Does climate change pose a threat or opportunity to Swedish business?

An explorative branch study of the Swedish business sector’s understanding of climate change

Johanna Brunge

Nyckelord

Climate change, mitigation, adaptation, response capacity and Swedish business sectors
Preface

This Master of Science thesis is written on the behalf of the Centre for Climate Science and Policy Research (CSPR), which is a joint venture between Linköping University and the Swedish Meteorological and Hydrological Institute (SMHI). The Centre conducts interdisciplinary research on climate change consequences, which includes strategies to mitigate greenhouse gas emissions and adapting society to its effects. It is these two important areas of research that this thesis is addressing in the context of how businesses perceive and deal with potential climate change issues.
Acknowledgement

The focus of this thesis is without a doubt in accordance with my interests and I am pleased to having had the opportunity to engage further in the climate change research, not to mention meeting the respondents in the sectors. Hence, I would like to acknowledge all the respondents for having taken the time and to sharing your views. I would also like to acknowledge my supervisor Mattias Hjerpe for valuable support from the very first start to the last written word. It has always been a thrilling task to, with the help of Mattias, refine the ideas and advance the progress.

When the need has arisen to discuss thoughts and ideas of this thesis, I have turned to my precious colleague Karin André who has helped me overcome obstacles and pass thresholds. Finally I would like to thank Emelie Brunge and Sean Grant for valuable support and editorial assistance.

Johanna Brunge

Stockholm, 7 June 2007
Abstract

Scientist and decision-makers on the international and national arena agree that the climate is changing and will continue to change over this century. In fact, even if greenhouse gas emissions are brought to a halt today, the earth is already, to an extent, locked in towards climate change over the next 30-40 years, as a result of the emissions that have been released during the development of the modern society. The next 20 to 30 years efforts to respond to climate change will decide the long-term effects of global warming (IPCC, 2007). Sweden and the Swedish business sector have now the opportunity to set an example for other countries, also concerned with sustainable development, by taking advantages of the possibilities to “climate-proof” business activities within commercial boards.

This qualitative study has examined the Swedish businesses’ understanding of the need to respond to climate change, with focus on mitigation and adaptation strategies. The study is based on eleven in-depth interviews with respondents that represent businesses within the sectors housing (including infrastructure), forestry industry (including paper and pulp production) and transport (including public transportation). The sectors were selected on the basis as they were particularly exposed to climatic impacts, but also with the aim to cover a large span of business activities. By applying a conceptual model of how a response process can take place in an organizational context (based on the parameters awareness and concern, idea of response strategy and response options), the understanding of the respondents was analyzed and assessed. The result indicates that the awareness of climate change is now high among the respondents, while the concern of its impacts varies in the sectors. In general, climate change is perceived as a wide-ranging external threat, that foremost changes conditions in the external context. Hence, in the perspective of the respondents, the largest reverse climate effects will not take place in “their backyard”, but will impact others directly and business indirectly. For that reason they do not consider themselves as exposed to direct impacts, but connect climate change to a need to reduce energy consumption and fossil fuel dependency. Hence, in many cases, the climate change issue has transcended from being treated as an environmental issue to an energy issue.

Finally, the results indicate that there is a strong link between adaptation and mitigation in a business context. As climate change is perceived as one by many external factors that can impact activities, businesses will not handle it differently from any other external challenges. For this reason, the concept of examining a systems’ totally response capacity, as has been the focus in this study, could improve further studies on businesses’ perspectives on dealing with climate change.

Keywords: Climate change, mitigation, adaptation, response capacity and Swedish business sectors
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1. Background

The year 2006 became one of the hottest and most extreme years in Sweden since data collections commenced in the 1860’s. The extreme torrents of water and landslides in Western Sweden in December 2006 pose a recent example of how Sweden has become more exposed to flooding over the last three decades, primarily due to milder winters and increased precipitation (SMHI, 2007). In addition, responses to the two extreme January storms in 2005 and 2007, popularly referred to as Gudrun and Per, are still being undertaken. These examples indicate how Sweden, a modern welfare country, is fairly exposed to present variations in weather. On top of this lies the issue of inevitable climate change and rising global temperatures that are expected over the next 30-40 years, posing a great challenge to the earth’s eco-systems’ and societies’ ability to live within them (IPCC, 2001; Klein et al., 2005). Moreover, new and strong evidences indicate that the largest part of the last 50 years temperature rise is caused by human activities (IPCC, 2001; IPCC, 2007). To cope with negative climatic impact, United Nations Framework Convention on Climate Change (UNFCCC) and the IPCC have identified two, now broadly understood strategies, recognized as adaptation and mitigation (Klein et al., 2005). As Stehr and von Storch put it, mitigation activities can be understood as protecting nature from society by means of reducing emissions of greenhouse gases. Adaptation strategies on the other hand, represent activities to protect society from nature by adjusting to direct or anticipated climatic impact (Stehr and von Storch, 2005). Both these strategies are considered essential in order to act in response to climate change and present weather variations (Firth and Colley, 2006; IPCC, 2007; Stehr and von Storch, 2005).

Recently there have been attempts in the climate change literature to combine adaptation and mitigation strategies in a debate that relates to “responses” to climatic impacts (See Tompkins and Adger, 2003; Wilbanks, 2005). The reason for this is that hitherto, mitigation and adaptation have been treated in different policy domains and are often competing for resources, despite the clear picture that combined responses are crucial in order to reduce climate change risks (Klein et al., 2005; Tol, 2005; Tompkins and Adger 2003; Wilbanks, 2005). Drawn from this line of reasoning, there are incentives for analyzing mitigation and adaptation within a combined framework and focusing on a systems total response capacity, which consider both facilitating and constraining factors for adaptation and mitigation activities (Tol, 2005; Tompkins and Adger, 2003). Accordingly, this thesis will presume that there is no choice between adaptation and mitigation. On the contrary, there is rather a need to pursue combined actions (Firth and Colley, 2006).

This thesis will examine the Swedish business sectors’ understanding of the need to respond to climate change, with a focus on mitigation and adaptation strategies. According to Arnell and Delaney (2006), climate change is one of many external factors that can induce changes for businesses, but it is unique in considering that it poses pressures to natural systems (that traditionally are taken for granted) and because it is pervaded by uncertainties. It can impact business in several important ways. For instance, considering that the modern social and economic system has developed during an era signified by stable climate, decisions made on historic data analysis are no longer a solid base to plan for the future (Bernes, 2003; Firth and Colley, 2006). For this reason, as the general awareness and understanding of its threats increases, prior expectations will be contested and customer expectations, market demands and regulations will likely change as the awareness grow (Firth and Colley, 2006, IPCC, 2001). Depending on the businesses’ capacity, experiences and willingness to respond to climate change risks, the impacts of climate change will vary significantly between sectors and companies (Firth and Colley, 2006; Tompkins and Adger, 2003). For that reason, a central focus in this thesis will be put on respondents’ awareness and concern about the risks in addition to their self-perceived capacity to respond to the risks. As Firth and Colley (2006) stress, those businesses that fail to respond will come out as sector losers, while those who rather see opportunities will become sector leaders. In the broader picture, Sweden and Swedish business has now an opportunity to set an example and make path for sustainable development.
1.2 Aim and scope

On the basis of interviews with relevant respondents in the three selected branches; (1) housing (2) forestry industry (3) transport, the primarily aim of this master thesis is to explore and assess the respondents’ understanding of the need to respond to climate change, with a particular focus on mitigation and adaptation strategies. A central task to this study is to apply a conceptual framework of response capacity in organizations, in order to explain and compare these views. As a closing stage, the thesis will discuss and explain whether climate change is perceived as a possibility or threat to business.

A number of focus questions have been developed to address the aim as outlined above. These include:

1. What is the awareness and concern in responding to climate change within companies in the housing sector, forestry industry and transport sector?

2. What are the perceptions of climate change in the businesses? (views on exposure, sensitivity, and response capacity?)

3. What do the respondents perceive as opportunities and difficulties in responding to current weather variations and future climate change?

4. How and by what measures are climate risks handled today in the selected sectors? Is there technical or other options available in the future?

5. How do the representatives frame the climate change issue? (Technical issue or a broader issue? Easy or difficult to change activities? Main strategies?)
2. Method

2.1 Research design

The research was designed to explore the respondent’s perception of climate change and their understanding of the need to respond to its impacts. Hence, qualitative interviews were chosen as the research method considering its strength in accessing the viewpoints and attitudes of selected respondents, which is otherwise not perceptible (Arksey and Knight, 1999; Kvale, 1997). The study began with a thorough literature review where relevant articles concerning the concept of response capacity, adaptive capacity, mitigation, adaptation and business significance to responding to climate change were examined. Based on the literature review, the three sectors, housing (including infrastructure), forestry (including paper and pulp production) and transport (including public transportation) were targeted as particularly exposed to climatic impacts, while they simultaneously have potential to mitigate greenhouse gases. Hence, it was assumed that the key concepts for response capacity could be easier targeted and assessed. The research design was bounded to nine business organizations within these three sectors. Within this boundary, I aimed at selecting a diverse sample of businesses whose activities covered a large span in terms of market context and resource use, with the exception of the housing sector where the companies were relatively similar. The aim of doing so was to enable a wider exploration and comparison of the different perceptions and to illuminate the multifaceted character of the sectors.

