilpasningsprojekter, der håndterer regnvand – og har skabelsen af merværdier i fokus – for at adressere sådanne projekters udfordringer og komplekse forhold, og for at realisere deres transformative ambitioner?*

Dette er undersøgt gennem litteraturstudier samt særligt gennem casestudier af tre store klimatilpasningsprojekter, nemlig Trekroner Øst, Klimatilpasning Kokkedal og KlimaByen Middelfart. Ved at studere disse projekter, processerne bag samt deres implementering er deres planlægningsstrategier og strategiske navigation beskrevet. Dette er undersøgt og diskuteret yderligere for at finde frem til generelle drivkræfter for klimatilpasningsprojekter, omstændigheder, der er afgørende for hvilken strategisk navigation, der er nødvendig, og endeligt fem anbefalinger til kommunale planlæggere, der skal til at give sig i kast med klimatilpasningsprojekter. Konkret anbefales det, at de bør arbejde aktivt med strategis planlægning og navigation; bruge de eksisterende omstændigheder som udgangspunkt; navigere i de eksisterende lovmæssige rammer; skabe kollektiv retning og fælles prioriteringer gennem samarbejdsnetværk; og udføre opsøgende inddragelse af interessenter. Ved at tage højde for disse forhold kan enkelte klimatilpasningsprojekter bidrage til at skabe generelle, systemiske transformationer, der kommer alt arbejde med klimatilpasning til gode.

Preface

This Master's thesis concludes my days as a student of the Sustainable Cities programme at Aalborg University Copenhagen. It has been written in the Spring and Summer of 2020.

The thesis is concerned with climate adaptation, namely the large, ambitious municipal projects that have been in number over the last decade. Climate adaptation is a relatively new task for the municipalities. It is a complicated area, and the usual municipal practices may be insufficient for addressing the issues and complexities it entails. This thesis attempts to uncover useful insights about strategic navigation that may support municipal climate adaptation projects.

Things are moving fast within the field of climate adaptation, and it can be difficult to find relevant, up-to-date information about projects and practices. Luckily, a large source of valuable knowledge exists in professionals working with climate adaptation. This thesis owns a lot to such competent professionals, who have contributed by participating in interviews, giving guided tours of climate adaptation projects, pointing me in the direction of useful contacts, and generally enlightening me on foci and challenges of climate adaptation. I would like to thank Signe Gudiksen, Jacob Kloch, Ulrik Lassen, Ejvind Mortensen, Jens-Phillip Petersen, Bjarne Rasmussen, Pernille Svane, Kirsten Toft, and Johan Vedel.

This thesis was initially conceived as a contribution to a Sweco project. Since then, the thesis has transformed considerably, but the early establishment of project direction has been helpful and significant to the final product. I would like to thank Jonathan Leonardsen at Sweco for pointers about direction, as well as advice on possible case studies and contacts.

Finally, I would especially like to thank Maj-Britt Quitzau, who has been my supervisor for this thesis. With large dedication and enthusiasm, Maj-Britt has provided invaluable feedback and suggestions throughout the process.

Happy reading,
Morten de Fine Olivarius

Contents

Terminology

English term	Danish term
Camber	Vejprofil
Climate scenarios	Klimascenarier
Elevation level	Kote
Footing	Sokkel
Framework local plan	Rammelokalplan
Impermeable surface area	Befæstet areal
Justification of planning	Planlægningsmæssig begrundelse
Light wells	Lyskasser
Overflow grate	Overløbsrist
Rainwater attenuation tanks	Regnvandsfaskiner
Recess (in a basin)	Udsparing (i bassin)
Service target	Servicemål/serviceniveau
Sewers: - Combined sewers - Separate sewers	Kloakker: - Fælleskloak - Separatkloak
Sewer connection charges	Kloaktilslutningsbidrag
SUDS, sustainable urban drainage systems	LAR, lokal afledning af regnvand
Wastewater guild	Spildevandslaug
Wastewater plan	Spildevandsplan

For this thesis, rain incidents are defined as:

- Extreme rain – rain incidents happening at most once every five years under current conditions
- Heavy rain – rain incidents happening between five times a year and once every five years
- Everyday rain – smaller rain incidents happening more than five times a year

Introduction

Climate change has increasingly become a focus of the public debate in Denmark during the last decade. Especially after extreme rain incidents, leaving basements flooded and causing damages for millions, climate change has been a topic of conversation for planners, engineers, and ordinary citizens alike. Climate adaptation measures have been implemented on many scales; from private individuals securing their basements against floods, to intermunicipal projects attempting to control the large amounts of water that may suddenly fall from the sky. Over the course of a few years, climate adaptation has become a central element in urban planning in Denmark.

Planning for climate adaptation is utterly complex. It involves a wide array of different sectors in the municipalities that may not be used to working together. Projects may require new and unusual configurations of roles. And experience of working with climate adaptation is limited, sometimes requiring planners to invent their own approaches as the work progresses. These new ways of working complicate the tasks of the municipal planners. Somehow, they must manage all this while creating projects that solve the pressing water issues and are broadly supported. This requires strong navigational capabilities of the planners, in order to strategically approach climate adaptation projects in ways that work. That is what this thesis is about.

Climate change and extreme rains

According to the International Panel for Climate Change, global warming caused by human activity is likely to reach 1.5°C between 2030 and 2052, compared to pre-industrial levels, unless drastic measures are taken (IPCC 2018). Such an increase in temperatures globally affects regions in different ways. For Denmark, the Danish Meteorological Institute (Olesen et al. 2014) has made projections for potential consequences of such an increase in temperature. Expected effects include sea level rises, rising temperatures, periods of drought, and changing precipitation patterns with more frequent and intense rainfalls. Especially rain is a pressing issue in large parts of Denmark; in a survey of 60 Danish municipalities, 84% of the respondents indicated that they had experienced extreme rain events locally, making it the most prominent effect of climate change (Lund 2016). The largest extreme rain incident recorded occurred in 2011, with floods in many parts Greater Copenhagen, causing damages for close to DKK 6 billion (Danish Emergency Management Agency 2012). With increasing global warming, such incidents are likely to occur more often in the future (Olesen et al. 2014).

In nature, some rainwater runs to local water bodies, but most evaporates or infiltrates in the ground. But in urban areas, this natural cycle is broken: surface areas that are paved or built-up prevent the natural processes, thus increasing the surface run-off (Orbicon, SLA, and Hoffmann 2013a). Sewers are constructed to manage this water. But when sewers cannot keep up with the amounts of water caused by large rain incidents, floods happen (Lund 2013). These floods can cause several issues: cause damages in basements and low-lying areas; cause sewer backup, leading contaminated wastewater into basements,

streets, and natural water bodies, creating health and environmental hazards; groundwater may be polluted; and infrastructure may be damaged, temporarily or permanently (ibid). Hence, rainwater management is an important task for municipalities. It is addressed as part of the climate adaptation planning which has gained traction in Denmark over the past decade (Post 2012; Krawack 2014).

Approaching climate adaptation

Climate adaptation is a relatively recent discipline in Danish municipal planning. Over the past ten years, extreme rain, public pressure, and growing focus on the necessity of climate adaptation has pushed the demand for municipal action (Lund and Nellemann 2012). In 2009, a proposal was made to include regulations for climate adaptation in local plans, presenting the first planning methods deliberately aimed at climate adaptation (Post 2012). Climate local plans were, however, not introduced until 2013 (Danish Environmental Protection Agency 2019). The year before that, an agreement was passed that all municipalities should develop climate adaptation plans before the end of 2013 (Danish Environmental Protection Agency 2018). The introduction of these came, amongst other things, as a reaction to extreme rain incidents in 2011 (Krawack 2014). The plans have ensured a focus on climate adaptation in all Danish municipalities.

Climate adaptation measures in Danish municipalities vary from small, local structures to large projects comprising entire neighbourhoods. The traditional solution for accommodating larger amounts of water has been to expand capacity of sewers; and perhaps to separate sewers into two systems for waste and rainwater, respectively, to avoid backup of wastewater in case of overflows (Orbicon, SLA, and Hoffmann 2013a). This is simple in terms of organization, as it is carried out by municipal wastewater companies with technical expertise and without broad involvement. But while this solution is easily organized and immediately effective, it is also an expensive and inflexible approach (Fryd and Jensen 2018). Another type of solution that has gained momentum in recent years is sustainable urban drainage systems (SUDS), where water structures are placed on the surface; this is the most common approach today (Krawack 2014). With natural elements such as rain gardens and grassy trenches, SUDS permit local water management by infiltration and evaporation, thus bringing the urban water management system closer to the natural cycle (Orbicon, SLA, and Hoffmann 2013a). SUDS are technically more convenient and less costly to implement, they are easier to adapt to changed needs, and they have a large benefit in that they can be used to create additional values in the local areas (Krawack 2014). Such additional values may include urban renewal, the creation of new recreational areas, increased biodiversity, and upgradation of public spaces, amongst many other things (Hoffmann, Jensen, and Elle 2015). Additional values are the everyday functions of climate adaptation measures that are otherwise only effective during and immediately after large rain incidents (Krawack 2014). These values may contribute to larger local support for projects, facilitating implementation of climate adaptation projects (Lund 2016).

Challenges in climate adaptation planning

While using SUDS rather than underground structures paves the way for better solutions, larger support, and additional values of climate adaptation projects, it also complicates matters. As solutions are moved

to the surface, they are suddenly a matter to everyone, rather than just to water technicians (Lund 2016). SUDS make rainwater management a common responsibility: they directly impact local residents and several municipal sectors, necessitating multisectoral cooperation and increased stakeholder involvement (ibid). And this work complicates the tasks of the municipal planners who may not be used to working with water management in this way (ibid). Here, some of the challenges of working with climate adaptation planning in practice are presented.

While many functional and tested methods for climate adaptation exist, implementation of these is still challenging. Insufficient funding and lacking legal opportunities are some of the barriers that hinder successful implementation (Lund and Nellemann 2012). The legal framework is experienced by municipalities and wastewater companies as overly rigid, badly coordinated, or entirely lacking for topics important to climate adaptation (Lund 2016). And although some methods exist, the municipalities do not have sufficient knowledge about how to use this in practice (Hellesen et al. 2010).

Further, planning for climate adaptation is a complex matter. The complexity of climate adaptation work is mainly due to the many interests at play. Surface solutions take up space in urban areas where space is a limited commodity; the solutions are likely to impact locals, as they are suddenly visible structures in the city; when placed on the surface, structures are covered by more legislation than underground pipes, placing them under the purview of additional sectors of the municipality; and this work is complex as no best practices or correct solutions exist (Hoffmann 2016). Surface climate adaptation interacts with a wide array of structures, including roads, nature, urban planning, culture, social issues, health, and stakeholders' views on the city, and climate adaptation essentially requires context-based solutions (ibid).

Climate adaptation planning is complicated by the fact that while water is naturally a coherent hydraulic system, it is not a collective societal system, but subject to a range of interests and regulations of different sectors. For successful climate adaptation projects, it is often a necessity to include many sectors of the municipalities as well as other stakeholders in collaboration; but this is difficult and require planners with strong navigational skills at the helm (Lund 2016). The good project should take many interests and opinions into account to obtain effective, locally-approved solutions; and further, it should include a flexibility to future changes which are difficult to know beforehand (ibid). Large efforts of coordination are necessary, to navigate the existing structures and requirements of often rigidly regulated municipal planning, while simultaneously embracing the multisectoral, innovative, and inclusive approach that is a necessity for surface climate adaptation projects. This calls for a strong strategic navigation of municipal planners.

Addressing the challenges through strategic planning and navigation

To combat the above-presented challenges of working with climate adaptation, municipal planners must approach planning through a range of plans, processes, and partnerships. Climate adaptation should be approached not just as a technical system, but as a dynamic, socio-material context in which interventions are made. This calls for deliberate processes of strategy making.

The traditional approach to water management would be technicians working with well-known technical solutions underground, or planners implementing structures regulated through local plans on the surface. This approach resembles responsive approaches to strategy making; known issues are approached with solutions decided in advance, and with limited stakeholder involvement (Healey 2009). This may be adequate to the implementation of climate adaptation projects in some instances, where linear approaches may solve the present needs. However, in most cases these measures are not enough to overcome the challenges and address the present issues in a satisfactory way. By instead applying a transformative approach to strategy making, broader topics are addressed through more dynamic and inclusive processes, and real socio-spatial change may be achieved (ibid).

The transformative approach is an alternative to the traditional, responsive planning. It is a way to address the challenges for climate adaptation planning presented above, and create functional, integrated projects that take many issues into account. Through a transformative approach to strategy making, directions for planning can be defined, creating a frame of reference for a project (Healey 2009). Within this, planners and other stakeholders can work towards solutions to issues of many kinds; both those defined in the beginning, but also other things surfacing along the way. The approach can be used to work collectively towards climate adaptation solutions that are beneficial to everyone, with additional values aimed at other topics and ensuring local support, and with structures that are dynamic and may be changed along the way as needs change. Transformative planning can be used to pursue not just the traditional solutions, but also to find new methods to address issues that are beyond the usual boundaries of climate adaptation planning.

It does, however, make great demands for planners. They must be both facilitators, innovators, and authorities, in order to achieve these transformative qualities and socio-spatial changes. Certain prerequisites may exist for large climate adaptation projects to be successful; but other than that, the strategic navigation of planners is central to how projects develop. This is complicated, as these practices of navigation are not catered for in the legislation and planning system. Hence, such navigation may include practices unfamiliar to planners accustomed to the traditional ways of planning for climate adaptation, using existing procedures such as technical underground solutions. Conversely, the rigid structures of the existing system are not taken into account in the theoretical ideas of strategic planning, meaning that planners must find their own ways to navigate strategically within this system. Still, in climate adaptation projects with transformative ambitions, such navigation is observed, to various extents. In this thesis, three such projects are examined, to uncover how they approach strategic navigation within the existing structures.

Climate adaptation projects are highly contextual, and strategies, contexts, methods, and outcomes of the projects are expected to be closely related. These connections are the focus of this thesis: the ways municipal planners navigate in climate adaptation projects with different degrees of transformative aims and under different conditions will be examined to find out how these connections are configured, and what it means for the projects in question. This is studied in the light of theories regarding strategic

planning and navigation. Ultimately, it is meant to point out a general direction for municipalities embarking on large climate adaptation projects, to provide inspiration for how strategic planning and navigation can be approached.

Problem area and research question

Many Danish municipalities face challenges when attempting to implement climate adaptation measures. Their knowledge is often limited on the matter; hence, they call for more guidance. Further, existing procedures for working with climate adaptation – through technical underground solutions or regulated by local plans – often represent responsive approaches to strategy making. These are often inadequate to address the complex situations that are present in climate adaptation projects with surface water management solutions. Different approaches are needed that can address the complexity in climate adaptation projects and contain the necessary transformative strategic aspects of modern planning. Successful projects are carried out, but often by using alternative methods and by prompting uncommon interactions between stakeholders. These approaches are interesting to examine in order to unearth the strategic navigation carried out by municipal planners, and the possibilities of working strategically within a largely rigid system. In this thesis, it is studied how three municipalities approach large climate adaptation projects concerning rainwater, and which planning strategies and strategic navigation lie beneath their work. It is attempted to uncover common drivers for climate adaptation projects, conditions that are decisive for necessary strategic navigation, and ultimately, recommendations for municipal planners embarking on climate adaptation projects to provide inspiration about strategic navigation.

The project will examine how large climate adaptation projects are implemented in Denmark; including through local plans and by other implementation tools and methods employed by municipal planners under certain conditions. Further, the types of strategy applied by municipal planners are examined in order to assess their significance in climate adaptation projects. This will happen through both literature studies and case studies of three large climate adaptation projects: Trekroner East, Kokkedal Climate Adaptation, and Middelfart – The Climate City.

The nature of these projects will be examined, including built structures, water technical elements, organizational aspects, and processes behind the projects. A certain focus is put on additional values, as they play a main role in mobilizing stakeholders and existing structures; this is essential to a transformative approach to strategy making. Then, drivers and barriers for the case projects will be studied in order to assess the different methods used. Finally, an examination will be carried out of the planning strategies and strategic navigation employed in the three case projects. Ultimately, all this is put together to inspect how strategic navigation is connected to contexts, methods, and outcomes in the complex reality of climate adaptation projects. This aims at producing recommendations for municipalities on how to approach strategic navigation in order to obtain transformative, integrated results in climate adaptation projects. All in all, this is an attempt to answer the following research question:

How can planners in Danish municipalities navigate strategically in the implementation of large climate adaptation projects related to rainwater – that include a focus on creating additional values – in order to address challenges and complexities of such projects, and realize their transformative ambitions?

It is understood that solutions and strategies such as those applied in the studied climate adaptation cases are highly contextual and may not transfer well to other municipalities. Accordingly, the outcome of this thesis is not meant to be specific guidelines for municipalities working with climate adaptation; rather, the goal is to provide inspiration for possible implementation methods, emphasize the relationships between strategies, contexts, methods, and outcomes, and provide recommendations about approaches to strategic navigation. The results are mainly intended for municipal planners working with climate adaptation.

Climate adaptation is a complicated topic, and to limit the scope of this thesis, some decisions have been made about the focus area. First of all, the focus here is on climate adaptation related to rain. While several other issues exist, rain is presently the most pressing challenge in Denmark, and is the focus of most large municipal climate adaptation projects. Further, many aspects of the examined projects are covered in a generalist manner, and not with the same level of detail as the strategic approaches. These aspects include technicalities of water management, organizational dynamics, legal regulations, and funding. They are important elements in climate adaptation projects, and are included in the studies; but only to the extent where they contribute to the general focus of this thesis, namely strategic navigation. In the end, content of the project is chosen carefully to contribute to understandings of strategic planning in climate adaptation, without diving too deeply into other aspects of the topic.

Research design

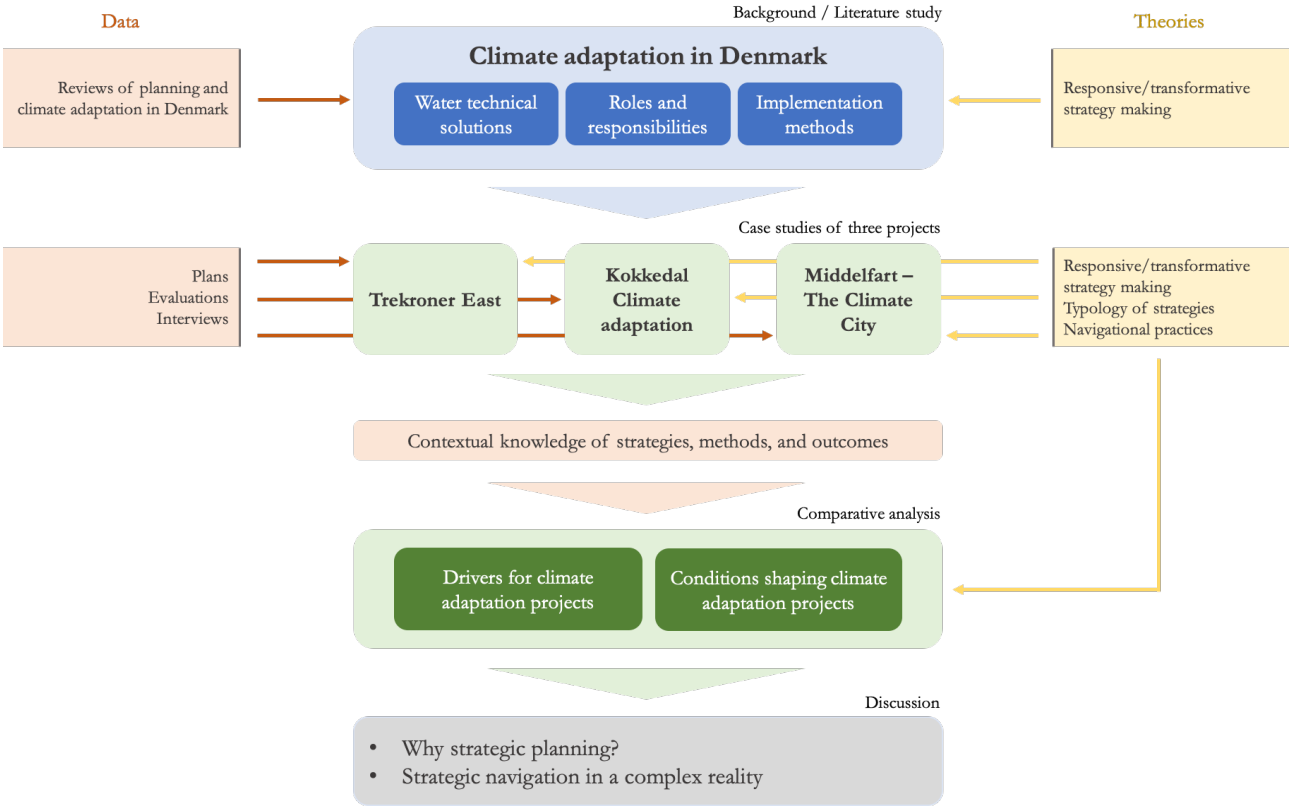
This thesis examines implementation of large climate adaptation projects by Danish municipalities. As presented above, municipalities in Denmark often face issues when working with climate adaptation. They may lack the tools and knowledge needed for successful implementation. They may face difficulties in engaging all stakeholders in the process. And the rigid nature of the structures such projects have to follow collide with the multisectoral, transformative strategy making that is a necessity for the relatively new type of project that climate adaptation projects are.

Three case studies constitute the bulk of the empirical findings in this thesis. They examine three large, recent climate adaptation project, in order to examine different approaches to implementation. These case studies have been developed through a literature review of available relevant material in writing, and expert interviews with people central in each of the three projects. They focus on different aspects of the climate adaptation projects, including water technical elements and additional values, processes, implementation methods, and strategic navigation. They are followed up by a comparative analysis used to highlight the similarities and differences of the three projects, to comment on drivers for climate adaptation projects, and conditions significant to how the projects are shaped. This is followed by a discussion on the need for strategic planning, and how it unfolds in a complex reality.

The main focus of this thesis is on the strategic planning and navigation Danish municipal planners apply when implementing large climate adaptation projects related to rainwater. Climate adaptation projects are often complex, and transformative strategy making may help address the challenges and complexities. To examine this, several aspects of climate adaptation projects are studied. First of all, it is examined which tools and methods exist for municipalities to implement larger climate adaptation projects. This is attempted answered through a review of literature concerning opportunities when working with climate adaptation in local plans and with other methods, as well as through the three case studies. Together, this forms a body of knowledge about possible methods for implementing climate adaptation, referring literature, plans, and practices.

Then, similarities and differences between the case projects are examined. These are uncovered through the case studies, and put together in the comparative analysis. The similarities are used to highlight common traits of climate adaptation projects that might act as drivers for such projects. The differences are used to understand the different conditions of the projects and how this impacts choice and applicability of different methods and strategic approaches. It is examined how existing structures, initial structural plans, and stakeholder involvement affects process and outcomes of the projects.

Afterwards, it is studied how the planning strategies applied by municipalities in the studied cases unfold in a complex reality. It is examined how each of the three municipalities approach planning in their specific contexts, and their approaches are categorized based on a distinction between responsive and transformative strategy making of Healey's (2009), as well as a classification of six strategy types of Sehested's (2009). This is exposed in the case studies, and examined further in the discussion. These analyses are informed by the understandings of strategic planning of Sehested (2009) and Healey (2009), as well as navigational practices described by Munthe-Kaas and Hoffmann (2017) – all presented below. It is discussed how navigation happens regarding different contexts, methods, and strategies. This discussion attempts to highlight the importance of creating context-dependent plans and strategies, as there is not one best practice for approaching climate adaptation projects. Hence, methods and strategic navigation used should always be developed with a sensitivity to the given context. Still, this discussion will attempt to provide recommendations for relevant practices of strategic navigation useful for municipal planners embarking on climate adaptation projects in the future. Connections between data, theories, and analyses are shown in the figure below.



General research approach, central analyses, and data collection are elaborated in the chapter *Methodology*. But first, the following chapter will introduce the theoretical framework that is applied in the study of strategic planning and navigation in this thesis.

Theoretical framework

In this chapter, the theories and terminologies that are important to this thesis are presented. These are used as lenses through which to view the different elements studied. As this thesis is largely based on grounded theory which creates rather than applies theories (see the chapter *Methodology*), the ideas presented here are not the main foundations of the later analyses, but rather tools used to shed light on the results emerging from these analyses, leading to further results. The empirical findings have been informing the choice of theories, rather than the other way around. Theories are selected that can be used to explain and explore perspectives of strategic planning. This includes examining which kinds of strategic planning that are applied in practice, and how they are connected to the tools and methods applied in climate adaptation planning. Strategic planning is viewed as vital to climate adaptation projects, a field where multisectoral cooperation and broad stakeholder engagement is typically regarded as indispensable means.

To capture the essence of the relevant theories, this chapter is divided into three parts. The first part describes changing planning paradigms, how strategic planning has emerged, and ways of distinguishing between types of strategic planning. The second part briefly introduces the role of the planner within strategic planning, and what might be expected of the modern, strategic planner. Finally, the last part presents the strategic navigation planners engage in, and how planning may be developed strategically in the relationship between planners, stakeholders, and the local context.

Shifting paradigms and strategic planning

The term 'planning paradigms' is used here to describe the various understandings of what planning can and should do; especially to describe a change in paradigms from project to strategic planning. The term 'planning strategies' is used for the ways of thinking and doing planning with different means and intends. Examining how diverse planning strategies are in play in different scenarios can help understand how planners act in planning situations. Actions taken can be discussed in the context of specific planning strategies, highlighting how ways of planning, types of actions, and outcomes are inextricably linked. And stakeholder relations – which are defining for planning strategies – can be scrutinized in order to emphasize different configurations of roles in projects of different types. In this thesis, the focus is on municipal planning of climate adaptation. Hence, the general focus will be on the planning strategies applied by municipal planners when working on projects pertaining to climate adaptation. This will be elaborated further in three case studies, where the theories presented here are used to determine and assess the applied planning strategies. For now, the following paragraphs will provide a general introduction to shifting planning paradigms and strategic planning.

Paradigmatic understandings of what planning can and should do have changed through time; essentially from seeing planning as a way to solve specific problems and pointing out directions for development (Albrechts 1991), towards a view on planning as a loosely-defined set of ideas and practices useful for

contextual collective learning (Munthe-Kaas and Hoffmann 2017), consensus building (Innes and Booher 1999), and mobilizing stakeholders and resources to clarify strategic potentials (Sehested 2009). While it is somewhat easy to pin down what constitutes the "traditional" paradigm of planning as a way of steering development towards certain aims within the existing situation and regulatory framework, strategic planning is much more ambiguous and wide-ranging. This is one reason why it is interesting to examine the different planning strategies applied in practice, and what they entail regarding tools, methods, and outcomes. Different views on strategic planning as well as a typology of strategy are elaborated below; but first, a brief history of modern planning should be presented.

The ongoing development of planning is interesting, as remnants of the traditional ways of planning are still present in some modern planning; a lot of the planning of today is still applying ideas of specific goals and controlled development, although it is categorized as strategic. Further, understanding the traditional ways of planning provides a picture of how strategic planning approaches are deliberately trying to challenge formerly dominant ideas. In the three case studies, this is useful for analysing the approaches used by the municipalities, to assess their position within the field of modern, strategic planning.

Strategic planning first gained traction in Europe in the 60's: first in the private sector, but it was quickly picked up on by public authorities as well (Albrechts 1991). Before that, an understanding had been prevalent of the city as a given construct, a somewhat static system, where planners were seen as skilled professionals who could steer development as desired, within legal regulations (ibid). Instead, the new paradigm of strategic planning proposed a more comprehensive way to look at the city; but after less than two decades, it was broadly abandoned again (Albrechts 2004). While strategic planning had the advantage of being able to address numerous issues at once, it was criticized for trying to tackle challenges too complex to plan for (ibid), for being possibly political in ways conflicting with contemporary ideals of free markets, and for being excessively costly (Albrechts 1991). Instead, project planning was introduced; employing limited-period blueprint plans subject to rigid regulation and focused on specific physical structures, in contrast with the open-ended and continuous nature of the decision-focused strategic planning (Albrechts 2004). An example of this relevant to the topic of climate adaptation could be purely technical solutions planned for underground water management, or inflexible local plans for surface solutions. While perhaps not fully returning to the former idea that planners can solve all problems, this was still a step back towards the old paradigm and its focus on isolated issues of single actors (Sehested 2009).

However, this reversion only lasted a short while. In the late 90's (Albrechts 2004) or early 00's (Sehested 2009), strategic planning re-emerged. Several causes have been pointed out: including globalization and increased regional competition in urban development; an economic pressure demanding focus on the most important tasks; a change in the public management, towards less authority and more network management; the issue of sustainability, requiring broad, comprehensive action plans; and the fact that this way of planning became a trend across many European countries (ibid). During the last 20 years, strategic planning has become more widespread in the public sector. In the Danish context, strategic

planning made its broad, national entrance with new regional plans, municipal plan strategies, and sectorial strategies within municipalities (Sehested 2009). Local plans, on the other hand, may in themselves be a type of project plans (although they can be used strategically); they are strictly regulated and largely inflexible, and can be seen as a type of blueprint plans where the end goal is physical change and is set in stone.

But what exactly is strategic planning? Several scholars have attempted to pin this down. Albrechts (2004) positions strategic plans as the opposite of project plans; strategies supplement or replace the rigid structures of blueprint plans. He introduces this normative definition: "… *strategic spatial planning is a public-sector-led … sociospatial … process through which a vision, actions, and means for implementation are produced that shape and frame what a place is and may become"* (ibid, 747). Strategic planning moves away from public-authority-controlled projects towards processes that are still public-sector-led, but co-created in broader networks. He goes on to emphasize that strategic planning is so highly contextual that its specific methods must be developed within the given context each time. For him, the intended outcome of strategic planning is "*an analysis of the main processes shaping our environment, a dynamic, integrated, and indicative long-term vision (frame), a plan for short-term and long-term actions, a budget, and a strategy for implementation"* (ibid, 753). Hence, strategic planning may focus on less tangible goals; where project planning has physical regulation as its goal, the aims of strategic planning can encompass relational changes and reconfiguration of roles, responsibilities, and focus areas.

Strategic planning in practice

There are many ways to approach strategic planning, as will be exemplified in the three case studies: these projects represent three different ways municipalities may work with strategy. But according to Healey (2009), strategies are not necessarily strategic. A lot of modern planning claims to apply strategic approaches, but Healey contests that. According to her, strategy making is complex and challenging, while much so-called strategic planning does not contain the necessary foci. To make a distinction, she suggests the notions of responsive and transformative strategy making. These terms are included here, as the three cases studied in this thesis exhibits clear traits of either responsive or transformative strategy making. Healey explains responsive strategy making as aimed at solving known problems with familiar methods. It may have the intentions of being strategic, but in its formation, it relies heavily on what is already known and which methods are already in use; it often results in blueprint plans using governmental regulation. In contrast, transformative strategy making is seen by Healey as to be strategic in its consequences: it aims at uncovering the locality-specific issues and opportunities, and mobilizing stakeholders to find context-based ways forward. Here, issues that might have been invisible before are brought into focus, multiple stakeholders are accessed to enlarge knowledge, and meaningful coalitions are built in order to channel the transformative energy towards identified issues. It is much more focused on context, governance, and strategic navigation.

Dimension of strategy making	Responsive strategy making	Transformative strategy making
Mobilize attention	Express what the current aims, values, and directions of our agency seem to be, with respect to shaping urban futures	Re-orientate attention to issues which lie behind immediate agendas, where this would highlight neglected opportunities and challenges
Scope the situation	Identify what our agency can achieve	Identify where the energy for change may lie and build coalitions for change which expand this energy
Enlarge intelligence	Summarize what we seem to know	Explore and recast agendas of problems, issues and potential actions and stakes, through accessing multiple sources of knowledge
Create frames and select actions	Find a way to give some kind of explicit expression and coherence to the above	Articulate strategic ideas within which specific issues and actions can be prioritized and given some justification and coherence

Responsive and transformative strategy making. Based on Healey 2009.

Whether responsive or transformative strategy making is applied has much to do with what is chosen as the content of a project, or, the way a project is framed (Healey 2009). According to Healey, "*The heart of a strategy … lies in the way that it frames ideas*" (ibid, 449). When embarking on any project, some things are chosen to be part of the focus, and some things are left out; broader framing and projects covering more content tends to be more complex. Where responsive strategy making tends to frame projects by including issues and possible solutions that are already known, transformative strategy making often frames projects by choosing a direction of attention and explorations, leaving the content of the project more open (ibid). This increases complexity and will often make strategic planning processes more difficult for planners, but on the other hand, more issues can be addressed, with more contextual and suitable solutions (ibid).

Healey's (2009) notion about the outcome of strategy making is perhaps more conceptual than that of Albrechts (2004): rather than attempting to change the situation, strategic work in Healey's understanding is aimed at changing the general direction of things (understandings, policies, etc.), and create a frame of reference or a shared orientation, "*to open up new possibilities and potentials, and to move away from previous positions"* (Healey 2009, 440). Generally, spatial strategies are useful when they create an orientation that many stakeholders share in processes of urban development (ibid).

In this thesis, the distinction between responsive and transformative strategy making is used to assess the strategic nature of the approaches applied by the municipalities of the three case studies. Amongst other things, content or framing is one factor used to explore this. But further typical traits can be used to

distinguish between responsive and transformative strategy making. These are used to structure the analyses of strategies in the case studies. They are vital to assessing the planning strategies applied by the municipalities, by examining whether and how the traits are present in the case projects. The traits have been observed in the work with the case studies, and are underpinned and elaborated here by drawing on a theoretical foundation.

