



CHALMERS
UNIVERSITY OF TECHNOLOGY



The meaning of environmental work in building management

An analysis of current discourses in the Swedish housing sector

Master's thesis within the Industrial Ecology programme

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Division of Environmental System Analysis
CHALMERS UNIVERSITY OF TECHNOLOGY
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Chalmers Reproservice
Göteborg, Sweden 2016

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Abstract

A gap between desired environmental performance and actual performance can be seen in the Swedish housing and building sector. Local and national environmental objectives are predicted not to be reached. Being a big contributor to the national environmental impact, the housing and building sector has a large responsibility in this.

In this study, including both a document and an interview study, discourses present in the housing and building sector have been identified. By structuring the empirical findings according to level of knowledge, and values, discursive patterns have emerged. The discursive patterns have been analysed and put into context by relating to a factual platform, which was also established as a part of this study. Through that exclusionary effects have emerged, and possible consequences of those exclusionary effects have been discussed.

The study concludes that the environmental impacts are substantial and generated both from upstream and downstream processes. Different types of impacts are created from different parts of the housing stock. However, the exclusionary effects of the discursive patterns identified are excluding certain aspects from environmental practice. All impacts are not considered and all possible solutions are not used. The most dominant conceptualisation of environmental work is to equate environmental impact with operational energy use and to focus on municipal housing, thereby excluding other phases of a buildings lifecycle and other parts of the housing stock.

The results from this master's thesis should be seen as a basis for discussion of how environmental work is being performed in the housing and building sector today. The study contributes with an increased knowledge of how current discursive patterns are influencing environmental practice. It also gives an increased understanding of how strongly discursive patterns influence what we perceive as possible, and highlights key points of interest for future research.

Keywords: Discourse analysis, Environment, Environmental work, Housing and building sector, Sustainable development, Swedish housing stock

Acknowledgements

This master's thesis was written within the master's programme Industrial Ecology, as a part of an individual master's programme, and was carried out from May to October 2016. The project was performed at the Department of Energy and Environment, Division of Environmental System Analysis at Chalmers University of Technology, Sweden. This master thesis was conducted with associate professor Henrikke Baumann as supervisor and as examiner.

I would like to thank Henrikke for all the help and support I have received during this project. I would also like to thank all people that I have interviewed for taking time to share their experiences and discuss this very important topic. Finally, I would like to thank family and friends for your encouragement during this time. Ylva, thank you for all useful inputs and interesting discussions. Mum and Dad, thank you for always helping out. Olof, thank you for your constant support, feedback and useful inputs. Without you this would not have been possible.

October 2016, Göteborg

Emma Holm

Abbreviations

| | |
|------|---|
| BBR | Boverket's Building Regulations |
| BRF | Cooperative Tenant-Ownership |
| CED | Cumulative Energy Demand |
| EU | European Union |
| GDP | Gross Domestic Product |
| GWP | Global Warming Potential |
| IEA | International Energy Agency |
| IPPC | Intergovernmental Panel on Climate Change |
| LCA | Life Cycle Assessment |
| PBL | Planning and Building Act |
| SABO | The Swedish Association of Public Housing Companies |

Swedish denotations

| | |
|--------------------------------|---|
| Bostads - försörjningslagen | The Housing Act |
| Boverket | Swedish National Board of Housing, Building and Planning |
| Energimyndigheten | The Swedish Energy Agency |
| Fastighetskontoret | Real Estate Department |
| Miljöbalken | The Environmental Act |
| Miljöförvaltningen | Environmental Department |
| Naturvårdsverket | Swedish Environmental Protection Agency |
| Stadsbyggnads- kontoret | Urban Planning Department |

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Appendix 1 – National and local environmental ambitions

Appendix 2 – Findings from the document study

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1 Introduction

1.1 A need for an enhanced environmental work

The interest for environmental work in the housing and building sector in Sweden today is substantial. Actions for making the housing stock more sustainable are performed and the environmental impact from the housing and building sector is frequently being discussed. Most people agree to the fact that the building industry is responsible for a large part of the global resource use and environmental impact, and that its role in environmental ambitions is of great importance. To argue that there is a need for an increased environmental work in the building sector and a further reduction of its environmental impact would therefore be to knock on an open door.

However, even though it is known that a reduction of the environmental impact from the building sector is needed in order to prevent irreversible changes in natural ecosystems and disruptions in the climate system, enough is not done. Current practices will not be sufficient if we want to achieve an environmentally sustainable development and fulfil national and local environmental objectives. Hence, a gap between environmental actions performed and political environmental ambitions can be identified. Different research methods analysing how the gap can be reduced exist. Renovation frameworks helping actors improve their environmental work have been developed and Life Cycle Assessments (LCA) can be used to show where the impact is generated and which activities that are contributing the most. Technological development has further been proposed to reduce the pressure that the housing and building sector puts on the environment.

However, even though the insight of what ought to be done is present and the sufficient technology is available, the actions performed are not achieving a desirable result. An alternative way to approach the gap could therefore be to investigate why certain actions are performed, rather than proposing different types of solutions. More specifically, investigating how different factors and discursive patterns are influencing the environmental practices. An example of such studies, where discursive power has been highlighted, is a study made by Gluch and Stenberg (2006) where it was investigated how the discourse of trade media influenced green building practice. In a study made by Bradley (2009) it was investigated how the strategies for urban sustainability in Sweden and Great Britain where underpinned by existing norms.

These studies are indicating that it may not be viable solutions for reducing the environmental impact that are missing, but that current discourses are shaping attitudes and limit ideas of which solutions actors see as possible to perform. In discourse theory a discourse is defined as a certain way of speaking about and understanding the world. In a discourse some actions are considered to be natural

and some to be unnatural, and the gap could therefore only be closed if the needed actions fit within current discourses and therefore are perceived as possible.

Environmental work in the housing and building sector has been equated with certain factors such as operational energy consumption and the use of toxic substances, and with certain efficiency indicators. As this study will show, several aspects and types of solutions are never considered and certain parts of a building's lifecycle, and certain environmental indicators are never treated. The present situation where building practice has a narrow definition of what is considered to be environmentally sound therefore raise a question if it is the current discourses that are shaping that definition and by that affect the chances of reaching the environmental objectives.

1.2 Aim and purpose

The aim with this study is to explore the conceptualisation of environmental sustainability in the housing and building sector in Sweden. It will be investigated how policies and environmental goals are transformed into action, and how the current discourses are shaping that process. This will be done by identification of different environmental discourses apparent in the management of the existing housing stock and by studying the exclusionary effects of those discourses. In an attempt to understand the discourses, they will be linked to different ideals and values which underline differences in opinion about how environmental sustainability should be achieved.

The intention with the study is not give the answer to which environmental strategies that should be used in the housing and building sector. By using a social constructivist approach the ambition is instead to highlight the strategies and reasoning used in current practice. By analysing current discourses, it may be possible to understand the reasons behind certain actions, challenge current practices and through that improve the performed environmental work.

