Sveriges lantbruksuniversitet
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Faculty of Natural Resources and Agricultural Sciences

From Challenges to Opportunities

– Climate Adaptation in Danish Municipalities

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Department of Urban and Rural Development
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- Climate Adaptation in Danish Municipalities

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Abstract

The increasingly dense and paved cities often situated in coastal areas, are challenged by climate change that intensifies damages to urban infrastructure. Through a theoretical framework combining Advocacy Coalition Framework with organizational learning theory of '*Ba'*, the public knowledge creation processes on climate adaptation in Danish municipalities are analyzed in an empirical study. Extreme weather events are found to have initiated a series of political responses, and the knowledge creation processes are deemed essential in finding innovative and flexible solutions to the uncertainties inherent in future climate changes. However, the current national regulation of the water sector are dominated by three major political priorities (analyzed as belief systems) that simultaneously promote and prohibit an adequate facilitation of the different learning contexts of *ba* essential for knowledge creation in the municipalities. The thesis concludes that a more systematic and proactive gathering, synthesizing and analyzing of practical experience gained at the municipal level during the implementation of climate adaptation projects bears vital insights for the development of a more coherent national regulative framework on climate adaptation, in which innovative learning processes could be improved.

Content

List of Abbreviations

AAU	Aalborg Universitet, Aalborg University
ACF	Advocacy Coalition Framework
AR5	Fifth Assessment Report
DHI	Danmarks Hydrologiske Institut, DHI Denmark
DMI	Danmarks Meteorologisk Institut, Danish Meteorological Institute
DMU	Danmarks Miljøundersøgelser – today DCE, Danish Center for Environment and Energy
DTU	Danmarks Tekniske Universitet, Technical University of Denmark
GEUS	De Nationale Undersøgelser for Danmark og Grønland, Geological Survey of Denmark and Greenland
IPCC	Intergovernmental Panel on Climate Change
KFT	Koordineringsenhed for Forskning i Klimatilpasning, Coordinating Unit for Research in Climate Adaptation
LAR	Lokal afledning af regnvand, local drainage of rainwater
LGDK	Kommunernes Landsforening, Local Governance of Denmark
OECD	Organization for Economic Co-operation and Development
RCPs	Representative Concentration Pathways
TdK	Tour de Klimatilpasning, Tour de Climate adaptation

1.0 Introduction

Climate change poses new challenges to Danish municipalities and utilities. Despite efforts to diminish greenhouse gas emissions climate changes are expected to happen during this century (DMI 2014a: 4). The impacts are already more than visable. In 2011 a major rainfall/cloudburst created damage for 6 billion DKr to the insurance companies; it was only a year before a similar event had been dealt with (Naturstyrelsen 2012: 5; Naturstyrelsen 2013: 3; Hall et al. 2015: 31). In 2050 Danish municipalities will face higher temperatures with milder winters and warmer summers characterized by more heat waves and more intensified rainfalls. Furthermore, the precipitation will increase alongside the risk of flooding (Naturstyrelsen 2013: 16-17). The sewage in the cities are not designed to these water masses and it challenges the political set standards for how much water they are required to handle (Paludan et al 2011: 22).

The focus of ensuring the cities against climate change has included a national politically aim to move the rainwater out of the pipes underground to handling rainwater locally and use the water as a resource in the urban spaces (Naturstyrelsen 2013: 3). Local discharge of rainwater on the surfaces is often much cheaper solutions than laying pipes in the ground (Krawack 2014: 4) and has the potential of creating added values in form of new green-blue areas with recreational, social and environmental benefits for the citizens. The political focus of realizing these synergies and potentials for added values are reflected in the majority of the municipal climate adaptation strategies (Lund 2013: 12).

The idea of local discharge and handling of rainwater should be seen in addition to other solutions and infrastructure investments, however, it is in compliance with research on ecosystems in cities, where green-blue areas absorb large water masses or simply slow down the speed of the water reducing the likelihood of water damages (Bolund and Hunhammer 1999: 296; Wong et al 2009: 678). Furthermore, blue-green areas have shown to have positive effects on human well-being and health (Hansen and Nielsen 2005: 8-10, 23).

Despite these opportunities the large uncertainties inherent in the climate projections are a huge obstacle for planning practices. The current experience in many Danish municipalities is that local administrative employees have found it difficult to highlight the relevance of climate adaptation for the politicians due to the uncertainty inherent in the climate scenarios (DMI 2014a: 19; Videncenter for klimatilpasning 2011: 2-3). Furthermore, the focus of lifting the water above ground gives rise to a lot of new practical questions; and simultaneously traditional approaches in engineering and planning are challenged since they often demand high investments for infrastructure intended to last 20-50 years; as opposed to climate adaptation initiatives demanding flexible solutions and innovative measures that can cope with larger uncertainties (Carmin et al. 2013: 15).

Subsequently, the municipal climate adaption operates in a rather complex organizational field. First of all the whole adaptation agenda is a nascent policy arena, where no best practices or general understanding of planning practices for climate change are agreed upon (ibid.: 9). Secondly, in the Danish context the organizational structure between the municipalities and the utilities have changed

significantly in the recent decades due to the political goal of dividing the authoritative political tasks from the operational tasks. The water utilities were separated from the municipalities and made subject to benchmarking models of an independent administration Utility Company under the Ministry of Business and Growth (Miljøministeriet 2009a: 1).

This results in a situation where the municipalities are interested in new city areas with integration of blue-green areas to the benefit of the citizens, but first and foremost securing the citizens against extreme weather events. The utility companies primarily need to fulfill their job handling the new masses of rainwater in a highly cost efficient manner. When the rainwater is moved from underground up to the urban spaces the utilities enter the resort area of the municipalities, since it falls under urban development plans. Furthermore, even though the municipalities are the project owners of the climate adaptation strategies and plans, it is the utility companies who have the resources and knowledge to perform the essential part of climate adaptation when it comes to hydrological expertise (Regeringen and KL 2012: 7; Andersen 2013: 10).

The organizational structures *"to move municipal tasks to external companies without direct democratic control, but solely bureaucratic control, does not make the climate adaptation work any easier. It can create barriers and box thinking making the process less smooth."* (Krawack and Madsen 2013: 29, translation by author).

1.1 Problem Field and Research Question

The dynamics at play between the municipalities and the utility companies are at the center of the analysis. Both are subjects to the newly established policies, which continue to develop, regulating the cooperation between the municipalities and the utility companies. An analysis by C.F Fratini and J.S. Jensen (2015) soon to be published identifies that current regulation between the utility and municipalities related to the water management pushes for two distinctive ends of urban renewal and economic efficiency (ibid.: 10). The two organizations are the actors primarily responsible for organizing and implementing the climate adaptation strategies; and therefore they are to find new procedures and practices when dealing with climate change.

The just mentioned analysis is an exemption of the fact that the empirical research of climate adaptation has seldom included the specific knowledge and experience of the urban and municipal employees who on a daily basis operates in this nascent and complex organizational policy field of climate adaptation (Carmin et al. 2013: 7). Thus the goal of the thesis is to respond to this lack of empirical research and analyze how the current regulation facilitates these cooperative processes between the municipalities and utility companies which lie at the heart of finding the new innovative solutions for climate adaptation. The gathering of experience and compilation of insights from praxis can be seen as central for understanding the processes of implementing climate adaptation strategies.

In order to fulfill the goal of the analysis Paul A. Sabatier's studies of the political process behind the U.S. Federal Clean Air Act of 1970 has proven inspirational (see section 2.1.1). It told a story, starting

at a local level with efforts to reduce smog and air pollution problems of large cities. The evolution of the regulatory framework took several years and involved a great deal of trial and error, of experience sharing and competence building – in short, it was a learning process, both in terms of creating new knowledge about how best to regulate and in terms of disseminating that knowledge.

Sabatier's analyses have subsequently proven relevant to neighboring research areas, and his advocacy coalition framework seems obviously relevant to the complex problems of climate adaptation as well. This insight has an important bearing on the research question underpinning this thesis. It sets out to analyze the learning processes within the cooperation between the municipalities and utility companies who have divergent interests and disciplinary knowledge of the water when operating in the current regulative framework with multiple goals, and when interacting beyond existing structures meeting the challenges of climate adaptation.

The complex cross-organizational learning processes are further analyzed utilizing organizational learning theory, which provides a framework not only for *describing* and mapping types of knowledge and contexts of learning. It also provides a framework for *evaluating* the extent to which these elements are (or are not) integrated coherently as well as a basis for *recommending* improvements to facilitate the process. This lead to the formulation of the research question:

Why does climate adaptation create learning processes between municipalities and the utility companies and how does that foster policy change?

1.2 The Structure of the Thesis

The structure of the paper follows the logics of the research question, where the central concepts from the theoretical framework guide the empirical analysis. Thus the theoretical framework is first of all presented with its relevance to the climate adaption agenda. Subsequently, a methodological chapter is outlined evaluating the epistemological implications of the theoretical framework.

This leads to the chapter of methods and operationalization describing how the data has been gathered and analyzed in the quest for answering the research question. It presents how the research question has been divided into three sub-questions:

(1) Why does climate adaptation as a new policy area influence the current regulation and cooperation between the municipalities and the utilities?
(2) Does this cooperation on climate adaptation create learning processes?
(3) How do these learning processes foster policy change?

The subsequent chapter unfolds the empirical data. An empirical approach is essential in the research field of climate adaptation as a nascent research area and political arena, where a broad and thorough understanding of the field is deemed necessary (Carmin et al. 2013: 7).

In the chapter of analysis, the first sub-question is investigated through an empirical study with inspiration from the work of C.F. Fratini and J.S. Jensen (2015), coupled with the theoretical concepts

of policy subsystem and belief systems from the Advocacy Coalition Framework (ACF). A coherent comprehension of the policy field is pursued, where an understanding of the Danish context and the rationales behind the climate adaptation agenda is identified. The second sub-question is sought answered by two case-studies, where an in depth analysis with the guidance of the organizational learning theory captures how the cooperation between utilities and municipalities on climate change generates new fora, where knowledge creation is fostered. In answering the third sub-question a comparison is conducted by insights gained from the answers to the first sub-question and the insights gained from the case studies. The theoretical framework analyzes how the current regulation is challenged by the learning processes in the municipal climate adaptation projects. Furthermore, it is investigated whether or not revisions of the regulation could improve its facilitation of innovative practices on climate adaptation.

The analysis will be completed by a discussion on the barriers for current practices and recommendation for how the innovative learning processes can be facilitated. This results in need for subsequent analysis in climate adaptation research, thus insinuating a continuous learning process, which is visually depicted in the circular research design (Figure 1).

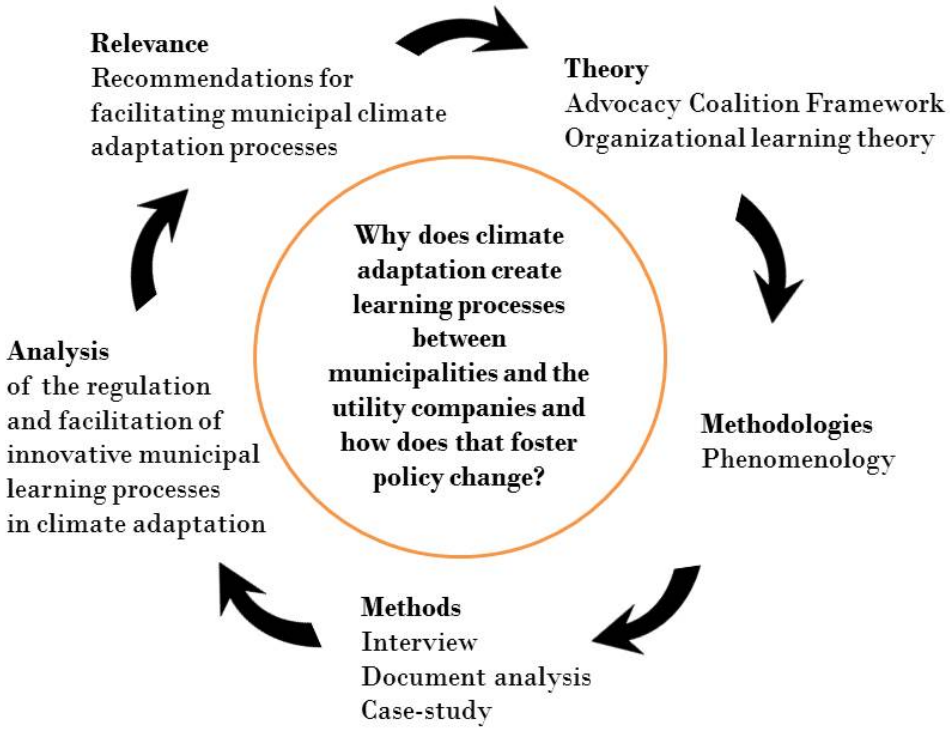

Figure 1: Research Design (2015).
The cyclical research design is centralized around the research question highlighted in the middle. The thesis structure is reflected in the five components: theory, methodologies, methods, analysis and relevance. The relevance of the thesis highlights finally the need for further analysis on climate adaptation, which implies a new learning process.

2.0 Theory

This section contains an introduction to the theoretical framework that will underpin the analysis. After the recognition of the complex issues of climate adaptation and the need for integration of insights from relevant environmental sciences, an introduction to the Advocacy Coalition Framework is outlined with emphasis on its relevance to municipal climate adaptation. Secondly, the organizational learning theory is displayed simultaneously with its central role in understanding and evaluating the current cooperation between municipalities and utilities.

2.1 New Wicked Problems and Integration of Relevant Insights

Climate change and adaptation pose complex challenges for growing urban areas. It relates to dynamically interconnected social and ecological aspects. In recent years, the focus on ecosystems within cities and their positive impacts on the urban environment and human well-being has gained increasing interest from environmental researchers as a response to the prevalent global urbanization (SCBDC 2012; Bolund and Hunhammer 1999).

In relation to this development in environmental research this analysis strives to integrate insights from relevant disciplines on climate adaptation from environmental sciences. This is done in order to give a more comprehensive understanding of the issue under study, which is perceived as beneficial in order to deal sufficiently with increasingly complex challenges dominating the exigent issues of sustainable development today (Repko 2012: 16, 33). These scientific developments influence the context in which the learning processes between the municipalities and the utility companies are displayed. This will be clarified further in section 5.2.2. However, the analysis itself is based on the theory of Advocacy Coalition Framework by P.A. Sabatier (1988) and the organizational learning theory of I. Nonaka, R. Toyama and N. Konno (2000) as described previously in the introduction.

2.1.1 The Relevance of Advocacy Coalition Framework and Organizational Learning

"*Tradition teaches that politics is about conflict and power […]. Politics finds its sources not only in power but also in uncertainty – men collectively wondering what to do […]. Policy-making is a form of collective puzzlement on society's behalf."* (Heclo 1974: 305).

Hugh Heclo emphasized knowledge acquisition when trying to understand policy changes and from the 1980's to end 1990's new theories started to shed light on the role of learning in policy change. (Howlett 1999: 86). The word *uncertainty* is worth noticing, since the aspects of uncertainty are present when it comes to climate adaptation, as described in the introduction. These include uncertainty inherent in climate adaptation itself due to its complexity, as well as the uncertainty towards new practices of planning for the future climate where a close cooperation between municipalities and utilities are deemed necessary.

As a part of this increased interest for the learning aspects in public policy processes P.A. Sabatier developed the Advocacy Coalition Framework (ACF) together with Jenkins-Smith in 1988 in order to explain the origins and the political process behind the Federal Clean Air Act in the US passed in 1970

(Sabatier 1988; Weible et al. 2009: 121). The framework has developed since then (Sabatier 1998; Weible et al. 2009; Weible and Sabatier 2011: 33-37) and been applied to a range of different cases and policy issues (Weible et al. 2009: 126). Policy-oriented learning plays a central role in the theory to explain policy change processes (Sabatier 1988: 133; Sabatier 1998: 117).

According to the first part of the research question the focus is to improve the understanding of why these specific learning processes occur: how complex issues are tackled by municipal and utility actors, how they collectively acquire new knowledge, co-operate and practically interact when finding new alternatives to traditional planning practices. However, the ACF mainly focuses upon the organizational environment for policy-oriented learning; and the theory has been less useful for understanding the specific learning processes in the cooperation between the two organizations.

Therefore, it has been necessary to supplement with organizational learning theories. The one that is applied in the analysis has been developed in the context of the private sector. However, knowledge creation within organizations are apparent and prevailing in the organizational learning theory by I. Nonaka, R. Toyama and N. Konno (2000), which will be enrolled in section 2.3. Furthermore, a large focus is given to the practical experience and the dynamics with knowledge flows, which relate to the practical reality of the administrative employees engaged in climate adaptation project. Thus the combination and different aspects touched upon in these two theories are relevant for answering all three sub-questions.

2.2 Advocacy Coalition Framework

The ACF consists of central key components, which form the framework shown in Figure 2. The dynamics with which these components interact and the underlying theoretical assumptions presented in the following constitute the analytical building blocks for understanding policy-oriented learning processes in public politics.

2.2.1 The Key Components and Dynamics of the Advocacy Coalition Framework

The Policy Subsystem

The central unit of analysis is the policy subsystem depicted in the right side of Figure 2. It is defined as *"[consisting of] the group of people and/or organizations interacting regularly over periods of a decade or more to influence policy formulation and implementation within a given policy area/domain"* (Sabatier 1998: 111). These groups of people and organizations are thought of as interacting in coalitions forming over time. The division between the policy subsystem and the broader political environment (Weible et al 2009: 123) enables the ACF to operate with multi-level governance in public policy processes (Sabatier 1998: 103) bypassing the need of an either-or-focus on bottom-up versus top-down approaches in implementation research. It includes both processes and do not favor either of them (Weible et al. 2009: 122). This makes it appropriate for the political agenda of climate adaptation and the research question of learning processes, where it is analyzed how the national

regulations affect the cooperation between the utilities and the municipalities, as well as how these actors' own initiatives and climate adaptation projects impacts future regulations of the water sector.

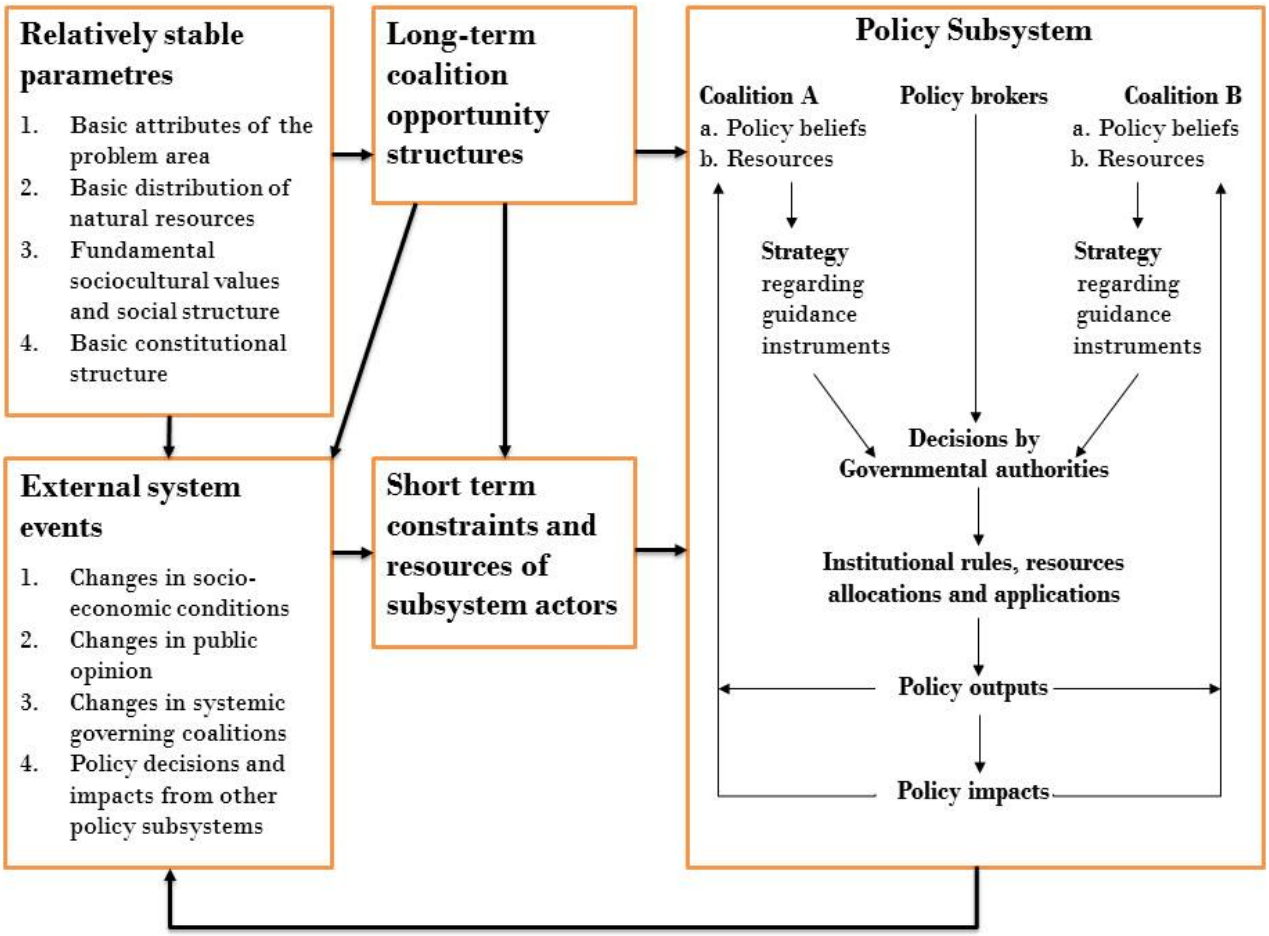

Figure 2: Advocacy Coalition Framework (Illustration adapted from Weible et al. 2009: 123).
The Figure illustrates the understanding of the policy subsystem (to the right in the Figure) placed in a larger political context. Furthermore, the internal dynamics of policy-oriented learning within the subsystem is illustrated by the arrows inside.

Policies

Policies are viewed as a product of the policy subsystem actors' belief systems containing value judgments, perceptions of causal relationships and assumptions of efficacy of policy instruments (Sabatier 1998: 99). This is reflected in the idea of human nature, where individuals are *"boundedly rational with limited abilities to process stimuli […] ACF explicitly identifies beliefs as the causal driver of political behavior"* (Weible et al. 2009: 122). The belief systems are described as a hierarchy in beliefs: highest are the *deep core beliefs* that are most difficult to change; they are mainly normative and highly broad relating to views on how the world is or should be like. These are followed by the *policy core beliefs* that predominantly relate to the policy subsystem area; they are hard to change but are more susceptible to new experience and tend to develop accordingly. At the bottom of the hierarchy

are the *secondary beliefs*, which are more specific and empirically based than the two previous (Sabatier 1988: 145; Weible et al. 2009: 122-123).

The belief systems are thought of as designating the direction of policies, whereas the ability to obtain and translate these beliefs into policies depends on the resources of the actors: money, expertise, supporters and legal authority (Sabatier 1988: 142-143). This is shown in Figure 2 as the resources internally and externally to the policy subsystem. The internal feedback mechanism between resources and belief systems in relation to the climate adaptation agenda emphasizes the resources as an essential part of the cooperation between the municipalities and the utilities.

Policy Change

The ACF highlights that policy changes start in two different ways, since it distinguishes between the external factors affecting the policy subsystem and the internal dynamics within. The internal dynamics refer to the policy-oriented learning processes depicted as the feedback mechanisms within the policy subsystem elaborated upon in the section 2.2.2. The external factors are the relatively stable parameters and the external events shown in the left side of Figure 2. The relatively stable parameters relate to characteristics of climate adaptation as a problem area, which like air pollution can be seen as a result of the global 'collective goods problem' of climate change. The other stable parameters are the natural resources of the country, fundamental socio-cultural value structure and basic legal structure (Sabatier 1988: 135-136). The last three mentioned are not seen as relevant to the nascent policy arena climate adaptation, since they are in accordance with their "name" thought to be stable for over decades (Sabatier 1988: 134), which they must be expected to have been in a Danish context. Furthermore, it stands in contrast to the relatively short time perspective applied in this analysis (see the section 2.2.3).

The external events, however, can vary substantially over a few years. These include changes in public opinion and abrupt socio-economic fluctuations, changes in governing coalitions and policy decisions from other subsystems. These factors are thought of as changing the short-term resources and constraints of the policy subsystem actors (Sabatier 1988: 136-137) and as previously mentioned influence the actors' ability to shape the policies.

The policy changes can thus in summary be categorized by three processes:

(1) External factors that influence the policy subsystem
(2) Endogenous processes of policy-oriented learning within the subsystem
(3) A combination of the two previously, where external events initiate internal policy-oriented learning (Weible et al. 2009: 124).

2.2.2 Policy-Oriented Learning

Learning is closely connected to the experience/practice (Howlett 1998: 89ff). The policy-oriented learning in the ACF is defined as "*relatively enduring changes in beliefs and strategies resulting from experience and/or new information as related to attainment, and possibly the modifications, of policy objectives."* (Weible and Sabatier 2011: 36). The assumption is that learning in that sense is

instrumental, that the involved actors try to increase their understanding in order to promote their own policy objectives that relate to the actors' belief systems avoiding information that challenge their deep core beliefs or policy core beliefs (Sabatier 1998: 104). Therefore, when introducing the concept of policy objectives as a driver for learning processes, the aspects of interests and conflicts are maintained. The power structures and conflicts in public policy process are an integrated part of the learning processes.

More precisely in the constant process of articulating belief systems into policies and implementing strategies, policy-oriented learning can be generated from (1) better understanding of the variables relevant for the belief system, (2) the refinement of one's comprehension of the causal relations within the belief system and (3) responding to exogenous events that challenge the belief system (Sabatier 1988: 149-151). In relation to the large uncertainties in climate change projections, such changes in comprehension of climate change impacts are an integrated part of policy implementation. The continuously changing knowledge on the climate developments challenges the existing belief systems.

2.2.3 Time Perspective

Climate adaptation is a relatively new policy field, and thus the analysis focuses on the creation of a new policy subsystem, which is a response to the demand for understanding how new policy subsystems emerge (Sabatier 1998: 114). This is in opposition to ACF that mainly applies to well-established policy subsystems, which have existed in ten years or more (Sabatier 1998: 111) highlighting the policy changes within such time perspective (Weible et al. 2009: 122). The ACF operates with this decadal focus on mature policy subsystems, since more nascent policy subsystems arising from a relatively new problem field like climate adaptation might not yet be dominated by coalitions with opposing policies, however, they can form over a longer time period as the policy core beliefs develop (Sabatier 1998: 114).

On this basis, the analysis will work with two time perspectives. Firstly, a historical view is applied in order to understand the establishment of the existing regulation of the water infrastructure and the origins of the current belief systems dominating the nascent policy arena. Secondly, a more narrow focus of the new political agenda within the last 5-7 years is applied. Correspondingly, in order for the internal learning processes and the knowledge generation process concerning climate adaptation to be at the center of the analysis the knowledge generation in the new policy domain of climate adaptation is therefore analyzed from an organizational learning theoretical perspective as mentioned previously; this is especially apparent in the case studies (see section 6.4). Thus an introduction of the organizational learning theory is introduced in the following section.