Common traits in responsive strategy making are fairly straightforward: the purpose is usually to solve specific problems or reach certain set goals of the agency carrying out the planning; process and planning are characterized by following existing procedures and using familiar practices; regulations may play a large role in the formation of the strategy; and stakeholder involvement is often minimal and aimed more at mustering public acceptance rather than exploring external knowledge and alternative directions (Healey 2009). Transformative strategy making, on the other hand, is more complex, demanding greater navigational competences from planners. While there is in its essence not one "best practice" for this, Sehested (2009) describes some elements that are seen to be recurrent in strategic planning in practice – in a form similar to Healey's (2009) notion of transformative strategy making. Here, four usual traits are presented: purpose, content, process, and stakeholder involvement (Sehested 2009). According to Sehested (2009), the main purpose of strategic planning will typically be to identify certain areas of focus. These are often picked based on their importance to the elements of which there is an interest to change direction. The content of these focus areas go beyond the mere physical regulation of blueprint plans and project planning, and aims to integrate additional priorities, such as health, economy, or education. A central focus in this broader reach will often be to establish a common understanding. In the words of Healey: "*spatial strategy making may involve something more than selecting what are the "critical" problems and identifying good ways of addressing them. It may also involve searching out and creating a political community which identifies with the urban complex in question*" (2009, 441). The process of the planning is usually cyclical, as opposed to the usual linear structure of project planning: strategic planning is characterized by flexibility and ongoing revisions following changing circumstances (Sehested 2009). The process may move in multiple directions (ibid). It is usually characterized by processes of governance, and ongoing negotiation about direction on all levels are typical (Healey 2009). Lastly, broad stakeholder involvement is fundamental in strategic planning, including many kinds of stakeholders on multiple levels, and engaging with them throughout the process (Sehested 2009).

Even with these common traits, strategic planning can have many different configurations. Sehested (2009) makes a distinction between six different types of strategy in two main categories: analytical and learning strategic planning. These categories are largely analogue to Healey's (2009) distinction between responsive and transformative strategy making, but goes more into detail with the possible variations between strategies. Sehested's typology is chosen for the analyses in this thesis as its description of common traits and strategic navigation in different strategy types fits well with the initial findings of approach and navigation of the planners in the case studies. While the typology is not necessarily directly applicable to concrete cases of strategic planning, the types are useful for evaluating and comparing

applied strategies. This is used in the case analyses, where the strategies of the three studied municipalities will be related to these categories and types of strategy.

According to Sehested (ibid), analytical and learning strategic planning represent two different planning paradigms. Analytical strategic planning is characterized by regarding actors as rational actors; the professional planner is central to the scientific substance of development; processes may involve different stakeholders, but are typically top-down oriented with a governmental approach; and the strategies will often come as formalized, blueprint plans, almost with step-by-step instructions for development. Under learning strategic planning, it is recognized that stakeholders are biased and never completely rational; the planner is a facilitator for creative processes of experimentation and governance; and the aim is to create common understandings, and ultimately to enhance places for everyone using them in any way. Both categories are further subdivided into three types each: the analytical category may be focused on strategies as structural planning, as rational fulfilment of objectives, or as legitimization and implementation of political decisions. This can be seen as a continuation of the traditional, responsive planning. The learning category, on the other hand, is focusing on strategies as rhetoric and symbolic action, as a common frame of reference, or as mobilization.

	Strategies as structural planning	*Strategies as rational fulfilment of objectives*	*Strategies as legitimization and implementation of political decisions*	*Strategies as rhetoric and symbolic action*	*Strategies as a common frame of reference*	*Strategies as mobilization*
Purpose	Long-term management of municipal structures	Increasing political management capacity; deduction from strategy over principle to action	Clarifying applied goals and visions; ensuring implementation	Documenting execution of orders, but shielding own organization; "hypocracy"	Creating meaningful development for many actors	To mobilize and create connection between actors to create knowledge and alternative scenarios
Process	Top-down and internal: professionally specialized	Top-down and internal: political and professional	Top-down: negotiation	Outsourcing to consultants; short, effective, and professional process	Broad and inclusive involvement process	Broad, inclusive dialogue and process of action
Participants	Professionals and politicians; stakeholders eligible for hearings	Professionals and politicians; corporate involvement; stakeholders eligible for hearings	Professionals and politicians, implementers; stakeholders eligible for hearings	Few, selected professionals and politicians; very limited involvement	Involvement of everyone affected and representatives	Involvement of everyone affected and representatives
Tools	Technical analyses; plans as maps; comprehensive strategies	Technical analyses; shorter political documents	Technical analyses; contracts; action plans	Technical analyses; symbolic documents	Collective learning processes; political debates; temporary	Collective negotiation processes; collective learning processes; concrete problem solving

Six types of strategy. Based on Sehested (2009), own translation.

The six types of strategy can be understood as on a continuum, moving from less to more strategic according to the definitions of strategic of Albrechts (2004) and Healey (2009), as presented above. This does not mean that more strategic forms are necessarily better; other parameters, such as democratic involvement or the outcomes of projects, would need to be introduced in order to support such evaluations. The six types are examples of levels of strategy across this continuum, but when assessing real-life situations, strategies are likely to fall in-between types or to draw elements from both the analytical and the learning paradigm. Sehested (2009) refers to an analysis of the planning strategies of different Danish municipalities: it shows that the concrete strategies are not identical to the six conceptual types described, but are often mixing different elements of the types. Still, the typology is very useful, as it provides a structure for discussing and comparing the strategic aspects of different planning strategies, which it is used for in the later analyses.

The role of the planner

Change in planning paradigms also causes a change in the role of planners. As mentioned before, there is a change from an idea of the planner as an expert providing solutions to problems, towards a view on the planner as a facilitator for creative processes. The strategic planner is expected to cover more territory and engage more stakeholders, and generally to possess a much wider set of competences. According to Albrechts (2004), the traditional idea of the facilitator was a government mobilizing the public sector to solve problems; today, the facilitator enables the common work towards contextual strategic direction through processes of governance and "*mobilization of a plurality of actors with different and even competing interests, goals and strategies"* (ibid, 751). He continues to mention several functions of strategic planners as someone constructing alliances, continuously learning, and exploring interests and new perspectives as much as specific solutions. Planners are not following an established route; they are creating the route, and may change direction many times.

The last point is similar to what Healey (2009) points out about governmental activity, which is relevant to the municipal planning studied in this thesis: she states that a traditional assumption has been that government activity would occur within formal areas, and in accordance with existing legislation. However, she asserts, a shift has happened towards a focus on agency. While governments have a central role, current studies of strategy making examines how informal relations and networks between multiple stakeholders "*create the practices through which the formal procedures are enacted*" (ibid, 444). Rather than being given through generalized practices, procedural rules, or structural forces, practices should be formed in the specific strategic contexts. This is certainly relevant in regard to climate adaptation: here, water management – a task usually taken care of by technicians in underground, invisible systems – suddenly becomes a concern and responsibility for everyone in an area when the system is moved to the surface and into urban spaces. Hence, climate adaptation is an area where this shift is happening quickly, pushing planners to reinvent their practices. This is visible in the three case studies, and the new and somewhat experimental practices of the planners are interesting to examine.

The shift in views and expectations of planners is not uncomplicated. According to Munthe-Kaas and Hoffmann (2017), planners need to find a new position between authority and innovators; it is "*a complex situation, where technical expertise is no longer sufficient to develop the city and planning is becoming increasingly inseparable from the politics and power*" (ibid, 290). It has been increasingly acknowledged that "*planning does not take place in a vacuum, but is based on a complex mix of political interests, practical concerns, laws and regulations, professional practises, municipal strategies and so on"* (ibid, 291). According to Munthe-Kaas and Hoffmann (ibid), planners can be considered navigators in a complex network of actors. They are both part of the network, but also in a particular situation as they contribute to the initiation of the network, and instigate certain strategic foci. Their role as navigators involves mobilizing and connecting different actors and elements in a process of persistently increasing complexity (ibid). The approaches planners use when navigating these complex situations are described by Munthe-Kaas and Hoffmann (ibid) as 'navigational practices'. The broad possibilities for navigating these networks and relations are clearly present in the three case studies, in which the planners apply vastly different approaches to their own roles and navigations, with different levels of complexity. Examining these are relevant for understanding the role of the municipalities as planners and strategic facilitators, and for discussing how the different approaches to strategic navigation are connected to different contexts, methods, and outcomes.

Strategic navigation

An aim of strategy making is mobilization; of stakeholders, localities, and situations. This ensures the true transformative qualities of a strategy; the ultimate strategy type in Sehested's (2009) typology is termed 'strategies as mobilization'. Mobilization is to restructure the existing elements, to reconfigure roles and relations, and generally, to re-imagine the context (Munthe-Kaas and Hoffmann 2017). Mobilization is central in the analysis of the cases. It is clear from the initial work with the cases that different elements are mobilized, and to different extents: it ranges from mostly involving changes of the physical space in a responsive strategy making manner to including transformative re-configurations of stakeholder relations. This is interesting to dive into; mobilization is where planning becomes truly strategic, and the mobilizations happening in the three case projects can say a lot about their strategic approaches, but also about their outcomes.

Mobilization is one of three interconnected competences described by Munthe-Kaas and Hoffmann (2017) as navigational practices; the other two are sensitivity and staging. These can be used to describe the ways in which planners draw elements and actions together in the process of strategy making, and for obtaining mobilization. The practices appear in all three case studies, but in different ways: the practices are closely connected, and the sensitivity and staging applied correlates with the mobilizations happening. The practice of sensitivity is about obtaining an understanding of context, both in regard to people, situations, and existing structures; a sensitivity towards these things is a prerequisite for site-specific knowledge creation as well as for embarking on contextual strategy development (ibid). Sensitivity can happen through studies of the local situation, stakeholder involvement, and by establishing project groups with direct ties to locals. Staging, then, is about imagining and articulating potential futures. It is the

intervention with the context, and the process in which the first experiments in strategy development are introduced (ibid). Staging is about bringing together stakeholders in new constellations and examining the possibilities for change; it can happen by publicly presenting plans and suggestions, by creating proposals prompting stakeholder involvement and participation, by working with unusual collaborations and partnerships, and by negotiations about direction. Staging must built upon sensitivity in order to engage the relevant stakeholders in an appropriate way, and to experiment and develop proposals in a manner that fits the context. The practice of staging can be more or less temporary; it is an exploratory and experimental process which will ultimately lead towards mobilization (ibid). In this thesis, sensitivity and staging are examined in order to understand how the municipalities of the case projects have strived for and reached their mobilizations. Mobilization can be regarded as the result of the planning process, and is as such an aim of the processes of sensitivity and staging. It is the ensuing restructuring and re-imagination of the configuration of the given context, and may include a changed alignment of actors, situations, and structures (ibid). The process does not simply flow from sensitivity to mobilization: it involves constant negotiations and back-and-forth processes between the three competences, retaining the idea about strategic planning as a circular rather than linear process.

The involvement of stakeholders is – as mentioned before – very central to strategic navigation and planning. It is necessary to involve stakeholders of many kinds in strategy making in order to find a balance in power. According to Albrechts (2004), a process with too much of a top-down approach is very likely to miss the local, historically evolved, contextual knowledge and qualification potential; or in the terms of Munthe-Kaas and Hoffmann (2017), it may lack sensitivity. On the other hand, Albrechts (2004) asserts, a pure bottom-up process might overlook the potential hidden in the linking of locality-specific structures with macrotrends. As any project is affected by many external factors, continual framing and facilitation is necessary to any process, alongside strategic navigation. These are all tasks of the strategic planners, emphasizing their complex role.

Strategic navigation is many things, and through the case studies, certain practices of navigation are found to be significant for the transformative outcomes of projects. These navigations pertain to how planners interact with different contexts and conditions, and through different processes. This is analysed in the case studies, and examined further in the discussion. The following chapter will present how this is all coming together: how the different analyses of this project contribute to the examination of strategic navigation and its connection to contexts, methods, and outcomes.

Methodology

On the following pages, it is described how this thesis is put together. It is structured to present the general outlines of analyses first, and then narrowing down towards the specific use of individual methods. First is a short explanation of the general research approach applied. This is followed by a presentation of the approach to the most central analyses in this thesis: the case studies and the subsequent comparative analysis. Lastly, the principal methods for data collection and analysis are introduced; including literature studies, interviews, site visits, and coding.

The research approach

This thesis is based solely on qualitative methods. These are applied in a research design loosely based on grounded theory: an inductive method where observations are at the centre, and theory is constructed from these in a dynamic process, where new insights constantly change the understanding of the study objects. In their review of the development of grounded traditions, Charmaz and Belgrave (2015) describe five defining traits applicable to any tradition of grounded theory: data collection and analysis happens concurrently; comparative methods are used at every analytic stage; analytical categories are formulated in the beginning of the research process; analytical writing is carried out throughout the process; and sampling is used to develop ideas. These approaches can be interpreted in different ways; they have all been applied in this thesis to some extent, as explained in the following paragraphs.

The simultaneous data collection and analysis has taken place as the main gathering of data has happened through expert interviews, which have been spread out over a period of three weeks. In between, analyses have been initiated: primarily in the form of coding of data from interviews, project descriptions, and other documents relevant for the following case studies. Experiences from each interview has been influential to the execution of the next – new understandings are incorporated into the interview guide as the interview schedule progresses. Further, memo-writing has been carried out carefully throughout the process; memo-writing is defined by Charmaz and Belgrave (2015) as a central strategy in grounded theory to keep all ideas and questions in mind as analysis and writing progresses. According to them: "*Such writing helps to avoid meandering data collection and losing ashes of insight*" (ibid, 3). For this thesis, uncountable pages of such memos have been written and revisited alongside data collection and analysis work.

The use of comparative methods at each analytical stage has happened at a more subconscious level than the above point. Through the coding of various data, different points and statements have been juxtaposed, prompting new understandings and ideas to emerge; these have been recorded through the memo-writing.

Analytical categories have been devised early in the process: they have been formulated to fit the initial analytical targets of the project, and have been reconsidered regularly, as new knowledge and

understandings of contexts and connections have surfaced. This corresponds to the idea in grounded theory about how coding should be executed.

Analytical writing has been carried out through *some of* the process. Ideally, this should happen at every stage, as it can spotlight holes in the existing knowledge of the researcher (ibid). In this thesis, however, analytical writing was initiated quite late in the process, as the initial data collection became very time consuming. For the latter part of the project period, a better balance between data collection, analysis, and analytical writing was established. This has been beneficial, as lacking knowledge has been easier to discern.

Finally, the use of sampling to develop ideas has not strictly been applied, but in some degree: as several interviews have been carried out for each studied case, these contexts have been revisited and new questions for elaboration and clarification have been asked; both to fill knowledge gaps, and to apply adapted analytical categories. According to Charmaz and Belgrave (2015), this can be viewed as an approach to theoretical sampling.

In its purest form, grounded theory "*emerges from rigorous data analysis, not from adopting preconceived theories*" (ibid, 2). An initial literature review may affect the way data is analysed, causing the analysis to miss out on the fresh eyes that grounded theory can provide. This thesis does not live up to this guideline: an initial literature review has been carried out, and theories of relevance have been explored. However, while the theories are used to organize and explain the data, the initial choice of theories has been informed by the empirical findings. Overall, this thesis roughly follows the ideas of grounded theory. The following chapter describes central analyses of this thesis, the case studies.

The case studies

The case studies in this thesis aim to provide insights about subjects that the literature review alone cannot answer. Through the case studies, it is attempted to uncover existing municipal practices regarding large climate adaptation projects, the strategies they apply, as well as factors that might determine the success of such projects. This is done through inquiry into the project planning, the implementation process, and the applied planning strategies. Three case studies have been carried out:

- **Trekroner East (*Trekroner Øst*):** Greenfield project with about 1,000 households. Located in Region Zealand. The project is essentially completed as of 2020.
- **Kokkedal Climate Adaptation (*Klimatilpasning Kokkedal*):** Large climate adaptation and urban renewal project consisting of numerous smaller projects spread over a project area with around 3,000 people residing within it. Located in Capital Region of Denmark. Project completed in 2017.
- **Middelfart – The Climate City (*KlimaByen Middelfart*):** Project comprising three existing neighbourhoods of different urban typologies with a total of about 500 households within the project boundaries. Located in Region of Southern Denmark. Project completed in 2019.

The three cases have been strategically selected based on the maxim that the right cases are better than many cases (Flyvbjerg 2006). Case selection is elaborated below. The cases are used for both hypothesis testing (e.g. "municipalities apply different planning strategies for implementing climate adaptation projects") and hypothesis generation (e.g. "municipalities may benefit from using these planning strategies when implementing climate adaptation"). In accordance with the grounded theory approach to this thesis, hypothesis testing and generation happens in parallel: when new results emerge in the case studies, the initial hypotheses and problems are reconsidered, thus changing the exact focus of the case analyses. In line with Flyvbjerg's (2006) writings on case studies, the case studies of this thesis are not as much about proving a point, as about learning. Context-dependent knowledge is created, relevant to understanding the field and the challenges within it. The results are not meant as generalizations; rather, they are supposed to help lead the focus, introduce valuable inspiration, and fuel further analyses.

In this thesis, contemplations forming the basis for the case studies and the subsequent comparative analysis include: what are the different ways in which climate adaptation can be implemented in Denmark? How much can be achieved by use of the methods of the Danish Planning Act? What other methods are in use? What role does citizen engagement play? What are drivers and challenges for different methods, and for climate adaptation as a whole? What planning strategies are applied by the municipalities? How are the strategies connected to context? What are the similarities and differences between the selected cases? What are determining factors for successful climate adaptation projects? To make an attempt at answering these questions, a meaningful selection of cases has been necessary. This is a vital element in any case study: finding the right cases. In this thesis, the process of case selection has been multi-staged. It has included clarifying the relevant case selection strategy; determining common parameters that the cases should satisfy in relation to each other; deciding on factors where the cases should vary; and finally, choosing cases. These stages are described in the below paragraphs.

Case selection strategies

According to Flyvbjerg (2006), by using an information-oriented case selection, a maximum of information can be derived from a minimum of cases. Using such a selection strategy, cases are chosen based on their expected features (ibid). This can be done in multiple ways, depending on the intended outcome. In this thesis, cases are attempted chosen based on maximum variation: cases are different on some dimensions, making them useful "*... to obtain information about the significance of various circumstances for case process and outcome"* (ibid, 230). This, of course, requires large similarities between the cases to ensure they are comparable – this is accounted for under *Common parameters* below. The chosen cases vary on the context that projects are implemented in: on greenfield land, on built-up public land, and on built-up public and private land in Trekroner East, Kokkedal Climate Adaptation, and Middelfart – The Climate City, respectively. Further, the three cases are chosen as the use of implementation methods vary significantly between all three. Other factors have affected the choice as well, including project localities and the engagement of locals in the projects. Of course, many other dissimilarities exist, but these are the most central to this thesis. Chosen parameters for these dissimilarities are elaborated below under *Variations between cases.* Use of the maximum variation strategy has been

useful to highlight different ways to implement climate adaptation, to better understand different planning processes, and to emphasize the diverse challenges of municipal climate adaptation.

While not a focus in the initial case selection process, one case has turned out to be a possible *critical case*: a case for which it can be said that if a hypothesis is not relevant for this case, it applies to no cases (ibid). To a large extent, this is the case for Trekroner East. If climate adaptation can be implemented mainly through use of local plans, it should be possible here; on newly developed, greenfield land in a large, resourceful municipality. Of course, Trekoner East is not a "perfect" critical case; planning is complicated and many unforeseen, external factors could affect the results. Still, it can be used to showcase what is possible with local plans alone under favourable conditions.

Common parameters

To ensure that cases are somewhat comparable, some parameters have been established that they should all comply with. First of all, it has been decided to work with climate adaptation projects rather than the single actions of cities or municipalities. Projects are coherent and usually have the same people working on them in a set period of time. If focus was on a municipality, their actions would comprise multiple measures made in different locations and times of innumerable reasons and with changing people at the helm. This would have been unnecessarily complex and difficult to analyse. Still, this thesis is aimed at providing inspiration to municipalities for future work with climate adaptation: hence, focus is on projects were municipal planners play a key role, and on the options and challenges that these encounter when working with climate adaptation projects.

Along those lines, it has also been decided to work with newer projects (with project periods within the last 20 years), as they follow more up-to-date regulations. Also, this makes it easier to fetch plans and other documents online, and to get in contact with people who have been involved. This has somewhat been a given, as most climate adaptation projects are planned within the last few decades; but it has still been a deciding factor.

It has been chosen to focus on projects in urban areas (as opposed to projects in rural areas), and specifically to focus on projects that comprise residential areas. Here, people are directly affected by climate change incidents, and certain configurations of roles and responsibilities exist that are expected to involve the broadest range of stakeholders and possibilities for active citizen participation. Further, focus of the projects can extend to other present, urban issues.

In choosing relevant urban areas to consider, it has been decided to focus on midsize towns with more than a few thousand inhabitants, while avoiding the largest Danish cities. This is chosen as midsize towns comprise a large share of the people living in Denmark, and thus are going to be lifting a large part of the burden of climate adaptation. These towns have more resources than the smallest Danish towns that often have limited capabilities for such projects. On the other hand, the largest cities are likely to have unusually wide possibilities compared to more than a handful of cities and towns of Denmark, making them

difficult to draw experience from. Projects in midsize towns may include many of the possibilities and challenges present in climate adaptation projects in general, and experiences from these are expected to be comparable and transferable to more contexts.

While midsize towns are in focus, it has been a priority to choose large projects within these. Projects on a large scale usually generates the biggest changes, showing the broad possibilities for climate adaptation and the range of implementation methods. They are likely to include a wide array of different stakeholders, making them more complex and requiring more extensive strategic navigation – thus making them more interesting to investigate. They may encompass a large area, driving them to include more urban challenges and multisectoral issues. And – for the benefit of the study of them – there are likely to be more data recorded about their creation, and more possible interviewees willing to tell about the process behind these large-scale projects. Cases are chosen as to be on a similar, comparable scale.

It has been an aim to study three projects fitting all the above parameters. This has been decided with the goal of obtaining as much information as possible from a small number of cases. Three cases have been deemed fitting, as it can cover cases with diverse content without involving an insurmountable amount of work considering the resources present for this thesis.

Variations between cases

Looking at similar projects does not go a long way. To maximize knowledge creation, and understand more nuances of municipal climate adaptation projects, it is relevant to consider cases that are different on some central aspects. The contexts of each of the cases makes room for different approaches to planning. And the methods and strategic navigation applied by the planners highlight the diverse possibilities that exist for municipal climate adaptation. Hence, the cases chosen are also selected based on how they differ from each other.

Based on the above criteria, 12 cases have been shortlisted. These have been found through the collection of examples of climate adaptation projects on the Danish Environmental Protection Agency's (n.d.) portal for climate adaptation, klimatilpasning.dk, as well as through conversations with professionals with knowledge about climate adaptation projects. The next step has then been to narrow the focus down to a meaningful selection of three cases. Some parameters have been established to choose three cases that are expected to be comparable, but still deviate significantly from each other. These should hopefully allow for the largest amount of knowledge to be generated.

Basically, a final case selection has been pursued where the cases are located in different regions of Denmark. Despite the small size of Denmark, regional differences are vast: for example, in 2015, GDP per capita was almost twice as large in the richest region compared to the poorest (Eurostat 2015). By choosing cases in different regions, these variations have been anticipated to either be illuminated as important to the outcomes of the case projects, or to be dismissed as of limited relevance to project results, as least for the chosen cases. Further, cases in different regions has also been a preference as intraregional

cooperation could include several relevant municipalities, which could lead to confusion and a muddled case picture.

The final three cases are also picked based on the existing structures that climate adaptation measures and additional values are implemented in. There are significant differences between the project areas: in Trekroner East, the climate adaptation system is built in an empty field, before any buildings are constructed. In Kokkedal, the climate adaptation project is implemented in a built-up area, but as many, smaller actions that can be strategically placed. And in Middelfart, new measures are present everywhere in the project area, including public streets, recreational areas, and private gardens. These differences are likely to affect the choice of implementation methods, and the approach to strategic navigation.

The cases are chosen to showcase different implementation methods as well as different planning strategies; the chosen cases are those from the 12 with broadest coverage concerning these factors. From the initial examination of the cases, they have seemed to vary a lot; they use a range of implementation methods and different planning strategies that are more or less transformative: Trekroner East is developed with local plans as the main tool of implementation, and without a broad focus on stakeholder involvement. In Kokkedal Climate Adaptation, measures are implemented based on agreements between the municipality and other actors, with a large focus on cooperation and collective learning. And in Middelfart – The Climate City, implementation is happening with the use of a spectrum of regulation and agreements, and a large focus on stakeholder involvement throughout the project.

Analysing the cases

Each of the three case analyses are built up in four main parts. While planning strategies and strategic navigation are the main areas of interest for the case studies, other foci are included to support the assessments of these strategies. First is an overall introduction to the case. This is meant to give a general idea about the case project, the measures in place, and the processes behind planning and implementation. It is supposed to support the reader's understanding of the project as a whole when its parts are put under scrutiny in the subsequent sections.

Next is a section presenting the physical aspects and the processes behind the case projects. It provides the foundations for understanding the project initiation, structures, and process, useful when the planning approach is assessed. Several themes are examined:

- **Before the project:** The events leading to the conception of the case project
- **Physical and water technical aspects:** A review of the structures made as part of the project, including a dive into the technical aspects of the constructed water management system
- **Additional values:** The values added by the project that are not directly linked to climate adaptation
- **Process:** The partners behind the project and how the project has been planned and changed along the way.

Then follows a chapter examining the project implementation. This is important for understanding the strategic navigation, as it exemplifies the methods and navigation applied by the planners, and how these influence planning strategies and strategic navigation applied in the project. It focuses on:

- **Implementation methods:** The different methods applied in the project to construct and maintain water technical structures and additional values
- **Drivers:** Factors helping the implementation process along
- **Challenges:** Factors obstructing project implementation
- **Lessons learned:** Knowledge created through the project that is useful to the municipality and/or for other climate adaptation projects

This is further elaborated in the last part: it evaluates the planning strategy and strategic navigation applied by the municipal planners in working with the case project, by introducing understandings from the theoretical framework in relation to the case. It follows up on all the previous parts, and introduce a theoretical angle on those. The applied strategic navigation is assessed in relation to the definitions of responsive and transformative strategic planning by Healey (2009) and a typology by Sehested (2009). Further, the projects are analysed in relation to the notions of navigational practices (Munthe-Kaas and Hoffmann 2017).

The results from the case studies are examined further in the subsequent comparative analysis and discussion. These draw on results from the case studies as the central point of analysis: they are elaborated and compared. The case studies are attempted designed in a way that eases comparison: by examining the same things, letting the studies follow a similar structure, and carrying out interviews in the same ways. The below section introduces the methods applied to gather and analyse the data that is used in the case studies.

Data collection and analysis

As mentioned before, this thesis relies on qualitative methods. Analyses have been based on data from literature studies, interviews, and site visits. The literature studies have examined the existing work on how climate adaptation can be implemented in Denmark by municipalities. Further, it has laid the groundwork for the case studies, as well as for the initial analytical categories. These have been elaborated more through the interviews, where additional data about the cases has been gathered, and additional analytical categories have been devised. Data from literature studies and interviews have been coded in NVivo with the relevant analytical categories in an iterative process. Finally, visits to the case areas have been made, each led by a former or current municipal employee with knowledge of the area: the visits have had the purpose of giving an impression of the place and the solutions in question, in order to get a better understanding of the whole.

Literature studies

Literature studies have been carried out in stages. An initial literature study has focused on the existing literature about municipal options for climate adaptation: useful methods, plans, governmental

guidelines, configurations of roles and responsibilities, and practices in the municipalities. The texts in focus have been reviews of planning and climate adaptation in Denmark, including Hellesen et al. 2010, Lund 2016, and Post 2012. These has been used to narrow down the focus of this thesis, as well as to describe the existing possibilities and common ways of working with climate adaptation. Later, literature studies have been used to support the case studies: both in the case selection, and as groundwork for the studies. The interviews are also partly based on these. The literature examined here has included project descriptions and plans, evaluations, municipal plans and climate adaptation plans, local plans, and other writing referencing case projects.

Interviews

This thesis could not have been completed without the knowledge of several professionals working with climate adaptation on the daily. They have contributed with guidance for direction of the project, case-specific knowledge, and own perceptions of climate adaptation in municipal planning. Most of these people have been included by means of research interviews: a qualitative method for data collection that can, amongst other things, be used to collect "facts" or gain insight into understandings, experiences, and opinions (Rowley 2012).

The intention of using interviews in this thesis have been to provide deeper insights and other perspectives than what is available in written form, such as in project descriptions, plans, and evaluations. Insight is sought into the origins and processes behind the case projects, as well as elaborations on structures, additional values, and citizen participation. Central has also been the focus on implementation process, and which methods have been used for this. It has also been a goal to uncover the interviewees' experiences of what went well and what was problematic in the project implementations; not necessarily their personal opinions, but perhaps rather their professional assessment of the matter. Finally, it has been attempted to gain an understanding of the planning strategies and strategic navigation present within the different municipalities.

Before the case-specific interviews commenced, a phone call with Jens-Phillip Petersen, Urban Planner in Municipality of Thisted, was made to get a better understanding of the field of municipal climate adaptation. Petersen told about the common considerations and challenges when working with climate adaptation on a municipal level, and highlighted some central issues that could be relevant to study further. While this conversation has neither been transcribed nor used directly in this thesis, it has been valuable in forming the approach early in the process. It has guided the specific focus, and has been considered when preparing the later interviews. After this, case selection was carried out and potential interviewees were found and contacted. A total of seven interviews were carried out; interviewees will be presented shortly. First, a few notes on the structure of the interviews.

Typically, research interviews are classified on their level of structure (Rowley 2012). The interviews carried out as part of this thesis are all semi-structured. Interviewees are experts within the different case areas. In the analysis, data from interviews is treated as "facts" about the case projects, and presented as

such; it is not emphasized which of the individual interviewees the knowledge stems from, and they are not directly quoted (although they are, naturally, referenced by name). It is understood that knowledge, opinions, and views are shaped by the person or through the interview process. But here, their statements are treated as unquestionable first-hand information about the cases; this resembles a neo-positivist approach (Rowley 2012).

In total, seven interviews have been conducted: two for Trekroner East, two for Kokkedal Climate Adaptation, three for Middelfart – The Climate City. Including more than one interview per case has been a priority, in order to approach the projects from more than one angle (the interviewees have had different roles in the projects). Further, returning to a case study to interview another person working on it has been beneficial as unanswered and follow-up questions can then be asked.

For conducting the interviews, a sort of interview guide has been developed (see Appendix; note that it is in Danish as all interviews have been carried out in Danish). As mentioned, the interviews have been semi-structured, and the guide has not been followed closely. Rather, it is a selection of questions that have been relevant to the cases and the focus points of this thesis. It can be viewed as a representation of what the interviews together should ideally answer for each case study. The questions have been generated employing a deductive approach – they are formulated on basis of the initial literature study, and have been reconsidered/rephrased/replaced when more knowledge has been obtained through further literature studies or as more interviews have been carried out.

For each interviewee, a number of questions have been chosen – depending on the role of the interviewee, and if some questions have been comprehensively answered in an earlier interview. After giving a brief introduction to this thesis, the interviewees have been asked the 5-10 questions chosen for them specifically. Sometimes, sub-questions have been asked as prompts. Questions have not been asked exactly as written: they have been phrased during the interview in order to keep it conversational. Likewise, questions have not been sent to interviewees beforehand, except for in the one instance were the interviewee (Bjarne Rasmussen, presented below) specifically requested it. However, this has not affected that interview significantly, except that the answers were perhaps slightly more elaborate and in-depth than those of other interviewees.

As the global COVID-19 pandemic has coincided with the time period allocated for this thesis, all interviews have been conducted over phone or video call, to avoid unnecessary physical proximity.

Interviewees

Relevant people on the case projects have been found in different ways. Project leaders and other central people that are mentioned in project descriptions have been contacted. Interviewees have referred to other relevant contacts. And two other people have helped finding contacts, namely Jonathan Leonardsen (Market Director, Urban Resilience and Development, Sweco; see *Preface*) and Johan Vedel (Project

Leader, Centre for Urban Development, Environment, and Industry, Municipality of Fredensborg). Altogether, this has resulted in a good selection of interviewees central in the different case projects.

Generally, people have been very eager to contribute to this thesis, and most of those contacted have answered within a short time. Only three people who were contacted have not answered: of these, it has turned out that two are retired. Instead, other contacts have been found, resulting in a reasonable number of interviewees considering the purpose of the interviews and the resources present for this thesis. It should be mentioned that several of the interviewees do not work anymore in the organizations they associated with during the case projects; however, this has not been considered affecting outcomes of the interviews.

The interviewees are (sorted by interview date):

- **Pernille Svane**, former Project Manager for Middelfart – The Climate City and still working as project leader in Municipality of Middelfart. Her knowledge is particularly about the last phase of the project, from when the construction work started. She was interviewed on May 1st, 2020.
- **Jacob Kloch**, Urban Planner in Municipality of Middelfart. He has a large insight into the planning of Middelfart – The Climate City. He was interviewed on May 4th, 2020.
- **Bjarne Rasmussen**, Engineer, Department of Nature and Environment in Municipality of Middelfart. He knows a lot about the structures and water technical solutions implemented in Middelfart – The Climate City. He was interviewed on May 5th, 2020.
- **Ejvind Mortensen**, former Project Manager for Kokkedal Climate Adaptation, Municipality of Fredensborg; currently Senior Consultant in ARGO. He has a broad knowledge about much of the process behind the project. He was interviewed on May 5th, 2020.
- **Kirsten Toft**, former Plan and Project Manager, Roskilde Forsyning; currently Senior Project Leader, HOFOR. She knows a lot about the entire process of Trekroner East, from the initial planning to final implementation. She was interviewed on May 6th, 2020.
- **Signe Gudiksen**, former Project Manager, Roskilde Forsyning; currently Project Leader, VandCenter Syd. She has knowledge about process, plans, and cooperation in Trekroner East. She was interviewed on May 18th, 2020.
- **Ulrik Lassen**, Senior Engineer at Rambøll and has worked on Kokkedal Climate Adaptation. He has broad knowledge about the project, including about planning, process, and cooperation. He was interviewed on May 19th, 2020.