1.3 Research questions

The aim of the study will be reached by:

- identifying and summarising current discourses in the Swedish housing and building sector by answering the following questions:
 - R1: Which discourses defining the environmental work can be found among the actors working in the housing and building sector?
 - R2: Which connections can be seen between the identified discourses and environmental values?

- R3: Which relations, influences and conflicts can be seen between the identified discourses?
- establishing a factual platform identifying the characteristics of the Swedish housing stock by answering the following questions:
 - R4: What is the status and composition of the Swedish housing stock?
 - R5: What is the environmental impact from the Swedish housing stock?
 - placing the discourses in a context comparing them with the factual platform and answering the following question:
 - R6: What are the exclusionary effects of the identified discourses?

1.4 Delimitations

This study investigates and analyse the discourses present both at a national and a local level. At the local level is the study delimited to investigate and analyse the discourses present in the environmental work in the housing and building sector in Göteborg. As the goals and strategies at a local level are formed based on national goals and ambitions, and since the work many times is influenced by national policy instruments, the findings in this study can probably be applied to many other cities and municipalities in the country.

Only buildings for housing are included in this study and buildings used for services are therefore not treated. The study is also delimited to mainly treat the existing housing stock and its environmental strategies, and not new production. There exists a broad agreement that in order to reduce the environmental impact from the housing sector, one needs to reduce the environmental impact from the existing housing stock. As the existing housing stock is substituted by less than 1 % per year, most of the buildings that will be in use when environmental targets are meant to be reached are already built (Högberg, 2014). This shows the great importance of the existing housing stock in the aim of reducing the environmental impact from the sector. However, many times the strategies for new buildings are closely connected to strategies for maintenance and renovation of existing buildings. Through that also the environmental impact for new buildings will partly be treated in the study, and even though the scope of the study is to investigate the housing sector also the building sector will be mentioned frequently.

Further, this study is delimited to only treat the anthropogenic environmental impact on climate and natural ecosystems, i.e. “environment” in this context refers to the natural environment and the natural ecosystems. When discussing environmental sustainability and environmental impacts, the definitions of environment and sustainability probably are as many as the people participating in the discussion. It is obvious that it is of great importance that the built environment

is free from toxic substances and have a healthy indoor environment, and that the topic needs attention, but it is beyond the scope of this study.

Finally, this study has no ambition to discuss the cost of different measures and the cost of environmental damage. However, cost does play an important role in the current discourse and is many times the factor which initiate and influence different decisions. Cost will therefore be mentioned in relation to other costs and perceived costs will be discussed. This study is however limited to only treat costs in that way and no calculations of which solutions, strategies and measures that will be the most profitable are being made.

1.5 Outline of the thesis

Chapter 2 gives a description of the status of the environmental work, and a gap between political ambitions and achieved results in practice is identified.

In chapter 3 the method for the study is described.

The study consists of two parts, of which the first is covered in chapter 4 to chapter 6. This part answers research question R1-R3 and identifies discourses present in the housing and building sector which influence the environmental work in management of the existing housing stock. The discourse analysis is based on a document study (chapter 4) which indicates overarching discourses and an interview study (chapter 5) where a more in-depth discourse analysis is performed. The findings from the document and the interview study are summarised in the final step of the discourse analysis (chapter 6). The identified discourses will be linked to different ideologies and values, and conflicts and connections will be highlighted.

The second part of the study is covered in chapter 7. This part puts the identified discourses in a context while answering research question R4-R5. By establishing a factual platform describing the status and the characteristics of the existing housing stock and the environmental impact it causes an analysis of the identified discourses will be possible. The ambition is to embrace all aspects of the environmental impact and have a holistic view, looking not only at one cause of the environmental impact, but several.

In chapter 8 the factual platform is used to analyse the exclusionary effects of the identified discourses and research question R6 is answered. In chapter 9 the findings from the study are discussed and in chapter 10 the study is concluded.

2 A gap between political ambitions and practice

2.1 Environmental ambitions

Both in Sweden and in the rest of the world there is an understanding of the consequences of our environmental impact. Research shows that the cost for not reducing our environmental impact and mitigate climate change will be higher than the cost for the environmental action needed today (Stern, 2007). Global agreements, European Union (EU) directives and national political ambitions have led to that environmental goals and strategies have been developed.

In Appendix 1 the Swedish environmental goals and strategies, and the local ones in Göteborg, is presented together with the definition of environmental sustainability used in this study. To summarize, the Swedish government has adopted 16 environmental quality objectives which describes the desirable state in which sustainable development can be achieved. These objectives have in turn influenced environmental ambitions in Göteborg and their 12 local environmental objectives.

2.2 Status of the environmental work

The environmental work, at both national and local level, is continuously being assessed and follow-ups on the environmental objectives are being made. This in order to see if current measures performed will be enough for the objectives to be reached.

Out of the 16 national environmental quality objectives only one is predicted to be reached until 2020, the objective “A Protective Ozone Layer” (Swedish Environmental Protection Agency, 2016). The environmental quality objective “Reduced Climate Impact” has a negative development as the concentrations of greenhouse gases in the atmosphere are increasing. The global emissions need to approach zero, and in order to achieve that societal changes, technical development, increased ambitions in the international climate debate and stricter new national policy instruments are needed. The environmental quality objective “A Good Built Environment” is the greatest challenge, which however sees a positive development. Several municipalities have an increasing holistic view on urban development and the environmental impact from buildings is more often considered from a life cycle perspective. (Swedish Environmental Protection Agency, 2016)

Out of Göteborg’s 12 environmental objectives none is predicted to be reached within the specified timeframe. Five are predicted to be very difficult or impossible to reach, and seven are predicted to be possible to reach if additional measures are initiated within the specified timeframe. (Miljöförvaltningen, 2016)

2.3 The identified gap

As none of the environmental objectives at local level in Göteborg, nor at a national level in Sweden, is predicted to be reached within the specified timeframe, a sustainable development will not be achieved. There is an evident gap between the goals and the pro-environmental actions being performed. If this trend is going to change building practice needs to change, and an important question is whether new solutions need to be invented, or if the solutions already exist but that current discourses hinder the use of those solutions.

3 Research method

3.1 The role of the researcher

3.1.1 The subjectivity of the researcher

In this study all of the generated material is considered to be a true representation of reality, however it is the researcher's representation of the reality and not an objective representation. The study aims at identifying the discourses which form and perform the strategies created to reach environmental sustainability within the housing and building sector. In this it is important to emphasize that also the researcher is part of a discourse and that all steps throughout the study will be influenced by that discourse. No such thing as an objective view exists and the positionality of the researcher will be influencing all aspects of the research. The formulation of research questions, the material generation, the used theory and method and the interpretation of them, the conducted fieldwork and all interpretations made and conclusions drawn will all be a result of the discourse of the researcher (Bradley, 2009). As subjectivity is impossible to avoid it is important that transparency is aimed for throughout all the steps of the study. The reader should understand how the research is done, what is included and what is excluded, and which conclusions that has been drawn by the researcher and which facts the reasoning is based on (Bradley, 2009). It is also important that the preunderstandings of the researcher, the theoretical positions, the methods used and the facts on which conclusions have been drawn are explained for the reader. In this way it will be possible to follow and evaluate the study and its findings, and then make an individual interpretation (Bradley, 2009).