2.3 Organizational Learning Theory

The organizational learning theory is developed by Ikujiro Nonaka, Ryoko Toyama and Noboru Konno (1998; 2000). The main focus is how organizations *through* learning processes create *new* knowledge (Ibid.: 15-16). It is originally developed in a private cooperative context; however, the concepts are more generic and apply to organizations in general (Nonaka et al. 2000: 5).

The influence on the theory by the Japanese philosopher, Kitaro Nishida (Fayard 2003: 25; Nonaka et al. 2000: 14) is apparent in the fundamental understanding of knowledge creation in organizations, which is not limited to organizations solely responding to challenges and problems. Organizations also define the problems, and in the actions of problem solving they develop new knowledge, which affect the environment as well as themselves (Nonaka et al. 2000: 6). Knowledge creation is viewed as a self-transcending process; because in the creation process the distinction between the self and the other is transcended in the interaction between individuals and the interactions with the environment (Ibid.: 8).

2.3.1 Knowledge

Knowledge is defined as *"justified true belief"* (Nonaka et al. 2000: 7). The term "true" is relatively understood, since knowledge is perceived as dynamically created in a context, thus it is context-specific. Furthermore, it is stressed that: *"Knowledge has the active and subjective nature represented by such terms as `commitment' and `belief' that is deeply rooted in individuals' value systems."* (Ibid.: 7).

This definition and understanding of the nature of knowledge does not directly contradict the belief systems of the actors in the ACF. However, knowledge is viewed more broadly; it operates beyond the terminology of "relevant variables" and "comprehensive causal relations". Knowledge relates to a continuous dialectic spiral process that moves between antithetical concepts such as chaos and order, mind and body, part and whole etc. The knowledge creation process transcends these contradictions (Ibid.: 6-7). These processes can occur within organizations and beyond organizational boundaries; knowledge can spread and develop through such dialectic processes (Ibid.: 12).Knowledge is seen primarily as a product of human interaction and the human's interactions with its environment; thus the creation of knowledge is a social process (Nonaka et al. 2000: 14-15), it relies on the self-transcendence of the individual and/or a group (Nonaka and Konno 1998: 45).

The basis of the theory is the two types of knowledge presented as: explicit and tacit knowledge. They are rather broad terms; however, they differ according to their form. The former is systematic and formal in its language (Ibid.: 7-8), whereas the latter is personal and relate to intuition, hunches and practice. Tacit knowledge is two dimensional, including both values and informal skills like practical knowhow and experience (Nonaka and Konno 1998: 42). Both types are needed in the knowledge creation process illustrated in the periphery of Figure 3a.

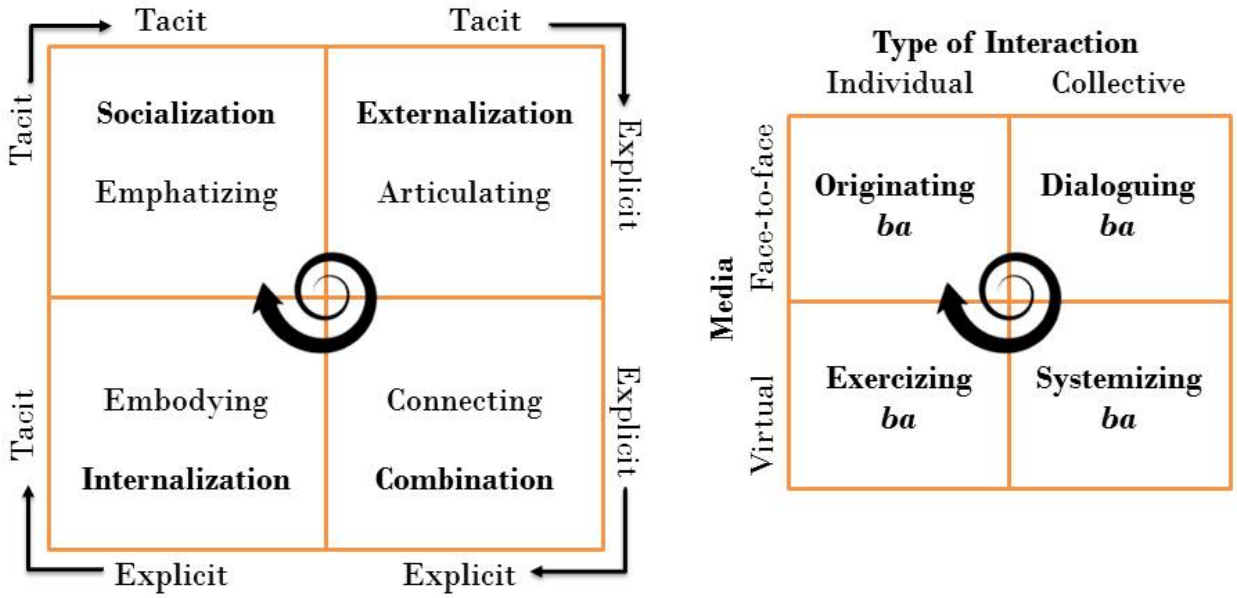

Figure 3: The SECI-process and the four corresponding *ba*s (Illustration adapted from Nonaka et al. 2000: 12, 16).
In the Figure is a compression of two figures. The one to the left (Figure 3a) illustrates the SECI-process, where the conversion of knowledge can be characterized according to the transformation process, either if it is from tacit to tacit, or from tacit to explicit, from explicit to explicit or finally explicit to tacit. The Figure to the right (Figure 3b) visualizes the *ba* in which the different knowledge conversion processes are appropriately facilitated. These *ba* are identified by to dimensions, type of interaction and media creating four distinctive *ba*: originating, dialoguing, exercising and systemizing.

2.3.2 Knowledge Creation

Knowledge creation can roughly be understood in three parts: (1) the SECI-process that relates to the dynamics between tacit and explicit knowledge (2) the *ba* that is the context of the knowledge creation and (3) the knowledge assets, which works as inputs, moderators and outputs of the process (Nonaka et al 2000: 8). SECI-process is visualized in Figure 3a, where the knowledge conversion between the tacit and explicit knowledge characterizes transformation, and where the individual transcends the boundaries of the self and through interaction takes part in the knowledge creation (Fayard 2003: 28).

- *Socialization* is the conversion of tacit knowledge through experience to new tacit knowledge. Due to the difficulties of formalizing tacit knowledge, this conversion process is often time and space specific; knowledge conversion is made possible due to physical proximity (Nonaka and Konno 1998: 43). It can for example occur in informal social settings, where worldviews and trust can be shared and established. The self-transcending process is present during socialization, since the empathy for the other in the exchange of specific experience breaks down barriers between individuals (Nonaka et al. 2000: 9, 13).
- *Externalization*, however, is the process of making tacit knowledge explicit; this often happens through the process of conceptualizing, where the development of concepts work as basis for new knowledge. The self-transcending aspect is present in groups, where active listening and contribution of all participants facilitate a fusion of ideas and intentions with the goal of articulate and formulate a coherent mental world (Nonaka and Konno 1998: 44). It is

emphasized, that a successful conversion relies on a logical order of metaphors, analogies and models (Nonaka et al. 2000: 9, 13). In the transformation of tacit knowledge to explicit both deductive and inductive reasoning as well as creative inference might be required (Nonaka and Konno 1998: 44).

- *Combination* is the conversion of explicit knowledge to new explicit knowledge. This includes three steps: (1) collecting and connecting new external knowledge, (2) synthesizing and analyzing the explicit knowledge during acquisition and integration of new concepts in planning strategies; dissemination of explicit knowledge play a central role in this process. (3) Editing and processing the knowledge in order to make it usable for the organization (Nonaka and Konno 1998: 45). Combination can be result of breaking down larger concepts and operationalize them for a local context. This knowledge generation can be facilitated through computerized communication or large-scale databases, where the digitals signals and gathered knowledge transcend the understanding of the individual or the group (Nonaka et al. 2000: 9-11, 13).
- When embodying explicit knowledge into tacit knowledge it is called the *internalization*; and this process is an individual experience triggering learning-by-doing. Thus the process includes actualizing external knowledge in praxis by experiments and actions (Ibid.: 10, 13). Thus the individual transcend his/her own understanding and incorporates knowledge into new practices. The individual needs to understand what is relevant to internalize and breaks the boundaries of the self to its context and the larger environment (Nonaka and Konno1998: 45).

Thus the concept of organizational learning involves both the creation and the transfer or dissemination of knowledge – tacit as well as explicit. The active element of creation and transfer implies an approach of mastery of knowledge, where the value of knowledge is in its practical use, and not in its own existence. The context for the practical use of the knowledge therefore becomes relevant and emphasizes the centrality of the concept *ba*.

2.3.3 The Concept of *Ba*:

One of the essential aspects of the knowledge creation process is the fact that knowledge is context-specific and thus depends on the context it origins from; it is not absolute. However, knowledge can spread through new knowledge creation processes in other contexts, where it develops and generate new insights within organizations as well as beyond organizational boundaries. Thus here the concept of *ba* becomes relevant, since it refers to the shared context in which the knowledge is created or disseminated (Nonaka et al. 2000: 13-14). *Ba* can be thought of as a shared context harboring meaning and facilitating knowledge creation through human interaction between each other and their environment (Fayard 2003: 26).

The *ba* is often not a fixed construction; the ones participating come and go as they relate to the *ba*. Since the participants change the *ba* as they interact within it, it also changes with people coming and leaving. However, the participants are also affected by the *ba*, since their mental models change throughout the knowledge creation process (Nonaka et al. 2000: 16).

Each of the different knowledge conversion processes in the SECI-model described above can be seen as related to corresponding types of *ba* illustrated in Figure 3b. They are defined by two dimensions, the horizontal axis differentiates between whether the interaction is between individuals or is happening in a group. The vertical axis shows different media that facilitate the interaction distinguished between physical face-to-face interaction and virtual communication. Even though the different *ba* relate to different steps in the knowledge creation process, it does not follow that the knowledge conversion only can function in its corresponding *ba* (Nonaka et al. 2000: 16). However, the different *ba* supports different steps of the knowledge creation and thus accelerates the learning process (Nonaka and Konno 1998: 46).

- The *originating ba* is the physically close interaction between few people. People share experience, feelings and mental models. It is a favorable time-space nexus to gain as much physical senses and psycho-emotional reactions in order to empathize and sympathize with each other. Thus the trust and commitment as the foundation for knowledge creation between human beings are emerging in this *ba* (Nonaka et al. 2000: 16-17). Organizational aspects relating to the *originating ba* is often organizational culture (Nonaka and Konno 1998: 46).
- In larger groups of people the dialogue becomes central, therefore the name for the *dialoguing ba* defined by the collective face-to-face interaction. It is a more consciously constructed *ba*, since an appropriate mix of knowledge and capabilities are central in facilitating the externalization and conversion of the tacit knowledge to explicit knowledge. It depends on the participants' ability to articulating their tacit knowledge, converting them into common concepts and reflect and analyze their own experience in those collective mental models (Ibid.: 17).
- The *systemizing ba* is a collective interaction in virtual fora. The information technology offers an opportunity for spreading, sharing and exchanging relevant information through databanks, online platforms etc. The ability to systematize, combine and make use of huge amounts of information facilitates the explicit to explicit knowledge conversion (Nonaka et al. 2000: 17; Nonaka and Konno 1998: 47).
- The internalization of knowledge through conversion of explicit knowledge to tacit knowledge is facilitated by the *exercising ba*. Practical learning, focused training and continued exercises are emphasized. Thus the embodiment or internalization of explicit knowledge is depending on making use of the explicit knowledge into daily practice and simulated application (Ibid.: 47). Self-reflection in action can be assisted by virtual manuals and simulation programs (Nonaka et al. 2000: 17).

The above has been a general characterization of the different *ba*, and these can be costly to maintain (Ibid.: 18). However, the *ba* defines the place, energy and the quality of transformation or dissemination of tacit and explicit knowledge (Ibid.: 14). The knowledge creation process can be supported by visionary proposals, time and financial resources (Nonaka and Konno 1998: 53).

Furthermore, because knowledge is viewed as a dynamic process the comprehension of and the conscious usage of the different *ba* can enhance and speed up the knowledge creation process (Nonaka and Konno 1998: 47). A *ba* can emerge spontaneously as well as being built intentionally. If the latter is the case then the manager's intentional gathering of the "right" mix of people is necessary to promote a fruitful SECI-process (Ibid.: 25). Subsequently, it is necessary to focus on the interaction between the different *ba* in order to facilitate the whole knowledge spiral of conversions forming the SECI-process (Nonaka et al. 2000: 16).

The idea of the context specific knowledge has defined the case-studies in order to answer the second sub-question on whether or not learning processes are happening and whether different *ba* are apparent in the cooperation between municipalities and utilities. It is fundamental in order to understand how and if the municipalities and utilities engage in new innovative measures and flexible solutions for climate adaptation.

2.3.4 Knowledge Assets

Knowledge assets work as inputs and outputs as well as moderators in the dynamic knowledge creation process and thus they are constantly changing and evolving (Nonaka et al. 2000: 20-21). Four types of assets are suggested in the theory and correspond to the four steps of the SECI-process and each of the *ba* (compare Figure 3a and 3b with Figure 4); though it is acknowledged that due to the intangible characteristics of dynamic knowledge assets it is difficult to evaluate and manage them. However, systemic knowledge assets are explicit and therefore much more tangible.

Experiential Knowledge Assets Tacit knowledge shared through common experiences • Skills and know-how of individuals • Care, love trust and security • Energy, passion and tension	**Conceptual Knowledge Assets** Explicit knowledge articulated through images, symbols and language • Product concepts • Design • Brand equity
Routine Knowledge Assets Tacit knowledge routinized and embedded in action and practices • Know-how in daily operations • Organizational routines • Organizational culture	**Systemic Knowledge Assets** Systemized and packaged explicit knowledge • Documents, specifications, manuals • Databases • Patents and licenses

Figure 4: The four types of knowledge assets (Illustration adapted from Nonaka et al. 2000: 20).
The Figure visualizes the different knowledge assets that are generated in the different *ba* corresponding to the same squares as in Figure 3a and 3b.

In some cases the knowledge assets can create inertia, so it becomes difficult for organizations to change courses and diverge from the course set out by previous experience; this happens if existing

knowledge assets hinder a SECI-process, e.g. successful experience or knowledge assets can be overused and hinder further integration of external knowledge assets (Ibid.: 25).

The organizational learning theory highlights the role of middle management, since they are thought to be the knowledge producers; they are at the so-called intersection between vertical and horizontal knowledge flows. They bridge the overall ideas and the complex "reality" at the front line of the organization; they are the ones formulating specific ideas and strategies (Nonaka et al. 2000: 23). The knowledge producers need to read the situation and be aware of the external knowledge relevant for a *ba* as well as the internal knowledge assets within the organization (Nonaka et al. 2000: 29). In order for knowledge to be used it needs to flow freely, and therefore trust and commitment within an organization is necessary to maintain an atmosphere internally that supports this exchange of knowledge (Ibid.: 28).

2.4 The Theoretical Framework

With the presentation of the two theories and their relevance to the collaboration on climate adaptation between municipalities and utilities the theoretical framework has been introduced. The ACF is seen as fundamental for understanding the emergence of the agenda on climate adaptation by the use of the concept of *policy subsystem*, which identifies actors influencing the policy agenda and their *belief systems* that underpin the political regulation. In order to understand and evaluate the organizational learning processes supporting the development of new innovative adaptation projects within the municipal context the organizational learning theory of *ba* is applied to two cases of two municipalities and their respective utility have executed a climate adaptation project diverging from traditional solutions. The insights gained from the case-studies of the learning processes can reflect back evaluating how the current regulation generates resources and facilitate the process of knowledge creation for developing innovative measures and flexible solutions for climate adaptation in Danish municipalities.

3.0 Methodology - Philosophy of Science Perspectives

One of the challenges of integrating insights from divergent theories is maintaining a coherent theoretical framework where ontological and epistemological contradictions are properly addressed. Furthermore, a reflection is necessary with regards to fundamental assumptions on what "reality" is, the knowledge that can be held by the inquirer, and how that knowledge can be and should be found (Guba 1990: 18). This is especially relevant since the research question deals with learning processes. Then the questions of what can be known and how to create knowledge are fundamental.

The theory of organizational knowledge creation and the theory of the ACF are first of all developed in two very different cultural and philosophical traditions. This is bound to create differences and contradictions in the methodological assumptions; however, both theories are found to be pragmatic, and through sufficient reflection coherent insights can be achieved through the empirical inquiry.

First, a philosophical background of the concept of *ba* is presented. Subsequently, the epistemological differences and similarities of knowledge creation in the organizational theory compared to the ACF are reflected upon from the perspective of phenomenological philosophy of science. On the basis of these reflections the argumentation for a pragmatic phenomenological methodology is presented.

3.1 Japanese Epistemology of *Ba* and the Flow of Knowledge

The Japanese sign of *ba* consists of two parts, the left part means ground, boiling water or something rising, whereas the right part of the sign means to enable. Therefore, the left-hand side can be seen as a latent potential, and the right-hand side the one giving direction and facilitating the unlocking of this potential. This dynamic refers to the philosophy of yin and yang, in which reality is thought of as *"a succession of events that flow without stopping"* (Fayard 2003: 25).

The flowing reality is reflected in the dynamic characteristics of knowledge as well as the human transcendence aspect described above as a vital element of the knowledge creation and the interaction between human beings and their environment. Thus an appreciation of knowledge creation and learning processes, also within the climate adaptation agenda, establishes a continuous flow of development in thoughts and innovative processes.

The knowledge flow is characterized by a dialectic relation between the potential and the enablement evident in the dynamic between the explicit and the tacit knowledge (see Figure 3a and Figure 3b). A similar dynamic in Western philosophy can be found in the distinction between inductive and deductive research methods; which should not be perceived as contradictory but rather as complementary. It is exactly in the dynamic between the two that the strategic knowledge community is created (Nonaka et al. 2000: 6-7).

The dialectic dynamic goes beyond the inductive and deductive distinction; it also refers to the dynamics between the individual and the physical environment (Fayard 2003: 27). The focus of the environment is stressed as I. Nonaka and N. Konno relate the theory of *ba* to the tradition of ecology, in which knowledge creation is viewed as an ecological process of cyclical cultivation (Nonaka and

Konno 1998: 53). The knowledge creation process unfolds in a living organic settings in the sense that it depends on being used due to its intangible characteristics; and the use of it demands an organic concentration to a specific time-space nexus (Ibid.: 41).

Thus the epistemological assumptions imply that the learning process and knowledge creation processes within the climate adaptation depend on the interaction between social realities and the physical environment. The emphasis on the interaction with the environment further leads to an appreciation of the essential role of experiential knowledge in learning processes.

Ba is grounded in an existentialistic tradition. In spite of the time-space nexus, the phenomenal aspect of *ba* relates to the fact that it does not confine to a physical space, but can be virtual as well as mental, which bridges to the tradition of phenomenology.

3.2 Phenomenological Epistemology, *Ba* and the ACF

From a Western perspective the existential tradition relates the philosophy of phenomenology (Kvale 2003: 65). The phenomenological philosophy of science refuses the dichotomy of object and subject, emphasizing instead the inextricably link of reality to human consciousness based on the concept of intentionality of consciousness (Cresswell 2013: 77). This implies that the ontological physical and material world is approachable for human perception through structural consciousness (Kvale 2003: 61). Thus the focus on describing and understanding the structural consciousness, in which reality is perceived, is the center of analysis inducing an empirical analytical approach:

"Phenomenology […] emphasises the attempt to get to the truth of matters, to describe phenomena, in the broadest sense as whatever appears in the manner in which it appears, that is as it manifests itself to consciousness, to the experiencer." (Moran 2000: 4).

The phenomenological approach is further appropriate for understanding various individuals' common and shared experience of a phenomenon in the quest of developing recommendation for changes in practices or policies (Cresswell 2013: 81). Therefore the empirical research is favorable for climate adaptation as a nascent policy field (Carmin et al. 2013: 7), where ongoing changes in the field of climate adaptation can be elucidated by understanding phenomenological developments leading to recommendations for coming revisions.

Phenomenology further stresses the exercise of practice rather than following a system in philosophy of science (ibid.: 4). The Japanese *ba* can be understood as a practice that describes a dynamic human perception of the world between inductive and deductive approaches. The practical understanding of phenomena is the dialectic relation between tacit and explicit knowledge (Nonaka et al. 2000: 6). This further implies that knowledge is founded in subjective insights, in which values, ideals and emotions are fundamental in the dynamic process of knowledge creation and the understanding of the social and physical world (Nonaka and Konno 1998: 42).

ACF originates from the Western philosophical approach emphasizing hypothetical-deductive research in order to achieve more static and absolute knowledge; however, it is a pragmatic theory that similarly stresses the role of values as a central part of the knowledge. The deep core values in the belief systems (values of how the world should be) are expressed through the *policy core beliefs* and the *secondary beliefs* that relate to the socio-historical context in which they are developed forming the basis for policy-oriented learning (Sabatier 1998: 109). Thus policy core beliefs are necessarily examined empirically as they are endogenous to the policy-oriented learning process (Ibid.: 108-109) as is the case in the concept of *ba*, where the empirical approach is at the center of analysis.

The research conducted in this paper benefits from the phenomenological approach, in which empirical data guide the analysis. The mapping of belief systems from the ACF has been beneficial in structuring the understanding of the socio-historical context wherein the structural consciousness is developed and through which the climate adaptation agenda is perceived. The Japanese epistemological knowledge creation guides the dynamic between theory and the gathered empirical data; whereas the concept of *ba* supports an understanding of how the dynamics between these belief systems and the interaction with the social and physical environment further shapes the knowledge creation process and changes our structural consciousness of the policy agenda of climate adaptation.

4.0 Methods

This chapter will present the methods used underpinning the phenomenological methodology where the empirical data is at the center for analysis. The first section outlines the operationalization of the research question. Subsequently, the methods are being individually described and argued for in terms of how the empirical data has been gathered and analyzed. All empirical data methods utilized are qualitative and the quality of the empirical data should be evaluated according to the strength and value of the knowledge produced (Guba and Lincoln 1994: 108; Kvale and Brinkmann 2009: 33); this will be done in section 4.5.

4.1 The Operationalization of the Research Question

The three sub-questions are essential in the operationalization of the research question and are as described in the introduction phrased as follow:

- Why does climate adaptation as a new policy area influence the current regulation and cooperation between the municipalities and the utilities?
- Does this cooperation create learning processes?
- How do these learning processes foster policy change?

In order answer the first sub-question and to understand how the current regulation has been influenced by climate adaptation it is necessary to understand the rationalities behind the regulation of the water sector that has been dominating prior to the policy concern of climate adaptation. Therefore at the beginning, a historical mapping of the development of the sewage system and its influence on the organization of the current water management is presented, where the insights primarily rely on a previous analysis by A. Lindegaard (2003). Furthermore, two unstructured interviews with the researcher at AAU and the employeed at Vandplus have been beneficial. Both of them work within the policy field on daily basis and experience the interaction with the relevant actors. They compile experience and understandings from several cases and thus their perspectives are deemed beneficial for an understanding of the current dynamics of climate adaptation. Additionally, a document analysis of the current political regulation and climate adaptation strategies of the municipalities is applied; where an extensive empirical data gathering have been conducted in order to understand the current political developments on climate adaptation.

Subsequently, the empirical study by C. F. Fratini and J.S. Jensen (2015) describing the development and trends in the water sector has been highly inspirational for guiding the understanding of the empirical data, where the theoretical concept of belief systems organize and systemize the many insights into a few rationality trends. The dynamics between the rationalities are identified prior to and after the climate adaptation has manifested itself as a nascent policy subsystem. Afterwards, the understanding of the changes in the underlying rationalities is compared to the changes in the current regulation addressing the cooperation between the municipalities and the utilities, answering the first sub-question.

In order to answer the second sub-question and identifying learning processes between the municipalities and the utilities a close examination to the individual cases are deemed necessary. Thus two case studies have been conducted focusing on the practical learning processes. Five semi-structured interviews are made using an interview guide shaped by the theory. The interviewees are selected securing a representation from the utilities as well as the municipalities. The first case study is further nuanced by the interview of an employee in the consulting company, who has been part of most of the climate adaptation processes and whose experience of the same learning processes is included in the analysis. The transcription process and the coding process guided by the organizational learning theory's concept of *ba* capture how the cooperation between utilities and municipalities on climate change generates new fora, where learning processes are fostered. The new knowledge gained in the *ba* can subsequently be identified as knowledge assets. Observational practices alongside the interviews could have been beneficial; however, due to lack of resources this was not possible.

In relation to the third sub-question it is difficult to empirically link learning processes to policy change (Weible et al. 2009: 131). However, the last sub-question is answered comparing the municipal insights and experience with the insights gained from a semi-structured interview conducted in the Danish Nature Agency; this is the organization responsible for policy-development on climate adaptation (Lindgaard-Jørgensen and Feilberg 2013: 7). Thus the municipal practical experience, on how the local learning processes on climate adaptation are facilitated by the current regulation, is compared to the reflections of an employee in the national administration. Through the semi-structured interview with the employee in the Danish Nature Agency the past and coming regulation changes are analyzed with regards to how learning processes in the local projects have increased the pressure for changes in those policies. The learning processes simultaneously are compared to the changing dynamics between the dominating belief systems, which potentially could lead to further policy changes in the regulation on climate adaptation.

4.2 Interview

The interview practice is viewed as a social praxis mastered by the interviewer where knowledge is produced; the value and strength of the knowledge depends on the social relation between the interviewer and the interviewed (Kvale and Brinkmann 2009: 34-35). The goal of the research interview is to produce and construct knowledge and this depends on the interaction between humans; knowledge is understood as systematic knowledge as well as knowledge from everyday life (Kvale and Brinkmann 2009: 18). This corresponds to the social dimension and the dynamics between tacit and explicit knowledge in the organizational learning theory as described in the *ba*.

The method of interview operates between (1) the spontaneous, unstructured interview, which can be characterized as a critical reflective conversation as opposed to (2) the formalized methodologically structured interview utilizing interview guides (Kvale and Brinkmann 2009: 33). A pragmatic approach is chosen where different interview practices depend on the purpose of the interview. The distinction between the unstructured and the semi-structured practices is visualized in the overview of the

interview, see Table 1, where the lighter blue highlight the unstructured interviews and the darker blue indicates the semi-structured interview practice.

Some of the interviews have been recorded and transcribed and coded; however, the other "interviews" can mainly be characterized as informal meetings, and notes have been the major documentation, where the central points have been reflected upon and written down shortly after the meetings. The ones not recorded and transcribed are marked (**) in Table 1, and the notes are gathered in the appendices.

After the interviews have been transcribed all of them have been coded. The coding has been done by the process of meaning condensation that originates from a phenomenological philosophy. The approach consists of five steps. First the transcribed interview is read through in order to give a comprehensive and holistic understanding of the perceptions of the interviewed, then meaning unites are identified, which on the third step are formulated as dense as possible. In the fourth step the meaning unites are compared to the research objective, and finally these essential themes are compressed into a descriptive statement (Kvale and Brinkmann 2009: 227-229).

