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# Climate Transition in Municipalities:

## Identifying ways to assess transition processes through indicators

*Linnea Ackerfors & Amanda Hederen*

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**Author**

Linnea Ackerfors & Amanda Hederén

**Abstract**

Climate change has been recognised as one of the biggest challenges of our time. To prevent further climate change impacts, nations at COP21 further stressed the need to mitigate their greenhouse gas emissions enough to prevent dangerous temperature rise and to adapt societies to become more resilient. Municipals have been found important actors in this transition due to their power to inflict change on a local level. However, there is a lack of methods to assess how transition is made due to the fact that transition is a fairly new approach to managing climate change combined with a lack of completed transitions in municipalities. The purpose of this study is to explore the use of indicators as a method to assess municipal transition processes. Focusing on two Swedish municipalities that have been deemed vulnerable but at the same time apt to combat climate change, this study uses a triangulation of methods that are divided into two phases. The first phase uses a literature review in order to create a scientifically based list of transition indicators. The second phase uses document analyses and interviews in order to test the indicators and analyse transition process on a local level. The study revealed that there are multiple barriers and triggers for transition such as conflicting interests, economic factors, political steering, knowledge building- and awareness and long term perspectives, but that there also exist important tools for municipal transition in the form of networks through multi-level collaborations and plans/objectives. The findings in this study also suggests that the use of indicators as a method to assess transition could be viable, but that it is limited due to its contextual nature and lack of successful transitions to compare with.

**Sammanfattning**

Klimatförändringar har ansetts vara en av de viktigaste utmaningarna i vår tid. För att förhindra att vidare skador av klimatförändringarna kom nationer som deltog i COP21 överens om att minska sina växthusgaserna tillräckligt mycket för att förhindra farliga temperaturförhöjningar och att anpassa sina samhällen till resilienta enheter. Kommuner anses vara viktiga aktörer i denna omställning då de har makt att påverka förändringar på en lokal nivå. Dock saknas metoder för att bedöma och mäta hur omställning utförs då omställning är ett nytt angreppssätt kombinerat med en brist på genomförda omställningar. Syftet med denna uppsats är att utforska användningen av indikatorer som metod för att bedöma och mäta omställningsprocesser. Genom att använda en triangulering av metoder som delats upp i två faser fokuserar studien på två svenska kommuner som har fastställts som känsliga inför klimatförändringarna men även att ha förmågan att hantera dem. Den första fasen består av en litteraturstudie som skapade en vetenskaplig grund som berörde en global och nationell nivå. Den andra fasen bestod av en dokumentanalys och intervjuer för att utforska omställningsprocesser på en lokal nivå. Studien visar på att det finns flera barriärer och drivkrafter för omställning som konkurrerande intressen, ekonomiska faktorer, politisk styrning, kunskaps byggande- och medvetenhet och långsiktighet men även att det fanns verktyg som var viktiga för kommunal omställning som nätverk genom samarbeten på olika nivåer och planer/mål. Slutligen visar även studien på att användningen av indikatorer som metod för att mäta omställning skulle kunna vara möjligt men att begränsningar finns då metoden dels är kontextberoende men även att det är svårt att göra jämförelser då ingen fullförd omställning har skett.

**Keywords**

Climate change, mitigation, adaptation, cities, municipality, transition, transformation, climate transition, urban.

## **Preface**

This bachelor thesis is a part of a scientific project on transition in Swedish municipalities that Erik Glaas and Mattias Hjerpe currently are working on at Linköping University.

We would like to thank our interviewees Linda Olsson, Per Strannelid, Helena Kock Åström, Matilda Westerling and Thomas Ekelund for participating in our study. We would also like to express our utmost thanks to our eminent tutor Erik Glaas for supporting us through our highs and lows, always encouraging us to take the study one step further.

Linnea Ackerfors and Amanda Hederén

Norrköping 2016-04-25

## **Abstract**

Climate change has been recognised as one of the biggest challenges of our time. To prevent further climate change impacts, nations at COP21 further stressed the need to mitigate their greenhouse gas emissions enough to prevent dangerous temperature rise and to adapt societies to become more resilient. Municipals have been found important actors in this transition due to their power to inflict change on a local level. However, there is a lack of methods to assess how transition is made due to the fact that transition is a fairly new approach to managing climate change combined with a lack of completed transitions in municipalities. The purpose of this study is to explore the use of indicators as a method to assess municipal transition processes. Focusing on two Swedish municipalities that have been deemed vulnerable but at the same time apt to combat climate change, this study uses a triangulation of methods that are divided into two phases. The first phase uses a literature review in order to create a scientifically based list of transition indicators. The second phase uses document analyses and interviews in order to test the indicators and analyse transition process on a local level. The study revealed that there are multiple barriers and triggers for transition such as conflicting interests, economic factors, political steering, knowledge building- and awareness and long term perspectives, but that there also exist important tools for municipal transition in the form of networks through multi-level collaborations and plans/objectives. The findings in this study also suggests that the use of indicators as a method to assess transition could be viable, but that it is limited due to its contextual nature and lack of successful transitions to compare with.

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# 1. Introduction

Climate change is considered one of the biggest challenges in modern times. In order to combat this, a global goal is to keep the global mean temperature rise within +2 °C compared to pre-industrial levels to prevent further loss of biodiversity, and to improve the livelihoods of people through improved resource management and adaptation actions at global and local scales (Turnheim et al. 2015, Kriegler et al., 2015). This goal was further strengthened at the 2015 UN Climate Conference COP21 (Conference of Parties) in Paris where the participating nations agreed to do their utmost in order to keep the global temperature increase well below 2°C as well as adapting their societies in order to manage the impacts of climate change (UNFCCC, n.d). Cities and municipalities role in mitigating and adapting to climate change is relevant since it is on the local levels that the effects of climate change will become reality. It is also on this level that a lot of actions and decisions are made to combat climate change, in many circumstances due to a lack of national engagement and leadership in the matter or because they have been recognised nationally and internationally as capable to take measures towards a transition of their societies to sustainable ones (Carter et al., 2015).

Transition into low carbon resilient entities is considered key to be able to manage climate change through mitigating and adaptive measures (O'Brien, 2012). Transition within the context of climate change can be defined in various ways depending on the context in which it is discussed. For this study, to mitigate through decreasing greenhouse gas emissions or adapt through creating a resilience to climate change effects, transition is defined as physical and/or qualitative changes in form, structure or meaning-making (Folke et al., 2010; Nelson et al., 2007; Pelling, 2011). Furthermore, transition can also take form as changes in psycho-social processes within a community and result in fundamental changes of lifestyle and human potential. This means that political/economic/social systems are altered to adapt and mitigate the affect human livelihoods have on the planet which is paramount to achieve transition (Sharma, 2007). Previously, incremental adjustments in societies has been predominant with a focus on short term solutions. It has thereby been suggested that fundamental changes is crucial in order to achieve transition to be able to create resilience and alter negative pathways (Pelling, O'Brien & Matyas, 2015) The definition of transition used for the study also entails that transition can be made both deliberately and non-deliberately and can thereby be achieved through an active process to reach concrete established goals but also through occurring events

and factors that triggered transition and is now analysed within a transformative context (O'Brien, 2012).

Previous studies have identified the need for drastic changes in societies to be able to combat climate change related issues on multiple levels, globally, nationally and locally to be able to create resilience and decrease greenhouse gas emissions (Burch et al. 2014; Turnheim et al. 2015 and Park et al. 2012). Since Swedish municipalities have political power to endorse measures and implement climate strategical planning due to the local planning monopoly (Antonson et al., 2016), it is of importance to analyse the local levels transition process.

Departing in the stake and potentials of municipalities to approach adaptation and mitigation, Johansson et al. (2009) conducted a study of municipalities in the county of Östergötland, Sweden. The study showcased that there is a need for fundamental transition in mitigating and adapting to climate change in the municipalities in the region in order to decrease emissions and to cope with anticipated climate change impacts.

It is however uncertain how municipalities work with transition on a local level, since there is no consensual way of measuring, assessing or evaluating transition (Turnheim, et al., 2015; Nalau & Handmer, 2015). It is thereby not possible to compare transition work between municipalities to assess the process of transforming. Today, the closest means of measuring municipalities' transition to sustainability in Sweden is conducted by the Swedish Society for Nature Conservation through a national survey. This survey is specified to analyse policies and level of ambition in municipalities, resulting in a climate index used to rank the organisation's levels of transition. The survey is based on questions regarding the reduction of energy usage, transportation and greenhouse gas emissions but also information to residents, employers, education in schools and sustainable spatial planning (Swedish Society for Nature Conservation, 2008). A problem with this type of method is that it does not provide a holistic image of the transition process, since it is solemnly based on a quantitative method when data is gathered. A survey could be a limited method depending on the aspects analysed in the survey (Kvale & Brinkmann, 2014) and might overlook important barriers/triggers to the transitions process. Alternative ways to assess transition in a more founded and process based level is to focus on key indicators. This study aims to contribute to the understanding of how transitional change processes can be assessed in municipalities through a qualitative approach that can showcase the barriers and triggers for transition and also which tools enable it.



## **1.1 Aim and research questions**

The aim of the study is to identify indicators which can be used to analyse transition processes in Swedish municipalities towards resilient and low carbon intensive entities, and to identify qualitative ways to assess such processes. The study seeks to answer the following questions:

- What indicators are key to understanding transition processes within Swedish municipalities?
- What tools, barriers and triggers are important for spurring and/or limiting climate transition in Swedish municipalities?
- How can climate transition processes in Swedish municipalities be assessed?

## **1.2 Limitations**

This study is conducted in two municipalities in the county of Östergötland, Sweden and is thereby providing a perspective that is restrained to that geographical area. Although, the findings of the study aim to be relevant also for other cities and contexts, municipalities of different sizes and populations were selected.

We also focus our study around transition indicators that we define as key actions that infers a transition process, such as measures. This allows us to find indicators in the literature, but also narrows the perspective and excludes indicators that could be defined differently. The purpose of working with indicators is to identify what indicates a transitional process to be able to see what has been done, what is lacking and what enabled work related to these indicators.

Another limitation is that the study focuses around the identified indicators, which have been identified from the database Scopus and selected documents for literature review and document analysis (see section, 3.2.1, 3.2.2 and 3.3.1). It is thereby not involving potential indicators that could have been identified from other databases and sources. The choice of Scopus as a database was to allow an interdisciplinary mixture of scientific articles that was relevant for municipal governance and management. With this, we do believe that a wide range of articles was selected that mirrored a just overlook on the scholarly field of transition studies. Hence, using only Scopus was considered adequate.

## 2. Theoretical departure

To understand the purpose of this study, it is important to define the frequent terms and theories within the scholarly field of transition. The following section describes these, their relevance for transition and the study at hand.

### 2.1 Adaptation and mitigation

Firstly, it is important to understand two notions that the theory of transition has progressed from: adaptation and mitigation. These have been frequently studied as strategies in the field of climate change. In order to understand the origins of transition and its purpose it is thereby of value to grasp how these notions relate to climate change transition. Climate change adaptation as defined by the IPCC is: *“The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects”* (IPCC, 2014).

Adaptation to climate change can also be understood as nations, societies and individual's capacity to cope with and adapt to climate hazards. The increase of society's capacity to cope with and adapt to the hazards following extreme weather will benefit from long-term solutions due to the long time-frames of climate change effects. Climate adaptation has been divided into four different groups (1) actions avoiding or limiting current or future climate hazards, (2) reduce vulnerability due to current or future climate hazards, (3) create functional and flexible system as a disaster response, (4) create functional and flexible system as a disaster recovery (Wamsler & Brink, 2014a).

According to O'Brien (2012) adaptation to climate change can be seen as a sort of acceptance of future changes and all that comes with it, which is problematic since it does not trigger transformative change that goes beyond dysfunctional systems. It can also be considered a way to accommodate change when incentives could be directed towards alternative approaches. The risk of adapting, instead of transforming is that the drivers that once brought upon the issues in the current paradigms and systems might still prevail during upcoming environmental changes and thereby hamper the transition to a functioning sustainable society (Pelling 2011).

Climate change mitigation is defined by the IPCC as means to decrease emissions of anthropogenic greenhouse gases: “*A human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs). This report also assesses human interventions to reduce the sources of other substances which may contribute directly or indirectly to limiting climate change (...)*” (IPCC, 2014). Mitigation can be carried out in relation to anthropogenic actions such as overconsumption and emissions from transport. The notion thereby also includes that it can involve counteracting actions, such as changes in consuming behaviour and low-carbon technology (Gillard et al. 2016).

Adaptation and mitigation frameworks are often interlinked to get a multi-perspective on transition processes but has been discussed as problematic since it can result in blind spots concerning ideas, politics, agendas and agency. Since they both function to alter human effects on the climate and how to cooperate with the environment, these can be seen as two paramount factors that both serves the same purpose, to transform society to a resilient entity (Gillard et al. 2016). Science of this scholarship has often focused on either mitigation or adaptation. O’Brien (2012) considers transition to be an alternative option to manage climate change that can trigger change at multiple scales and levels of society.

## **2.2 Transition and transformation**

Transition and transformation can be used separately to discuss change on different levels/time frames of change, but for this study they are used synonymously to explain the same phenomena. To clarify these definitions, we have defined transition and transformation separately below. This study focuses on both transition and the transformation, but the term transition will be used mainly.

Climate transition occurs as a result to change the system fundamentally from one state to another creating a whole new system, representing a transformation. Park et al. (2012) presented four phases of transition, creating general patterns that transitions tend to characterise within. The first one is the pre-development phase, in which there are no visible changes but some (on an individual level) tests and experimentation occur. The second phase is the take-off, whereby some changes in structure within the society starts to developed alongside innovation and destabilisation in the regime. The third phase is the acceleration of the structural transformation. With this, changes in the society starts to develop and accumulate, facilitating change. The

fourth phase is stabilisation where the system is developed towards balance again (Park et al., 2012).