All interviews have taken between a half and one hour. After permission from the interviewees, they have all been recorded. Within the week of each interview, they have been transcribed for easier coding and analysis.

The way interviews are planned and carried out leans on the grounded theory approach of this thesis. The interviews are generally broad, opening for the thesis to be formed by the knowledge obtained from each interview. As each of the interviews are carried out, the interview guide is adjusted to slight shifts in project focus, and to refine the questions to make them more clear and relevant. For interviews regarding

the same case area, a different set of questions is prepared for each interview in order to build upon the knowledge already found.

Coding

Data relevant to the case studies has been coded thematically in the qualitative data analysis program NVivo. This data includes case descriptions, plans, evaluations, and interview transcripts. All data is coded for the project area it relates to: meaning that all nodes exist in three version, one for each case. There are 13 identical nodes per case project, briefly explained here:

- **Project background:** What went before the project, and why was it initiated? (e.g. because of an extreme rain incident)
- **The good narrative:** Interesting points and facts that adds to the narrative about the project
- **General, including structure:** Simple project facts (e.g. project area) and the overall structure of the project
- **Water technical elements:** The structures constructed to manage water, and information about the new water system (e.g. dimensioning, flow, treatment)
- **Additional values:** Descriptions of the additional values the project has brought along, including how these are integrated in the project
- **Process:** The planning and construction of the project, including any major events in the project period
- **Roles, including citizen participation:** Configuration of roles and responsibilities within the project, including engagement and roles of citizens
- **Use of the Planning Act:** How paragraphs in and plans under the Planning Act have been applied to realize the project
- **Use of other methods**: Further methods used to realize the project (e.g. public street legislation, wastewater plan, volunteerism)
- **Challenges, drivers, and success factors:** Factors that have been helping the project along or slowed it down; and factors that have been central in the success of the project
- **Funding:** Information about parties funding the project, and other factors relating to project economy
- **Evaluation:** Completed and planned evaluations of the project, including of the water technical structures, the additional values, and the public reception
- **Other points:** Anything else that might be relevant to the project (mainly single points that would else belong in categories by themselves)

This is the final selection of nodes. In tune with grounded theory, it has transformed along the way. A first set of nodes was chosen based on the initial literature review. Nodes have been reconsidered with each step of data collection and analysis – especially when going through the interview transcripts, and when writing the case studies. Nodes have been added (if missing) or removed (if superfluous), and categories have been merged or split up when it has made the approach to analysis more straightforward. The final set of nodes has been useful for categorizing the topics covered in the case studies.

Site visits

Finally, visits to the three case areas have been carried out to get a feeling of each area, see the solutions implemented, and get a better understanding of the elements and the connection between the solutions. The visits have been guided by municipal employees, current or former, with knowledge about the areas – these people are also mentioned above, under 'Interviews'. Visit times and guides have been:

- **Trekroner East:** May 11th, 2020, with Kirsten Toft (former Plan and Project Manager, Roskilde Forsyning; currently Senior Project Manager, HOFOR)
- **Middelfart – The Climate City:** May 20th, 2020, with Bjarne Rasmussen (Department of Nature and Environment, Municipality of Middelfart)
- **Kokkedal Climate Adaptation:** June 10th, 2020, with Johan Vedel (Project Leader, Centre for Urban Development, Environment, and Industry, Municipality of Fredensborg)

During these visits – which have taken between one and two hours – important elements of the projects have been presented, including water technical elements and additional values, and clarifying questions have been answered. The site visits have helped increase insight into the cases and to form the narratives in the written case studies. Again, as this thesis has been conceived during a global pandemic, appropriate measures have been taken to ensure that site visits have happened in a responsible manner.

All in all, the methods presented above are the ways by which this entire project has been formed. The following chapters are structured as to introduce the central elements of climate adaptation, including water technical aspects; configuration of roles and responsibilities; and climate adaptation planning in Denmark and its possibilities. These introductions ensure the main understandings are present before embarking on the case studies and the subsequent comparative analysis.

Water technical terms and elements

This chapter will provide a brief introduction to the terminology used and measures referred in the following chapters. There are two main parts to this: the first section introduces some important definitions that are used in the case studies. The next one presents water technical elements and climate adaptation solutions present in the case studies.

It is an important understanding that the water cycle is a cohesive system, and it must be handled as such. In built-up areas, water cannot follow its natural cycle without creating inconveniences; hence, there is a need for technical interventions to maintain the cycle without compromising quality and function of the urban area. This water management starts when the rain falls, and ends when the water is infiltrated, evaporated, or led to recipients. This is the foundation for climate adaptation.

Terms and definitions

The terms presented here are recurring through the project and central in understanding how climate adaptation projections and planning are carried out.

Climate scenarios are different projections of climate change in the future, developed by IPCC. The different scenarios include predictions of changes in temperature, precipitation, and wind. Municipalities define a reference scenario in their climate adaptation plans. Most – including all three case municipalities – use the A1B scenario: a scenario presenting medium severe effects of climate change until 2050, including significant increases in precipitation and days in a year with heavy rain (Danish Nature Agency 2013). A **climate factor** is a way of correcting for the projected changes by multiplying the current intensity of rain with a given factor to predict the future rain intensity (ibid). Climate scenarios and factors are important to consider for municipalities, as the amounts rain they must handle are associated with great uncertainties.

For this thesis, **extreme rain incidents** are defined as rain incidents of a magnitude that is recurring at most once every five years under the present conditions. **Heavy rain** is defined as rain incidents that might happen as often as five times a year. **Everyday rain** is referring to smaller rain incidents – these make up 95% of the total rainfall (Orbicon, SLA, and Hoffmann 2013a).

The **service target** is the frequency of rain incidents within which water systems must be able to contain the water; in other words, for rain incidents beyond the service target, water overflow is accepted (Lund 2016). It is the role of the wastewater company to ensure the service target, which is usually ten years for combined sewers and five years for separate sewers (ibid).

Dimensioning refers to the capacity of water structures, measured in repetition periods; i.e. a sewer dimensioned for a 10-year rain incident have capacity for such an incident, but will overflow when larger

rain incidents occur. Dimensioning of water structures is closely related to climate factor; often, dimensioning is stated as a repetition period taking a certain climate factor into account.

Water technical structures and climate adaptation solutions

The structures and solutions presented here are traditional ways of handling water, as well as more recent ways of handling it when working with climate adaptation. All mentioned measures are used to varying extends in the case projects. The following paragraphs are based on a climate adaptation technology catalogue by Orbicon, SLA, and Hoffmann (2013a).

Underground sewers are the traditional approach to managing waste and rainwater. Underground pipes lead water invisibly below the city. The sewers are either combined, with waste and rainwater in the same pipes, or separate, with one system of pipes for wastewater and one for rainwater. This is done to prevent wastewater backup in situations with heavy rain, and to avoid sending almost clean rainwater to water treatment plants.

Solutions on the surface are often referred to as SUDS; sustainable urban drainage systems. Handling rainwater on the surface is often cheaper than establishing separate sewers when capacity is reached. But it may pose some challenges: e.g. it consumes more surface space, and it is more dependent on gravitation and on being constructed to utilize the natural slopes of the landscape. SUDS include solutions of many different kinds; some are presented below.

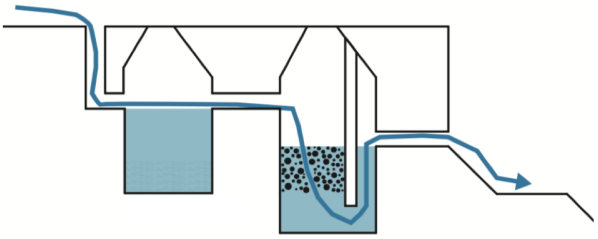
Channels on streets and grassy wadis are typical means of leading water on the surface. These lead water from streets and other impermeable surfaces to the recipient; the water body that rainwater must be discharged to. On the way there, different measures can be used to delay or treat the water.

Three ways to lead water: in channels in the middle of streets, in street-side drains, and in grassy wadis. Source: Orbicon, SLA, and Hoffmann 2013a.

Rainwater basins can delay water, making sure that no part of a water system is overburdened, leading them to overflow. Generally, two types exist. Retention basins have a permanent water level; detention basins are dry most of the time, but are filled with water in case of large rain incidents. Often, the basins are equipped with recesses, letting water flow along at a steady pace or when capacity is reached.

A basin slowly letting water seep through at a steady pace. Source: Orbicon, SLA, and Hoffmann 2013a.

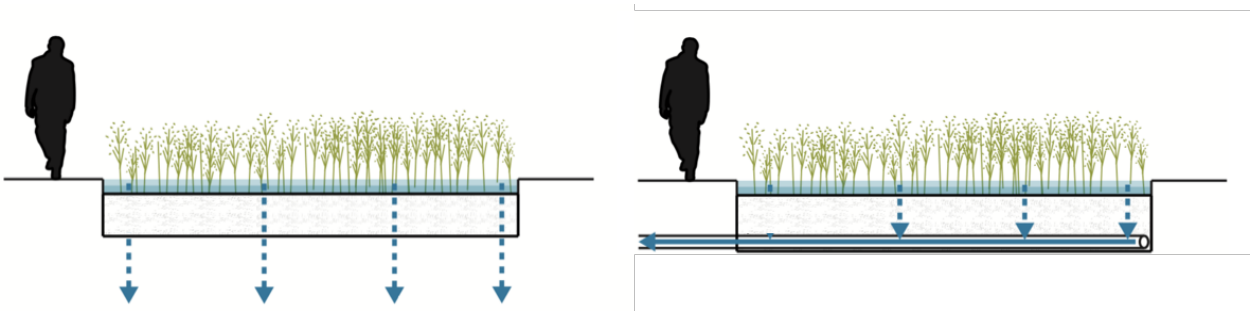
Treatment of rainwater may happen in these basins, as nutrients and heavy metals in the water are sedimentated. Other means for treatment include sand traps, where water is treated in a similar manner; oil separators, which utilize the fact that oil floats on top of water to capture it by having their recess in the bottom of the separator tanks; rain gardens, where the soil and plants capture some of the impurities in the water; and first flush diverters, which fills a tank with the first and most polluted volume of water. All these measures require cleaning occasionally.



A sand trap and an oil separator. Source: Orbicon, SLA, and Hoffmann 2013a.

Instead of discharging water to a recipient, it can also be infiltrated. This relieves the water management system and can contribute to groundwater recharge. Infiltration is advantageous in many instances, but it requires the underground to be able to absorb water in sufficiently large quantities. Infiltration can happen in wadis, rainwater basins, and rain gardens, and does in itself provide some water treatment. Infiltration measures can easily be installed on individual plots.

Rain gardens can be used to delay or infiltrate water. If infiltration is possible and desirable, the rain gardens can infiltrate water and contribute to groundwater recharge. If infiltration is not an option, water can be delayed as it seeps through the soil, and then led on through the system from an underground drain pipe.



Rain gardens for infiltrating (left) or delaying (right) water. Source: Orbicon, SLA, and Hoffmann 2013a.

Along being useful for handling rainwater, these surface solutions provide new opportunities for using the visible water to create additional values. This is elaborated much further in the case studies. For now, the next chapter will review the usual configuration of roles and responsibilities in climate adaptation projects working with measures such as those presented here.

Configuration of roles in climate adaptation

Climate adaptation projects in Denmark, whether strategic in nature or not, are subject to certain regulations regarding the configuration of rules and responsibilities. This is a complex matter, especially on the topic of funding. Discussions on both the distributions of responsibilities, regulations on climate adaptation, and the matter of funding can be found in several other publications (see e.g. Krawack 2014; Lund 2016). This is not the central focus of this thesis. Rather, the configurations of roles and responsibilities in Danish climate adaptation projects are introduced here to provide an understanding of these topics, in order to establish a frame of reference for later chapters.

Thus, this chapter is not a deep dive into distribution of roles in climate adaptation. It introduces the aspects of the configurations that are most relevant to the later analysis. These are the responsibilities of the actors that are central in the projects, namely wastewater companies, municipalities, and private property owners. It should be noted that distribution of responsibilities is not clearly defined on all aspects in the legislation on the subject (Lund 2016). In this chapter, the main responsibilities are presented in a generalized manner; in reality, the configurations are much more complicated and unclear. The more detailed aspects are discussed elsewhere (e.g. in Lund 2016).

The role of wastewater companies

The wastewater companies are committed to ensuring that all wastewater and rainwater is led away from properties within the public sewerage catchment areas, according to the service target set by the municipality (Lund et al. 2012). The service target determines how much rainwater systems must handle, and the frequency of rain incidents where water on terrain is accepted – usually, this is at most once every ten years for areas with combined sewers for waste and surface water, and once every five years for areas with separate sewers (Lund 2016). However, wastewater companies are not responsible for private basements; only for securing buildings above ground level (Lund et al. 2012). The service target must be met, despite increasing amounts of water to be controlled; the wastewater companies are also responsible for ensuring that the sewer systems are dimensioned for these amounts of water, and for the maintenance of the systems (Lund 2016). Hence, they play an important role in avoiding floods caused by everyday rain and other rain incidents within the service target (ibid).

The wastewater companies are owned by the municipalities in which they operate (Lund et al. 2012). Usually, climate adaptation projects are carried out in cooperation between municipalities and wastewater companies: the wastewater companies have the main responsibilities for meeting the service target and regarding the funding of these projects (Lund 2016). The funding from wastewater companies comes entirely from tariffs, mainly sewer connection charges paid by private individuals (Krawack 2014).

The role of municipalities

On the other hand, municipalities have the most central role when it comes to planning of climate adaptation projects (Lund 2016). They oversee the general management, in particular of the spatial planning; including municipal and local plans, as well as wastewater plans (Lund et al. 2012). Through these plans, they can to some extend regulate the conditions of connection to the sewer systems for single plots, e.g. by planning for areas where private properties are not connected to sewers for rainwater (ibid). When developing new residential areas, they also have the opportunity to include broad regulations for water management; this is elaborated in the next chapter. Such local plan processes include consultation and dialogue, and through this, negotiations about the planning can take place.

With the introduction of the municipal climate adaptation plans, the main responsibility for climate adaptation is placed with the municipal councils (Lund 2016). Further, they decide the service target, and while the wastewater companies are responsible for the compliance with this, the municipalities are responsible for measures providing further protection (ibid). Additionally, municipalities are responsible for further measures with functions not entirely focused on water management; i.e. additional values in the form of physical elements (ibid). Municipalities finance the parts of climate adaptation projects that are not directly related to meeting the service target, and that have some legal basis: including measures securing beyond the service level, and elements aimed at creating additional values (Krawack 2014). This economic framework often causes issues regarding the distribution of funding in climate adaptation projects (ibid).

The role of private property owners

Private individuals are essentially only obliged to ensure their own property. Buildings should be kept in a condition where they are resilient to rain, and basements must be secured, e.g. by perimeter drains or with pumps (Lund et al. 2012). If making changes on their plots, property owners must follow regulations in local plans (ibid). Further, the way water is handled on private plots must not be a nuisance to neighbours (ibid). Private individuals bear the costs associated with measures taken on their own properties; these measures may in some cases be subsidized by the municipality, e.g. by refunding part of the sewer connection charges (Krawack 2014).

While it is not a statutory obligation, many municipalities believe that all property owners have some responsibility for the common water management (Lund 2013). Private properties constitute a large part of cities, and thus, a significant share of climate adaptation measures must be implemented there (Hellesen et al. 2010). Further, the public measures taken does also impact locals; particularly when climate adaptation measures are implemented on the surface (Orbicon, SLA, and Hoffmann 2013a). The distribution of roles is unclear when it comes to the responsibilities of private individuals, and it is a challenge for municipalities to involve them in a meaningful way (Hellesen et al. 2010); examples of how this is managed in practice are provided later, in the case studies.

A few notes on the distribution of roles

Of course, many other actors have a role to play in climate adaptation. Emergency services, consultants (Lund 2013), companies, organizations, locals, and users of the areas in question (Lund 2016) all have a role to play in climate adaptation as well. And their responsibilities are growing: while locals and companies are not legally obligated to do much more than maintaining their own properties, most municipalities see their participation as vital to successful climate adaptation, and expect them to participate actively in climate adaptation projects (Hellesen et al. 2010). The majority of private individuals share this understanding (Lund et al. 2012).

The question of funding is also much more complex than presented here. For climate adaptation projects managing water on the surface, a much-debated element is the opportunity for wastewater companies to co-finance projects that have both water technical and additional functions. This is thoroughly discussed in Krawack (2014). On top of the distribution of funding between the main actors, many climate adaptation projects are also financed by foundations, EU funds, etc.

Generally, there is good cooperation between municipalities and wastewater companies, although they are not entirely pleased with the present regulations (Krawack 2014). While the configurations of roles and responsibilities are not a central focus in this thesis, the associated challenges are present in the case studies. Roles and cooperation are a central theme in all climate adaptation; in this thesis, it is examined with the primary aim of understanding and analysing the planning strategies applied by the studied municipalities.

The next chapter goes into detail with the options municipalities have for planning for climate adaptation; both trough traditional measures such as local plans, and through measures that are not strictly meant for climate adaptation, but are useful still.

Climate adaptation in municipal planning

This chapter introduces the presence of climate adaptation in the Danish planning system. As the position of climate adaptation in planning has gained more attention the past decade, new regulations have been issued in support of that; these are summarized. Then, as the focus of this thesis is on municipal climate adaptation, two central plan types on the municipal level are then introduced; climate adaptation plans and local plans. Their purposes and possible regulations of climate adaptation measures are presented. However, their effects are limited, and other measures are often necessary to successfully implement climate adaptation projects. Examples of such measures are provided, based on a study of literature on the subject. This chapter provides the basis for the analyses of municipal climate adaptation projects in later chapters.

The Danish planning system

Climate adaptation in Denmark is embedded within a hierarchy of plan types, managed by different levels of government. The central piece of legislation containing the framework for this hierarchy is the Planning Act (2020). The act has coherent planning as its purpose, with different main objectives regarding economic development, support for nature and biodiversity, and public participation (ibid). Under the Planning Act, the Danish plan system is defined.

The Planning Act ensures decentralized responsibility by having plans dispersed across all levels of authority; from the national government to regional councils and to municipalities (Danish Nature Agency 2012). In the planning hierarchy, plans and regulations on higher levels are more authoritative. The highest levels of regulation are legislation and directives from the EU. These are implemented and hence catered for in the Planning Act and other acts. The highest level of planning in Denmark is the national level: planning on this level focuses on government policies, and nationwide sector plans are prepared here, including traffic and Natura 2000 plans (ibid). On the regional level, regional development plans are prepared, as well as sector plans regarding raw material planning (ibid). Finally, in municipalities, municipal plans and strategies for planning are created, and numerous sector plans pertaining to the local conditions are developed (ibid). Further, municipalities are responsible for local plans.

Local plans are where plans and political strategies of municipalities are concretized; they determine future development of demarcated areas, and they are legally binding for local property owners (Danish Nature Agency 2012). The municipal plan describes a framework for local plans in the area; both in terms of general zoning, as well as more elaborate regulations for desired development (ibid). The specific content of local plans can vary considerably, depending on their intended function in an area; they may regulate urban development, architectural appearance, or single, specific themes such as signage in an area (ibid). It is also through local plans that measures on private property can be planned, including certain climate adaptation measures.

In parallel with these plans, municipalities are also responsible for developing numerous sector plans in accordance with the related sector acts. The sector plans touch upon a broad range of topics (including waste management, traffic, and wastewater), and many of them are based on a multitude of acts and regulations that are not necessarily coordinated. Sector legislation and planning are complex affairs that are not central to this thesis. For the reader with a particular interest in the subject, a list of acts and regulations concerning water – relevant for climate adaptation focusing on water issues – can be found in Danish Environmental Protection Agency 2015 (in Danish).

Within several plans in the planning system, climate adaptation measures can be planned for. However, as mentioned earlier, many municipalities are not aware of the possible extend of their climate adaptation planning. Further, the Planning Act in general and local plans in particular have been criticized for not providing adequate tools and methods for climate adaptation. This has been attempted accommodated through regulatory changes.

Recent changes to planning regulations

Methods for implementing climate adaptation have been a growing demand from municipalities, especially in the last ten years; extreme rain incidents, pressure from the public, and an increased focus on climate change and adaptation in general have pushed this demand (Lund and Nellemann 2012). To cater for this growing need for climate adaptation in cities, several changes in Danish legislation have been made in recent years. In 2012, with the annual financial plan, the Danish government and Local Government Denmark (*Kommunernes Landsforening)* agreed that all of the 98 Danish municipalities should have climate adaptation plans, a new type of sector plans, in place before the end of 2013 (Danish Environmental Protection Agency 2018). The idea was to encourage municipalities to initiate broad climate adaptation efforts, and provide them with the tools necessary for developing such plans (Danish Nature Agency 2013). Looking forward, these plans should be guiding for the municipalities in their efforts to assess and combat local effects of climate change.

This first step has been followed by amendments to the Planning Act with the goal of enhancing the tools for climate adaptation planning that local authorities have. In 2013, soon after the introduction of climate adaptation plans, §15(1) in the Planning Act – describing the possible legal purposes of local plans – was changed to include climate adaptation as a legitimate justification of planning (Danish Environmental Protection Agency 2019). Plans mentioning climate adaptation as a purpose are classified as climate local plans. While the change was minor in terms of the changed wording, it has been influential for how municipal councils can interpret the topics that local plans can regulate, making it easier to set requirements for climate adaptation measures in these plans (ibid). Further changes were introduced in 2018, where it was made possible to include requirements in local plans that mitigation measures must be constructed in flood-prone areas (ibid). The possible regulations in local plans are elaborated later.

These new initiatives have given municipal councils more possibilities of regulating for climate adaptation through local plans. At the time when climate adaptation plans and climate local plans were introduced,

the Danish Nature Agency (2013) published a guiding manual for implementing climate adaptation with these plans. This manual provides municipalities with some of the knowledge they have been missing about possibilities about planning for climate adaptation, and it is certainly valuable in the development of these two plan types. However, climate adaptation measures in local plans have their limitations; mainly that they can only regulate future changes, not existing structures. Thus, climate adaptation in existing built-up areas must sometimes be planned and implemented by using other methods. These possibilities are elaborated later in this chapter, and in the following case studies. First, content and possibilities in climate adaptation plans and local plans are presented.

Municipal climate adaptation plans

Municipal planning for climate adaptation is, of course, not an entirely new thing. In a report from 2010, Hellesen et al. examine how climate adaptation is approached in Danish municipalities. They point out how in 2010, years before the requirement for climate adaptation plans, about half of the studied municipalities had a climate plan or strategy of some kind in place. Further, about three out of four of the municipalities had included climate adaptation in local plans in some way. This shows that climate adaptation was already an area of focus at that time. However, the report concludes that the climate adaptation at the time was of a very technical nature, and that citizen participation was not broadly applied when planning for climate adaptation – a rather responsive approach. This contrasts with another point in the report, where it is observed that a large part of climate adaptation measures should be on private properties – both as they often make up a large part of the surface area, and as many of the adverse effect of heavy rain happens here, such as basement floods and sewer backup. Perhaps this is why local plans have been such a central focus in municipal climate adaptation planning, although other methods can be effective as well; more on this later. Nonetheless, the introduction of mandatory municipal climate adaptation plans has ensured that all municipalities plan for climate adaptation to some extent.

What exactly are the climate adaptation plans? The plans are intended to be at the centre of municipal climate adaptation efforts, prioritizing and pointing out the direction for coordinated efforts (Danish Environmental Protection Agency 2018). They should be ready by the end of 2013, and typically contains these elements: a description of the local situation; a risk mapping, based on a selected scenario for predicting climate change; framework for the effort and corresponding guidelines; and optionally, an action plan (ibid). The climate adaptation plans have been published as either parts of or appendices to the municipal plans; if an action plan is included, it will typically be necessary to implement the initiatives in other sector plans as well (Lund 2013).

The obligation of municipalities to develop climate adaptation plans is not part of the Planning Act or other acts; it is solely specified in the 2012 financial plan between the Danish government and Local Government Denmark (Lund 2016). Further, action plans are not required, the plans are not legally binding, and municipalities have only been obligated to make that one plan in 2013; they do not have to be renewed (ibid). Thus, the plans could be taken lightly by municipal councils. But mostly, this is not the case. In her study of ten climate adaptation plans, Lund (2013) concludes that the studied

municipalities have used the plans actively. On several topics, they have had the same priorities: they have all wanted to separate rain and wastewater in the sewer system; they want to manage rainwater primarily through infiltration, or alternatively use retention and detention basins to delay the water; and they all want to utilize the handling of water on the surface to ensure additional values, especially in the form of recreational values.

This shows a central value of the climate adaptation plans: municipalities are forced to consider climate change and climate adaptation, and they are inspired to use it in conjunction with other urban themes. Principally, the responsibility for developing and implementing the plans lies with the municipal councils and the wastewater companies; but as the task grows to involve more sectors, additional actors are involved as well from different areas (Lund 2016). This is positive in that it promotes multisectoral planning, but it also makes the processes more complicated (ibid); and increases the need for transformative planning approaches. This might make it difficult for municipalities to benefit fully from using the plans, considering that they already called for more guidance before they were introduced. Some guidance was issued along with the requirement of developing these plans – see Danish Nature Agency (2013) – but it is rather general, and only provides limited guidelines for the specific ways municipalities should approach the plans in their unique contexts.

All in all, the climate adaptation plans are valuable as they put risk mapping and climate adaptation on the agenda in all Danish municipalities. They encourage the municipalities to apply strategic approaches to their climate adaptation efforts as they promote coordination of actions and collaboration across sectors. But they include no requirements for action plans or renewal, and can easily be dismissed. And while they encourage a certain way of planning for climate adaptation, no new tools or methods are introduced as such. Local plans, on the other hand, are one such tool; the following section will introduce the opportunities of planning for climate adaptation using local plans.

Local plans and climate adaptation

Local plans are where a lot of the regulations affecting private property owners are located; in fact, the local plan is the only plan type with direct and binding legal effect for locals (Lund 2016). This may be why they are often seen as vital to projects planning for climate adaptation on private properties. While some local plans are developed only to regulate specific topics, in other situations, municipal councils are obligated to develop local plans for certain types of projects, if the planned changes may have a large impact on the local area (Danish Business Authority 2017). Local plans are made after a certain structure: they introduce the situation and purpose of the plan; then, the specific regulations are presented, starting with a statement of purpose which is where it is established how other regulations should be interpreted; then, a general description follows of the content and aims of the plan written in a way that should be understandable to all stakeholders, giving them the opportunity to object to the plan; finally, the relation between the plan and other relevant planning in the area is presented (ibid). Often, maps are attached as well.

The recent changes to the Planning Act that affect climate adaptation planning are aimed at different parts of the local plans. The new possibility from 2013 of making climate local plans consists of the opportunity to write climate adaptation aims into the statement of purpose, thus ascertaining that regulated topics should be understood in relation to climate adaptation effects (Lund 2016). The change in 2018 regarding measures in flood-prone areas adds a new topic that can be regulated in local plans: including reserving undeveloped land for rainwater basins or infiltration, or regulating placement of buildings or evaluation levels of footings in an area (Danish Environmental Protection Agency 2019). These changes have expanded the possibilities of local plans. But they also have limitations. The introduction of climate local plans was criticized for only permitting climate adaptation as a possible statement of purpose, and not including climate mitigation such as measures for limiting CO_2 emissions; and for not providing new and broader possibilities for regulating for climate adaptation (Puggaard 2012). And even with new possible regulations, local plans can still only control future use; they cannot push changes to structures already in place, but are only effective in case of new constructions or extensive renovations (Lund 2016).

Still, quite broad possibilities for climate adaptation planning do exist in local plans. The Planning Act (2020) lists the topics that can be regulated through local plans in Art. 15(2), known as the local plan catalogue. While only a few of these are directly describing climate adaptation, many of them can be interpreted in ways that support using them for climate adaptation planning (Danish Nature Agency 2013). Because of the broad possibilities of interpretation of the local plan catalogue, it is not possible to compile a comprehensive list of possible regulations for climate adaptation in local plans. However, informative guidance in the possibilities was issued by the Danish Nature Agency in 2013 (ibid, 42-45). It covers many possible regulations, except for on the possibilities of regulating for climate adaptation in flood-prone areas, mentioned above, as this was not possible until 2018.

In the following list, a selection of the mentioned possibilities has been made. It is by no means exhaustive: it is based on what have been used in the case projects, presented later. The point of this is to show the regulative possibilities of local plans, as they are quite broad: in principle, they can include regulations for most of the physical climate adaptation measure used in the case projects. But there are large limitations to using them as well; these will be elaborated afterwards. The list includes possible regulations and reference to the relevant article in the Planning Act. It is entirely based on the guidance from the Danish Nature Agency (2013).

Local plans can be used to:

- Establish technical solutions to reduce water runoff, e.g. green roofs and permeable surfaces – 15(1)
- Designate areas for storing water in case of heavy rain – 15(2:2)
- Design streets to make them able to lead rainwater, e.g. by raising curbs; or with permeable surfaces – 15(2:4)
- Decide placement of buildings on single plots – 15(2:6)

- Require certain minimal elevation heights of footings of buildings – 15(2:7)
- Set requirements for establishment and design of areas for infiltration or retention of water, and water channels and ditches that can lead large volumes of water – 15(2:9)
- Require connection of buildings to common drainage systems, rainwater basins, etc. – 15(2:12)

It is important to note that while these regulations may be possible, they need to be justified from a planning point of view (Danish Nature Agency 2013). Though some elements may still be considered lacking (Lund 2016), with such possibilities, local plans could seem like a good way to plan for climate adaptation. But the plans may not always be that useful, for several reasons. First of all, just because something is in a local plan does not mean it is implemented immediately: the above-mentioned fact that local plans can only regulate future uses may put an end to the good intentions of the plans in already built-up areas. It is difficult to know when, if ever, the regulations are implemented in these cases, as implementation of its regulations is only legally binding if significant changes are made to existing structures, or if new are built. Hence, the tool may mainly be useful in new developments. Another and perhaps more paradigmatic problem is the fact that local plans to a large extent represent a responsive type of planning, perhaps even a view on plans as blueprints, with minimal flexibility and set solutions. Modern climate adaptation planning, on the other hand, necessitates a transformative strategic planning.

Other approaches to climate adaptation planning

Transformative strategic planning works with directions rather than solutions (Healey 2009). This contrasts with the rather rigid structure of planning under the Planning Act, which must follow generalized procedures and implement already known solutions. Local plans can only be used within the given framework, and their conception are facilitated by municipal councils. Conversely, transformative strategic planning calls for dynamic processes and broad stakeholder involvement, and while a facilitator is still needed, the strategy making is happening more in a process of governance, through interactions between stakeholders (ibid).

But transformative strategic planning is happening in Danish municipalities. However, the methods used are often going beyond the Planning Act. These possible methods, amongst other things, are examined in the three case studies. They exhibit and examine possibilities of planning for climate adaptation in Denmark – using planning strategies ranging from responsive to transformative. But before that, the results of a brief literature study aimed at uncovering alternative methods are presented here. Different texts on climate adaptation in Danish municipalities have been explored to find examples of such methods – presented below. The intention is to provide an initial overview of the span of possibilities, and the prevalence of municipalities seeking out alternatives to using the Planning Act for climate adaptation planning.

One way of promoting climate adaptation outside the Planning Act is by using the municipal wastewater plans. In these plans, it can be specified that certain plots are uncoupled from the sewer system for their surface water (Danish Environmental Protection Agency 1999). An agreement must be made between

municipality and property owner to make this happen; but when it has been completed, it is essentially irreversible (ibid). The uncouplings will usually happen in conjunction with establishment of private solutions for surface water management (ibid). The municipality can carry out these uncouplings as voluntary agreements with locals, gradually reducing the pressure on the sewer system; this can be incentivized by providing a refund of part of the sewer connection charges (ibid). In a study from 2010, it was found that 11 out of 73 questioned municipalities actively promote such sewer uncouplings (Hellesen et al. 2010).

Hellesen et al. (2010) have reviewed municipal climate adaptation practices. Through their study, it is uncovered how many climate adaptation measures are implemented through other planning themes. Possible measures related to rainwater that they mention are road plans, where roads and streets can be designed to lead water; plans pertaining to water extraction and wastewater, that can be used to plan expansion and division of the sewer system; and emergency plans that can be designed to mitigate effects of floods caused by extreme rain incidents.

Lund (2016) mentions water streams as possible tools for controlling water: by regulating capacity and retaining excess water, floods can be avoided. For this, the Watercourse Act is useful: the purpose of the act is to ensure that watercourses can be used for discharging water, especially surface water (Watercourse Act 2019). This can be employed for climate adaptation, provided that the necessary discharge permits are obtained (Lund 2016).

Climate adaptation on private properties is still necessary, and if it is not regulated through local plans, voluntary action can be a useful approach. According to a large study of their opinions and practices, most Danish property owners are inclined to viewing climate adaptation as a challenge that they have part of the responsibility for (Lund et al. 2012). But they are more likely to act if they are informed about possibilities and perceive a risk for their own property; hence, information about climate adaptation measures and existing risks can enable private action (ibid). A way of keeping local initiatives going, if not through uncouplings registered in the wastewater plan, is with easements. These can be used to maintain measures made in agreement between municipalities and property owners (Post 2012). According to a survey from 2012, they were used as such in nine out of 86 questioned municipalities, sometimes also as supplements to local plans (ibid).

These examples of different approaches to municipal climate adaptation can be included in a transformative strategic planning approach. Other methods and how they can be combined in strategic plans are examined in the case studies. These approaches may provide more flexibility compared to the rigid procedure of local plans in some situations where local planning meets the aforementioned challenges. By employing a range of different solutions, it may be easier to change direction and find solutions along the way, in a transformative process. There is no guidance for how this should be carried out, that is a central characteristic of transformative project planning: it makes large demands for the strategic navigation of municipal planners. They must mobilize people and structures by having a

sensitivity towards context, and they should carry out a staging in the context to engage stakeholders of many kinds in order to make strategies that resonate with the locality.