This process has been completed in the case of the unstructured interview with the employee at Vandplus (a project by Danish Nature Agency (Naturstyrelsen 2015: online) and the semi-structured interview with the employee at the Danish Nature system. However, the interviews conducted in the case-studies have been coded utilizing the theoretical concept of *ba*. In those cases where relevant empirical data has been poorly matching these concepts an adequate code has been given the transcribed text, which is presented in the appendices. The codes and the descriptive statements have further guided the analysis.

The interviewees	Relevance of interview
Researcher, AAU** Appendix 7	The researcher did research on climate adaptation in Denmark, and had an understanding of the historical dimensions on the sewer system, the newest research in climate adaptation in Denmark, including the research from Water-in-Cities (Vand i Byer).
VandPlus Appendix 8	The employee had been included in the cooperation between selected cases, where climate adaptation projects have been implemented, thus the person had an in-depth understanding of the complex problems and the problem field.
Naturstyrelsen Appendix 6 and 9	The employee had continuously been working in the field of regulations on climate adaptation that effect the cooperation between the utilities and the municipalities. The person had in-depth knowledge of the political climate affecting the regulation changes and the flow of information between the municipalities and the national authority.

Jyllinge Nordmark - Roskilde Utility Appendix 1 and 11 - Roskilde Municipality** Appendix 2 - Consulting Company Appendix 3 and 10	One employee or more from each of the three organizations have been interviewed, since they have in-depth knowledge on the local experience of coordination and learning processes in the specific case. Furthermore, they have experienced how the learning processes have been facilitated by the national regulation.
Gladsaxe – Gyngemosen Eastern catchment area - Gladsaxe Municipality Appendix 5 and 12 - Nordvand Utility Appendix 4 and 13	One employee or more from each of the two organizations have been interviewed, since they have in-depth knowledge on the local experience of coordination and learning processes in the specific case. Furthermore, they have experienced how the learning processes have been facilitated by the national regulation.

Table 1: The Interviews (2015)

The table presents the interviewees and their relevance in the analysis. The unstructured interviews have been given a lighter blue; they have been conducted to get commencing insights into the problem field; whereas the darker blue illustrates the semi-structured interviews, where the quest of answering the research question to a larger extent has been the reason for conducting the interview. The interviews noted with (**) that have not been recorded and transcribed.

4.3 Document Analysis

Reports and documents have been used as empirical data, and as means of triangulation in comparison with the empirical data gathered from the interviews (Bowen 2009: 27-28). The document analysis has been beneficial in mapping of the belief systems and the corresponding regulation of the water sector. The official papers of regulation are supplemented with descriptions concerning how the legal documents are to be interpreted by the municipalities and the utility companies. Document analysis has in this case been effective in order to get an overview of the motivation for the legislation of the water utilities; this includes finding, selecting, appraising and sometimes synthesizing the data contained in the documents (Ibid.: 28).

A transparency of this process has been strived for, thus the data collection process and the most used documents' relevance and centrality in the analysis is highlighted below in Table 2. Furthermore, the empirical presentation containing various and wide representation of documents and empirical source are included in the analysis. A complete list of these different sources is outlined in the reference list tagged '*Empirical Documents and Internet Sources*'.

The procedure of the gathering of reports has mainly been through (1) the use of the search engines Google, Ecosia and google scholar, (2) recommendations from the interviewees and (3) the webpage: *klimatilpasning.dk*, which is a central online platform started and maintained by the national authority, Danish Nature Agency (Naturstyrelsen) in cooperation with relevant authorities and interest groups

(Naturstyrelsen 2014b: online). The broad research process has secured a general overview of the research field and simultaneously generated a lot of documents and reports, therefore the final selection criteria have followed a rationale of centrality and relevance of the issues dominating the analysis; which is argued for and displayed in Table 2. The Table is not absolute or by any means complete, however, the presentation is a characterization of the most essential contributions to the analysis. For a full overview please refer to the reference list.

Documents	Relevance and centrality
• Concito reports: Krawack, S. and M.B. Madsen (2013): Klimatilpasning – organisering og økonomi. *Climate adaptation – organization and economy* Krawack, S. (2014): Evaluering af regelsættet for klimatilpasning. *Evaluation of the regulation of climate adaptation.* • DHI report: Lindgaard-Jørgensen, P. and M. Feilberg (2013):ViB – Integreret forvaltning af Vand i Byer – Er integreret byvandsforvaltning vejen til bedre klimatilpasning? *Integrated Water Management by Water in Cities – Is integrated urban water management the way towards better climate adaptation?* • Analysis of level of municipal satisfaction: Baes-Jørgensen, J. (2015): Kommuner kræver enklere regler for klimatilpasning. *Municipalities demand simpler rules for climate adaptation.*	Examination of the organizational and financial consequences, as well as the level of satisfaction in municipalities with the current regulations.
Governmental papers and regulations: • Ministry of the Environment (2009): Lov om vandsektorens organisering og økonomiske forhold. *Law on the water sector's organization and economic conditions* • Ministry of the Environment (2013): Lov om ændring af lov om betalingsregler for spildevandsforsyningsselskaber m.v. og lov om vandløb. *Law on the change of law on rules of payment for the utility companies etc. and law on water streams* • Ministry of the Environment (2013): Vejledende notat om reglerne for spildevandsforsyningsselskabers medfinansiering af kommunale og private projekter vedrørende tag- og overfladevand. *Guidance note on the rule for the utility companies' co-financing of municipal and private project concerning roof and surface water* • Ministry of the Environment (2014): Bekendtgørelse om	An overview of the current regulation of the Water sector

spildevandsforsyningsselskabers medfinansiering af kommunale og private projekter vedrørende tag- og overfladevand. *Declaration on utility companies' co-financing of municipal and private projects concerning roof and surface water* • Ministry of the Environment (2015): Vejledende notat om reglerne for spildevandsforsyningsselskabers medfinansiering af kommunale og private projekter vedrørende tag- og overfladevand. *Guidance note on the rule for the utility companies' co-financing of municipal and private project concerning roof and surface water*	
Works of Fratini, C.F. and J.S. Jensen • Fratini, C.F. (2015): Sociotechnical systems as place specific matters of concern: The role of urban governance in the transition of the water system in Denmark. • Fratini, C.F. and J.S. Jensen (2015): Urban water governance transitions in the Capital Region of Denmark: between innovation of function and innovation of place.	Providing a fundamental understanding of the trends in the management of the water sector. Assisting in organizing the empirical data and identifying the development of belief systems.
• Paludan, B., N.H. Nielsen, L.N. Jensen, A. Brink-Kjær, J.J. Linde and O. Mark (2011): En kogebog for analyser af klimaændringers effekter på oversvømmelser i byer. *A cookbook for analyses of urban flooding as effects of climate change* • Naturstyrelsen (2014c): Analyse af IPCC delrapport 2 – Effekter, klimatilpasning og sårbarhed. *Analysis of IPCC W2 report – Effects, climate adaptation and vulnerability.* • DMI (2014a): Fremtidige klimaforandringer i Danmark – Danmarks Klimacenter rapport nr. 6 2014. *Future climate change in Denmark – Danish Climate Centre report no. 6 2014.*	Current information on the situation of climate adaptation in Denmark and the perception of the climate adaptation strategy.
Lindegaard, A. (2003): Ud af Røret. Den hygiejniske diskurs og videnskabelige praksis ved etableringen af det Københavnske kloaksystem 1850-1900. *Out of the pipe. The hygienic discurse and scientific practices with the implementation of the Copenhagen sewage system 1850-1900.*	The historical establishment of the sewer systems and the rationalities behind.

Table 2: The Documents used throughout the analysis (2015)

The Table summarizes the relevance and centrality of the empirical data and reports utilized in the analysis and the description and presentation of empirical data in chapter 5. They are grouped according to their similarities.

4.4 Case-studies

After the more broad understanding of the research field was developed with unstructured interviews and document analysis, the insights and processes under examination needed further exploration on the exact relations and dynamics happening between municipalities and utilities. Thus two case studies were conducted, since the strategy of case studies can be preferred when doing exploratory inquiries concerning contemporary complex social phenomena (Yin 1994: 3-6). The strength of the case-study is that the inquirer can deal with a large variety of evidence and empirical data, this include interviews and observations (Ibid.: 8). The case-studies elaborate on the specific learning processes during cooperation through interviews with relevant people involved from both the municipalities and the corresponding utility companies. Observations have, however, not been conducted due to lack of time and resources even though it could have been beneficial. However, follow up empirical evidence from documents have been conducted for some of the experience presented by the interviewees.

The cases are (1) the climate adaptation project in Jyllinge Nordmark in Roskilde Municipality and (2) the climate adaptation project of the five projects in the Eastern catchment area of Gyngemosen in Gladsaxe Municipality. They are chosen first of all because they have actively been engaged in implementing climate adaptation projects, thus learning processes can be expected to have happened. Both project were started before the adoption of the co-financing regulation, therefore it is possible to analyze how they organized themselves prior to the new rules and to highlight whether the Water Sector Law facilitated or prevented the implementation of these projects.

There are of course challenges of choosing two cases where projects have been conducted, excluding the alternative explanations for why such projects have not been carried through in other municipalities. However reports and empirical analysis from both Concito (see Table 2) and C.F. Fratini and J.S. Jensen (2015) have been supplementing with relevant information from alternative cases.

The case studies are conducted with respect to the local environmental and social context of the selected cases. Thus the interview guides, which is primarily guided by the theory, is adjusted according to the case and the interviewees, where a representative from both the municipality and the utility who has been involved in the projects under study has been interviewed. The first case also includes the consulting company in order to get a third person without direct interests in the project, but who had been involved during most of the cooperation between the two collaborators.

4.5 The Quality of the Methods and Empirical Data

The empirical data used and the methods applied needs to be subject for reflection of improvements. Various argumentations for how qualitative research should be evaluated have been debated continuously (Creswell 2013: 243-250). However, eight validation strategies that are frequently used among qualitative researchers are also guiding the evaluation of the methods and empirical data utilized in this phenomenological research. The strategies are (1) prolonged engagement and persistent

observation, (2) triangulation, (3) peer review or debriefing, (4) negative case analysis, (5) clarifying research bias, (6) member checking, (7) rich, thick description and (8) external audits (ibid.: 250-253).

The first strategy of prolonged engagement and persistent observation has been difficult to follow, since the resources and time constraints of a master thesis are given in advance. However, half a year of investigation in the area has undoubtedly given some fundamental understandings of the climate adaptation field.

The application of the interview technique without additional observatory studies has been limiting as it depends on the reflectivity of the interviewees. This is a study in learning processes as social praxis, and the empirical data gathered have been collected during an on-going learning process. This strengthens the data quality as well as weakens them. First of all the interviewees have experience and practices fresh in mind as they are in the middle of them. However, future knowledge developments and retrospective insights are omitted from the research. Observational empirical data could have improved the quality of data gathered in that sense that there is a tendency for interviewees to please the interviewer. This refers to the social relation between the interviewer and the interviewed as described in section 4.2. As a consequence the questions in the interview guide are kept open, and the interviewees are encouraged to bring long descriptions of their own experience. Simultaneously, questions where learning processes have been explicitly stated have been avoided instead their own experience of how the climate projects have been organized and what have been achieved have been at the center of the interviews.

The second strategy relates to the interconnection between the methods of interview and document analysis. Transparency has been the key for how the collection, appraising and synthesizing process have been conducted within the limited time and resources. Where complementary information is found necessary in the case-studies the empirical data from documents have been supplemented.

The strategy of peer reviewing has not been utilized, however debriefing can be said to be applied in the sense that the research has been conducted in continuous dialogue with a person already conducting analysis on climate adaptation. Furthermore, the scientific evaluation of the master thesis will follow the standard procedures.

As the phenomenological approach is highly empirically based the fourth strategy of negative case analysis has been integrated in the process of coding. The relevant aspects in the interviews for the research question that cannot be categorized as a learning process have been given an individual code in the analysis and incorporated as found necessary for gaining a comprehensive understanding of the research area. This strategy could have been improved significantly by letting another code the interview as well, which could have identified more negative cases, which further also could have strengthened the reliability (Creswell 2013: 253). However, it has not been possible.

With regards to the fifth strategy, it is important to emphasize as an environmental researcher the normative belief of the urgency and necessity of finding an effective way of implementing climate

adaptation underpin this analysis and the recommendations for the future regulation of the area. As described in the methodological chapter, section 3.2, values and beliefs are a fundamental part of knowledge. Thus the presentation and clarification of normative directions should be seen as strengthening the research outcome rather than a burden for the research process. However, biases such as misrepresentation and one-sided reflection of empirical data is by all means strived to be avoided by the use of transparency and triangulation as described above.

The sixth strategy is followed by sending the thesis to all the interviewees and asking them to comment on the outcomes of the analysis. And their insights have further been incorporated in the final thesis. The seventh strategy of presenting rich and thick description has been followed in chapter five, where a thorough descriptive presentation of the climate adaptation policy field and its developments are presented. This further strengthens the transparency because it makes it easier for a reader of the thesis including the interviewees to identify whether or not significant and central empirical data have been omitted from the research. However, the transparency has been compromised in the online and publicly accessible version. Here the transcriptions of the interviews have been omitted due to the sensibility of the data.

The external audit of the supervisor and examiner will improve the acceptance of the linkages between theory and empirical data and point to improvements, which further strengthens the reliability of the study.

The research quality should also be judged by its relevance. The perspective of analyzing the climate adaptation as a learning process is as illustrated in the research design (Figure 1) addressing important aspects of how the climate adaptation regulation could be evaluated in order to identify whether or not such learning processes of finding innovative practices for local environmental and social circumstances are facilitated by the current regulation. The ability of the conducted research to answer this question should be the basis of judging the appropriateness of the research itself.

5.0 Empirical Data

In this section the empirical data underpinning the analysis will be presented. First an introduction to the historical development of the sewer system is outlined with the focus of the rationales and logics behind its establishment, mainly based on the works of Anne Lindegaard (2003), who has analyzed the establishment of the sewers in Copenhagen. Subsequently, an introduction to the latest scientific climate scenarios follows including an overview of the political response, and finally an introduction of climate adaptation as a new policy agenda is displayed.

5.1 The Sewer System in the Modern Cities

The sewer system as an essential element in the modern cities dates back to the middle of the 19th century, where the question of how to handle sewage was intensely discussed by doctors and technicians, especially in the capital of Copenhagen. The main controversy was whether or not the human feces was seen as a valuable resource that could be used as fertilization by farmers, or whether it was a dangerous waste product that should be transported in pipes underground to the sea due to health reasons. It was an on-going discussion prior to the first establishment of a sewer system in Copenhagen 1860, and it kept on being revitalized until the major extension of the sewer system was inaugurated in 1898 (Lindegaard 2003: 107).

The subject of sewer system and hygienic issues happened mutually as the scientific community developed internationally, and the specialization of the disciplines manifested itself through specialized scientific journals (Repko 2012: 47-48; Lindegaard 2003: 110). An international focus on the question of public health in the development of cities evolved. It had strong roots in the British tradition (Szreter 1988: 1), where especially the British scientist Mr. Chadwick was referenced in the Danish debate. He emphasized the idea of the sewage and water supply to be handled by the public authorities in the hands of the knowledgeable officials with technical and medical scientific backgrounds (Lindegaard 2003: 113).

According to ethnologist A. Lindegaard (2003: 109) the argumentation for the establishment of the sewer system correlated with and benefitted from this development in scientific practice. Natural and technical science enjoyed the prevalence of the scientific method during the 19th century. Instead of seeing health, illness and mortality as connected to living conditions and surroundings in general, the focus on proving specific causes for specific illness such as cholera, typhoid and smallpox started to dominate (Ibid.: 114). Doctors, medical scientists and engineers united around hygienic issues, which was mirrored in their educational programs such as Technical Hygiene at Danish Technical University (DTU, at that time Polyteknisk Læreanstalt) and Hygiene at the medical institute at Copenhagen University (Ibid.: 116). In 1879 the Association for Health Care Services was established based on a strategic cooperation between doctors and engineers/technicians (Ibid.: 117). The sewer system was seen as progressive advances rooted in the principle of *tout-à-l'égout* (everything-in-the-sewer) that found its legitimacy in the contemporary scientific practices.

Much of the insights by A. Lindegaard (2003) focus on the social network and intellectual and scientific developments, which was a prerequisite for why the sewer system came to be a central element of building cities, where rainwater and waste water both are handled in the sewers. However, a corresponding understanding of the environmental conditions in the urban areas at that time, might give an equally important understanding how the physical realities influenced the social and scientific institutional developments.

The situation of hygienic issues and social illness were no doubt present, in the summer of 1853 a cholera epidemic had just ravaged the city of Copenhagen (Lindegaards 2003: 114). The daily life in the city was foul and filthy and many died of epidemics like the cholera (Hilden 1973). These developments were happening in all of Europe's major urban areas. E.g. in contemporary England people continued to gather in ever increasing cities where mortality and morbidity increased rapidly (Szreter 1988: 13).

However, in the last 30 years of the 19th century this trend was discontinued by a sudden fall in mortality. Different explanations have been debated, and S. Szreter (1988: 14,16) argues that it was the construction of the infrastructure like the sewer systems and specific application of specific health measures promoted by the local authorities. The ideas of Chadwick that favored central administration of public health had been changed from a state perspective and applied to the local authorities instead (ibid.: 15). This resulted in their political implementation by the Public Health Act from 1972 (ibid.: 16).

It is difficult to estimate what influence the establishment of the sewer system has had on public health (Szreter 1988: 1); however the British Medical Journal (BMJ, one of the world's oldest general medical journals) did a survey among their own readers on what had been the greatest medical advance since 1840. 11.300 readers replied and according to their answers it was the introduction of clean water and sewage disposal (Ferriman 2007: 111). Further investigation is required to understand these relations more fully; however, it highlights the central role of the sewer system in the development of the cities.

The current administration of the sewers in Denmark today has roots in this development; similarly to English tradition the sewage system's maintenance and the construction have been the responsibility of municipal officials in the technical departments. National training programs for civil engineers have supported the technical development and implementation of sewers throughout the entire country (Fratini 2015: 7-8).

In 1947 a standing committee of water professionals was formed producing national technical standards regulating the design and maintenance of the water infrastructure. In 1970s the regulation was moved to the Ministry of the Environment with the increased focus of securing high quality groundwater as source for drinking water; later the environmental impacts of waste water have generated further regulative standards (Fratini 2015: 7-8). Thus the sewer system has a tradition for being dominated by high engineering practices and regulation that emphasize fixed standards and service obligations (Carmin et al. 2013: 15).

5.2 Climate Adaptation and Urban Infrastructure

In recent years with the increased focus of climate adaptation the management and regulation of the sewer system is being debated again. In order to understand the debate it is deemed necessary to highlight the challenges that the urban infrastructure faces from climate change. Therefore this section starts with a short overview over the current climate change projections, scenarios and uncertainties as it is presented by the scientific community in Denmark from the Danish Metrological Institute (DMI) based on the first sub-report in the Fifth Assessment Report (AR5) from the Intergovernmental Panel for Climate Change (IPCC) and other regional scientific climate organizations.

The insights are supplemented with an analysis from a report by the Danish Nature Agency that highlights climate changes relevant for Denmark, which builds on the second sub-report of the IPCC's AR5 concerning climate adaptation and vulnerability (Naturstyrelsen 2014c: 7). The report subsequently describes the ministerial strategy for dealing with the expected climate changes in Denmark. The strategy is compared to new scientific solutions, primarily from the environmental sciences handling urban climate adaptation. As a final part of this section the latest policy changes on the regulation of climate adaptation is presented and visualized.

5.2.1 Uncertainty and Climate Change

Many global changes as well as local and regional trends being consequences of climate change will have implication for Danish conditions (e.g. food production and migration trends) (Naturstyrelsen 2014c: 20). However, the changes focused upon here are the ones related to and affecting precipitation patterns within Denmark as it is those most relevant to the cooperation between the utilities and the municipalities. Even though the regional differences are large internally in Denmark (ibid.: 34-35), the following will be an introduction to the changes in Denmark in general. The local challenges will separately be dealt with in the case studies.

Temperature

It is rather certain that the temperature under all circumstances will increase compared to the 1870s even more than it already has (DMI 2014a: 8). How much depends upon the emissions of greenhouse gases, therefore different scenarios describe different emission trajectories. The scenarios in the AR5 are a result of Representative Concentration Pathways (RCPs) that measure the radiation concentration (watt/m^2) based mainly upon the development on greenhouse gas concentrations in the atmosphere. This type of measurement results in the fact that the scenarios mainly focus upon the anthropogenic climate forcing towards 2100 discarding other factors that could influence the temperature (DMI 2014a: 6).

When estimating the regional changes in temperature the RCPs are coupled with regional climate models for Denmark (Ibid.: 9). The result is that the annually average temperature expectedly will increase by 1,2 (±0.5) C^o in the low emission scenario, where as it will amount to an increase of 3.7 (±1.0) C^o in the high emission scenario. During summer and autumn the temperature is expected to increase relatively more compared to winter and spring periods (Ibid.: 10-11).

Precipitation and Groundwater

The annual precipitation is consequently expected to increase both in amounts of rain as well as intensity. In Table 3 the hydrological prognoses for climate change indices are displayed, including their uncertainties in parenthesis. The first column refers to the period just passed, where the latter two are the future projections. The first two indices describe the increase of days during a year with rain, whereas the last three describe the increased intensities of rainfalls.

Indices	1990	2050	2100
(1) Precipitation > 10 mm (days/year)	19 (±2)	22 (±2)	26 (±3)
(2) Precipitation > 20 mm (days/year)	2 (±0.3)	3 (±0.5)	5 (±0.7)
(3) Annually greatest day of precipitation (mm)	70 (±8)	75 (±8)	81 (±10)
(4) Greates 5 day precipitation (mm)	94 (±6)	100 (±5)	108 (±7)
(5) Rainfall intensity (mm/day)	5,0 (±0.2)	5,2 (±0.2)	5,6 (±0.2)

Table 3: Indices of changes in precipitation in Denmark (Illustration adapted from DMI 2014a: 20)

The table shows the climate indices in Denmark. The three columns each refer to a mean over a time period on thirty years: 1990 = 1961-1990, 2050 = 2021-2050 and 2100 = 2071-2100. All the numbers are a result of model simulations with a resolution of 25x25 km^2, thus the estimated extreme values (index 3 and 4) will in general be smaller than measured extreme values, that normally relies on point measurements. For the prognoses the A1B-scenario is utilizes (the IPCC scenarios from AR4, contrary to the projections of temperature increase based on the RCPs from AR5). The uncertainties is a result of the ensemble-based standard deviation related to the ensemble mean of 14 runs of the climate model for 1990 and 2050, but only 8 runs for 2100. Index 1: number of days during a year with precipitation exceeding 10 mm. Index 2: number of days during a year with precipitation exceeding 20 mm. Index 3: total amount of rainfall during the day of the year with most rainfall in the grid point where the value is the greatest. Index 4: total amount of rainfall during the five subsequent days with most rainfall averaged over Denmark. Index 5: Average rainfall for all days with rainfall exceeding 1mm.

Denmark will be at the border dividing Northern Europe that dominantly will receive more rain, whereas the Southern Europe will have less precipitation. Even though this two trends influence the Danish weather patterns, it is recognized that the general trend implies an increase in precipitation, which will happen first and foremost during winter. In the summer periods it will be different as they will be characterized by several and longer lasting heatwaves, interrupted with more frequent and intense extreme rain events (Ibid.: 13-14, 19).

The seasonal diversity of precipitation will have impacts on the groundwater table. During the wetter winters the groundwater table will rise as opposed to the summers characterized by heatwaves, which will make it decrease. At extreme weather events the groundwater table will increase reducing the ability of the rain water to continue percolating into the ground. As a consequence it will increase the risk of flooding accordingly (Paludan et al. 2011: 15). The domination of groundwater hydrology in Denmark implies that future flooding events will depend upon the local groundwater table (Naturstyrelsen 2014c: 38-39). Especially in the coastal areas, the groundwater table is expected to increase with implication for the ability of urban drainage and increased risk of water penetration to the sewer system. This is further coupled with an increase of salt water intrusion to the groundwater due to sea level rise (Paludan et al. 2011: 16).

Storm Surge and Flooding

The risk of storm surge is affected both by changes in wind and sea level rise and both of them are hard to project. The changes in wind are difficult to estimate, since the complex wind patterns as known today are expected to change, thus the existing wind trajectories becomes unreliable. However, a general increase in middle wind speed will potentially increase and the dominant wind direction will likely be from west (DMI 2014a: 15).

The sea level is expected to rise, however, by how much is highly uncertain, and it will vary regionally around the globe. In Denmark the land uplift will counteract some of the sea level rise, however, the conditions and development of ice melting in Antarctica will have influence on the Scandinavian region due to changes in the earth's gravitational field. In spite it is estimated to amount to 0.7 m over the century (Naturstyrelsen 2014c: 41) and DMI projects that the absolute maximum reasonably expected sea level rise towards 2100 compared to the reference of 1986-2005 will be 1.2 m (DMI 2014a: 17). The two highly uncertain trends together will influence and are expected to increase the risk of storm surges as well as their heights (Naturstyrelsen 2014c: 18).

In the dominant climate today the risk of extreme rainfall events happening at the same time with a storm surge is very small, since the former usually happens during summer periods and the latter during winter. However, this relation is expected to change and the risk of the two extreme weather events happening simultaneously will enlarge, therefore amplifying the damages that it can cause (Naturstyrelsen 2014c: 48).

The Coherent Hydrological System and Vulnerability

These many interconnected relationships between the temperature, the sea level rise, the groundwater, the precipitation and the dominating wind patterns requires a holistic approach to the hydrological system in order to understand the impacts of climate change. Discharge of water within the cities usually dealt with in the sewers is increasingly being influenced by multiple waters like groundwater, lakes and streams as well as rainwater and the sea level rise (Paludan et al. 2011: 15), which all increase the risk of flooding.

The economic losses due to flooding in Europe has augmented significantly in the last centuries; this is not solely due to the fact that the flooding has worsened, it is also a result of the fact that economic activities have boosted in the flood-prone areas (Naturstyrelsen 2014c: 11). Denmark is especially vulnerable to flooding, since compared to other European countries it faces relatively high damage costs due to sea level rise compared to GDP; and it is highly expensive to protect as a result of the long coastline (ibid.: 41).

Climate adaptation deals with large uncertainties. It is affected by many interrelated factors, human induced as well as ecological parameters. The scientific climate models simulations are highly complex and subject to large uncertainties. Furthermore, the human induced factors such as greenhouse gas emissions and other social developments depend upon social trends and political decisions.