Climate transformation could be defined as when the state of a system changes through transition and becomes a new transformed system. Pelling, O'Brien & Matyas (2015) argue that in order to define and understand the term transformation, an explanation of three of its functions is needed. First; transformation includes fundamental change through adaptation, mitigation and technical mediation with potential to transform. Second; as actions or interventions for transformation occurs the limits of incremental adaptation is reached. Third; transformation is a pathway to address fundamental failures of development, i.e. decreasing greenhouse gas emissions by connecting adaptation, mitigation, and sustainable development (Pelling, O'Brien & Matyas, 2015).

Park et al. (2012) argue that when the transition process is considered successfully developed and completed, the decisions-making can go back to incremental adaptation, until transitional adaptations is needed again. It is necessary to study what enables transition, what needs to be in place to achieve it and how it can be assessed to be able to evaluate the process.

### **2.3 Previous studies**

Transition can occur both intentional and unintentional through decision-making and es (Park et al., 2012), which both are included in this study. Previous studies have investigated different means of transition through various ways such as multi-level governance theory (Burch et al. 2014), transition pathways (Turnheim et al., 2015), socio-technical transition systems that focuses on climate mitigation measures and social-ecological resilience systems that focuses on climate adaptation (Gillard et al., 2016) but there is a lack of interdisciplinary studies (Turnheim et al., 2015) on what drives transition and what circumstances that are essential for it to progress.

Another identified problem is evaluating transition due to the lack of understanding of the differences between incremental adjustments and transformation. In the term transformation there is also a vague understanding of what is transformed, and why, and whose interest that will be fulfilled by the transformation and what is the consequences of the transformation (Nalau & Handmer, 2015).

The use of strategic planning has previously been identified as an important tool in the context of climate change transition, since it is a strategy to conceptualise objectives and visions for transition that involves a mixture of actors, perspectives, areas, policy issues and interests (Hrelja, Hjerpe and Storbjörk, 2015). Since scholars has found that responses to climate change occurs parallel in multiple levels, areas, actors and scales (Bulkeley 2010; Davoudi, Crawford & Mehmood, 2009; Romero-Lankao 2012), planning can be considered a key tool to manage climate change transition (Hrelja, Hjerpe and Storbjörk, 2015). Since transition occurs at different levels and scales (Kates, Travis & Wilbanks, 2012), the tools that enables it is crucial to identify to be able to assess it and what drives/hampers it. Barriers and triggers that have been found important for transition in the scientific literature are amongst others: economics, political governance and long term perspectives vs. short term. These can all be both barriers and triggers depending on how they are managed and if/how they are prioritised (Hrelja, Hjerpe and Storbjörk, 2015; Turnheim et al. 2015; Burch et al. 2014; Park et al. 2012; Romero-Lankao 2012; Bulkeley 2010; Storbjörk, 2010; Davoudi, Crawford & Mehmood, 2009).

### **3. Method**

We chose to approach this study with a triangulation of methods which is a combination of methods that serves to study the same phenomenon (Denzin, 1970). The methods were conducted through two phases. The first phase consisted of a literature review that created a scientific base for the study with a global as well as a national level perspective gathered from international scientific literature and national documents in order to identify indicators for transition. The second phase focused on analysing concrete transition processes in two Swedish municipalities; Finspång and Linköping. Here, document analyses on municipal level as well as qualitative interviews with key actors were conducted to test the indicators, examine influencing factors for transition and to analyse implementation processes. The following sections will describe these steps and how they are interlinked.

#### **3.1 Selection of municipalities**

When selecting municipalities for this study we emanated from a report of Johansson et al. (2009) that had studied the risks and vulnerabilities of climate change that municipalities in the county of Östergötland are facing as well as their ability adapt. The report overviewed municipal interviewees' perspectives on climate change and how to operate within it. We decided to departure from this study in order to identify relevant municipalities for this study. Selection of the municipalities was done according to three predetermined criteria of ours to fit the study. Firstly, we wanted to make the results of the study suitable for generalisation. Due to this we selected two municipalities of different sizes: Linköping as a larger city with approximately 153 000 citizens (Linköping Municipality, 2016) and as a smaller city Finspång with a population of approximately 20 700 (Finspång Municipality, 2012). Secondly, the municipalities should have identified potential impacts/risks they expected to have with climate change. According to Johansson et al. (2009), these two municipalities faced similar risks from climate change, but had different resources to operate and manage it. Thirdly; they should have some sort of existing work with climate transition in order to be able to perform the study, which both Linköping and Finspång had (Johansson et al., 2009). A comparison between these two could possibly highlight similarities but also differences and underlying reasons within the municipalities transition work such as barriers and triggers, thereby making the result available for generalisation.

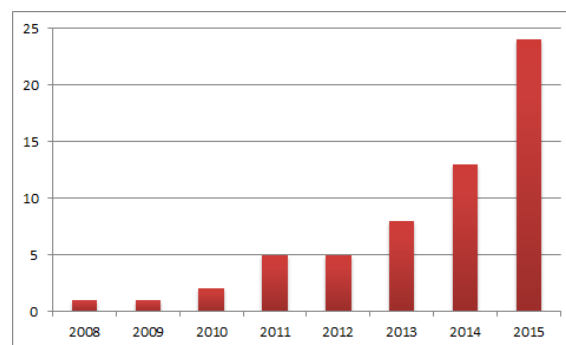
### 3.2 Phase one: identifying the indicators

The first phase formed a platform for the study through identifying indicators of transition on a multilevel scale through literature reviews.

#### 3.2.1 Literature review- identifying indicators in the scientific field

The first step in gathering empirical data was through a literature review in order to develop the fundamental basis for the study by providing a global overlook on indicators found within scientific field of transition.

The literature review was initiated by identifying keywords for the selection of articles. This was followed by a literature search in the database Scopus ranging from the years 1997 to 2015, although the majority of the selected scientific articles were published between 2008-2015 (See fig 1). The initial search was based on the keywords: climate change, mitigation, adaptation combined with either transition or transformation, which provided a large amount of articles. In order to decrease the search results, additional keywords were implemented to the original keywords with either ‘cities’ or ‘municipality’ which resulted in a comprehensive but manageable amount of articles. The selection of articles from the literature review was based on the relevance of the articles to serve the purpose of this study, and/or ability to explain the transformation/transition processes. The articles relevant to the study were saved in Refworks and duplicates were removed. This resulted in 103 potential articles from the literature search. A further 53 articles were removed from this list since some of them were not available or deemed irrelevant for the study by being outside the scope of the study.



*Fig 1. Number of relevant papers published throughout the time period of 2008 -2015 used in this literature review (50 articles).*

When the article search was completed a categorisation was performed based on their area of function and indicators of transitional change from the articles were identified.

### **3.2.2 Literature review- calibrating the indicators into a Swedish context**

The results from the literature review provided a broad overlook, but it reflected a global perspective and was not fitted to a Swedish context. In order to fit the purpose of this study we conducted a calibration to narrow down the perspectives of the indicators to fit the study and through this be able to converge the data.

The calibration was carried out by comparing the identified indicators with documents from key institutions working with climate change mitigation and adaptation in Sweden in order to potentially narrow down the identified initial indicators to a smaller number of indicators deemed most important in a Swedish context, and to include additional indicators if new ones were found. The selected documents were: a report on transition from the Swedish Environmental Protection Agency (2002), a website presenting a collection of areas of implementation in a transitional context by the Swedish Meteorological and Hydrological Institute (Klimatanpassningsportalen, n.d) and proposition 2007:60 by the Government office of Sweden (2007) on how to transform the Swedish society into a resilient nation to climate change. The documents were selected due to their comprehensive content as well as their action-orientated take on transition that fitted the purpose of the study.

Indicators from these documents were categorised in areas of transition and synergised with the indicators and categories from the literature review (see appendix 2) through a deductive approach to find predetermined categories (Kvale & Brinkmann, 2014). Categories and indicators deemed out of the hands of the municipalities were removed. In order to not lose any indicators of value, new indicators that were found in the Swedish sources was included, thus maintaining an explorative approach.



### 3.3 Phase two: Testing the indicators

The second phase departed from the list of indicators established in phase one and aimed to test the identified indicators and to analyse how they related to the municipalities' transition processes through document analyses and qualitative interviews

#### 3.3.1 Document analysis

A document analysis is a systematic method to study documents in order to gain understanding and empirical knowledge regarding its content. The process of performing a document analysis is finding material, appraising the data and synergising its content (Bowen 2009). In this study the document analysis was used to test the indicators on the documents from the municipalities.

Since we chose to study the municipalities of Finspång and Linköping, a document analysis was done based on the indicators from phase one to test if they fit the context of the municipalities. The documents studied were official documents of the municipalities' websites that covered the field of climate transition such as climate- and energy plans, comprehensive plans, Agenda 21 reports etc. (see table 1). Due to this we analysed measures that related to the developed list of indicators but also find new ones that were added to our indicator list, which is a common way of using empirical data from document analyses (Bowen, 2009). This can also lead to identification of blind spots in the documents that can be inquired about in further research (Bowen, 2009). The few not identified indicators was investigated during the interviews to see if they were relevant for the municipalities (see section 3.3.2).

*Table 1. Documents used for the documents analysis.*

<b>Linköping</b>	<b>Finspång</b>
Comprehensive plan (Municipality of Linköping, 2010b)	Comprehensive plan (Municipality of Finspång, 2011)
Nature preservation program (Municipality of Linköping, 2013b)	Nature preservation program (Municipality of Finspång, 2003a)
Environment and risk factors in Linköping (Municipality of Linköping, 2010c)	Finspångs Tekniska Verk website (Finspångs Tekniska Verk, n.d)

Traffic safety program (Municipality of Linköping, 2009a)	Finspångs Tekniska Verk annual report (Finspångs Tekniska Verk, 2014)
Traffic strategy (Municipality of Linköping, 2010b)	Cultural environmental program (Municipality of Finspång, 2015b)
Cultural historical background for comprehensive plan (Municipality of Linköping, 2009b)	Energy plan (Municipality of Finspång, 2015a)
Environmental policy (Municipality of Linköping, 2013c)	Agenda 21 Report (Municipality of Finspång, 2003a)
Sustainability report (Municipality of Linköping, 2013a)	

### 3.3.2 Interviews

Using qualitative interviews creates flexibility and lets the interview develop in different directions depending on the interviewee's knowledge of the topic. By selecting a qualitative approach for the interviews, this study gains an appreciation of the key actors understandings and perspective through first-hand experience (Bryman 2008; Bryman 1997). Qualitative interviews do not aim to have a great amount of questions seeking to quantify the answers, but rather to have a smaller selection to reach a depth in the answers and in the collected data (Malterud 2009; Bryman 2008).

We selected five interviewees/respondents for this study, two from each municipality and one from the County Administrative Board (CAB) with whom we conducted semi-structured qualitative interviews. The interviews were all roughly an hour long. One was conducted over the telephone due to logistic difficulties and the other four face to face.

According to Bryman (2008) semi-structured interviews are suitable to investigate pre-established themes on the topic, but also give the interviewee the ability to steer or develop the answers on their own. A semi-structured interview might also be favourable if several entities or organisations are interviewed in the same study (Bryman, 2008), which was the case for the study at hand. The method also entitles that the questions are of an open structure and the order

that the questions are asked in does not have to follow a predetermined order (Kvale & Brinkmann, 2014; Bryman, 2008).

The qualitative interviews built upon the gathered data from phase one in order to test the relevance of the indicators. The qualitative interviews also aimed to inductively identify influencing factors for transition such as barriers, triggers and tools, which is important in order to work with mitigation and adaptation within the indicators, in an attempt to analyse what drives climate transition work forward in the municipalities and what could hamper it. We maintained an explorative approach to be able to add potential new indicators that emerged during the interviews and to avoid being locked to our framework of initial indicators (Kvale & Brinkmann, 2014).

The interview guide for this study was developed based on the indicators from the literature review and the document analysis (see appendix 1). Because of the different interviewees (coming from different municipalities and one from the County Administrative Board), three different interview guides were developed that varied slightly, seeking to investigate the same topic but with some different indicators and perspectives depending on what entity the interviewee represented (see appendix 1 for an example of the interview guide). Since we decided to use qualitative interviews it was important that the interview guide was flexible (Bryman, 2008; Holme & Slovang, 1996).

### **3.3.3 Selection of interviewees**

We selected the five interviewees based their professions within climate transition questions. Two interviewees were selected from each municipality that worked with climate related topics. An additional person was selected from the County Administrative Board (CAB) in Östergötland (see table 2). The CAB interviewee was selected because of the person's profession as a coordinator of climate adaptation issues on a regional level in the county that Finspång and Linköping belongs to. The choice of interviewees was made to get an overarching perspective on how the municipalities actually work with climate transition.

Table 2. Interviewees for the study

<b>Finspång</b>	<b>Linköping</b>
Environmental strategist	Environmental strategist
Energy and climate strategist	Project leader within comprehensive planning
Coordinator of climate adaptation of the County Administrative Board (CAB) in Östergötland	

### 3.3.4 Analysis of the interview data

Transcription of the interviews was done separately by the authors. Analysis of the gathered data from the interviews was done stepwise. Firstly, all five transcribed interviews were read and themes were identified separately by each author. Secondly, the identified themes were compared and categorised. This provided themes used to scrutinise the gathered data from the interviews and contextualise it in order to be able to make comparisons and identify potential correlations and differences. In order to identify the themes of transition work regarding the indicators the analysis of the material was done through an inductive approach (Kvale & Brinkmann, 2014). Key quotes were also identified and presented to contextualise points made in the result. These have been altered slightly to avoid colloquial language and translated from Swedish to English. Opinions shared by the interviewees as well as when their opinions parted was identified to showcase and substantiate the results to provide a better transparency.

### 3.4 Reliability and validity

Transcriptions were made individually and were checked by the author who did not do the specific transcription with the help of notes taken during the interviews. This was followed by an analysis made on each interview by both authors individually. The results from each author's analysis were compared and themes were identified that both agreed upon. This double analysis increases the study's intersubjective reliability that increases the reproductivity of the methods used for the study (Kvale & Brinkmann, 2014).

The use of a triangulation of methods can be considered a mean of creating further credibility to the study since it through multiple methods seeks to showcase evidence of the same research question in various methods and different sources of empirical data that decreases potential of bias that a study with one method could have (Bowen 2009; Eisner 1991).