3.1.2 The researcher's contribution

This study has no ambition to state what is preferable environmental work within the housing and building sector, nor will it suggest any particular strategies which should be developed. No value will be put in the work conducted today and no opinions will be raised regarding what is good and what is bad. Instead the goal with this research is to identify patterns of what is being said and written, and to highlight which impact these patterns of reasoning might have. The researcher's ambition is to open up new perspectives and that those new perspectives might lead to new types of strategies being developed, or that the understanding of our reasoning will increase the success of the conducted environmental work in the housing and building sector.

3.1.3 Point of departure

In order for you, as a reader, to understand the choices made throughout the study and to be able to make your own analysis of the presented result it is important that the researchers point of departure is presented. This research started with a desire to write about the environmental sustainability work in the housing sector and the

possibilities for it to develop. With the belief that the environmental burden of the housing stock needs to significantly be reduced the ambition was to investigate what would be needed in order to improve the environmental work of the sector. However, rather soon it was realised that in order to understand what is needed to make a change in the performed environmental work one needs to understand the environmental work, what it is based on and how it is performed. These ideas led the study towards the path of a discourse analysis and a social constructionist approach. With limited experiences of such methods this study has been a journey of learning and trying, and constantly realising that also the researcher is part of a discourse and the choices made during the research have many times been a result of that.

Initial literature research indicated that energy consumption is very closely linked to environmental impact, climate change in particular, and that energy efficiency is needed in order to mitigate climate change (Thoreson, 2013). There is a very clear and dominant focus on the operational energy use per square meter in the most common environmental measures taken. The operational energy use needs to be low in all new buildings, and that it needs to be reduced significantly in the existing housing stock. It is often argued that the existing housing stock has an important role in the achievement of the national ambition, to reduce the energy use from the building sector with 50% until 2050, as the existing housing stock will make up such a large share of the total housing stock in 2050. Researchers are discussing a window of opportunity to integrate energy efficiency measures in the needed renovations of the buildings from the million homes programme and the record years, a window of opportunity which cannot be missed. What is more seldom mentioned is that the operational energy a building uses during its lifetime is around the same size as the energy used for constructing the building. Seldom mentioned are also all other environmental impacts than the ones created by the energy use and seldom discussed is if we use the best possible strategies for reducing the total environmental impact of the building sector. This study will elaborate with and develop the question of why certain solutions are performed and discussed, while other solutions are left out. This curiosity will be the leading question throughout the study together with the belief that we, by highlighting what we are doing, can realise the things which we are not doing.

3.2 Theoretical positions

3.2.1 A social constructionist approach

By using discourse analysis, a social constructionist approach, characterised by a critical stance towards obvious knowledge, is being applied (Winther Jørgensen & Phillips, 2000). The approach views the social world as something which is produced actively by human beings rather than predetermined or defined by external circumstances. Social constructionism portrays the world and our truth as

something made and maintained through social processes. The connection between actions and worldview makes some actions considered to be natural and some to be unnatural to perform (Winther Jørgensen & Phillips, 2000).

A discourse is defined as a certain way of speaking about and understanding the world (Börjesson & Palmblad, 2007). The specific meaning of the term varies and the different versions of discourse theory and analysis are many (Sharp & Richardson, 2001). However, what all discourse analyses have in common is their aim to understand the social world together with the perception that it is ideas, interpretations and meanings attached to the world which drive human behaviour (Arts & Buizer, 2009). It is suggested that discourse analysis could be used to challenge the status quo and facilitate change by highlighting the things which are taken for granted (Sharp & Richardson, 2001). It is also argued that the reflective characteristics of discourse analysis is needed in order to start discussions of current conceptions of the world, and that there is a need for researchers who give alternative pictures and question the things we take for granted (Börjesson & Palmblad, 2007). By using discourse analysis for the study it will be possible to challenge the existing conceptualisation of environmental sustainability in the sector and to investigate the consequences of accepting one version of the world rather than another. What the situation would have been if another discourse would have been dominating and by that another version of the world which would have been valid (Winther Jørgensen & Phillips, 2000).

3.2.2 All materials are a true representation of reality

Within discourse analysis the classic distinction between different material, where some material is considered to be a truer representation of the reality and therefore have a higher hierarchy, is not made (Börjesson & Palmblad, 2007). Instead all material which exist in reality, and thereby also describing reality, is considered to be equally true and could therefore be analysed with the same analytical tools. One difference between two types of material is however discussed in discourse theory, the difference between naturally occurring material and material produced by the researcher (Börjesson & Palmblad, 2007). The first type, called secondary data, could be a text published in a journal or at a webpage by someone independent of the research. As it is spontaneously generated it is suggested to give a more accurate picture of reality than the primary data, which typically could be a survey produced by the researcher.

In this study a wide range of material will be used and the ambition is to generate data which will bring a deeper understanding of how environmental sustainability is being conceptualised. By doing a literature study, a document study and an interview study, material which is both describing and forming the environmental work in the management of the existing housing stock will be generated. As the material from the interview study is produced by the researcher, discourse theory

will place it with a lower hierarchy than the rest of the material which is spontaneously generated. However, if the interview situation is viewed as a situation of interaction it could be considered to be as true as the rest of the material (Börjesson & Palmblad, 2007).

3.2.3 Pairs of opposites affecting ideas of environmental sustainability

This study is formulated as an investigation of the conceptualisation of the environmental dimension of sustainability. As described in Appendix 1, what environmental sustainability is, and how it should be achieved, is defined normatively.

Hedenus et al. (2015) have listed different pairs of opposites resulting in different perceptions of what we believe are the best solutions for a sustainable development. By describing the identified discourses through these pair of opposites light will be shed on how ideologies and values affect the strategies developed for achieving environmental sustainability. Different discourses are giving environmental sustainability different meanings, which leads to that different strategies are seen as possible. The pair of opposites which are discussed in this study are the following:

- *Anthropocentrism – Ecocentrism*
Anthropocentrism grants humans with intrinsic value and nature only with instrumental value while ecocentrism grants entire ecosystems an intrinsic value.
- *High substitutability – Low substitutability*
This category is about to which extent one believes that the ecosystem services offered by nature can be replaced with monetary capital and new technology.
- *Efficiency – Sufficiency*
Efficiency solutions reduce the amount of resources needed for a product or service while sufficiency solutions limit the use of the particular product or service.
- *Technology – Lifestyle changes*
This category goes broader than the previously and distinguish between the ones which sees technology as the main solutions to environmental problems and the ones which believes that lifestyle changes are needed.
- *Individual solutions – political solutions*
This category is about who is responsible for solving the environmental problems, if it is the individual or the policy makers.