Most of the urban infrastructure is challenged by climate change. Besides from the sewage system in the water sector, the energy, transport and information technology is expected to be negatively affected as well (Naturstyrelsen 2014c: 21). The challenge is to be updated with and plan for continuously developing scientific knowledge. Many of the prognoses, climate projections and scenarios are subject to considerable uncertainties, and furthermore there is a time lag between the publishing of new knowledge and the underlying sciences and empirical data; thus the newest published papers are often based on empirical data dating two or three years back (Naturstyrelsen 2014c: 2,8). Planning for such uncertainties is new to the municipal authorities, however flexible strategies when it concerns urban infrastructure is being recognized in many larger cities (Carmin et al. 2013: 15).

5.2.2 Danish Strategy of Adaptive Governance

In order to deal with these uncertainties in the decision-making process, the aforementioned report from the Danish Nature Agency claims the effectiveness of *adaptive governance*. It is briefly defined as a decision-making based on two elements (1) analysis of future scenarios and (2) innovative and creative solutions utilized in pilot projects regularly evaluated. Furthermore, the solutions should be flexible and therefore resilient to uncertainties of climate change as well as uncertainties of the effects of climate adaptation project. They should be developed in the local context, since there is no right way of doing things across sectors and geographical regions (Naturstyrelsen 2014c: 23). Traditional long term planning is recognized as difficult to utilize in these cases prone to large uncertainties and longtime horizons (ibid.: 23). This reasoning further applies to traditional cost-benefit analysis that is difficult to utilize for climate adaptation strategies especially in coastal areas as the large uncertainties undermine the certainty of estimations, thus these analyses offers a poor tool for decision-making processes (ibid.: 24).

Inspired by IPCC the operationalization of this strategy includes a large focus on risk assessments based on climate scenarios and socio-economic projections in urban areas. The “right” investment in urban infrastructure is seen as a way of increasing the cities’ resilience (ibid.: 25-26). The climate adaptation decisions should be taken upon economic estimation of the consequences of climate change and the costs of climate adaptation projects. These should be valuated compared to the risk of such

weather events happening and the economic effects of countering them. For example the adaptation of urban coastal areas imply a risk assessment of flooding in cities compared to an evaluation of the costs and benefits of countering these events including additional amenity values e.g. green areas, detention basins and extended sewer systems. Additionally flexibility in solutions are appreciated, since the investment in dikes, sewers or roads are often very costly and apply to long time horizons. Thus it is favorable to be able to adjust the investments if the projections for increased rain and sea level rise changes (Ibid.: 50).

Examples of such climate risk assessment based on socio-economic analysis can be seen conducted by the Ministry of the Environment with the assistance of consulting companies (Miljøministeriet 2007). Furthermore, in relation to sea level rise climate adaptation is argued for socio-economically, since the potential costs of climate changes in many cases exceed those of coastal protection, and this economic advantage of climate adaptation is expected to increase (Naturstyrelsen 2014c: 19). However, the ones to deliver the majority of these actual investments are mainly private actors, since the responsibility for coastal protection usually lies with the private landowners, which include municipalities and private house owners (Miljøministeriet 2009b: 3). Therefore the extensive collaboration between relevant actors are emphasized, including decision makers at local as well as national level when it comes to securing appropriate legal frameworks for those investments to happen (Naturstyrelsen 2014c: 21).

The strategy inspired by the IPCC again includes a long term goal of making the climate adaptation more efficient based on the collection of the climate adaptation experience, therefore through learning improve the climate adaptation efforts (ibid.: 27).

Resilience Reasoning

The terminology and idea of adaptive governance is a concept taken from a resilience thinking that applies to the theoretical concept of social-ecological systems. And the IPCC report referred to in the Danish strategy is also inspired by the resilience approach (IPCC 2014: 5). Thus the reflection of its similarity with the resilience research is relevant, since the resilience approach is starting to dominate in many policy fields concerning challenges of climate and environmental changes (Brown 2014: 107). When applied to climate adaptation alternatives to current water management practices are argued for (Marlow et al. 2013: 7150). The politicized use of adaptive governance in Danish climate adaptation strategy described above, only confirms this development. Therefore an outline of perspectives from the resilience approach is given in the following.

Resilience is defined as "*the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks"* (Folke et al. 2005: 443). The idea is that it is essential to manage the interaction between the social and ecological aspects of socio-ecological systems in order to sufficiently guide societal decision in a sustainable way (ibid.: 443).

The following quote summarizes the emphasis that is put on the need for change in water management, it comes from a scientific article arguing for alternative water management practices by T. H. F. Wong

and R. R. Brown: *"With the widespread realisation of the significance of climate change, urban communities are increasingly seeking to ensure resilience to future uncertainties in urban water supplies, yet change seems slow with many cities facing ongoing investment in the conventional approach"* (Wong and Brown 2009: 673). The disconnect between the scientific literature supporting changes in water management and the dominating investments in traditional approaches are analyzed in a critical review of the new urban management gathered under the concept of Sustainable Urban Water Management (Marlow 2013: 7152).

The changes needed are framed as a co-evolution to the new environmental challenges like climate change and the growing realization of the fact that humanity influences the ecological environment, which in turn influence human wellbeing. This is seen as the next stepping stone developed from the concern in the middle of the 19th century dominated by public health (Ibid.: 7151) described in section 5.1. This historical co-evolution of the sewers is displayed in Table 4. The table highlights the central solutions of water management as it has developed up until now. These have been very costly and thus demanded centralized financing and management (Ibid.: 7152).

Existing Infrastructure	Service Focus	Driver for Change	Solution
Unstructured system with some storm sewers in large cities	Basic services	Population growth and assocated issues, especially pollution adn inadequacy of local water supply	Piped water
Water pipes	Secure supply of wholesome water	Excessive demand placed on waste disposal system, leading to contamination of urban areas with stagnant water and faecal matter. The perception of diseases being related to noxios smells was also a key driver	Sewers (combined and seperate)
Water pipes and sewers (combined and seperate)	Public health and drainage in larger cities	Contamination of surface waters with sewage and impact on health of downstream communities	Water Treatment Works (WTWs) and protected catchments
Water pipes, sewers and WTWs	Waterway pollution	Degradation of urban water ways, nuissance issues and loss of amenity values	Sewage Treatment Works (STWs) and separation of sewers
Water pipes, sewers and WTWs, STWs	Food protection and drainage	Extension of paved urban areas required extensive drainage systems	Extensive Storm Sewers

Table 4: Stepwise Development of Urban Water Systems (Illustration adapted from Marlow 2013: 7151).
The table illustrates a co-evolution of the central solution to water management and the corresponding water infrastructure up till now. In the first column the existing water infrastructure is described, and rationale behind or the focus of service for this specific infrastructure is viewed in the second column. The challenges that meet the infrastructure are presented in the third column, where the last column displays the new solution to the water infrastructure, which in turn changes the existing infrastructure. This cyclical understanding is displayed through five rounds illustrated as five rows in the Table.

The new ideas and the alternative solutions involve a new infrastructure that can be seen as either a response to or as a natural development of different types of water systems (Brown et al. 2009). According to Table 4 the new solutions should address the problems of the extended paved surfaces and climate change, which implies extensive storm sewers in the last row coupled with local discharge of water.

A fundamental restructuring of the water management in cities is suggested, which includes a transformation of the infrastructure as well as the social institutional settings. According to the resilience perspective too much is invested in existing structures at the expense of the new socio-technical solutions e.g. diverse water supply (Wong et al. 2009: 764-766). The emphasis is given to decentralized solutions like the establishment of urban ecosystems, which is used as a label for natural blue and green areas in the cities. They are found to meet some of the challenges of climate adaptation such as rainwater drainage and sewage treatment (Wong et al. 2009: 678; Bolund and Hunhammer 1999: 297-298). In order to mitigate flood risks approaches like ecological regeneration and enhancement of recreational values are seen as central, as they establish dynamic and stable waterways, which support resilient or healthy ecosystems (Marlow et al. 2013: 7152).

A sub-branch of the Sustainable Urban Water Management approach called the Integrated Urban Water Management framework is highly promoted by the Global Water Partnership. It aims to *"ensure the co-ordinated development and management of water, land, and related resources by maximising economic and social welfare without compromising the sustainability of vital environmental systems."* (Bahri 2012: n.p.). Their Technical Committee has been given the task to develop an analytical framework that can realize the aim (Ibid.: n.p.). They have identified political instrumental economic regulation guided by the goal of resource scarcity and efficient alternative use of water resources as key elements in their strategies. This includes e.g. economic incentives for the use of waste water for secondary purposes. Furthermore, the integration of stakeholders is a vital part of their framework including cross-sectorial cooperation where finding and defining collective goals and mutual benefits are vital for more resilient practices (ibid: 6,7,12).

Critique of Resilience Reasoning

One of the critiques to resilience reasoning is that often water management researchers or politicians with a resilience approach end up having a technological framework beforehand or a political strategy prior to the inclusion of relevant stakeholders (Folke et al. 2005: 462). Furthermore, these approaches have been subject for critique mainly related to the controversies of applying natural science theories to social aspects. The main criticism refers to under-theorizing social aspects by omitting social, political and cultural dynamics and power relations. It has implications for the policy development, since it has spread to spheres of politics related to contemporary debates about global environmental change (Brown 2014). These critiques have been met by further investigation in the social dimensions. However, normative stances are still being made and little have happened in order to approach theories of political ecology, which have evolved around such aspects (Ibid.: 114).

Guidebooks and programs from international organizations based on other scholarly literature highlight the necessity of citywide impact and vulnerability assessments, followed by sector- and impact based adaptation strategies. Finally emphasis is put on the benefits of inclusion of relevant stakeholders. Many of these approaches look similar to the ones of resilience thinking as they emphasize the need for best possible climate data and projections; however, they simultaneously focus on traditional strategic goal-oriented planning practices that are structured as linear processes. Both strategies apply a rational approach, which are experienced as difficult realizing in reality, since the local authorities and organizations have to balance practical issues accounting for political pressures and local priorities (Carmin et al 2013: 17-18).

The same critique is found in the works of C.F. Fratini and J.S. Jensen (2015), where it is stated that myopic political processes are not sufficiently accounted for in such analysis, illustrated by the following quote.

"While we recognize the appeal of such integrated governance approaches, we however also suggest that they tend to overlook the importance of the situated micro political processes by which the boundaries of urban socio-technical system are continuously defined and redefined by a variety of actors and actor constellation that operate from different socio-material positions." (Ibid.: 2).

In order to included these processes in this analysis the Danish political context is highlighted and outlined in the next section.

5.2.3 An Overview of the Policy Changes

In this last section of the chapter on empirical data the developments and regulations in Denmark of the sewage system in recent years have been outlined. Some relate directly to the agenda of climate adaptation and others have significant influence on the collaboration between the utilities and the municipalities. An overview is given in the following timeline (see Figure 5), and in the description it has been fruitful to categorize them accordingly to three titles: (1) 'climate adaptation organization and research', (2) 'the Water Sector Law' and (3) 'the cloudbursts'.

Figure 5: Timeline of events in the climate adaptation agenda (2015)

(Water background modified from open source, accessible link, press here, or see 'flick' in reference list under Pictures). The timeline displays events affecting the political climate adaptation agenda in Denmark. It begins in 2008 where the previous government took the initiative to adopt a national climate adaptation strategy, until today, where the last revisions of the announcement on utilities co-financing are published. The lines indicate approximately when during the year that the different events occurred. The laws, announcements and other governmental programs and reports are shown with a light blue; the actual organizational changes with the establishment of the utility companies have been given a darker blue and the climate events have been indicated by the darkest blue. This is done in order to differentiate their qualitative differences and indicate their affiliation to the environmental sphere and social sphere.

Climate Adaptation Organization and Research

For the first time in 2008 the previous government published a national climate adaptation strategy (see Figure 5). The strategy was created with the acknowledgement that even though the mitigation agenda was important, the adaptation to the coming climate changes needed to be more organized than it had been previously (Regeringen 2008: 7). Thus the strategy contained three elements (Ibid.: 8):

(1) Establishment of a knowledge center on climate adaptation responsible for a climate adaptation portal. This resulted in the webpage *klimatilpasning.dk*. In 2011 the knowledge center was moved from the Climate and Energy Ministry to the Danish Nature Agency, in order to obtain a better coordination of the national climate adaptation administration (Naturstyrelsen 2011: online).

(2) An administrative unit coordinating climate adaptation and securing coordination across public organizations was established, which like the web-portal also is placed in the Danish Nature Agency under the Ministry of the Environment (Lindgaard-Jørgensen and Feilberg 2013: 8)
(3) Creation of a coordinating unit that secured a larger focus in the research on climate adaptation. This resulted in the Coordinating Unit for Research in Climate Adaptation (KFT), that primarily consisted of natural science researchers from Danish Technical University (DTU), Geological Survey of Denmark and Greenland (GEUS), Danish Meteorological Institute (DMI), Danish Environmental Research (DMU, that is now closed and their activities are undertaken by the Danish Center for Environment and Energy) at Aarhus University and Copenhagen University. The researchers from the latter two only had a few researchers in landscape architecture and planning, as well as a few from either environment law or environmental economics (KFT 2008: 9).

An analysis from Danish Hydrological Institute (DHI) based on an integrated water management approach emphasizes that fragmentation in management and organization of the efforts to meet climate change is problematic. They highlight the need for reviewing the organizational and management structure of the water sector as well as the incorporation of relevant actors (Lindgaard-Jørgensen and Feilberg 2013: 5-6). However, a comparison with other OECD countries shows that even though the concentration of management in the Danish Nature Agency is not tantamount to a well cross-organizational coordination, it provides a relatively good foundation for coordinating a national approach across sectors and relevant actors. It (Ibid.: 9).

Klimatilpasning.dk as a web-portal tries to gather and collect relevant information to citizens, municipalities and businesses in the process of climate adaptation. Scientific knowledge is gathered and distributed through the portal (Naturstyrelsen 2014b: online). One of the main tasks of the scientific network KFT is to deliver the authoritative data and climate effects to the web-portal (KTF 2008: 3).

In 2010 an evaluation was published reviewing the climate adaptation research in Denmark. Most of the research done was in natural science and technology amounting to 48 %. 22 % was done in social sciences and less in humanities (Ministeriet for Viden, Teknologi og Udvikling 2009: 42-50). Further analysis or mapping would be required to gain a more current image of the research on climate adaptation.

During the interview with the researcher at AAU, it was pointed out that the research on climate adaptation is highly influenced by the actors related to and with interests in the sewer systems, and that they affect the agenda on climate adaptation with their scientific disciplinary backgrounds (appendix 7). The network or partnership that was referred to is called Vand-i-urbane-områder/Vand-i-byer (Water in urban areas/Water in cities). The network was created in 2010 and their stated purpose is to develop new and better water technologies, systems solutions and integrated water management (Vand i byer, n.d.: 1) as a response to climate change that affects the urban water cycle. Their main activities include decentralized methods of drainage of rain water, scenario projections for future investments in

order to handle climate uncertainties and develop climate resilient and sustainable cities (Vand i byer 2010: 6).

The network includes universities, utility companies, producers and entrepreneurs, consulting companies, public institutions (e.g. municipalities) and other interest organizations. The scientific organizations of the network are dominated by natural science partners and engineering and technology (Vand i byer 2015: online) among others DTU, the institute for water and environmental technology, educating engineers with focus of sustainable and environmental technologies in e.g. waste water treatment and water discharge (DTU n.d.: online).

The Water Sector Law

Alongside the development of climate adaptation research a large restructuring of the water sector has been implemented with significant influences on the implementation of climate adaptation projects. Thus this section is devoted to these organizational changes.

In the previous organization of the sewer system as described in section 5.1 the local utilities used to be a part of the municipal administration financed by water tariffs, which were decided upon by the municipalities. It was prohibited to make profits from these; instead a balancing financial principle regulated that sector so the costs balanced the income from the tariffs over time (Fratinti 2015: 4).

Then in 2003 a report from the Danish Competition and Consumer Authority stated that the water sector was too inefficient. The sector was dominated by small publicly owned utilities, and it was found by centralization of utilities, economies of scale could be realized. A bench-marking analysis showed that by breaking with the so-called "natural monopoly" and liberalizing the sector 1.3 billion DKR could be gained. It applied to the water suppliers as well as the sewage sector, since they were regulated by the aforementioned balancing financial principle, which was evaluated as not creating incentives for innovation. The price difference on water tariffs between municipalities were large, and by measuring the productivity of each utility plant and comparing their efficiency the technical potential as well as scale potential for improvement were identified (Spenner and Wacker 2003: 100-111).

Additionally, it was mentioned that the fact that the water tariffs and other taxes were not clearly divided could lead to the situation where income from the tariffs were used to finance other municipal public services. Thus it was stressed that by unifying the finances of the water sector to annual accounts would improve the transparency for the citizens as well as create opportunities for private operators to enter the market (Ibid.: 102).

As shown in Figure 5 in 2009 the government passed the Water Sector Law with three objectives 1) securing a water and sewage sector with high health and environmental quality, 2) ensuring the security of supply and 3) efficient water management with high transparency for the consumers. (Miljøministeriet 2009a: 1). At the end of 2010 the utility companies had been created throughout Denmark (see Figure 5) (Fratini 2015: 12).

The Utility Secretariat was created under the Ministry of Business and Growth (Kfst n.d.: online) with the obligation to annually benchmark each water utility company. The benchmarking model is to be decided upon by the environmental minister alongside the content and the design of the inventories and measurements (Miljøministeriet 2009a: 2). Annually the Utility Secretariat appoints a price cap for each water utility company on the basis of (1) historical prices, (2) a general efficiency demand and (3) an individual efficiency requirement estimated from the benchmarking model (Ibid.: 3).

The Cloudbursts

Two cloudbursts hit Northern Sealand in two consecutive years (both are shown in Figure 5). In August 2010 a great rainfall got close to the Capital of Copenhagen, however, it missed the center and mainly fell north of the city; some places it amounted to 98,6 mm in 24 hours (DMI 2010: online). Only a year later in 2011 it happened again and this time Copenhagen didn't get off the hook. Many streets, basements and low-lying apartments were flooded. During the 2nd of July most of the Capital area received 30-90 mm and in a few spots it exceeded 100 mm (DMI 2014b: online). The damages amounted to 6 billion (Krawack and Madsen 2013: 2). In the picture below one of the central streets looks like a street from Venice, an unfamiliar view to the citizens of Copenhagen.

Photo - Flooding in Istedgade (2011):

Anne Christine Imer Eskildsen. Retreived from the DMI webpage. Obtained special permission to use picture in this paper. See klimatilpasning.dk in reference list under pictures or click here

These two cloudbursts revealed the vulnerability of current urban water infrastructure (Hall et al. 2014: 122). From May two months previously and during the summer of 2011 a Tour de Climate Adaptation (TdK) was carried out by the Knowledge Center on Climate Adaptation (the ministerial unity that later was moved to the Danish Nature Agency and responsible for the web-portal *klimatilpasning.dk*) and Local Governance of Denmark, the municipalities interest organization (LGDK, in Danish: Kommunernes Landsforening). In order to spread the word of the web-portal and evaluate the municipal climate adaptation municipalities, utilities and the Danish Nature Agency were invited to six

seminars on climate adaptation. During the summer simultaneously with the cloudbursts the interest for the seminars increased and in the end most of the municipalities had participated (TdK 2011: 1).

During the TdK a lot of information and knowledge from municipalities who had already started various projects were collected. It revealed that many municipalities were unsure of how to handle the increase in rainwater; the large uncertainties on the future rain patterns prohibited a constructive dialogue with the citizens and the local politicians. They were unsure on how to find new solutions and implement decentralized drainage projects (LAR-projects, local drainage of rainwater). It complicated things that it was unclear what part of these new solutions that could not be financed over the water tariffs, and in general the regulation of the water sector was seen as a hindrance to the implementation of the climate adaptation projects. In those municipalities that had succeeded with bringing the climate adaptation to the agenda, it was found that local weather events had initiated the process and locally dedicated employees at the municipalities had been key for the further work (TdK 2011: 1-2).

In October the same year a new national government formed and as a part of their governmental program it was decided among other things that the municipalities were to make a climate adaptation plan within the next two years (see Figure 5). The regulation of the water sector should also be evaluated in respect to whether it supported the utilities in financing the climate adaptation and whether the division of work between the municipalities and the utilities were suitable for alternatives to the sewers (Regeringen 2011: 33).

The Government launched a new legislation in 2012 that should enter into force January 2013 (Regeringen 2012) (also shown in Figure 5). The obligatory climate adaptation plans were introduced as the platform that makes ends meet in the large cooperation across organizations, where the local solutions were to be defined, prioritized and financed (Naturstyrelsen 2013: 3). The climate adaptation plans needs to contain an estimation of the climate change risks for flooding. On the bases of flooding maps and value maps provided by the State, the municipalities had to decide upon their own level of ambition and priorities, and accordingly a plan of actions and how they are financed. There is in that sense no requirement for the municipalities to do more than their own level of ambition and priorities prescribe them to (Ibid.: 7).

LDGK and the Government each year decide upon the economy for the municipalities under the resort of the Ministry of Finance, and in the agreement for 2013 the municipalities were to lift the investment in climate adaptation by 2.5 billion DKR. These investments were targeted the assignments that the utilities normally are responsible for. Furthermore, the utility companies should be granted the opportunity to relieve the municipal investments through the water tariffs as far as the investments concerned drainage or handling of rainwater (Regeringen and KL 2012: 7). The regulation was adopted so the utilities could finance investments in areas owned by the municipalities, citizens or private companies. However, these investments were solely related to those parts of the projects that dealt with the handling or drainage of rainwater. Those parts of the projects concerned with other values like amenity should be financed by the owners. Subsequently, the utilities could finance 100 % of the

projects in the cities and at roads, if it could be argued that the whole project had to do with drainage or handling of rainwater and if it did not exceed the costs of a similar traditional sewage project. However, they would not be able to be project owner, which is clearly either the municipality or the private collaborators, who has the final responsibility for the project and who own the installation. From January 1st 2015 the utilities would only be able to finance 75 % (Miljøministeriet 2013b: 2-5). However, this was changed to last another year until 2016 (Miløjministeriet 2015: 3) (see Figure 5).

Finally in the future a new Water Sector Law is expected (Lindgaard-Jørgensen and Feilberg 2013: 10). These latter developments in the regulation is experienced as a consequence of the national political will for securing the financing of municipalities' climate adaptation initiatives and hasten their implementation rather sooner than later (appendix 9: 3).

5.3 The Empirical Foundation for the Analysis

The outline of the context of Danish climate adaptation was presented first by the historical insights to the development of the sewer system and organization, followed by a presentation of the physical challenges of climate change, the national governmental strategy and the research on climate adaptation. Finally, the political situation and development of the regulation on climate adaptation has been presented. These developments will found the empirical basis for the first part of the analysis.

6.0 Analysis of Learning and Policy Change regarding Climate Adaptation

"In Copenhagen as well as in the rest of the country the center of discussion concerns how large a proportion of the future extreme rain should be handled by green roofs, gabions and local discharge, and how much the sewers should handle – and as in the 1850s there is uncertainty in calculations, local surroundings that should be respected, and ideology, involved" (Andersen 2012: online; translated by the author).

Since 1898, with the inauguration of the major extended sewer system, both waste water from households and factories, the waste from new water closets and rainwater from the streets have been managed together in the underground widespread pipe system tagged *tout-à-l'égout* (Lindegaard 2003: 109). As journalist Ulrik Andersen of the local magazine 'The Engineer' expresses it in the above quotation, the sewer system is now up for discussion again as it was during its implementation.

Inspired by the empirical analysis of socio-technical systems by C.F. Fratini and J.S. Jensen (2015) and the application of the concept of belief systems from the ACF, the underlying rationales of this discussion are being mapped, concerning the organizing of the water sector in Denmark. Subsequently, the central actors influencing the climate adaptation agenda are identified and analyzed as a policy subsystem, thus emphasizing the Danish context. The mapping of belief systems, their interrelated contradictions and compatibilities as well as the identification of climate adaptation as a new policy subsystem will help answer the sub-question of why climate adaptation as a new policy area influences the regulation and the cooperation of the municipalities and the utilities.

On this basis a partial conclusion is presented; it forms the foundation for the case studies, in which specific learning processes are investigated by the organizational learning theory of *ba.* The different *ba* during the practical implementation process of climate adaptation projects are described and essential knowledge assets are identified. This answers the second sub-question on whether cooperation between municipalities and utilities results in learning processes.

These knowledge assets and learning processes are subsequently analyzed with regards to the dynamics of the three belief systems influencing the regulation of the water sector. If knowledge creation processes change the dynamics of the belief systems this could imply further policy change thus answering the last sub-question. The regulations are accordingly evaluated regarding whether they facilitate such innovative processes. In the end of the analysis corresponding recommendations for policy changes are outlined.

As described in section 2.2.1, the ACF views policies as offshoots from the belief systems of the actors within the policy subsystem. These contain value judgments, perceptions of causal relationships and assumptions of efficacy of policy instruments. Belief systems are shaped as hierarchies of *deep core beliefs*, *policy core beliefs* and *secondary beliefs*. The deep core values are seen as external to the policy subsystem and its general values of how the world should or should not be; these are hard to

identify and will not be included in the analysis, since it is the two other levels that affect the development of the policy subsystem and the regulation on climate adaptation.

6.1 The Belief System of Hygienic Technology

The policy of establishing an extensive sewer system covering most of Copenhagen became reality in 1898 (section 5.1). The *policy core belief* relates to the contemporary increased focus on the scientific field of public health; which can be understood as a reaction to the filthiness, morbidity and mortality confronting the daily life of urban residents in the 19th century. The belief that it is valuable to actively improve the health of the general population can be thought of as founded in this time period aided by a scientific approach to urban development of major European cities especially London (Tarr 1985: 96).

The development in natural science and the formation of scientific disciplines helped to shape the *secondary beliefs*. Specific illnesses were thought of as having specific causes, which could be restrained through technical solutions. The discovery of bacterial breakthrough had a huge influence on the medical sciences and the further promotion of hygienic infrastructure, in which the sewage system played a vital role (Lindegaard 2003: 119). The introduction of technical standards on specific service goals applied to the establishment of the sewage systems regulated and maintained by the municipalities, were seen as a central element in realizing the policy core belief concerning public health.

6.1.1 Reflection on Insights from the Theoretical Framework

The two theories, ACF and the organizational learning theory, offer a fuller understanding of the establishment of Hygienic Technology as a belief system and its successful implementation. However, due to lack of space some reflections on the theoretical framework will instead highlight the differences between the two theories and serve as inspiration for the further analysis.

The ACF builds on the idea of coalitions. The doctors and technicians formed an alliance educationally, scientifically and politically based on the belief system of Hygienic Technology. They further had the necessary resources for having the ability to efficiently influence the policy agenda and for fostering policy change following Figure 2.

First of all, the doctors as well as the technical scientists belonged to the upper bourgeoisie that secured their financial requirements for participating in the official as well as unofficial international scientific networks in which new ideas on public health were shared (Lindegaard 2003: 110-111). Secondly, they also had the necessary expertise to participate in the scientific discussions and developments due to their educational backgrounds. As described by A. Lindegaard (2003), they set up educational programs including public health and technical hygiene, which can be described as their strategy for institutionalization and securing continued expertise for the implementation of the policy objectives of the sewer system.