As Bryman (2008) points out, the result qualitative interviews lies in the interviewees knowledge and experiences about the subject. This means that the result is a reflection of their individual perspectives and is thereby subjective which is important to acknowledge. This hampers the reproductivity of the study since it is the chosen interviewee's personal views that are highlighted. Additionally, the relationship established between the interviewers and the interviewees is unique and can affect the outcome of the interviews which also affects the reproductivity of the study (Kvale & Brinkmann, 2014).

### **3.5 Research ethics**

Prior to the interviews, the interviewees were offered anonymity but due to the fact that we needed to highlight the interviewee's professions the anonymity might not have served its purpose. Nevertheless, all interviewees confirmed the use of their real names for the study but are referred to as their professions.

To accommodate the interviewees, we let them decide the location for the interviews and made sure they could participate and read/comment on the analysed transcribed material to avoid misunderstanding and misconceptions. Comments from the interviewees on the analysed material were taken into consideration and altered.

## **4. Analysis and discussion**

The analysed results are presented in two main sections below, which are compared to other findings in the scientific field in the end of each sub-section. The first section analyses the importance of the identified indicators of transition for the two municipalities based on results from the literature review, document analysis and the interviews. The second section presents the results regarding the process of transition gathered from the interviews.

### **4.1 Indicators of transition**

#### **4.1.1 Indicators on a global level**

Initially, the literature review on scientific articles from Scopus showcased a global comprehensive overview on indicators of transition. The literature review provided a total of 40 indicators from 50 articles (see appendix 2). These indicators were additionally categorised into different areas of function such as energy, flood, spatial planning, forestry, blue green infrastructure, transport, agriculture, health, water, behaviour and waste. The categorisation of the indicators was separated according to if they were based on adaptation or mitigation. Some indicators fell under the scope of both adaptation and mitigation and were therefore separated together. This allowed an overview of the amount of indicators that fell into these three groups to secure a mixture of literature that did not just involve one or the other since our use of ‘transition’ involves both mitigation and adaptation.

The results were 40 indicators that varied in scale, levels and function areas and were more or less specific for the studied cases. The articles provided information on transition work from all over the world with large geographical differences and more or less detailed examples of how transition work has been conducted. We found that most of the indicators came from the literature regarding adaptation (28 indicators out of 40) and these mostly concerned water, spatial planning, health and forestry.

#### **4.1.2 Indicators in a Swedish context**

Examination of the scientific field on transition provided this study with a broad spectrum of indicators, where some of the indicators might or might not fit in the context of Sweden. To

narrow the selection another calibration was conducted through the use of Swedish documents from the Swedish Environmental Protection Agency, the Swedish Meteorological and Hydrological Institute and the Government office of Sweden, as presented in section 3.2.2.

The document from the Swedish Environmental Protection Agency provided the study with 10 indicators with a mitigating character in five different areas of function: energy, transport, food, education, spatial planning. For example, within the area of energy, this analysis found indicators such as reduced energy usage, energy consultation, measures for developing system for renewable energy sources and developed system (production and policy) for renewable energy sources (see appendix 3).

The collection of indicators from the Swedish Meteorological and Hydrological Institute resulted in 16 indicators in 11 different areas of function: spatial planning, water, ecosystem services, erosion, health, agriculture, crisis management, culture, biodiversity, forestry and energy. The indicators were of an adaptive character for example; spatial planning contains indicators such as climate adaptation of buildings and strategies to handle of contaminated soil in a changed climate (see appendix 4).

Proposition 2007:60 by the Government Office of Sweden provided indicators of both mitigating and adaptive character in a Swedish context, 19 indicators was found and in 10 areas of function: transport, energy, technology, water, spatial planning, erosion, forestry, agriculture, biological diversity and health (see appendix 5).

The result from the analysis of the Swedish documents shows that some of the indicators were similar or the same as the results from the scientific articles from Scopus. The results from Scopus (appendix 2) and the Swedish documents (appendix 3; 4; 5) were combined and calibrated, creating the indicators list presented below (see table 3). This resulted in 48 indicators in nine areas of function. Some indicator was removed because they did not fit the limitations of this study, such as indicators that are not within the municipalities' area of responsibility. For example, the need for burial of phone lines due to increased vulnerability from extreme weather such as storms, which is argued in the proposition 2007:60 by the Government office of Sweden to be the Swedish Post and Telecom Authority's responsibility. Other indicators were removed during the calibration because of their geographical dependence, such as protection measures handling increased desertification which might be important in countries with different geographical location and a warmer climate than Sweden.

*Table 3. Indicator list based on the calibration of the results from the literature reviews (scientific articles from Scopus and Swedish documents), including a total of nine areas of function with 48 indicators fitted in a Swedish context of municipalities with its roots in scientific studies.*

<b>Areas of function</b>	<b>Indicator</b>
Energy	<ul style="list-style-type: none"> <li>• Energy consulting services for individuals and companies</li> <li>• Information projects on energy saving (e.g., earth hour challenge)</li> <li>• Political governance and municipal collaboration to promote efficient energy (e.g., district heating and electricity production)</li> <li>• Increased preparedness to the effects of climate changes at electricity plants and electricity generation facilities (e.g., dams, wind turbines, district heating/cooling)</li> <li>• Decrease usage of non-renewable energy sources (e.g., coal, oil)</li> <li>• Production of renewable energy</li> <li>• Optimise waste management to decrease CO2 emissions</li> </ul>
Transport	<ul style="list-style-type: none"> <li>• Improved efficiency of existing transport systems</li> <li>• Decrease amount of fossil-intensive travels and transport</li> <li>• Improve walking- and biking possibilities</li> <li>• Increase transport security to climate change (e.g., landslip/flooding)</li> <li>• Planning and actions to decrease urban air pollution</li> </ul>
Construction	<ul style="list-style-type: none"> <li>• Policy and instrument for climate adaptation (e.g., flooding/wind/snow/drought) of existing buildings and new constructions.</li> <li>• Policy and instruments for energy efficiency (e.g., heating) of existing and building and new constructions.</li> <li>• Measures for- and management of polluted land in construction</li> <li>• Plans for sustainable land use through urban densification</li> <li>• Mapping areas in risk of erosion (e.g., landslip) and flooding according to the plan- and building legislation and implementing measures for this in constructions</li> </ul>
Spatial planning	<ul style="list-style-type: none"> <li>• Objectives and policies to improve the municipalities spatial planning for climate change</li> <li>• Cooperation with other municipalities regarding climate adaptation in spatial planning</li> <li>• Planning green areas in comprehensive plans and develop policies to avoid heat islands</li> <li>• Measures for preserving and planting new areas of greenery</li> </ul>



	<ul style="list-style-type: none"> <li>• Evaluation of previous mistakes to improve the overall work within spatial planning</li> <li>• Mapping societal risks and vulnerabilities of extreme weathers and identify triggers of force within municipalities</li> </ul>
Agriculture and forestry	<ul style="list-style-type: none"> <li>• Planning/adapting agriculture to incoming positive and negative effects of climate change (e.g., longer vegetation periods/increased rain/drought)</li> <li>• Counselling regarding climate related issues on forestry- and agriculture (e.g., binding coal in land and managing climate risks)</li> <li>• Planning and working with risks related to immigration of foreign species and spreading of vermin, fungus and parasites</li> <li>• Enhance usage of locally produced timber</li> <li>• Crisis preparedness and protection from harvest damage in agriculture and forestry (e.g., drought/fire/flooding)</li> </ul>
Environment	<ul style="list-style-type: none"> <li>• Economically value and implement ecosystem services in planning processes and create preservation plans for these and species</li> <li>• Implement climate adaptation aspects in management of national environmental objectives</li> <li>• Policy and measures to preserve biological diversity in a changing climate</li> <li>• Plan to manage increase contamination hazards from agriculture to public bathing places</li> </ul>
Health	<ul style="list-style-type: none"> <li>• Identifying vulnerable groups for heat waves</li> <li>• Implement warning systems for increased temperatures</li> <li>• Implement cooling systems in public spaces to protect vulnerable groups from heat waves</li> <li>• Action plan and preparation to manage heat waves (e.g., planting trees/protection/cooling) and its effects</li> <li>• Spreading of information regarding climate related problems for individuals (e.g., dampness/mold/mite)</li> <li>• Policy to integrate public health within climate adaptation</li> </ul>
Sewerage, storm water and drinking water	<ul style="list-style-type: none"> <li>• Mapping storm water systems capacity for urbanisation and extreme weather</li> <li>• Implement climate adaptation measures to prevent flooding (e.g., land drainage, ditching, water conduit and drainage)</li> <li>• Analysis of drinking water supplies in relation to climate change (e.g., water catchment, microbiological changes, elevation above sea level,)</li> <li>• Measures to prevent contamination of drinking water (e.g., water cleansing)</li> <li>• Climate adapted storm water plan/drinking water plan in municipalities</li> <li>• Education on drinking water supply in a changed climate</li> </ul>

	<ul style="list-style-type: none"> <li>Projects and mapping of reserve water (e.g., due to drought or contamination)</li> </ul>
Others	<ul style="list-style-type: none"> <li>Preventive measures for the protection of cultural heritage (e.g., maintenance)</li> <li>Planning for increased stresses on the environment due to enhanced/altered tourism in Sweden caused by climate change</li> <li>Adult education through information/ education/ policy regarding climate change and changed food cultural (e.g., organic food and less consumption of meat)</li> </ul>

#### 4.1.3 Testing the Indicators in Finspång and Linköping.

After establishing relevant indicators for the Swedish context, document analyses were performed to test their relevance for the chosen municipalities. This allowed us to identify 30 of our 48 indicators in Linköping's documents and 35 in Finspång's documents. The indicators were identified in the documents in accordance to if they were an active work/measure. Indicators were also identified if they suggested planned work depending on if there were an indicator that concerned planning in the area of function. The document analysis also resulted in identifying two new indicators in Linköping and three new indicators in Finspång. These are marked in grey in table 4 that presents the results.

Table 4. The results form of the documents analysis on Linköping and Finspång

Areas of function	Indicator	Linköping		Finspång	
		Identified	Source	Identified	Source
Energy	Energy consulting services for individuals and companies	X	<i>Sustainability report (Municipality of Linköping, 2013a)</i>	X	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Information projects on energy saving (e.g. earth hour challenge)	X	<i>Sustainability report (Municipality of Linköping, 2013a)</i>	X	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Political governance and municipal collaboration to promote efficient energy (e.g. district heating and electricity production)	X	<i>Sustainability report (Municipality of Linköping, 2013a)</i>	X	<i>Energy plan (Municipality of Finspång, 2015a)</i>

	Increased preparedness to the effects of climate changes at electricity plants and electricity generation facilities (e.g. dams, wind turbines, district heating/cooling)			<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Decrease usage of none-renewable energy sources (e.g. coal, oil)	<b>X</b>	<i>Sustainability report (Municipality of Linköping, 2013a)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Production of renewable energy	<b>X</b>	<i>Comprehensive plan (Municipality of Linköping, 2010b)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Optimise waste management to decrease CO2 emissions	<b>X</b>	<i>Environmental policy (Municipality of Linköping, 2013c)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	New indicator: Strategy for sustainable procurement that can occur within the municipal environmental and energy demands with policy			<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	New indicator: Policy for decreased energy usage	<b>X</b>	<i>Environmental policy (Municipality of Linköping, 2013c)</i>		
<b>Transport</b>	Improved efficiency of existing transport systems	<b>X</b>	<i>Sustainability report (Municipality of Linköping, 2013a)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Decrease amount of fossil-intensive travels and transport	<b>X</b>	<i>Sustainability report (Municipality of Linköping, 2013a)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Improve walk- and biking possibilities	<b>X</b>	<i>Traffic safety program (Municipality of Linköping, 2009a)</i>  <i>Comprehensive plan (Municipality of Linköping, 2010b)</i>	<b>X</b>	<i>Agenda 21 report (Municipality of Finspång, 2003a)</i>  <i>Comprehensive plan (Municipality of Finspång, 2011)</i>
	Increase transport security to climate change (e.g. landslip/flooding)			<b>X</b>	<i>Comprehensive plan</i>

					(Municipality of Finspång, 2011)
	Planning and actions to decrease urban air pollution	<b>X</b>	<i>Sustainability report (Municipality of Linköping, 2013a)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	New indicator: Action/information program to decrease CO2 emissions and emissions of particles.	<b>X</b>	<i>Comprehensive plan (Municipality of Linköping, 2010b)</i>		
<b>Construction</b>	Policy and instrument for climate adaptation (e.g. flooding/wind/snow/drought) of existing buildings and new constructions.	<b>X</b>	<i>Environmental policy (Municipality of Linköping, 2013c)</i>  <i>Environment and risk factors in Linköping (Municipality of Linköping, 2010c)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Policy and instruments for energy efficiency (e.g. heating) of existing and building and new constructions.	<b>X</b>	<i>Comprehensive plan (Municipality of Linköping, 2010b)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Measures for- and management of polluted land in construction			<b>X</b>	<i>Comprehensive plan (Municipality of Finspång, 2011)</i>
	Plans for sustainable land use through urban densifying	<b>X</b>	<i>Comprehensive plan (Municipality of Linköping, 2010b)</i>	<b>X</b>	<i>Comprehensive plan (Municipality of Finspång, 2011)</i>
	Mapping areas in risk of erosion (e.g. landslip) and flooding according to the plan- and building legislation and implementing measures for this in constructions	<b>X</b>	<i>Environment and risk factors in Linköping (Municipality of Linköping, 2010c)</i>	<b>X</b>	<i>Comprehensive plan (Municipality of Finspång, 2011)</i>
<b>Urban planning</b>	Objectives and policies to improve the municipalities urban planning for climate change	<b>X</b>	<i>Environmental policy (Municipality of Linköping, 2013c)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Cooperation with other municipalities regarding climate adaptation in urban planning	<b>X</b>	<i>Comprehensive plan (Municipality of Linköping, 2010b)</i>	<b>X</b>	<i>Comprehensive plan (Municipality of Finspång, 2011)</i>