To conclude this chapter, it should be noted that well-functioning climate adaptation projects can be made with local plans as the main tool – Trekroner East is an example of that, as presented below. Further, while good strategic navigation goes a long way in making effective, strategic work, there are certain conditions that contribute, too. Such driving forces for projects will be examined through the three case studies.

Implementing climate adaptation in practice – three case studies

While looking at methods for implementing climate adaptation measures may provide inspiration for municipalities working with such projects, the reality of municipal climate adaptation is a much more complex matter. The implementation tools are just one part of the process towards realizing climate adaptation projects. Other factors may be just as important, such as finding the right solutions that fit the local context, ensuring effective cooperation between project participants, or establishing stakeholder relationships that pave the way for knowledge building and local acceptance. And especially the strategic navigation of municipal planners is important to whether they achieve the transformative qualities they aim for.

This makes it interesting to look into the actual practices of municipalities that have worked with large climate adaptation projects. Many questions arise, such as: how have the municipal planners approached the projects? Which tools and methods have they applied? What processes has led to the final configurations of the projects? And what are the planning strategies and strategic navigation applied by the municipal planners in order to get there?

Some answers to these questions are attempted uncovered through the three case studies. Short outlines of the distinctive characteristics of the three projects are provided below. It must be kept in mind that the practices and planning strategies applied in the case studies provides a picture of the work of the municipalities, but does not show the full extent of their work. The strategies applied are not predefined, but developed through the work on the specific projects. As such, the case studies do not provide a general insight into the work of the three municipalities, but rather into their work specifically on the case projects.

In short, the three cases are characterized by the following:

- **Trekroner East** (*Trekroner Øst*) is located in Trekroner, a few kilometres east of Roskilde, and is a new development on a formerly bare field. This has given the planners a certain freedom, as they have not needed to work a climate adaptation project into existing urban structures. The project has focused on creating large, coherent SUDS between the houses in the area, leading water to nearby recipient water bodies. Regarding additional values, the focus has mainly been to ensure better aquatic environment in local lakes. The case is significant as it is planned as a greenfield project, and was established before houses were built; and as local plans have been the central tool for implementation.
- **Kokkedal Climate Adaptation** (*Klimatilpasning Kokkedal*) is located centrally in a suburb to Copenhagen. While it was initiated based on flood incidents caused by rain, this has only been one focus of the project. Most of the issues pertaining to rain was remedied in another project,

and Kokkedal Climate Adaptation has had additional values as central priorities. These are focused on urban quality and social issues in local public housing projects. The project has been established with a cohesive system for water management, and 40 subprojects adding additional values around the town. The case is significant as it has almost entirely been planned through partnership agreements, while plans and other methods are not central to its implementation.

- **Middelfart – The Climate City** (*KlimaByen Middelfart*) is located in the old town of Middelfart. It was initiated based on rain incidents that flooded several houses and basements in the area. For combatting future floods, SUDS have been established in the project's three parts. The systems are very visible, and have been used actively to create additional values in the area, including by beautifying the city with rain gardens, by establishing a large playground and sports facility, and by upgrading many public areas through town. The case is significant as it applies a broad range of methods to implement the planned solutions, and as citizen participation has been utilized very actively.

Climate adaptation projects are often very complex, necessitating some limitations in the case studies. Here, it is attempted to provide an overall picture of the cases, without diving into every aspect. The main focus is on climate adaptation and derived additional values, while the projects generally comprise more than just that. Hence, the case studies do not dive deep into the processes and organizational aspects of the projects, but primarily when it is related to climate adaptation and planning strategies. And while additional values are a central focus, only the intended ones are included here. Others might exist as well, but may be unintended consequences (such as increased property values); these have not received particular attention.

The order of the case studies is selected loosely based on the innovative qualities of applied implementation methods, the transformative qualities of their strategies for climate adaptation, and the amount of stakeholder involvement happening through the projects – which all happens to somewhat correlate with their years of initiation. The studies are presented in the same order as above: Trekroner East, Kokkedal Climate Adaptation, and Middelfart – The Climate City.

Trekroner East

Fields surround Trekroner East, grazed by cattle from local farms.

Trekroner East (*Trekroner Øst*) is the most recent part of a relatively newly developed town a few kilometres east of Roskilde, in the larger development area of Trekroner. It is located in a scenic landscape surrounded by open fields, and lies close to Roskilde University Centre (RUC). Upon completion, all of Trekroner is expected to have 5,000 inhabitants (Roskilde.dk 2018), a large part of these in the approximately 1,000 households that are a part of Trekroner East (Laridanmark.dk n.d.), an area of 100 hectares (Gudiksen 2010). Currently, the area is nearly fully finalized after almost 20 years of construction (Toft, pers. comm.).

The planning of Trekroner started in 1972, the year RUC was built (Toft, pers. comm.). However, it would take decades before most of the plans were realized. In the 90's, development began in parts of Trekroner, and in January 2005, the framework local plan for Trekroner East was passed by the city council (Municipality of Roskilde 2005). Later, local plans have been made for the different parts of the area. Climate adaptation, specifically rainwater management, was a part of the plans from the beginning. The principal planning was carried out by Municipality of Roskilde and Roskilde Forsyning (the name of the local utility company then; today it goes under the name Fors; wastewater management is one task of the company). While the term 'climate adaptation' was not a focus then the same way it is today,

handling of rainwater locally was still a priority in the planning (Toft, pers. comm.). There were two main reasons for this: Capacity at the local wastewater treatment plant was insufficient at the time, and both wastewater and rainwater would have to be transported a long way in order to be treated at a different one – a solution both expensive and unnecessarily extensive (ibid). Further, the local lakes of Langebjerg were in a bad environmental condition, partly because of a lack of water entering them: leading some of the runoff rainwater from Trekroner East to the lakes could be beneficial (ibid). With these two factors in mind, Municipality of Roskilde and Roskilde Spildevand made it a priority to retain and utilize the water locally.

Today, Trekroner East is characterized by groupings of mostly single-family houses, but also some blocks of larger buildings with multiple apartments. Two main roads, Trekroner Parkvej and Skrænten, creates a loop servicing the smaller roads – cul-de-sacs, mostly – where groups of houses in similar materials are placed alongside. Everything is tied together by a network of paths for walking and cycling. The groups of houses have different local plans, eight in total (Danish Business Authority 2020), with detailed design criteria; except for one, where no specific aesthetic principles are mentioned. Here, the people moving in have been free to build houses after their own wishes, as long as these have been within building regulations (Toft, pers. comm.).

Map of the greater area of Trekroner, with the case area marked in red. Source: Apple Maps with contour drawn upon.

There are two catchment areas in Trekroner East, divided by a watershed approximately along Trekroner Parkvej. All rainwater from the eastern side is led to the Langebjerg lakes – two small lakes just next to the area (Laridanmark.dk n.d.). Rainwater from the western part is led to Himmelev Brook, a watercourse central in the greater area of Trekroner (ibid). To accommodate the large amount of water that can potentially be transported to the existing water bodies, the brook has been expanded to have a much larger capacity (Toft, pers. comm.).

All runoff water from Trekroner East is managed in SUDS, and carried through channels, wadis, and open basins, and eventually ends in Roskilde Fjord (Laridanmark.dk n.d.). Because a central part of the project is the rejuvenation of the environmental condition of the Langebjerg lakes, infiltration is not a priority – it is more important that water is led to the lakes (Toft, pers. comm.). For treating the water, oil separators have currently only been installed around parking lots, but space has been allocated for additional separators in case it is found to be necessary in the future (Laridanmark.dk n.d.). For now, it is assumed that the grass and underlying sand filters in the wadis, as well as seepage drains before the Langebjerg lakes, are adequate for ensuring that heavy metals and nutrients are stopped before they enter protected water bodies (ibid).

Trekroner East was a new development project, carried out in a formerly empty field, and planning and constructing of the water structures happened before buildings were built. This has been beneficial, as it has been much easier to place the structures in ways that account for the existing slopes of the terrain and reaches every house. To ensure that every plot is connected to the common water system and that rainwater is successfully drained, local plans for the area include a point of discharge and an elevation level for the footing of the building for each plot; these are also included in the sales agreements and in easements (Gudiksen, pers. comm.). In this way, local plans – besides the municipal wastewater plan – are the main way that the implementation of the water system is secured (ibid). Besides discharge points and elevation levels, they include regulations on placement of water channels and basins, configuration of the terrain to make water runoff efficient, and designs for where overflow water will run to in case of very extreme rainfall, to keep damages at a minimum (Gudiksen, pers. comm.).

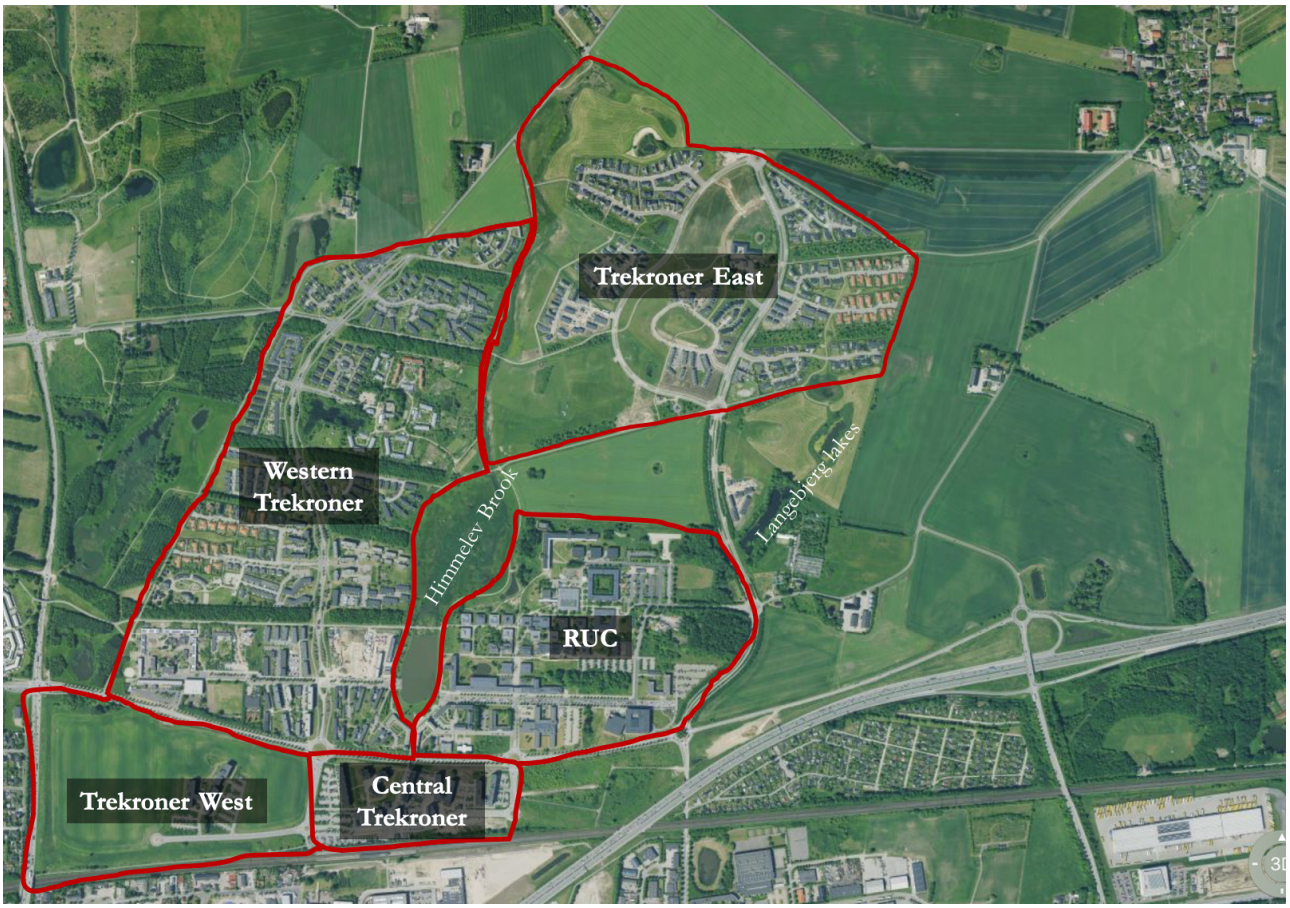
To maintain the effective operation of much of the surface water system, a home owners' association including a wastewater guild, has been established that all home owners in the area are required to be members of (Toft, pers. comm.). They are responsible for maintaining most of the water channels amongst the houses, while the wastewater company is only responsible for selected main water channels and basins in the remaining system (ibid). With these things in mind, the SUDS in Trekroner East can be seen to be very thorough, incorporating every house and involving all residents in the area.

The project

In their climate adaptation plan, Municipality of Roskilde includes three main principles for climate adaptation: viewing water as a resource, not a problem; innovative investments creating additional values; and climate adaptation as a shared responsibility (Lund 2013). Technical climate adaptation measures

must provide additional values in the form of recreational or architectural elements, or be integrated into existing structures, and on rural land, the solutions must be integrated into the landscape (ibid). Although the first climate adaptation plan came a decade later than the construction of Trekroner East began, these ideas have also been employed in the development of the new residential area.

Trekroner East is part of the larger, relatively recently developed town of Trekroner. Trekroner is separated by Himmelev Brook, running from south to north through the area, splitting the area into the eastern part, Trekroner East, and the western part, just known as Trekroner. To keep confusion at a minimum, the western part will be referred to as Western Trekroner from now on (there is another area called Trekroner West, but it has no relevance here). The below map attempts to clear things up. Nonetheless, Trekroner East is the main focus in this analysis.



Map of the different parts of Trekroner. Source: Apple Maps with contour drawn upon.

The development of Trekroner East is not a climate adaptation project per se; rather, it is a development project of a new residential area with eight clusters of housing, where climate adaptation happens to play a considerable role (Gudiksen, pers. comm.). In contrast with the two other cases studied, the area has not been assigned a name including the word 'climate', and climate adaptation has not been a main selling point. Perhaps because the project came some years before the two others, and climate adaptation was not as much in focus at that time (ibid). Still, Trekroner East is a rather special development: a newly

developed residential area, built on former farmland, meant to rejuvenate local water bodies, and using the local nature as inspiration for the urban design (Attwell et al. 2013).

As climate adaptation is the topic of this thesis, aspects pertaining to the SUDS will be the main focus for the rest of this chapter. While the SUDS are part of the overall project, the planning of these are subject to different approaches and planning strategies than the project in general. But it is difficult to separate the two from each other, and both will be included in the next sections.

Before the project

When RUC was built in 1972, the first planning of Trekroner was initiated. The idea was to develop the area surrounding the university, but it took a long time before specific plans were developed (Toft, pers. comm.). A draft urban plan for the area came in 1988, but the general development work did not commence until around 1998 when Munksøgård, a shared housing settlement, was established (Bille 2008).

Western Trekroner was built in the beginning of the 00's, and around the same time, detailed planning of Trekroner East began (Toft, pers. comm.). Behind the process stood planners from Municipality of Roskilde and Roskilde Forsyning (the wastewater company which, at the time, was part of the municipality), and they defined the main issues at stake in the area of Trekroner East (Toft, pers. comm.)

The construction of Trekroner East began around 2005, and is essentially completed as of 2020 (Toft, pers. comm.). The central project aims have been to ensure a local area adapted to climate change, utilize rainwater to enhance polluted water bodies, and strengthen natural biodiversity in the area, all through one main concept: by ensuring proper management of rainwater beginning at the end of every drainpipe (Attwell et al. 2013).

Generally, measures related to climate adaptation have been planned to be part of all of Trekroner, in different ways. For RUC and its immediate surroundings, separate sewers, possibilities of water infiltration, and establishment of rainwater basins are included in the local plans, even the older and still valid ones dating as far back as to 1988, when the local train station had just opened (see e.g. Municipality of Roskilde 1988). In the more recent local plans, these measures are more extensive and directly pronounced to be meant for climate adaptation; these plans are presented further below, under *Implementation methods.*

Physical and water technical aspects

Trekroner East does not have sewers for rainwater, and there are no storm drains leading to a combined sewer; hence, all water must be discharged in the area (Toft, pers. comm.). The area is divided by a watershed along Trekroner Parkvej: all rainwater falling east of the street is led towards the Langebjerg lakes, while water from west of the street is led into Himmelev Brook (ibid). Water led to the Langebjerg lakes enhances the aquatic environment there by creating a better water flow in the formerly stagnant

lakes: to ensure that enough water enters the lake, no infiltration measures are constructed on the eastside of the watershed – only a system of on-street channels, wadis, and basins is constructed here (ibid). Water from the western side of the street is led towards Himmelev Brook, and infiltration is allowed here; a lot of water is infiltrated through the wadis (ibid).

When water falls on private properties in Trekroner East, it is the responsibility of the property owner to lead it into the common rainwater system (Toft, pers. comm.). Before building on the individual plots in Trekroner East, developers and buyers have been informed about the required elevation level for the building footing, and from which point on their plot they have to discharge to the common system (Gudiksen, pers. comm.). These requirements have been important to ensure an adequate slope of private water channels considering the existing landscape, and to ensure the whole water system is connected in a functional way: in this way, all surface water from private properties is led into channels in the streets, or wadis between the houses (ibid). Streets are designed with channels that water falling on the streets is naturally led into. Through the system of channels, wadis, and some underground pipes, water is discharged to either of the water bodies, and from there, it is led through various brooks and canals, eventually ending up in Roskilde Fjord (Backhaus n.d.)

Left: a discharge point from a private property; the part in the foreground belongs to the common system. Right: the darker part of the asphalt is where rainwater runs, here to a drain leading to one of few underground pipes. The channel here used to be painted light blue.

Besides elevation levels and discharge points, the overall plans for buildings in Trekroner East are deliberately vague. The main structures, vegetation belts, street network, and subdivisions of plots are given, but specific placement of buildings within plots and the specific appearance of these buildings are not specified in advance (Bille 2008). Development after the main structures were constructed has been led by developers, consultants, and municipal technicians – later, it has been enshrined in local plans (ibid).

The existing terrain in the area has been the cornerstone in designing the water technical solutions: the built-up area is constructed to utilize the existing water bodies and slopes of the landscape to lead water (Backhaus n.d.). It has been vital that the structures for water management was designed before anything was built, to ensure the water could flow more or less unobstructed; hence, most SUDS structures were constructed three years before they were put into use (Toft, pers. comm.). In this way, it has been a big advantage that the development has happened on a formerly empty field. Still, finding the right elevation levels and points of discharge for every single plot has been a challenging task, as the landscape changed slightly during construction (Gudiksen, pers. comm.). This is elaborated below, under *Challenges.*

Leading water on the streets has the advantage that it takes up a lot less space than if it should be in separate structures all over Trekroner East. And the way the SUDS have been constructed means water is generally very visible in the area. Leading water on streets and in wadis is very defining for the visual profile of Trekroner East, and many of the water structures have some aesthetic and recreational values (Antje n.d.).

Several changes have been made around the recipient water bodies: the Langebjerg lakes have been cleared of waste and incipient tree growth, and a basin with a filtration system has been installed between the lakes and the wadis leading rainwater there (Attwell et al. 2013). Himmelev Brook, on the other side, has been modified to have a much broader profile by breaking down one of its sides, making it resemble a basin more than a brook in some places (Toft, pers. comm.). Some measures are implemented for treating the rainwater: the wadis have sand filters at the bottom, providing some retention of nutrients and heavy metals; the filtration basin before the Langebjerg lakes will do the same (Laridanmark.dk n.d.). Further, the Langebjerg lakes have been equipped with dampers used for clearing them of phosphorus in late Summer, where it floats close to the surface; here, water levels are decreased with about one metre (Attwell et al. 2013). Vegetation in basins and water bodies is cut down annually, effectively removing nutrients and heavy metals (Laridanmark.dk n.d.). No oil separators are installed around the lakes, but room has been allocated for this in case it turns out to be necessary in the future; currently, oil separators are only placed by parking lots in the area (Toft, pers. comm.).

The water system in Trekroner East is dimensioned for between five and ten-year rain incidents. On-street channels are designed for a five-year incident, which is the municipal service target (Toft, pers. comm.). Wadis have a larger capacity, approximately for a ten-year incident (Gudiksen, pers. comm.). Similarly, the rainwater basin before the Langebjerg lakes is designed for a ten-year incident (Antje n.d.).

The water system and the terrain are configured to lead water to where it does the least damage in case of floods (ibid).


Left: Himmelev Brook. Right: a grassy wadi between the clusters of houses.

Additional values

First of all, the rainwater management in Trekroner East helps avoid floods in the area in case of heavy rain; there have been no problems due to rainwater so far (Gudiksen, pers. comm.). The focus on enhancing the aquatic environment in the lakes also seems to be effective so far (Toft, pers. comm.). The rejuvenation of the water bodies has also contributed to giving them recreational value in themselves, as they are pleasantly looking and enjoyable to visit; that this could be combined with rainwater management is an important additional value (Attwell et al. 2013). Municipality of Roskilde is continuously considering the possibilities for increasing biodiversity by making the water system more attractive to plants and animals (Antje n.d.).

The focus on climate adaptation has informed the design of the built-up areas: water is integrated into streets and in wadis, of which many have a variety of plants growing in them (Toft, pers. comm.). Also, when establishing the solutions leading water across private gardens, several residents have used this as an opportunity to integrate the flow of water into the gardens in a recreational manner. Generally, water is

very visible in the townscape during rain (Gudiksen, pers. comm.). Originally, streets were divided into blocks of different colours, and with water running in channels painted light blue; however, these have since been removed, for reasons unknown (Toft, pers. comm.).

Process

Trekroner East has been developed in several stages. Water and traffic infrastructure was established before any other development began (Toft, pers. comm.). The framework local plan was adopted in the beginning of 2005, marking the beginning of the development of housing in the area (Municipality of Roskilde 2005). Later, the eight local plans for the area have been adopted between 2006 and 2017, in parallel with the development of the eight individual clusters of housing (Danish Business Authority 2020).

As the framework local plan for the area does not specify detailed guidelines for the design and planning of the single residential clusters, the development of these started out as quite flexible (Bille 2008). The local plans for each of the clusters were developed with input from different stakeholders, including the municipality, the wastewater company, consultant, contractors, and developers; this has ensured that housing types are varying through Trekroner East, but somewhat similar within the different clusters (ibid). While most of the local plans have some guidelines on the visual profiles of buildings, one does not include this, allowing a great amount of freedom in visual identity of buildings in that cluster (Toft, pers. comm.). When plots were sold, the municipality put buyers in contact with municipal technical advisors, thus allowing professionals and non-professionals alike to buy and develop the plots (ibid).

The process of planning and development of Trekroner East has been characterized by a strong cooperation between Municipality of Roskilde and Roskilde Forsyning (Toft, pers. comm.). Together, they have effectively upheld the plans they initially developed together, despite requests from developers to do things in different ways (ibid). Together with the fact that the area was developed in a bare field, this has ensured a large liberty of the municipality and wastewater company to plan as desired.

Citizen participation has been limited to a few situations. Before the framework local plan was developed, a large workshop was held to get inspiration for the later plans and development: facilitated by RUC, it included people living in the adjacent areas as well as about 50 organizations and businesses (Toft, pers. comm.). Other than that, engaging in the processes has primarily been possible during the consultation periods for the local plans being developed in the area. These situations are aimed at the development of Trekroner East in general, not of the SUDS in particular. The only citizen involvement process focused solely on the climate adaptation measures were orientation meetings held to inform the new residents about the operation of the SUDS (Gudiksen, pers. comm.).

The development of the SUDS in Trekroner East has been about 25% cheaper to establish compared to the underground alternative; however, the expenses to maintain it are higher (Gudiksen 2010). Still, the costs after 70 years are assumed to be less than what separate sewers would cost to establish (Jensen and

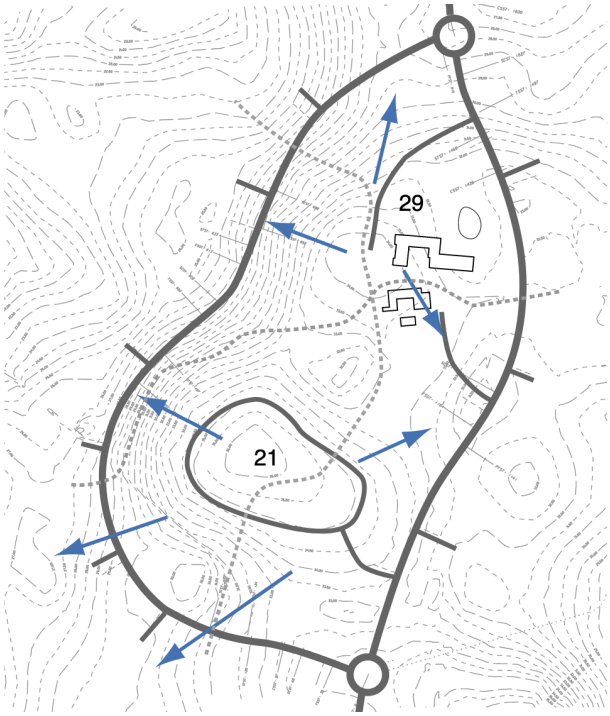
Fryd 2009). The SUDS have been financed by the wastewater company, as its function is water management in compliance with the service target.

Implementation

The realization of the visions for Trekroner East, including the SUDS, has happened mainly by the use of local plans. Regulations are included in sales agreements for the individual plots, and enshrined in easements registered on all plots in the area. A home owners' association encompassing a wastewater guild has been established that all residents should be part of, ensuring the operation and maintenance of the water system. The examination of these different implementation methods is followed by a review of the drivers and challenges when implementing the project, and the lessons learned in the process.

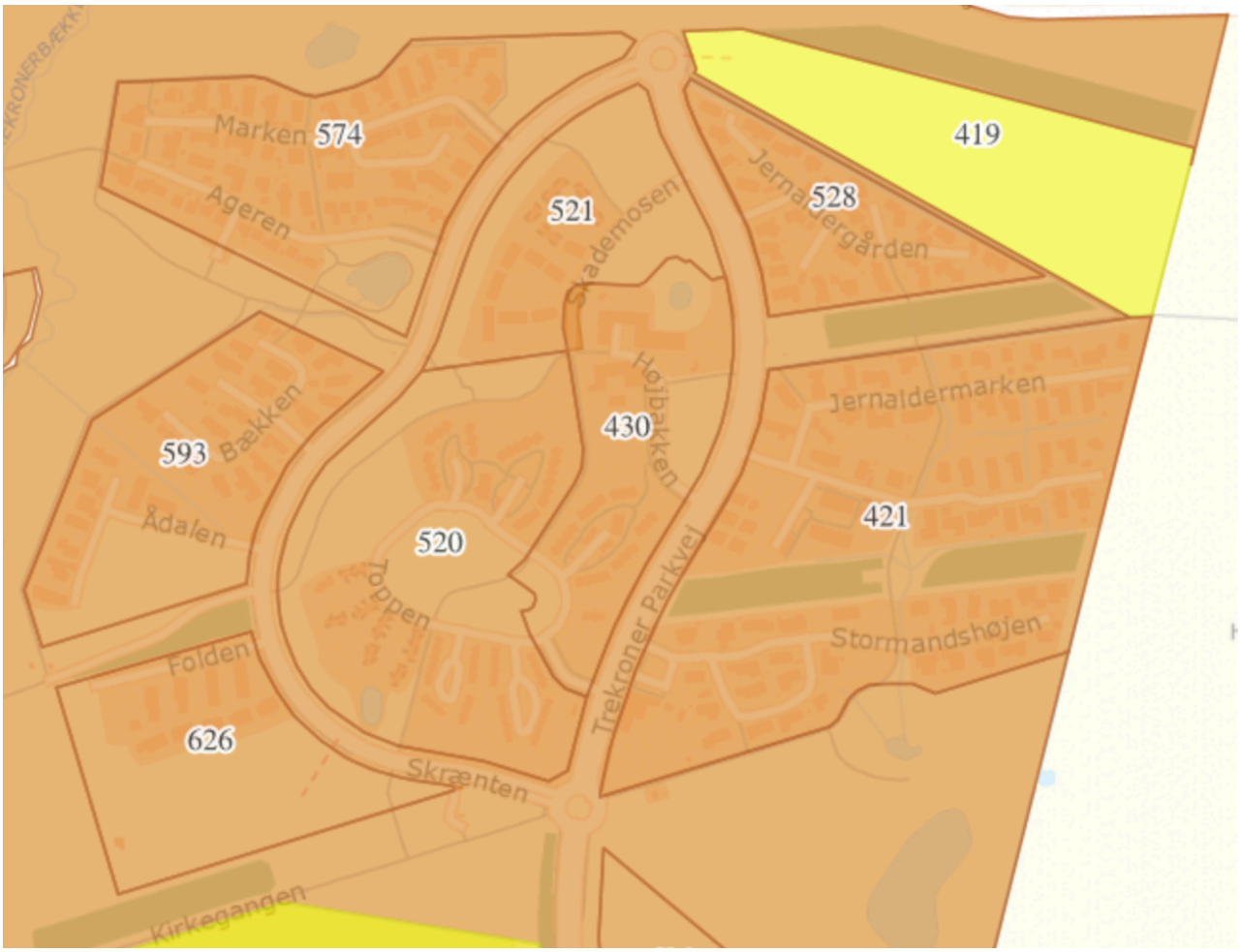
Implementation methods

A framework local plan is in place for a large part of Trekroner (Municipality of Roskilde 2005). It is divided into several sub-areas, of which Trekroner East is one. The framework local plan was the first plan in place for the Trekroner East area, and it has guided development of the later local plans. The plan is aimed at ensuring a certain kind of development in the area. It regulates a broad array of topics, including requirements for the shaping and maintenance of the water bodies in the area (including Himmelev Brook and the Langebjerg lakes), for the design of networks of streets and paths, as well as some general requirements for buildings in the area. Further, the framework local plan sets the scene for the SUDS in Trekroner East: it divides the space into catchment areas, and provides suggestions for placement of structures for water, including wadis and basins. More detailed guidelines for this must then be prescribed in the local plans.



The principal plan for water management in Trekroner East. Source: Municipality of Roskilde 2008.

Eight local plans have been prepared for Trekroner East (Danish Business Authority 2020). They regulate development and use in each of the eight clusters of houses in the area, and they replace the framework local plan for the areas they cover. The plans have many similarities when it comes to the SUDS, but significant differences regarding visual identity of buildings. Roskilde Municipality is the official authority behind the plans; but the development of each of the plans has been inspired by inputs from developers, consultants, and contractors as well (Bille 2008). The regulations regarding water management are presented below. Note that just one of the eight local plans for the area is referenced here: the plan for *Skademosen*, the area in the middle of Trekroner East (Municipality of Roskilde 2008). This plan is essentially representative for the local plans of the area, as the other plans largely contain the same regulations regarding water management as mentioned here. They have slightly different regulations concerning maximum impermeable surface area and whether infiltration is allowed or not, depending on the location of their planning area. But the one plan referenced does contain the central regulative elements in SUDS of Trekroner East, where the regulations pertaining to water management have not changed significantly over the course of 11 years between the first and latest local plan. Further, because of the central placement of this local plan area, discharge to both the Langebjerg lakes and Himmelev Brook is covered.



The eight local plan areas of Trekroner East. Skademosen is area 521. The yellow area (419) is zoned for a burial area. The orange shading covering the entire area is the framework local plan. Source: Danish Business Authority 2020.

The plan for *Skademosen* (Municipality of Roskilde 2008) determines that a collective system for rainwater management must be established on both private and public property. Rainwater from private plots must be discharged to this system. From here, it is led either to Himmelev Brook or the Langebjerg lakes, depending on whether a specific building is west or east of the watershed, respectively. For plots discharging to Himmelev Brook, it is permitted to establish infiltration measures, after permission is granted from the municipality. For plots discharging to the Langebjerg lakes, on the other hand, infiltration should be prevented as much as possible; water should be led in impermeable trenches and channels, and rainwater may not be used for other purposes (such as for watering in private gardens). The plan further contains regulations about the design of the water system; it should consist of wadis and channels on streets, or in underground pipes only if water cannot be led on the surface for some reason. Options for terrain alterations are limited to a maximum of 0.5 metres. Building materials are regulated to avoid pollution of rainwater. And it is determined that a home owners' association should be established including a wastewater guild that is responsible for the operation of most parts of the SUDS, and that all property owners must be members of this association. Finally, the local plan determines required elevation levels for building footings as well as rainwater discharge points for every plot within its area.

An example of an impermeable water channel in a private garden.

Other documents support the regulations in the local plans. Discharge permits and regulations for individual properties are registered in the municipal wastewater plan (Toft, pers. comm.). Further, the

requirements are included in the sales agreements for the individual properties (Gudiksen, pers. comm.). The sales agreements reiterate the regulations from the local plans, clarify the responsibilities of the individual property owner, and has maps appended detailing the elevation levels and specific water discharge points (Municipality of Roskilde 2014). On top of this, a number of easements are registered for all plots. Three of these are relevant to the SUDS, namely one regarding connection of properties to the collective system, one regarding discharge of rainwater, and one regarding the compulsory membership of the home owners' association (ibid).

The home owners' association and the related wastewater guild are important to the operation and maintenance of the rainwater system. They are responsible for all maintenance of structures on private area, which encompasses the majority of the rainwater system. Just one water channel within the residential area is owned by the wastewater company – a main channel leading through the area – the rest is under the purview of the wastewater guild (Toft, pers. comm.). As an appendix to the statutes of the home owners' association, instructions for operation can be found (Grundejerforeningen Trekroner Øst 2006). These present the tasks of the wastewater guild: including care and maintenance of wadis, channels, and basins; methods and points of control of the water system; and ensuring that the locals have knowledge of the system. The wastewater guild is responsible water from all properties in the area, and has large authority: for example, it can require property owners to install rainwater basins on their own plots if they discharge more water than what the system has capacity for (Grundejerforeningen Trekroner Øst 2010).