These actions can be illustrated by the internal circular learning process in the policy subsystem given by Figure 2 (here the central concepts of the Figure are highlighted in *italics*). After the coalition

succeeded in implementing their *strategy* of sewage systems, it helped form the basis for the *decision* to complete the sewage system in Copenhagen by 1898. These technical solutions were backed by the allocation of resources to the *institution* of Polyteknisk Læreanstalt (today DTU), which ensured a technological *competence* in the municipalities to back the municipal utilities. The *regulation* standards of water quality became the institutional rules that ensured further *resource allocation* to the relevant institutes reinforcing the policy-oriented learning process and the implementation of sewage systems.

Politically legitimacy was gained through the creation of associations influencing the political agenda. With the full establishment of the Copenhagen sewer system in 1898 and the Hygienic and Technical Congress in 1903 emphasizing and celebrating how the Hygienic Technology was an essential foundation for the further urban progress and civilization (ibid.: 120), the implementation of the belief system can be said to be completed. Alternative ideas such as the ones described in section 5.1 that highlight the economic value of human feces to agricultural practices, were disregarded.

The ACF assumes the existence of coalitions, which emphasizes the essential role of the contemporary scientific networks nationally as well as internationally. These networks developed and promoted the understandings and policy objectives of Hygienic Technology through policy-oriented learning processes. Furthermore, they offered an opportunity for gaining access to the necessary resources like money, expertise, supporters and legal authority as required for obtaining and translating the belief system into actual policies of the sewer system. With these aspects the political processes and dynamics in the quest of influencing the political agenda are accounted for.

The theory of organizational learning introducing the Japanese concept of *ba* offers complementary insights and understandings. It provides an increased focus on the doctors' and the technicians' interaction with their local environment and their perception of the living conditions in contemporary European cities. This refers to the dialectic relation between environmental surroundings and social realities described in section 3.1. As a response to the daily interactions, especially the doctors with the contemporary presence of mortality and morbidity might have urged for changes.

The theory focuses upon the knowledge creation process itself and thus improves the understanding of how knowledge is created through the SECI-process over time. It focuses on the successful integration of the international knowledge assets that developed especially in the British context, and in which the sewer system played an important role for increasing public health. Analyzing the SECI-process would focus on the social networking of technicians and doctors, and would emphasize routines, meeting practices, exchange of information through letters and scientific journals. These would be analyzed as different *ba* having the ability to generate different knowledge assets, which foster the further creation of knowledge within the scientific field of Hygienic Technology (see Figure 3a and Figure 3b).

Additionally, the theory would stress the importance of tacit knowledge gained during the implementation of the first sewers, and how this process generated new practical tacit knowledge assets. The know-how can be made explicit through a *dialouging ba* and further promoted and developed through a *systemizing ba*. Congresses and international meetings and the associated

scientific journals can be understood as such *ba*, through which the process of disseminating new knowledge assets was facilitated. The tacit knowledge of trust and social coherence between doctors and the rest of the bourgeoisie in the context of Copenhagen (Lindegaard 2003: 113) could be seen as an important premise for the combination of explicit knowledge assets from the medical sciences and the technical sciences, which was fundamental for the policy development of the sewer system.

The two theories can be seen as enabling the understanding of two complimentary aspects of the learning processes during the process of implementing the sewer system. The theory of *ba* introduces the continuous dynamics and the practical aspects of a knowledge creation between doctors and technicians, which are to some extent absent in the ACF. Furthermore, it can assist in identifying potential improvements, as different knowledge assets might be combined, developed or modified pushing the SECI-process forward. Simultaneously, the *ba* highlights the dialectic interaction with the environmental context that shaped the creation of new knowledge assets on public health, and hence the importance of regarding this context as fundamental for the learning process. Therefore, the organizational learning theory is expected to improve the understanding of knowledge creation on climate adaptation solutions and innovative practices.

Within the ACF the environmental context is mostly seen as an external context affecting the subsystem and the internal coalitions, thus the understanding of the policy-oriented learning process is different from the knowledge creation processes of *ba*. However, the assumption of the coalitions complements the analysis by providing aspects of political conflict between belief systems during the implementation of the sewers. Thus it is anticipated to benefit similarly in relation to the nascent policy field of climate adaptation enabling the understanding of political dynamics. These are empirically investigated and are the focus of the next section.

6.2 The Policy Subsystem

First of all, emerging contours of the climate adaptation policy area are examined before going further into the different belief systems (see section 6.2.1) and the knowledge creation between utility companies and the municipalities. The ACF's concept of policy subsystem is found useful defined as *"the group of people and/or organizations interacting regularly over periods of a decade or more to influence policy formulation and implementation within a given policy area/domain"* (see section 2.2.1). The defining and illustration of the policy subsystem and interactions (see Figure 6) will be based on the empirical data outlined above and a critical reflection of the condensed descriptive statements of the two interviews from the employed at Vandplus and the Danish Nature Agency (respectively appendix 8 and 9).

The cloud bursts in 2010 and 2011 (see Figure 5) are physical phenomena that affect the political and social reality. The ACF defines these environmental events as external initiating a series of political changes that manifests the policy subsystem of climate adaptation described in section 5.2.3. The development had started some years previously in 2008 with the political strategy of the former government and the establishment of the strategic research network, KFT, which is illustrated in the

right side of Figure 6. However, the consolidation of the policy subsystem with the climate adaptation agenda was first and foremost a response to the extreme weather events (Carmin et al. 2013: 9).

The manifestation of the policy subsystem with the cloudburst and the subsequent series of political responses the existing coalition of the belief system on Hygienic Technology (see section 6.1) is challenged. The policy view of the centrality of the sewer system in modern cities can be seen as being questioned as the current combinations of handling waste water and rain water together in the same sewers are found incapable of dealing with current climate changes (appendix 9: 5).

The corresponding new regulation (see section 5.2.3) requests of the municipalities to adopt a strategy on climate adaptation. Additionally, further cooperation between utility companies and the municipalities are favored with the additions to the Water Sector Law clarifying the finance of climate adaptation projects. Thus the access of resources is changed for the actors within the policy subsystem as the tariffs can be used for handling rainwater alongside roads, water streams and in recreational areas (appendix 9: 3). Thus the cooperation between the municipalities and utilities to find decentralized alternative solutions that support amenities in the city planning has been promoted by the government, even though these projects to some extent could have been carried out with the previous regulation (appendix 9: 3).

As a consequence of the governmental strategy targeting the municipalities and the utilities as the ones primarily responsible for initiating climate adaptation initiatives with corresponding cooperation and organization, they are depicted in Figure 6 with two diverging colors to highlight their centrality of the policy subsystem and as two different organizations after the separation of the utility companies in 2009.

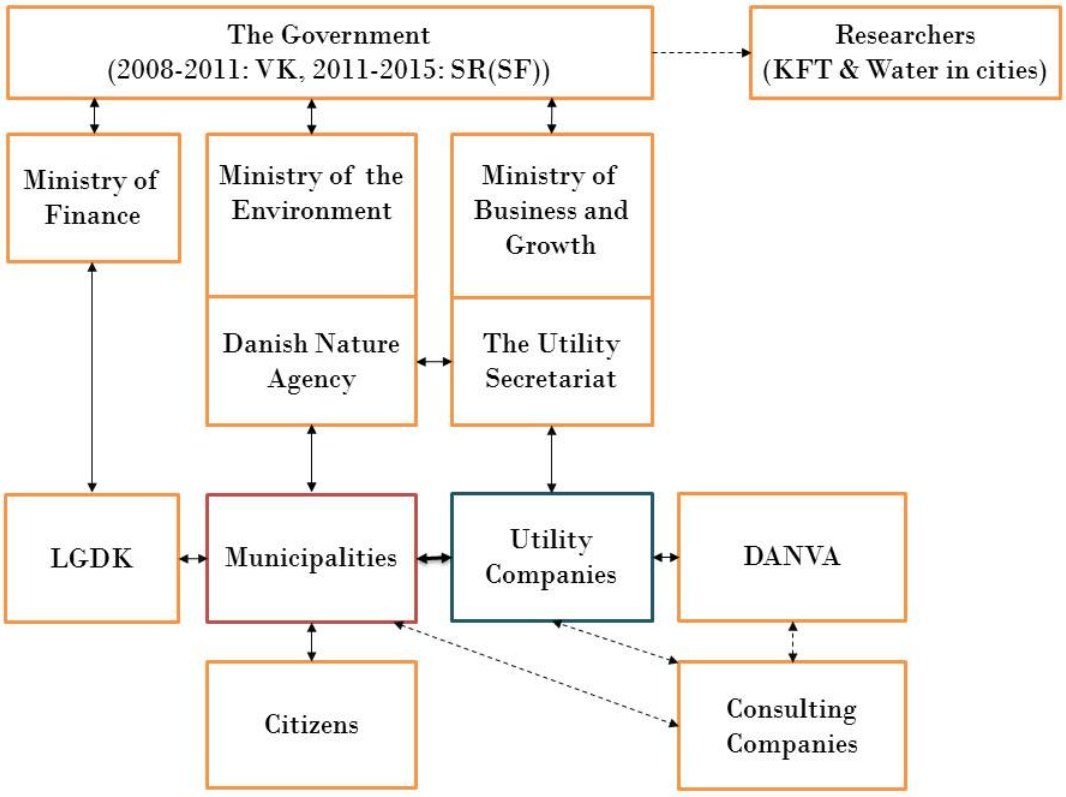

Figure 6: The policy subsystems' actors and their interactions influencing policy creation and implementation (2015)
The municipalities and the utility companies are seen as the most central actors for the implementation of the climate adaptation, thus they have been given a different color than the rest of the actors similarly displayed as squares. The interactions between the actors are indicated by an arrow. The researchers and the consulting companies have been given a dotted line since they primarily provide scientific and systematic knowledge for the climate adaptation projects, thus having an underlying and indirect influence on the policy creation and implementation. Not all the interactions have been illustrated by arrows, since it would make it more difficult to interpret the figure.

The government is depicted at the top, since the regulation goes through the respective ministries with different resort areas. The ones identified with influence on the cooperation between municipalities and utilities are the following three:

1) The Ministry of Finance influences the negotiations of the economic agreements between the LGDK and the government, where the overall expenses for the municipalities are decided upon; this was seen in the agreement for 2013 (section 5.2.3 – The Cloudbursts). In the interviews it is recognized that the idea of raising taxes for climate adaptation in one municipality is not just an option when negotiating the municipal expenses, since that would imply lowering the taxes in other municipalities. Thus when municipal politicians prioritizing climate adaptation projects their allocated financial resources have been competing with other core policy areas (appendix 8: 7; appendix 9: 6).
2) The Ministry for Business and Growth accommodates the Utility Secretariat that was established as a consequence of the Water Sector Law, and sets the economic framework for the

utilities. It is responsible for the annual benchmarking of the utility companies even though the benchmarking model is decided upon by the environmental minister. Accordingly, a little arrow illustrates this relationship between the environmental ministry and the Utility Secretariat (see Figure 6).

3) The Danish Nature Agency, a subunit or board under the Ministry of the Environment plays a main role in the policy subsystem. It accommodates the knowledge center on climate adaptation that is responsible for coordinating the national climate adaptation strategies and actions. The web-portal *klimatilpasning.dk* is under their resort area even though it is serviced by a huge variety of actors. Furthermore they are the central actor responsible for the policy-development on climate adaptation (Lindgaard-Jørgensen and Feilberg 2013: 7).

The municipalities are first and foremost accountable to their citizens shown by an arrow between the two. With the government in the top of the figure and the citizens at the bottom the vertical axis of Figure 6 is intended to illustrate the political structure. Both the municipalities and the utility companies have their respective interest organization: LGDK, and DANVA that actively take part of the public political discussions. In the documents from these two organizations some of the interests regarding climate adaptation can be identified for the municipalities and utilities. The municipalities and utilities are furthermore aided by the consulting companies in their work on climate adaption, thus they have been included in Figure 6 as well.

6.2.1 Belief Systems

The new ideas initiated by the cloudbursts in 2010 and 2011, will be described by the belief system 'Water Sensitive Cities'. As described above this change has influenced the regulation of the Water Sector Law; the underlying rationale of the law is investigated as a belief system of 'Economic Efficiency'. Both of them affect the practical implementation process of climate adaptation projects.

The Belief System of Water Sensitive Cities

The belief system of Water Sensitive Cities can first and foremost be seen as originating from growing challenges and understandings of climate changes' influence on urban water systems. The *policy core belief* is generated from these increasing concerns and awareness of the limitations to current infrastructure including physical difficulties in handling current climate change events, where flooding is frequently and more intensely damaging urban infrastructure. This also relate to the awareness of inherent uncertainties of projections and future scenarios on how climate change will impact the urban residential areas in the future. Therefore, more flexible and decentralized urban ecosystem supplements are promoted and argued for. Subsequently, the human perspective is in some cases broadened from public health to include the necessity of ecological health as a condition for the well-being of human communities (Marlow et al. 2013: 7151).

The policy core belief builds on arguments from the natural sciences on ecological systems, which are revitalized through the growing field of resilience thinking. Investment in and management of the resilience and health of ecological urban environments are viewed as essential for meeting the

challenges of climate change. They are as identified present in the Danish national strategy leaning on the IPCC's second sub-report AR5 that similarly draws on resilience thinking.

The *secondary beliefs* can be analyzed as three main arguments identified by D.R. Marlow et al. (2013), when decentralized and local water management practices are promoted. The first is a direct consequence of the policy core belief of general ecological health, where intelligent planning of urban spaces and natural ecosystems such as green and blue areas are seen as more beneficial for urban areas than current paved surfaces and traditional sewer systems. These alternatives meet many objectives simultaneously such as mitigating the risk of flooding and creating urban amenities. The second argument addresses water security, making sure that there is enough water meeting the increasing demand from the urban population. Thus the utilization of lower quality of water are promoted through water recycling, rainwater harvesting for purposes other than drinking such as toilet flush, industrial water use and groundwater recharge. The last argument and third *secondary belief* further relates to resource efficiency, minimizing the use of water in order to reduce costs as well as the ecological water footprint (Marlow et al. 2013: 7152-7153).

A last *secondary belief* has been identified especially in the Integrated Urban Water Management perspective, where the focus of integrating climate adaptation cross-sectorial with inclusion of stakeholders and collaboration between water management actors and e.g. urban planners are seen as key strategies for the success of decentralized solutions (section 5.2.2 – Resilience Reasoning).

The Belief System of Economic Efficiency

Prior to the cloudbursts in Northern Sealand the whole water sector was reorganized and regulated with other rationales (described in section 5.2.3 – The Water Sector). The primary *policy core belief* that constituted the motivation for the Water Sector Law was based on the idea that natural monopoly prevents competition in the market of the water sector and therefore economic efficiency gains are lost at the expense of the water consumers. This rationale manifested itself in specific policies analyzed as *secondary beliefs*.

The first *secondary belief* relates to the perception of the traditional financial principle of balancing costs and benefits over time as inefficient, since it did not encourage innovation, and the small-scale utilities were analyzed to miss out on economies of scale. Thus instead the principle was replaced by a benchmarking model that should increase competition among the utilities, and as a consequence the Utility Secretariat was established imitating an artificial market.

The same rationale can be found in the *secondary belief* regulating the taxes. In the agreement between the government and the LGDK the overall expenditures for the municipalities are maintained in spite of the new policy area of climate change that the municipalities have to attend to (Ministry of Finance 2012: online). The municipal expenditures are influenced by the ideas of Economic Efficiency promoted by the Ministry of Finance playing a central role in the yearly negotiations on the economy of the municipalities. Thus, the only extra financial resources for lifting the investment on climate adaptation by 2.5 billion are the co-financing of the water tariffs. Further financial resources are not

found necessary since the economic advantages of lifting the handling of rainwater above ground are found self-evident (appendix 9: 5).

Another *secondary belief* is identified in the usage of the utilities' finances from the water tariffs, which was found to lack transparency. Consequently, the regulation of separating the utilities from the municipalities was argued to clarify the separation of taxes and tariffs and further secure transparency and efficient use of the financial resources. The tariffs were to be used on water management and no other municipal public services (see section 5.2.3 – The Water Sector Law). The division of the two organizations implies a division of ends and means. The political ends were to be decided by the municipalities, and the means would be regulated by an economic model detached from the environmental and local context (Fratini and Jensen 2015: 7).

Furthermore, the *secondary belief* of transparency securing efficient use of financial resources of the utility is maintained in the forthcoming reduction of the co-financing from 100 % to 75 %, where the municipalities have to co-finance with 25 %. This regulation is based on the idea of separating the taxes from the water tariffs, where the utilities are not to finance other public services (appendix 9: 6).

The fact that the projects co-financed by the municipalities and the utilities are owned by the former, further implies that the final responsibility of the projects is in the hands of the municipality. The municipality is responsible for the general maintenance and operation of the climate adaptation installations; however, the expertise of fulfilling these tasks is often not present in the municipality, thus they can be outsourced to the utility companies (Miljøministeriet 2015: 2; Andersen 2013: 50). Therefore the division of goals and means are maintained.

The Three Belief Systems

As a reference point the belief systems are collectively presented in Figure 7, specifying their policy core belief and the secondary beliefs. The following sections will describe the interrelations between the belief systems where the secondary beliefs either colliding or are compatible. Furthermore, it is related to how these interrelations can influence the cooperation between the utilities and the municipalities. Section 6.2.2 sheds light on the interests of the municipalities and the utilities, while highlighting the relation between the Water Sensitive Cities belief system and the Economic Efficiency belief system. In section 6.2.3 potential lock-in effects of knowledge assets are elucidated while comparing the belief systems of Water Sensitive Cities and Hygienic Technology.

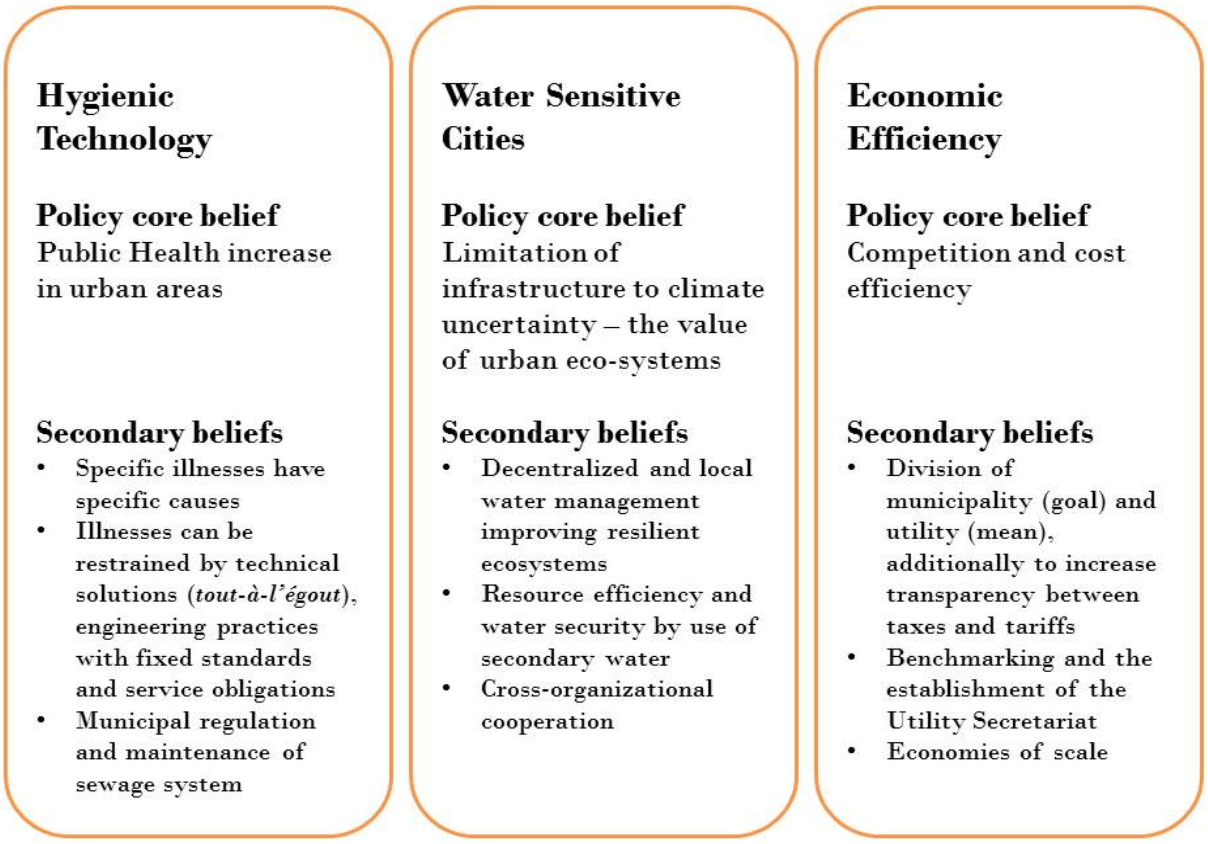

Figure 7: Belief Systems (2015)
The Figure illustrates the different belief systems identified in the policy subsystem of climate adaptation. First their name is given followed by the policy core belief. Finally three central secondary beliefs fundamental for implementing the policy core belief are presented.

6.2.2 Interests of Municipalities and Utilities

According to the interviewees the cooperation between the actors depends on both actors seeing the climate adaptation projects as an advantage compared to traditional solutions. This follows the logics of ACF, in which the instrumental rationality of the actors' refers to the idea of successfully realizing the belief systems (see section 2.2.1 – Policies). Several barriers to the cooperation have been experienced, including contradictions in their respective understandings and objectives for climate adaptation. It is found necessary to find a common project that makes sense to both the utility company as well as the municipality. This also includes finding a common agreement on who owns what, who finances what, and who is responsible for which actions. Subsequently, the first experience gained from implemented projects creates understanding and concepts that might help the process for the next climate adaption project (appendix 8: 5, 7; Andersen 2013: 42).

The municipalities have an interest in climate securing their citizens following the logic of the belief system on Water Sensitive Cities, where decentralized solutions to urban water management are introduced as a *secondary belief*. This will entail new recreational open spaces in the midst of their urban areas to the benefit of the citizens. It is appreciated that the projects can be financed by the utility

companies, as they themselves have tight budgets (appendix 9: 6; appendix 8: 3, 7). These options will be limited with the regulation of the utility companies only being allowed to finance 75 % of the climate adaptation project under the co-financing rules. As described the regulation is founded in the *secondary belief* of Economic Efficiency, according to which the tariffs and taxes are to be separated. Therefore, the municipalities have stated that, as a consequence of this regulation the financing and implementation of climate adaptation projects will slow down (appendix 9: 6).

This is an example of two secondary beliefs from each belief system that might collide and create policy debate. Critical voices have stressed that the financial sources are two different types of taxes paid by the same citizens, who are indifferent to how they pay for climate adaptation (Krawack 2014: 8). This logic implies an emphasis on the importance of continuous investments for new alternative solutions. However, the division of tariffs and taxes maintain increased control with the financial resources and create innovative incentives according to the central *secondary belief* in the belief system of Economic Efficiency. Even though, the co-financing rules have been extended once from 2015-2016 (Miljøministeriet 2015: 3) and the regulation might be reconsidered in the revision of the Water Sector Law, the logic of separating the taxes from tariffs will be secured in a different way, if the current regulation is to be abandoned (appendix 9: 6).

It is further recognized in the interviews that the division of the municipalities and the utilities as another *secondary belief* of the Economic Efficiency belief system does create organizational challenges in implementing the climate adaptation projects. These challenges concern questions on who owns the climate adaptation installations, and which organization is responsible for financing and ensuring its maintenance. However, it is simultaneously being recognized that the separation of utilities from the municipalities have granted them more identity clarifying the role of a water utility company. This enables them to focus on their specific tasks, which to some extent also can benefit the decentralized climate adaptation projects (appendix 9: 1; appendix 8: 5).

The utilities are interested in meeting the service goals decided upon by the municipality either through traditional sewage solutions or climate adaptation projects. They further have an interest in the latter as far as it might be the cheaper solution, which helps them comply with the annual benchmarking. In this respect the two belief systems can enforce each other. Since the decentralized climate adaptation solutions thus simultaneously accommodate the *secondary beliefs* of Water Sensitive Cities as well as those of Economic Efficiency. The projects are found to meet several goals in decentralized solutions, securing against climate change and creating amenity, while applying to economic efficiency objectives (appendix 9: 5).

However, the utilities find it a hindrance that they are not to be the project owners of the climate adaptation projects according to the regulation. They finance the majority of the projects and they also have the expertise to carry out the projects, thus it is in their interest to be project owners of the climate adaptation projects in order to have the final responsibility (appendix 9: 1; DANVA 2014: online). From the perspective of utilities the *secondary belief* of the Economic Efficiency concerning the

regulation of project ownership can be seen as creating barriers for the cooperation between utilities and municipalities in implementing the belief system of Water Sensitive Cities.

The regulations of the Water Sector Law have in some cases been so strict and bureaucratic that the socio-economically optimal solution has not been implemented. The municipalities or the private actors owning the land or road on which the climate adaptation project is to be carried out, have not been able to either finance the recreational aspects not related to drainage of water or have not had the resources to fulfill the role as project owners. Thus, the utilities have an interest in lifting that task of the project consequently being project owners (DANVA 2014: online). It could be economically beneficial for them as well, if the alternative is cheaper than the traditional underground solution (appendix 8: 3).

Thus the regulation, related to the Economic Efficiency belief system, can be said to create bureaucracy that can prevent an efficient implementation of climate adaptation projects realizing the belief system of Water Sensitive Cities. Following the above example it can also prevent the implementation of the most cost efficient solution realizing the objective of the belief system of Economic Efficiency itself.

However, it is still an option for the utilities and the municipalities to utilize the old rules when implementing climate adaptation projects (appendix 9: 4). The reason for the co-financing regulation was that, in the experience of the municipalities, the climate adaptation projects were carried out in spite of the Water Sector Law rather than facilitating an organizational cooperation between the municipalities and the utilities (TdK 2011: 3). Thus it was an attempt to ease the cooperation between the municipalities and utilities as the climate adaptation projects were a priority for the current government. Thus a full revision of the Water Sector Law would take too long to process. Such a revision is, however, being debated (appendix 9: 3).

Furthermore, in the Danish Nature Agency it is recognized that the rules might have been too bureaucratic, and that they will be changed in the following revision as no one is interested in the bureaucracy for the sake of bureaucracy. Additionally, it is thought that experience gained from finished or current climate adaptation projects, on how the regulation facilitates the cooperation between utilities and municipalities, could benefit an evaluation of regulative framework, where such new knowledge can provide the basis for a revision of the Water Sector Law (appendix 9: 2, 3).

6.2.3 The Lock-in Effects of the Sewage System and Hygienic Technology

As it is pointed out by Marlow et al. (2013: 7157) the implementation of the secondary beliefs of the Water Sensitive Cities are not realized as fast as the ones promoting the belief system could hope for. Various reasons can be found e.g. the fact that the centralized sewage systems of existing water infrastructure create lock-in effects in investments (Ibid.: 7153). However, in a Danish context further barriers have been pointed out in the previous section, such as (1) asymmetric expertise simultaneously with requirements of project ownership and (2) coming 75 % co-financing by the municipalities.