	Planning green areas in comprehensive plans and develop policies to avoid heat islands	<b>X</b>	<i>Comprehensive plan (Municipality of Linköping, 2010b)</i>	<b>X</b>	<i>Comprehensive plan (Municipality of Finspång, 2011)</i>
	Measures for preserving and planting new areas of greenery	<b>X</b>	<i>Environment and risk factors in Linköping (Municipality of Linköping, 2010c)</i>	<b>X</b>	<i>Comprehensive plan (Municipality of Finspång, 2011)</i>
	Evaluation of previous mistakes to improve the overall work within spatial planning	<b>X</b>	<i>Environmental policy (Municipality of Linköping, 2013c)</i>		
	Mapping societal risks and vulnerabilities of extreme weathers and identify triggers of force within municipalities	<b>X</b>	<i>Environment and risk factors in Linköping (Municipality of Linköping, 2010c)</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
<b>Agriculture and forestry</b>	Planning/adapting agriculture to incoming positive and negative effects of climate change (e.g. longer vegetation periods/increased rain/drought)				
	Advisement regarding climate related issues on forestry- and agriculture (e.g. binding coal in land and managing climate risks)			<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Planning and working with risks related to immigration of foreign species and spreading of vermin, fungus and parasites				
	Enhance usage of locally produced timber				
	Crisis preparedness and protection from harvest damage in agriculture and forestry (drought/fire/flooding)	<b>X</b>	<i>Sustainability report (Municipality of Linköping, 2013a)</i>		
<b>Environment</b>	Economically value and implement ecosystem services in planning processes and create preservation plans for these and species	<b>X</b>	<i>Sustainability report (Municipality of Linköping, 2013a)</i>		
	Implement climate adaptation aspects in management of national environmental objectives	<b>X</b>	<i>Nature preservation program (Municipality of Linköping, 2013b))</i>	<b>X</b>	<i>Energy plan (Municipality of Finspång, 2015a)</i>
	Policy and measures to preserve biological diversity in a changing climate	<b>X</b>	<i>Environmental policy (Municipality of Linköping, 2013c)</i>	<b>X</b>	<i>Nature conservation program</i>

					(Municipality of Finspång, 2003)
	Plan to manage increase contamination hazards from agriculture to public bathing places				
	New indicator: Action program to preserve biological diversity			<b>X</b>	Nature conservation program (Municipality of Finspång, 2003a)
<b>Health</b>	Identifying vulnerable groups for heat waves				
	Implement warning systems for increased temperatures				
	Implement cooling systems in public spaces to protect vulnerable groups from heat waves				
	Action plan and preparation to manage heat waves (e.g. planting trees/protection/cooling) and its effects				
	Spreading of information regarding climate related problems for individuals (e.g. dampness/mold/mite)				
	Policy to integrate public health within climate adaptation				<b>X</b>
<b>Sewerage, storm water and drinking water</b>	Mapping storm water systems capacity for urbanisation and extreme weather	<b>X</b>	Environment and risk factors in Linköping (Municipality of Linköping, 2010c)	<b>X</b>	Comprehensive plan (Municipality of Finspång, 2011)
	Implement climate adaptation measures to prevent flooding (e.g. land drainage, ditching, water conduit and drainage)	<b>X</b>	Environment and risk factors in Linköping (Municipality of Linköping, 2010c)	<b>X</b>	Comprehensive plan (Municipality of Finspång, 2011)
	Analysis of drinking water supplies in relation to climate change (e.g. water catchment, microbiological changes, elevation above sea level.)	<b>X</b>	Environment and risk factors in Linköping (Municipality of Linköping, 2010c)	<b>X</b>	Comprehensive plan (Municipality of Finspång, 2011)
	Measures to prevent contamination of drinking water (e.g. water cleansing)				<b>X</b>

	Climate adapted storm water plan/drinking water plan in municipalities				
	Education on drinking water supply in a changed climate	<b>X</b>	<i>Environment and risk factors in Linköping (Municipality of Linköping, 2010c)</i>	<b>X</b>	<i>Finspångs Tekniska verk (Finspångs Tekniska Verk, n.d)</i>
	Projects and mapping of reserve water (e.g. due to drought or contamination)			<b>X</b>	<i>Comprehensive plan (Municipality of Finspång, 2011)</i>
	New indicator: Measurements to decrease leakage from sewerage cleansing plant			<b>X</b>	<i>Finspångs Tekniska verk (Finspångs Tekniska verk, 2014)</i>
<b>Without specific area of function</b>	Preventive measures for the protection of cultural heritage (e.g. maintenance)	<b>X</b>	<i>Cultural historical background for comprehensive plan (Municipality of Linköping, 2009b)</i>	<b>X</b>	<i>Cultural environment program (2015)</i>
	Planning for increased stresses on the environment due to enhanced/ altered tourism in Sweden caused by climate change			<b>X</b>	<i>Comprehensive plan (Municipality of Finspång, 2011)</i>
	Adult education through information/ education/ policy regarding climate change and changed food cultural (e.g. organic food and less consumption of meat)			<b>X</b>	<i>Agenda 21 report (Municipality of Finspång, 2003b)</i>

The indicators that could not be found in either of the two municipalities were mainly related to: health, agriculture and forestry. Other not-identified indicators were for example ecosystem services in planning processes. The not-identified indicators were further investigated during the interviews to seek out if these were relevant for the municipalities or not.

All interviewees explained that they could see a connection between indicators regarding agriculture and forestry and climate related issues, and how they related to transition work within municipalities, but that there were no active work with these indicators. According to the environmental strategist in Finspång, agriculture and forestry is under consideration to be

involved in upcoming climate strategic plans. Although all four interviewees from the municipalities agreed that these were areas of interests in the matter of preservation, these two areas were considered to be out of their hands belonging to their own separate branches. This was confirmed by the coordinator of climate adaptation from the CAB who also considered these areas to be the responsibilities of the Swedish Forest Agency and the Swedish Board of Agriculture.

Regarding indicators that were not identified within the area of health, the interviewees could confirm the indicators relevance for their municipalities. The indicators regarded identifying vulnerable groups in society and heat waves etc. (see table 4) were all discussed by the interviewees. In Linköping the interviewees discussed the relevance of protection from heat as a factor concerning city planning and constructing especially concerning vulnerable people such as elderly and children. The interviewees from Finspång both referred to information from the Swedish Meteorological and Hydrological institute and that they had provided reports and advice on how to consider vulnerability for heat waves within city planning. The environmental strategist from Finspång pointed out that there is an ambition in the municipality to connect climate change factors into the health sector in the municipality. The coordinator of climate adaptation from the CAB explained that a reason that indicators from this area were not available in the documents could be that documents could be undergoing updates since health issues related to climate change are normally included nowadays in comprehensive plans and detailed plans of municipalities. If not, he explained that it could be an area mostly worked with within the region rather than on a local level.

Another indicator that could not be identified through document analysis was ecosystem services in planning processes. The coordinator of climate adaptation from the CAB explained that this is an indicator that will become more occurring in municipal work within transition in the future, but since it is a relatively new approach it might not be introduced within the municipalities yet or considered. He also explained that this is something that the CAB is currently working with that will supply the municipalities with actions plans regarding ecosystem services in the future. Accordingly, there was an awareness of ecosystem services in both municipalities but no active work yet to involve them in planning processes.



#### **4.1.4 Summarised discussion regarding the indicators**

In the development and testing the indicators we found that there are different aspects that tend to affect the indicators relevance for the municipalities transition that depends on the context they function within. Factors that could be important to bear in mind when developing indicators are the municipalities' ability to handle risks, hazards and their vulnerability and also the geographic dependence of the indicators since the municipalities vary in geographical characteristics (Wamsler and Brink, 2014a).

For instance, climate risks including floods, rainstorms, windstorms, extreme temperatures and raised sea levels are results of climate change and will create further risk, hazards and vulnerability in the future (Wamsler and Brink, 2014a) calling for a need of transition. The climate risks that we know of today create the framework for our knowledge of the measures needed and also create the paradigm for the indicators relevance. Although some indicators of transition could still be used in a global context, it is primarily indicators seeking to lower emissions and change behaviours that could be contextualised on a global scale. Still these indicators could be argued also to be depending on socio-technical and socio-ecological aspects in a developing society (Gillard et al., 2016).

The indicators geographical dependence could be explained as the varying need for different measures in municipalities making the knowledge of the context important for the indicators. Sweden is a country with a huge geographical diversity from the southern flatlands to the mountain regions in the north. Even in Östergötland there is a geographical difference with flatlands, hill areas, coastal areas, and a difference in agricultural and forestry opportunities (Johansson, 2009). The understanding of the geographical differences is of interest when testing the indicators. The geographical differences create different conditions, and the risks, hazards and vulnerabilities caused from change climate and will probably play out different, leaving some indicators more important in some municipalities than others. Measures that create adaptive capacity is individual to the context; measures that is short-term solutions in one area could create a long-term solution in another (Wamsler and Brink, 2014a).

The results indicated that the identified indicators within agriculture and forestry could be irrelevant for a municipal level since it was deemed to be out of the hands of the municipalities. If these indicators are disregarded, five indicators are excluded. Since the health indicators and ecosystem service indicator appeared to be existing within the municipal transition work, these can be regarded as relevant. However, this is once more contextual and may thereby only be of

importance for the municipalities studied. Since agriculture and forestry was to some degree considered to be relevant still within the municipalities, these could potentially be relevant in the future depending on the collaboration between the branches and the municipalities. Since municipalities have been considered important actors to respond to climate change and works on a local level where actions to combating climate change are expected (Antonson et al., 2016), their relation to other branches such as forestry and agriculture and how these can cooperate, is of importance to manage transitional obstacles.

The results suggest that most of the identified indicators from the literature reviews are relevant both in the studied municipalities and in a Swedish context, but that they, as with the agriculture and forestry could be managed by other authorities and thereby fall outside their responsibilities.

## **4.2 The process of transition**

This section presents the analysed results related to triggers, barriers and tools deemed to influence transition processes in Finspång and Linköping.

### **4.2.1 Influencing Factors for Transition - Triggers and Barriers**

Following sub-themes are the different factors that were discovered through the interviews that are influencing the municipalities' abilities to achieve transition.

#### **4.2.2 Long term planning/thinking**

The result from the interviews shows that one important factor for transition work is the municipalities' ability to create a long term planning as well as an integrated long term thinking in all sectors towards all stakeholders in the municipality. Long term planning and thinking acts as both triggers and barriers in the municipalities. All our interviews talk about three main aspects: long term planning, long term measures and the need to integrate all actors and organisations.

Our result shows that different plans and processes could facilitate a long term transition work. The interviewees speak of different crucial plans as keys to work with transition, for example the energy plan, climate adaptation plan and the comprehensive plan. All interviews lift triggers and possibilities to plan with a long term perspective. The project leader within comprehensive

planning in Linköping also talks about the importance of the comprehensive planning, and that it is their main targets to maintain for several mandates and beyond them. Although long term planning is important, its effects could also be seen as a barrier. The energy and climate strategist in Finspång and the environmental strategist in Linköping argued that it is hard to work with long term solutions because its effects might not show until far into the future. The environmental strategist in Linköping spoke of long term planning in other sectors and how there might be conflicting interests when implementing measures that are long term and perhaps difficult to understand as beneficial for short term interests:

*“Today it might be seen as a burden but in 20 years [the measures] might be a factor of success”*  
(Author’s translation)

All interviewees agreed that long term planning is important for the transition work in the municipality. That includes that the plan processes and the steering documents involves long term visions and goals influencing the organisational work. The environmental strategist in Finspång states that the comprehensive plan is an important tool and vision for the long term process and sustainable development, triggering the work and enables different actors to understand their involvement. As mentioned above one of the barriers with long term solutions could be conflicting objectives, as the environmental strategist from Finspång points out that some long term measures could be good for the environment but stakeholder could argue that it strives against their economical profitability. For example, he explains that the long term effective measure “traffic- free city centre”, would be good for the environment and could trigger the transition work. But the stakeholders could lose customers because of this measure and this creates a barrier, one that could be solved by smart strategic- and spatial planning. The energy and climate strategist in Finspång argues that this could be turned around and that some measures could give socioeconomic profits and even economic profits in the future, the difficulty is to convince the stakeholders.

As all interviewees from the municipalities points out some actors and sectors might not understand their participation in the transitional process, and it's important to inform these actors and sectors to be able to create long term plans with an integrated thinking. This is also confirmed by the coordinator of climate adaptation from the CAB, who also points out that long term measures could be hampered or stopped by external circumstances. Climate adaptation from the CAB mentions the refugees’ reception as an example of external circumstance:

*“Then of course, many municipalities have not had the same opportunity to work with climate adaptation measures, much of their personnel and financial resources has gone to the reception of refugees. And it shows quite clearly on the smaller municipalities” (Author’s translation)*

#### **4.2.2 Politics**

One of the factors discussed as both a barrier and a trigger was politics and political steering. On the one hand, all interviews from the municipalities experienced that they had political support to work with climate related issues, but on the other hand there was also a general opinion that the politics could hamper the progression if these questions were not prioritised by the city council. The energy and climate strategist from Finspång elaborated that the politically approved measures and plans are the ones that are foundational for how and what and how much she can work with climate adaptation and mitigation. Whereas the political ambition and direction appears to be key to steer the municipal transition work forward, there is also an in-built discrepancy when measures are taken within climate mitigation and adaptation. As described by the environmental strategist from Finspång, there is a need for a political maturity and awakening to really commit to transitional undertakings. Whether there is a commitment or not determines when and how prioritised the transition is. Due to this, climate transition could be slowed down. As explained by the energy and climate strategist in Finspång, there is often a slight discrepancy in municipalities due to the long processes. The environmental strategist from Linköping explained that there is also a need for increased knowledge within the political municipal organisation to enable progress.

Similarly, as told by the coordinator of climate adaptation from the CAB, political steering in the municipalities are one of the fundamental enablers of transition but also political steering from a governmental level. He explains that the CAB functions as implementers of governmental regulatory compliances through shouldering the responsibility to support the municipalities that ultimately respond to climate change through actions, which makes the importance of political governmental steering key to the process of transition. Legislation and regulatory compliances was one of the political factors that all interviewees agreed were important for their possibilities to further their transition work. In both municipalities, a lot of focus had previously been directed to mitigating actions, whereas there is now a growing focus on adaptation and transition (deliberate or non-deliberate). Top-down steering from the government as well as other responsible authorities as enablers was discussed by the energy

and climate strategy of Finspång, which we interpreted as another key influencing factor for transition:

*“I think that a clearer directive top-down from the government and parliament that falls down to the County Administrative Board is important that states - This is what we are doing now. A clarity in what they want, what direction they want to move and a clarity concerning when thing is to happen.”* (Author’s translation)

We can conclude that according to the interviewees, politics in various levels are a crucial influencing factor for transition in the municipalities and can function as a trigger and enabler as well as a barrier that hampers progressions.