The majority of the businesses were considered sector leaders with access to all form of capital, technology, and a large potential to implement it. Accordingly, two companies in the housing sector are leaders in both infrastructure construction and housing production, whereas one company is primarily specialized in the latter. With respect to the forestry sector, the study encompasses one company that is a producer and marketer of consumer goods and paper article in addition to a company that manufactures printing paper, paperboard and timber. In addition to the two companies, a Swedish Forestry Group (SFG) was selected due to its forestry market activities and because its resource base was greatly affected by the two latest severe storms. Moreover, the selected companies within the transport sector include one manufacturer of heavy trucks and buses and one company that provides logistic services. While these two companies are significant players on the global market, the final organization in this study is a regional provider of public transportation services and considerable smaller in size in comparison to the other actors. Nonetheless, considering the documented vulnerability to climate change on some sections of its infrastructure, in addition to its possibility to mitigate greenhouse gases, the public transport organization (PTO) was considered to provide the study with valuable insights.

Table 1 describes the selected companies and their main business concepts, in addition to their role in this study. The descriptions are based on the businesses’ own presentations but have been simplified in the table in order to illuminate their role in the study. The majority of the respondents hold upper-level positions with significant responsibility over strategic issues within the companies, while some respondents work with environmental management systems, hence, are engaged in the practical work within the organizations.
Table 1: Description of the selected companies and organizations encompassed in the study.

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>BUSINESS CONCEPT</th>
<th>ROLE IN STUDY</th>
<th>Respondents and their professional roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing (H)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company A(h)</td>
<td>Construction-related services and project development</td>
<td>“Residential developer”</td>
<td>Respondent A(h) Coordinator for EMS with focus on residential development</td>
</tr>
<tr>
<td>Company B(h)</td>
<td>Construction, property and road developer</td>
<td>“Property and construction developer”</td>
<td>Respondent B(h) Environmental Director for Construction development</td>
</tr>
<tr>
<td>Company C(h)</td>
<td>Developer of housing and residential area</td>
<td>“Housing producer”</td>
<td>Respondent C(h) Environmental Director</td>
</tr>
<tr>
<td>Forestry (f)</td>
<td>Consumer goods and paper company</td>
<td>“Paper and consumer goods producer”</td>
<td>Respondent A(f) Director of Environmental Affairs</td>
</tr>
<tr>
<td>Company B(f)</td>
<td>Manufacturing of printing paper, paperboard and saw timber</td>
<td>“Paper manufacturer”</td>
<td>Respondent B(f) Project Director (energy and environment)</td>
</tr>
<tr>
<td>Forestry Group Organization (SFG)</td>
<td>Manufacturer of paper pulp and producer of wood, sawn timber products and bio-fuel</td>
<td>“Forestry manager and paper pulp producer”</td>
<td>Respondent C(f) Coordinator for EMS and forestry management</td>
</tr>
<tr>
<td>Transport (t)</td>
<td>Manufacturer of heavy trucks and buses</td>
<td>“Manufacturer”</td>
<td>Respondent A(t) Environmental Director</td>
</tr>
<tr>
<td>Company B(t)</td>
<td>Provider of Logistics services</td>
<td>“Logistic services provider”</td>
<td>Respondent B(t) Coordinator for EMS and quality</td>
</tr>
<tr>
<td>Public transport organization (PTO)</td>
<td>Provider of public transportations</td>
<td>“Public transportation provider”</td>
<td>Respondent C(t) Coordinator for EMS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Respondent D(t) Project leader for infra-technical issues</td>
</tr>
</tbody>
</table>

2.1.2 Selecting the respondents

The names of the respondents were obtained by investigating the company information as found on the Internet. The aim was to get in touch with employees with insight into the overall environmental affairs of the company. Relevant persons whose names were available on the homepages were contacted for interviews. The persons either considered themselves suitable to participate in the study, or in other cases, I was forwarded to other persons with insight in climate change issues.

Initially, nine respondents were selected and contacted. However, in the case of the SFG and the public transportation organization, the initially selected respondents mostly provided me with information about one theme of interest, thus, to cover the overall subject matter I was forwarded to additional persons with insight into either the businesses’ risk management activities or energy strategies. For instance, in the case of the SFG, the first respondent foremost answered questions about forest management that in this study was mainly connected to adaptation. Therefore, the additional respondent was contacted in order to cover the area connected to mitigation strategies. A similar situation arose when conducting
an interview at the PTO. The first respondent mainly worked with coordinating the environmental management system, but had little insight into the organizations strategies to deal with climates related risks. An author of the Swedish inquiry “Klimat och Sårbarhetsutredningen” provided the name of an additional respondent at the organization who was engaged in climatic risks in regards to rail bounded traffic.

Altogether, eleven interviews were conducted. Ten of these can be characterized as face-to-face in-depth interviews, whereas the interview with the additional respondent at the forestry SFG was conducted over the phone.

2.2 Planning the interviews

As mentioned, the aim of employing interviews as method in this thesis was to obtain the perceptions and understanding of the respondents in order to interpret their meaning. Hence, the conducting of the interviews were semi-structured, which is a method characterized by a combination of an open dialogue but by using a basis of prepared themes and open-ended questions (Kvale, 1997). An interview guide was formed, comprising general themes and key questions (connected to the focus questions) in order to frame the discussion in the interview. However, in keeping with the aim of the research problem, spontaneous answers, where the respondents were allowed to express his or her opinions on the matter, were also sought after. To this end, open-ended questions were central in the interview guide. For instance, the question “how does the company deal with potential threats of climate change” was posed at an early stage in the interview in order to allow the respondent to steer the direction towards adaptation or mitigation themes. The interview guide comprised the following four themes (See Appendix 1 for full version).

A: Climate change significance in relation to business activities- Relates to focus question (1), (2) and (5) concerning perception of climate change in addition to views on exposure, sensitivity, and response capacity

B: The management of risks and strategies to reduce greenhouse gas emissions- Relates to focus question (3) concerning possibilities and difficulties for taking measures and focus question (4) concerning present strategies to handle climate risks.

C: Knowledge and self-perceived responsibility area- Relates to focus question (1) regarding awareness and concern

D: Thoughts about future strategies- Overall theme to generate views on the perception of climate change risks and how they can be handled

2.2.1 Ethical issues

The themes mentioned in the previous section were, along with general information about study’s purpose, sent to each respondent in advance. The purpose was to inform the respondents about the interview’s focus in case they required preparation, but also to inform consent and to request for the use of a tape recorder. Hence, the respondents’ rights were clarified and explained in advanced, but also repeated in the beginning of each interview. All the respondents approved of the use of recorder and had no problem to participate with names. However, as already mentioned, the names were chosen to be concealed when presenting the results, as they have little implications on the aim of the study. Of more importance are the respondents’ professional roles as these have undoubtedly significance for the answers. Finally, it is important to point out that the quotations used in this study have been translated into English, which inevitable will have affected the originally
Statements. The original answers are in fully presented in Appendix 3. As far as possible, I have aimed at putting the quotations of the answers into their contexts.

2.3 Conducting the interviews

Each organization was studied in advance of the interviews in order to become familiar with their business concepts and environmental activities. In addition, notes and reflections were written down after the interviews to make use of the first impressions. A general reflection is that the interview sessions went well. However, this section will bring up two aspects that have could have impacted the empirical material and in brief describe the interview process.

The first interview was conducted at company A(h) in the housing sector, where the respondent dealt with coordinating the environmental management system for the unit concerned with residential development. After the interview, the interview guide and the questions were evaluated and regarded as suitable for upcoming interviews. Considering the organizations different business areas, I noticed that questions concerning adaptation to climate change were easier to pose, for instance in the housing sector and the forestry companies, in contrast to the heavy truck and buses manufacturer and the logistics provider. Likewise, it was easier to obtain views on mitigation strategies when interviewing the latter companies in comparison to the interview with the forestry manager. When the focus became centered on specific areas, for example, strategies to mitigate greenhouse gas emissions, I, as an interviewer, may have put more weight on those areas seeing as the respondent found it most relevant to discuss in relation to climate change. In any case, all respondents were asked questions concerning both adaptation and mitigation strategies, and, as mentioned, two additional interviews were conducted to obtain insight in both areas.

The second in-depth interview took place at company B(h) in the housing sector. Unfortunately, during this interview, an error occurred in connection with the recording procedure. As a result, the conversation failed to be recorded and could therefore not be transcribed like the other interviews. To make up for the loss, the impressions and recollections of the conversation were carefully written down to shortly after be sent to the respondent who provided complementary additions, in written form. However, due to this error, the empirical material in this sector shrunk in comparison to the information gained in the other sectors, which may have affected the overall results. For instance, in contrast to the two other interviews within this sector, this respondent possessed knowledge about strategies concerning development of infrastructure projects, which the other two respondents were not associated with. Later on in the research process, the same respondent was contacted over phone to complement this area with information. Moreover, with regards to the selection of relatively similar businesses in this sector, the consequences would most likely have had more negative impacts had it occurred in the forestry sector or transport sector where the disparities were greater.