- *Reformism – radicalism*
Reformism is a belief that small adjustments will be sufficient for solving the environmental problems while radicalism is a belief that more fundamental changes are needed.

3.3 Document study

In the first step of the discourse analysis a document study, identifying existing environmental strategies and the overarching environmental discourse, was performed. Environmental strategies and measures developed at national, local and company level were analysed based on a qualitative text analysis. In addition to this a quantitative content analysis on different text corpora, representing different actor perspectives, was made. The analysis is based on empirical findings and empirical driven selection criteria and it is important that the reader remember that it is not the reality which is presented here but the researcher's interpretation of reality. In the text and content analysis it is not all text, content and words which are presented and analysed, but the parts which the researcher believes is interesting to highlight based on the empirical findings.

3.4 Interview study

In the second step of the discourse analysis it was analysed how environmental goals are transformed into action among identified key actors. Respondents were identified through an actor analysis and a snowball sampling process.

The interviews were performed as semi-structured interviews with open questions. Focus was on letting the respondent talk as freely as possible about their experiences of measures done to maximize the reduction of the environmental impact. All interviews were recorded, reflected upon directly after the interview and then listened to for further reflections. Lastly an interview protocol was written. The interview protocol summarises the interview and highlights important findings and important quotes. The interviews were hence only partially transcribed. The following work scheme was followed for all of the interviews.

- Performing and recording the interview
- Direct reflection
- Listening through the recording, second reflection
- Writing an interview protocol using empirically based category structuring

3.5 Structuring the result according to themes

In the last part of the discourse analysis the findings from the document study and the interview study are summarised and analysed. With the findings it was possible to identify and specify different discourses in the housing and building sector.

It has been concluded by Gluch and Stenberg (2006) that the most influential factors for pro-environmental behaviour are values and norms together with level of knowledge. The differences in the environmental sustainability discourses identified are therefore explained through differences in ideology and values, and different levels of knowledge. Connecting and conflicting elements of the discursive patterns are also identified in order to enable a further discussion of the consequences current discourses have for the environmental work in the sector.

4 Document study

4.1 General

This chapter presents the performed document study which had the goal to identify the overarching discourse of the conceptualisation of environmental sustainability in the building and housing sector. In Appendix 2 different national and local action plans were mentioned, and different actor groups were presented. In this section they are represented by different text corpora which have been analysed. The analysis was done both by qualitative text analysis and quantitative content analysis.

The material analysed in this section is meant to represent the measures developed from environmental strategies. The ambition is to conclude which type of measures and actions that most often is proposed and carried through. The different measures were categorised according to the empirically grounded categories in Figure 4-1.



Figure 4-1: Empirical grounded categories used in the document study

4.2 Qualitative text analysis

4.2.1 General

To be able to carry through with the strategies and reach the desired goals described in chapter 2, different actions have been developed at different levels by different actors. Described actions, which can be both intended or already performed e.g. in the form of action plans and instructions, are in this section analysed qualitatively. The actions' relation to the ambitions at the different levels is showed in Table 4-1. The ambition with the content analysis is to categorise current practice according to the categories in Figure 4-1.

Table 4-1: Analysed corpora's connections to ambitions

| | Ambitions | Actions |
|------------------|---|--|
| National | <ul style="list-style-type: none">• Environmental Quality Objectives• Governmental ambitions• National Budget | <ul style="list-style-type: none">• Corpus 1-4 |
| Local (Göteborg) | <ul style="list-style-type: none">• Local Environmental Objectives• Local Budget• Local Environmental Programme• Local Strategical Climate Programme | <ul style="list-style-type: none">• Corpus 5-7 |
| Industry | <ul style="list-style-type: none">• Environmental ambitions in industry | <ul style="list-style-type: none">• Corpus 8-9 |

The text analysis was carried through in the following way. First the text material was defined and read. Notes were made for each category listed in Figure 4-1 according to the following principles. Every different type of environmental indicator, measure, building and phase of a building's lifecycle was listed in respectively category and valued according to the scale in Figure 4-2.

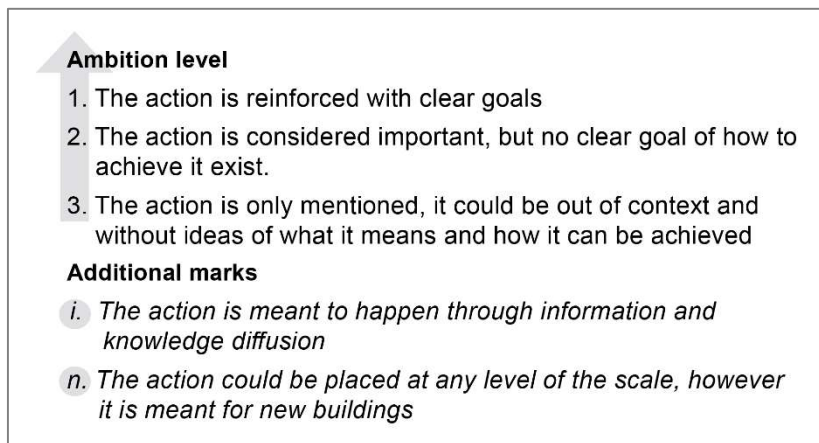


Figure 4-2: Scale used to indicate level of activity in text analysis

When the findings from the text analysis were summarised together with the findings from the content analysis, this scale was used to indicate to which extent the action is being performed or discussed. In the same way as a word mentioned a large number of times in the content analysis indicates high activity, an action with a low number on the scale indicates high activity. The letter i is used for indication of actions only including information and knowledge diffusion. This is relevant information as it indicates that someone else is expected to perform the action. The letter n is used for indication of actions only including new construction. This is relevant information as it is important to see the different discourses for existing buildings and new construction separately.

4.2.2 List of corpora

The corpora analysed in the qualitative text analysis are listed in Table 4-2. The corpora are meant to represent environmental strategies and measures developed at national, local and company level and in Appendix 2 their exact content is described. The findings from the analysis are shown in Table 1-1 to Table 1-9 in Appendix 2. In section 4.4 the findings are summarised together with the findings from the quantitative content analysis described in the following section.

Table 4-2: List of corpuses analysed in the qualitative text analysis

| | | |
|----------------|----------|---|
| National level | Corpus 1 | Information published by Energimyndigheten ¹ |
| | Corpus 2 | Information published by BeSmå |
| | Corpus 3 | Information published by BeBo |
| | Corpus 4 | Information about the municipal energy and climate counselling |
| Local level | Corpus 5 | Göteborg's environmental action plan |
| | Corpus 6 | Göteborg's Environmentally Sound Building Programme |
| | Corpus 7 | The steering directives and environmental action plan of Framtiden AB |
| Industry | Corpus 8 | Environmental ambitions at construction firms |
| | Corpus 9 | Environmental ambitions at housing companies |

¹The Swedish Energy Agency (hereafter denoted *Energimyndigheten*, the Swedish name)

4.3 Quantitative content analysis

4.3.1 General

In the previous text analysis, the most important action plans for environmental sound building in Göteborg were analysed together with other text corpora describing the environmental work in the sector, both at a national and company level. In this section larger text corpora have been analysed at a more detailed level.