### **4.2.3 Economic aspects**

Regarding economic aspects that influence municipalities’ ability to work with transition, all interviewees stated that economy is a fundamental framework for how, if and what they can do. As explained by the project leader within comprehensive planning in Linköping, economy for them in their work mostly mean that they need to suggest cost efficient solutions that are realistic combined with always including an economical consequence description when introducing a new plan. The other interviewees from both municipalities explained that their work is constricted by economy in a way that there needs to be an economic incentive as well when environmental and climate related measures are suggested. Due to this, the size of the municipality is an important factor. The coordinator of climate adaptation from CAB explains that the economic barriers faced by municipalities is a result of a lack of finances from the government that is apparent for both large and small municipalities, as well as for the CAB that does not get enough funding to properly support the municipalities as much as needed. Regarding the size problematics of municipalities within this he states:

*“The larger municipalities often have better resources to work with climate adaptation. They have employees that are responsible of it, they have their own educations, better economic resources whilst the smaller one [...] are aware of the problematics regarding it but have not progressed much since it requires resources they might not have, both economically and personnel”* (Author’s translation)

Since smaller municipalities have less resources they are dependent on funds but also support through networks with other municipalities. This might not affect larger municipalities as much,

but the coordinator explains that the economic barriers are always present. This was confirmed by the interviewees from the smaller municipality Finspång who both expressed the need for more funding, the importance to present the socio-economic advantages with climate measures and to utilise other sources of funding and help outside the municipality's organisation. But even though Linköping is a larger city with more resources, their environmental strategist confirmed that they also have these barriers to overcome, but perhaps not to the same degree.

Another economic barrier is the fact that municipalities are funded by taxes from their citizens. The energy and climate strategist from Finspång explains that this creates issues of prioritising what to fund. Municipal sectors such as schools and elderly care are core-sectors of high importance to the municipality which she explains leads to that these can be prioritised financially. Working with climate and environmental questions might not be prioritised financially, even if there is a desire to work with those issues, since they are not core-issues for the municipality. The environmental strategist from Linköping also discusses the need for economic incentives and its importance to successfully work with transition. She explains that an important part is to acknowledge within the municipality that it will be more expensive to, for example, repair damages that occurs in the future due to climate change than to work preventive and thereby save money.

Analysis of the results shows that there are both negative economic aspects as well as economic incentives with transition work that varies depending on the size of the municipalities. There might be a matter of competing interests when environmental measures are to be taken, but as explained by the energy and climate strategist in Finspång, money can be seen as a language everybody understands regardless of their understanding of the need for climate adaptation or mitigation.

#### **4.2.4 Knowledge building and awareness**

All interviews talked about awareness and knowledge as both triggers and barriers. The lack of awareness and knowledge of climate change could function as a barrier in plan process and long term measures and could trigger the effects and help the process. Further knowledge can be triggered by a need to understand and to be able to solve urgent questions, as a type of survival factor towards extreme weather. As the environmental strategist at Linköping points out, the municipalities that has worked with transition the most is the municipalities who has been affected by floods or other types of extreme weather. Awareness and knowledge could be

gathered as a precaution for future measures and possible risks and hazards. The environmental strategist at Linköping talks about awareness and the knowledge regarding risk, hazards and vulnerability, contributing to trigger the effects of the measures:

*“For example, environmental toxins. If I do not know that they are in my everyday life, then it’s not a priority to avoid or get rid of them [the toxins] and there are other reasons that I could continue to go on as normal. The level of awareness affects how much we work with it [transitional measures], the awareness and the knowledge.”* (Author’s translation).

Most of the interviewees argue that one of the triggers to seek this knowledge is the responsibility towards the citizens. In order to create a safe environment and society for the citizen, they need knowledge about future risks and hazards towards vulnerable groups and areas in the municipality. The environmental strategist at Linköping also points out:

*“It is much better to work with preventing-measures than to work with repairing-measures afterwards, it is a question about money, but also a matter of trust from our citizens. I think it is very important that citizens trust the municipality’s work.”* (Author’s translation)

The coordinator of climate adaptation from CAB explains that if the municipalities fail to create safety for the citizens, the local development will not evolve, and this could also create a trigger for transition.

#### **4.2.5 Summarised result discussion on the influencing factors in transition work**

The analysed result suggests that there are various triggers and barriers for transition within both municipalities. Identified triggers include political directives, regulatory compliance, economic incentives, the survival factor and awareness- and knowledge building. We could see a tendency that the starting trigger for transitional change in the municipalities originated from an increased awareness infused by the survival factor in some cases, which was followed by political directives and regulatory compliances, distribution of economic resources and planning before implementing measures. Within this, a discrepancy was inbuilt and various recurring barriers hampered the transitional process. Burch et al. (2014) discusses ways of identifying who and what triggers transformative change and conducts their study through creating a conceptual framework that derails from MLG (multi-level governance theory) as well as theories of development paths. They describe that there are two dimensions that needs to be considered in the challenge of combating climate change: The need to massively reduce GHG

emissions to stabilise the change and that vulnerability and emissions are infused in path dependencies that are often non-compliant to change. This correlates to the finding in the two municipalities where a lot of focus previously has been on mitigating measures and similar governance structures have been present which could be considered a path dependency.

According to Burch et al. (2014), path dependency itself is a great barrier for achieving sustainable transition since it halts innovation and accumulates over time since more knowledge and resources are invested in the present path. Interviewees from both Finspång and Linköping pointed out an increased need for knowledge, internally within the municipal organisation, which could be a potential way to move beyond negative path dependencies and explore new integrated alternative ways of managing barriers of transition such as contesting interests. To be able to erase dysfunctional path dependencies, Burch et al. (2014) considers strategic collaborations as fundamental. In both municipalities there were employed strategists (such as the ones interviewed for this study), but the issues seemed to arrive from a lack of integrated governance.

One of the fundamental issues arrived from knowledge making and awareness, which concerns how to trigger transition or increase current attention to transition work. Hrelja, Hjerpe and Storbjörk (2015) investigated the means of creating transformative force within spatial planning and strategy making in climate change transition and used Albrechts (2006) conceptual framework for spatial planning to identify how transformative force can potentially be triggered through three elements: 1. Filtering ideas (how climate change issues are acknowledged within the frames of current paradigms), 2. Focusing and Framing (What is relevant for attention in current visions and how climate change is framed) and 3. Generation of mobilising force (How procedures and tools to mobilise the force are operationalised for implementation). These procedural steps can be applied to the transitional process of the municipalities in this study. Firstly, they have a perceived idea of what climate issues are at hand and an idea of how these might affect them in the future. They also have a focus, that can be altered depending on the municipal political governance and contesting interests (such as the refugee reception), which also creates a framing for how much focus climate related issues get in comparison to other sectors. Lastly, they have mobilised force within the municipalities through for example employing strategists, establishing key plans with objectives and visions. Steps have been taken, but the analysis identified many barriers as well as triggers as described above. Both the testing of the indicators and the analysis of the interviews highlights that there is an existing transition work, but that there are barriers and triggers that are influencing the process.



The analysed results show that the municipalities' faces difficulties and barriers in their transition work such as a lack of resources, conflicting interests, lack of governmental steering and integration of the climate matters. To cope with barriers learning processes had been argued to facilitate the outcome (Storbjörk, 2010). Coping with the barriers through learning processes could occur through instrumental task-oriented, problem-solving or communicative actions. Instrumental task-oriented action could be explained as technical predictions through visualising tools for storm water management and problem-solving could occur due to risk management predicting future risks and hazards with climate change. Communicative actions can be declared as the tools for networking and multi-level collaborations (Armitage, Marschke & Plummer 2008).

### **4.3 Influencing Factors for Transition - Tools**

The following section presents the tools for transition that have been identified through the interviews as key factors in their transition work.

#### **4.3.1 Networks/ multi-level collaboration**

Regarding networks and multi-level collaboration as a tool for transition work, our result shows that the networks and collaboration can appear and function within and outside the internal organisation. The main purpose of the networks and collaborations is to gain knowledge, learn about technical-instrument for transition and gain support/support other actors in their transition work.

All the interviewees speak of internal networks and collaborations as a way to engage the municipalities' different core-sectors and reach out to local corporations. Though the idea of collaboration and networking is good, it can be difficult to involve sectors that don't see their involvement in questions concerning climate change. The environmental strategist in Linköping explained that when she invited the core-sectors in the municipality to a meeting concerning questions about adapting to climate change, it was first and foremost the planners working with the comprehensive plan that was and is actively working with these questions. Even though, for example, the future effects might affect elderly as a vulnerable group in society which is a question concerning a core-sector working with elderly care that is important to involve.

All the interviewees from the municipalities and the coordinator of climate adaptation of CAB speak of the local industries and corporations as an important collaboration partner in the transition work. The environmental strategist in Finspång explained that the municipality is active in “Energiriket”, a network for local industries and corporations. The participation is not mandatory and the network is for industries and corporations with a good-will to do more for the environment than they are obliged to.

In the interviews the interviewees talk about external networks and multi-level collaborations as a way to collect knowledge and to gain ideas how to move forward in their work. Both Linköping and Finspång are engaged in multi-level collaboration with other municipalities, regional cooperations and national networks such as “Klimatkommunerna” [The Climate Municipalities]. Both municipalities are also part of a multi-level collaboration called Borgmästaravtalet [Covenant of Mayors], a European Union network also directed towards municipalities that promotes a good-will to work harder for the environment than they are obliged to do the European directives. Collaboration can also occur with the universities and research authorities, Finspång has through the years been a part of a science project examining alternative ways to develop a modern energy plan, as the environmental strategist of Finspång points out:

*“The collaboration with the university on the work with the energy plan made our politicians proud, we want proud politicians. They [the politicians] even wanted to take the work further and decided to join the Borgmästaravtalet.”* (Author’s translation)

The result from the analysed shows that collaborations and networks can facilitate the processes with developing and implementing plans and objectives.

#### **4.3.2 Plans and objectives**

It was apparent that plans as tools were key for both municipalities and their transition work. As mentioned by the environmental strategist from Finspång, the comprehensive plans in municipalities’ create a basis for how and what the municipality works with. This involves both mitigation and adaptation more or less but climate adaptation is mainly mentioned as an area that needs more work in the future. The interviewees from Finspång explained that they are going to develop a climate adaptation plan next year and are currently spending this year preparing and gathering information for it. This plan will become a strategic step forward to increase the focus on climate adaptation in the municipality that so far has an established work

regarding mitigation. They both explained that their energy plan is paramount for their work that has led to them stepping up as a climate active municipality. With this plan, the energy and climate strategist from Finspång explains that she feels like she has a solid back-up to suggest measures and push the municipalities work further. This plan was the result of the municipality having the chance to participate in a scientific study from Linköping University (as mentioned above) that helped them gather information, establish measurement plans, set relevant objectives and delegate responsibilities. Thanks to this plan, the environmental strategist considers the municipality to have come much further than expected due to the small size of the municipality.

The Linköping interviewees also discussed the comprehensive plan as an integrated tool that enables them to seek out what areas they are working with within the municipalities. Both referred to this as fundamental and the project leader of comprehensive planning explained that they are currently working on a thematic adding to the plan regarding risk- and environmental aspects to the comprehensive plan that will have a longer time scale to be able to be useful for future changes in the comprehensive plan. Other than this, the coordinator from the CAB explained how the CAB has a responsibility to review the comprehensive plans to make sure all impacted areas are included which ensures that the municipalities are showcasing an awareness of climate related issues.

The environmental strategist explained that other than the comprehensive plan they are also working on an upcoming climate adaptation plan. The reason for these plans to develop now for both municipalities seems to be depending on the fact that it is "the right time" where the political directions, funding and resources fall into place to establish these climate adaptation plans in both municipalities.

Both municipalities have established objectives and visions that are essential for what they want to achieve with their transition work. The interviewees from Linköping both described their municipality's main objective, which is to become a CO<sub>2</sub>-neutral city in 2025. Due to this, the environmental strategist in Linköping elaborated that there is a vision within the municipality to be a transitional climate city that is a part of a global movement that is transforming. She also mentioned that within this, connections to the 1.5 °C objective set by the UN in 2015 was an ambition, to be a part of achieving that objective. In Finspång the interviewees discussed their climate objectives and that they aim to have fossil free transport in the municipal organisation in 2025, which is an objective regulated in the energy plan. Other than this, they

explained that the city is very proud of its successes with the energy plan, which resulted in a desire to be in the frontline of climate transition. The energy and climate strategist and the environmental strategist from Finspång agreed that one of the objectives to achieve now is to create a strategic climate adaptation plan. The coordinator from the CAB also considered a strategic climate adaptation plan to be the next important step for the municipalities in order to proceed with their transition to resilient low-carbon entities and explains that:

*“I think it is pretty important that [municipalities] work with developing a climate adaptation plan so that they become aware of their own municipalities problematics regarding this. And I think we are in the starting pits in the county, that we have started to collaboratively discuss this matter in networks that is coordinating the county’s climate adaptation”* (Author’s translation)

#### **4.3.3 Summarised result discussion on the tools for transition**

Our results indicate that networks and collaborations could create fundamental stepping stones for municipalities and act as support to processes further down the line. Gillard et al. (2016) discuss the issues of transitional change due to its interdisciplinary, multi-perspective/level/scale nature and how it can be addressed and understood further. Interdisciplinary networks and multi-level collaborations can occur as a tool throughout the whole implementation process. Scholarly, transition has gained an increased amount of attention and been considered to be a solution to manage the environmental change. There are many difficulties for transitional change, since it contests fundamental basis of the society such as legislation, financial systems, policies etc. (O’Brien, 2012, Pelling, 2011). Through networks and multi-level collaborations these difficulties can be further processed and identified solutions can be exchanged. Identifying effective strategies for transitional change in the context of environmental change is considered to be one of the greater challenges for global change studies this decade that might be benefitting from a transdisciplinary approach (O’Brien, 2012). The analysed results also show the difficulties of engaging core-sectors that does not see their participation in the transition work.