The ACF would further point to whether or not a sufficient coalition has been created as it was the case in the historical perspectives on the establishment of the centralized sewers. The KFT and the network

of Water in Cities form a scientific community that promotes new innovative solutions. Old standards might be revised. For example the interest organization of the utility companies DANVA (also a member of the partnership Water in Cities) has published a promotion for the use of secondary water (lower water quality than traditional drinking water) for other purposes through their online magazine, which follows the rationale of the second argument in the belief system of Water Sensitive Cities.

Furthermore, these arguments follow the approach of the government described in section 5.2.2, in which the future uncertainties challenge the old technical goal-emphasizing infrastructure solutions of the belief system of Hygienic Technology. Instead other innovative and flexible solutions are favored, which align with decision support systems of risk assessments and climate projections capable of adjusting to future uncertainties.

The organizational learning theory of *ba* complements the ACF by analyzing the knowledge creation process within the scientific community. Most of the researchers have roots in the technical and natural science backgrounds. The entrepreneurial approach to the problems arising from climate change is present in the focus on natural science research, which dominates both research groups: KFT and Water in Cities (see section 5.2.3 – Climate adaptation organization and research). As described in section 2.3.4 the knowledge assets have the ability to create inertia as they operate as moderators, input and output of the knowledge creation process, where they can be subject to over-utilization. With the growing concern of the sewers' ability to handle the future rain manifested by the governmental climate adaptation strategy of 2008, a knowledge creation process is politically demanded and accordingly initiated.

The knowledge assets that have been created and promoted in the last century with the creation of the extensive and centralized sewage systems, form the basis of knowledge known as technological hygienic solutions. They accordingly reflect the management, organization and the infrastructure of the water sector, where the existing sewer system is continuously being invested in, renovated and maintained as physical pipes underground of our cities living up to specific standards and service obligations. Thus the knowledge assets of the sewers evidently work as *inputs* into the knowledge creation process.

The knowledge assets can simultaneously *moderate* the participants of the research crew, where the natural and entrepreneurial science researchers are dominating the research and the further knowledge creation process. Accordingly, the solutions and new knowledge assets can be expected to reflect the same logics of the knowledge assets that have dominated the inputs and moderated the knowledge creation process relating to Hygienic Technology.

The same inertia can be identified in the ACF, where the coalition between doctors and technicians that succeeded in implementing the policies in the belief system of Hygienic Technology has had large influence on the organization, the physical characteristics and the governance of the water sector in Denmark as described as an internal policy-oriented learning process in section 6.1.1, securing further financial and scientific resources for the current regulation of the sewer system.

This is not to underestimate the value of integrating such knowledge assets in the development of new innovative solutions; it is solely to elucidate the fact that alternative knowledge assets tacit as well as explicit not applicable to the belief system might be disregarded before fully being understood, made explicit or elaborated upon.

This might be the case as reflected in their main strategies in Water in Cities, which among others include increasing efficiency in product maturation and marketing of the new water technologies. This is clearly stated as an economic goal for realizing the export potential of these new technologies to emerging economies or economies in transition (Vand i byer 2010: 2, 6). These aims primarily relate to a combination of the belief systems of Economic Efficiency and Hygienic Technology, where innovative processes should increase economic efficiency and could develop the further establishment of technological solutions.

It is, however, more complex; in spite of the potential lock-in effects with the increased focus on natural and technical sciences a lot of the rationales within the Water Sensitive Cities belief system are also found among the researchers as they focus on decentralized solutions and integrated water management (see section see section 5.2.3 – Climate adaptation organization and research).

These aspects are furthermore problematized as it was pointed out during the interview with the researcher at AAU, that the new decentralized solutions above ground create new practical and social challenges. The integration of social sciences can be deemed necessary, since the technical solutions must be incorporated into the social sphere of the citizens (appendix 7). Thus, alternative political, practical and social aspects can be thought of as necessary to include in the research inquiries and knowledge creation process in the quest for finding new innovative solutions. Maybe these solutions are not technical as such.

This is further recognized in the report from DHI, member of Water in Cities; where it is emphasized that the requisite technology and equipment to secure an effective handling of rainwater exist; but the management of water and technology, including the fragmentation of the efforts to meet climate change, is problematic. The DHI report highlights the need for reviewing the organizational and management structure of the water sector as well as the incorporation of relevant actors (Lindgaard-Jørgensen and Feilberg 2013: 5-6).

Practical and local political contexts simultaneously influence the implementation process of climate adaptation projects. The local authorities in the municipalities need to balance the practical reality with the rational approach in the belief system of Water Sensitive Cities (Carmin et al. 2013: 18). As described in section 5.2.2, this relates to the critique of resilience thinking in general, where social, cultural and political aspects are not sufficiently accounted for.

6.3 Partial Conclusion

In order to answer why climate adaptation influences the regulation and cooperation between the municipalities and the utilities the mapping of general rationales in belief systems dominating the policy subsystem of climate adaption has proven beneficial. Before outlining their contributions some initial reflects of the ACF's applicability to the policy area of climate adaptation are presented.

6.3.1 The Relevance and Limitations of ACF

The ACF have been beneficial in understanding and framing the policy subsystem of climate adaptation and further identifying the belief systems characterized as Hygienic Technology, Water Sensitive Cities and Economic Efficiency. They are seen as dominating the regulation of the cooperation between the municipalities and utility companies. However, they cannot be characterized as coalitions that collide. The ideologies and belief systems transcend the organizational structures and therefore cannot be attributed to specific actors within the policy subsystem.

According to the ACF, the fact that these belief systems cannot be contributed to coalitions of specific actors that collide might be due to the fact that it is a relative newly established policy subsystem and subject to nascent policy subsystem developments (see section 2.2.3). In more mature policy subsystems the coalitions are expected to decrease in number and the coalitions to solidify (Sabatier 1998: 114). However, the question is whether this will happen in this case. So far the changes in regulation can be seen as an attempt to make the rationales from either belief system meet. The continuous revision of the co-financing regulation and the potential opening of revision for the Water Sector Law can be analyzed from a less conflict-oriented theoretical standpoint.

6.3.2 The Belief Systems and their Interrelated Dynamics

The governmental climate adaptation strategy from 2008 introduced the belief system of Water Sensitive Cities to the Danish water sector. However, it was first as a consequence of the cloudbursts in 2010 and 2011 that the climate adaptation agenda was consolidated as a policy subsystem, in which the limitations of the existing infrastructure in terms of handling current climate events were clearly identified. The policy subsystem of climate adaptation is a nascent one, characterized by an awareness of the inherent uncertainties in the projections and future scenarios for how climate change impacts will develop in the future. It is expected that flooding will become more frequent and more intensely damaging to urban infrastructure. It creates difficulties in planning for the future.

With the introduction of the belief system of Water Sensitive Cities new approaches for handling rainwater in the urban areas have been spreading, challenging the belief systems of both Hygienic Technology and Economic Efficiency.

The solutions thought of as the traditional ones, which were a result of the public health debates are currently up for revision. More flexible and decentralized urban ecosystem supplements are promoted and argued for challenging the dominant municipal centralized secondary beliefs of Hygienic Technology. Economic Efficiency has been the main rationale for the Water Sector Law, ensuring the

division of the municipal budget from the utilities income, and where the utilities and the municipalities have been separated in order to apply more market-like structures in the water sector breaking with the natural monopoly. However, the regulation of the Water Sector Law has been challenged as new secondary belief of cooperation between municipalities and utilities have been promoted following the rationale of the Water Sensitive Cities belief system. It has shown to give rise to organizational challenges, which have been attempted to be met by the Government and the Danish Nature Agency with the adoption of the co-financing regulation.

The new cross-organizational cooperation policies encourage cooperation between the utility companies and the municipalities. Furthermore, the climate changes might even have facilitated a better dialogue between the municipalities and the utilities, since they have been forced to collaborate (appendix 9: 1). In order to analyze these processes further a closer examination of the specific cases of collaboration between the municipalities and the utilities is deemed necessary and will be undertaken in the following case-studies.

The climate events of 2010 and 2011 have resulted in more cooperation between the municipalities and utilities with corresponding regulation, because the inherent uncertainties of the climate adaptation agenda addressed new ideas within the belief system of Water Sensitive Cities, which challenges the previously dominating regulation of the water sector rooted in the belief system of Hygienic Technology and Economic Efficiency.

However, the regulation of co-financing climate adaptation projects seeks to combine secondary beliefs of the Economic Efficiency belief system and the Water Sensitive Cities belief system by encouraging cooperation and maintaining control over the finances. This control is apparent in the economic models subscribed to and promoted by the Ministry of Finance in the negotiation on annual municipal budgets, and when the Ministry for Business and Growth applies the benchmarking model to the performance of the utility companies. Whether this combination of the two belief systems will be successfully implemented will depend on the future revision of the Water Sector Law, since currently the co-financing has resulted in uncertainties about financing climate adaptation projects.

Cooperation between the municipalities and the utilities is characterized by organizational challenges, in which the different interests of the two organizations unfold. Both have incentives for realizing the socio-economically optimal solution, especially if it is cheaper for the utility company compared to a traditional project. However, the financing of the projects reveals an asymmetry between the two, since the utility companies are those financed by the water tariffs earmarked explicitly for water utilities' operational tasks, whereas the municipalities have to prioritize the project often at the expense of other policy areas. It relates to aspect of project ownership, which cannot be granted to the utilities. This is problematized by the utility companies, since these are the main financers and often the ones with the hydrological expertise to carry out the project.

The analysis of the belief systems and the nascent policy subsystem of climate adaptation highlights that the increased uncertainty for the future climate and the increased risk of flooding have initiated

changes in belief systems and that new approaches, flexible solutions and innovative practices are asked for. However, the approaches argued for by the researchers on climate adaptation are often above are non-sensitive to the political practical context in the municipalities, as described in section 5.2.2 with the focus on resilience thinking and section 6.2.3 with the focus of lock-in effects in knowledge assets.

Natural science approaches have been dominant in how the research on climate adaptation has been organized. As shown above this might create lock-in effects and inertia in knowledge creation processes, since the knowledge assets are moderating and functioning as inputs for the research process. Thus inquiry in climate adaptation might not sufficiently account for political and social aspects of the innovative solutions.

However, as a response to these challenges of lock-in effects the next section 6.4 on case-studies will highlight the social reality in the municipality, where such political aspects influence the implementation of climate adaptation projects. When new innovative solutions are implemented above ground they are adapted to the local environmental conditions, it implies the inclusion of integrating water as a part of the urban planning process. This development gives the local engineers at the water utilities a new role that includes knowledge creation in the development of urban planning with recreational values (Fratini and Jensen 2015: 5). Thus the learning processes of including social and political aspects into new innovative practices are assumed happening in the local municipalities in the cooperation with the utilities, where the local climate events are being dealt with by municipal authorities.

6.4 The Cases of Climate Adaptation

The second sub-question tries to examine whether the increased cooperation between the municipalities and the utilities create learning processes. In the following, the two cases will shortly be described and then the concept of *ba* will guide the analysis of how the two organizations cooperate around the climate adaptation projects, and how that further initiates learning processes and create new knowledge assets.

6.4.1 Roskilde – Jyllinge Nordmark

The houses in Jyllinge Nordmark are of great risk of being flooded frequently. In the future this risk will be exacerbated due to climate change. The area is surrounded by water. There is water coming from the fjord, and the risk of storm surge increases with the rising sea level. The groundwater table is also high preventing the increasing precipitation from percolating. Instead the waters will run to the river, Værebro Å that curves and encloses the area of Jyllinge Nordmark before flowing to the fjord (Orbicon 2014: 7). The river often floods especially when heavy rainfall coincides with high water levels in the fjord. Then there is a risk of a negative water flow with the water from the fjord running to the river instead of the other way around, thereby increasing the risk of flooding (ibid.: 15).

Previously, Jyllinge Nordmark was a summerhouse area, but in 1998 the former municipality decided that it should be a normal residential area (Gundsø Kommune 1998: n.p.), and the percentage of paved surfaces has increased accordingly, preventing the rainwater further from percolating (appendix 10: 6, 10). The sewers are only sized to handle the waste water as opposed to the sewers in most city areas following the logic of *tout-à-l'égout*. Therefore, the citizens of Jyllinge Nordmark are responsible themselves for handling the rainwater on their own ground (Roskilde Kommune 2013: 8). This implies that the utility company has no legal responsibility for handling the increased precipitation, which would have required the municipality to plan for separately sewerage the area decided upon in the sewage plan (appendix 11: 2). However, in this case the utility would only be responsible for handling the rainwater that statistically repeats itself every five years (Roskilde Forsyning 2010: 7). Thus a traditional solution would not be optimal; it would be too expensive, and it would result in the house owners continuously having their houses flooded every five years, due to their low altitude. This is acknowledged by the municipality as well as the utility company (appendix 10: 10; appendix 11: 2).

The reason why the utility company is nevertheless engaged in the project of Jyllinge Nordmark is the fact that they own a vacuum system, which is affected by the large amount of water in the area. Thus they have an interest in collaborating and finding a solution (appendix 2: 14; appendix 11: 5). However, the problems are complex, and no one really has an overview of the hydrological challenges and how these relate to each other (appendix 11: 1; appendix 10: 13).

In 2007, 2010 and 2013 there have been incidents of heavy rainfall and storm surge with houses being flooded (appendix 11: 1; appendix 2: 1; Grontmij 2013: 5). The citizens affected have contacted the municipality, and their many concerns and worries have accumulated emphasizing their urge for something to be done about it (appendix 11: 9). In response to the many inquiries from the citizens a

dike has been planned to secure the area against storm surge such as the one of 2013. However, this might reflect negatively on the ability to handle rainwater (Orbicon 2014: 67).

It is the responsibility of the land owners to initiate planning and to finance such a dike; yet the municipality has taken the lead in finding a solution (appendix 11: 6, 16), since the land owners are not capable of doing so. They cannot afford mortgage their houses, as it is almost impossible to sell the houses in the area, and many of them are still traumatized after the previous flooding events (appendix 10: 2). No matter what solution is decided upon, the land owners will have to contribute financially to some extent. The municipality has however allocated money for the project (appendix 10: 6).

The Knowledge Creating Process

The seriousness of the situation has made it obvious that the solution for climate adapting Jyllinge Nordmark is not to separately sewerage the area, as this would not prevent the houses from getting flooded, and there is a general understanding from the actors involved that the need for cooperation is self-evident (appendix 11, 2). The utility company has an interest in the area due to the vacuum system, and the municipality has to find a solution for the citizens living there. This is the background for the climate adaptation project initiated by the heavy rainfalls of 2007 and 2010 prior to the co-financing regulation.

One of the main contributions of the knowledge creation process in Jylling Nordmark is the production of the conceptual knowledge assets, which are generated in two *dialoguing ba*. They are seen as fundamental for the success of the project, as they also generate financial resources and legitimacy (appendix 2: 12).

In the beginning of the project the municipality took the lead in establishing a *dialoguing ba*, it was a weekend seminar facilitated by an external partner. Two representatives from each organization participated, and the municipal director was present backing the project (appendix 2: 7). The face-to-face contact in a limited group generated a socializing process in which tacit knowledge assets like trust were shared among the participants. Furthermore, the need for finding a collective and holistic solution for Jyllinge Nordmark was subscribed to, based on tacit as well as explicit knowledge of the problems in the area. Such interaction created conceptual knowledge assets concerning the future visions for the area shared through common experience.

The project of Jyllinge Nordmark has also been facilitated by workshops, in which the land owner associations have been included in the project from the very beginning (appendix 10: 8). These workshops can also be characterized as *dialoguing ba*, since the main task is to find the concept or vision for Jyllinge Nordmark. The workshops generated mutually shared conceptual knowledge assets on the idea of how it is to live in the area as well as on the implications for and responsibilities of the different actors. These explicit knowledge assets are generated from both tacit knowledge assets such as practical experience of living in the area made explicit by the land owners, as well as sharing of explicit knowledge assets on the flooding problem facing the residents of Jyllinge Nordmark. The idea is to analyze and utilize their already existing social structures like the boat guilds which foster

experiential knowledge assets such as trust and local knowhow shared by the citizens (appendix 10: 2, 6). Thus the *dialoguing ba* of the workshops facilitates a process where the citizens, municipality and utility company collectively generate mutually shared explicit knowledge on the concept of Jyllinge Nordmark, which can be characterized as conceptual knowledge assets.

Internally in the municipality the tacit knowledge assets generated in the first weekend has to be cultivated to secure the further resources for the project and its acceptance from the higher authoritative levels within the municipality. In this way the municipality can continue to take the lead in supporting the citizens finding holistic and innovative solutions for the area. These processes take time and resources, thus they can be difficult to prioritize, if many other things have to be taken care of, and if the citizens urgently want to see action (appendix 10: 7; appendix 11: 9). Thus either an *originating* or a *dialoguing ba* that maintains the mutually shared tacit and explicit knowledge assets vertically within the municipality related to the project of the holistic innovative goal for Jyllinge Nordmark could be beneficial. However, such a *ba* has not been identified in the interviews. Further insights into the routines, workflow and procedures of the municipality would be necessary; additional observational studies might prove fruitful.

The conceptual knowledge assets are continuously being shared benefitting the cooperation between the municipality and the utility on Jyllinge Nordmark, which are facilitated through an *originating ba* and a *dialoguing ba*.

The *originating ba* is a weekly meeting with one employee from each respective organization, they have no agenda in advance, and they meet face-to-face socializing and sharing tacit knowledge assets like trust alongside tacit and explicit knowledge on whatever they are working with. This can generate a following articulation process through a collective reflection of interfaces and make it explicit where their work might influence or affect each other positively as well as negatively. This is seen as the central element of their cooperation (appendix 11: 14).

The *dialoguing ba* is a weekly meeting, where several people are included, and the agenda concerns the specific project on Jyllinge Nordmark. What characterizes those meetings is the need for the utility company to coordinate with the municipality around the dike, thus through dialogue the plans and progress of the project are articulated and made explicit to both organizations (appendix 2: 8). Furthermore, explicit knowledge is most likely also combined, synthesized and analyzed during these meetings. The *ba* therefore facilitates both the conversion of tacit knowledge into explicit knowledge and the combination of explicit knowledge. Thus the knowledge assets generated in these meetings could be characterized both as conceptual and systemic knowledge assets.

Previously, there have been conflicts between the two organizations, where the municipality has emphasized its active ownership as the main owner of the utility company (appendix 2: 4; Roskilde Kommune 2011). However, in dealing with these conflicts a mutual respect between the two organizations has developed. It can be assumed that the weekly meetings facilitate to some degree a

socializing among the employees, in which mutually shared tacit knowledge of how they cooperate and create routine knowledge assets are fostered through a continuous SECI-process.

These routine knowledge assets created in both the originating and dialoguing *ba* make it easy for the municipal employees to contact the relevant partners in the utility company and the other way around. The amount of bureaucracy is minimized and potential unintended conflicts of interest in the collaboration are resolved before they evolve and become problems (appendix 2: 10; appendix 11: 14). It is not only unintended interest conflict that is discovered early on in the process; the same goes for positive interest solutions which make the cooperation easier. An example would be for the municipality to decide on a specific service level for the vacuum system owned by the utility company in Jyllinge Nordmark. It was an idea generated during the meetings, when it was made explicit that the specific service level could function as a lever for the utility's work on rain water management in Jyllinge Nordmark (appendix 11: 10). This is included in the next draft for the coming sewage plan (Roskilde Kommune 2015: 27).

Furthermore, it makes it easier for the two organizations to stretch further executing tasks other than those simply assigned to them (appendix 2: 9, 11). E.g. the utility company finances the phase of investigation questioning the citizens and identifies the local problems (appendix 11: 10). The insights from these activities are highly appreciated in the municipality (appendix 2: 11).

The collaboration on climate adaptation in Jyllinge Nordmark has been formalized in a cooperation agreement (Roskilde Kommune 2014). This has been helpful as a tool in order to articulate, specify and have a dialogue on the content of the project. It has generated focus on the project and in the cooperation agreement the tasks are made explicit and delegated. This has helped generate resources for the project as well (appendix 11: 10, 11). These are all knowledge assets that are generated in a *dialoguing ba*, and which are fundamental for creating mutual understanding for the project. This way of organizing the collaboration has been such a success that the model is expected to be used for other climate adaptation projects, which is written down in the draft for the next sewage plan (Roskilde Kommune 2015: 7). Thus an extra unintended positive effect by the mutually shared tacit and explicit knowledge is that they can spread to other policy areas and work as moderators in other projects unrelated to Jyllinge Nordmark. If the cooperation agreements tend to develop as a practice for the cooperation in general between the two organizations, and, if executed regularly, it might become a routine knowledge asset that functions as a foundation for their continued collaboration.

The different forms of *ba* are connected to each other. The one-time dialoguing *ba* in the weekend established the project of Jylllinge Nordmark with shared tacit and explicit knowledge generating conceptual knowledge assets like a vision for the project of Jyllinge Nordmark. As a result resources were allocated to the project, thereby creating the opportunity to establish a new continuous *ba* as the coordinating weekly meetings and workshops, where further articulating and systemizing of tacit and explicit knowledge is created in order to find a solution to the climate adaptation of area. This has resulted in the cooperation agreements, in which the cooperation, financing and delegation of tasks are

made explicit and further internalized into practice. This maintains the momentum and allocation of resources for the climate adaptation projects.

The municipality recognizes that it has different knowledge assets than the utility company as they have different tasks. Despite that the expertise of the utility company is different from the expertise within the municipality (appendix 2: 5), there is a mutual respect between the two organizations with regards to their differences in professionalism; and this respect is in itself an important experiential knowledge asset for the collaboration to succeed (appendix 10: 2). It is further stressed that human factors like personality highly influences the success of the cooperation (appendix 10: 22).

What is to be Learned from the Case of Jyllinge Nordmark?

The dialectic relation between the environmental surroundings and the social reality as described in section 3.1 affirms itself in the case of Jyllinge Nordmark. Accordingly, the complexity of the physical area forces the actors to establish new cooperative frameworks and structures in order to create holistic and innovative solutions that the actors involved can be satisfied with. The cooperation between the municipality and the utility is appreciated by both organizations.

"We have learned to stick to some things and visions. To be a little bit more assertive: we need to try to go this way, and how is it we end up going that way. That has been the biggest learning process for us" (appendix 10: 17, translated by the author)

Learning processes concerning how to cooperate for more holistic solutions in climate adaptation have been achieved, thus striving for solutions that integrate the explicit knowledge of the physical environmental conditions of Jyllinge Nordmark with the experiential knowledge assets of the social structure of the citizens. This learning process is facilitated through cooperation in the contexts of *ba*. Especially the dialoguing *ba* has proven successful for information to flow between the employees in both organizations generating and coordinating ideas and solutions.

A major first step in organizing and finding new innovative solutions is to develop the general trust and respect in the collaboration process, where human relations and personality plays a role. It is realized that a fundamental part for the success of Jyllinge Nordmark is the inclusion of tacit knowledge of knowhow and social structures in the innovation process, finding specific solutions and defining the problems. It is a technical problem, but is also a management problem and a social challenge.

The process of developing a solution for Jyllinge Nordmark is still ongoing; there is no final solution yet, and the time horizon operates with implementation in 2016 (Roskilde Kommune 2014: n.p.). The utility company and the municipality work in the context of innovative processes of knowledge creation that takes time. The innovative process needs to be legitimized internally within the municipality in order to get the resources, including finance, that facilitate the process.

Furthermore, it is found that the requirements for the utilities to document their activities are extensive, and it is difficult for the secretariat to analyze whether such a project of Jyllinge Nordmark is durable, thus making the administrative documentation a challenge (appendix 10: 18).

The Jyllinge Nordmark project was started before the regulation of co-financing and has maintained this way. Instead, the two organizations rely on their cooperation agreements under the previous regulations, which they have the opportunity to do (appendix 9: 4). The utility and the municipality have found a different way in the cooperation agreements to coordinate their innovation process. They hope to be able to continue this way, even though the administrative requirements are different from those under the co-financing rules (appendix 2: 14)

Both the utility and the municipality see the separation of the organizations as facilitating the cooperation to some extent, since the two organizations are being more clear on their different roles and tasks in the cooperation of the climate adaptation projects, in spite of the process becoming more circumstantial and resource intensive administratively (appendix 11: 19; appendix 2: 3).

6.4.2 Gladsaxe – Gyngemosen

Gladsaxe Municipality has been challenged by flooded basements due to the increased precipitation patterns since 2009. The eastern hydrological catchment area for the bog Gyngemosen was collectively sewaged with rain water and waste water. However, it turned insufficient when the increased frequency of cloudbursts loaded the sewers (Grontmij 2012: 5). Citizens increasingly contacted the municipality as well as the utility company asking about plans for future solutions (appendix 12: 1, 2).

The political adoption of a new sewage plan coincided with the heavy rainfall incident of 2011 (Figure 5), thus the draft to the sewage plan was evaluated in the light of urgency for finding solutions to the climate changes. The local politicians' reaction to citizens' querying resulted in the final sewage plan, which included various political instruments for climate adaptation (appendix 12: 1). It highlighted separate sewerage from roads while using the rainwater for recreational values, and a continuation of the already implemented economic incentives for house owners and land owners to discharge water locally (Gladsaxe Kommune 2011: 3).

The projects on climate adaptation in the Eastern catchment area for Gyngemosen took place prior to the adoption of the co-financing rules, and have been an autonomous process, in which one idea has led to another (appendix 13: 1, 2). Since the initial problems in 2009-2011 a larger climate adaptation project integrating five smaller sub-projects with each other has been developed. Underlying the project is the general idea of delaying the water flow and simultaneously creating amenities in areas that were favorable for the municipality in relation to their interests (Nordvand n.d.*a*: online).

The Knowledge Creation Process

Reactions to the heavy rain incidents and the experience of limitations to the physical sewage infrastructures initiated political reactions in the administration of Gladsaxe municipality similar to those at the national level (section 5.2.3). This consolidated a momentum on climate adaptation of the

political subsystem at the local level. The political instruments adopted by the local authorities align with the *secondary beliefs* of the Water Sensitive Cities belief system.

The cooperation between the municipality and the utility on climate adaptation has developed since the incidents of 2011, and now it operates at three administrative levels. First of all the collaboration on the specific climate adaptation projects is assigned to a project leader from each organization working continuously together on realizing the projects. This is a common way of establishing communication among the two organizations (appendix 8: 7) facilitated by a *dialoguing ba* similar to the weekly meetings in the case of Jyllinge Nordmark. This secures a flow of information in the process and continuous mutually sharing of tacit and explicit knowledge in the cooperation.

Then there are recurrent meetings between the administrative leaders of the utility company and the municipality, which can be characterized most of all as an *originating ba*. The continuous socializing process between the heads of administration maintains experiential knowledge assets including trust and openness for new climate adaptation projects, which moderate the cooperation and mutual understanding of each other. This is expressed in the following quote:

"Our technical director and the director of the utility have good relation, so they trust each other and are open to each other's agendas. So in one way or the other it is founded at the very top of the system. Openness about it, and they are open to contradictions and strategies, and what we want to obtain by climate adaptation. And we are open to the limitation in relation to their financial scope as a utility." (appendix 12: 7, translated by the author)

Finally, after the rain incidents of 2011 the municipality established a working group on climate adaptation with representatives from different departments within the municipality and an employee from the utility (appendix 12: 7). The municipal working group on climate adaptation can also be characterized as a *dialoguing ba*, which has developed a conceptual knowledge asset on the common approach to climate adaptation across the different focus areas within the municipality.