In this quantitative content analysis words in different text corpora have been counted in order to investigate how different actions and measures are discussed. It has been investigated which terms that are frequently used, and which terms that are not. The generated corpora which have been analysed are listed in the right column in Table 4-3. The corpora are meant to represent the different actors relevant to the performed actions analysed in the content analysis.

Table 4-3: Analysed corpora's connections to actors

| How actions and measures performed are discussed ... | Generated corpora |
|--|-------------------|
| ...among the ones which develop policy instruments | • Corpus 10 |
| ...among the ones which build, manage and own properties | • Corpus 11 |

With the ambition to categorise the environmental work according to the same categories used in the text analysis and listed in Figure 4-1, different words have been selected and counted using the qualitative data analysis software Nvivo. The idea is that the words will give a hint of which type of measure that is being discussed, e.g. energy and efficiency indicates efficiency measures and area of living space indicates sufficiency measures. The words will also give a hint of which types of buildings that are being discussed and if a life cycle perspective is present. The words chosen for the analysis are frequently occurring words which are representative for the different questions.

4.3.2 List of corpora

The corpora analysed in the quantitative content analysis are listed in Table 4-4. The corpora are meant to represent different actor perspectives and in Appendix 2 is their exact content described. Table 2-1 in Appendix 2 shows the results from the content analysis of the different corpora. In section 4.4 the findings are summarised together with the findings from the qualitative text analysis.

Table 4-4: List of corpuses analysed in the quantitative content analysis

| | |
|-----------|--|
| Corpus 10 | Reports published by Boverket ¹ |
| Corpus 11 | Articles published by real estate branch magazines |

¹Swedish National Board of Housing, Building and Planning (hereafter denoted Boverket, the Swedish name)

4.4 Summation of findings

4.4.1 General

In this section a summation of the document study is made for the four categories defined in the beginning of the chapter. Both the findings from the qualitative text analysis and the quantitative content analysis are discussed. Similarities and differences between the different corpora are highlighted.

4.4.2 Environmental indicators which the measures relate to

It is usually the national environmental impacts which are mentioned in the discussions, and the environmental impacts from building materials used in Sweden but produced in another country are often left out. The city of Göteborg states that they have the ambition not to push the environmental impact into the future or outside the region. However, no measures for preventing that from happen can be seen.

Reducing operational energy use clearly has the highest priority when environmental actions are being considered. The energy goals are sometimes related to goals of reduced greenhouse gas emissions and sometimes renewable energy sources are discussed. In that sense also emissions to air are being

considered. This is confirmed by the content analysis, where energy is one of the most frequently used words in all corpora studied.

Other impacts from the operational phase mentioned are waste, hazardous substances in materials and water consumption. However, the impact from construction phase is often left out. Waste during the construction phase and the embodied energy of buildings are only mentioned in a few places, and always as more visionary ambitions. However, all these environmental indicators are mostly considered for new buildings and e.g. waste generated by renovation measures is not being discussed.

Ecosystem services are almost not mentioned at all. In the few cases they are mentioned it is not by the term ecosystem service, but in terms of the actual service. E.g. in one corpus it is mentioned that one needs to make sure greenery is preserved. Yet again, this is mainly for new areas and buildings, and work to increase ecosystem services provided by the existing housing stock cannot be seen to any great extent.

4.4.3 Type of measures proposed

A very dominant attitude is that the environmental impact from the housing and building sector should be solved with efficiency measures. Tendencies of solutions including lifestyle changes do exist, such as household waste recycling and fossil free transport by bike, carpools, electric vehicles or public transport. However, this can mainly be seen in the ambitions for new buildings and areas and among the private companies which sell apartments. As they market lifestyles in order to sell apartments these indications can be seen as a marketing trend rather than actual actions.

Efficient use of space in order to be able to live smaller is suggested by one company, however the dominant way to discuss efficiency measure is per square meter living area and not per capita or per apartment. This create a situation where the actual amount of the resource use is considered less important than the use per square meter and solutions for living less spacious are not considered for achieving a reduced environmental impact.

An attitude that environmental work, and solutions for a reduced environmental impact, need to be profitable, is dominating. Energy use and household waste during the operational phase, environmental indicators that are among the ones most frequently mentioned, are directly related to costs for the housing owner. A reduced environmental impact is never alone seen as reason enough to renovate the existing housing stock, and only economical profitable measures are carried through. Also the regulations developed are never formulated so strict that they risk harming the market and the companies within it. Economic growth is of high importance and prior to the environmental impact. The market is put first and

prioritised. The environment can only be saved as long as the market stays intact as a damaged market could never be the solution to a reduced environmental impact

Almost every actor analysed states that they aim at being forerunners and leaders in the environmental work of the housing and building sector. However, the way in which they are going to be forerunners are almost always explained as reaching further than what is required by the regulations. Forerunners are being more efficient and not doing things in a different way.

4.4.4 Part of the housing stock which the measures relate to

The networks developed for energy efficient renovations, see corpus 2 and 3, are much more developed for multi-dwelling buildings than for one- and two-dwelling buildings. Also Boverket is working harder to find solutions for reducing the environmental impact from the multi-dwelling housing stock than from the one- and two-dwelling housing stock. When the need for renovation within the Swedish housing stock is discussed, multi-dwelling buildings from the record years and the million homes programme are especially mentioned. A big opportunity to achieve a major energy reduction in the Swedish housing stock is seen in the possibility to integrate energy reduction measures in renovations of these buildings. It is however mainly municipal housing which is the target and private housing and cooperative tenant-ownership (hereafter denoted BRF, the Swedish acronym) are mainly reached through information.

In the quantitative content analysis, it was shown that one- and two-dwelling buildings were mentioned with the same, or higher, frequency than other words describing other parts of the housing stock. This is interesting as it is in contradiction to the rest of the findings. It would therefore be of interest to analyse the context in which the words are used further in order to understand this contradiction.

In Göteborg's environmental action plan (Miljöplan in Swedish) a lot of focus on new buildings and how to build them with low environmental impact can be seen. The existing housing stock is mentioned but mostly only in relation to a reduced use of energy and phasing out of substances hazardous to health.

The municipality is seen as a very important actor for reducing the environmental impact from the housing and building sector. If one studies how many times the words municipal and private are mentioned in the reports published by Boverket, it is clear that the municipality have a central role in their work.