Drivers

The fact that Trekroner East is constructed in a formerly bare field has been a huge advantage for its development and implementation. It has been possible to establish the surface rainwater management structures before other construction began. Hence, other buildings have had to follow the logic of the SUDS, rather than the other way around, which would be the case in already built-up areas (Toft, pers. comm.). And it has been possible to adapt the system to the natural slopes of the landscape; a necessity for open rainwater systems (Gudiksen 2010). The greenfield development has most likely made local plans much more useful for the planning than they would be in an already built-up area; there, the plans would only steer future development, but in the case of Trekroner East, all development was future when project planning began. Easements are similarly affected by the greenfield development; here, they can be registered freely, before people move in, while they would have to be registered as agreements between municipalities and property owners in existing areas.

The development of the eight local plans of the area was guided by the framework local plan; this plan has been highlighted as a vital tool for the development of Trekroner East, as it ensured that the initial plans for the area were preserved throughout development (Gudiksen, pers. comm.). Further, the local plans have been strong tools for implementation and for maintaining plans and structures, as they are anchored within legislation.

Cooperation with residents is present in the area through engagement of the locals as active parts in the project: as they are responsible for operating and maintaining the rainwater system (through own structures and through the wastewater guild), they contribute to the success of the climate adaptation in Trekroner East.

Trekroner is an attractive residential area (Toft, pers. comm.), which is likely to have broadened the opportunities for the municipality to implement structures as desired. Further, the good cooperation between municipality and wastewater company has been essential to the project. They have agreed from the beginning on the aims of the project, and have followed through on the initial plans without giving in to resistance from contractors and developers (Toft, pers. comm.). This cooperation and their strong focus on preserving the original plans have been drivers in ensuring the implementation of the SUDS centrally in the area, although perhaps at the expense of flexibility and broad additional values.

Challenges

The beginning of construction, before the first houses were built, met some challenges. The area was surveyed and elevation points – important for planning water flow and points of discharge – were measured; but when construction began and heavy construction machinery rolled over the formerly open field, the soil was compressed, causing the initial elevation level measures to be off by up to 15 centimetres (Gudiksen, pers. comm.). Further, when Museum of Roskilde searched the fields for historical remains, they dug trenches through the area and filled them up again, also affecting elevation levels (ibid). These landscaping changes necessitated adjustment of the plans for the area (ibid). This underlines how planning in itself cannot necessarily take everything into account, but must be informed in interaction with reality.

As mentioned above, developing a residential area in an empty field has its advantages. But at the same time, such greenfield development makes it more ambiguous who the stakeholders are, as the most obvious ones – local residents – are not there at project start. This has limited stakeholder participation, and perhaps meant that the project planning could not benefit from local knowledge and insights in the same way as the other case projects have. The limited involvement could have led to less interest in moving in to the area; but this has not been the case, as Trekroner is an attractive area (Toft, pers. comm.). But perhaps, it has resulted in fewer additional values than what could have been created with local support and engagement.

Trekroner East was, with its large focus on rainwater management, a rather unique development at a time where climate adaptation was not a large focus in urban development in Denmark (Gudiksen, pers. comm.). Because of this, it was limited how much the project could draw on inspiration and knowledge from similar projects. Hence, the planning of Trekroner East has likely been challenged by limited experience with the field of implementing open rainwater systems into new development areas. An example of this could perhaps be the limited experience with creating additional values based on SUDS within residential areas: water in the streets has been utilized to a limited extent, but now popular

measures such as rainwater playgrounds, on-street rain gardens, and other structures using water to add quality to public spaces have not been included in the project.

Lessons learned

Strong cooperation between municipality and wastewater company, as well as the use of a framework local plan to guide the entire process, have proved to be effective tools for upholding the plans and ideals initially thought out (Gudiksen, pers. comm.). This way of planning ahead has been crucial for the success of Trekroner East and especially its rainwater management system (Attwell et al. 2013).

A group of the central planners behind the project (Attwell et al. 2013) has found three factors related to local plans that have contributed to the successful development of the SUDS. First of all, mandatory requirements in local plans are imperative to ensuring the effectiveness of a surface water management system; property owners should not be able to derogate from the plans, and these regulations should be registered in the wastewater plan to the extent possible. Second, it has eased coordination that just one home owners' association was established for the entire area of Trekroner East. The water structures have been clearly divided between them and the wastewater company, and the association has received written instructions for operating the rainwater system. This has ensured that the operation is functioning seamlessly. Third, an initial design draft – determining the placement of channels and buildings with attention to the existing terrain – is necessary for a successful project with surface rainwater management.

Finally, the project in Trekroner East showcases how climate adaptation – in this case in the form of a surface rainwater management system covering the entire area – can be implemented with local plans as the primary tool, at least when planning for a new development area. All the main features of the water system have been catered for in the eight local plans, including the establishment of a home owners' association overseeing its operation and maintenance. And the local plans have had sufficient legal authority to ensure implementation of all measures. Of course, other plans and tools have been used, too: including the wastewater plan, sales agreements, and easements. But these mainly support the regulations already included in the local plans. In themselves, the local plans refer to all central regulations necessary for ensuring the wastewater system, showing that under the right conditions, local plans can contain the regulations necessary for implementing climate adaptation projects.

Planning strategy and strategic navigation

In this chapter, a distinction is made between the general development of Trekroner East, and the specific development of the SUDS. This distinction is relevant as the two have been approached in different ways, although they are part of the same project. There are significant differences in the strategic approach to the residential areas, and to the water management structures. The focus of this thesis is climate adaptation, and this will get the most attention here; but the general planning is mentioned as well, as they are ultimately correlated.

Trekroner East is not a climate adaptation project per se. It is first and foremost a town expansion project, adding a new residential area to the town of Trekroner. It does, however, take rainwater into account to a large extent; mainly as a resource useful for rejuvenating local water bodies, but climate adaptation is an important outcome as well. This focus on water has been important to the navigation carried out by the project planners from Municipality of Roskilde and Roskilde Forsyning. As a clear focus from the beginning, it has shaped plans, negotiations, and development of the area.

It should be noted that the fact Trekroner East is a greenfield project has certain implications for strategic planning. The fact that few structures were in place before the project – including physical constructions and elements related to tradition and culture – means that there is less knowledge to draw from. This is especially evident as there were no one living in the area when planning commenced, and consequently, a usually important group of stakeholders has been missing. As covered above, the empty field has provided the planners with both opportunities and challenges; it has made it easier to freely implement solutions without local opposition, but has also made it more difficult to mobilize stakeholders for the development locality-based solutions, as there were no local residents. This is likely to have had an impact on the planning strategy applied by the municipality and the wastewater company, making it more technical and perhaps less inclusive.

The general planning of the residential areas of Trekroner East is adaptable to wishes from different stakeholders, and rather flexible in its approach, bordering on a transformative approach to planning and strategy making. This shows through the involvement of different actors in shaping the local plans, and the fact that the eight local plans were made over a span of 11 years, permitting trying out different approaches in the plans. In the detailed planning of each of the eight local plan areas, developers and contractors were invited to participate in the development here. This planning is not following a strictly linear structure, as the planning of the eight areas happened at different times, and knowledge and experience from the earlier planned areas could inform and inspire the more recent areas; resulting in a somewhat experimental approach to the planning.

The planning for the water management aspects is approached in a less flexible, more rigid manner. It would seem like the planners have included a fair amount of flexibility regarding some topics, such as architecture, while others – particularly the SUDS – are non-negotiable. The planning of these falls in the category of responsive strategy making. It has been aimed at solving predefined problems, and the solutions have been planned in the initial process. Although the structures for SUDS are in themselves rather innovative, the implementation has stuck to traditional methods. For implementing the SUDS, local plans and easements have been used in responsive ways, with expert decisions, technical solutions, and limited involvement. The flexibility is limited, and in this project, SUDS are not actively aimed at creating additional values besides those occurring as direct consequences of the solutions. By the understanding of Healey (2009), the planning strategy for climate adaptation in Trekroner East is not entirely strategic: while it has aimed at addressing certain issues related to water quality in an innovative way, and aptly embedding climate adaptation in this, the solutions are mainly aimed at physical regulation

through traditional methods (the establishment of a wastewater guild for managing rain water is perhaps the exception). Further, the project's process has mainly been linear: problems were defined from the beginning, and certain solutions were selected based on pre-existing knowledge. These have been followed through, and attention has been paid to sticking to the initial plans: for main elements of the SUDS, the planners have avoided large deviations from the original goals. Moreover, stakeholder involvement has been limited to an initial workshop and the required local plan hearings.

The planning approach to the rainwater system in Trekroner East is almost entirely technical. The recreational values of surface water are understood and emphasized by the planners, but this value seems to occur more as a side effect of the SUDS than as a central purpose. Of course, placing the structures on streets and in grassy wadis rather than in underground pipes has been an active decision. But other factors have influenced this as well, such as cost-effectiveness. In the technical planning approach to rainwater management employed in Trekroner East, planners and technicians are seen as experts responding rationally to the challenges present. This understanding contributes to a top-down planning approach regarding the rainwater management, with plans of a blueprint nature.

The planning of the SUDS in Trekroner East is characterized by long term goals: the system has been planned in a certain way that should ensure specific outcomes (namely rejuvenation of the Langebjerg lakes and recreational values in the area). While other aspects of the planning have been open for negotiations, the water management system seems to be set in stone. It was planned in the beginning of the project by specialists from the municipality and the wastewater company, providing analyses of how it could be carried out; almost as blueprint plans, providing the exact solution to the issues at hand, and with limited stakeholder involvement. In the strategy typology of Sehested (2009), it can be considered as a 'strategy for structural planning'. This is the least strategic of the described plan types, and limits the extent of transformations that are likely to be achieved. By following such a planning strategy, the planning of Trekroner East has perhaps been limited regarding the potential outcomes of the project to be mainly concerned with technical and material changes. Planning of the SUDS has been purposely static, and the planning strategy has aimed at realizing it in a manner closest possible to how it was originally conceived. This has ensured an effective implementation of the system, but perhaps at the expense of possible additional values that were not thought out from the start.

The mobilizations that have happened in the development of Trekroner East have mainly been of the physical elements. The nature surrounding the new residential area has been mobilized and altered. Both to cater for the need for a larger flow of water through the Langebjerg lakes; but also to be able to accommodate the amounts of rainwater discharged from Trekroner East to Himmelev Brook. In this way, nature and the urban have been mobilized in their interrelationships, with mutual benefits. Within Trekroner East, the rainwater system has been mobilized as something that concerns everyone, as it has been placed on the surface rather than in underground pipes. All property owners are engaged in the operation and maintenance of the system, giving it an untraditional role in a residential area. This has led to an active engagement of the residents: these have been mobilized through the establishment of the

home owners' association and wastewater guild. Through this, residents play an important role in the rainwater management in Trekroner East. This has created a new configuration of roles, as the majority of the SUDS within Trekroner East are not under purview of the wastewater company as it would usually be, but of the local residents. As such, the role of the locals has been mobilized and reconfigured in regard to the water technical systems. However, arriving at this unusual distribution of responsibilities has not actively involved the residents; rather, it has been decided by the planners, and residents have been a means more than active participants in establishing this reconfiguration. As such, it is rather the role as resident that has been mobilized, more than the residents themselves.

For the planners to make these mobilizations happen, a sensitivity to the local conditions has been required. The sensitivity has been directed mainly at the material elements: the surrounding nature, the water bodies in adverse conditions, the slope of the terrain. Social conditions, culture, and traditions were not present in the area of Trekroner East before, as it was merely a bare field. This has meant that first-hand locality-dependent knowledge and opinions could not be considered, and that the stakeholders that would otherwise be most obvious – local residents – were not present. Of course, people and organizations from the surrounding areas might have had stakes in the area, and they were invited to participate in the initial consultation processes. But typically important aspects to be sensitive towards – local social dynamics, contextual knowledge, opinions of residents – have been missing. This is perhaps a reason why the staging carried out is very static. Experimentation is minimized, it is even a set goal that the SUDS should resemble the initial plans. For the SUDS, staging has primarily happened as discussions within the professional partnership within municipality and wastewater company, rather than in a visible, public context.

All in all, the development of the SUDS in Trekroner East has been characterized by somewhat innovative ideas, but a responsive planning strategy prioritizing technical expertise and fulfilment of specific goals, with less of a focus on broad stakeholder involvement and the possibilities for including further additional values. In the end, however, the planning of Trekroner East has achieved what it set out for. Today, it is an attractive residential area with a well-functioning rainwater management system, preparing the area for future heavy rain incidents; although, perhaps, with fewer additional values than what could have been.

Kokkedal Climate Adaptation

Part of the new recreational areas around Usserød Å in Kokkedal.

Less than 30 kilometres from Copenhagen, Kokkedal is located as part of two municipalities in Northern Zealand: Fredensborg and Hørsholm. It has around 10,000 inhabitants, and is not officially considered to be an independent suburb in itself, but rather a relatively new part of the town of Hørsholm: these two have been melting into each other over the course of the last half century where most of Kokkedal was built, presumably as a consequence of planning under the regional Finger Plan (Christiansen and Steenholt 2018). Housing in Kokkedal is characterized by single-family units in a maze of small streets, but also several typical public housing projects from the 1970's in terraced houses and midrise apartment buildings. When the residents in Kokkedal want to get close to nature, they can visit the meadows around Usserød Å – the stream cutting through Kokkedal – or go to the coast of Øresund by Nivå Bay.

During heavy cloudbursts in 2007 and again in 2010, Usserød Å went over its banks: in a low-lying area east of the stream, in the part of Kokkedal belonging under Municipality of Fredensborg, several single-family houses were flooded (Realdania n.d.a). As Usserød Å is the catchment area for a large part of Northern Zealand, these floods were likely to happen again the next time a cloudburst would occur (ibid). Plans were made to make changes to the stream, making it less prone to floods: an intermunicipal project was carried out to ensure this and to enhance the environmental and recreational values of the area around

the stream (Usseroed-aa.dk n.d.). Simultaneously, rather than just focusing on this single concern, Municipality of Fredensborg saw the opportunity to approach several local issues: including the bad condition and social challenges burdening the public housing, and a lack of quality public spaces in Kokkedal (Marling and Kiib 2019.). By partnering with Fredensborg Forsyning (the local water utility company, in charge of managing wastewater), Realdania, and local housing associations, a large project was conceived within the municipality with three focus areas: rainwater management, refurbishment in the public housing projects, and improvements of the common areas in Kokkedal (ibid). Over time, several funds joined the projects, leading it to be the largest coherent climate adaptation project in Denmark at the time (Realdania n.d.a) – but with urban renewal as an equally, if not more, important focus (Mortensen, pers. comm.).

In April 2012, a project competition was initiated (Municipality of Fredensborg n.d.). To guide the proposals, four studies of Kokkedal were published, emphasizing the intended foci of the project. These studies included an examination of the possibilities of SUDS and their potential additional values, a mapping of patterns of movement for the residents of Kokkedal, interviews with locals about their views on different parts of the area, and a demographic overview of Kokkedal (ibid). In December 2012, a winning proposal for the project was found (Realdania n.d.a). It was later incorporated into a master plan: the final title for the project became Kokkedal Climate Adaptation (*Klimatilpasning Kokkedal*), and soon hereafter, the work on the project commenced (ibid). In 2017, the construction work was finished, and the project was inaugurated on a rainy day in September (Zoffmann 2017).

In its final form, Kokkedal Climate Adaptation covers an area of 69 hectares with 3,000 people residing within (Municipality of Fredensborg n.d.). Besides the public housing projects, the area includes a school, a senior centre, a community centre, a sports hall, a small shopping mall, and the meadows surrounding Usserød Å (ibid). Many structures have been built under Kokkedal Climate Adaptation, but mostly as several smaller projects rather than a fully linked system (Mortensen, pers. comm.). Much of the water infrastructure made to avoid future floods of Usserød Å was already in place prior to the large effort made by Municipality of Fredensborg: In August 2012, as part of the intermunicipal Usserød Å-project, a dike was built on the Eastern bank of the stream, and part of the stream was dug out to have a double profile, giving it capacity for extreme rains where the normal profile would overflow (Fryd and Jensen 2018). Another important technical element that was already in place are the separate sewer systems for rain and wastewater, which were constructed as Kokkedal was expanding in the 1970's: these systems guide wastewater to the local treatment plant and then into Usserød Å, while rainwater is led directly into Usserød Å and onwards to Øresund (ibid).

Map of Kokkedal with the case area marked in red. The red dot indicates the residential area that was flooded several times. Source: Apple Maps with contour drawn upon.

New technical water infrastructure made under the Kokkedal Climate Adaptation project includes rainwater basins, water brakes, and troughs, but the existing separate sewer systems are still fundamental in the current water management system (Fryd and Jensen 2018). The complete system is resilient to at least a 100-year flood, and is deliberately greatly overdimensioned (ibid). Besides the technical elements, 40 smaller projects have been made in Kokkedal, constituting a huge part of the total project: these include rain gardens, playgrounds incorporating rainwater, recreational areas, and reinvented natural areas; many of these projects have technical functions as well, primarily as detention basins (ibid). These projects have added central additional value to the project. Valuable upgrades have been made as well for the public housing in the area: this needed refurbishment and especially the midrise housing area Egedalsvænge was burdened by the stigma of being on the governmental list of particularly vulnerable public housing areas in Denmark (Lassen, pers. comm.), and featured on a similar list conducted by the Danish police, measuring crime rates and sense of insecurity (Nøhr 2020). Through Kokkedal Climate Adaptation, these areas have been renovated and by placing some of the subprojects within their perimeter, it has been attempted to make them more open and approachable for all residents of Kokkedal. It seems to have been successful: Egedalsvænge is no longer on any of the lists of particularly vulnerable public housing areas, and crime rates and sense of insecurity have dropped following the project (ibid). An ongoing research project is seeking to clarify whether the physical changes have been instrumental for these positive effects (ibid).

The 40 projects as well as other rainwater infrastructure part of Kokkedal Climate Adaptation have been built either on public land under the municipality, or on private land owned by housing associations whom the municipality have made contractual agreements with: this ensures that the municipality maintains control over the projects, and that the projects have been carried out and are maintained according to the master plan (Mortensen, pers. comm.). To summarize, Kokkedal Climate Adaptation has been successfully implemented, both in terms of the climate adaptation measures, but as much when it comes to urban renewal. As the latter has been an equally important aspect of the project, it would have made sense to include it in the project title, alongside climate adaptation (Lassen, pers. comm.; Mortensen, pers. comm.).

The project

Municipality of Fredensborg have clear ambitions regarding climate adaptation. The municipality developed a second climate adaptation plan in 2018, following up on the initial one from 2014, with more detailed and precise risk analyses and foci (Municipality of Fredensborg 2019). While the new plan is rather short compared to climate adaptation plans from other municipalities, it is also quite committed to the task: it includes an action plan with specific goals and plans for the future climate adaptation measures in the municipality (ibid). This includes intended actions for developing urban areas, where they plan to implement water management measures in practical and cost-effective ways; utilization of municipal buildings and areas for climate adaptation measures; and information and guidance aimed at citizens and companies considering constructing such measures themselves (ibid). Further principles are included in the wastewater plan, stating that all new sewers must be separate, and dimensioned as to ensure a general service level of ten years for combined and five years for separate sewers; that actions should be taken to ensure local management of rainwater from roads and buildings in residential areas; and that areas should be identified where rainwater can be led to in case of floods (ibid). In a supplement to the municipal plan regarding climate adaptation, further guidelines are provided concerning the integration of climate adaptation measures in the area, declaring that these measures should be devised as surface projects with recreational values (Municipality of Fredensborg 2017b).

While these plans are more recent, similar principles have been guiding for Kokkedal Climate Adaptation. The essence of the project has been to implement climate adaptation measures in a way where the water becomes a unifying element, creating a cohesive architectural and structural system through the town (Vandplus n.d.). Besides this, it has meant to demonstrate how such a project can be carried out within the typical structure of a suburb; and further, to integrate climate adaptation with urban renewal through broad partnerships (ibid).

The water issues present in Kokkedal are related to Usserød Å: particularly the floods that happened in 2007 and 2010 when it went over its banks (Realdania n.d.a). The climate adaptation measures taken under Kokkedal Climate Adaptation – besides the changes made as part of the Usserød Å-project – follow a main principle of retaining rainwater during rain, and slowly leading it into the stream, to ensure that its capacity is not exceeded when extreme rain incidents occur (Lassen, pers. comm.). The measures are

dimensioned for large extreme incidents with a very large margin of error, and have thus minimized the risk of future floods in the area (Fryd and Jensen 2018).

The foci of the project reach far and wide. Climate adaptation has been the titular theme, but it is also a means for changing certain structures of the city (Ramboll.com 2015). Several issues are addressed: increasing amounts of rain, the functional segregation of the town, coordination of different development plans, and a lack of public spaces for recreational activities (Realdania n.d.a). Urban renewal in and around Egedalsvænge has been central, alongside general upgradation of public spaces (Lassen, pers. comm.). Climate adaptation has in itself been a focus, but it has also been a tool for achieving predefined additional values that have had high priority in the project (Mortensen, pers. comm.).

Before the project

While Kokkedal Climate Adaptation and the Usserød Å-project are principally two separate projects, the Usserød Å-project has still been integral to the initiation of Kokkedal Climate Adaptation. The water technical elements from each project addresses the common goal of avoiding future floods of surrounding residential areas. And the events leading to the inception of both projects are the same: the floods in 2007 and 2010.

The two floods happened due to extreme rain incidents, and impacted a large part of the area around Usserød Å in several municipalities; in Kokkedal, damage happened to single-family houses located in a lower-lying area on the eastern banks of the stream (Mortensen, pers. comm.). Soon, a political decision made it a priority to secure these houses from further floods (ibid). The intermunicipal project was initiated in order to reduce the risk of such floods along the flow of Usserød Å, and to highlight the stream as an important natural and recreational resource (Usseroed-aa.dk n.d.). The immediate problems were solved with dikes and double profile (Fryd and Jensen 2018). But planners in Municipality of Fredensborg saw an opportunity to expand the project within their own municipality, use the momentum to create additional climate adaptation, and especially, to combine it with other agendas (ibid). Several pipeline projects were pooled, and in 2012, Kokkedal Climate Adaptation was initiated as an umbrella under which solutions were developed aimed at multiple issues: including safeguarding of flood-prone buildings, reduction of the hydraulic strain on Usserød Å, and renovation of outdoor areas around the local shopping mall, sports hall, and two large public housing projects, one of them the vulnerable public housing area Egedalsvænge (ibid). With the competences and funding behind these smaller projects coming together, Kokkedal Climate adaptation grew to become amongst the largest Danish climate adaptation projects of the time (ibid).

As suggested by its title, the project in Kokkedal is about climate adaptation. But as mentioned before, the aspects of urban renewal and combatting social issues in the vulnerable public housing areas has been important aims as well. The climate adaptation measures have to a large extent been a way to obtain the desirable additional values, more than merely to retain water in the area. In the remainder of this chapter, the climate adaptation aspects will be the primary focus. This distinction is made as implementation

methods and planning strategies differ significantly between the climate adaptation focus and the other foci. But as climate adaptation is in some regards inseparable from the other aspects of the project, these will be touched upon as well.

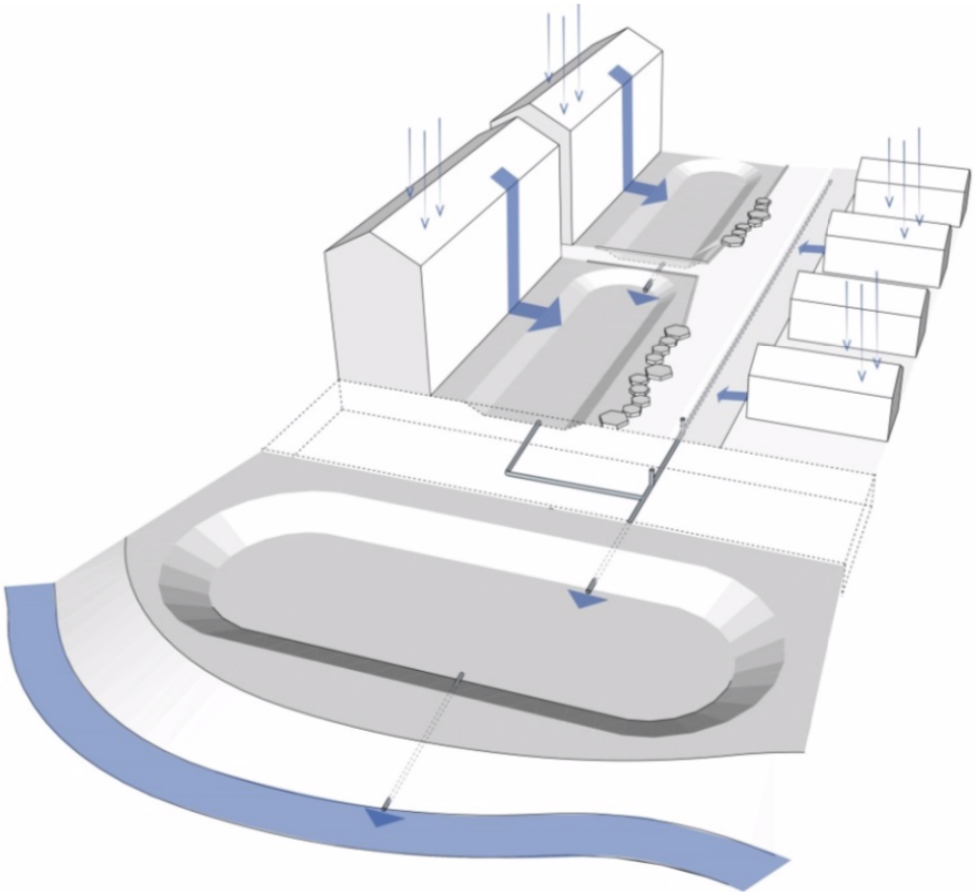
Physical and water technical aspects

While the intermunicipal work carried out in and around Usserød Å is technically a different project, the measures taken are still important for the local climate adaptation in Kokkedal. Therefore, a few words should be said about these measures first. To accommodate larger volumes of water, the drainage capacity of Usserød Å was increased in Kokkedal using two methods: first, by building a dike on the eastern banks of the stream along where the floods had happened, to avoid that large volumes of water would flood these low-lying areas in case of heavy rain; second, by creating a double profile, with low edges for the amounts of water running through on everyday basis, and higher with a much larger water capacity to accommodate heavy rain incidents (Fryd and Jensen 2018). Implementation of measures was completed in August 2012, around the same time as when planning of Kokkedal Climate Adaptation began to pick up speed (ibid). In other parts of the catchment area of the stream, other interventions have happened: e.g. sluice controls have been improved to better regulate water flow, and large retention basins have been established that can accommodate large volumes of water and simultaneously help retain nutrients to improve the aquatic condition of the stream (ibid).

Usserød Å. The grass in the foreground is the part of the double profile prepared for extreme rain incidents.

Then, Kokkedal Climate Adaptation. Where the Usserød Å-project has focused on the water in the stream, this project has been about local rainwater management and has focused on water before it enters the stream. For this, 40 connected projects have been established around Kokkedal, with visible management and recreational values of water as the recurring theme (Fryd and Jensen 2018). These are scattered across the project area and function as detention or retention basins for handling the runoff water from roofs and streets (ibid). The entire area of the project has separate sewers, dimensioned for a five-year rain incident; these make up the majority of water transport infrastructure, while surface water structures only constitute 14% of the total length of water transport elements in the project (ibid).

The basic principle of the water management in Kokkedal Climate Adaptation, as illustrated below, consists of three main elements: the existing separate sewers, local basins in residential areas, and larger basins in close proximity to Usserød Å (Fryd and Jensen 2018). From roofs and roads, rainwater is led either directly to separate sewers, or to basins with capacity for five-year rain incidents, from where it is slowly discharged into the sewers over the course of a day; in case the sewers or these basins reach capacity, water is led on to larger basins with capacity for 20-year rain incidents, also discharging to the sewers, but over three days; in case of even more extreme rain, these basins overflow directly to Usserød Å, or to lower-lying areas where the water does minimal damage (ibid).



The basic principle of water management in Kokkedal Climate Adaptation. Source: Fryd et al. 2019.

As such, the existing sewer system makes up the frame for the climate adaptation project which, in accordance with the municipal climate adaptation plan, is a cost-effective solution, as the separate sewers were there already. Instead, the significant funds for the project have been used for the structures contributing to urban renewal and the quality of public spaces and recreational areas in Kokkedal (Fryd and Jensen 2018). This includes the 40 subprojects such as rain gardens, rainwater playgrounds, and recreational areas. Some of the projects have involved larger changes, such as the green areas around Usserød Å: these have been altered into attractive recreational areas, with increased biodiversity and offering multiple activities for visitors (Realdania n.d.a). The bulk of the volume for water detention in the project, about 78%, is placed in these areas (Fryd and Jensen 2018). Further, the central urban area around the shopping mall, the local school, and the sports hall has received a general overhaul, leading to better connectivity across the urban centre (Realdania n.d.a). Finally, a broad path cuts through the area between the urban centre and the recreational areas around Usserød Å, also providing better connectivity and new ways around Kokkedal for the locals (ibid).

The total water system of Kokkedal Climate Adaptation is dimensioned for a projected 20-year incident in the year 2110, with a large safety margin (Lassen, pers. comm.). The water technical solutions should be able to accommodate very large rain incidents; even in case of a 100-year rain, floods in critical areas are expected to be avoided, as water is led to areas where it does the least damage (Fryd and Jensen 2018). The solutions are overdimensioned by 64% and 74% for 5-year and 20-year basins, respectively (ibid). Most important are still the sewers for rainwater, and the project is largely dependent on their continued existence (ibid).

It can be discussed whether the new structures help to avoid floods such as those initiating the project. First, the solutions from the Usserød Å-project solved the most pressing issues; and second, the placement of the new rainwater basins does not benefit the areas that experienced floods in 2007 and 2010 (Mortensen, pers. comm.). Still, the large volumes the water management system can now accommodate makes the remaining area of Kokkedal very resilient to even the most extreme rain incidents; and perhaps more importantly, the project has resulted in large additional values and improvements of the urban quality of Kokkedal, maybe even outshining the climate adaptation effects achieved (ibid).

Additional values

While additional values are often outcomes that have been developed based on planned climate adaptation measures, it is basically the other way around in Kokkedal. This is perhaps a result of combining many projects under one theme, climate adaptation. Water management has been a priority, but so have renovation of buildings, upgradation of public spaces, and connecting the public housing projects, the urban centre, and the recreational areas (Lassen, pers. comm.). As climate adaptation was the project title, it has then been a principle that the projects made under Kokkedal Climate Adaptation should, to the extent possible, include an element of water (ibid). The 40 subprojects carried out around the project area are all connected to water in some regard.

Green areas around Usserød Å.

The 40 projects are located across the entire project area, are at different scales, and with different functions. Most of them function as water detention in case of rain, giving the water recreational, aesthetical, or entertainment value (Realdania n.d.a). The largest projects – concerning water capacity – are the new green areas around Usserød Å; but much smaller projects are present throughout Kokkedal (ibid). Examples include several playgrounds and sports facilities, the largest one next to the local school; gardens with different purposes and visual profiles; art installations; and a platform next to Usserød Å where school children can learn about water systems and aquatic life (ibid). The projects are thematically connected by water: they use water as part of their visual identity, detain water when it rains, or facilitate learning about water.

On top of this, thorough renovations of buildings within the public housing projects has happened alongside the project; while not directly a part of Kokkedal Climate Adaptation, this has contributed to the overall impression of the transformation Kokkedal has gone through (Holmberg 2013). Especially apartments and common areas of Egedalsvænge have been improved, and the area has benefitted a lot: it no longer appears on lists of vulnerable housing or high crime areas, and the physical changes are likely to have contributed to this development (Nøhr 2020).

Common areas in Egedalsvænge.

The many projects that are part of Kokkedal Climate Adaptation are generally well-received: many attractive areas have been established, and especially the area around Usserød Å are frequented a lot by locals (Mortensen, pers. comm.). The new recreational areas, the better sense of security, and the increased urban quality have likely been the largest effects of the projects overall; and perhaps climate adaptation has been as much a goal in itself as it has been a driver for a common approach to the other issues present, and for reaching these additional values (ibid).

Process

After the two instances where Usserød Å overflowed, swift action was required, which was provided through the intermunicipal project (Mortensen, pers. comm.). While the project was still being implemented, the Kokkedal Climate Adaptation-project was initiated: it was recognized that this would take a lot longer to finish, as the many foci of the project should be addressed collectively, and many additional values were on the drawing board (Holmberg 2013). Several processes came together to initiate the project. Municipality of Fredensborg were in dialogue with Realdania prior to the project about different projects in the municipality that Realdania could possibly support; this dialogue led to the conclusion that it would be feasible to collect the projects under one, by letting climate adaptation lead the way for other urban renewal projects (Lund and Sehested 2014). Thus, Realdania played a central role from the beginning of the project. Further, discussions between Municipality of Fredensborg, Fredensborg Forsyning, and the local housing associations resulted in an agreement about cooperation

and co-funding of projects addressing the existing challenges (Lassen, pers. comm.). This paved the way for central project partnerships.

Several bilateral partnerships are established as part of Kokkedal Climate Adaptation, the most central one being between Municipality of Fredensborg and Realdania: this partnership is also the frame of reference for the other partnerships between the municipality and each of the other actors in the project (Holmberg 2013). All parts are represented in a steering group, where other organizations funding the project are also included (Lund and Sehested 2014). This configuration of roles makes the organizational aspects of the project rather complicated, as several of the participants act as developers for different parts of the project (Lassen, pers. comm.). Further, the municipality has two roles at once, both as developer, but also as the local authority for many areas of the project (ibid). While the steering group should ensure that common goals were pursued, no agency was officially designated the role of project coordinator; the municipality took this role upon itself to some extent, as the necessity of a central coordinator was obvious during the process (ibid).