2.3.1 Analyzing the interviews

So far this ‘over all method’ section has explained and motivated the choice of research design and the selection of respondents. This section will describe the approaches used in the analyzing phase. All things considered, the empirical material of this thesis is made up of ten in-depth interviews, in addition to one phone interview. The answers provided insight into how the respondents perceive the climate change issue and their views on possibilities and hindrances to taking action. Considering that all interviews, save one, were fully transcribed, the empirical material from the interviews contained an extensive amount of information, including interview notes. Hence, a large bulk of the thesis was directed to the analyze phase, which consisted of three steps.
First, each interview was read, re-read and individual sections of interest were spontaneously highlighted. In the answers, I searched for similarities and differences as well as their perception of vulnerability, adaptation, mitigation and response capacity. Fundamentally, I aimed at allowing the material to create categories, however, considering that many of the answers followed the interview guide, the answers could, in general, be easily connected to the predetermined themes. After each interview had been processed, the remaining material was made up of larger categories and subcategories that connected to the focus questions, for instance, what exposure to climatic impacts do the respondents identify? What is the self-perceived degree of sensitivity to the impacts and the capacity to respond? In the second step, the answers were compiled into three matrixes representing the answers in each sector. Those facilitated a comprehensive analysis since similarities and dissimilarities in the answers became apparent. In the third step, the three sector-based matrixes were compiled into a summarizing matrix that comprised all three sectors. Consequently, the transcriptions were processed in several stages. On the basis of the matrixes, general thoughts were summarized and compiled into a general analysis of the perceptions and views on climate change. This analysis and the summarizing matrix were later discussed with an external researcher with the purpose of underpinning the results and to evaluate my interpretations.

2.3.2 Reliability

Considering the fact that the selection of respondents in this study is not extensive for the whole sectors, the research is restricted to the answers of the selected respondents in addition to the interpretations I have made when conducting the research. However, all through the research process I have strived for putting my results against other researchers results, as well as discussing my judgements with external persons with insights into the research area. All things considered, the fundamental base of this study is made up of three key essentials, 1) a state-of-the-art literature review, 2) qualitative interviews with selected respondents as based on an interview guide, 3) a conceptual model for how an organizational response process can occur. A general reflection is that the empirical material obtained from the interviews, in addition to the climate change literature comprising IPCC’s Assessment Reports as well as scientific articles, make up a coherent research base. Hence, it is reasonable to believe that similar results, as presented in this thesis, could be achieved if originating from the same base.
3. Literature review: Business’s responses to climate change

This literature review will describe the most current literature that has been written on the subject of response capacity. The key findings of response capacity will be summarized in a conceptual model that will explain how responding measures can be taken by businesses and organizations.

3.1 Exposure, Sensitivity and Response Capacity in an organizational context

To begin the process, it is first necessary to explain some central concepts that relate to response capacity, namely vulnerability, sensitivity, adaptive capacity, and mitigation capacity. IPCC’s Third Assessment Report (Working Group II, 2001) provides definitions and highlights their connections. As follows, this section will outline and explain how these key terms are understood in context with this thesis and in relation to an organizational context.

**Vulnerability** or susceptibility to climate related pressures represents the degree of a system’s inability to deal with the adverse impacts of climate change (IPCC, 2001). This, in turn, depends on a systems exposure; sensitivity and adaptive capacity (Yohe and Tol, 2002). For instance, industries whose business activities rely on climate-sensitive resources, such as agriculture, forestry and fishery, are, according to IPCC (2001), more vulnerable to climate change than industries with diversified economic activities. With respect to businesses, susceptibility to climate related pressures also include changes in the exogenous context, for instance, through altered customer expectations and market demand, changed access to natural resources, in addition to changes in technological or regulatory contexts. Climate change is only one of many factors that can affect the exogenous condition for business, but is unique in many ways as it is pervaded by uncertainties (Arnell and Delaney, 2006).

**Sensitivity** to climate change is by IPCC, defined as “the degree to which a system is affected, either adversely or beneficially, by climate related stimuli” (p.6). In the context of this thesis, it relates to what extent climate change is considered significant to business activities. Does it pose a big or small challenge for business? In that sense, sensitivity is closely linked to the organizations ability to adjust to external stress, that is, the capacity to respond. IPCC (2001) defines **adaptive capacity** as a system’s ability to adjust to external stress. In addition, depending on the degree of adaptive capacity, a system (or economic activity), can reduce the potential risk of impacts; deal with the impacts, or even turning them into opportunities (IPCC, 2001). With respect to business organizations, Lorenzoni et al. (2000) suggest that adaptive capacity has two main dimensions, one subjective and one objective. The subjective dimension relates to the organizations self-image of their ability to respond to climatic impacts, which is based on the understanding that “we need to act”. The objective dimension on the other hand concerns the managerial capacity and structure (flexible or inflexible) of the organization, which encompass the access and implementation of information, the ability to take measures and access to capital and resources, and so forth. Taken these concepts into account, the impacts of climate change on business will likely be diverse and handled differently, even for businesses that operate within the same sector and supply similar goods and services (Arnell and Delaney, 2006; Lorenzoni, et al., 2000).

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1 The key terms defined in IPCC’s Third Assessment Report (TAR) is used in exactly the same form in the IPCC WGII Fourth Assessment Report (2007)
2 Climate related stimuli according to IPCC (2001) include climate variability, frequency of extremes in addition to the magnitude of impacts.
To reduce short-term and long-term vulnerability to climate change, adaptation and mitigation strategies are considered essential, whether the scale is global or regional (Wilbanks, 2005). In brief, mitigation strategies encompass all methods aimed at reducing greenhouse gas emissions and to increase uptake through sinks. Nevertheless, the strategy in itself is not sufficient as time lags in the atmosphere causes inevitable climate changes (IPCC, 2007; Klein et al., 2005; Wilbanks, 2005). As a complementary response strategy, adaptation has received increased attention in the policy and research community (Smit et al., 2000). It can occur in a variety of forms and accordingly, a number of definitions have been proposed in the climate change literature. Common to most of them is that adaptation implies ‘a change to better suit a new condition’ (Smit et al., 2000, p. 6). In this manner, pressures from climate change, and present weather variations alike, can be reduced or even managed. While adaptive capacity has become established as a concept on the impact level, mitigation capacity is its reflection on the emission level. Accordingly, activities to mitigate greenhouse gases depend on the same sort of factors as the capacity to adapt (Yohe, 2001).

3.1.2 Differences and Synergies between Mitigation and Adaptation

As has been stated in this thesis, the incentives to analyse adaptation capacity and mitigation capacity within a combined framework is growing. However, this call is challenged by the differences in characteristics of mitigation and adaptation. For that reason, to target synergies between the two concepts, it is first essential to understand their differences. Simply put, Klein et al. (2005) stress that they differ in at least three key areas: 1) spatial and temporal scales, 2) extent of their costs and 3) different actors and type of policies.

As Table 2 illustrates, benefits of mitigation primarily function on a global scale, while adaptation works within the local or regional frame in relation to the impacted system. Moreover, benefits from present mitigation measures are long-term whereas benefits from adaptation activities often yield an immediate effect. It is, in general, easier to determine cost-effectiveness of mitigation measures, providing that the initial costs is known and can be compared with the achieved emission reduction.

Table 2: Main differences between mitigation and adaptation (Klein et al., 2005)

<table>
<thead>
<tr>
<th>Differences</th>
<th>MITIGATION</th>
<th>ADAPTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Spatial and temporal scale</td>
<td>Global benefits, long-term effects</td>
<td>Local or regional benefits, often immediate effect</td>
</tr>
<tr>
<td>2) Extent of their cost</td>
<td>Cost-effectiveness is (in general) easier to target</td>
<td>Benefits diverse, harder to target</td>
</tr>
<tr>
<td>3) Actors and policies involved</td>
<td>Concerns a relatively limited number of sectors and actors (e.g. energy, transportation, agriculture, forestry sectors)</td>
<td>Activities vary within a range of sectors. Decision-making takes place at different scales, from local individuals to national planners</td>
</tr>
</tbody>
</table>
Adaptation benefits, on the other hand, can be very diverse and are for that reason harder to target. Finally, according to Klein et al (2005), mitigation is mainly central for a limited number of sectors\(^3\), while adaptations; in contrast, vary within a range of different sectors\(^4\). Hence, decision-making concerning adapting to risks takes place at different scales and by different actors, varying from a grassroots level to national planners (Klein et al., 2005).

Even though these differences are well known and widely addressed in the climate change literature, thus far the knowledge regarding synergies between adaptation and mitigation is relatively limited. These can occur when response policies to climate change are designed to control emissions of greenhouse gases, while simultaneously reducing the adverse impacts of climate related stimuli. To exemplify, a win-win situation can take place when trees are replanted in urban regions, which will both mitigate carbon dioxide as they grow, but also reduce potential risks of heat pressures in the summer (Klein et al, 2005). Based on the differences and synergies as outlined above, it is understood that an integrated response strategy must be broad in its scope and encompass a variety of aspects from different scales (Wilbanks, 2005).