4.4.5 Part of a building's lifecycle which is treated in the measures

The operational phase clearly is in focus for the intended and performed environmental actions and embodied energy is very seldom being discussed. In

Göteborg intentions of putting stricter demands on the procurement process are present. However, no well-defined measures in order to achieve that are yet developed. Also the lifecycle approach is mentioned by several actors, but no full lifecycle perspective is being applied.

A holistic view on the environmental impact from the sector and the use of LCA-studies are discussed among regulators and strategy developers. However, no actions include decisions based on LCA and the quantitative content analysis shows that it is not frequently mentioned. Miljöbyggnad, which is the environmental assessment system and certification scheme that is most commonly used, has a strong focus on the operational phase.

5 Interview study

5.1 General

In this section the performed interview study, conducted with actors supposed to transform environmental strategies into actions, is described. The performed interview study started by identification of key actors, and then through action research and snowball sampling respondents were gathered. The findings have been analysed with a mixed method approach and structured according to certain categories.

5.2 Data collection through interviews

5.2.1 Actor analysis and identification of respondents

The identification of respondents took the starting point in Göteborg's local environmental strategies. In, and for the development of, the strategies, the following were identified as key actors:

- Boverket – develops regulations and other policy instruments
- The city of Göteborg – develops strategies and action plans
- The municipal housing companies – seen as the key for the reduction of environmental impact from the existing housing stock.

The actors were contacted and through snowball sampling suitable candidates were identified. During the study new actors and respondents were identified and contacted. The findings steered the study and worked as a guide through the analysis which resulted in that aspects and actors left out of the discussions were not treated in the study. That is a delimitation but as the study aims at investigating the existing discursive patterns and conceptualisation of environmental sustainability that is a natural delimitation to make. Also, by noting the things left out, one gets an idea of which flaws the current discourses may have.

5.2.2 The interviews

The interview guideline used for the interviews was developed with the aim to facilitate an open discussion regarding the actor's views on the environmental impact flows caused by their decisions. Of interest is the respondents' definition of environmental work, their struggles and their ideas. The goal with the interviews is to see how the different actors are developing environmental strategies or transforming environmental strategies into action. By identifying choices and reasoning regarding environmental work it is possible to study how environmental goals are transferred through a series of actors to environmental actions.

An interview protocol was written for all the conducted interviews. The interview questions and the categories used in the document study worked as inspiration for the development of the following empirically based categories, used to summarise the findings from the interviews:

- Definition of environmental work
- Part of lifecycle treated and thoughts of lifecycle perspectives
- Level of integration of environmental work
- Characteristics of needed incentives and tools
- Is enough environmental work done?
- Who is responsible for reducing environmental impacts?
- Influential factors for the environmental work

The main findings from each interview can be found in Appendix 3 where the interview protocol is summarised according to the categories above. A mixed method was used in order to analyse the findings from the interviews. First a qualitative analysis was made where all different answers and aspects mentioned in each category was listed. Then a quantitative content analysis was made where it was counted how many times the listed answers and aspects were mentioned, see Table 2-1 in Appendix 3.

5.2.3 List of interviews

Ten interviews have been conducted with actors working with environmental strategies in and for the housing sector. Municipal housing companies have been the starting point as they are mentioned as key actors in the local environmental action plan of Göteborg. Actors at influential authorities have also been interviewed. All interviews were conducted during the spring 2016 and lasted between 30 minutes and one hour. All interviews were conducted at the respondents' workplace, except interview 4 and 10, which was conducted by phone. See Table 5-1 for a list of all the conducted interviews.

Table 5-1: List of interviews

| | | |
|--------------|--|------------|
| Interview 1 | Environmental Strategist, MHC ¹ A | 2016/04/26 |
| Interview 2 | Project manager, MCH A | 2016/05/17 |
| Interview 3 | Sustainability Strategist, MHC B | 2016/05/31 |
| Interview 4 | Environmental project manager, MHC B | 2016/06/22 |
| Interview 5 | Project Manager, MHC B | 2016/05/12 |
| Interview 6 | Property Analyst, MHC B | 2016/06/08 |
| Interview 7 | Fastighetskontoret ² Göteborg | 2016/05/04 |
| Interview 8 | Stadsbyggnadskonotret ³ Göteborg | 2016/05/16 |
| Interview 9 | Miljöförvaltningen ⁴ Göteborg | 2016/06/01 |
| Interview 10 | Boverket | 2016/05/25 |

¹MHC = Municipal Housing Company

²Göteborg's Real Estate Office (hereafter denoted *Fastighetskontoret*, the Swedish name)

³Göteborg's urban planning department (hereafter denoted *Stadsbyggnadskonotret*, the Swedish name).

⁴Göteborg's environmental department (hereafter denoted *Miljöförvaltningen*, the Swedish name).

5.3 Summations of findings

5.3.1 General

In this section a summation of the interview study is made for the seven categories defined in the beginning of the chapter. Similarities and differences between the different interviews are highlighted.

5.3.2 Definition of environmental work

Energy use, and the use of toxic or hazardous substances in building materials, are the most common definitions of what environmental work includes. Sometimes, e.g. at one of the municipal housing companies interviewed, is the energy use also discussed in relation to carbon dioxide emissions and climate impact. Household waste, resource use and promotion of reuse and recycling are other impact categories often mentioned in the definitions. Ecosystem services have only been mentioned once, during one of the interviews.

5.3.3 Part of lifecycle treated and thoughts of lifecycle perspectives

For all environmental indicators discussed it is almost only the operational phase that is discussed. For hazardous substances is a lifecycle perspective applied if databases of hazardous substances are being used, e.g. Sunda Hus. Having a lifecycle perspective is discussed among regulators and environmental strategies. However, it is mostly discussions, and so far are lifecycle demands considered to be too difficult and complex to formulate.

5.3.4 Level of integration of environmental work

Environmental work is not that well integrated in normal practices as it is perceived as something you chose to do in addition to what you normally do. Aspects, such as energy use and hazardous substances, which are regulated and standardised are rather well integrated. However, it is only regulated aspects which have managed to become a natural part of normal practices and strategies and ambitions for a constant improvement in environmental work seem to be missing. A conclusion drawn from the fact that when respondents were asked about strategies or methods for gathering new knowledge it was clear that no such thing existed.

5.3.5 Characteristics of needed incentives and tools

The most important aspect for environmental work to be performed is identified as economical profitability. The importance of measurability and possibilities for follow ups, together with unified systems are also aspects mentioned as important. A desire to use well-known techniques and easy, understandable systems have made pilot projects attractive.

5.3.6 Is enough environmental work done?

The opinions diverge regarding the question if enough environmental work is done or not. Some, e.g. environmental strategists, are convinced that we have to do more, a lot more. Actors with less knowledge in environmental issues seem to be confident that they do what they can, and that someone else is taking care about it. Also, the environment is not the only important thing to consider, and other things are competing for attention. Economic growth and economic profitability, together with solving the housing shortage, seem to be considered more important than environmental work.