Project planning was initiated with an architecture competition in two parts: the first one in April 2012, and the second in August 2012 (Realdania n.d.a) – the same month that the structures of the Usserød Å-project were finalized in Kokkedal. Material for the competition included results from the preliminary project planning (Lund and Sehested 2014), a competition programme, and four publications presenting possibilities with SUDS, interviews with locals, patterns of movement of selected residents of Kokkedal, and demographic studies of Kokkedal, respectively (Municipality of Fredensborg n.d.). The competition was won by a team consisting of Schønherr, BIG, and Rambøll with a project titled "*The Blue-Green Garden City"* (ibid). The project was influenced by the English concept of Garden Cities, and had water as a recurring theme connecting the elements of the project (Lassen, pers. comm.). However, the project focused primarily on the possible combinations of water and urban spaces, and a narrative about the movement of water and residents, while not going much into detail with the water technical aspects of the project (Mortensen, pers. comm.). This meant that there would not be sufficient water in the system to create all the subprojects originally planned (Lund and Sehested 2014), and that the project was slowed down as ambitions for water management and water technical modelling had to be made after the architecture competition (Lassen, pers. comm.). Finally, a master plan was developed for the area, detailing and adjusting the plans outlined in the winning proposal (Holmberg 2013).

This was not the end of the coordination work, however. A continuous effort was made by the municipality to ensure good dialogue between project partners; a challenging task, amongst other things because of the unclear role of the wastewater company, which was needed to finance structures that were not clearly their jurisdiction; and because of the infamous 'Christmas tree case', where the management board of Egedalsvænge stepped down due to a conflict that involved the decision of not having a Christmas tree in the common area (Mortensen, pers. comm.). The network efforts proved successful, and in the end, Kokkedal Climate Adaptation has been implemented in a manner resembling the master plan, resulting in many successful partial projects (ibid).

Until the approval of the master plan, extensive citizen participation was conducted with local residents and other stakeholders in the area, with the purpose of creating a sense of local ownership and affiliation with the project (Holmberg 2013). The participation process was very open to inputs, leaving a difficult task of prioritization for the steering group as to which projects should be included, and which should be left out (Mortensen, pers. comm.). The participation process included, amongst other things: a public meeting prior to the architecture competition; presentations of several project proposals with public debate; public meeting about the winning proposal; workshops and guided tours to central parts of the project area; meetings with stakeholders representing different institutions in the area; and continual meetings with resident representatives from the public housing projects (Lund and Sehested 2014). After the development of the master plan, however, citizen involvement largely ceased (ibid).

The budget of Kokkedal Climate Adaptation is ambiguous, perhaps because it is indefinite exactly what is a part of the project and what is not. Figures for the total budget range between DKK 118 million (Vandplus n.d.) and DKK 145 million (Realdania n.d.a). In one report (Lund and Sehested 2014), funding is broken down as DKK 22.1 million paid by Municipality of Fredensborg, DKK 13.4 million by Fredensborg Forsyning, DKK 44.5 million by Realdania, 35.4 million by the two public housing associations, and DKK 5 million from the Danish Foundation for Culture and Sports Facilities (*Lokale og Anlægsfonden*). These numbers differ slightly in other reports (e.g. Holmberg 2013). What is perhaps more interesting than the exact numbers is the fact that the renovation of buildings in the public housing projects – which is not a part of the Kokkedal Climate Adaptation-project – has been funded by the Danish Social Housing Sector (*Landsbyggefonden*) with DKK 510.6 million, several times more than the total budget of Kokkedal Climate Adaptation (Lund and Sehested 2014). Another interesting thing is the process of fundraising carried out in the project: after Realdania joined forces with the municipality, the other foundations were very eager to fund the project as well; as if the participation of Realdania was been a verification of the project, making the others open their money bags (Mortensen, pers. comm.).

Realdania's interest in the project has to a large extent been based on the fact that the project has been innovative, approaching climate adaptation and urban renewal in a way that was unusual at the time (Realdania n.d.a). A condition for the participation of Realdania has been that three evaluation projects should be prepared. These focus on the water technical solutions, the architecture and urbanity, and the experiences from the project partnerships (Municipality of Fredensborg n.d.). Contents of these are briefly summarized under *Lessons learned* below.

Implementation

Kokkedal Climate Adaptation has been implemented mainly through agreements made between project partners. Certain factors have acted as driving forces for this method and the project in general; similarly, it has also met some challenges. Much have been learned through the project; both by project participants, but also because the project has had demonstrative purposes, and several evaluations have been published. All this is presented in this section.

Implementation methods

While the master plan guides the development of the project, the main approach used to ensure implementation of the devised elements are the partnership agreements (Mortensen, pers. comm.). All the actors contributing to funding the project are part of such agreements, and are consequently sharing the legal, economic, and operational responsibilities; thereby, the agreements contribute to breaking up sectorization and ensuring integrated, contextual solutions (Holmberg 2013).

All structures of Kokkedal Climate Adaptation are established solely on plots owned by parties included in the partnership agreements (Mortensen, pers. comm.). Under the agreements, distribution of responsibilities have been established: structures are constructed either with the plot owners or the municipality as developer, while operation and maintenance are the responsibility of the plot owner, or the wastewater company if it pertains to purely water technical solutions (ibid). The 40 projects of Kokkedal Climate Adaptation are placed in areas owned by the public housing associations (e.g. SUDS within their common areas), on public area under purview of the municipality (e.g. rainwater playgrounds adjacent to the local public school), or owned by the municipality (e.g. the large basins and recreational areas around Usserød Å); in any case, the parties are contractually obligated to establishing, operating, and maintaining the structures in accordance with the partnership agreements (ibid).

The partnership agreements are a strong tool as they are binding for the involved actors, securing that measures are carried out according to the plans. No measures are made on plots owned by other actors, such as private individuals, meaning that all it has been possible to arrange all development between the agreement parties (Mortensen, pers. comm.). What has been challenging, however, has been to arrive at understandings and plans that all partners agreed upon. The cooperation leading to successful project implementation has been driven by establishing and maintaining strong relations between actors, by working to ensure shared understandings, by creating a sense of equality between actors, and by working strategically with decision-making and prioritization (Lund and Sehested 2016). These factors are elaborated below under *Drivers.*

Because of the binding nature of the agreements, no other methods have been necessary to ensure project implementation. The municipality has paid attention to whether local plans would be obligatory (Mortensen, pers. comm.). But as the use of the areas within the project have not been altered substantially, it has not been necessary to make new local plans as part of the project (Lassen, pers. comm.). A few local plans effectuated in parallel with Kokkedal Climate Adaptation does, however, relate to the project area (see Municipality of Fredensborg 2015; Municipality of Fredensborg 2017a): on the topic of climate adaptation, these contain regulations on water basins and other water technical structures in order to ensure proper management of water in cases of extreme rain. The plans are not made as part of Kokkedal Climate Adaptation, but are supporting the elements from the project as well as the development guidelines in the municipal plan and climate adaptation plan. While Kokkedal Climate Adaptation itself has not required local plans, some regulations should still be observed, and some permits have been required; such as regarding protected nature, discharge of water, and earthmoving (Lassen,

pers. comm.). But all in all, the partnership agreements have been at the centre of the implementation process of Kokkedal Climate Adaptation.

Drivers

In the project in Kokkedal, climate adaptation has been a driver for urban renewal. At the same time, several other factors have been driving forces for the implementation of the project as a whole.

A main driver for the successful implementation of Kokkedal Climate Adaptation has been the broad cooperation. The organizational configuration involving a multitude of actors has ensured large funding and strong competences for planning and implementing the project (Vandplus n.d.). In one of the evaluations of the project, concerning the approach to project management (Lund and Sehested 2016), some of the main factors ensuring the success of the cooperation and the partnership agreements have been pointed out. First of all, it has been important to establish and maintain strong relations between the different actors. This is understood as relations on the personal level; by knowing the other people working on the project, cooperation has been observed to flow much more smoothly. This has required a project leader being a very active force in facilitating the creation and maintenance of these relations. Second, shared understandings have supported the strive towards shared goals. These shared understandings must be sustained even if people working on the project are substituted. This has been reinforced by a set of procedures of keeping track of agreements, compromises, and negotiations that have been part of the shared narrative; carried out by writing these down, and by having meetings were these things have been discussed. Third, it has been important to create a sense of equality between the actors. Everyone should feel that their views matter in order to involve all parties actively and establish the aforementioned relations between actors. Finally, strategic decision-making and prioritization of project measures should be carried out as a collective process. This will often be part of discussions regarding economy, where much of the negotiations happen. These negotiations are likely to be more fruitful if strong actor relations and common understandings are present: then negotiations can be carried out although they may involve decisions that some parties do not initially agree with. These factors have been present in the Kokkedal Climate Adaptation-project, and has made the processes of negotiation and planning between project partners much more efficient (ibid).

Another factor contributing to the success of the project has been the early involvement of Realdania. By working alongside the foundation from such an early phase of the project, Municipality of Roskilde has ensured valuable competencies for the project, as well as significant funding: as Realdania was committed to the project, several other organizations and foundations contributed to the project with substantial economic support (Mortensen, pers. comm.). The initial work with Realdania has likely been the basis for establishing the strong partnerships that would become the core of the project implementation.

Other factors have been vital for the project as well. Without the rain incidents leading to floods of Usserød Å in 2007 and 2010, the project – having climate adaptation at its core – would likely not have been initiated in its current form. The fact that no properties owned by private individuals needed to

have new structures established on them has made project implementation simpler; no land use has been restricted, and new elements have been established for the benefit of all locals. And the opportunity for combining several projects that were already being planned has laid the foundation for the broad, multisectoral collaboration that has been so defining for the project.

Challenges

The way Kokkedal Climate Adaptation has been organized through partnership agreements has also created challenges along the way. A significant one has revolved around the configuration of roles, and particularly of Fredensborg Forsyning. While the way the partnerships are generally run have been characterized by an approach reminiscent of network management, the management of the wastewater company is more rigid (Lund 2018). This makes negotiations more difficult, since the flexibility of the wastewater company is limited as it must operate within certain regulations (ibid). During the process, Fredensborg Forsyning at times felt a pressure to partake in activities beyond its purview (Mortensen, pers. comm.). And at times, the company felt entirely out of place in the planning processes, as the project was about so many other things than climate adaptation and water management (Lassen, pers. comm.). Further, it has been difficult to find a proper level of detail for the planning: Fredensborg Forsyning has needed quite detailed descriptions of their responsibilities, while the general process has been driven by a less detailed, more flexible approach to planning (Lund 2018). This has further emphasized the need for common understandings and strong actor relations to ensure good cooperation between parties working under such markedly different regulatory conditions (ibid). Since the project, some of these uncertainties have been cleared up e.g. by the introduction of new opportunities for wastewater companies to co-finance projects of this kind, and as the companies have built larger knowledge regarding the topics of climate adaptation and additional values (Lassen, pers. comm.). But still, wastewater companies are regulated heavily, which may continue to complicate the organization of such projects.

Another challenge in the process has been the lack of a coordinator role. As different actors were developers on different parts of the project, the project was at times dragged in multiple directions at once (Lassen, pers. comm.). Fruitful negotiations on visions and understandings of the actors involved in the partnerships could have been obtained more easily if one actor had the role of coordinator for the project (ibid). Looking back, all actors of the partnerships agree that such a coordinator would have been an advantage for the planning process and project implementation (Lund 2018).

Other small challenges have appeared through the process. Some local residents were unhappy with the timeframe of the project, some with the relocation of parking spots, and some did not feel like they benefitted from the projects (Mortensen, pers. comm.). But generally, only little opposition from residents have surfaced, perhaps because no private individuals have had to make changes to their own properties, while on the other hand, most of them have benefitted from the project (ibid).

Set of stairs built as part of Kokkedal Climate Adaptation, connecting the residential areas to the area around Usserød Å.

Lessons learned

Kokkedal Climate Adaptation has generally succeeded in meeting its goals. Climate adaptation measures are functional, and interesting and valuable public spaces have been created in Kokkedal; most elements are popular and well-visited, and the water management structures contribute to meeting set service targets (Mortensen, pers. comm.). The way a climate adaptation focus has been used in the project to approach general urban renewal has been inspiring to future projects: the combination of urban development, recreational areas, and climate adaptation is a common tactic of many projects today, but at the time of this project, it was a rather novel approach (Lassen, pers. comm.). And the way project planning has been organized, through partnership agreements with several actors, has shown a way to approach such projects where broad interests, knowledge, and competences come together to form a broad, multidisciplinary project (Lund 2018).

It was anticipated from the beginning that the project would have demonstrative value to future work with climate adaptation and related additional values. This was a reason for Realdania's participation in the project, and it was vital for their interests that proper evaluation was carried out (Realdania n.d.a). Three evaluation reports have been prepared, providing inspiration for other municipalities in similar

situations. One focuses on the water technical solutions applied in the project (Fryd and Jensen 2018). Points from this have been included throughout the section on *Physical and water technical aspects* above. The evaluation characterizes the main tools used in the water management system and gives detailed introductions to the measures implemented in different parts of the project area, useful as inspiration for other projects. Another evaluation report focuses on the architectural solutions and the urban spaces created (Marling and Kiib 2019). It especially focuses on how the new structures have improved urban quality and how it has had an impact on the social issues present in Kokkedal. The final evaluation has focused on the partnership approach to the project, and is in three parts (Lund and Sehested 2014; Lund and Sehested 2016; and Lund 2018). It focuses on the configurations of the partnerships, on what went well and what was challenging, and on central factors for a successful process using such an approach. This have been elaborated a little under *Drivers* and *Challenges* above. The evaluations demonstrate new, integrated ways of approaching a large climate adaptation project.

The climate adaptation aspects of the project are functional, but perhaps the large overdimensioning of the system will turn out to be superfluous in the future. The amounts of water in the system might be reduced over time, e.g. due to less impermeable surface area or establishment of infiltration measures on private properties; this would make the water structures unnecessarily large and could mean that there is not enough water for the functions of some of the subprojects under Kokkedal Climate Adaptation, e.g. rainwater playgrounds (Fryd and Jensen 2018). It is likely that runoff water is reduced in the future, as SUDS are integrated in the municipal plan and climate adaptation plan. This is a factor that is easy to overlook in climate adaptation projects: that the projects are not final, and future changes will impact their function and dimensioning.

Planning strategy and strategic navigation

Kokkedal Climate Adaptation is promoted as a climate adaptation project, but it is as much an urban renewal project. A focus on climate adaptation is used through the project as a way to guide development throughout Kokkedal, but climate adaptation is not the largest priority. Most of the water management measures needed to secure Kokkedal from floods were implemented under the Usserød Å-project. And while the new measures do contribute to meeting the service target, the planning and design of the subprojects has not had climate adaptation as the top priority. What it has done is making Kokkedal a safer, more enjoyable area with numerous public spaces connected by a common focus on water on the surface. Climate adaptation is the headline used for creating this connection.

The planning strategies applied in the overall project and specifically for climate adaptation, respectively, are closely connected and difficult to separate, but they are carried out in different ways. The overall project is understood here as the general processes leading to the 40 subprojects and creating additional values, while climate adaptation is understood as the technical solutions. Both are equally important to understanding the strategic navigation lying behind the planning of Kokkedal Climate Adaptation. In this section, both are referred: while the planning for climate adaptation is the main focus of this thesis, the general planning of the project is more significant for the process and outcomes. That they are

different is perhaps because climate adaptation in the project has been viewed more as a means for creating additional values, rather than a main aim. Many water technical structures are placed underground, where they do not create additional values, and residents are barely involved in rainwater management. Irregardless, Kokkedal Climate Adaptation has succeeded in both securing the project area against floods, and creating additional values concerning urban quality.

The overall planning approach in Kokkedal Climate Adaptation is focused on certain issues – especially urban quality and social issues in the public housing projects – but has an open approach to defining the solutions to these. As its aims, it has a direction and certain areas of focus, rather than specific, predefined goals. A common frame of reference is established for the project, where surface water is placed at the centre of the many subprojects that are planned for. The specific content of these are not predefined, but planned along the way and open to many different priorities regarding their envisioned outcomes. In the process towards defining these subprojects, many stakeholders are involved: initially, the public is involved broadly through meetings, presentations, discussions, workshops, and tours. And all through the project, central actors are involved in shaping the decisions through bilateral agreements bringing them together across sectors. This is corresponding with a transformative approach to strategy making, defined by Healey (2009), and is significant for the general planning: it has been subject to continuous negotiations through established coalitions of central actors. For the planning of climate adaptation measures, the approach has been more ambiguous. Of course, the concrete implementation of much of the individual water management measures – through the subprojects – has been subject to the general planning approach. But the planning of the water management system in itself has been largely predefined. The basic principles have been defined in the master plan, placing most of the water infrastructure underground, as purely technical structures. Thus, the water management system has not been subject to the same negotiations as the urban projects, but has been approached as a more technical, less flexible solution, more reminiscent of a responsive approach to strategy making. This may be a symptom of the fact that to a large extent, the climate adaptation in the project has been a means to approaching general urban renewal as much as an end in itself.

The planning process has been characterized by a large degree of flexibility, in some regards. The process has been formed along the way by appearing opportunities and inputs from stakeholders. Project plans have been developed in collaborations under the project partnerships. And the process has been receptive to the opinions of all these actors, in order to establish a strong, common understanding. This has ensured a somewhat cyclical process, where ideas and plans have been continuously developed. However, one central factor has been challenging this. The rigid regulations that the wastewater company has been subject to has complicated the planning process. While the general approach has called for negotiations and a large degree of flexibility, the regulations pertaining to the wastewater company have required clear and specific plans, and has not allowed much flexibility regarding distribution of responsibilities and especially questions regarding funding. In this project, this has been solved through negotiations and by establishing a common understanding of the fact that the wastewater company has limited flexibility. This has been possible because of the strong relations and cooperation between actors; but it is a general

challenge that is likely to occur in strategic planning when one or more parties are subject to inflexible protocols.

The purpose of the project has been to mobilize different actors to create connections and collaborations about knowledge creation and negotiations of possible futures. When not considering the main water technical aspects, the overall project applies a learning approach, similar to what Sehested (2009) calls 'strategies as mobilization'. The process has very much been the aim, and the partnerships created have been inclusive, flexible, and characterized by on-going negotiations and collaborative learning. Some factors in the project point in directions of other strategies; e.g. the inflexible role of the wastewater company, the fact that most citizen participation is limited to the initial planning, and that residents are not actively participating in implementing, operating, or maintaining the final solutions. But besides this, the process and partnerships exhibit a highly strategic, mobilizing approach to planning.

Looking solely on the climate adaptation aspects of the project tells a different story. The planning of these has been less flexible and more bound to an initial plan for the water management system. This is perhaps because the climate adaptation focus in the planning has widely been a way to promote the project and push the other focus areas. This demonstrates an approach closer to 'strategies as rhetoric and symbolic action': practical and static solutions for most of the water management system are developed early in the project, planned by experts and with limited public participation. The 40 projects do constitute a part of the water management system; but most of it is placed underground, and does therefore not permit working additional values into it. Climate adaptation has not been an urgent need after the Usserød Å-project was carried out, and including climate adaptation alongside the other priorities in the project has to a large extent been a way to push these priorities forward. Hence, climate adaptation has partially worked as a symbolic focus connecting the other focus areas.

In the planning and implementation of Kokkedal Climate Adaptation, many actors and localities have been mobilized. In the planning project, project participants and property owners have been mobilized through the partnerships, where they have been included in the planning on similar terms, which has further created a mobilization of actor relations and configurations of responsibilities. The mobilizations of project areas have resulted in reconfigurations of places to have new or enhanced functions as urban spaces and meeting points. And in itself, the project has mobilized the relation between climate adaptation and urban renewal, by combining them in an integrated project. Many elements of the socio-material context have been up in the air during the process, characteristic of a planning process with a strongly strategic approach.

In order to make these mobilizations happen in a meaningful way, a good amount of sensitivity to the context has been necessary. This has been ensured by the detailed studies of Kokkedal carried out before the project. Further, it has been achieved by including many actors with strong local ties in the project partnerships: including the municipality, the wastewater company, and the public housing associations. The process of constructing the partnerships has involved a large amount of sensitivity. On top of that,

meetings with resident representatives and many citizen involvement arrangements early in the process have been used to gather knowledge and opinions about local issues. Altogether, this has ensured that the planning actors has had a good understanding of the local situation, present challenges, and suitable types of solutions from the beginning.

Besides the sensitivity, processes of staging have been very present through the planning and implementation of the project. This has happened in the initial stakeholder participation, when results from the architecture competitions were presented for locals and others with interest in the project. And it has especially occurred in the work within the partnerships. This work has principally been one long project of continual stagings, where many ideas have been brought up in negotiations leading towards a final consensus. These processes have been very open-ended and inclusive towards all involved actors and opinions, although the wastewater company has been somewhat limited by certain regulations for their participation in the project. Meanwhile, other stakeholders not contained in the partnership agreements have not been included as much in these processes, as most citizen involvement ceased after the master plan was developed. Local residents have had their opinions heard, but have not been actively involved through the process, in negotiations, or during project implementation. Hence, the staging has mainly happened within the partnerships, and cooperative relations between the project partners and local residents are not mobilized as much as they could have been.

Climate adaptation has been the driving force for initiating a large-scale, multisectoral project, and for engaging a broad range of actors. It has been the starting point and likely a large factor in making Kokkedal Climate Adaptation a successful project, even as it is broadly an urban renewal project. While it has lacked public participation in the negotiation and implementation phases, it has still managed to achieve transformative results during the process, and in the new configuration of urban spaces and rain water management structures around Kokkedal.

Middelfart – The Climate City

Small square in the old town of Middelfart.

Middelfart is the fourth largest town on Funen with just short of 16,000 inhabitants (Statistics Denmark 2020). It is located on the westernmost part of the island, and surrounded by the waters of Lillebælt on three sides. Parts of Middelfart rise more than 40 meters above sea level, these hills contributing to the alluring qualities of the landscape with forest areas and the long stretch of coastline adjacent to the town. In the lower lying parts of Middelfart, in the direction of the to this day still active Old Harbour (Gammelhavn), the old town is located, with houses dating back to the 16th century. The soil below the town consists mostly of clay, which may be one reason why the Danish Museum of Ceramic Art, CLAY, is situated here.

From 2012 to 2019, a large climate adaptation project was realized in the western part of Middelfart. The projects, aptly titled The Climate City (*KlimaByen*), was the result of initial investigations of how the problems created by rainwater in the town could be solved. These problems had especially shown themselves in the years immediately before project initiation, where sewage back-up in basements and water overflow to Lillebælt were likely to happen when heavy rainfalls occurred (Klima-byen.dk n.d.). During a period of five years, approximately 30 households experienced sewage back-up (Rasmussen,

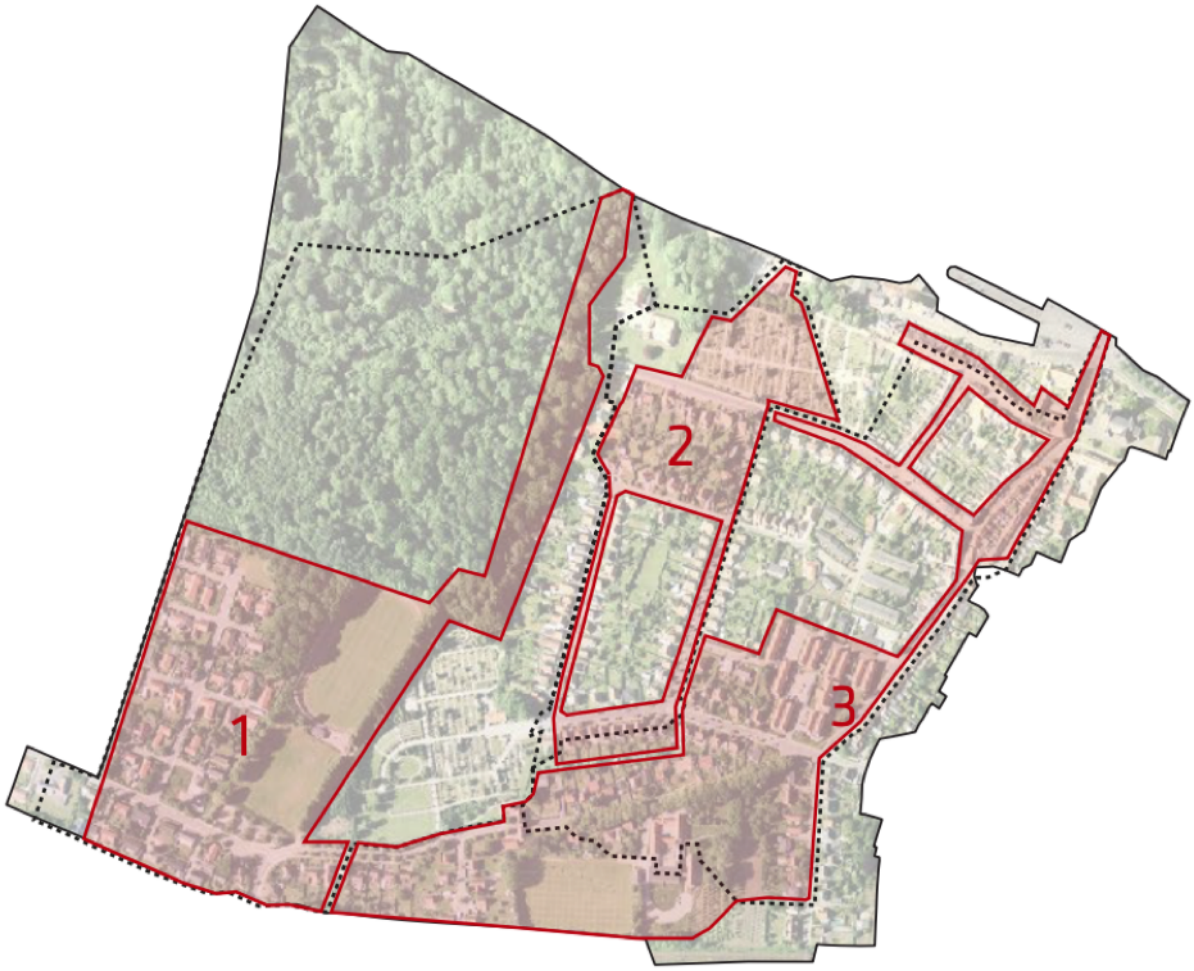
pers. comm.), and it was calculated that sewer water overflowed to Lillebælt 86 times in just one year (Svane, pers. comm.).

Map of Middelfart with the case area marked in red. Source: Apple Maps with contour drawn upon.

It was soon decided that rainwater should be managed on the surface. This was a result of the initial studies – carried out by Municipality of Middelfart, Middelfart Spildevand (the local wastewater company), and Realdania – showing that the traditional solution of separate sewers would be too cumbersome an approach. More than 500 households were located in the area of 45 hectares that would become the perimeter of the project. Connecting all these buildings to a new sewer system would be expensive, also for the residents (Svane, pers. comm.). Instead, managing rainwater on the surface would not only save most of the locals a fair amount of money; it would also make it possible to use the water to create additional values.

Numerous water technical elements have been constructed to enable management on the surface: some streets have been narrowed to make room for streetside rain gardens, other streets have been converted to lead water in the middle through the town, a large playground area has been established where water is detained and used for aesthetic purposes, wadis have been dug around the town, and on all public streets, storm drains have been closed with concrete, necessitating the management of all road water on the surface (Rasmussen, pers. comm.).

In its final form, the 45 hectares of climate town comprises three neighbourhoods with each their urban typology: the Woods (*Skovkvarteret*) on the highest point of Middelfart has modern single-family houses and is located close to the forest, drawing on nature as an inspiration for the design of the local rain gardens. The Avenues (*Allékvarteret*) has classic houses from the 30's and 40's and streets where streetside trees have now been planted to better fit the streets named after trees. And the City (*Bykvarteret*), the old town of Middelfart, has houses several hundred years old and typical cobblestone streets. Finally, an important part of the project is the Activity Forest (*Aktivitetsskoven*), consisting of a playground and a sports venue, where water is an important design theme throughout. Besides the three neighbourhoods and the Activity Forest, a cemetery, a senior centre, and several gardens of private residents are involved in uncoupling rainwater from the sewer system and handling it locally.



Overview of the three neighbourhoods of The Climate City: 1) the Woods, 2) the Avenues, 3) the City. The dotted lines indicate catchment areas. Source: Orbicon, SLA, and Hoffmann 2013a.

When the next heavy rain incident happens, most water is ultimately led to Lillebælt. Because of the prevalence of clay in the ground below Middelfart, infiltration is not a central method in the rainwater management (Svane, pers. comm.). Rather, the sloping of the landscape is utilized to lead water through streets, pipes, and wadis towards the harbour and finally Lillebælt (Rasmussen, pers. comm.). On the way, water is treated through rain gardens, sand traps, first flush diverters, and an oil separator (ibid). The

new measures have so far been successful in preventing sewer back-up and other unfavourable effects of heavy rains (ibid). Additional values include the Activity Forest as a recreational area, rain gardens on numerous streets (for aesthetic value, but simultaneously functioning as traffic calming devices), increased biodiversity, and beautification of the senior centre, several private gardens, and other areas around the town.

Realizing this project has primarily happened through constructions made on municipal streets and on municipal properties, but it has also relied on the voluntary uncoupling of rainwater from the sewer system by residents (Kloch, pers. comm.). Further, a small number of easements have been recorded regarding public water infrastructure on private properties as agreements between the municipality and private residents (ibid). Other agreements also lay the ground for the successful implementation, including use of the cemetery for retaining and leading water (ibid). Generally, the implementation process has been characterized by municipal actions and a good amount of volunteerism, and throughout the process, citizen participation has been a priority (ibid).

The project

Municipality of Middelfart strives to be amongst the most progressive Danish municipalities when it comes to work on climate mitigation and adaptation (Municipality of Middelfart 2014). The municipal plan (Municipality of Middelfart 2017) contains descriptions and guidelines on several aspects of climate adaptation: these include regulations on land use to avoid constructing new buildings in areas threatened by floods, and to reserve space for future climate adaptation infrastructure such as basins; a desire for experimentation and making Middelfart a "climate lab" in regard to methods and technology, planning, partnerships, and citizen involvement; and plans for how future urban development should take climate adaptation into account by handling rainwater as close to the source as possible. The last topic will be ensured through new local plans by including requirements that all future buildings must collect rainwater – either to utilize it locally, or to manage it through infiltration or detention (ibid).

These regulations are also described in the municipal climate adaptation strategy (Municipality of Middelfart 2013) and the accompanying plan (Municipality of Middelfart 2014). The strategy sets the scene for climate adaptation in Middelfart, while the plan defines concrete actions, goes in depth on the water technical calculations and appoints several priority areas. The three top priority areas are all within the area constituting The Climate City (ibid).

Both the municipal plan and the climate adaptation strategy and plan are conceived in parallel with the Climate City project: in 2013 and 2014, respectively. They represent similar priorities as are present in the project, and additional strategies for planning of new build-up areas and such. Ways of managing rainwater similar to how it is done in The Climate City can be seen in the ongoing planning; an example is newly developed residential areas, where sewers are only constructed for wastewater; rainwater must be handled on the surface (Kloch, pers. comm.).

Before the project

With its location on the bank of Lillebælt, Middelfart is prone to floods in case of storm surges, but also by future rising sea levels (Municipality of Middelfart 2014). Heavy rains and cloudbursts are large challenges as well, and are affecting the town more often (ibid). These have led to sewer back-up in basements and on terrain. The problems have especially manifested themselves in the lower-lying parts of Middelfart; because of the form and heavy slopes of the terrain, all water from the catchment area in which the town is located is led through these on its way towards Lillebælt. Until the Climate City project was inaugurated, this caused significant issues: Before ending up in the sea, water could accumulate in the lowest parts, where sewers could not keep up with the flow (ibid). While the parts of Middelfart towering up to 40 metres above sea level did not need to be particularly concerned about the rain, residents of the downtown areas felt the problems water can cause. In a five-year period, about 30 instances of wastewater back-up in basements were recorded – a large number considering the limited size of the coastal part of town (Svane, pers. comm.). Further, computer models recorded around 86 instances each year where untreated wastewater overflowed to Lillebælt, as sewer capacity could not keep up: when large amounts of water came raining down, water management went out of control (ibid). In 2005, analyses of sewer back-up in basements were initiated in the area (Kloch, pers. comm.). These were the first measures leading to the Climate City project. From here, it evolved substantially until it became the project existing today.

The solutions in The Climate City manage rainwater on the surface. As the existing combined sewers did not have the capacity for heavier rains on more impermeable surface area, it was necessary to increase capacity; either by expanding the existing sewers and dividing it into separate sewers for rain and wastewater, or by removing rainwater from the sewer system entirely (Orbicon, SLA, and Hoffmann 2013a). There were several advantages of the latter solution: it was likely to be less costly, it led to a smaller risk of sewer back-up in basements as well as discharge of polluted water into natural water bodies, and it would be more economically efficient as rainwater would not have to be transported to and treated at a wastewater treatment plant (ibid). Below, the different constructions made are presented – both the purely water technical, as well as those providing additional values.

Physical and water technical aspects

The part of Middelfart that The Climate City is in lies on a slope leading downwards to Lillebælt. Hence, it is central that all employed solutions utilize this natural gravitation to lead the water towards Lillebælt. Further, the basis of the design of The Climate City is the division into three neighbourhoods. They have each their trail for local rainwater runoff, and are distinct in terms of urban design of the climate adaptation measures (GHB, Adept, and Orbicon 2015). The different urban typologies are staged to fit the existing conditions in the three parts of town: the Woods is designed with the forests and the landscape in mind, drawing organic shapes from nature into the streets, and handling water in rain gardens and with similar green elements; the Avenues has a sharp geometry in its orthogonal street design, and handles surface water partly in urban canals, partly in green structures; and the City has hard paving and water is led directly in streets with trough profiles to its destination, Lillebælt (ibid).

Dividing the area into three neighbourhoods has been with urban design in mind, but it has also been a necessity. As all storm drains in the whole area of 45 hectares have been closed, a single way of leading water would be insufficient to handle the potentially enormous amounts (Rasmussen, pers. comm.). By finding three different, natural ways to lead water, it has been possible to manage all rainwater successfully, by leading and treating water through various structures.