### 3.2 Moving towards response capacity

**Response capacity**, as loosely defined by Tompkins and Adger (2003) is “the human ability to manage the generation of greenhouse gases and the consequences of their production” (p.8). According to the same authors, a *response* refers to any measures employed to handle environmental change, by any actors and at all scales. For that reason, it depends on time, context, and regional circumstances as well as by different societies and groups. In addition, it builds on the available response options that can constrain and facilitate adaptive capacity and mitigative capacity. However, as is illustrated in Table 2, the range of different options related to adaptation and mitigation differs and would be too diverse to target and assess. For this reason, Yohe (2001) stresses that the focus should not be put on investigating the scope of options; rather, the potential lies in focusing on the factors that *determine* mitigative and adaptive capacity. Adaptive capacity is considerably more established in the climate change literature in comparison to the notion of response capacity and mitigative capacity, however, the parallels between the concepts are apparent as they are influenced by similar factors (Yohe and Tol, 2002; Yohe and Moss, 2000 in Yohe, 2001). In the broader context (communities, nations, policy-making, regions, or local scale) these factors encompass a rather long list of determinants, such as the availability and implementation of technology and information, social willingness and ability to change, access and availability to capital (human, social financial, natural), the structure of key institutions, empowerment and equity, capacity to spread risks, public’s awareness and the decision-makers ability to handle credible information (see Tompkins and Adger, 2005; Yohe, 2001; Yohe and Tol, 2002). However, for the purpose of this thesis, constraining and facilitating factors for businesses to respond through mitigation and adaptation will rather relate to theories concerning organizational behavior, albeit, they bear a resemblance to the determinants as outlined above. In the next section, the key response elements will be encapsulated into a conceptual framework that describes a possible response process for organizations.

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\(^3\) Energy and transport sectors in industrialized nations, in the agricultural sector, but also forestry and energy sectors in developing countries (Klein et al., 2005).

\(^4\) For instance, agriculture, tourism and recreation, nature conservation, human health, water supply, coastal management and urban planning (Klein et al., 2005).
3.3 Conceptual framework of the organizational response process

Berkhout et al. (2006) and Arnell and Delaney (2006) describe and explore the adaptation process, taking the standpoint of businesses and firms. Berkhout et al. (2006) establish in their study that organizations adapt in accordance to their know-how. For that reason, important factors to the adaptation process are the business’s ability to understand and to interpret information and uncertainties related to climate change. Other crucial factors relate to issues of costs and revenues, market demands, competition, technological change and regulatory restrictions, which set the constraining frame for businesses ability to adapt. Based on Berkhout’s et al. (2004) findings, Arnell and Delaney (2006) conclude that an organizational adaptation process has four basic components. These will be presented here, but in a slightly modified form that encompasses both mitigation and adaptation capacity.

The first component of the response process relates to “awareness and concern” (correlates to the subjective side of adaptive capacity, that is, the understanding that “we need to act”). Clearly, there will be no strategies to respond to potential climate change threat if awareness and concern of its risks are low or absent. Second, the business will need to identify what accomplishment the responding strategy aims at and how it can be carried out. Put in other words, it needs to obtain an “idea of response strategy”. According toArnell and Delaney, this can involve strategies that aims at maintaining the same standard of service and products, provide new products and services that hold similar standard and purpose, stop offering the product or service on the market, or take no measures at all (recognized as “muddling through”) (Arnell and Delaney, 2006).

In Tompkins and Adger’s (2005) model of response capacity, they suggest that a system’s ability to reduce its vulnerability depends on a “response space”, which sets the boundaries for available response options. According to the authors, the response space can expand or be reduced depending on the availability and implementation of new technology in addition to (in their context) the decision-makers’ willingness to change. Arnell and Delaney (2006) take a similar standpoint but define adaptation space as “the set of options which are potentially available to an organization to deal with possible climate and other changes” (p.229). As the same idea will be used in this study, the third component of the organizational response process concerns the notion of response space that here will be described as “the knowledge about available response options to deal with potential climate related risks and other changes”. Given that an organization will act in response to external changes (such as new technology and market changes and the like) as well as build up a regular understanding of available options, the response space is inherently dynamic (Arnell and Delaney, 2006; Tompkins and Adger, 2005). Figure 1 illustrates the outlined response components included in this study’s conceptual framework of how businesses could respond to climate change. At this stage it is necessary to recall the fact that businesses and firms will respond differently to external changes. Figure 1 illustrates this by encompassing three external factors that influence the outlined response components A, B and C. These factors draw on previous explanation of the central concepts in the climate change discourse, but are well pinpointed by Arnell and Delaney (2006). First, the response components are shaped by the businesses susceptibility to external changes (see explanation of vulnerability). Second, in line with the objective feature of adaptive capacity, the business’s access to resources and ability to respond to external changes will set the boundaries of its total response capacity. Finally, increasing awareness of climate change potentially yields changes in regulation and market demands that will determine the performances of businesses.

5 Heavily dependent on Arnell and Delaney’s (2006) adaptation process for businesses and firms.
The conceptual framework that has been developed on the basis of the literature review, will assist the task to assess the selected companies understanding of the need to respond to climate change.
4. Results: Perceptions of climate change risks, sensitivity and response capacity

With the aim of discussing the respondents understanding of the need to respond to climate change, it is necessary to describe how the respondents perceive the climate change issue. Important questions of concern include if is it of significance or not? Does it pose a big or small challenge for business? What possibilities and hindrances in taking measures do the respondents perceive? To provide an insight into these questions, the central theme in this result section is to highlight in what way and to what degree they discern their business activities to be affected by climate change (which relate to their recognitions of exposure and sensitivity). The section will also present how the issue is handled today, and describe views on perceived response capacity to manage the identified impacts ascribed to climate change. The answers will be outlined sector-wise, starting with the housing sector and ending with the transport sector. Later on in this thesis, the results will be discussed in relation to the conceptual model of the organizational response process.

4.1 Housing sector

4.1.1 Risks

In general, the respondents perceive the climate change issue foremost as an wide-ranging exogenous issue that primarily will impact business activities through changes in the financial system and through policy regulations. It is highly connected to the companies’ business activities, seeing as the housing sector makes up for 40 per cent of society’s total energy use. Consequently, the respondents put a strong focus on becoming more energy efficient, both in regards to the actual building process, but also in relation to the buildings total lifetime. Changes in customer expectations as a result of climate change and increased electricity prices are also mentioned as an impacting factor of significance. In this matter, the climate change issue is considered as one factor that, in combination with other aspects, will impact business. Hence, while energy efficiency strategies are mentioned as a major area of concern, adaptation to potential direct risks is of considerable smaller significance according to the interviews. Respondent C(h)’s response to a question concerning the climate change significance for the business sector, mirrors this general standpoint.

I don’t think [the climate change issue] is so much a matter of increased temperatures in Sweden, nor [national] increased water levels; rather, it is a question dramatic economic change in the world order. [1]

Nonetheless, all the respondents express that there is an awareness concerning the direct impacts, such as floods, heat waves, extreme weather and land slides, and argue that these are taken into consideration, both in housing development and infrastructure projects alike. Overheated buildings are also referred to as a potential problem that can arise as a result of increased average temperatures in Sweden. Potentially, this could conflict with targets for energy reduction.
4.1.2 Sensitivity and response capacity

In common for all companies, global warming and predicted climate change is being discussed in the group executive boards. Clear signals from the higher management in addition to their ambition to act, is mentioned as a fundamental factor in dealing with any business related concerns. Whilst climate change itself is perceived and acknowledged as a large global challenge, at this point the respondents in this sector do not consider their businesses as particularly sensitive to the potential risks it poses. As mentioned, the companies are foremost working systematically with energy reducing activities and have invested large means in development projects for energy efficient buildings. In general they see big possibilities in this area due to the fact that they are large companies with extensive competence and access to recourses. Hence, while the technology exists, its high cost is the limiting factor. The answer of respondent B(h) mirrors this standpoint:

There is no real limit for what you can accomplish, yet, you always have to consider the costs. /…/ We focus significantly on taking energy efficiency measures /…/ one can win market advantages when looking at the possibilities connected to climate change [2]

However, the same respondent stresses that even though measures are undertaken and the executive board is engaged in the discussion, there is a need to establish an assessment tool for calculating the release of carbon dioxide per building project. Seeing as the incentive of doing so is relatively new, the primary challenge for the company relates to the difficulty in finding facts and measurement data. Furthermore, all respondents bring up the aspect of inflexibility of implementing new factors as the overall time for a private managed project, that is, from the point the ground has been acquired to the time when it is ready to move in to, normally take place under a period of three to five years, according to the respondents. In some cases it might even be a matter of ten years, as complications or conflicts might occur during the process. As respondent C(h) stresses: “being long-term is a long process”.[3]

With respect to adaptation strategies to direct impacts, measures are foremost an aspect that is reflected upon in comparison to mitigation activities. In addition, according to the respondents’ answers, the companies seem to differ in how far adaptation measures to direct impacts have been put into practice. For instance, respondent A(h) points out that direct physical impact is discussed only within the environmental circle, however, at this stage, practical measures are not implemented in the broader organization. Respondent B(h) and C(h) on the other hand, point out that their companies have begun to incorporate climate related risks in the initial planning stage in order to build with respect to climate change risks. In the context of what possibilities respondent C(h) discerns in reducing risks of weather related impacts, the respondent answers:

In order to reduce risks… The risks we have talked about [during this interview] are above all rising temperatures, floods, increased precipitation, and to some extent wind. Provided that we can exclude the risks of hurricanes, which I do not think we are talking about here, we are already dimensioned to substantial precipitation. Not to forget, precipitation can also come as snow, /…/. But I mean, seeing as we have a high precipitation as it is, we already build in accordance to that.[4]

Thus, the perceived response capacity is, in general, high as the respondents consider their businesses as capable of responding to the identified indirect and direct challenges. Respondent C(h) points out that there is always a possibility to rebuild the buildings in accordance to new risks, taking into account their long lifetime. Respondent B(h) argues that despite customers’ willingness to live nearby shorelines where flood risk is apparent, the company is able to respond to the demand by discussing possibilities such as “can we build under other conditions? Higher up or further up from the shoreline? Or can we build in any other ways?”[5] With respect to infrastructure projects, however, respondent B(h) argues that the company has less influence over the construction process and risk assessment in

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6 Quotation has been translated based on written comments. See appendix 4 for original statement.
comparison to their private property development activities, seeing as authorities usually own the infrastructure projects. Nevertheless, the respondent has faith in the clients’ awareness of climate change and argues that the basic data for risk assessment is sufficient. It is rather a question of financial margins and willingness to invest in risk reducing measures.