The challenges of combining knowledge from different departmental areas are not so much between the utility company and the municipality as well as within the municipality's different departments. The working group has received essential resources and enjoyed backing from the politicians as well as the local administrative leaders in the municipality in their work for building and maintaining the conceptual knowledge asset of a broader vision for climate adaption in the municipality (appendix 12: 3).

During the climate adaptation projects new tacit knowledge and knowhow is generated, when explicit knowledge is internalized in the practice of implementation. An imaginary checklist of what should/could be done or not done in the different projects subsequently functions as a knowledge foundation for the next projects (appendix 12: 6).

With regards to the five sub-projects, the above ground solutions were initially mainly promoted by an enthusiastic employee at the utility, as it was prior to the organizational establishment of the other *ba*. A *dialoguing ba* can be identified when the employee invited himself for coffee at the municipality in the department for roads, where he had good personal relations to an employee (appendix 13: 2), thus the contact was based on experiential knowledge assets of trust. He presented the idea that when separating the rainwater from the waste water, the former could be handled above ground. This would prevent the utility from having large expenses to underground basins as was the original plan (appendix 13: 1). Instead it could be combined with the municipal interests of urban recreational values. A further informal *dialoguing ba* between the relevant actors was established (appendix 12: 5), and the economic advantages were explored; as long as the "alternative" solution compared to the "traditional" underground solution was cheaper, it would be beneficial for both parties (Realdania 2013: online). Among other things the process resulted in a water pathway that delay the water flow in continuous basins while creating recreational value alongside a secure cycle pathway for kids biking to and from school (Nordvand n.d.*b*: online)

The importance of the continued *dialogue* between the utility and the municipality plays a central role in maintaining the already existing tacit knowledge assets shared by the two organizations. This practice is evident from the fact that the sewage plan was developed together in close collaboration (appendix 13: 2). This certain culture of close cooperation between key actors can be analyzed as *routine* knowledge assets manifested in practice.

Throughout the work with especially the water pathway along the bike lane explicit knowledge assets have been combined. The environmental specialists in the municipality have been concerned about the discharge of the water, worrying which wet areas the rainwater would affect, and what type of water would percolate to the groundwater (appendix 12: 3). Further analysis has shown that water from roads may contain heavy metals, oil and tar substances. These can be removed relatively easily, but during winter when the road is salted, the increased salt content might reach the groundwater. Thus until now the rain water from the water pathway ends up in the sewers during the time of year when the salt content is too high. Two projects have been started from this dilemma, one cross municipal working group that focuses on alternative ways to combat slippery roads; and another that examines how the mix of the rainwater from the residential area Marielyst can be mixed with the salty waters from the roads (Gladsaxe Kommune 2013: 5-6). Thus a combination of projects has generated a new knowledge learning spiral.

The citizens living in Marielyst need to separate their rainwater as well. It was founded on the idea that the economic incentive for the citizens to percolate their own rainwater is to reimburse the connection fee for being attached to the sewage system. An *originating* and a *dialoguing ba* were established with the residents of the area in the workshop with the citizens, the municipality and the utility. Not only the fundamental socializing process was establish with the outcome of experiential knowledge assets, but similarly a conceptual knowledge asset of a clear delegation of tasks was decided upon (Klikovand n.d.*b*: online).

The increased *dialoguing ba* between the Traffic Department and the utility has resulted in tacit knowledge asset of practical processes in cooperation and mutual trust. These knowledge assets have been functioning as moderators in other projects; e.g. new roads are equipped with rain beds instead of speedbumps (appendix 13: 6). Thus the knowledge assets are spreading through the *dialoguing ba* among the actors, where ideas and tried out knowledge are implemented in similar projects. It is also spreading through the *exercising ba*, where the establishment of the water pathway could be combined with the climate adaptation project in Marielyst. This consequently stimulates the establishment of new *originating* and *dialoguing ba*.

Willingness, Collaboration and Regulation

The tacit knowledge of trust and mutual understanding of each other's agendas have proven essential for the establishment of the new projects, with informal meetings of *originating* and *dialoguing ba* facilitating the exchange of ideas. This mutually shared tacit knowledge in the form of experiential and routine knowledge assets have been maintained during the process of collective production of the sewage plan. However, the cooperation between the Traffic Department and the utility has been new, stretching over previous administrative borders created learning processes, where merging ideas has proven beneficial, as described in the following quote:

"And then you start to talk together, because the different disciplines always think in different solutions, but when you talk, then it is often that two plus two make at least five, right." (appendix 13: 1, translated by the author).

In the process of establishing a climate adaptation agenda, it has been fundamental that the administrative leaders have prioritized and supported the process, which has resulted in the establishment of the climate adaptation work group internally in the municipality underpinning the continuous focus on climate adaptation and secure maintenance of routine knowledge assets of thinking across traditional administrative boundaries, also internally in the municipality (appendix 12: 3).

It was emphasized that the personal willingness to carry through the projects has been the reason for its success. The process has been dominated by the belief that there is a solution and a commitment to try new things. If the people cooperating around the five projects in Gyngemosen had been someone else, the same regulations might have hindered that process of reaching as far as it has (appendix 13: 2).

This sense of commitment might be challenged in the future if the budgets of the municipality and the utilities are being rationalized. Then the flexibility and willingness to collaborate will decrease as the financial scope is limited (appendix 13: 13). The five projects in Gyngemosen increased the operating costs for the utility which was financed by a small surplus before reaching the price cap (appendix 13: 11). Such a trend of increasing operative costs are expected by the utility with the growing need to handle risks of flooding due to climate change (appendix 13: 10, 13).

This can be analyzed as a practical worry that in the future the two belief systems of Water Sensitive Cities and Economic Efficiency might collide further. Innovative solutions might increase the overall

operational costs but simultaneously be socio-economically beneficial in relation to climate adaption and amenity values.

6.4.3 The Knowledge Creation and Learning Process in Two Municipalities

Similar to the national administrative level the local environmental conditions and social context initiate a local political reaction, with new solutions for dealing with climate changes being sought in the establishment of different *ba*. These are mainly found to be characterized as *socializing* and *dialoguing ba*. In order for the cooperation to function in the *ba*, the experiential knowledge assets of trust and understanding are found essential as moderators. The mutually shared tacit knowledge is continuously being "cultivated" in the different *ba*, simultaneously in the collaboration on the sewage plan. Even though this opposes the clear division of the financial means and political ends, both organizations find this interaction necessary for fruitful collaboration.

A systematic evaluation of the climate adaptation projects has not been identified in either of the municipalities. *"There is no evaluation processes in that way, there is almost always no money for that"* (appendix 10: 22). However, both municipalities emphasized that it was a learning process, where the evaluation was more implicit in their work habits, e.g. in the case of Gladsaxe they operate with an imaginary checklist formed by previous experience. Thus a systematic gathering of knowledge assets internally in the municipalities or across municipalities facilitated by a *dialoging ba* or a *systemizing ba* with the goal of further developing climate adaptation projects is not prioritized.

The climate adaptation work with Marielyst and the inclusion of citizens are in stark contrast to that of Jyllinge Nordmark. Since the area is not collectively seweraged. Roskilde municipality does not have the same opportunity to reimburse the citizens. In the end it will be the citizens who will have to finance the majority of the solution for the area in which securing against storm surge and handling of rainwater are correlated.

In the example from Gladsaxe the belief systems of Water Sensitive Cities and Economic Efficiency are combined, which has been beneficial for all involved actors. However, in the case of Jyllinge Nordmark the complexity of the hydrological area and the social situation forces the municipality and the utility to enter uncharted territory, and the costs of the solution to the case of Jyllinge Nordmark is unidentified. Such complexity further requires administrative resources both from the municipality and the utility. These resources are to be financed within the current budget of the utility and the municipality, which are both subject to secondary beliefs of Economic Efficiency regulating the taxes and the tariffs. However, the implementation of the final project will eventually be financed by the residents in the area; if they are incapable of this they will have to be supported by the municipality.

The knowledge creation process has been dependent on political support for resources to finance the process. However, it can be difficult to know prior to or during the process what the final outcome or economic gain is going to be for a climate adaptation project. A certain financial buffer is necessary for the actors to collaborate on development projects. This might prove incompatible in the long run with

the benchmarking model of the Utility Secretariat and a strict Economic Efficiency implementation directing the development of taxes.

6.5 How Learning Processes Influence Policy Change

It is difficult to document a relation between learning processes and policy change (Weible et al. 2009: 131). However, the analysis will be rounded off by combining the insight from the first part of the analysis investigating the first sub-question with the second part of the analysis examining the second sub-question. Within this combination lies the insight to answer the last sub-question on how local experience and learning processes can foster policy change. These dynamics are sought illustrated in Figure 8.

In relation to ACF the policy subsystem of climate adaptation has been identified as a consequence of the external climate change events fostering a greater focus on securing urban areas against future climate change. Similarly the local weather incidents have initiated local responses in the municipalities.

The three identified belief systems facilitate the analysis of the dynamics within the policy subsystem (they are depicted in the top of Figure 8). They have been identified to influence the regulation and the cooperation between the utility and the municipality, the two organizations being accountable for implementing the adaptation projects, which the municipality decides upon in its climate adaptation plan. Historically, the Hygienic Technology belief system has led to a municipal management of the sewers, in which the technological standards and engineering solutions dominate. The Economic Efficiency belief system, however, introduces "artificial" *competition* through the benchmarking as an essential element in the development and the innovation advances of the water sector. This subsequently leads to a separation of political ends and financial and operative means, which has caused the establishment of the utility companies.

With the introduction of the Water Sensitive Cities belief system, these trends are interrupted by the predominating secondary belief of cross-sectorial *cooperation* between the municipality and the utility as well as local stakeholders. The emphasis on both competition and cooperation is illustrated in the field of interaction and organization in the center of Figure 8. The current two-dimensional political regulation trying to combine the belief systems of Water Sensitive Cities and Economic Efficiency has been found to both facilitate and counteract the local climate adaptation projects illustrated in the following quote:

"Well, most people would say: now we have been separated, and then we have been forced to collaborate again. But one could also say that the utilities have become more conscious about their identity, and in that way maybe be more ready to cooperate with the municipality and have requirements, so you secure a division of what is to be financed by the tariffs and what should not be financed by the tariffs." (appendix 9: 1, translated by author).

This interpretation is found in the municipalities as well as the utilities, where a precision of the different roles has been appreciated to a certain degree by both the municipalities and the utilities (appendix 11: 19; appendix 2: 3).

Alongside the political goals of promoting cooperation between the utilities and municipalities as well as competition among utilities, the presence of three belief systems subsequently creates *conflict* between the political goals in the implementation (see Figure 8). The first conflict emerges between the belief systems of Hygienic Technology and Water Sensitive Cities, where traditional pipe and water sewage solutions are challenged by decentralized local discharge of water, described in section 6.2.3 and illustrated in the quote of the beginning of the analysis. Primarily, this conflict can be characterized as learning processes, in which the role of the water engineers is extended in the cooperation with the urban planners and new innovative and holistic alternatives are elaborated (Fratini and Jensen 2015: 5). From the government this learning process is sought promoted by the co-financing regulation favoring the implementation of *secondary beliefs* of the Water Sensitive Cities belief system.

The second conflict arises between the belief systems of Water Sensitive Cities and Economic Efficiency, even though their respective rationales do not necessarily oppose each other. On the contrary, to some extent they can be seen as promoting each other. The new solutions are seen as more efficient and can succeed in bringing new amenity values to urban areas. The insights gained from implemented climate adaptation projects create more climate secure urban areas and are by some hoped to create a potential for exporting new technologies and solutions. However, as identified in section 6.2.2 this is not always the case, since the strict division for finance can prevent an implementation of the socio-economic optimal solution.

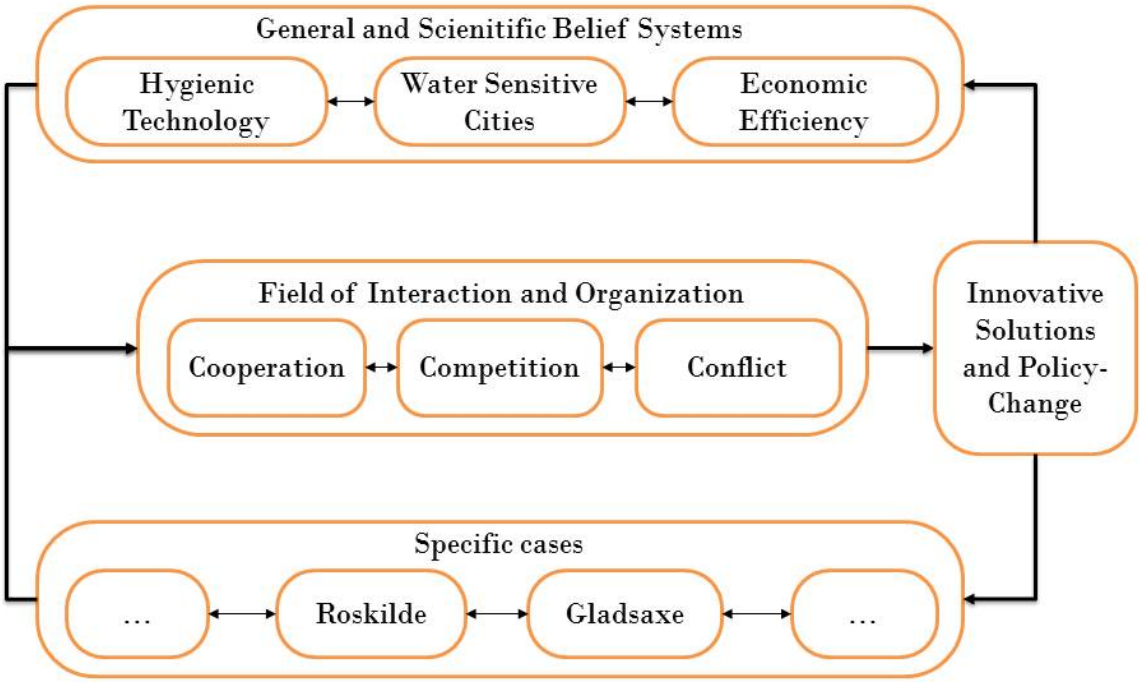

Figure 8: How learning processes foster policy change (2015)
The Figure illustrates the dynamics operating in the policy subsystem of climate adaptation. The three belief systems of hygienic technology, water sensitive cities and economic efficiency are illustrated in the top. They influence the regulation and thus the cooperation between the municipality and the utility, which is illustrated by the arrow from the belief systems to the field of interaction and organization. The specific cases are illustrated in the bottom with emphasis on the two forming the basis of the analysis. In these specific cases the administrative employees practically organize and interact as they respond to the challenge of climate adaptation, shown as the similar arrow from the bottom field to the middle field. Through the dynamics of cooperation, competition and conflict knowledge creation processes are happening producing innovative solutions and fostering policy change reflecting back to both the general belief system and the specific cases.

The local administration in the municipalities and the utilities has to balance the three dynamics that influence their collaboration processes on climate adaptation. The cases of Roskilde and Gladsaxe are shown in the bottom of Figure 8, and the arrow from the cases to the field of interaction and organization illustrates their ability to balance the three dynamics. The local environmental context initiates learning processes between the actors, which are founded primarily on the *originating* and *dialoguing ba*. Through these *ba*s, the *cooperation* between the two organizations is facilitated and new innovative solutions and climate adaptation projects are developed. However, the local contexts are mutually defined by *conflicting* local political priorities and practical conditions. As described in the case of Jyllinge Nordmark the specific social reality is a part of the problem but also a part of the solution. Additionally, conflicts between the two organizations can prove beneficial for future cooperation on climate adaptation if they are appropriately dealt with.

Furthermore, the artificial *competition* implemented as a consequence of the Economic Efficiency belief system is experienced to limit the implementation of some climate adaptation projects, since the requirements for documentation are extensive. With the continuous growing experience and knowledge

creation processes in the municipalities political pressure has emerged highlighting the challenges of the current regulation both by the utilities and the municipalities.

From the experience gained in the municipalities a growing perception in the LGDK stresses that the co-financing regulative rules are too bureaucratic (Baes-Jørgensen 2015: online). DANVA, the interest organization of the utilities, emphasizes that rules on co-financing have prevented optimal socio-economic solutions from being implemented, when the project owner is incapable of financially and organizationally support the project (DANVA 2014: online). Furthermore, DANVA suggests that the organizational and financial challenges of two organizations cooperating should be dealt with locally (DANVA 2014: online).

The solutions to the organizational challenges referred to in the two cases studies were in spite of the regulation. In the case of Jyllinge Nordmark the development of the cooperation agreements is a commencing routine knowledge asset, which does not necessarily harmonize with the co-financing regulation (appendix 2: 14). The five projects in the Eastern catchment area of Gyngemosen were owned by the utility; however, the project was initiated prior to the co-financing regulation and in spite of the Water Sector Law, in which the division of tariffs and taxes limited the ability of the utility to enter such projects. However, as the projects have received high recommendations, it is not questioned whether it was appropriate or not (appendix 13: 16).

The experience of the conflict between the two belief system of Water Sensitive Cities and Economic Efficiency is expressed in the following quote by an employee at a utility company. It is described how the ability of the municipality and the utility to participate in a continuous development and knowledge creation process on climate adaptation might be challenged by a strict implementation of the belief system of Economic Efficiency:

"One of the reasons why you went through with the reorganization [the secretion of the utility], it was that a lot of money should be saved, and then you cannot increase the costs of operation. But that is a perspective of all kept equal, that we do not change what we do, and we do that these years, because we think climate […]. I see a future problem in this, also in relation to the options we have for participating in developing projects, the closer we get to the threshold of pain, the more difficult it will be to collaborate, because both the municipalities and the utilities get less financial scope, and then both parties will start stick to their own." (appendix 13: 13).

The coming revision of the co-financing regulation and the Water Sector Law can be seen as a consequence of this political pressure generated in the learning processes and knowledge creation processes in the municipalities. However, what the political outcome and development will be is still to be seen.

These insights influence the dynamics between the belief systems of Economic Efficiency and Water Sensitive Cities that in turn influence the regulation of the area. This is shown in Figure 8 by the arrow from the field of interaction and organization to the box of 'innovative solutions and policy change';

and the arrow back to the box of 'general and scientific belief systems'. This circular movement illustrates the policy-oriented learning process within the policy subsystem, as well as the knowledge spiral between different *ba*.

6.6 What to Do Now?

This last section of the analysis will be an attempt to respond to the challenges of the current regulation presenting policy recommendations for the coming revisions of the Water Sector Law. It will be based on the aim of changing the regulation so its ability to facilitate the knowledge creation processes for developing innovative solutions is improved. This is thought to foster an efficient and effective climate adaptation process within the municipalities. On the basis of the analysis the ACF and organization learning theory bear substantial insights for these policy recommendations.

First of all, the weather events creating the momentum on climate adaptation bring an opportunity for to function as a lever for new innovation processes in the cooperation between the utilities and the municipalities.

In the case-studies it was found that too little emphasize was put on evaluating or combining explicit as well as tacit knowledge assets through evaluation processes internally as well as across municipalities (section 6.4.3). However, this is stressed as a vital element in the national strategy inspired by IPCC (section 5.2.2). The role of the middle managers in the SECI-process is emphasized in the knowledge creation process of *ba,* as they are the ones with direct contact to their environment. These middle managers correspond to the administrative employees at the utilities and the municipalities. Through an establishment of a *dialoguing ba* these employees could make their tacit as well as explicit knowledge explicit to each other and thus share their experience in the work on climate adaptation. Such process could facilitate a transmission of knowledge throughout the country.

The identification of the belief systems and their three internal dynamics of cooperation, conflict and competition shed light on the local employees' task to balance these dynamics during the implementing climate adaption projects, so they assist in finding new innovative solutions. The myopic political realities in the municipalities need to be included in the scientific development of finding innovative solutions; however, they are absent in current scientific literature from resilience thinking and other processes promoted by international organizations (see section 5.2.2 – Critique of Resilience Reasoning).

The coming evaluation of the co-financing rules and the Water Sector Law should include the practical experience of the administrative personnel and the presence of the three dynamics of cooperation, competition and conflict. The current double-sided regulation, in which a simplistic theoretical view assuming that the two belief systems of Economic Efficiency and Water Sensitive Cities are compatible, needs to be challenged. In some cases the two belief systems might enforce each other, but it cannot be assumed or taken for granted in innovative processes of climate adaptation.

The insights gained from the organizational learning theory emphasize the need for facilitating sufficient *ba* in the innovative processes for finding flexible and appropriated solutions to the climate adaptation challenge. In the application of a knowledge-creation-perspective the recognition of the fact that climate change induces uncertainty is matched by a strategic and corresponding SECI-process, in which knowledge assets continuously can be tested and revised responding to this uncertainty.

However, the knowledge creation process depends on all the four steps in the SECI-process, including an internalizing of explicit knowledge to tacit knowledge during implementation. This stresses the need for knowledge assets to be adapted to the local municipal environmental and social contexts; these contexts are as identified in the case studies also a part of the solutions. Such a strategic SECI-process further emphasizes a sufficient information flow between a national level and a municipal level facilitated by appropriate *systemizing ba*. The maintenance of such *ba* is costly, however, beneficial in the long run (Nonaka et al. 2000: 18), especially if we take the challenges of climate adaptation seriously.

Four specific and concrete recommendations to the existing *ba* can therefore, be identified:

1) Securing future organizational and financial resource to the knowledge creation process between the utility and the municipality is essential in order for them to be flexible enough to engage in development projects. It has been shown that in cases where sufficient organizational and financial capacities are maintained between the municipality and the utility, innovative processes have been implemented, however, if not innovative solutions can be prevented from being elaborated (Fratini and Jensen 2015: 10).
2) Evaluation processes within municipalities after implementing climate adaptation projects are lacking. Such processes can be facilitated by prioritizing them in the existing *dialoguing ba*. If they do not take place external facilitation can be necessary for starting such processes. The evaluation proposal could be extended and applied to cross-municipalities cooperation, where a *dialoguing ba* can be beneficial as it is exemplified in the organizational learning theory (Nonaka et al. 2000: 18-19). Thus a revitalization of Tour de Climate Adaptation might be beneficial, and existing social networks like Klikovand (voluntary cross municipal cooperation) (Klikovand n.d.*a*: online) and Water in cities could facilitate more strategic evaluation processes. Such *dialoging ba* promotes the externalization of the tacit knowledge of the administrative employees in the municipalities, who are crucial to the knowledge creation process as they are at the intersection of the horizontal and vertical organizational knowledge flow and have the ability to bridge the national climate adaptation ideas with the reality in the municipalities (Nonaka et al. 2000: 22-24).
3) The already existing online platform *klimatilpasning.dk* could improve and become a *systemizing ba* to a larger extent than it already is; i.e. evolving from being a knowledge collector and spreader to systematically and statistically analyze, compare and synthesize empirical data, qualitative as well as quantitative. The essential characteristic of *klimatilpasning.dk* is the easy and free access that secures a continuous information flow from

the municipalities and back again. If the Danish Nature Agency would see that such a *systemizing ba* as too controversial for them to maintain, an external agency like the network Water in Cities could facilitate such a database.

4) Inclusion of external knowledge assets from abroad could further be improved. In a Danish context we focus solely on water infrastructure, as opposed to cities like Toronto, where they include aspects of heat and the social implication of climate adaptation (Carmin et al. 2013: 16). This was the practice hundred years ago, where knowledge assets generated especially in contemporary England with the establishment of the sewer system, went through a policy-oriented learning process adapted to the context of Denmark aided by a sufficiently strong coalition generated efficient resources for the belief system of Hygienic Technology. Similar developments could be done concerning climate adaptation.

The three latter suggestions could help break the lock-in effects of the current knowledge assets from the Hygienic Technology belief system. Further empirical analysis on the KTF and Water in cities working habits and knowledge creating processes will be necessary to assessing how their existing *ba* could be evolved.

A critique from the Economic Efficiency belief system would highlight the large amount of resources that would go for the implementation of these suggestions. However, from the perspective of organizational learning theory such resources are worth investing in, since the additional improvements to the knowledge creation and the innovative processes in the long run will strengthen the efficiency of implementing sufficient climate adaptation solutions.

In order to secure such resources, the ACF highlights the need for a strong political coalition to actively support such *secondary belief* recommendations. Insights from the historical coalitions between doctors and engineers might prove fruitful and further mapping of current relevant actors for such a coalition could prove beneficial.

7.0 Conclusion

This thesis sets out to answer the research question: '*Why does climate adaptation as a problem create learning processes between municipalities and the utility companies and how does that foster policy change?'*. Developing a comprehensive understanding of the complex field of climate adaptation turned out to be a daunting task. However, the perspective of learning processes was more than beneficial; also with regards to the need for subsequent analysis.

From the perspective of ACF the climate change events in 2010 and 2011 are found to be external events that consolidated the policy subsystem of climate adaptation. These events initiated changes in the internal relations among actors within the policy subsystem; they triggered the launching of alternative climate adaptation projects and revealed the existence of competing general and scientific belief systems influencing the organization and implementation of new innovative practices meeting the challenge of climate change. The organizational learning theory has supported the understanding of how practical experience through implementation of climate adaptation projects in the municipalities plays an important role in identifying municipal learning processes and knowledge creation. The obstacles of maintaining and promoting such processes within the current regulative framework have led to policy changes like the co-financing regulation; and in the future it might give rise to a more fundamental revision of the Water Sector Law.

The belief systems are found to regulate the collaboration between municipalities and utilities influencing the level of conflict, cooperation and competition within the water sector. All three dynamics can facilitate the innovative processes. To a certain extent the *conflicts* originating from the division and increased independence of the utilities have proven constructive; however, the potential of disrupting beneficial *cooperation* between the organizations is evident. It often depends upon the personality in the social context whether such cooperation can function. With the implementation of the Water Sector Law, the artificial *competition* has influenced the resources of both the municipalities and the utilities; and in the future it is important for both organizations to have financial and organizational room for maneuver to actively engage in development projects.

Politically, it is important to respect the complexity of the collaboration between municipalities and utilities and their need to balance the presence of the three identified dynamics in order to master the knowledge creation process. The regulative framework is currently incoherent with regards to the belief systems of Economic Efficiency and Water Sensitive Cities. With the up-coming revision of the Water Sector Law there is an opportunity to actively rethink the regulations, so that they support the municipal innovation processes to a larger extent.

Therefore, the final recommendations given are first and foremost to facilitate in a *dialoguing ba* and subsequently a *systemizing ba* the compilation, synthesizing and analyzing of practical knowledge gained in the municipalities. Through such process the experience gained at municipal level can support the development of a more coherent regulative framework. The most obvious recommendation flowing from this thesis is to strengthen this central function.