5.3.7 Who has the responsibility for reducing environmental impacts?

Who is held responsible for the environmental work differs a lot between the different respondents. The dominant attitude is however that it is someone else who has the main responsibility. The ones who work in the companies think that those who develop regulations and strategies are responsible, and also that the individual tenant have a responsibility. Those who develop the strategies think that the companies have an individual responsibility. Some are arguing that we need to work together and are by that suggesting that everyone has a responsibility. It is also argued that as long sufficient information is spread the individual is capable of taking responsibility.

5.3.8 Influential factors for the environmental work?

EU-directives and political ambitions at local and national level together with environmental strategies and goals within the city are mentioned as the most influential factors for the respondents' environmental work. The regulations and environmental focus areas which are directing the environmental work are in turn developed in accordance with what companies and producers are able to achieve. The possibility to measure and follow up on the environmental work influence which actions that are being performed. Regulations and demands, economical models and prerequisites, and the ability to motivate decisions, are identified as important influential factors for the amount of environmental work performed.

6 Structuring the result according to themes

6.1 Presenting the result

In this section the findings from the document study and the interview study are summarised and categorised according to different themes. The identified discursive patterns have been linked to different values, their relations to other discourses have been highlighted and discursive conflicts have been identified.

6.2 Structuring the findings with pairs of opposites

6.2.1 General

How an actor perceives the natural environment and which ideology and values he or she has will result in his or her own definition and view on environmental sustainability. This will place the actor within a specific environmental discourse which will in turn influence which solutions and strategies that actor sees as possible for a sustainable development. To categorise the findings further they have therefore been linked to different pairs of opposites, relating to different perceptions of how environmental work should be conducted. In addition to the pair of opposites listed by Hedeneus et al. (2015) the pair of opposites high level of knowledge and low level of knowledge has been added. This was made because the level of knowledge has shown to have large influence on pro-environmental behaviour (Gluch & Stenberg, 2006).

6.2.2 Anthropocentrism or Ecocentrism?

All findings are indicating an anthropocentric world view. Environmental work is perceived as a cost and something which you do, if you can afford it, in addition to normal practice. Environmental concern is never expressed as something you have because you care about the ecosystem, rather it is something you do because someone demands it or because you can make a profit out of it. Environmental work is something which you can choose to prioritise, but if a lot of other things need attention the priority may get lower (Interview 3, Interview 6, Interview 9). Another indication of the conception that humans have a much higher intrinsic value than nature is that in the performed environmental work it is the local environment together with monetary profit maximization that are most prioritised.

6.2.3 High or low substitutability?

The findings indicate that beliefs in both high and low substitutability are present. Depending on your belief in the level of substitutability of the ecosystem services provided by nature, one experiences different levels of urgency. The actors with environmental issues as their main task are of the opinion that more needs to be done (Interview 1, Interview 3, Interview 9). That we only have one planet and that

we need to act to reduce our environmental impact. The actors which not are responsible for environmental issues are to a much greater extent convinced that someone is taking care of it, that it will be alright and that we always can fix it (Interview 5). It is usually the actors with answers indicating a low competence within environmental issues that believe that we do enough. If that is because they believe in high substitutability or do not have enough knowledge to have an opinion is not known. What, however, is clear is that other risks, such as the risk of constructing a building that does not function properly, are perceived as higher than the risk of irreversible changes in ecosystem due to the impact caused by the construction (Interview 2). A strong tradition of using well known techniques is evident.

6.2.4 Individual or political solutions?

The respondents hold many different actors responsible for the environmental work and a trend of holding someone else than yourself responsible can be seen. The ones developing regulations and environmental strategies are considering regulations as minimum levels and information provision is seen as the key to initiate the individual company or tenant to take responsibility. However, by project managers regulations are seen as the desirable levels and little effort is put in taking individual responsibility and reaching further.

A clear example of the belief in individual responsibility is the often occurring attitude that one should not tell the tenants how to live their lives, and one should not force companies and producers to live up to difficult demands. This indicates that the responsibility lies with the individual. However, individuals are often referring to regulations and strategies developed at a higher level and therefore place the responsibility at political solutions. As concluded before, the responsibility lies with someone else.

Despite this several companies, both municipal and private, have a strategy of being forerunners and reaching higher than regulations. Reaching higher than minimum levels have therefore been equated with ambitious environmental work. If the private companies do that because they take individual responsibility or because they see a market value in being environmentally sound is not clear. However, it is still an individual choice as no one demands the extra effort of them. Municipal companies on the other hand usually state that they should take responsibility and be forerunners because political ambitions, steering directives and local and national environmental strategies demands it. The responsibility therefore indirectly lies at another actor than at themselves.

What should, however, not be forgotten is that some actors are talking about the importance of collaborations, and in some cases a shared responsibility is assumed instead of handing it over to someone else. (Interview 1, Interview 4, Interview 9).

Among the municipal companies and the local authorities have unified demands and strategies been developed. This in order to create possibilities to helping each other, and to send a clear signal to producers of which demands and requirements that applies.

6.2.5 Efficiency or sufficiency?

An efficiency mind-set is dominant for almost all the environmental work identified and very few sufficiency measures have been seen. The majority of the proposed actions and strategies are suggesting that we should continue doing what we are currently doing, just more efficiently. The energy use per square meter living area should be decreased instead of reducing the needed square meters and living area. New efficient technologies are discussed rather than how we can change our way of living in order to reduce our resource use and environmental impact.

6.2.6 Reformism or radicalism?

The identified environmental work in the housing and building sector are very much about doing the same thing as before, just a little bit better. Many actors have stated the goal that they should be forerunners. Something which they aim to achieve through reaching further than regulations. More radical ideas of doing things in a different way than before are seldom suggested. There are, however, some actors which states that it will be difficult to reach our environmental targets with only efficiency measures and that lifestyle changes will be needed (Interview 3, Interview 9).

Another example of reformism in the environmental work are the project managers stating that we do all we can, we chose the best materials there is (Interview 2). A more radical idea, which also have been suggested (Interview 5), would be to think that we actually can do more. That we could use another technique for building the house as we then could use other less toxic materials. It is suggested that for making this possible, architects need to have other values and prioritises when designing a new building (Interview 5). That they should learn how to design buildings without the need for toxic material.

One should, however, remember that the housing and building sector is conservative and prefer reformism rather than radicalism for other aspects than the environmental work. Well-known techniques are always chosen so that the safety and durability of the buildings can be guaranteed. A high share of the interviewed actors mentioned the importance of using well-known system and techniques and the empirical material shows that there exists a broad agreement in the sector that pilot projects are needed for an improved environmental work.

Other statements which indicates reformistic values are the regulators stating that informative policy instruments are preferred over stricter regulations. That

regulations and demands should not be too strict, resulting in hitting companies and suppliers too hard. The more radical idea of putting the demands which would be required to reach the environmental objectives is not seen as possible and met with laughter (Interview 10).