4.2 Forestry industry

4.2.1 Risks

As in the house-building sector, the general perception in the forestry sector is that climate change is a wide-ranging external issue that closely connects to energy strategies. In similar ways, climate change is being discussed at group executive board levels in all companies and is taken seriously by upper-level managers. With regards to exposure, the majority of the respondents agree that a changing climate can significantly impact businesses activities, both directly and indirectly, however, in general, the respondents put more emphasis on the latter. Seeing as pulp and paper processes consume large amounts of energy, the general view is that the firms are highly susceptible to the indirect affect of increased energy and resource prices. Hence, the prime focus of business activities is to reduce the use of energy and fossil fuels in the pulp and paper industry. In addition, striving for energy self sufficiency is both of a strategic and a political concern, considering that dependency on fossil fuels is considered as potentially harmful to business. For these reasons, the climate change issue has moved from being treated as an important environmental concern to be closely linked to energy strategies. Respondent A(f) viewpoint reflects this observation:

If I look back at the company, a couple of years ago these questions where primarily managed on the environmental side, we were the ones who dealt with them. Nowadays, the [climate change] questions are handled at the energy division, which is also where the larger investments take place and where the expenses are handled. Thus, it is strongly connected to energy [strategies], when one continues to work with carbon dioxide reducing measures.[6]

Furthermore, changes in regulation as a result of the EU’s ambition to increase the quantity of renewable energy is perceived as a potential threat to business, as an increased demand for renewable resources likely would induce competition of the forest as a resource. While taking these factors in to consideration, the general perception of climate change relates to external changes in market and regulation that may well be enhanced by climate change.

Whilst awareness of indirect impacts is high among the respondents, the direct consequences of climate change are considered to be of less significance. Some respondents identified potential risks, which included increased storm frequencies, insect and parasitic attacks in addition to technical difficulties when cutting timber. Positive aspects that were mentioned included amplified forest growth in addition to enhancements in hydropower productions, as precipitation will increase. Respondent C(f), who is concerned with silviculture measures at the SFG, argues that a scenario where Swedish average temperature will increase by approximately two degrees is not dramatic for the current forest strategy where spruce represent the central forest type, bearing in mind that spruce is already adapted to wide-ranging conditions in the hemisphere. In addition, noxious insects, such as pine weevil and spruce bark beetle are, according to the respondent, already fundamental to the present forestry model. Yet, with a warmer climate, the respondent mentions the risk of being subjected to other harmful vermin that are common in Germany or in more southern climatic zones, but adds that those are for the most part already thoroughly dealt with at present-day. Taking a Swedish forestry perspective, the respondent rather believes that most of the effects of global warming will be beneficial because growth rate of timber will increase. This viewpoint is mirrored in the next quotation, which also reflects that the prime difficulty, according to the respondent, relates to technical difficulties when cutting timber:
A shift in the climatic zones would not, in our opinion, implicate dramatic changes for spruce cultivation. Currently we have a preparedness to cultivate spruce with genetic material from southern climatic zones. [...] However, if we will have a very sudden climate change, that positively will damage the forest through milder winters, wetter winters and more frequent storms, such as the ones that have stricken us recently, it will be more difficult to carry out silviculture methods because of technical reasons.[7]

To some extent, this viewpoint is in contrast to respondent D(f) who also operates within the SFG. This respondent perceives climate change as a significant issue that has the potential to affect the entire performance and condition of forestry management. In a worst-case scenario, the respondent stresses that in 75 years; forestry industry might not even exist.

4.2.2 Sensitivity and Response Capacity

As the previous section illustrated, the three respondents 7 concerned with energy issues considered their businesses being indirectly exposed to climate change, as energy and resource prices possibly will increase. As a consequence, these factors could induce tougher competition within the sector. Both in respect to reducing energy and fossil fuel dependency, as well as coping with direct impacts such as storms and extreme weather; the common view is that the companies have a relatively high response capacity to handle projected climate change. This standpoint is also expressed in the SFG, although its members felt severely effects of the two recent hurricanes. Yet, perceived sensitivity to climatic related impacts appear to be varying in this sector. The paper manufacturer and the SFG, whose major fields of activity are pulp and paper processing, appear to be more sensitive to competition in relation to the paper and consumer goods producers, considering the fact that the pulp price is determined on the global market. For that reason their businesses are constrained to make larger investments unless returns are provided within a comparatively short period. As is mirrored below, this standpoint is expresses by respondent B(f) who offered his view on a question relating to the company’s general willingness to implement better technology.

The will [to implement better technique] exists; however, we cannot take on large expenses in comparison with our competitors unless we know that we will get the capital back, that we are competitive on the market and that the quality of our products are sustained in the future. So, while there is a will to be in the front position, we need to think about what happens in the branch as a whole.[8]

Furthermore, while the paper manufacturer and the SFG perceive competition as a hindering factor for long-term investments, respondent A(f) stresses that they are a company with capability to afford larger investments, for example, substituting coal and oil with renewable alternatives. Thus, in the context of whether the respondent considers it easy or difficult to implement alternative fuels, the respond is:

Well, I would not say that it is difficult, apart from that it requires large investments. But I believe that in order to stimulate a positive effect on the environment, companies with “muscles”, those can afford larger investments that benefit the environment, are central for dealing with the problems of global warming. Hence, large companies can make a huge positive change here. [...] So I believe that capital and environment go hand in hand in this matter. We can make changes and we are eager to make them.[9]

Despite the variations in self-perceived capabilities to invest in long-term projects, all companies strive to be on the cutting edge in streamlining their productions; hence, they have on-going projects to reduce fossil fuel dependency, energy consumption and to mitigate greenhouse gases. Constraints to taking further steps in the substitutions processes of fossil fuel foremost concerns the low oil price in comparison to costs for renewable alternatives. Uneven regulation in Europe is also mentioned as a hindering factor for the consumer goods

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7 Respondent A(f), B(f), D(f)
producer, who faces difficulties in developing district-heating systems in European countries, based on production waste.

With respect to adaptation measures in response to direct impacts, respondent A(f) and B(f) have little information about current strategies and consider the question to be a concern for the forest administration division. As they mainly own forest in the north of Sweden, they point out that their forestry areas were not as harmed by the recent hurricanes as forests in the south. Hence, in general, they do not believe that their companies have assessed the need to adapt to negative climatic impacts, but have faith in that the present forestry strategies are at satisfactory. Respondent C(f) at the SFG have more insight in the issue and stresses that the current strategy where spruce is central has been evaluated and compared with other alternatives. Based on the evaluation, it was established that the current model is still the most advantageous one; however, some issues ought to be further highlighted for future management. For example, there are possibilities to choose other spruce types with genetic material from southern climatic zones, which are adapted to predicted climate scenarios. Another possibility is to fell the trees a few years earlier in order to reduce risks of storm felling. It is also possible to increase the forest’s robustness by improving the forest thinning and forest clearing techniques. Considering the long lifecycle perspective of forestry in addition to aspects of investment costs, the respondent argues that alternative strategies must be guaranteed superior to the present model. For instance, according to the respondent, if a forest owner would decide to plant leaf wood instead of spruce, the initial investment would be considerably large. The profit, however, would be delayed until the matured wood is logged. With respect to noxious insects respondent C(f) stresses that northern forest owners probably will be more sensitive to vermin infestation in the long term than forest owners in the south, seeing as they already live with the problems today. Consequently, the self-perceived response capacity to climate change impacts is, in general, considered to be high.