Analysis of the interviews suggests that plans as tools for transition as well as objectives/visions are key to the process of transition. Both municipalities had various plans that created the basis for their work, with special emphasis on the comprehensive plan. Thus, suggesting that the

spatial planning is an important step. Within the plans, objectives and visions were set that serves to steer the municipalities in the right direction.

Hrelja, Hjerpe & Storbjörk (2015) has studied spatial planning as a means to achieve transition locally in Swedish municipalities and conclude that there seems to be a distinctive difference from the goals and vision established in the municipal comprehensive plans and the decision-making in the legislation of plans through detailed development plans where more actors were involved to negotiate priorities. This phenomenon with competing interests has been prevalent in both municipalities and that even though there might be an ambitious comprehensive plan, there might still be compromises when settling the detailed plans. As mentioned by the coordinator from the CAB, they do have a responsibility to review the plans from the municipalities and ensure that consideration has been taken to climate related issues, but that does not mean that municipalities are going to take actual measures. In the two studied cases by Hrelja, Hjerpe & Storbjörk (2015), environmental assessment strategies and climate change context could even be excluded from the discussions of the detailed development plans since the economic growth was considered more beneficial and to bring up the climate change aspect could contest this choice. If the situation was as severe in the municipalities of this study, we do not know but there were indications that similar problematics was present. In their study, Hrelja, Hjerpe & Storbjörk (2015) suggests that an attractive storyline is what saves the outcomes of the plans through a desire to be an attractive city if that involves being climate smart and sustainable. If it were not for this, they argue that planning would have been even weaker to facilitate transition. Both municipalities in this study had ambitious objectives and visions and a willingness to be an attractive city was apparent. As such, this could be a reason for their progress so far, being able to match up a lot of the indicators for transition that we have identified. If so, there is a need to maintain the idea that a resilient, adaptive low-carbon city is in fact an attractive vision. If this is questioned, the drivers for succeeding with planning which has been shown to be a key tool, might fail to trigger transition.

## 5. Concluding discussion

As mentioned in the introduction, the municipalities chosen for this study was selected from the study made by Johansson et al. (2009) that had identified climate change vulnerabilities, risks and adaptive abilities in municipalities in the county of Östergötland. In this study, Finspång and Linköping had both identified risks such as flooding and increased temperatures that had contributed to trigger their transition work. Other than this, interviewees from Finspång considered regulatory compliance and national governance that infused demands on their climate actions to be one of the main drivers for them. Furthermore, there was an experienced lack of political municipal support and general support from networks, other than the support from the CAB. There was also a lack of focus on climate matters where economy appeared to be a main priority. In Linköping, the political support was considered one of the main drivers and the main obstacle was objective- and interest conflicts that hampered their progression. In our study, we have identified that both municipalities have both similarities in how they worked in 2009 when Johansson et al. conducted their study, but there has also been a development.

There appears to be a greater political support in Finspång that is deemed to be one of the enabling factors for the municipality. The energy plan was and is still currently considered to be of great help to push them forward, but they have also progressed through employing an energy and climate strategist, begun planning a climate adaptation strategy and through connecting with more networks such as applying for Klimatkommunerna [The Climate Municipalities] and continued their participation in Borgmästaravtalet [Covenant of Mayors]. Despite being a smaller municipality their transition work has, according to this study, made progress and despite the lack of resources, the increased awareness and municipal focus has resulted in a more defined plan for the development of the municipality.

In Linköping, the political support was and appears to still be fundamental for the municipality. In Johansson et al.'s (2009) study interviewees explained that a lot of focus in the municipality was on mitigation actions and most measures were taken within the spatial planning. According to the results of this study, this is still the case and there is a need for further integration of climate focus in other sectors. Conflicts between objectives and interests are still an issue, but there has been an identified need for more knowledge within the municipality. The upcoming climate adaptation plan is a step forward for the municipalities, since this was an area that needed prioritisation when Johansson et al. (2009) conducted their study.

Through the use of indicators as a method we can conclude that there has been a development in both municipalities and that both have started to focus more in involving adaptation in their organisation whilst still working with climate mitigation measures. As explained by Johansson et al. (2009) this is an important step since mitigating measures are more easily measured and evaluated with direct effects whilst adaptive measures are often more long term and harder to evaluate. Long term planning and perspectives have been identified as difficult barriers to overcome for both municipalities, which continues to be a matter of conflicting interest where other core-issues and immediate response measures can be prioritised. But the fact that both mitigation and adaption measures- and planning are active aspects in the municipalities allows the effects of these both to change the municipalities resilience in a more nuanced approach that alters the fundamental awareness that affects policy making and integrates more sectors than just spatial planning or environmental ones which is beneficial for the results of their measures short term and long term (Johansson et al., 2009).

As mentioned above, this study seeks to explore means of qualitatively assess climate transition in a municipality based level. One of the main approaches was to identify indicators that can be used for assessing the climate transition work. In our result we can see some difficulties with the indicators and the indicators list that we have promoted and also an advantage due the identified pattern that indicates a generalisability of the indicators. These difficulties include: *indicators dependence of the context, starting-pits indicators and indicators that today fall outside municipalities responsibilities.*

Due to the difficulty related to *indicators dependence of the context* there might be a need for key indicators in future studies using this approach. A key indicator could be described as indicators especially important due to factors in the specific municipality examined concerning socio-technological-, socio-ecological- and geographical dependencies that impact the effect on the measures that the indicator is promoting. These indicators could be of both a mitigating- and adaptive character. To understand and find these key indicators and their function, the municipalities' use of strategic planning could be seen as an essential source of information, due to the involvement of different actors, perspectives, areas, policies issues and interests (Hrelja, Hjerpe and Storbjörk, 2015). Through the document analysis on the documents from the municipalities and the interviews we can conclude that some indicators are more relevant than others due to their contextual specifics. For example, indicators regarding flooding can be seen as context specific since some are more exposed than others. As presented in Johansson et al. (2009) Linköping had been affected by flooding more than Finspång and had thereby worked

more preventative with these factors whereas Finspång had started implementing measures against flooding since they saw an increased amount of flooding in other municipalities in the county. Contextual based factors such as these are important to acknowledge when utilising indicators to detect transitional progress since municipalities varies greatly geographically and socio-economically/technically.

As our result shows, some indicators are of a character which is new for the municipalities, we call these *starting-pits indicators*. These indicators could be described as indicators that could potentially not be found through documents analysis since they are newly identified within the municipalities and the documents tend to have a delay because of the bureaucratic- and political systems. The starting-pits indicators could further be characterised by an increased or new-found awareness of their importance in the municipality but there is not yet any actual work with measures or any policies implemented on the subject but still indicates that the municipalities are aware and about to start working with the indicator. In this study, indicators concerning health and ecosystem services could be seen as starting-pits indicators. By using starting-pits indicators in future studies as this one, an understanding of the triggers and the process as Albrechts (2006) discusses could be used to understand the paradigm or anomalies within the process. Park et al. (2012) defines climate transitions four phases as explained in section 2.2. According to these phases we can see similarities in how climate transition progresses in the municipalities and that they both appears to be in phase two where the take-off occurs which starts to destabilise current governance systems and triggers innovation. The starting-pits indicators such as the ones identified in this study could be seen as a part of a take-off phase. They are nevertheless relevant and important indicators to assess municipal climate transition since it is with these that path dependencies can be shifted, thus allowing new development paths to be created that is key to climate transition (Burch et al., 2014).

The category *Indicators that today fall outside municipalities responsibilities* could be discussed whether or not it is a difficulty per se. But we would like to argue that the indicators that fall outside the municipalities responsibility suggests a need for fundamental changes of the current system, that is called for in the literature (Pelling, O'Brien & Matyas, 2015; Gillard et. al., 2016; Nalau & Handmer, 2015; O'Brien, 2012; Burch et al., 2014;). The risks of not fundamentally altering existing systems can result in incremental adjustments that fail to change the negative processes that led to the unsustainable current system (Pelling, O'Brien & Matyas, 2015; Nalau & Handmer, 2015; Park et al., 2012). To be able to transform into a low-carbon and resilient entity as a municipality, there is a need to understand what triggered the negative



functions to avoid falling back to old pathways (Burch et al., 2014). As our result show it is mainly the indicators concerning agriculture and forestry that fall outside their responsibility today. As the climate changes and the effects of it starts to show, we argue that the municipalities' responsibilities will have to change with it. As explained by the interviewees for this study, they can see a connection to how these sectors are relevant for their municipalities' ability to work with climate change. Due to this, networks between the sectors, their responsible authorities and the municipalities could be a start to enhance municipalities' ability to succeed with transitional change.

As mentioned earlier, we have also found a pattern that indicates a generalisability in using our indicators on municipalities of different sizes with different capacities. All the indicators were essential for the understanding of the transitional process in the municipalities. The lack of measures connected to the indicators in the municipalities could indicate a need for a different approach to using the indicators and also characterising the complexity of working with the indicators. This means that the indicators needs to be understood conceptually to be fitted to specific municipalities, through a use of document analysis and interviews. But to be able to generalise the findings more studies needs to be conducted on more municipalities. We found that the indicators (see table 3) presented in this study, fitted in a Swedish context and the municipalities' contexts, and indicators as an approach could be a valid way to assess municipalities' transition through the need for an understanding of the context they function within.

Finally, by comparing our study to the study conducted by Johansson et al. (2009), we can see that there has been a progression with the municipalities' transition work. The purpose of this study was to investigate how transition can be assessed, and we conclude that indicators can be used for this purpose. However, it is important to acknowledge that there is a difficulty in assessing how far a municipality has come, due to the lack of examples of successful transitions. Since we do not have a municipality to compare with that have undergone a full transition, the method of assessing transition through indicators only reflects that progression has or has not occurred and what the drivers and barriers are for this. Future studies that can detect a full transition are needed for a complete picture of climate transition to be able to see exactly how far a municipality has come. Since climate change indeed has been considered the biggest challenge of our time, climate transition studies are essential to understand how we develop our societies, and as this study show, what enables and hampers the process to be able to create low-carbon intensive resilient societies and be able to meet the global goals.



## 6. References

- Albrechts, L. (2006), Shifts in strategic spatial planning? Some evidence from Europe and Australia. *Environment and Planning*, vol. 38, 1149–1170.
- Antonson, H., Isaksson, K., Storbjörk, S. & Hjerpe, M. (2016), "Negotiating climate change responses: Regional and local perspectives on transport and coastal zone planning in South Sweden", *Land Use Policy*, vol. 52, pp. 297-305.
- Armitage, D., Marschke, M. & Plummer, R. (2008), Adaptive co-management and the paradox of learning, *Global Environmental Change*, 18(1), pp. 86–98.
- Boezeman, D. & Kooij, H.J. (2015), "Heated debates: The transformation of urban warming into an object of governance in the Netherlands" in *Evolutionary Governance Theory: Theory and Applications*, pp. 185-203.
- Bowen, G. A. (2009), "Document Analysis as a Qualitative Research Method", *Qualitative Research Journal*, Vol. 9 (2) pp. 27 - 40.
- Bryman, A. (1997), *Kvantitet och kvalitet - I samhällsvetenskaplig forskning* Studentlitteratur: Lund.
- Bryman, A. (2008), *Samhällsvetenskapliga metoder*. 2 .ed. Liber AB: Stockholm.
- Bulkeley, H. (2010), Cities and the governing of climate change. *Annual Review of Environment and Resources*, vol. 35, pp. 229–253.
- Burch, S., Shaw, A., Dale, A. & Robinson, J. (2014), "Triggering transformative change: a development path approach to climate change response in communities", *Climate Policy (Earthscan)*, vol. 14, no. 4, pp. 467-487.
- Busch, H. & McCormick, K. (2014), "Local power: Exploring the motivations of mayors and key success factors for local municipalities to go 100% renewable energy", *Energy, Sustainability and Society*, vol. 4, no. 1, pp. 1-15.
- Byrne, J., Taminiu, J., Kurdgelashvili, L. & Kim, K.N. (2014), "A review of the solar city concept and methods to assess rooftop solar electric potential, with an illustrative application to the city of Seoul", *Renewable and Sustainable Energy Reviews*, vol. 41, pp. 830-844.

- Carden, K. & Armitage, N.P. (2013), "Assessing urban water sustainability in South Africa - Not just performance measurement", *Water SA*, vol. 39, no. 3, pp. 345-350.
- Carter, J.G., Cavan, G., Connelly, A., Guy, S., Handley, J. & Kazmierczak, A. (2015), "Climate change and the city: Building capacity for urban adaptation", *Progress in Planning*, vol. 95, pp. 1-66.
- Chelleri, L., Schuetze, T. & Salvati, L. (2015), "Integrating resilience with urban sustainability in neglected neighbourhoods: Challenges and opportunities of transitioning to decentralized water management in Mexico City", *Habitat International*, vol. 48, pp. 122-130.
- Chelleri, L., Waters, J.J., Olazabal, M. & Minucci, G. (2015), "Resilience trade-offs: addressing multiple scales and temporal aspects of urban resilience", *Environment and Urbanization*, vol. 27, no. 1, pp. 181-198.
- Cloern, J.E., Knowles, N., Brown, L.R., Cayan, D., Dettinger, M.D., Morgan, T.L., Schoellhamer, D.H., Stacey, M.T., van der Wegen, M., Wagner, R.W. & Jassby, A.D. (2011), "Projected evolution of California's San Francisco bay-delta-river system in a century of climate change", *PLoS ONE*, vol. 6, no. 9
- Colenbrander, S., Gouldson, A., Sudmant, A.H. & Papargyropoulou, E. (2015), "The economic case for low-carbon development in rapidly growing developing world cities: A case study of Palembang, Indonesia", *Energy Policy*, vol. 80, pp. 24-35.
- Colombier, M. & Li, J. (2012), "Shaping climate policy in the housing sector in northern Chinese cities", *Climate Policy*, vol. 12, no. 4, pp. 453-473.
- Davoudi, S., Crawford, J., & Mehmood, A. (2009), *Planning for climate change*. London: Earthscan. European Commission.
- Davoudi, S., Zhao, P. & Brooks, E. (2014), "Retrofitting cities for low-carbon urban futures in Europe and China", *DISP*, vol. 50, no. 3, pp. 6-10.
- Denzin, N. K. (1970), *The research act: A theoretical introduction to sociological methods*. New York: Aldine.
- Eames, M., Dixon, T., May, T. & Hunt, M. (2013), "City futures: Exploring urban retrofit and sustainable transitions", *Building Research and Information*, vol. 41, no. 5, pp. 504-516.