The three ways through which water is led in The Climate City. Source: Orbicon, SLA, and Hoffmann 2013a.

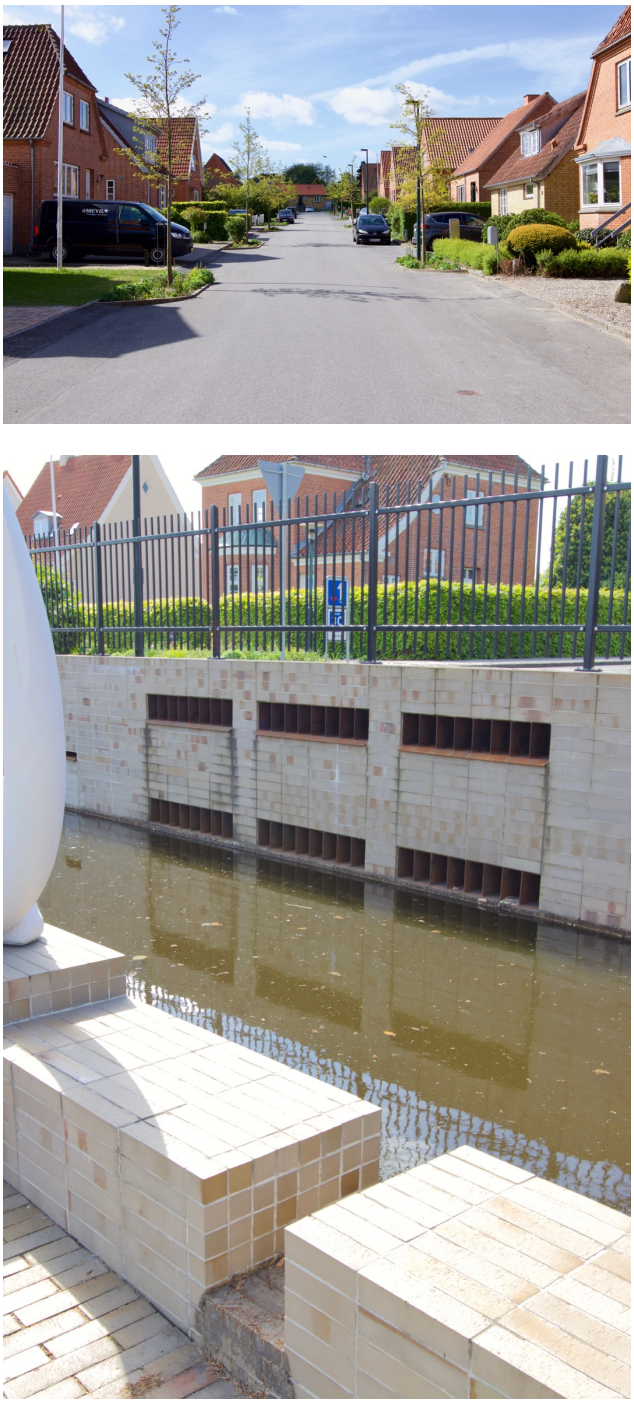
In the Woods, water is mainly managed in rain gardens on streets. The main flow of rainwater is collected in the rain gardens in the smaller streets, then led along the larger street Julievej to detention basins in the Activity Forest; from here, it is led to the trench Postens Rende, which discharges directly to Lillebælt (Svane, pers. comm.). Good examples of the specific changes made in this neighbourhood can be found on Karensvej. Here, the usual parabolic camber of the street has been changed to a single slope camber, leading all water to one side of the street (Rasmussen, pers. comm.). There, the sidewalk has been removed, and street-long, curved rain gardens have been built instead. For everyday rain incidents, they absorb most water; otherwise, they detain it (ibid). When one rain garden is full, water will continue to the next. And when the capacity of the gardens is exceeded, overflow water runs to a pipe leading it to the Activity Forest (ibid). This is the case for the water that Karensvej receives from connector streets located higher. From three lower-lying connector streets, surface water is led directly to the Activity Forest

across three private plots (ibid). All rain gardens in The Climate City contribute to water treatment: bacteria in the soil break down oil from the streets, and heavy metals are detained (ibid). Over time, the heavy metals will result in ground pollution above allowed thresholds, and the soil must be renewed: therefore, soil samples will be taken every ten years to monitor the quality (ibid). As the project was finished recently, this has not been done yet. The rain gardens in the Woods are dimensioned for everyday rain incidents, meaning that there is currently overflow to the Activity Forest about five times a year (ibid). Some streets in the Woods do not have structures as intensive as those on Karensvej, but just wadis leading water to the Activity Forest.

Some of the new elements on Karensvej in the Woods.

In the Avenues, rainwater is led through smaller streetside rain gardens, but also directly on the streets. The changes made on individual streets in this neighbourhood have depended on the wishes of the residents (Rasmussen, pers. comm.). The street Egevej has had both sidewalks removed and is remade into a shared space with rain gardens and streetside oak trees. Langedamsvej, on the other hand, has only had a few trees planted on the sidewalk. All water is guided to the street A.C. Hansens Allé, from where it runs to a large sand trap before it enters a retention basin on Vestre Kirkegård. The basin has a recess, and when it rains, water flows on a path through the cemetery at a leisurely pace (ibid). A new path through the cemetery with clay tiles has been constructed as part of the project; before, it was just a gravel path (Orbicon, SLA, and Hoffmann 2013a). To avoid too much water on the surface in case of heavy

rain, the basin is equipped with an overflow grate, functioning similarly to that on a bathroom sink: through here, water enters an underground pipe with a width of 800 millimetres and is led directly into Lillebælt (Rasmussen, pers. comm.). From the path, water is similarly led out of the cemetery, across the harbour, and into Lillebælt. This system is secured for a 100-year incident with a climate factor of 1.3 (ibid).



Clockwise from top left: streetside rain gardens on Egevej; on-street rain garden on A.C. Hansens Allé; sand trap before Vestre Kirkegård; retention basin on Vestre Kirkegård.

The City is the old part of town, characterized by hard paving and non-permeable surfaces. The street design leaves no room for rain gardens; instead, the main street has been altered from parabolic camber to a broad trough, leading rainwater on the surface in the middle of the street (Svane, pers. comm.). It flows for 900 metres until it reaches the harbour: here, it is treated before it is discharged to Lillebælt (ibid). Possibilities for managing rainwater on private plots is limited in the City. Rather, drain pipes along the street with the trough have been turned around, leading water into the street instead of to the sewer in case of rain (Rasmussen, pers. comm.). In two places, the street turns 90 degrees and the water flow must turn likewise; to enable this, the curbs of the sidewalk have been raised to keep the water on the street, and basement light wells and entranceways have been secured by constructing low walls around them (ibid). In everyday rain, a small stream of water will run down the street, while in case of extreme rain, the whole street may be filled with water: however, as the slope of the street is quite steep, causing the maximum flow of water to be between two and three cubic metres per second, this is unlikely to happen (ibid). By the harbour – just before discharge to the recipient – the water enters a 4,500-litre sand trap to catch heavy metals and other impurities, and afterwards an oil separator with a capacity of 900 litres per second (ibid). In case of everyday rain, the oil separator will purify all water; in case of heavy rain incidents, it functions as a first flush, while remaining water will flow over the quayside (ibid). The water system on the main street of the City is dimensioned for a future 20-year rain incident with a climate factor of 1.3 – equalling an 80-year rain incident of today (Svane, pers. comm.). Under these circumstances, it will be impossible to cross the street dry-shod (ibid).


In the City, drain pipes have been turned towards the street to lead water onto it; light wells have been secured by low walls.

The Activity Forest has three "glades" or three plateaus with different functions; one with a playground, one with athletics equipment, and one with a field for different sports. The glades are surrounded by grassy troughs planted with flowers and small bushes; in case of overflow from the nearby streets, they fill up with water and function as detention basins with infiltration (Rasmussen, pers. comm.). If the water level reaches a certain level, water will flow to a pipe leading it to Postens Rende and then to Lillebælt (ibid). As Postens Rende is quite deep, it has sufficient capacity for even the most extreme rain incidents, and further, leading more water through it is beneficial for local plant and animal life (Orbicon, SLA, and Hoffmann 2013a). Big sediments and impurities in the first runoff water from the Woods is

sedimentated in first flush basins just before water enters the Activity Forest: this ensures that soil in the Activity Forest does not have to be renewed as often as that in the on-street rain gardens (Rasmussen, pers. comm.).


The three glades in the Activity forest are surrounded by green areas, and connected by orange bridges.

Generally, the structures in The Climate City are dimensioned for between a 20-year and a 100-year incident with a climate factor of 1.3 – significantly better than the service target usually required in areas with combined sewers, where sewer overflows may happen every ten years (Rasmussen, pers. comm.). This is expected to be sufficient, even if the amounts of precipitation escalate faster than predicted, as it is also expected that more private plots will be uncoupled from the sewers system for rain water over the years (Kloch, pers. comm.).

Other structures

Above, the main features of The Climate City are presented. In itself, avoiding that rainwater from streets and sidewalks enters the sewers reduces the load on the sewer system with almost 50% (Rasmussen, pers. comm.). However, several smaller actions have been taken to contribute to the efficiency of the new rainwater management system. While these actions are relatively small in themselves, they are important fragments of the total project. Further, they are great examples of methods for municipalities to enhance local rainwater management. Three subprojects are presented below: private rainwater management, uncoupling of a senior centre, and construction of public water infrastructure on private properties.

Private rainwater management and voluntary uncoupling of surface water from the sewer system is a central strategy throughout The Climate City. The private properties are an important place of action, as they contain 51% of the impermeable surface area in Middelfart (Middelfart Spildevand, Municipality of Middelfart, and Realdania n.d.). A goal has been set that 10% of households should ideally uncouple their property from the sewers – a goal that is almost met (Rasmussen, pers. comm.). Residents choosing to handle all rainwater on their property have had their drains closed off and uncoupled from the sewer system for surface water, and they have been refunded 40% of the sewer connection charges, approximately DKK 23,000 in 2013 (Jensen 2014). Implementing water management on private plots has not been without its challenges, including that the underground of Middelfart has limited some

opportunities for water management. Because of the large amount of clay in the underground, infiltration is only possible to a limited extend, in flowerbeds and lawns, while rainwater attenuation tanks are mostly not a viable solution (ibid). The solution has been that everyday rain must be handled in the gardens, and in case of heavy rain, residents are allowed to discharge water to the municipal surface system up to five times a year (Svane, pers. comm.). Locals have been encouraged to take action on their plots: around the end of the project period, the municipality offered professional counselling on possibilities and necessities of handling rainwater in their gardens (ibid). To further inspire people to make their own rain gardens, another project – which is strictly not part of the Climate City project – has been carried out in the Avenues: seven private rain gardens created in 2013. This was a project carried out by Haveselskabet to demonstrate the different possibilities of handling surface water in private gardens (Jensen 2014). The water they cannot handle in their own gardens is discharged to Postens Rende (ibid). The seven gardens represent seven different ways of managing water – more or less visible, and with varying costs (ibid). The gardens serve as examples for others who would like to uncouple their sewers for surface water.

The Senior Centre Skovgade is owned by the municipality (Kloch, pers. comm.), making it possible for the municipality to uncouple its surface water from the sewer system. It is the largest public senior centre in the municipality with around 50 apartments and a large impermeable surface area (ibid). The total area of around two hectares has been uncoupled, and in its middle, a courtyard with water management structures has been established were a parking lot used to be (Rasmussen, pers. comm.). This has taken a lot of rainwater out of the sewer, and has contributed largely to the goal 10% uncoupling of homes (Kloch, pers. comm.).

In a few places, it has been necessary to place public rainwater infrastructure across private properties – such as between a street in the Woods and the detention area in the Activity Forest (Rasmussen, pers. comm.). In these rare occasions, easements has been registered as agreements between the municipality and the landowner at the time, ensuring that the infrastructure will stay there in the future (Svane, pers. comm.). Landowners have received small compensations (Rasmussen, pers. comm.).

Postens Rende, leading overflow water from the Woods, the Activity Forest, and uncoupled gardens on Egevej to Lillebælt in events of heavy rain.

Additional values

The Climate City solves pressing issues related to water; sewer back-ups and wastewater overflow to recipients are prevented. Besides this, it incorporates multiple additional values: the approaches to handling heavy rain also benefits the area as they function as traffic calming measures, they improve local biodiversity, and they provide citizens with a better-looking, greener town with more recreational facilities (Rasmussen, pers. comm.). And the changes have for the most part not been at the expense of the existing functionality of the area: e.g. making streets smaller has not negatively impacted traffic, as many streets were severely overdimensioned before (Orbicon, SLA, and Hoffmann 2013a). Below, the most obvious additional values are presented.

A large additional value is the creation of the Activity Forest. It offers a broad range of facilities in its three glades: one with a playground for smaller kids; one with different equipment for athletics, such as a track for long jumps, as well as a container with athletics equipment and a public toilet; and one with a playing field with markings for different kinds of ball sports (Rasmussen, pers. comm.). The glades are connected by playful bridges, such as a trampoline bridge and a balancing bridge; but also regular bridges ensuring accessibility for everyone (ibid). When visiting the Activity Forest, a high biodiversity reveals itself with a multitude of flowers and grasses thriving around the glades.

One of the bridges in the Activity Forest.

Throughout The Climate City, measures have been taken to make the town a more beautiful and enjoyable place. Distinct clay tiles have been used as a recurring element, including as edges for rain gardens, sidewalks in certain parts of town, stairs and sitting arrangements, as well as on the path leading through the cemetery (ibid). These clay tiles are likely chosen because of the clayey underground as well as because Middelfart is home to CLAY, the Ceramics Museum of Denmark. Works from the museum have been placed around The Climate City, too. Another way the town has been beautified is with the construction of the public rain gardens, decorating streets and simultaneously increasing biodiversity and reducing vehicle speed (ibid).

The residents that have in some way been contributing to the project on their own plots experience further additional values. If private properties have been used for public water infrastructure (mainly wadis crossing parts of gardens or driveways), the property owners have received a financial compensation (ibid). If plots have been uncoupled and residents have converted their own gardens into rain gardens, they are benefitting from both a refashioned garden, and the refund of 40% of the sewer connection charges (Jensen 2014). These benefits are important: as people in upstream areas do often not experience the issues of rainwater as much as people downstream, they will need other incentives to contribute to climate adaptation – such as high-quality rain gardens (ibid; Svane, pers. comm.).

Process

As mentioned above, the first step towards what would become The Climate City were taken in 2005, when analyses were carried on sewer back-up in basements. The initial work on a comprehensive climate adaptation project started years later, in 2012. Here, Realdania had joined the process, and with Municipality of Middelfart and Middelfart Spildevand they formed the project steering group (Realdania n.d.b). Their interests in the project were different, but complemented each other well: Realdania had an interest in the project as it was a large lighthouse project with potential learnings relevant to other municipalities, and because of a large focus on citizen participation; Middelfart Spildevand are obliged to maintaining a capacity of sewers and other water infrastructure sufficient for meeting the service target, and investing money in this project was a way to do this, perhaps even cheaper for Middelfart Spildevand than a simple expansion of the sewer pipes; and Municipality of Middelfart had an interest in urban renewal and in making the town more attractive (Kloch, pers. comm.).

The project steering group carried out an initial study of how climate adaptation in a large area could contribute to urban development and beautification in Middelfart (Realdania n.d.b). The study was published in January 2013, and contained the framework for the coming work with the chosen area in Middelfart: including the three neighbourhoods and related ways to lead water, existing plans and projects to consider, inspiration for water technical as well as recreational elements, and examples of how different SUDS could be incorporated (Orbicon, SLA, and Hoffmann 2013b). This laid the groundwork for the architects participating in the following, two-part architecture competitions.

The architecture competitions took place from 2014 to 2015 (Danish Environmental Protection Agency 2020). The first one had six architect firms participating (Hoffmann and Wejs 2015), while the second one had three, chosen from the participants in the first round (Rasmussen, pers. comm.). In the end, GHB Landscape Architects won the competition, but all three proposals were bought by the municipality, allowing them to make use of all proposed elements in the final project (ibid). While GHB did the overall plans for the three neighbourhoods (with a few inputs from the other proposals), Adept Architects made the design for the Activity Forest, and Orbicon supplied technical advisors and consulting engineers (ibid).

From 2015 to 2017, the project was developed and refined, and the construction phase took place from 2016 to 2018; the official inauguration of the project, however, was not until September 2019, almost a year after construction ended (Danish Environmental Protection Agency 2020). The project changed along the way. Both because of the nature of the project as an open one where everyone could contribute with their ideas, and as different elements in Middelfart were changed: a grocery store closed, leaving space for new, permeable surfaces, the senior centre were uncoupled from the sewer system for surface water, and the grounds of the cemetery were included in the project (Kloch, pers. comm.). Steering the project successfully through these changes has especially been possible because of a strong cooperation between Municipality of Middelfart and Middelfart Spildevand: they have been working together

throughout the process to find solutions – sometimes of untraditional character – that they could both agree on, and with a common vision for what The Climate City should become (Svane, pers. comm.).

Throughout the process, citizen involvement has been happening, and this with a large responsiveness to the wishes from residents. Locals have directly been part of the development and shaping of specific solutions of the project through meetings, workshops, and visits to localities of the project; this involvement has created a large citizen engagement (Lund 2016). The engagement process started in late 2012. when a public meeting was held where the overall plans were presented, but with no solutions suggested; rather, this meeting should let locals contribute with their ideas without being limited by prior decisions (Hoffmann and Wejs 2015). The following day, a walk around town was arranged for professionals and citizens to visit and discuss the area in question (ibid). Later, after the architect proposals were published, street meetings were held on many of the local streets, and the opinions voiced by the locals were accommodated: for example, in the Avenues, the residents of Egevej would like both their sidewalks removed in favour of a shared space, while the people on Langedamsvej wanted to keep both their sidewalks – both wishes were fulfilled (Rasmussen, pers. comm.). Similarly, an important user group were involved in the planning of the Activity Forest: the kids of the local school, Vestre Skole (ibid). Many of the school kids lived in the area and used the existing facilities that would now be altered to have water management functions, too – and their wishes and knowledge of the area were central for designing the Activity Forest (Hoffmann and Wejs 2015). Generally, citizen participation happened in every phase and every area of The Climate City (Svane, pers. comm.). Besides the goal of qualifying the solutions and ensuring that locals would be satisfied with the solutions, an important aim of the citizen participation was also to get locals to take part in the project themselves, voluntarily – particularly by uncoupling their plots from the sewers for surface water, and in a few cases, by allowing public water management structures to be built on their property (Hoffmann and Wejs 2015; Svane, pers. comm.). The citizen participation process succeeded in getting a good number of locals to uncouple their homes, and general displeasure with the project has been minimal. The biggest controversy might be the few locals who have voiced their discontent with the water flowing in the streets of the City during heavy rain (Lapp and Bergman 2019).

The total budget for The Climate City was DKK 80.4 million, of which DKK 4 million was granted by The Danish Foundation for Culture and Sports Facilities (*Lokale og Anlægsfonden*) specifically to the Activity Forest, while the remainder was funded by Municipality of Middelfart, Middelfart Spildevand, and Realdania (Danish Environmental Protection Agency 2020). Rain gardens on private properties have been financed by the refund of the sewer connection charges, and in addition by the owners' own payments depending on their wishes for their gardens (Jensen 2014). The whole project has been relatively cheap, considering the alternatives. A mere expansion of the existing combined sewers could perhaps cost DKK 40 million alone (Rasmussen, pers. comm.). And construction of separate sewers would be even more expensive, and would in addition cost DKK 40-50,000 for each homeowner having to establish new sewer connections (Jensen 2014). Further, these solutions would be without the additional values created when handling rainwater on the surface.

Implementation

Implementation of The Climate City has relied on several methods to establish and maintain the desired effects. These include legislation on public streets, use of easements, and the municipal wastewater plan. Volunteerism has also played an important role. The different approaches are covered below. Following that, driving factors and challenges for these methods and the project are reviewed, and finally, the possible lessons learned from this project.

Implementation methods

The municipality's role as public street authority has been utilized. The sewer uncoupling of surface water from streets has been central, as it removed almost 50% of rainwater from the combined sewers (Rasmussen, pers. comm.). The measures made on streets include rain gardens, altered street camber, removal of sidewalks, a few changes to driving direction and placement of parking spots, and the handling of heavy rain on some streets. These changes have been made in accordance with the 'Act on public streets etc.' (*"Lov om offentlige veje m.v."*), and as they have not significantly changed the functions of the streets, it has not required new local plans or amendments to the existing ones (Kloch, pers. comm.). While there are important changes to the streets in terms of water management, the individual measures established have not caused big changes: two short streets have been converted to one way streets in each their direction; parking spots have been moved, but the total number remains the same; rain gardens have not negatively impacted the traffic flow on streets; and the removal of sidewalks have not reduced access for pedestrians, but rather changed their place on the streets (ibid).

Easements have been recorded regarding climate adaptation measures for two types of situations. In the few cases where it has been necessary to establish public rainwater infrastructure across private properties, easements have been recorded to ensure that this infrastructure can be sustained and maintained, and landowners have received a compensation (Kloch, pers. comm.). Further, easements have been recorded for the plots where voluntary sewer uncoupling have happened – to allow the discharge of water to public water infrastructure, and to set the record regarding responsibilities and maintenance (see e.g. Tinglysningsretten (2014) for the easement on the plots discharging to Postens Rende). Besides easements, these uncouplings have been entirely voluntary and largely facilitated through the citizen involvement process (Svane, pers. comm.). These uncouplings have been the centre of concrete actions of residents; besides these, measures have been taken almost entirely on public land. The exceptions are the structures made on the cemetery grounds: a retention basin, water flowing down a central path, and the underground pipe. The construction of these has been made possible through an agreement between the municipality and the church council (ibid).


The path through the cemetery on which rainwater will run; and the end of the pipe leading water under the surface of the cemetery in case of heavy rain.

The municipal wastewater plan contains, amongst other things, an overview of sewer uncoupled properties (Municipality of Middelfart 2016). Here, it is recorded when a property is uncoupled from the sewer system for rainwater – in most cases, a virtually irreversible action (Kloch, pers. comm.). Further, the plan lists discharge permits for the uncoupled properties, describing how often and to where overflow water can be discharged (Municipality of Middelfart 2016). It is also the wastewater plan that contains the possibility of having 40% of the sewer connection charges refunded if plots are uncoupled (Lund 2013). The plan is binding to residents to ensure that the uncouplings are sustained, and that rainwater is discharged correctly the five times a year overflow to public structures is allowed (ibid).

Finally, Municipality of Middelfart has uncoupled one of its own buildings, the senior centre (Rasmussen, pers. comm.). As it is a municipal building, and as the changes have not conflicted with the local plan for the centre (Municipality of Middelfart 1996), this measure has been straightforward, and with a large, positive effect (Rasmussen, pers. comm.). The same has happened with the Activity Forest: it is on municipal property, and Municipality of Middelfart has been free to change it without making or changing plans. This has been simplified by the fact that the current use of the area does not differ significantly from before, where it was also a sports facility (Kloch, pers. comm.).

The new courtyard in the middle of the senior centre.

No local plans have been made or altered to implement the measures that constitute The Climate City: such plans have not been necessary to ensure implementation, nor have they been assessed to be required for the changes made (Kloch, pers. comm.). While local plans have not been a central tool in this project, whether they would be required for the changes made has been a question asked throughout the entire work on The Climate City (Kloch, pers. comm.). While it was never an intention to avoid local planning, most measures were established either in places where they were covered by other planning, where the existing conditions allowed them, or by agreements with private property owners (ibid).

Drivers

The large rain incidents and their consequences in Middelfart marked the beginning of the work that would become The Climate City. Climate adaptation had been an obvious need in the city, and besides this, the climate adaptation focus was also a positive force for funding: by making use of funds allocated for climate adaptation, a larger, wide-ranging renewal of the town was made possible, with rainwater management measures at its core (Danish Environmental Protection Agency 2020). Further, funding and assistance from Realdania helped the project along. Realdania agreed to participate as this large-scale project, combining water management and urban development, could contribute to their vision of developing novel solutions and inspiring methods useful for other projects (Svane, pers. comm.).

Citizen participation has been a big focus throughout the project, and this may be a contributor to the general satisfaction with the process, and that only a few locals have complained about it. This has been vital to creating acceptance of the project, and to engage locals to actively take part in it by uncoupling their own properties from rainwater. Voluntary agreements about private sewer uncoupling have been motivated by the refund of part of the sewer connection charges, and have been further supported by information campaigns and the invitation from the municipality to have a free professional consultant help with uncouplings and rain gardens (Svane, pers. comm.). Further, the broad participation and the creation of many additional values have likely been ensuring a large acceptance and sense of ownership for the local residents. As of today, the goal of 10% private uncouplings is almost met (Kloch, pers. comm.).

A central factor for the successful project implementation has been the good cooperation between Municipality of Middelfart and Middelfart Spildevand: a cooperation characterized by flexibility, responsiveness, and common visions (Svane, pers. comm.). Generally, the project has been crafted in a way that all stakeholders could agree upon, minimizing the challenges that can occur in a project of this scale (Danish Environmental Protection Agency 2020). Further, that all implemented structures are solidly anchored in legislation (e.g. the binding qualities of easements, the municipal ownership of many of the used areas) helps to ensure that the project is maintained as it has been planned.

The existing landscape and structures have been important to the project design of The Climate City. The fact that the project area is located on a slope leaning towards the recipient, Lillebælt, ensures that rainwater can be disposed of fairly easily (Rasmussen, pers. comm.). A large part of The Climate City also had sufficient space for new rainwater infrastructure on streets: except for in the City, streets were greatly overdimensioned for traffic (Orbicon, SLA, and Hoffmann 2013a). Generally, the possibility of using publicly owned areas (including streets, the Activity Forest, and the senior centre) has made project implementation easier.

Challenges

The implementation methods have relied on plans and legislations where the municipality has been able to follow through with their intentions. But by making a large part of the process about citizen involvement, a challenge of negotiation appears. Municipality of Middelfart has had to do a large amount of work to ensure broadly covering negotiations of the plans and solutions. And sometimes, opinions of locals have been changing the project. An example is as no rain gardens were implemented on Langedamsvej, although it was originally intended; but it was left out due to opposition from a few locals (Rasmussen, pers. comm.). Here, ambitions were toned down and transformations were not achieved because of the opinions of a few people, making the negotiation process resemble a strive for consensus, although likely unintended. Generally, this approach of continual negotiations and public involvement has made the process more complex and laborious for the municipality; it has had to navigate between many opinions, possibilities, and prioritizations. But it has been time well spent, as this process has ensured broad acceptance, effective solutions, and attractive additional values.

As with any climate adaptation project made around the same time, it has been a challenge that only limited experience existed. A clear example of this in The Climate City is the treatment of rainwater in rain gardens: it is still unknown whether this is adequate, and consequently, samples will be taken recurrently to ensure the effect (Rasmussen, pers. comm.). These unknowns have required Municipality of Middelfart to be innovative and take changes on their methods and solutions.

The only public complaints there have been about The Climate City have been by a few residents in the City, who criticized the municipality for leading large amounts of rainwater on streets in instances of extreme rain (Lapp and Bergman 2019). But this is perhaps an expected reaction, as it is unusual for people to see these amounts of water on the streets, when they are used to water management happening invisibly underground (Rasmussen, pers. comm.).

Lessons learned

The Climate City project shows how many relatively small interventions can come together and form a large, comprehensive project. The utilization of publicly owned land – including streets, green areas, and the senior centre – has ensured the uncoupling of almost half of the impermeable surface area within the project area. Streets have been changed using the Act on public streets while the other areas have been changed by the municipality as it owns these. Leading water across private plots as well as the cemetery solves a challenge of leading water to a recipient without major, negative impacts on these areas, and perhaps even with benefits. These methods may all be relevant to apply in future projects.

The strategy of engaging citizens and having them uncouple their own properties for rainwater is central as well. For locals, the incentive to do this has been the refund of the sewer connection charges, as well as the option of having assistance from professional consultants free of charge. The inclination to contribute to the project is likely to have been strengthened by the large citizen involvement process: both as many people have had their opinions heard, but also as information about the nature of the water challenges might have clarified that private action does make a difference – contrary to what many believe (Lund et al. 2012).

Generally, it seems like the thorough citizen participation process has been beneficial: besides the private uncouplings, this shows as a minimum of complaints have been voiced towards the project. The process has included citizens from the beginning, and it has reached out broadly by arranging workshops, walks, street meetings, and the participation of school children. Many ideas and wishes have been expressed, and they have been heard: most clearly in the Avenues where each street is changed according to wishes from its residents.

Municipality of Middelfart has taken insights from the project onwards to their future planning. An important change to the general planning in the municipality is how future residential areas will be planned: without rainwater sewers (Kloch, pers. comm.). Residents will, for the most part, have to manage rainwater on their own properties, and the municipality will ensure that sufficient infrastructure such as

rainwater basins exist to enable this; the Climate City project has shown the possibility of this type of planning (ibid).

Planning strategy and strategic navigation

The planning in The Climate City is characterized by a comprehensive focus where climate adaptation paves the way for many aesthetical and functional upgrades of Middelfart. Broadly speaking, the content of the project can be seen to address areas such as health (the Activity Forest), traffic (on-street and streetside rain gardens working as traffic calming devices), biodiversity (the broad variety of plants introduced throughout the project area), urban beautification (most areas within the project have faced a significant visual overhaul), recreational areas (the Activity Forest as well as numerous smaller plazas and areas), and of course climate adaptation for large rain incidents at the heart of the project. The topics are covered to varying degrees; e.g. elements functioning as traffic calming devices are only introduced on a few streets. Still, the fact that so many areas are covered to some extent shows a planning strategy that has been open to other foci than just what the initiating challenge was.

That a successful, multifaceted project has been achieved may to a large extent be contributed to the large focus on stakeholder engagement throughout the project. Rather than providing a final plan for the area, Municipality of Middelfart has presented a direction, and many inputs have been taken into account along the way. According to Healey (2009), these are typical traits of a transformative strategic planning: the identification of a direction as the purpose, rather than a set goal, and the involvement of a broad range of stakeholders. Further, rather than just working with what is already known, Municipality of Middelfart has mobilized attention to the broader opportunities for development in the area, rather than just focusing on the specific aims of climate adaptation. By making stakeholder involvement on several scales – from town meetings all the way down to meetings on single streets – many sources of knowledge have been included in the process. And the project has largely been informed by strategic ideas and directions, rather than being aimed at specific, practical solutions that were known beforehand. This is seen in the continuous involvement of stakeholders, as well as in the development of untraditional solutions to the issues at hand. Here, strategies have led the final solutions, instead of letting known solutions dictate strategy.

The engagement of locals has been characterized by a large degree of receptiveness and voluntariness. It has been entirely voluntary to construct any structures on own plots, but still, a fair number of locals have chosen to do so. This can be contributed to the large focus on stakeholder involvement, information campaigns about climate adaptation and possibilities on own plots, offers of consultancy services for locals considering taking such measures, personal gain in the form of refashioned gardens, and monetary incentives in the refund of part of the sewer connection charges. When easements have been used, it has also been voluntary, and through agreements between the municipalities and property owners. Letting these matters be voluntary emphasizes the transformative qualities of the planning approach; an approach that is open to the changes that may occur along the way, rather than being set on certain solutions from the outset.

With The Climate City, Municipality of Middelfart has aimed at creating meaningful development for many stakeholders, by continually negotiating the project in processes where both planners and stakeholders have obtained new knowledge and understandings. Many needs and wants have been addressed, stakeholder engagement and dialogue have happened with many stakeholders and throughout the process, and collective learning process is a fitting term for the public meetings and workshops held. This places the strategy of the municipality on the type defined by Sehested (2009) as 'strategies as common frame of reference': defined as strategies with a broad and inclusive process of dialogue that everyone affected by the project are included in, and with collective learning processes as the main tools, The definition of this strategy type fits the Climate City project very well, as a common frame of reference has been established that has allowed discussion and negotiations of possible futures. Likely, the use of this type of strategy is why the final project has faced only a minimum of complaints from locals and other stakeholders. It has ensured a development that is meaningful to many stakeholders, as they have been able to participate in the project and negotiate futures based on shared understandings and directions rather than goals.

Many elements have been mobilized in the work with The Climate City. First of all, the physical structure of Middelfart has been opened for significant changes to streets and other public spaces. Even in the old town of Middelfart, it has been a possibility to make changes to structures that otherwise might seem to be set in stone. Water management structures and additional values are the outcomes of this mobilization. And this is not just in public spaces; some private gardens have also been used for climate adaptation structures, reconfiguring them to be still private, but also contributors to common priorities. Further, in the processes leading to the final plan for the area, actor relations have been mobilized for a time. The relations between the municipality and local residents have been reconfigured during the process, giving the locals an important voice in the decision-making and shaping of elements in the project. These relations have, for the most part, returned to the initial situation. The exception to this is where private property owners have installed climate adaptation measures on their own properties. In these situations, a new distribution of responsibility is evolving, where citizens voluntarily take on some responsibility for climate adaptation – rather than expecting it to be the responsibility of the municipal council. These are perhaps early steps to establish climate adaptation as a shared responsibility.

The mobilizations taking place through the project have been enabled by the practices of sensitivity and staging. In The Climate City, the practice of sensitivity – of seeking to understand the local situation – has been observed to a large extent: rather than using well-known methods to solve defined problems, the municipality has approached the project with a large sensitivity to the local conditions, values, and needs and wants of citizens. This has been used to both engage relevant stakeholders, to develop context-based solutions, and to utilize the opportunities present in the area. An example of the latter is the inclusion of the senior centre in the project – this was a solution easily implemented, but only because the opportunity was uncovered in the process. No specific path has been followed for the practice of sensitivity; the municipality has been led by knowledge created along the way through the process of engaging with the local context.