4.3 Transport sector

4.3.1 Risks

Considering the diverse selection of fields of activities within this sector, the way the respondents perceive climate change risks and identify exposure to negative climatic impacts differs. Respondent A(t), at the manufacturing company, and respondent B(t), at the logistic services company, mainly raise issues concerning customer expectation on transport in addition to national and EU legislation, but talk little about exposure to direct impacts. However, this phenomenon is also a result of the raised questions in the interview as more focus was put on mitigation strategies. While the extensive regulation on the transport sector does not include restrictions of carbon dioxide emissions, the customers put strong demands on resource efficiency when purchasing logistic services and heavy trucks and buses. As a result, the general perception of the companies represented is that greenhouse gas emissions are highly connected to fuel consumption-related expenses, which, in turn, implies strategies to streamlining business and develop new business concepts in order to meet market demands. Thus, the two companies foremost perceived climate change as a factor that can induce changes in the external context. This standpoint is illustrated in the quotation where respondent A(t) answers a question regarding how projected climate change can impact business:

To some extent it can affect us [directly] seeing as we have service establishments and other constructions that could be affected by floods and similar things. But we have that under control, we know what can happen and how, so that is of small concern. The main part concerns changed customer expectations that could affect our business. That is the indirect connection. And if the threat of climate change will grow, legislation can change, or the market could react in some way which will influence the demand of road transports. So, that is what I think our business is exposed to.[10]
However, considering higher efficiency demands on motor systems, respondent A(t) stresses that the engineers at the manufacturing company foremost perceive opportunities rather than obstacles in meeting the demands. In this sense, the potential climate change impacts, as have been discerned, are foremost perceived as a challenge of positive character. Respondent C(t) alike, who coordinates the PTO’s environmental management system, points out that the most significant environmental goal of the organization is to become totally independent from fossil fuel. In this context, climate change is foremost connected to mitigation measures, but the respondent points out that climate change is not the most important concern; rather it is viewed as an issue among other environmental aspects. At present, all rail bound transportation is driven by renewable energy; thus, the main focus is to increase the amount of renewable driven buses. For this reason, in contrast to the other respondents’ answers, the progress of reducing greenhouse gas emission is an environmental aspect that is considered to be under control. With respect to direct impacts, respondent D(t) at the PTO stated that several sections of the subway system are highly vulnerable to flooding, hence, increased precipitation and sea level rises induced by climate change is considered to be of great significance to the public transport system.

### 4.3.1 Sensitivity and Response capacity

This section will continue to describe how the risks are handled today in order to highlight the respondents’ self-perceived response capacity. Starting with the PTO, both the respondents consider the capacity to put measures into practice as considerably high, considering that the County Counsel finances the larger transport system. In addition, as the quotation reflects, respondent D(t) points out that the organization has a clear picture of its vulnerability and knowledge about how to respond:

> We have heard this many times now, and in the end we have thought it through and taken it in. Thus, we have a quite clear picture of the present situation. And the measures we have taken and the decisions we have made concerning levels are adequate /…/ People can safely use the subway.[11]

As preventive measures, respondent D(t) describes that several levels surrounding exposed technical systems and underground railway tracks have been raised in accordance to predicted 1000-year sludge. In addition, exposed platforms have been equipped with pump valves in order to increase preparedness in case of raised water levels. Moreover, the respondent points out that in comparison with Prague’s subway system, that was subjected to severe flooding in 2002, Lake Mälaren’s water level rises slower. Hence, as is described in the next quotation, the respondent perceive extensive possibilities to control the risks of flooding:

> We are always ready, and we constantly check the levels [of Lake Mälaren]. For instance, if the water level in Västerås is one decimeter higher in comparison to Stockholm, then we know that it will eventually be raised here as well, when the water runs this way. So we always keep an eye on this. In addition, the group Ports of Stockholm daily publishes data about Lake Mälaren’s water levels that one can have a look at.[12]

Accordingly, as adaptive measures have been undertaken, the sensitivity to the risks connected to climate change have been significantly reduced. With respect to the PTO’s mitigation objectives, respondent C(t), likewise, discerns possibilities in putting the organization’s strategies into practice. Today, the organization foremost invests in increasing the amount of ethanol and biogas driven buses, but other alternatives, such as fuel cell driven buses are also under investigation. Considering this commitment, many external stakeholders are willing to provide the organization with new prototypes or technology, in particular in regards to ethanol fuel. Consequently, the self-perceived response capacity is high. Yet, a general opinion for the PTO and the logistics provider is that the limited number of vehicle
manufacturers and uncertainties surrounding new technology are restricting factors for business.

In contrast to the PTO’s relatively high freedom of action, the logistics provider stresses that the branch is subjected to commercial pressures, which signify that each expense requires coverage. Today, the logistic company is working externally and internally to comply with customer demand and to meet internal mitigation targets. First, the company has introduced two “green” services that enable customers to transport their commodities with consideration to the environment. These services compensate the release of greenhouse gases by neutralizing the released emissions, for instance by using alternative fuels in other transports, or by replanting forests in developing countries. However, as is illustrated in the quotation, at this point, customers have not to a larger extent showed willingness to purchase the green products in a larger extent:

Our customers regard environmental consideration as something very important. However, so far we have not reached the level where they are prepared to buy these green products. It is a very cost-conscious branch, the transportation and logistics branch. Everyone has large downward pressures on prices and every penny should be rationalized. Therefore, it is a principal for us as well. Yet, we think it is important to have these green products available and that we can offer them to those customers who are willing to do something about this.[13]

In general, the logistics provider and the manufacturing company, mitigate greenhouse gas emissions by assessing and streamlining the internal traffic flow and by maximizing the networks effectiveness and production. In addition, employing and providing instructors in eco-driving, and by increasing the loading factor in trucks are strategies employed to reduce fuel consumption. The perceived response capacity to meet the identified challenges are considered to be high, however, with respect to hindering factors to sustainable measures, the respondents mention that the limitations in infrastructure are still a problem, as fuel pumps with alternative fuel are not at this point, widespread in Europe.

Furthermore, while respondent C(t) and B(t) consider technology as a constraining factor to business, the manufacturing respondent argues that it is rather a matter of finding potential alternative fuels than changing vehicle technology. For this reason, the respondent argues that the present technology, with respect to vehicle development, is, in fact, sufficient today, however, as long as alternative fuels are more expensive in relation to fossil fuel, alternative vehicles will not be able to compete with conventional technology. Hence, in contrast to respondent B(t) and respondent C(t), the respondent perceives the situation as a question of finding a wide-spread and accessible alternative fuel that can be used in the contemporary diesel engine rather than finding new vehicle technology. The following quotation responds to a question concerning the exchange of knowledge and cooperation within the sector. As is illustrated, respondent A(t) primarily requests improved regulatory rules that facilitates the use of today’s available options:

It is also a matter of creating administrative regulations that can support and facilitate the use of today’s know-how, but this is an area that is somewhat limping. And as a result we end up in a situation where ethanol buses are not competitive because ethanol is taxed equally as cognac instead of as in Sweden, where ethanol fuel is not taxed at all.[14]

According to the respondent, the overall challenge to reduce fossil fuel dependency in the transport sector is to find solutions to optimize the overall logistic system and to introduce broad regulations that can facilitate a broader use of alternative fuels. While these undertakings are considered to be a task for decision-makers, the role of the manufacturing company is to continue to develop the diesel engine by making it more resource efficient and able to run on different fuels.
5. Discussion and key findings

So far, this thesis has described the respondents’ perception of climate change with the aim of bringing light on their understanding of the need to respond to its potential impacts. This discussion section aims at explaining comparing these views by applying the conceptual framework of the organizational response process. The application and the full outcome of the conceptual model is outlined in Appendix 1. From the results, the following key findings have been targeted.

1. Climate change is perceived as a wide-ranging external issue that, in all sectors, is closely connected to energy and resource use.
2. The strategies to cope with potential impacts of climate change are diverse, however, mainly they concern measures to reduce energy use, resource use and fossil fuel in order to decrease greenhouse gas emissions.
3. Exposure to climate risks relates foremost to external changes, while physical impacts are less considered. However, the perceived response capacity is high in all sectors. Hence, climate change is not considered to imply dramatic impacts in near future.
4. Climate change is perceived as one factor that in combination with other aspects potentially can impact business. There is a general high awareness about the risks, but with an apparent focus on mitigation strategies, while adaptation to direct impacts is not as understood.

5.1 Awareness and concern of climate change risks

According to Arnell and Delaney (2006) ‘awareness’ of climate change is not the same as the ‘concern’ about its impacts. Based on the results in previous section, it is concluded that at this point, the respondents’ awareness of climate change is high and they acknowledge the issue as a global threat that is here to stay. No new knowledge about its consequences is required; rather, it is perceived as an aspect that needs to be integrated and implemented in business strategies. However, while the “subjective side” of response capacity, that is, “we need to act”, is high with regards to mitigation strategies, concerns about adaptation to physical climate change effects are generally low. This is illuminated by the fact that all executive boards are engaged in taking mitigation measures, while adaptation to physical impacts is, in general, less understood. For instance, as exemplified in the forestry sector, adaptation to threats is considered to be at forestry management level, while mitigation is highly associated with energy reduction strategies.

When applying the conceptual model of organizational response process on the results, as is illustrated in Table 3, the concern about climate change risks is apparently connected to the degree of external influences, that is: 1) The degree of susceptibility to external changes, 2) resources and capabilities to respond, and 3) the degree of regulatory and market constraints. Consequently, the concern of climatic impacts on business is diverse among the respondents. For instance, as is illustrated in Table 3, the competition of biomass in the forestry sector is considered to be an important aspect for the companies, seeing as they are exposed to increased prices on their resources. Hence, as climate change intensifies the competition, the companies consider it important to be active in responding to the challenges. Moreover, the PTO has a high awareness and concern about the transports system’s exposure to flooding, yet, it is not considered to be sensitive to the potential impacts considering that the perceived response capacity to deal with the risks is significantly high. This perception relates to the PTO’s high self-perceived availability to resources and capabilities to respond in addition to a low-perceived degree of market and regulatory constraints (seeing as a large part of the business is financed by the County Council). Hence, bearing in mind that practical adaptive measures have been undertaken, the risk of climate change is considered low. The logistics provider, on the other hand, has a high concern regarding the need to mitigate greenhouse
gases, but a low concern with respect to adaptation to direct impacts. Consequently, the self-perceived susceptibility to external changes mainly concerns indirect impacts related to changes in the regulatory and market context, rather than physical climatic impacts. For this reason, the company is handling indirect risks and seizing opportunities (by developing new products and streamlining business), while direct impacts are considered as something the company will have to “muddle through”.