Eisner, E. W. (1991), *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. Toronto: Collier Macmillan Canada.

Finspång Municipality (2012), *Finspångs folkmängd ökar för sjätte året i rad*. Available at: <http://www.finspang.se/Kommun-och-demokrati/Nyheter/2015/Finspangs-folkmangd-okar-for-sjatte-aret-i-rad/> Collected 2016-04-25

Finspångs Tekniska Verk (2014), *Årsrapport för VA-verksamheten för räkenskapsåret 2014* Finspång.

Finspångs Tekniska Verk (n.d), *Vatten Finspång* Available at: <http://www.finspang.se/finspangstekniskaverk/Miljo--kvalitet/Vara-basta-miljotips/Hemma/> Collected: 2016-03-11

Folke C, Carpenter SR, Walker BH, Scheffer M, Chapin FS III, and Rockström J. (2010), Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society* vol.15 (4): Article 20.

Gillard, R., Gouldson, A., Paavola, J. and Van Aalstine, J., (2016), Transformational responses to climate change: Beyond a systems perspective of social change in mitigation and adaptation. *Wiley Interdisciplinary Reviews: Climate Change*, vol. 7(2), pp. 251-265.

Government Office of Sweden (2007), *Sverige inför klimatförändringarna - hot och möjligheter* ID: SOU 2007:60.

Greca, P.L., Barbarossa, L., Ignaccolo, M., Inturri, G. & Martinico, F. (2011), "The density dilemma. A proposal for introducing smart growth principles in a sprawling settlement within Catania Metropolitan Area", *Cities*, vol. 28, no. 6, pp. 527-535.

Hofmann, M., Müller, N.D., Stankiewicz, C.J., Pfnür, A. & Linke, H.J. (2015), "The effects of knowledge orders on climate change policy in urban land management and real estate management: a case study of three German cities", *Urban Research and Practice*, vol. 8, no. 3, pp. 336-353

Holme, I. M., Slovang, B, K (1996), *Forskningsmetodik- om kvalitativa och kvantitativa metoder*. 3 ed. Studentlitteratur: Lund

Hrelja, R., Hjerpe, M., Storbjörk, S., (2015), "Creating Transformative Force? The Role of Spatial Planning in Climate Change Transitions Towards Sustainable Transportation", *Journal of Environmental Policy and Planning*.

IPCC (2014), Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 117-130.

Johansson, M., Hjerpe, M., Simonsson S., and Storbjörk S. (2009), *Hur möter östgötakommunerna klimatfrågan? En kartläggning av risker, sårbarhet och anpassning inför klimatvariationer och klimatförändringar* Rapport 2009:4.

Kalafatis, S.E., Grace, A. & Gibbons, E. (2015), "Making climate science accessible in Toledo: The linked boundary chain approach", *Climate Risk Management*, vol. 9, pp. 30-40.

Kates, R.W., Travis, W.R., Wilbanks, T.J., (2012), Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* vol. 109 (19), pp.7156–7161.

Khan, F. & Borgstrom-Hansson, C. (2015), "Using the Earth Hour City Challenge to identify high leverage points for footprint reduction in cities", *Journal of Cleaner Production*.

Klimatanpassningsportalen (n.d), *Verktyg för anpassningsområden* Available at: <http://klimatanpassning.se/atgarda/anpassningsomraden/verktyg-for-anpassningsomraden>  
Collected: 2016-03-08.

Kocabas, A. (2013), "The transition to low carbon urbanization in Turkey: Emerging policies and initial action", *Habitat International*, vol. 37, pp. 80-87.

Koop, S.H.A. & van Leeuwen, C.J. (2015), "Application of the Improved City Blueprint Framework in 45 Municipalities and Regions", *Water Resources Management*, vol. 29, no. 13, pp. 4629-4647.

Kriegler, E., Riahi, K., Bauer, N., Schwanitz, V.J., Petermann, N., Bosetti, V., Marucci, A., Otto, S., Parouso, L., Rao, S., Arroyo Currás, T., Ashina, S., Bollen, J., Eom, J., Hamid-Cheriff, M., Longden, T., Kitous, A., Méjean, A., Sano, F., Schaeffer, M., Wada, K., Capros,

P.P., van Vuuren, D., Edenhofer, O., (2015), *Making or Breaking Climate Targets: the AMPERE study on staged accession scenarios for climate policy*. Technol. Forecasting Social Change vol. 90 (Part A): 24-44.

Kumar, V., Del Vasto-Terrientes, L., Valls, A. & Schuhmacher, M. (2015), "Adaptation strategies for water supply management in a drought prone Mediterranean river basin: Application of outranking method", *Science of the Total Environment*,

Kvale S. & Brinkmann S. (2014), *Den kvalitativa forskningsintervjun*. 3:1 ed. Studentlitteratur: Lund.

Lassa, J.A. & Nugraha, E. (2015), "From shared learning to shared action in building resilience in the city of Bandar Lampung, Indonesia", *Environment and Urbanization*, vol. 27, no. 1, pp. 161-180.

Linköping Municipality (2016), *Statistik info 2016:02* Available at: <http://www.linkoping.se/Global/Om%20kommunen/Fakta%20om%20Link%C3%B6ping/Statistiska%20fakta%20om%20Link%C3%B6ping/Statistikinfo/Statistikinfo%202016/2016%20nr%2002%20folkm%C3%A4ngd.pdf> Collected: 2016-03-17.

Liu, W., Wang, C., Xie, X., Mol, A.P.J. & Chen, J. (2012), "Transition to a low-carbon city: Lessons learned from Suzhou in China", *Frontiers of Environmental Science and Engineering in China*, vol. 6, no. 3, pp. 373-386.

Maibach, E.W., Chadwick, A., McBride, D., Chuk, M., Ebi, K.L. & Balbus, J. (2008), "Climate change and local public health in the United States: Preparedness, programs and perceptions of local public health department directors", *PLoS ONE*, vol. 3, no. 7.

Malterud, K. (2009), *Kvalitativ metod i medicinsk forskning*. Studentlitteratur: Lund.

Martinez, G.S., Imai, C. & Masumo, K. (2011), "Local heat stroke prevention plans in Japan: Characteristics and elements for public health adaptation to climate change", *International Journal of Environmental Research and Public Health*, vol. 8, no. 12, pp. 4563-4581.

McCormick, K., Anderberg, S., Coenen, L. & Neij, L. (2013), "Advancing sustainable urban transformation", *Journal of Cleaner Production*, vol. 50, pp. 1-11.

McPhearson, T., Andersson, E., Elmqvist, T., Frantzeskaki, N. (2015), "Resilience of and through urban ecosystem services", *Ecosystem Services*.

Mickwitz, P., Hildén, M., Seppälä, J. & Melanen, M. (2011), "Sustainability through system transformation: Lessons from Finnish efforts", *Journal of Cleaner Production*, vol. 19, no. 16, pp. 1779-1787.

Miranda Sara, L. & Baud, I. (2014), "Knowledge-building in adaptation management: concertación processes in transforming Lima water and climate change governance", *Environment and Urbanization*, vol. 26, no. 2, pp. 505-524.

Moloney, S. & Horne, R. (2015), "Low carbon urban transitioning: From local experimentation to urban transformation?", *Sustainability (Switzerland)*, vol. 7, no. 3, pp. 2437-2453.

Municipality of Finspång (2003 a), *Naturvårdprogram Finspång*.

Municipality of Finspång (2003b), *Tio år efter Rio – Fem år i Finspång Rapport om det lokala Agenda 21-arbetet Finspång*.

Municipality of Finspång (2011), *Översiktsplan - Framtiden finns i Finspång Finspång*.

Municipality of Finspång (2012), *2021 är vi 21 156 invånare i Finspångs kommun*. Available at: <http://www.finspang.se/Kommun-och-demokrati/Nyheter/2012/2021-kommer-vi-att-vara-21-156-invanare-i-Finspang-kommun/> Collected: 2016-06-12.

Municipality of Finspång (2015a), *Energiplan - Energi och klimat strategi för 2015-2018 Finspång*.

Municipality of Finspång (2015b), *Kulturmiljöprogram Finspång*.

Municipality of Linköping (2009a), *Trafiksäkerhetsprogram för Linköpings kommun. Linköping*.

Municipality of Linköping (2009b), *Kulturhistoriskt underlag till översiktsplan för staden Linköping. Linköping*.

Municipality of Linköping (2010a), *Översiktsplanen för staden Linköping*. Larssons Offerttryck AB: Linköping.

Municipality of Linköping (2010b), *Översiktsplanen för staden Linköping - Trafikstrategi*. Larssons Offerttryck AB: Linköping.



Municipality of Linköping (2010c), *Miljö- och riskfaktorer i Linköping*. Larssons Offertryck AB: Linköping.

Municipality of Linköping (2013a), *Hållbarhetsrapport 2013*. Linköping.

Municipality of Linköping (2013b), *Naturvårdsprogram Del 1: Natur och naturvård i Linköping*. Elanders Sverige AB, Linköping.

Municipality of Linköping (2013c), *Miljöpolicy för Linköpings kommun*. Linköping.

Nalau, J. & Handmer, J. (2015), "When is transformation a viable policy alternative?" *Environmental Science and Policy*, vol. 54, pp. 349-356.

Nelson, D.R, Adger, W.N, and Brown, K. (2007), Adaptation to environmental change: Contributions of a resilience framework. *Annual Review of Environment and Resources* vol. 32: pp. 395 –419.

Neumann, M.B., Rieckermann, J., Hug, T. & Gujer, W. (2015), "Adaptation in hindsight: Dynamics and drivers shaping urban wastewater systems", *Journal of environmental management*, vol. 151, pp. 404-415.

O'Brien, K. (2012), "Global environmental change II: From adaptation to deliberate transformation", *Progress in Human Geography*, vol. 36, (5), pp. 667-676.

Park, S.E., Marshall, N.A., Jakku, E., Dowd, A.M., Howden, S.M., Mendham, E. Fleming, A. (2012), "Informing adaptation responses to climate change through theories of transformation", *Global Environmental Change Part A: Human & Policy Dimensions*, vol. 22, no. 1, pp. 115.

Pelling, M (2011), *Adaptation to Climate Change: From Resilience to Transformation*. Abingdon: Routledge.

Pelling, M., O'Brien, K. & Matyas, D. (2015), "Adaptation and transformation", *Climatic Change*, vol. 133, no. 1, pp. 113-127.

Perales-Momparler, S., Andrés-Doménech, I., Andreu, J. & Escuder-Bueno, I. (2014), "A regenerative urban storm water management methodology: The journey of a Mediterranean city", *Journal of Cleaner Production*.

- Ray, D., Bathgate, S., Moseley, D., Taylor, P., Nicoll, B., Pizzirani, S. & Gardiner, B. (2014), "Comparing the provision of ecosystem services in plantation forests under alternative climate change adaptation management options in Wales", *Regional Environmental Change*.
- Roberts, D. & O'Donoghue, S. (2013), "Urban environmental challenges and climate change action in Durban, South Africa", *Environment and Urbanization*, vol. 25, no. 2, pp. 299-319
- Romero-Lankao, P. (2012), Governing carbon and climate in the cities. *European Planning Studies*, vol. 20, (1), 7–26.
- Rosenzweig, C. & Solecki, W. (2014), "Hurricane Sandy and adaptation pathways in New York: Lessons from a first-responder city", *Global Environmental Change*, vol. 28, pp. 395-408.
- Ross, M.T., Fawcett, A.A. & Clapp, C.S. (2009), "U.S. climate mitigation pathways post-2012: Transition scenarios in ADAGE", *Energy Economics*, vol. 31, no. SUPPL. 2, pp. S212-S222.
- Sharma, M. (2007), Personal to planetary transformation. *Kosmos Journal*. Vol. 7(1).
- Shukla, P.R. & Dhar, S. (2015), "Energy policies for low carbon sustainable transport in Asia", *Energy Policy*, vol. 81, pp. 170-175.
- Stone, B., Vargo, J., Liu, P., Hu, Y. & Russell, A. (2013), "Climate change adaptation through urban heat management in Atlanta, Georgia", *Environmental Science and Technology*, vol. 47, no. 14, pp. 7780-7786.
- Storbjörk, S. (2010), 'It Takes More to Get a Ship to Change Course': Barriers for Organizational Learning and Local Climate Adaptation in Sweden, *Journal of Environmental Policy & Planning*, 12:3, 235-254.
- Stosius, A., Kofalk, S. & Schleuter, M. (2012), "A concept for the development of model indicators for policy makers to adapt German inland waters to climate change", *iEMSs 2012 - Managing Resources of a Limited Planet: Proceedings of the 6th Biennial Meeting of the International Environmental Modelling and Software Society*, pp. 1735.
- Swedish Environmental Protection Agency (2002), *Handlingskraft för klimatet - Om svenska kommuners arbete* Stockholm. ISBN: 91-620-8096-2.

Swedish Society for Nature Conservation (2008), *Klimatindex för kommuner 2007* (PDF) Available at: [http://www.naturskyddsforeningen.se/sites/default/files/dokument-media/2008\\_klimat\\_klimatindex\\_kommuner\\_2007.pdf](http://www.naturskyddsforeningen.se/sites/default/files/dokument-media/2008_klimat_klimatindex_kommuner_2007.pdf).

Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B. & van Vuuren, D. (2015), "Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges", *Global Environmental Change*, vol. 35, pp. 239-253.