The practice of staging – of intervening with the socio-material context – is observed as strategy development has been happening as a procedure alternating between strategic proposals and stakeholder involvement, gradually pushing the process of strategy making forward. This process has been experimental in the ways it encounters the knowledge and wishes from stakeholders, and in the way that proposed solutions have been formed. And the involvement of locals in multiple ways and different situations – workshops and street meetings, but also through the focus on creating additional values – has contributed to the mobilizations. A very concrete example of a staging in Middelfart is the establishment of demonstration rain gardens. This is a spatially delimited experiment showcasing a possibility, and likely inspiring others to follow suit.

A central element in the sensitivity and staging of the Climate City project, as well as to the general stakeholder involvement through the process, is the inclusion of additional values. Not only have these expanded the project scope to many other areas beyond climate adaptation. They have also created broader interest in the project, and engaged many different stakeholders. Through the practices of sensitivity and staging in the public participation processes, the additional values have been developed based on local context. The proposals for additional values, outlining possible futures of the project, have been presented and negotiated in these same contexts. This has facilitated the final mobilization of local citizens in their relation to the area, and the mobilization of roles and responsibilities for climate adaptation. By being open to many possible configurations of the final project, Municipality of Middelfart has made it meaningful for many locals to participate in the project development, and be active players in its implementation. And by considering all locals as stakeholders, the project has become a collective learning process for people working with or living in The Climate City. Hence, the inclusion of additional values has been central to the strategic navigation of Municipality of Middelfart, and defining for the successful implementation of the project.

Comparative analysis

Climate adaptation projects are complex and require much from planners. And different projects are developed within different contexts and under various conditions. This affects planning strategies, methods used, and outcomes. This chapter examines and analyses the results from the three case studies in relation to each other. Two questions are raised here, in the attempt to uncover common truths and contextual knowledge from the case projects: what are general drivers for municipal climate adaptation projects? And what factors impact the methods, strategies, and outcomes of such projects?

First, general drivers for climate adaptation projects are found through comparison of the three case projects. Then, dissimilar conditions of the cases are examined to comment on the effects these have on possibilities and choice of methods, approach to strategic navigation, and structural outcomes. The navigational aspects of climate adaptation planning are discussed further in a subsequent chapter.

Drivers for climate adaptation projects

Some elements pushing project development and implementation are observed across cases. These are thought to be general drivers for climate adaptation projects that go beyond implementation methods and navigation applied. Although projects may succeed without, these elements can often contribute to the initiation and success of climate adaptation projects.

First of all, extreme rain incidents can be drivers for climate adaptation projects and attract funding. Both Kokkedal Climate Adaptation and The Climate City in Middelfart were initiated after rain incidents caused issues in the areas. These rain incidents led to large local awareness and political interest in the potential issues of water, and have thus functioned as drivers for the early phases of the climate adaptation projects. Further, such incidents can attract funding opportunities for projects managing rainwater. And when the first funding is obtained, it is likely that more will follow, as seen in the project in Kokkedal. According to Lund (2018), support from large foundations works as a seal of approval for projects, giving them not just larger economic flexibility, but also encouraging political and public backing. When an association such as Realdania contributes to projects with funding as well as expertise – which is the case in both Kokkedal and Middelfart – it creates favourable conditions for those projects both in regard to economy, expertise, and support.

Branding climate adaptation projects by giving them a title can be a driver for projects by contributing to local engagement, even pride in the projects, and help implementation along. This has been observed in Kokkedal and Middelfart, where project titles contribute to awareness and engagement in the projects. Further, in Kokkedal, the climate adaptation project has been used to rebrand an area that had an unfavourable reputation before, making it known as a neighbourhood of climate adaptation rather than a vulnerable one. While names have been used for the projects in Kokkedal and Middelfart, which both include ‘climate’ in their titles, Trekroner East does not have one; it just bears the name of the area. This

accentuates the fact that while Kokkedal and Middelfart are specifically climate adaptation projects, Trekroner East is mainly a town development project; it does have a certain focus on climate adaptation, but it is not a headline; and it does not achieve additional values and transformative qualities reconfiguring urban socio-material structures as much as the other two projects. According to Dahl-Hansen and Hoffmann (2015), giving a project a name can provide a focus for the actors involved, creating a better cohesion; it can ensure broader knowledge about the project, creating networks and attracting funding; and it may change the perception of an area, forming new and positive associations. This speaks in favour of giving climate adaptation projects titles.

Further, strong leadership is highlighted for all three case projects as a vital driver for their success. All projects have been driven by competent planners skilfully managing the projects and striving for good relations and effective collaboration between all project partners. Such collaborations have especially been present in Kokkedal, where strong municipal-led partnerships have been the main arena for negotiations led by processes of staging. Across cases, the municipal project leaders have been in front of planning and collaborations. They have taken on responsibilities of maintaining many of the necessary functions in the projects: including leadership, coordination, fund-raising, and on-going negotiation with project partners. Here, Kokkedal is somewhat an exception, as the coordinator role was not present; but in a subsequent evaluation (Lund 2018), it has been highlighted that it would have been beneficial if this role had been more clearly defined, emphasizing its importance. Moreover, all three case projects have aimed for transformative qualities – although to different extents and with different outcomes. For achieving intended mobilizations, the planners have adapted to the demands of the situation by embracing innovative approaches to climate adaptation; such as in Middelfart, where solutions fitting the local context have been developed through a large sensitivity and stagings carried out in collaboration with locals. Further, planners have ensured implementation through a variety of sometimes untraditional methods; such as in Trekroner East, where planners have navigated the existing legal framework and collaborations to ensure implementation of plans according to their aims. The leadership and good navigational capabilities exhibited by planners in all projects have been a driver for the projects.

Conditions shaping climate adaptation projects

The above are factors pushing climate adaptation projects forward. Many other conditions impact climate adaptation projects as well. Some are formative for the design, development, and strategic approach of projects. They may affect possibilities for physical interventions, delimit the range of useful methods, and influence the strategic approach. Planning may need to be shaped according to these conditions, thus impacting the final outcomes. Here, the impact of three such conditions are examined that through the case studies have proven to be significant: namely existing structures in the project area, ambitions for water technical solutions, and approach to stakeholder involvement. These conditions influence different stages of planning, and they influence each other as well. They are examined here to illustrate how some approaches may work in certain situations, but that context and factors such as these are decisive to what works.

Existing structures

Existing structures are a given condition that is highly influential for possible choices of implementation methods, stakeholder involvement, and strategic approach. The case studies are good examples of this, as they represent significantly different starting points. Trekroner East is established in an empty field, Kokkedal Climate Adaptation is planned primarily in residential areas, and Middelfart – The Climate City is established over an area comprising several urban typologies, including the old city where few changes are possible.

Finding suitable and useful methods are an important aspect of the navigation of planners, and strongly related to context. Contexts provide different possibilities and limitations regarding the navigation in implementation methods in the case studies. In Trekroner East, local plans are useful as the main implementation method, as planning takes place in an empty field. This allows all regulations possible in the plans to be applied, and they can be expected to be implemented. In the two other projects, local plans are not used as their expected effect is limited: these projects concern built-up areas, and using local plans there would likely have limited immediate effects, as the plans can only regulate future use. Hence, the planners must find different possible solutions here.

While structures can be built as desired in Trekroner East, it is a challenge to create contextually founded solutions as no pre-existing structures, local knowledge, or local stakeholders exist. This may limit additional values and local ownership. In Middelfart, on the other hand, few structures can be changed in the historical and densely-built old city, and implementation requires somewhat untraditional methods, but the changes made can take local preferences into account. This is a central point about the effect of existing structures: the larger freedom of structures and methods in undeveloped areas is opposed by the context-sensitivity obtainable in already built-up areas. Hence, meaningful additional values are likely easier to achieve in existing areas, where they can address present needs and issues.

Other existing conditions are significant for projects as well. An example is the landscapes present in the three case areas. In Trekroner East and Middelfart, the landscape was already sloped and useful for leading water to the local water bodies. Had the area that would become Trekroner East not had the right slopes, these could be changed; but this would not be a possibility in built-up Middelfart. Middelfart has further been challenged by the fact that infiltration is only possible in limited areas. This has imposed a relatively narrow frame of solutions on Middelfart. In Kokkedal, the landscape has not been beneficially sloped, and existing structures have not allowed changes to this. This has made underground sewers the functional solution for most of the water technical structures and is likely to have impacted the planning process, as the underground solutions provide less flexibility and possibilities of involvement.

In regard to planning strategies, areas with no existing structures may reach good results with less transformative strategies than in built-up areas: when things are planned in an empty field, fewer interests must be taken into account, and more can be achieved through plans with predefined aims. Contrarily, situations in populated areas change all the time, and opinions are many; here, it is less likely that good

results and broad support can be achieved with top-down, expert planning. Hence, different contexts permit different strategies. Still, new development areas may benefit from employing transformative strategy making approaches when it comes to creating transformative change over time, and developing additional values for attractive areas.

Ambitions for water technical solutions

The initial plan for how the technical water management structures should be configured impacts the rest of a project. The traditional solution of underground sewers will usually result in a simple project with limited negotiations and involvement; while SUDS usually include a broader project with focus on additional values, entailing complex navigation and involvement. But this is not always the case. These initial plans are influenced by the existing structures as well as by the transformative ambitions of the municipal planners. The three case studies provide examples of how changes made to water technical structures can be formative to a whole project.

In Trekroner East, no sewers existed prior to the project: hence, it has been meaningful to avoid any rainwater in sewers by establishing the entire rainwater system as SUDS. This shows a rather transformative approach to rainwater management, especially at a time where SUDS were not very common. Under different conditions, this would pave the way for large involvement and multi-stakeholder negotiations about the specifics of these surface solutions. But as the area was empty before, and due to the approach of strategies as structural planning present here, this did not happen. This has resulted in a surface system with limited additional values in the residential area.

Kokkedal already had separate sewers in place that are now used for rainwater management in the climate adaptation project; new water technical structures are limited to several detention basins. This has delimited the processes of negotiation and involvement: these focus on the basins, limiting the spatial extent of the project, and the types of additional values possible: these should be configured as structures detaining water in specific locations.

Middelfart has decided to close rainwater drains and handle all rainwater on the surface, providing the opportunity for additional values all over the area; some are planned ahead, some have been open to negotiation during the process. As the SUDS have been present all over the project area and have had an impact on numerous stakeholders there, this approach has necessitated strong sensitivity to the local context, and navigation in negotiations with all these stakeholders.

Perhaps these examples are telling for the typical development processes: when new SUDS have to be established, more elements may be mobilized, more stakeholder involvement is needed, and a broader spectrum of additional values may be created. And contrarily, when much is already existing, negotiations may concentrate on a limited section of the system. Hence, the initial plans impact the necessary and possible navigation of the planners, and contribute to forming the context navigation must happen within. Of course, this also depends on the transformative ambitions of the planners; but the initial plans

for technical solutions are likely formative for the planning strategies, as they determine the boundaries planners must work within, and the extent of elements that are open for negotiation.

Approach to stakeholder involvement

Stakeholder involvement may happen in many parts of the planning processes. It is impacted by existing structures, e.g. as a greenfield development such as Trekroner East have no local residents to include during planning. Further, it is affected by initial plans for water technical solutions, as they may determine to what extent involvement should happen; such as in Kokkedal, where involvement is extensive regarding design of elements with additional values, but very limited when it comes to other aspects. And of course, it is an active choice of planners how much local stakeholders should be involved.

Stakeholder involvement in the three case projects has had different preconditions. In Kokkedal, it has happened through workshops focused on certain subprojects at the earlier stages of the project. Later, in the implementation process, broad hearings of locals have ceased, but more narrow involvement has still been happening through the partnerships and negotiations with local representatives.

In Trekroner East, the main way stakeholders have been able to voice their opinions has been through local plan hearings. This method has limited outreach, since Trekroner East was largely an empty field at the time of local planning. Still, active stakeholder engagement happens in the area, as locals are responsible for rainwater management. Engaging locals like this has been possible as it has been planned into the area from the beginning; locals have not been included in this decision, but it is legally binding through the plans for the area.

The situation in Middelfart has essentially been the opposite. Here, stakeholder engagement has been comprehensive with a large outreach, where the municipality has actively approached locals through e.g. public meetings, workshops, and street meetings. While residents of Trekroner East are legally obliged to manage rainwater, it is a voluntary possibility for locals in Middelfart. Through information campaigns, freely available consultants, and economic incentives, the municipality has attempted to get locals to contribute voluntarily; and it has worked to the extent planned. However, Middelfart has also met challenges in the extensive involvement; for example, rain gardens are omitted on one street due to opposition for a few residents. Hence, while the involvement can support understanding and knowledge about localities and create local support, a large degree of involvement may result in some watered-down and non-transformative solutions in order to satisfy all opinions.

Stakeholder involvement is closely linked to planning strategy; more transformative types of strategy include more involvement. This is desirable in most situations to uncover contextual knowledge and values, create local support, and perhaps even engage locals as active participants in the climate adaptation. But it is also closely linked to context and existing structures: for example, it is unlikely that the approach in Trekroner East would float in an already built-up area such as Middelfart, where locals would likely be unhappy with the significant changes happening to their localities had they not been heard. As such,

stakeholder involvement is adapted for the local context, where planners navigate in the contexts of the existing, and thus somewhat formative for planning strategies.

Navigating climate adaptation projects

These above sections provide examples of how the navigation of planners is related to contexts, methods, and strategies under certain conditions. To navigate these conditions, the practices of sensitivity, staging, and mobilization are vital. As seen in the case projects, mobilizations can target many elements, including physical structures and relations between these, relations between physical elements and people, stakeholder relations, and configurations of roles and responsibilities. Likewise, sensitivity can be aimed towards physical or social elements, with different levels of detail. And staging can be carried out in different arenas and with different intents for experimentation and flexibility. These practices are part of any project, although to varying extents. What is important for the outcome of projects is how the practices are approached, and how actively they are carried out. Strong sensitivity and staging are clear signs of transformative planning approaches, and with these, more extensive mobilizations can be achieved.

For obtaining truly transformative qualities, the practices cannot be applied aimlessly. While transformative strategic planning does emphasize broad and inclusive directions, the needs for limitations and for framing are also acknowledged. It is beneficial to determine certain areas of focus within which navigation can unfold. Such focus areas are attempted defined in the next chapter.

Discussion

Through this chapter, it is attempted to provide general pointers for municipal planners approaching climate adaptation projects. Focus areas for navigation of planners will be defined and examined through a look at the conditions presented above, the navigation of planners in the three case projects, the connections between strategic approaches, contexts, methods, and outcomes, as well as other experience and evaluations of strategic planning for climate adaptation. These focus areas will lay the foundation for recommendations aimed at municipal planners working with large climate adaptation projects. First, however, a few words should be said about the relevance of strategic planning.

Why strategic planning?

Transformative strategic planning may help address many of the challenges present when working with climate adaptation planning. First of all, it is a way of thinking in systems rather than in isolated projects. Climate adaptation with rain water as its focus works with a hydraulic system, but this is traditionally not approached as a societal system. With a transformative strategic approach, system thinking can be accommodated to a larger extent through the inclusion of a variety of different sectors and stakeholders in the projects. This can create better and more integrated solutions. Further advantages include the opportunity of establishing broad collaborations with many competences and the possibility to fund projects collectively; the opportunity to experiment with new and unusual solutions; and a larger degree of flexibility of solutions, making them adaptable to future changes.

Perhaps most importantly is the way in which transformative strategic planning aims at reconfiguring the existing system. Most urban areas in Denmark are not planned for the extreme rain incidents that are already happening; and it is difficult to fit the necessary water technical structures into already built-up areas. Moreover, the existing legal framework is not geared for climate adaptation projects; it does not include clear and coordinated regulations and possibilities for implementing such structures. With transformative strategic planning, planners can challenge these existing structures; both by navigating around them, but particularly by demonstrating different configurations of structures, roles, and responsibilities in urban areas – thus slowly changing common practices and impacting systemic structures.

Climate adaptation is still a relatively new task in municipalities, and a complex one: transformative climate adaptation projects require context-dependent solutions; measures for climate adaptation must fit into a legal framework for planning that may not always be accommodative of them; broad stakeholder engagement is often a prerequisite for implementing transformative projects; and the multisectoral nature of climate adaptation projects means that several foci are often encompassed under one project. Such projects require strong navigational capabilities of planners as they create new approaches and ways of planning. All three case municipalities have – to different extents – been experimenting in their work with the climate adaptation projects. They have had no best practices to follow, but have developed own

methods, strategic approaches, and cooperative relations through the projects – all fitting the contexts and goals of each project. Hence, planning and implementation of the projects have been learning processes for everyone involved.

Context has a lot to say concerning strategic approaches. In some contexts, transformative strategic planning may be a necessity to achieve the ambitions of climate adaptation projects; this is likely the case in Middelfart, for example. In other contexts, a transformative approach may achieve satisfactory results. But moreover, certain contexts may make it extremely difficult to conduct transformative strategic planning. When planning in a formerly empty area such as Trekroner East, fewer interests and material factors must be taken into account, making responsive strategies useable. Still, the situation would benefit from a transformative approach, which can encompass more interests and, at least for the studied cases, generate more additional values. This can be challenging to reach in an area where nothing is in place beforehand, and thus, Trekroner East is locked to a responsive strategic planning, while other areas have better options of exploring transformative approaches.

Ideally, structures should always be open for transformations: according to Lund (2016), the long-term effects of climate adaptation measures are not known yet; and changes in urban areas can impact these functions, or require changes of them. Such a degree of adaptability is not observed in the case projects. Here, the strategic approaches mainly address matters of contextual sensitivity, flexibility of solutions, multisectoral cooperation, integrated plans, project support and funding, and experimental ways of implementation.

Strategic navigation in a complex reality

Through the case studies and the comparative analysis above, five focus areas have been selected. These are areas under which planners can benefit from improving and utilizing their navigational competences, in order to achieve transformative qualities of strategic planning of climate adaptation projects. The focus areas are discussed based on the case studies, the theoretical framework, and examples from other research. It has been attempted to consider how contexts and approaches influence each of the areas. The outcome of this section is five recommendations aimed at municipal planners regarding transformative, context-sensitive strategic approaches to large climate adaptation projects.

First, working actively with strategic planning and navigation is a necessity to develop strategic approaches that fit given contexts and conditions. Different planning strategies are useful in different situations depending on varying conditions and ambitions. There are no right ways of approaching planning, but some fit specific contexts better. By being actively aware of strategies and directions, an approach can be chosen that accommodates the transformative ambitions in the given situations. Sehested's (2009) six types of strategy are a good reference for this, as they outline relevant parameters of strategic approaches that might be included in considerations. Further, the navigational practices described by Munthe-Kaas and Hoffmann (2017) should be applied consciously, and it should especially be considered what projects attempt to mobilize: e.g. physical structures, actor relations and responsibilities, or socio-material

relations. Finally, the strategic approach should include a flexibility to unforeseen events happening in project planning and implementation; by being accommodative of such changes, projects can be truly transformative.

Second, the existing conditions should be used as a point of departure. This pertains to several elements, including to which extend the area is built-up, the existing landscape and slopes that may be utilized for leading water, which water technical structures that already exist, the space available for constructing new structures, etc. This is part of what the practice of sensitivity should address: a physical context-sensitivity. For this, Munthe-Kaas and Hoffmann (2017) suggest the practice of 'listening' as an important task of planners. The necessary navigation within this focus area is about making project structures function within existing conditions that might not immediately accommodate these structures. Some creativity is advised, and projects should include an awareness of untraditional places where functions can be implemented; like in Middelfart, where the streets in the old part of town have been modified to function as water channels. Such unconventional possibilities can likely be found in any context, but it will often require planners to navigate in experimental and alternative approaches to utilize them. Specific approaches to mobilizing the existing resources are suggested by Dahl-Hansen and Hoffmann (2015): including using actor analyses, mapping existing qualities in cooperation with locals, and being actively aware of how chosen involvement methods establish the roles of locals.

Third, navigation within the existing legal framework is necessary. Climate adaptation is regulated by broad and uncoordinated legislation, and this necessitates planners with competences to navigate in legislation and possible interventions, to find methods that can be used to translate plans and ideas into concrete implementation of solutions. While it poses some challenges, broad possibilities do exist within the existing legal framework; it is just about finding those that fit the given conditions. This requires a certain creativity and experimentality of planners. It is relevant to examine the different possibilities that exist with single methods. For example, easements can be used in distinctly different ways, as seen in Trekroner East and Middelfart, where they are used with a responsive and a transformative approach, respectively. Methods should be chosen with regard to existing conditions, transformative aims, and chosen strategic approaches. Such navigation within legal frameworks is important in order to arrive at transformative projects that go beyond the often rigid structures of the existing. In the long term, regulatory changes would make climate adaptation projects more approachable; concrete changes are suggested by Krawack (2014), with a common regulatory framework for the system of water as a prominent proposal.

Fourth, it is advisable to create common directions and shared priorities through collaborative networks. Such a network approach can be used to coordinate efforts and as arenas where stagings can be carried out. This is in contrast with the usual configuration in municipalities, where multisectoral collaboration is largely lacking (Hellesen et al. 2010). Navigation in collaborations and involvement happens in the relations between planners and stakeholders: including other project participants and local residents. According to Albrechts (2004), the good strategic planning should be characterized by "*active*

involvement, open dialogue, accountability, collaboration, and consensus building" (ibid, 754). It is the role of the planners to ensure this, demanding certain capabilities and navigational competences. Regarding other project participants, it is vital to ensure good cooperation and shared goals. This has been a huge focus in Kokkedal, where partnerships have been the main approach to planning and implementation. An evaluation of the Kokkedal project by Lund and Sehested (2016) highlights important aspects of good navigation in such a collaboration: including creating strong relations, creating shared understandings and goals, maintaining equality and trust between partners, and collective decision-making. Partnerships can be complicated by actors who must work within strict regulatory systems, which is often the case for waste water companies; this is an ongoing challenge for all work with climate adaptation.

Fifth, stakeholder involvement with outreach should be pursued. Besides partnerships between main actors, stakeholder involvement is also an important field to navigate. It varies depending on context and strategic approach. Involvement can include letting locals and other stakeholders have their opinions heard; or by letting locals participate actively in the climate adaptation project. Consultations are used to ensure sensitivity to contexts, to gather local knowledge, and to create acceptance. Active participation contributes to the function of the project. Active participation can happen in three ways, according to Hellesen et al. (2010): through regulation, information, or cooperation. Regulation is used in Trekroner East, where locals are obliged to handle rain water and maintain the local SUDS. Information and cooperation is used in Middelfart for the assisted sewer uncouplings of single plots. This indicates two vastly different views on roles and responsibilities of the locals. According to Lund et al. (2012), most municipalities prioritize active and voluntary participation, but to successfully achieve this, it is necessary that locals know the effect of their contributions. Navigation in collaborations and involvement of stakeholders is important to clarify stakeholder relations, establish strong and effective collaborations, and ensure context-sensitivity and local support. It is closely related to the planning strategies applied, and is crucial for socio-material mobilizations.

Embracing a transformation of conceptions

These focus areas are relevant to all climate adaptation project with transformative ambitions. Of course, they should be adopted to the specific conditions they are carried out within; this is a central point of strategic planning.

Besides these focus areas, municipalities working strategically with climate adaptation should generally embrace a transformation of conceptions. This is as much an aim of transformative strategy making as arriving at successful projects is. By challenging the existing structures, both physical and systemic, climate adaptation projects with transformative ambitions can contribute to changing the ways urban climate adaptation – regarding structures, approaches, and roles and responsibilities – are conceived. This can inspire other projects, or ultimately lead to systemic changes.

Planners can embrace such a change by engaging in transformative strategy making. They should draw inspiration from other projects with similar ambitions. They should experiment and work with

aspirations and directions rather than immediate possibilities. And through strategic navigation, they should discover the methods and approaches that fit their given contexts and conditions; and that may be used in or inspire other situations as well.

Every project achieving some transformations contribute to this change in conceptions: they are steps towards new understandings of possibilities and approaches. If projects are promoted broadly or evaluations are carried out, even more so. By demonstrating what can be done in municipalities working transformatively with climate adaptation, the effects of structures, approaches, and navigation applied locally can reach widely.

Conclusion

Danish cities are impacted by climate change; especially the occasional extreme rain incidents are problematic, and cause material damages as well as issues related to health and environment. Such rain incidents are becoming more frequent, and cities across the country are making climate adaptation measures to be ready for the next cloudburst. This involves constructing physical structures in urban areas to ensure that rain water can be managed. But other aspects than the physical must be mobilized to cater for the broad foci of climate adaptation projects. This requires a good amount of strategic navigation for planners to mobilize relevant stakeholders, negotiate priorities and directions, and fit the solutions into the often rigid structural and legal framework of the existing.

This thesis is concerned with the research question: *How can planners in Danish municipalities navigate strategically in the implementation of large climate adaptation projects related to rainwater – that include a focus on creating additional values – in order to address challenges and complexities of such projects, and realize their transformative ambitions?* The question is attempted answered through reviews of literature on the matter and three case studies, of Trekroner East, Kokkedal Climate Adaptation, and Middelfart – The Climate City.

As expansion or separation of sewers are often the more expensive approach, the typical way of working with climate adaptation today is with SUDS. These surface solutions are cheaper and technically easier to implement, and can be used to create additional values. The water technical structures include channels and wadis, rain water basins, and different measures for treatment. Additional values are broad, and may include aesthetical, recreational, environmental, social, and economic values, etc.

Certain factors drive the implementation of climate adaptation, while others pose challenges to it. Three drivers uncovered through the analyses are: extreme rain events can push climate adaptation agendas and attract funding; branding climate adaptation projects by giving them a name can make them more impactful; and strong leadership with capable navigation contributes to reaching transformative aims. Challenges of climate adaptation projects, on the other hand, include existing physical structures that may make implementation more difficult; a rigid legal framework that is not geared for climate adaptation projects; a locked-in distribution of responsibilities challenging the multisectoral approach necessary in such projects; and a wide array of sometimes conflicting interests in the projects.

Municipalities embarking on climate adaptation projects must address these challenges. Further, they often have ambitions of transformative effects of their projects. They may attempt to develop new approaches to these projects, combine climate adaptation with other municipal priorities, or reconfigure the distribution of roles and responsibilities. This calls for strategic planning and navigation.

There are many elements that planners must navigate. The existing legal framework is one; as acts and plans are for the most part not made with climate adaptation in mind, it may be challenging to find the right methods that fit climate adaptation plans. The analyses have highlighted a range of methods that may be useful here, depending on context, including: local plans in greenfield developments, use of areas owned by project partners, project development through bilateral partnerships, registration of easements, and voluntary agreements.

To achieve transformative results in projects, further navigation is necessary. Certain navigational practices should recur: sensitivity to context should be used to gain insights and knowledge about local conditions, existing priorities, and opinions of stakeholders. Staging should be applied to experiment, negotiate, and demonstrate possible futures. And this should result in mobilizations; reconfigurations of the former physical aspects, actor relations and responsibilities, or socio-material relations. To what extent and how these are approached is dependent on planning strategies.

There is not one right way to approach strategic planning. Different planning strategies are useful under different conditions; it depends on many factors, including the varying conditions present, and the transformative ambitions of the municipal planners. The case studies provide good examples of how the municipal planners navigate strategically in their given contexts and with different degrees of transformative aspirations, showing how strategies, contexts, methods, and outcomes are connected. The structural planning strategy of Trekroner East responds to the limited preexisting structures in the area, and results in rather responsive implementation methods and primarily mobilizations of the physical structures, without broad additional values. The approach to strategy as mobilization in Kokkedal entails extensive negotiations and mobilization of many socio-material aspects in the area in general; while the use of strategy as rhetoric or symbolic action regarding the rainwater system specifically entails technical solutions, limited involvement, and few additional values. In Middelfart, the strategy functioning as a common frame of reference mobilizes many stakeholders and fuels the navigation in possible implementation methods, with broad additional values as a result. All projects have succeeded in reaching their initial aims, but with different strategies and extents of transformative qualities.

Strategic approaches do not appear out of nowhere. Through the analyses, three conditions that are central to the establishment of planning strategies and approaches are uncovered. First, existing structures are determinative for project development and navigation. In greenfield developments, structures can be built freely, no local stakeholders are present, and responsive strategies may be adequate for addressing the needs of the project. While in built-up areas, possible structures are limited significantly as most space is usually occupied, and more interests are at play, calling for a transformative planning approach. Second, the ambitions for water technical structures are defining. A greenfield development and an area with sewers have different starting points. And if an area has separate sewers before the project starts, there is less incentive to work with SUDS and additional values. From the case studies, it looks like that when more extensive new SUDS are planned, more mobilizations will happen, necessitating broader stakeholder involvement, and possibly resulting in more additional values. Third, approach to stakeholder

involvement determines how much inputs from locals and other stakeholders can form a project. Further, it determines the role of locals, including how they are involved and whether they act as active participants in implementation and management of climate adaptation structures. Thus, it impacts possible implementation methods and obtainable mobilizations. These conditions are three amongst many; they show how strategy development is not just a product of municipal priorities, but of innumerable conditions.

Based on the analyses, five recommendations have been established for municipal planners. These aim at guiding attention towards the focus areas that are important to navigate when commencing transformative, context-sensitive strategic approaches to climate adaptation projects. The recommendations are:

1. Work actively with strategic planning and navigation
2. Use the existing conditions as a point of departure
3. Navigate in the existing legal frameworks
4. Create common directions and shared priorities through collaborative networks
5. Pursue stakeholder involvement with outreach

These recommendations point at important focus areas; and much work must be done under these. As climate adaptation is a complex field, and innumerable factors play a role in projects, success cannot be guaranteed. But transformative approaches to strategic planning and strong navigational competences go a long way.

Besides these recommendations, municipalities should generally embrace a transformation of conceptions: about structures, approaches, and rules and responsibilities when planning for climate adaptation. Projects do not only change their own locality; they may have broader impact. By drawing on experience from other projects, experimenting, and generating approaches and results that can inspire others, steps are taken towards a systemic transformation for the benefit of municipal climate adaptation projects across the country.

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Appendix: Interview guide

- Giv en introduktion af mit projekt og fokus
    - Lidt mere uddybende, det skal stå klart hvad der er mit primære arbejdsområde (planlægning, planlov, implementering af tiltag, planer og love, proces) og hvad min tilgang er.
        - Store klimatilpasningsprojekter
        - Tre casestudier
        - Processen omkring implementering
        - Merværdier
        - Hvordan projektet er udmøntet i planer og love.
- Projektet
    - Hvad var bevæggrundene for, at det blev sat i gang:
        - Særlige regnhændelser/oversvømmelser?
        - Bestemte klimatilpasningsmål?
        - Tanker omkring merværdier?
    - Hvad er der blevet anlagt – vandteknisk og merværdier?
        - Hvad er der blevet lavet af utraditionelle løsninger?
    - Hvad skulle nye vandtekniske anlæg løse?
    - Hvem skulle merværdier imødekomme?
    - Hvorfor blev dette projekt valgt? Var der alternativer i spil?
    - Hvilke forudsætninger var der for dette projekts succes? (Bevillingsgivende regn, Realdania-penge etc.)
    - Er dette projekt atypisk/hvad er utraditionelle træk ift. andre klimatilpasningsprojekter, du har arbejdet på?
- Udmøntning i love og planer
    - Hvordan er projektet udmøntet i planlægning?
        - Er der lavet lokalplaner for projektet, som indeholder bestemmelser om klimatilpasning?
            - Eller findes der eksisterende planer, der rummer dette?
            - Hvilke muligheder ser de i lokalplaner?
        - Hvilke øvrige planer har været i brug?
            - Hvorfor har dette været tilgangen / nødvendigt?
        - Hvordan har man gjort, hvis lokalplaner ikke har været brugt?
    - Hvilken lovgivning og muligheder i lovene har været i brug for at sikre projektets implementering og fortsatte drift?
        - Hvordan (gennem lov) fastholdes det planlagte?
        - Hvad med f.eks. servitutter?
    - Hvordan har I haft planloven for øje gennem planlægningen?
- Planlægning og proces
    - Hvem var med til at udarbejde og implementere projektet? Inkl. bygherrer
    - Hvem initierede projektet?
    - Hvilke udfordringer og opbakning mødte projektidéen?
    - Hvem finansierede projektet?
    - Hvordan var rollefordelingen mellem parter i praksis?

- Hvad var samarbejdets betydning for, at projektet kunne realiseres?
- Hvad har borgernes rolle været?
- Skulle borgerne foretage sig noget for at få projektet implementeret?
- Hvordan og hvornår fandt borgerinddragelse sted?
- Var der nogle indsigelser, hvis ja, hvordan blev de så håndteret?

- **Endelig implementering**
  - Hvordan blev projektet konkret implementeret? (På hvilken baggrund?)
    - Hvilke planer blev ført ud?
    - Hvad blev bygget?
    - Hvad gjorde borgerne?
    - (Hvornår) overlod kommunen projektet til private?
  - Hvilke udfordringer og barrierer fandtes under implementeringen?
    - Især særlige udfordringer for denne (relativt nye) slags projekter evt. med utraditionelle løsninger i fokus her.
  - Hvordan fastholdtes det planlagte projekt under implementeringen?
  - Hvordan indgik borgerne i implementering – f.eks. hvis der skulle separatkloakeres? Er de med i projektet eller tvinges de til ændring eller bliver det lokalplanlagt?
  - Hvilke elementer har haft betydning for dette projekts gennemførsel? Hvad har været succesparametre?
    - For projektets tilblivelse? F.eks. tilskudsgivende regn
    - For bred accept af projektet? F.eks. merværdier
    - For udmøntning af projektet i praksis? F.eks. lokalplankatalogets rammer
    - For projektets implementering? F.eks. bredt samarbejde… Kommunens indblanding i projektet.
  - Er der nogen læringer, der kan tages med til andre projekter?
  - Hvad sker der fremadrettet med projektet, hvordan arbejdes der videre?
- **Øvrige spørgsmål**
  - Er der noget relevant, jeg overser?
  - Hvem kunne ellers være relevante at tale med?