Table 3: The Table illustrates the overall concern to indirect and direct impacts. Based in the perceptions, four different response strategies have been identified.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Housing</th>
<th>Forestry</th>
<th>Transport</th>
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<tbody>
<tr>
<td></td>
<td>Indirect Impacts</td>
<td>Direct Impacts</td>
<td>Indirect Impacts</td>
</tr>
<tr>
<td>Awareness</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Concern</td>
<td>High</td>
<td>Low</td>
<td>High</td>
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<tr>
<td>Susceptibility to external changes</td>
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<td>Medium-High</td>
<td>Medium-High</td>
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<tr>
<td>Resources and capabilities</td>
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<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Degree of market and regulatory constraints</td>
<td>Medium</td>
<td>High</td>
<td>High/ PTO Low</td>
</tr>
<tr>
<td>Overall perception of indirect and direct impacts</td>
<td>High concern and high response capacity</td>
<td>Low concern and high response capacity</td>
<td>High concern and high response capacity</td>
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<tr>
<td>Overall perception of indirect and direct impacts</td>
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<td>Low Risk</td>
<td>Low Risk</td>
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<tr>
<td>Response strategy</td>
<td>Handling risks and seizing opportunities</td>
<td>Wait and see/ Assess risks and consider options</td>
<td>Handling risks and seizing opportunities</td>
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</tbody>
</table>

Simply put, the overall picture based on Table 3 demonstrates that the general concern is high in relation to mitigation needs, while the concern about adaptation to physical climate effects is relatively low. Hence, a general conclusion drawn from the conceptual model is that the self-perceived ’exposure’ to climate risks is low, while the self-perceived ’response capacity’ is high. For this reason, direct climate change risks are not considered to imply dramatic impacts on business. With respect to mitigation, however, the general perceived ‘exposure’ to indirect impacts is considered to be medium or even high, while the general self-perceived ‘response capacity’ is considered high. Hence, the overall risks of climate change are, in general, considered to be low seeing as measures are being undertaken. Finally, based on the strategies to cope with risks, the respondents appear to be aware that the increased awareness of climate change will impose sector winners and losers.
5.2 Response strategies

This section will discuss the perceptions of climate change in the view of “what” the businesses are striving to achieve by responding and “how” it will occur. First, considering that the concern about climate change effects varies, naturally, the current strategies to cope with potential impacts of climate change are diverse too. However, as things stand today, all companies strive to improve or maintain the same standard of products and services, but as mentioned above, the logistics provider and the vehicle manufacturer both aim at providing different products, which holds the same function. The housing companies as well, strive to reduce energy use in the housing productions, while holding the same, or even better, standard. With respect to ‘how’ these goals are achieved, in general, all sectors are concerned with energy or fossil fuel reducing activities, while responses to direct impacts varies. Based on the perceptions as outlined in Table 4, the response strategies could be considered to fall into four identified categories (drawn on Berkhout et al, 2006):

1. **Muddle through**: Climate risks are not taken into consideration; hence no response measures are planned.

2. **Wait and see**: There is an awareness of climate change risks, but it is not considered to be a pressing issue. More has to happen in order to respond.

3. **Assess risks and consider options**: The organization evaluates the risks connected to climate change and options in order to prepare for responses.

4. **Handling risks and seizing opportunities**: The organizational resources and capabilities are utilized in order to reduce risks and seize advantages of climate change

Considering that all companies have strategies to cope with indirect affects and strive to be on the cutting-edge in streamlining production and reducing energy use, the overall strategies to respond to climate change falls into the third and four categories. That is, all business organizations in this study are “assessing the risks and consider options’ but some also tend to ‘handling the identified risks and seize business opportunities’ by responding to indirect climate change effects. For instance, some companies have revised their business activities (e.g. undertaking energy-reducing measures and providing/introduced products that compile with climate change policies), and some are striving to integrate climatic risks in present routines (e.g. updating risk assessment lists in the housing sector, assess current strategy and response options in the forestry industry). According to Smit et al. (2000), who have provided a defining framework of adaptation, these mitigation strategies could be considered as a dimension of adaptation, considering that the businesses adjust their activities in compliance with socio-economic changes. In addition, adaptation measures, as pointed out by IPCC WGII, (2007), are usually integrated in overall risk assessments and rarely directed to climate change alone, which correlates to the overall results in this study, as climate change is perceived as one of many factors that can impact business. Taking into consideration that the two concepts mitigation and adaptation are linked, the current adaptations to climate changes can mainly be considered to refer to handling external changes.

With respect to adaptation to physical impacts, however, as mentioned, the concern is in generally low (with exception of the PTO who has taken practical adaptation measures), yet, some businesses consider themselves as already taking direct climatic risks into account (e.g. the housing sector and the SFG). At the same time, the general perception among the respondents is that adaptation considerations are relatively ‘novel’ ideas. Considering the general standpoint that physical climatic impacts are not considered as posing significant risks, some companies rely on “muddling through” (the logistics provider, the vehicle manufacturer and the forestry industries), while others assess risks and consider options (e.g. housing companies, and the SFG) or “wait and see” (one housing company).
5.3 Perceived response space

Considering that the companies perceive themselves as capable to meet changes in needs and demands, the knowledge about available response options in the sectors is high. To compare with Berkhout’s et al. (2006) findings, the examined companies in the study generally tended to employ already known and available response options, rather than investing in development projects that could generate new ways of dealing with challenges. For this reason, the authors implied that old measures could potentially be chosen over others when responding to climate change. The respondents in this study, however, cited many examples of how the businesses are investigating alternative measures and are investing in research projects to stimulate the development. For instance, the SFG is financing three exclusive research projects with a focus on forestry improvement. The PTO, is taking part in development projects to test new technology, the manufacturer and the housing companies are developing prototypes where groundbreaking technology is being tested. For this reason, the overall response capacity is, in this study, considered to be improved as technical and other options are perceived as being or becoming available. However, all response options are assessment by their “technical and economical feasibility and reasonability”.

5.4 Final remarks

Based on this study’s results, the main identified constraints of undertaking response measures (both in terms of mitigation and adaptation) relates to the large gap between investment costs and revenues, which is influenced by the exposure to competition. Moreover, taking the differences between mitigation and adaptation (as described in Table 2) into consideration, cost-benefits of mitigation are easier to target and go in conjunction with cost-efficiency objectives (Klein et al. 2005). Hence, value return for investments costs in mitigation activities is perceived in short-term future, while value return for adaptation measures are unclear. The model used in this study draw distinctions between direct impacts, indirect impacts and adaptation and mitigation. However, in the perspective of organizations, there is likely to be no separation between indirect and direct impacts, mitigation and adaptation strategies, nor between climatic and non-climatic causes (Berkhout et al., 2006). For this reason, the concept of examining a system’s totally response capacity, as has been the focus in this study, could improve further studies on businesses’ perspectives on dealing with climate change.
6. Conclusions

The result of this study indicates that the awareness of climate change is now high among the respondents, while the concern of its impacts varies in the sectors. The overall perception of climate change issues is perceived as a wide-ranging external threat, that foremost changes business conditions in the external context. Hence, in the perspective of the respondents, the largest reverse climate effects will not take place in “their backyard”, but will impact others direct and business indirectly. For this reason they do not consider themselves as exposed to direct impacts, but connect climate change with a need to reduce energy consumption and fossil fuel dependency. Hence, in many cases, the climate change issue has transcended from being treated as an environmental issue to an energy issue, and resources are invested in research and technology.

Finally, the results indicate that there is a strong link between adaptation and mitigation in a business context, seeing as the business in this study adapt to climate change by focusing on mitigation. As climate change is perceived as one by many external factors that can impact business, the business will not handle it differently from any other external risks that challenge business. For this reason, the concept of examining a systems' totally response capacity, as has been the focus in this study, could improve further studies on businesses' perspectives on dealing with climate change.

6.1 Suggestions for further research

This study has focused on large businesses with high capacity to respond to any external challenges to business. Hence, continued studies in this research area could examine how small businesses with less access to capital could, by small financial means, increase their response capacity to “climate-proof” their activities. There is also an interest of examining the differences between the strategically level in business, where most of the important know-how of responding is to be found, and the practical level in the organization that carry out the work, in order to reduce barriers to respond signals within an organization. For instance, is the organization doing what it is aiming to do? How can the organization facilitate the use of new response options and avoiding getting fixed in old routines? In a broader perspective, further studies could also continue to develop the concept of response capacity, where both mitigation and adaptation is included, but with the aim of facilitating inter-sectorial policy-making on the national arena. Such research could examine the relationships between business and policy-makers with the aim to research how the barriers of responding to climate change can be overcome.
7. References


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Appendix 1

Original Interview guide

1. Berätta kort om din roll här på….

A: Klimatfrågans betydelse

2. Vilken betydelse framtidens klimatförändringar för er verksamhet? (attityd)
   Är det en fråga bland andra?
   Hur betydelsefull är klimatfrågan i jämförelse med andra frågor?

3. Hur påverkar vädervariation och klimatförändringar er verksamhet?
   Vilken påverkan utgör störst hot för verksamheten? (översvämningar, torka, storm, extremare väder etc.)