UNFCCC (n.d), *Historic Paris Agreement on Climate Change 195 Nations Set Path to Keep Temperature Rise Well Below 2 Degrees Celsius*. Available at: <http://newsroom.unfccc.int/unfccc-newsroom/finale-cop21/> Collected: 2016-06-12.

Van Dijk, E., Van Der Meulen, J., Kluck, J. & Straatman, J.H.M. (2014), "Comparing modelling techniques for analysing urban pluvial flooding", *Water Science and Technology*, vol. 69, no. 2, pp. 305-311.

Vedeld, T., Coly, A., Ndour, N.M. & Hellevik, S. (2015), "Climate adaptation at what scale? Multi-level governance, resilience, and coproduction in Saint Louis, Senegal", *Natural Hazards*

Velasco, E. & Roth, M. (2012), "Review of Singapore's air quality and greenhouse gas emissions: Current situation and opportunities", *Journal of the Air and Waste Management Association*, vol. 62, no. 6, pp. 625-641.

Wagner, I. & Breil, P. (2013), "The role of ecohydrology in creating more resilient cities", *Ecohydrology and Hydrobiology*, vol. 13, no. 2, pp. 113-134.

Wamsler, C., & Brink, E., (2014a), "Moving beyond short-term coping and adaptation", *Environment & Urbanization*, , pp. 86.

Wamsler, C. & Brink, E. (2014b), "Planning for climatic extremes and variability: A review of Swedish municipalities' adaptation responses", *Sustainability (Switzerland)*, vol. 6, no. 3, pp. 1359-1385.

Wamsler, C. & Brink, E. (2015), "The role of individual adaptive practices for sustainable adaptation", *International Journal of Disaster Resilience in the Built Environment*, vol. 6, no. 1, pp. 6-29.

Wamsler, C., Luederitz, C. & Brink, E. (2014), "Local levers for change: Mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions", *Global Environmental Change*, vol. 29, pp. 189-201.

Ward, P.J., Pauw, W.P., van Buuren, M.W. & Marfai, M.A. (2013), "Governance of flood risk management in a time of climate change: The cases of Jakarta and Rotterdam", *Environmental Politics*, vol. 22, no. 3, pp. 518-536.

Whiteman, G., de Vos, D.R., Chapin, F.S., Yli-Pelkonen, V., Niemelä, J. & Forbes, B.C. (2011), "Business strategies and the transition to low-carbon cities", *Business Strategy and the Environment*, vol. 20, no. 4, pp. 251-265.

Williams, K., Joynt, J.L.R. & Hopkins, D. (2010), "Adapting to climate change in the compact city: The suburban challenge", *Built Environment*, vol. 36, no. 1, pp. 105-115.

Zimmermann, K., Boghrat, J. & Weber, M. (2015), "The epistemologies of local climate change policies in Germany", *Urban Research and Practice*, vol. 8, no. 3, pp. 303-318.

## **7. Appendix**

Appendix 1 Interview guide

Appendix 2 Literature review from Scopus

Appendix 3 Literature review Swedish Environmental Protection Agency

Appendix 4 Literature review Klimatanpassningsportalen

Appendix 5 Literature review Government office of Sweden

## Appendix 1 Interview guide

### **Intervjuguide Finspång**

Vi inleder med att förtydliga syftet med studien och upplägget. Sedan förklarar vi för intervjupersonerna att de har möjlighet att vara anonyma, att de gärna får ta del av det bearbetade transkriberade materialet och komma med synpunkter om det är något de funderar över. Vi frågar även om det går bra att vi spelar in samtalet och om det går bra att vi återkommer om något behövs tydliggöras. Slutligen berättar vi att vi gärna skickar uppsatsen när den är klar. Kommun/länsstyrelse infogas där “---” förekommer i intervjuguiden

### **Inledande frågor**

- Kan du berätta om din yrkesroll? Vad arbetar du med för frågor och vad har du för erfarenhet?

### **Generella klimatfrågor**

- Hur tror du att Finspång/Linköping kan komma att påverkas av klimatförändringar?
- Hur arbetar du med klimatförändringar? (strategiskt eller praktiskt)
  - Vad innebär det för dig och din roll inom ----?
- På ett generellt plan, är det generellt i Finspång lätt eller svårt att:
  - Minska utsläpp av växthusgaser?
  - Anpassa kommunen till effekter av klimatförändringar?

### **Konkret klimatarbete**

- Vilka specifika projekt/åtgärder har kommunen arbetat med inom ditt område?
- För varje projekt/åtgärd, vad underlättade eller försvårade arbetet?
- Vad planerar ni att arbeta med kring klimat framöver?
- För varje sak som dyker upp: vad skulle kunna underlätta och försvåra detta?

### **Prioriterade områden/sektorer**

- Inom vilka områden anser du att ---- är mest verksam i fråga om klimatarbete?
- Hur kommer det sig? (Exempel områden: Energi, transport, bygg, stadsplanering, jordbruk/skogsbruk, miljö, hälsa, avlopp/dagvatten och dricksvatten). Medveten prioritering eller annan förklaring?
- Vilka områden arbetas det mindre/inte alls med? Varför just dessa?

## **Styrning**

- Vad skulle behöva finnas på plats för att ni ska kunna jobba mer med klimatrelaterade frågor/projekt/åtgärder?  
- (t.ex. politiskt stöd, styrmedel, strategier och mål, policys, integrering, ansvarsfördelning m.m.).
- (Vad skulle du vilja uppnå i ert klimatanpassningsarbete?)

## **Sektorsspecifika frågor**

- Hur arbetar ni med folkhälsofrågor inom klimatomställning? (Värmeböljor/risk för sårbara grupper) Om det inte är ni, vem?
- Hur ser ert arbete ut kring jordbruk och skogsbruk i förhållande till klimatomställning? (Skördeskadeskydd/ brandrisks arbete/ inköp av närproducerat virke).
- Av de indikatorer vi identifierat är det några om vi skulle vilja höra om ni arbetar. Ej identifierade indikatorer: Ekosystemtjänster i planprocesser?

## **Avslutning**

Fråga om det finns något som respondenten vill tillägga eller förtydliga eller har frågor om något som kommit upp under intervjun. Avsluta med att förtydliga att vi kommer ge en möjlighet till granskning/ skicka det bearbetade transkriberade materialet till respondenten. Tacka för intervjun och fråga om det är okej att vi höra av oss om vi har ytterligare frågor.

Appendix 2 Literature review from Scopus

<b>Mitigation</b>		
<b>Area</b>	<b>Indicator</b>	<b>Reference</b>
Energy	Energy efficiency	Colombier, M. & Li, J. (2012)
	Energy efficiency	Liu, W., Wang, C., Xie, X., Mol, A.P.J. & Chen, J. (2012)
	Energy policys	Ross, M.T., Fawcett, A.A. & Clapp, C.S. (2009)
	Energy policys	Kocabas, A. (2013).
Flooding	Flooding management	Van Dijk, E., Van Der Meulen, J., Kluck, J. & Straatman, J.H.M. (2014)
Spatial planning	Air quality	Velasco, E. & Roth, M. (2012)
	Land use management	Hofmann, M., Müller, N.D., Stankiewicz, C.J., Pfnür, A. & Linke, H.J. (2015)
	Sustainable transformation plans	Mickwitz, P., Hildén, M., Seppälä, J. & Melanen, M. (2011)
Water	Water resource management	Koop, S.H.A. & van Leeuwen, C.J. (2015)
Waste	Waste management	Colenbrander, S., Gouldson, A., Sudmant, A.H. & Papargyropoulou, E. (2015)

<b>Adaptation</b>		
<b>Area</b>	<b>Indicator</b>	<b>References</b>
Energy	Energy efficiency	Davoudi, S., Zhao, P. & Brooks, E. (2014)
Flooding	Flooding management	Vedeld, T., Coly, A., Ndour, N.M. & Hellevik, S. (2015)
	Risk assessment of flooding	Ward, P.J., Pauw, W.P., van Buuren, M.W. & Marfai, M.A. (2013)
Blue green infrastructure	Sustainable spatial planning	Greca, P.L., Barbarossa, L., Ignaccolo, M., Inturri, G. & Martinico, F. (2011)



	Ecosystem service-based planning	Wamsler, C., Luederitz, C. & Brink, E. (2014)
Spatial planning	Urban adaptation	Roberts, D. & O'Donoghue, S. (2013)
	Urban adaptation	Carter, J.G., Cavan, G., Connelly, A., Guy, S., Handley, J. & Kazmierczak, A. (2015)
	Urban adaptation	Chelleri, L., Waters, J.J., Olazabal, M. & Minucci, G. (2015)
	Urban adaptation	Rosenzweig, C. & Solecki, W. (2014)
	Urban ecosystem services	McPhearson, T., Andersson, E., Elmqvist, T. & Frantzeskaki, N. (2015)
	Urban reconstruction for sustainability	Eames, M., Dixon, T., May, T. & Hunt, M. (2013)
Water	Adaptation to increased sea levels	Cloern, J.E., Knowles, N., Brown, L.R., Cayan, D., Dettinger, M.D., Morgan, T.L., Schoellhamer, D.H., Stacey, M.T., van der Wegen, M., Wagner, R.W. & Jassby, A.D. (2011)
	Waste systems	Neumann, M.B., Rieckermann, J., Hug, T. & Gujer, W. (2015)
	Water management	Lassa, J.A. & Nugraha, E. (2015)
	Water management	Kumar, V., Del Vasto-Terrientes, L., Valls, A. & Schuhmacher, M. (2015)
	Storm water management	Kalafatis, S.E., Grace, A. & Gibbons, E. (2015)
	Water resource management	Wagner, I. & Breil, P. (2013)
	Water resource management	Miranda Sara, L. & Baud, I. (2014)
	Inland water management	Stosius, A., Kofalk, S. & Schleuter, M. (2012)
	Sustainable policy	Chelleri, L., Schuetze, T. & Salvati, L. (2015)

Health	Management of urban heating systems	Boezeman, D. & Kooij, H.J. (2015)
	Management of urban heating systems	Martinez, G.S., Imai, C. & Masumo, K. (2011)
	Local health care in the context of climate change	Maibach, E.W., Chadwick, A., McBride, D., Chuk, M., Ebi, K.L. & Balbus, J. (2008)
Forest	Forest preservation	Stone, B., Vargo, J., Liu, P., Hu, Y. & Russell, A. (2013)
	Forest planting	Stone, B., Vargo, J., Liu, P., Hu, Y. & Russell, A. (2013)
	Forest planting	Ray, D., Bathgate, S., Moseley, D., Taylor, P., Nicoll, B., Pizzirani, S. & Gardiner, B. (2014)
Behavior	Individuals adaptation	Wamsler, C. & Brink, E. (2015)
	Individuals adaptation	Wamsler, C. & Brink, E. (2014b)

<b>Adaptation and mitigation</b>		
<b>Area</b>	<b>Indicator</b>	<b>Reference</b>
Energy	Increased usage of solar power/energy	Byrne, J., Taminiau, J., Kurdgelashvili, L. & Kim, K.N. (2014)
	100 % renewable energy	Busch, H. & McCormick, K. (2014)
	Corporate climate strategies in cities	Whiteman, G., de Vos, D.R., Chapin, F.S., Yli-Pelkonen, V., Niemelä, J. & Forbes, B.C. (2011)
	Decreased CO2 emissions in cities	Moloney, S. & Horne, R. (2015)
Spatial planning	Real estate planning	Hofmann, M., Müller, N.D., Stankiewicz, C.J., Pfnür, A. & Linke, H.J. (2015)
	Structural transformation processes	McCormick, K., Anderberg, S., Coenen, L. & Neij, L. (2013)

	Decreased urban footprint	Khan, F. & Borgstrom-Hansson, C. (2015)
Water	Urban water management	Carden, K. & Armitage, N.P. (2013)
	Stormwater management	Perales-Momparler, S., Andrés-Doménech, I., Andreu, J. & Escuder-Bueno, I. (2014)
Transport	Transport systems and policies	Shukla, P.R. & Dhar, S. (2015)
Health	Knowledge transformation epistemologically for transition	Zimmermann, K., Boghrat, J. & Weber, M. (2015)
Behavior	Municipal behavior on suburban transformation	Williams, K., Joynt, J.L.R. & Hopkins, D. (2010)

Appendix 3 Literature review Swedish Environmental Protection Agency

<b>Mitigation</b>	
<b>Swedish Environmental Protection Agency (2002)</b>	
<b>Area</b>	<b>Indicator</b>
Energy	Reduced energy usage
	Energy counselling
	Developed system (production and policy) for renewable energy sources
Transport	Alternative transport possibilities
	Increased traffic security
	New transport policy
Food	Changed food culture
	Decreased environmental stress of food choices
Adult education	Information sharing
Spatial planning	Development of infrastructure for environmental friendly transport

Appendix 4 Literature review Klimatanpassningsportalen

<b>Adaption</b>	
<b>Klimatanpassningsportalen (n.d)</b>	
<b>Area</b>	<b>Indicator</b>
Spatial planning	Climate adaptation of buildings
	Management of polluted land
Water	Drinking water supply
	Stormwater management
	Waste/water management
Ecosystem services	Protection of ecosystem services
Erosion	Prevention of erosion risks
	Landslips
Health	Heat waves
Agriculture	Climate adaptation for agriculture
Crisis Management	Crisis preparedness
	Fire hazard preparedness
Culture	Cultural heritage protections
Biological diversity	Nature protections
Forestry	Forestry management
Energy	Energy supply
Agriculture	Drought management

Appendix 5 Literature review Government office of Sweden

<b>Mitigation and adaption</b>	
<b>Government Office of Sweden (2007)</b>	
<b>Area</b>	<b>Indicator</b>
Transport	Traffic safety
	Increased resilience of infrastructure
	Telecommunications
Energy	Energy production
Technology	Dam plant
	District heating
Water	Drinking water supplies
Spatial planning	Flooding management in settlements
	Erosion in coastal settlements
	Storm water and wastewater management
	Construction rules in real estate
Erosion/ landslip	Mapping of geographical areas
Forestry	Forest management
Agriculture	Climate adaptation in agriculture
Biological diversity	Fishing
	Biodiversity and ecosystems
	Migration of foreign species
Spatial planning	Increased tourism
	Heat waves
Health	Heat waves
	Air quality
	Contamination proliferation