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Pictures

- Flickr: Water background – open source, link: https://www.flickr.com/photos/evilpettingzoo42/202629810/in/photolist-iUwMq-4rpgN4-8zC5RJ-9ZXYme-hrgpEc-8xYmft-e5DNHr-qGi2CH-99Rk7a-9m5Acc-8uXsAe-avj78A-rkqGLk-9XrBTj-crXgmW-2DXmmp-ah2cL7-sc6yPd-gLQYMR-q2XChV-dbvGB6-MyDkj-911PZH-pecjNH-9m7XjD-puGrek-aF7TS3-7tnjVM-41UtrK-brhtTV-8NrpS1-6db29G-8xYnma-9NdspX-8G1rWJ-7tUMX5-cy7r9A-9cQ8v1-9oj6TU-9Y6mQK-8NnVVk-9Y6kSD-bbn7ka-azHnQk-kLYDcT-7HZSPE-6N1w7J-8ArTAS-7TJyMZ-9XY4Si

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9.0 Appendix

In the following the appendices are divided so that the interview guides are shown first, subsequently notes from non-transcribed interviews (the one from Roskilde Municipality is referred to as notes in the interview guide). Finally the transcribed interviews are gathered in the end (however not available in the online publication, however, with exception of the condensed descriptions).

9.1 Interview Guides

Appendix 1: Roskilde Water Utility

Theoretical components	Questions
External events	Hvad var det som fik gang i Jyllinge Nordmark klimatilpasningsprojekt?
Belief systems	Hvad synes du har været nøgleudfordringen i Jyllinge Nordmark Klimatilpasningsprojekt?
	Hvilke fordele kunne I på det tidspunkt se ved at arbejde sammen? (Eftersom oversvømmelser i området giver afledte driftsomkostninger på spildevandssystemet, er Roskilde Forsyning interesseret i at deltage i klimatilpasning) Hvilke udfordringer har du set der har været i samarbejdet mellem jer og kommunen?
	Hvilke organisatoriske beslutninger stødte I hovedsageligt på i samarbejdsprocessen? Eksempelvis, hvordan blev I enige om - Hvem finansierer projektet? Hvordan ser den økonomiske byrdefordeling ud nu? (Råmosegrøfterne og fælles pumpelag) - Hvor langt er I i forhold til at vurdere om der skal etableres en fælles offentlig regnvandsafledning? - Hvem er projektejer for klimatilpasningsprojekterne? - Hvem tager sig af driften efterfølgende? (Kommunen tager sig af driften ad pumperne).
	Hvilke kompetenceforskelle har der været hos kommune og forsyning – hvordan har I håndteret det?
	Hvordan har de politiske krav oppe fra indvirket på forløbet? - Politiske krav (klimatilpasningsplan, medfinansiering) - Effektiviseringskrav (den årlige benchmarking)?
Learning processes	Hvem var initiativtageren bag projektet? Hvem etablerede kontakten imellem jer og kommunen?

	Hvordan etableredes samarbejdet med Roskilde kommune? Hvordan blev det formelt organiseret? Blev der nedsat en projektgruppe og styregruppe?
	Hvordan vil du beskrive hele den samarbejdsproces der har forløbet mellem jer og kommunen under klimatilpasningsprojektet? Hvad har været kendetegnende for det?
	Blev der afholdt indledende møder: - sammen, hver for sig? - Ændrede strukturen sig på de møder undervejs?
	Hvordan kommunikerede I mellem møderne? Hvem referer tilbage?
	Ændrede begrundelsen sig for klimatilpasningsprojektet undervejs, eller kommer der flere argumenter til løbende? Fandt I frem til de argumenter sammen?
	Er der opstået forsinkelser i processen? Hvad skyldtes de?
Knowledge assets	Hvilke fordele ved samarbejdet om Jyllinge Nordmark er blevet realiseret synes du? Er der nogle fordele I så tidligere, som ikke er blevet realiseret?
	Ville I være gået anderledes til samarbejdet med den erfaring I har nu? Der er en klar ejerstrategi i handleplanen – hvilken proces ligger forud for den: *"Efter at forsyningsområdet er omdannet til aktieselskaber, har kommunen afgivet sin direkte indflydelse på forvaltning af spildevandsforsyningen. Imidlertid er byrådet eneejer af selskabet, så byrådets ejerstrategi for samarbejdet mellem kommune og forsyning sikrer, at kommunens almennyttige interesser også bliver varetaget gennem tæt dialog og samarbejde. Byrådet godkendte ejerstrategien i foråret 2011, og strategien er et vigtigt omdrejningspunkt for samarbejdet."*
	Har I foretaget opfølgende evalueringsprocesser til fremtidige projekter?
Pressure from the municipalities	Hvilke forandringer vil I gerne se i forhold til medfinansieringsreglerne?

Appendix 2: Roskilde Municipality

Theoretical components	Questions	Notes	Meaning units
External events	1) Hvad var det som fik gang i Jyllinge Nordmark klimatilpasningsprojekt?	Pres fra borgerne Stormfloden i 2013 ca.	Local context
Belief systems	2) Hvad synes du har været nøgleudfordringen i Jyllinge Nordmark Klimatilpasningsprojekt?	Vi ejer jo ikke noget derude, som sådan, det er jo ejerne selv der skal stå for nedsivningen af regnvandet. Lige nu er der fokus på stormfloden, selvom det på den lange bane helt sikkert ligger mere i at skulle håndtere regnvandet.	The citizens original problem from the old rules Rainwater and flooding
	3) Hvilke fordele kunne I se i begyndelsen se ved at arbejde sammen? Hvilke udfordringer har du set der har været i samarbejdet mellem jer og forsyningen?	Det var selvindlysende, at det var en fælles opgave. Der er selvfølgelig en udfordring at arbejde sammen som to organisationer, og det gør samarbejdet vanskeligere og mere omstændeligt med to organisationer. Men hvis man skal se positivt på udskillelsen, så er det også en fordel i at man bliver skarpere på hvad det er man vil have, og til at forstå hinanden, da man bliver tvunget til det.	Self-evident A challenge to cooperate cross-organizational, but more identity
	4) Hvilke organisatoriske beslutninger har været centrale i samarbejdsprocessen hvem gør hvad, og hvem finansierer hvad? Eksempelvis, hvordan blev I enige om - Hvem finansierer	Jeg ved der har været nogle kampe mellem forsyning og kommunen, hvor kommunen har lagt arm med forsyningen. Jeg har på den måde ikke selv været inde over, men jeg ved der har været noget med det. Nu har det nok også været nemmere at finde midlerne til det eftersom vi er en velhavende kommune. I forhold til det projekt med de to pumper vi havde, så var det hovedsageligt i den ene at forsyningen havde problemer, så det var dem der	Confrontations, disagreements Wealthy municipality Knowledge assets from experience

	projektet? Hvordan ser den økonomiske byrdefordeling ud nu? (Råmosegrøfterne og fælles pumpelag)	finansierede den, og så finansierede vi den anden.	
	5) Hvilke kompetenceforskelle har der været hos kommune og forsyning – hvordan har I håndteret det?	Der er jo helt sikkert forskelle i vores kompetencer, og det skal der også helst være, de er gode til det tekniske, og vi kan mere det holistiske. Det har givet nogle knaster, men vi er gode til at forstå hinandens verdner, interesser og finde en god løsning på det.	Asymmetry in competences, but good respect and mutual understanding
	6) Hvordan har de politiske krav oppe fra indvirket på forløbet? - Effektiviseringskrav (den årlige benchmarking)? - Politiske krav fra lokale politikere og nationale politikere	I forhold til det politiske, så ved jeg ikke om det har været på det niveau endnu. Men der kom jo krav om klimatilpasning, men der havde vi allerede været i gang med Jyllinge Nordmark.	Prior to co-financing regulation
Learning processes	7) Hvem var initiativtageren bag projektet? Hvem etablerede kontakten imellem jer og kommunen? Hvordan etableredes samarbejdet med Roskilde forsyning? Hvordan blev det formelt organiseret?	Jamen det var kommunen, som tog initiativet, og startede projektet og inddrog forsyningen Vi havde den der weekend, hvor direktøren også var med, og der var en facilitator udefra, som sørgede for processen. Det var to fra forsyningen og mig og min kollega fra vej og park, og så ham fra Orbicon. Og der kan man sige, var det nødvendigt? men det tror jeg faktisk at det var. Så blev det jo formaliseret gennem handleplanen etc. Og i aftaleformen	Municipality started the process Originating and dialoguing Facilitated *ba* necessary Dialoguing

		Så har der været en periode, hvor der ikke har været så meget kontakt, og det har hjulpet med den daglige kontakt der så har været om jyllinge nordmark, som har genetableret noget af den samme forståelse for samarbejdet om klima.	JNM resulted in revival of *ba*
	8) Hvordan vil du beskrive den samarbejdsproces der har forløbet mellem jer og kommunen under klimatilpasningsprojektet? Hvad har været kendetegnende for det?	Vi har de der ugentlige møder om Jyllinge Nordmark, hvor forsyningen er med inde over, og det har gjort at vi får kan koordinere også i forhold til digeprojektet.	Weekly *ba* Systemizing and dialoguing
	9) Hvordan kommuniker I imellem møderne? Hvem referer tilbage?	Jamen der er en meget uformel kontakt, vi tager bare telefonen eller mailer til hinanden alt efter som vi har behov for det. Det gør at vi ikke først skal igennem en chef og det gør det hele meget mindre kompliceret.	Informal trust, not much bureaucracy
	10) Ændrede begrundelsen sig for klimatilpasningsprojektet undervejs, eller kommer der flere argumenter til løbende? Fandt I frem til de argumenter sammen?	Det har været en løbende proces, så vi lærer hen ad vejen. Når jeg sidder med vejloven f.eks. så giver det mening at projektet ikke bare handler om en cykelsti, men at man også kan tænke regnvand indover.	Dynamic knowledge process, assets gained in a flow *Ba* and knowledge assets spreading to other areas
Knowledge assets	11) Hvilke fordele ved samarbejdet om Jyllinge Nordmark er blevet realiseret synes du? Er der nogle fordele	Det er meget givende at forsyningen går ind og er med til at lave rundespørge blandt borgerne og kortlægge de problemer, som der er. De giver mig nogle oplysninger, som jeg ellers ikke ville have haft adgang til, at de tænker det med i processen. Jamen, vi får ved hjælp af den løbende kontakt	Utility take responsibility, challenging old roles and established rules Dialoguing

	I så tidligere, som ikke er blevet realiseret?	klappet nogle ting af inden de kunne blive opfattet som et problem, så vi får samme forståelse af hvor det er vi skal hen, og hvilke konsekvenser vores handlinger kan have for den anden part.	Weakly Originating *ba* → No unintended conflicts and better projects
	12) Ville I være gået anderledes til samarbejdet med den erfaring I har nu?	Altså det var en genistreg at vi satte os ned og tog på den der weekendophold Vi har også været i Paris sammen Det har gjort at forsyning og kommune har kunnet række udover deres egne opgaver og vi har kunnet finde nogle andre løsninger.	Genious to emphasize the socializing
	13) Har I foretaget opfølgende evalueringsprocesser til fremtidige projekter?	Evaluering af trin 1 & 2 i løbet af 2015…	On going process
Pressure from the municipalities	14) Hvilke forandringer vil I gerne se i forhold til medfinansieringsreglerne?	*M2 og M3* Hvis vi kan få lov til at fortsætte som vi har gjort det, så er det jo fint, det er jo som sådan ikke noget der er vedtaget eller bekræftet nogen steder fra, hverken over byrådet eller ved forsyningssekretariatet. De samarbejdsaftaler lever ikke op til de krav der er i medfinansieringsreglerne. Der bliver noget med hvem der er projektejer og projektejerskabet. Medfinansieringen bliver opfattet som meget bureaukratisk, og det gør at alle har opgivet at bruge det undtagen de store kommuner, der har kræfterne til det. Der er helt sikker nogle interessekonflikter imellem os og forsyningen, de har nogle andre interesser og kan netop sige hvortil de vil finansiere og ikke mere. Så længe vandet ikke løber ned i kloakken, så er det ikke vores problem. *M1*: Det tror jeg helt bestemt at det er et problem for nogle kommuner rundt omkring, hvor forsyningen og kommunen ikke har en særlig	No registration of the *ba*, routines they want to continue Project owner problem Too bureaucratic Interest conflicts Old thinking: rigid structure The need for

		god dialog, men jeg håber at det går bedre med det. *M2 & M3:* Det var helt nødvendigt at Roskilde forsyning havde en interesse i at deres vakuumsystem ikke skulle oversvømmes, så kunne vi alle gå til opgaven, og vi var derfor to ligeværdige partnere, der indgik et projekt og aftaler sammen. Der ligger noget i **afbetalingstiden** på lånene i vandsektorloven, den blev så ændret så det harmoniserede med resten. Fra de 25 til 40årige låneperioder. Samtidig med **investeringsreglerne**, man skal jo også betale for de miljømæssige effekter, og der skal være mulighed for at lave de projekter, som giver mening på langsigt, muligvis skal forsyningen lægge nogle penge ned nu, men i det store billede, er der jo også andre ting der spiller ind… Udskillelsen af vandselskaberne var en ideologisk kamp, som der er stort opbakning til i Folketinget, så den bliver nok ikke ændret. Det er jo ærgeligt, for det forhindre de gode løsninger, hvis man ikke har et givende samarbejde. Miljøomkostningerne bliver jo ikke regnet med i deres modeller.	dialoguing The importance of the vacuum Equal partners Too much economic efficiency can hinder the long-term solutions The separation has complicated the cooperation

Appendix 3: Orbicon, a Consulting Company

Theoretical components	**Questions**
External events	Hvad var det som fik gang i Jyllinge Nordmark klimatilpasningsprojekt?
Belief systems	Hvem var initiativtageren bag projektet? Hvem etablerede den uformelle kontakt Hvad synes du har været nøgleudfordringen og fordelen i samarbejdet om Jyllinge Nordmark Klimatilpasningsprojekt?
	Hvilke fordele kunne de hver især se ved at arbejde sammen? Lå det i kortene at det skulle være et samarbejde?

	Hvad var din rolle i samarbejdet om klimatilpasningsprojektet: Jyllinge Nordmark?
	Hvad er din oplevelse af de organisatoriske beslutninger, var der uenighed om hvad man ville og hvilke rammer det skulle foregå under? Eksempelvis, - Hvem finansierer det? Hvordan relaterer det sig til medfinansieringsordningen? - Hvem er projektejer? - Hvem tager sig af driften efterfølgende? Er der overensstemmelse mellem målsætningen og de organisatoriske rammer?
	Hvilke kompetenceforskelle har der været hos kommune og forsyning – hvordan har de håndteret det?
	Er der noget som har været udfordrende ved samarbejdet i løbet af processen? Og hvordan håndterede i eventuelle uenigheder? - Politiske krav (klimatilpasningsplan, medfinansiering) - Effektiviseringskrav (den årlige benchmarking)? - Hvordan har I arbejdet med ansvaret for at regnvandet skulle kunne bruges i børnenes leg?
Learning processes	Hvordan etableredes samarbejdet? Blev der nedsat en projektgruppe og styregruppe? Hvordan blev det formalt organiseret?
	Hvor tit var du en del af de møder, der blev afholdt? Hvordan blev din ekspertise brug i samarbejdet?
	Er der opstået forsinkelser i processen? Hvad skyldtes de?
Knowledge assets	Hvilke fordele er blevet realiseret?
	Hvordan kunne man være gået anderledes til samarbejdet med den erfaring man har nu?
	Er der foretaget opfølgende evalueringsprocesser til fremtidige projekter?
Pressure from the municipalities	Hvilke forandringer forhold til medfinansieringsreglerne kunne du se vil gaven samarbejdet?

Appendix 4: Nordvand Water Utility

Theoretical components	Questions
External events	Hvad var det som fik gang i Idrætsparken og HøjeGladsaxe?
Belief systems	Hvad synes du har været nøgleudfordringen i de projekter?
	Hvilke fordele kunne I på det tidspunkt se ved at arbejde sammen? Hvilke udfordringer har du set der har været i samarbejdet mellem jer og kommunen?
	Hvilke organisatoriske beslutninger stødte I hovedsageligt på i samarbejdsprocessen? Eksempelvis, hvordan blev I enige om - Hvem finansierer projektet? Hvordan ser den økonomiske byrdefordeling ud nu? - Hvem er projektejer for klimatilpasningsprojekterne? - Hvem tager sig af driften efterfølgende?
	Hvilke kompetenceforskelle har der været hos kommune og forsyning – hvordan har I håndteret det?
	Hvordan har de politiske krav oppe fra indvirket på forløbet? - Politiske krav (klimatilpasningsplan, medfinansiering) – opbakning fra lokalpolitikerne? - Effektiviseringskrav (den årlige benchmarking)? Har i oplevet det som begrænsende i forhold til hvad I måtte bruge penge på i disse projekter? - Hvordan oplever I at dokumentationskrav i forhold til forsyningssekretariatet fordrer eller udfordrer jeres arbejde med klimatilpasningsprojekterne?
Learning processes	Hvem var initiativtageren bag projektet? Hvem etablerede kontakten imellem jer og kommunen? Hvordan etableredes samarbejdet med Gladsaxe kommune? Hvordan blev det formelt organiseret? Blev der nedsat en projektgruppe og styregruppe?
	Hvordan vil du beskrive den konkrete samarbejdsproces der har forløbet mellem jer og kommunen under klimatilpasningsprojektet? Hvad har været kendetegnende for det?

Appendix 5: Gladsaxe Municipality

Theoretical components	Questions
Identifying the external events	Hvad var det som gjorde at I startede på klimatilpasningsprojektet i Gladsaxe?
Identification of belief systems	Hvem var initiativtageren bag projektet?
	Hvilke fordele kunne I på det tidspunkt se ved at arbejde sammen? Synergi-effekter i den konkrete kontekst?
	Hvilke organisatoriske beslutninger stødte I hovedsageligt på i samarbejdsprocessen? Eksempelvis, hvordan blev I enige om - Hvem finansierer det? - Hvem er projektejer? - Hvem tager sig af driften efterfølgende?
	Hvilke kompetenceforskelle har der været hos kommune og forsyning – hvordan har I håndteret det?
	Er der noget som har været udfordrende ved samarbejdet i løbet af processen? Og hvordan håndterede i eventuelle uenigheder? - Politiske krav (klimatilpasningsplan, medfinansiering) - effektiviseringskrav (den årlige benchmarking)? - Hvordan har I arbejdet med ansvaret for at regnvandet skulle kunne bruges i børnenes leg?
Identifying learning processes	Hvordan etableredes samarbejdet med forsyningsselskabet?
	Hvordan vil du beskrive hele den samarbejdsproces der har forløbet mellem jer og forsyningsselskabet under klimatilpasningsprojektet? Hvad har været kendetegnende for det?
	Hvilken rolle spillede Vandplus som medspiller i forhold til idrætsparken?
	Blev der afholdt indledende møder: - sammen, hver for sig? - Ændrede strukturen sig på de møder undervejs?
	Hvordan kommunikerede I mellem møderne? Hvem referede tilbage?

Appendix 6: Danish Nature Agency

Vandsektorloven, udskillelsen af forsyningen, og det faktum at det er kommune og forsyning som skal samarbejde:

- Hvor ser I at det understøtter klimatilpasningsprojekterne?
- Hvor ser I at det udfordrer samarbejdet om klimatilpasningsprojekterne?

Hvad var årsagen *ifølge jer* til at man lavede medfinansieringsbekendtgørelsen i sin tid? Hvordan oplevede I processen op til?

Hvordan oplever I sammenspillet mellem vandsektorlovens tilblivelse og det politiske ønske om at realisere de synergieffekter der kan opstå i klimatilpasningsprojekterne ved at opnå rekreative elementer og samtidig løse problemerne med de stigende vandmængder? Hvordan påvirker de to dagsordner hinanden?

Nogle kommuner og forsyninger oplever selve ansøgningsprocessen til medfinansieringen som meget bureaukratisk. Ville det være muligt at forenkle processen og dokumentationskravet for kommunerne og forsyningerne, og på den anden side sørge for at pengene fra vandtaksterne går til det som er politisk bestemt?

Mit indtryk er at indtil videre vælger nogle kommuner og forsyninger at gå uden om medfinansieringsaftalen og så finder de en egen måde at gøre det på. Hvad er jeres oplevelse af det?

Det at forsyningen kun kan finansiere 75 % af klimatilpasningsprojekterne med kommunen, som blev udskudt og som nu træder i kraft efter jan. 2016. Hvordan ser I at det vil påvirke investeringsniveauet fremover?

Hvilket pres har I oplevet fra Kommuner og Forsyninger i forhold til medfinansieringsaftalen?

Det indtryk jeg har fået er at både kommune og forsyning ser en udfordring i at ejerskabet af klimatilpasningsprojekterne skal tilfalde kommunen, da det er forsyningen der står for udgifterne og i stort omfang selve driften. Hvilke udfordringer eller muligheder ser I til at finde alternativer til hvem der er "projektejer" eks. delt projektejerskab?

9.2 Notes from Non-transcribed Interviews

Appendix 7: Researcher at AAU

Gengivelse af de temaer, der blev drøftet:

Klimatilpasningsdagsordenen kom oprindeligt fra politikerne, og sådan som jeg ser det, så er agendaen i dag meget præget af at initiativerne kommer fra spildevandsverdenen (du kan slå op under vand i byer-netværket): DTU-miljø, DANVA, Landbohøjskolen og de kommer alle sammen fra en teknisk verden, som taler et bestemt sprog. De har derfor svært ved at nå ud til byplanlæggeren og den sociale forvaltning.

Det er helt evident at den offentlige sektor er præget af silotænkning. Der har eksisteret nogle kontrolregimer i vandsektoren, som var gode til at løse modernismens problemstillinger. Det har skabt en professionalisme inden for siloerne. Men i det øjeblik at man løfter byen under byen op på overfladen, så støder de forskellige professionalismer sammen. Når vandet der før blev håndteret i de store rør under jorden, pludselig skal være en del af byrummene. Det relaterer sig til at pludselig skal man til at skabe ikke bare 'innovation of place' men 'innovation of multifunctions'.

Denne udfordring betyder selvfølgelig ikke at man skal annullere alle de gode ting, som moderniseringen førte med sig.

Eksempler, som det er værd at kigge på: Roskilde (Jyllinge Nordmark), Skt Kjells plads, Brøndby, Gentofte, Fredensborg, Solrød og Egedal.

9.3 Transcribed Interviews

Appendix 8: Employed at Vandplus

The condensed description

1) The utilities still have the option of not cooperating under the co-financing regulation, since they imply organizational challenges with regards to utilities not project owners and they are the once putting down lots of resources. Thus doing climate adaptation without the co-financing the utilities become the project owner, but can lead to the implementation of old solutions. Furthermore, the co-financing rules are rigid and inflexible regulation.
2) The recreational aspect costs little compared to the expenses paid by the utilities, and the decentralized solution are often much cheaper, thus the utilities can save a lot of money. This has been a priority with the separation of the utility companies, since they have to defend annually their expenses in relation to the benchmarking model. It complicates things even more that the two organizations have different time perspectives in investment years, and different traditions for applying for money.
3) The law of co-financing might be revised in order secure more flexible finance application processes and in order to find a solution to the project owner problem. If the utility can make a

project better and cheaper compared to a traditional solution, but cannot finance the whole project because it is not allowed to do so as the extra costs are solely recreational value, and the municipality can't finance it either since they are low of money, then the utility will end up losing the money.

4) However, on the other hand, the money shouldn't be used on things that are of no benefit for the utility company. Thee typographical foundation needs to decide whether it makes sense for the utility companies.
5) The climate adaptation project needs to make sense for the municipality as well as the utility. It creates generally two types of challenges in the process and the meaning creation. The former relates to the challenges of (1) Project ownership, (2) financing, (3) operation and (4) risk handling. Where the latter relates to two different languages: Djøf language vs. engineering from each organization.
6) Example for evaluation from Kokkedal exemplifies these
7) Normally a project leader is found in each respective organization as an applied structure for the cooperation. However, the knowledge created in one projects is transferred to the next project, and it is about investing in these processes, despite the fact that the municipalities is in high competition for prioritizing other policy areas. It is fundamental that each partner feels heard in the process. Learning processes that spread throughout the system.
8) With increased urbanization it becomes more and more expensive to dig underground, and as the world becomes more and more complex it is necessary to cooperate. There is always motives of course but also the willingness to find a solution
9) There is a need for catching up and theorize over these issues and can relate to a general critique of the structure of the public sector. Where people think in one organization and not whole solutions. Climate adaptation breaks the existing frames. This is different in the project under Vandplus, since that is the framework from the beginning

Appendix 9: Danish Nature Agency

The condensed description

1) The Water Sector Law has supported the utility companies' identity, and to some extent facilitated the cooperation between the municipalities and the utility companies. Climate adaptation projects might have improved the dialogue among the two, despite the problems, e.g. the fact that the utility that finances and has the expertise of carrying out the project does not function as project owner.
2) There is an understanding that the rules have been too bureaucratic, even though some of this might be a result of the uncertainty prior to experience with the new rules of co-financing. Too much bureaucracy is undesirable and it is clear that rules are there to be used and not to create documentation. However, it might decrease with experience, new concepts and standards of how these projects are carried out and can guide the development in this respect.

3) The political agenda has been dominated by the willingness to emphasize recreational climate adaptation where the co-financing regulation was an expression of this, by allowing for utilities to finance handling of rainwater alongside roads, water streams and in recreational areas, which have been appreciated by the municipalities. It should be prioritized as soon as possible also under the current Water Sector Law. A revision of the Water Sector Law is up for debate, where the whole regulation might be harmonized.
4) The co-financing regulation extended the options of the utilities to finance climate adaptation projects at roads, water streams and recreational areas. However, even though many projects could have been carried out without the co-financing regulation they were an attempt to politically emphasize the new solutions and the willingness for the climate adaptation to go in this direction.
5) These solutions work well together with the economic perspectives, they are seen as self-evidently much cheaper. Furthermore, and it makes sense to incorporate the aspect of climate adaptation in the urban planning and the construction sector, so new buildings and urban areas are not in large risk of flooding. This has become obvious with climate change that that the sewage water should be separated from the rain water. It was not speculated upon how much money actually went down into building the pipes underground.
6) The separation of the taxis and the tariffs have been in order for the municipalities not to mix the incomes and use them for other purposes, thus the idea of the 75 % financing of the municipalities was an expression for maintaining this separation. However, the municipalities say that it will decrease the investment in these new solutions, because no municipalities will increase taxes and thus the money has to compete with other policy areas. Thus a revision can be discussed where the separation is retained in a different way.
7) In relation to the regulation of water quality that is the resort of the health ministry, and they remain rather strict on those rules.
8) The co-financial regulation will be evaluated during 2015, and it will have to follow the fact that the risk scenarios for the municipalities change and so does the scientific climate knowledge. The climate adaptation plans show high levels of ambition in the municipalities for the municipalities, so the climate adaptation plan as a part of the municipal planning are an important instrument.

Appendix 10: Consulting Company

Appendix 11: Roskilde Utility

Appendix 12: Gladsaxe Municipality

Appendix 13: Nordvand Utility