4. Hur länge har branschen arbetat med frågor som rör klimat?
   Vad satte igång arbetet?

5. Hur hanterar ni potentiella risker som kan orsakas av klimatförändringar? (fokus på mitigation eller adaptation?)

B: Hantering av risker samt minskning av utsläpp

6. Hur hanteras riskerna i verksamheten (anpassning)? Dvs, vilka strategier och policys finns?
   Berätta!
   Hur kan riskerna förebyggas? (finns sårbarhetsanalyser? Analyserat anpassningsbehov?
   Planerat för anpassning?
   Vilka åtgärder och teknik finns tillgängliga idag?
   Vilka åtgärder finns i framtiden, (teknik eller andra faktorer?)

7. Vilka svårigheter möter verksamheten i att handskas med klimatrelaterade risker (anpassning)?
   Vilka hinder ser du att det finns för att genomföra förebyggande åtgärder?
   Är det lätt att byta ut eller införa ny teknik?
   Annat att tillägga?

8. Vilka möjligheter möter verksamheten i arbetet att förebygga klimatrelaterade risker (anpassning)?
   Är det lätt eller svårt att anpassa verksamheter till nya klimatrelaterade risker?

8. Hur arbetar verksamheten med att minska koldioxidutsläpp (och andra växthusgasutsläpp)?
   (mitigation)
   Vilka åtgärder finns tillgängliga idag?
   …och i framtiden?

9. Vilka möjligheter finns att genomföra åtgärder som minskar klimatpåverkan? (mitigation)
   Finns teknik eller andra åtgärder det tillgänglig nu?
   …och i framtiden?

10. Vilka svårigheter möter verksamheten i arbetet att reducera klimatpåverkan?
    Varför?
C: Kunskap och verksamhetens betydelse för klimatfrågan

11. Vilken kunskap är viktig för att reducera utsläpp och förebygga risker relaterat till klimatvariationer? Var kommer kunskapen ifrån gällande klimatförändringarnas påverkan och strategier för att handskas med dom? Finns det ett behov av kunskap för att arbeta med riskförebyggande och utsläppsreducerande strategier? (kunskapsluckor?)

13. Vilka aktörer samverkar ni med för att få kunskap?


D: Framtid osv.

15. Var står ni om fem år i arbetet med riskhantering relaterade till klimatförändringar samt i att minska utsläpp?

16. Vad krävs för att komma dit?

17. Något du vill tillägga?
Appendix 2
Interview guide, English

1. In brief, what is your role here at…

A: Climate change significance in relation to business activities

2. What does projected climate change mean to your business? (attitude)
   Is it an issue among other concerns?
   How significant is the climate change issue in relation to other concerns?

3. In what way do present weather variations and projected climate change impact your business?
   What type of impact poses the largest threat to business?

4. For how long has the branch worked with climate related concerns?
   What initiated the work? (how? by whom?)

5. How does the company deal with potential threats of climate change? (Focus on mitigation or adaptation?)

B: The management of risks and strategies to reduce greenhouse gas emissions

6. How and by what measures are climate risks handled today?
   How can risks be prevented? (Have risks been assessed and analyzed?)
   Analyzed need of adaptation? Planned for adaptation?
   What measures and technology are available today?
   Is there technical or other options available in the future?

7. What difficulties in terms of taking adaptation measures are recognized? (adaptation)
   Is it easy or difficult to change activities?
   Do you want to add anything else?

8. What possibilities in terms of taking risk preventive measures are recognized?
   Is it easy or difficult to adjust to new climate related risks?

9. How and by what measures is the business reducing greenhouse gas emissions today? (mitigation)
   What measures and technology are available today?
   …and in the future?

10. What difficulties in terms of mitigating climate impact does the business recognize?
    Why?

11. What possibilities in terms of undertaking mitigation measures is discerned?
    Anything else to add?
**C: Knowledge and self-perceived areas of responsibility**

12. What knowledge is considered important in order to reduce emissions and prevent risks related to climate variations?
   - From whom and where is knowledge concerning climate change risks and measures to handle them obtained?
   - What type of knowledge is sought for in order to reduce emissions and prevent climate related risks? (Any gaps in knowledge?)

13. What external stakeholders do you cooperate with in order to share and obtain knowledge about climate change?

14. What is the self-perception of your organization’s role to perform with respect to climate change in the broader society? (*attitude*)
   - Do you consider that responses to climate change are in your area of responsibility?

**D: Future etc.**

16. Where do you stand in five years with respect to responding to climate change (reduce risks and mitigate greenhouse gases)?

17. What undertakings are considered necessary to reach that point?

18. Is there anything you would like to add that we have not discussed so far?
Appendix 3

Original quotations

Housing sector

Risks

[1] Respondent C(h) p.19
/**/men jag tror ju inte att det handlar om temperaturer i Sverige eller om vattennivå stiger så mycket, utan jag tror ju att det här blir dramatiska ekonomiska förändringar i världskartan.

Sensitivity and response capacity

[2] Respondent B(h) p.20
Tekniken finns, men har hittills varit något kostsam /**/ Idag fokuserar man mycket på energieffektivisering. /**/ Om man ser möjligheter med klimatfrågan vinner man konkurrensfördelar.

[3] Respondent C(h) p.20
/**/det tar tid att vara långsiktig.

[4] Respondent C(h) p.20
Förebygga risker... det vi har pratat om är framförallt temperaturhöjningar, vattenhöjningar, nederbördssökningar, och i viss mån ökad vind. Det är väl dom riskerna vi står inför. Om det inte blir orkaner, vilket jag inte tror vi pratar om här, så är vi dimensionerade för rejält med nederbörd. Det innebär förmodligen att det kan bli rejäla snömängder, man ska inte glömma bort det, nederbörd kan även komma ned som snö /**/ Men jag menar, det där bygger vi redan för idag, vi har ju sats säga ett nederbördsvikt klimat.

[5] Respondent B(h) p.21

Forestry industry

Risks

[6] Respondent A(f) p. 21
För några år sedan om jag ser tillbaka på bolaget, då var det främst miljösidan som jobbade med dom frågorna mycket, det var vi som drev dom. Nu är frågorna mer på energisidan för slutligen är det där investeringarna kommer, hur kostnaderna hanteras och så vidare. Så det är ju en stark koppling till energi om man ska fortsätta att jobba med just CO₂.
[7] Respondent C(f) p.22
/…/ så att flytta klimatzonerna några steg norrut skulle inte innebära någon större dramatik tror vi, när det gäller att odla gran då. Vi använder redan nu genetiskt material som kommer längre söderifrån. Så vi har beredskap att använda gran av olika härkomst då /…/ Om det inte blir en väldigt hastig klimatförändring, för det är klart att det kommer att skada skogen på ett eller annat sätt. Om det blir väldigt milt och väldigt blåstigt på vintern, då får vi kanske fler stormar av den här typen som vi har haft nu. Då blir det svårare att bedriva skogsbruk av tekniska skäl.

Sensitivity and response capacity

[8] Respondent B(f) p.22
Ja alltså viljan finns, men som jag sa, vi kan inte dra på oss jättestora kostnader jämfört med konkurrenterna, vi måste veta att vi får tillbaka investeringarna och att vi är konkurrenskraftiga och att vi har bra produkter även i framtiden. Så viljan finns, vi vill ligga i framkant, men samtidigt måste vi se över vad som händer i branschen i övrigt.

[9] Respondent A(f) p.22
Svårt, nej det ska jag inte säga, men det är stora investeringar. Och jag upplever det så här, för att kunna få en positiv effekt på miljön och för att kunna göra en skillnad, så är det bolag med lite muskler som kan göra de här investeringarna som är viktiga. Så att jag tror att en viktig aktivitet på hela den här problemen med global warming, är att stora bolag gör bra investeringar som främjar miljön. /…/ Så jag tycker att kapitalet går hand i hand med miljön i det här avseendet. Vi kan göra förändringar och vi gör dem gärna.

Transport sector

Risks

[10] Respondent A(t) p.23

Sensitivity and response capacity

Nu har vi hört det här några gånger och till slut har man funderat och det har sjunkit in. Så nu är man ganska klar på vad som gäller i dagsläget. Och de här
åtgärderna som vi har gjort, de nivåer vi har tagit beslut om, de häller fortfarande kan man säga.


[13] Respondent B(t) p.25
Kunderna säger att miljö är väldigt viktigt, hittills har man inte kommit längre än till att man är beredda att köpa de gröna produkterna. För det är en väldigt kostnadsmedveten bransch trafik och logistik, man har en väldig kostnadspress på varje procent. Varje öre är viktigt att rationalisera för kunden då och för oss också. Men vi tycker att det är viktigt att vi har de här produkterna framme och att vi kan erbjuda dem till de kunder som vill göra någonting åt det här.

[14] Respondent A(t) p.25
/…/ Sen handlar det ju om att få administrativa regler som stöttar upp det här, där man verkligen använder det man kan, och det är som sagt där det haltar lite grann, där hamnar vi då rätt var i ett läge där etanolbussarna inte kan konkurrera, därför att etanolen beskattas som konjak. Istället som i Sverige där det är noll procents skatt på bränsletanol.
## Appendix 4

<table>
<thead>
<tr>
<th>Sector</th>
<th>Housing</th>
<th>Forestry</th>
<th>Transport</th>
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</thead>
<tbody>
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### Factors that can influence response elements

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