6.2.7 Technology or lifestyle change?

In the identified strategies and actions technology is suggested to solve most of the environmental problems. However, as already been mentioned some actors are suggesting that lifestyle changes are needed as a complement if environmental objectives are going to be reached. Some of the lifestyle changes are to use less of something, e.g. use less water or consume less, while others are to change the technology used, e.g. from petrol to electric cars.

The lifestyle of individuals is an important factor for our environmental impact and it is suggested that peoples' lifestyle to a large extent is influenced by the built environment. Solutions which influence lifestyles and by that affect environmental impacts from other sectors, e.g. transport and consumption, are mentioned as important (Interview 3). However, no clear strategies of how to achieve that exist and examples can only be seen in pilot projects and for new areas (Corpus 5).

6.2.8 High or low level of knowledge?

The empirical material is indicating different levels of knowledge among the actors influencing the environmental impact from the housing and building sector. Many times the interest for environmentally sound building is high. However, knowledge about the environmental impact from the sector, what it consists of and what can be done in order to reduce it, is often lagging the awareness that something needs to be done. Even though this is the case, no defined strategies of how new knowledge is going to be gathered have been identified. It is even stated that no such strategies have been developed (Interview 9).

This creates a situation where actors with insufficient knowledge are dependent on opinions of others regarding the most optimal things to do and the investments preferable to make. Strategies developed by experts and certain impact factors, e.g. operational energy use, toxic substances and household waste, equated with environmental work will therefore have a big impact on the work performed by the actors with less knowledge regarding environmental issues. This have created a situation, visible in all the empirical material, where the environment seldom is discussed and where focus instead is on specific factors which are seldom questioned.

6.3 Dominant discourses

6.3.1 General

It has been shown that the environmental work in the housing and building sector is closely connected to other discourses present. Environmental work is performed when it is possible to conduct without interfering with other dominant discourses. Discourses identified from the document and interview study which has been shown to have a great impact on the environmental work conducted are the following:

- One should mind one's own business and not interfere too much with other's
- The importance of measurability
- One should only suggest solutions which one can motivate
- The requirement of economic growth and economic profitability
- Only use well known techniques

In this part of the analysis it has been investigated how those discourses are influencing the environmental work

6.3.2 Mind your own business

From the interview study it is clear that a dominant discourse is that one should not tell anyone how to do certain things. One should not tell tenants how to live their lives, one should not put too strict demands on private companies, etc. Instead one should focus on the things one has the mandate to control. As a result of this reasoning it is mainly three different parts of the housing stock that are being discussed.

- Multi-dwelling buildings
- Municipal housing companies
- Million homes programme – a window of opportunity

Multi-dwelling buildings are usually not owned by private owners or owner occupied and it is therefore easier to approach them with certain requirements. Either by “marknvisning” for new buildings at land owned by the municipalities or through the municipal housing companies. For existing buildings, it is almost only municipal housing that is regulated through strategies, as those buildings are the only ones the municipality consider themselves have mandate to steer. The law is of course regulating all buildings, however Boverket, which is developing the regulations, do not want to put too strict demands on the construction firms and the housing companies and cause a decrease in production speed.

Multi-dwelling buildings from the million homes programme is in the overarching discourse seen as a problem area that needs improvement. In the national budget

money is reserved for making these improvements and suggesting environmental improvements at the same time is therefore not seen as any major intervention.

6.3.3 Measurability

A dominant discourse identified is the one where only the measurable things are the ones that count. Many are highlighting the importance of measurability and the ability to show key numbers. This result in that only environmental work that is measurable is the environmental work that is being performed. The following environmental indicators are treated in the identified work:

- Reduction of energy use
- Reduction of waste and toxic substances
- Reduction carbon dioxide emissions

This shows that all the environmental indicators developed by Boverket, further explained in section 7.3.2, are being used. However, only with the focus on the operational phase and the local environment. Ecosystem services and the environmental impact from the construction phase, two things that are difficult to measure, are not treated to any great extent.

An example of this is the fact that many seems to know, or have an idea of, that certain materials do have a lower environmental impact than others. E.g. wood is more preferable than concrete in terms of carbon dioxide emissions. However, that is not enough for choosing wood over concrete. We do not have the knowledge enough.

6.3.4 Only suggest solutions which you can motivate

This discourse is very closely linked to the one previously described. Measurability is one way to motivate one's decisions if sufficient knowledge is missing. The dominating discourse is that one wants to have clear evidence of the impact of the proposed solutions. In situation where no clear strategies or key numbers are available sufficient knowledge could motivate one's decisions.

As deep knowledge about environmental issues and the complexity of their solutions often is missing, the actors usually go for well-known solutions suggested by others. Housing companies go for targets reaching slightly higher than regulations and consultants go for conventional solutions. An example of this is the fact that the construction phase is not given much attention. Several years ago research showed that the operational phase generated the largest part of the environmental impact and it has then become tradition to focus on operation energy use, see section 7.3.4. Even though this is no longer true few attempts of including other phases from the lifecycle can be seen. When approaching actors with the

question why that is, you get the answer that it is too complex, and that they wait for the initiatives of others. The knowledge required for acting by your self is not sufficient and the possibility for motivating the work is low. The responsibility of changing the convention is therefore moved to someone else, someone else with more knowledge in the matter.

6.3.5 Economic profitability

A strong discourse demanding economic profitability can be seen at many places in our society, and the housing and building sector is no exception. Our economy is market driven and both private and municipal housing companies need to make a profit. Also at a national and regional level economic profitability is important as a constant economic growth is a prerequisite for our economy. Putting too strict demands is avoided because of the fear of putting economic growth at risk.

This has created a situation where efficiency solutions have been preferred over sufficiency solutions. Most of the environmental work performed is work where costs easily can be calculated and where a profit can be seen. Environmental work is mostly about trying to do the same thing as before, e.g. with new installations and thicker walls, instead of trying to do things differently, e.g. by reducing living space.

6.3.6 Using well-known techniques

The building and housing sector is rather conservative and a dominant discourse is to only use well-known techniques. The reason for this is to avoid dangerous situations and insufficient durability. This leads to that environmental sound techniques are only being used if someone else has been using them before, and pilot projects are therefore valued high and many times seen as the solution for environmental work in the sector. This also leads to that it is reformistic rather than radical ideas which are being suggested.

6.4 Conflicting discourses

In this step of the analysis conflicting discourses have been studied and identified. Conflicting discourses are giving different answers to the same question and by that causing a conflict. The following conflicts between present discourses have been identified:

- Actors working with environmental issues are of the opinion that a continuously improving environmental work is urgent, and actors with less knowledge are not. The latter category is suggesting that we do enough as standards and regulations are being followed, while the first category is emphasising that we have to do more.

- Regulations are perceived as minimum demands by regulators and desirable levels by the ones following them. It is in the same way in the procurement process, the purchaser is demanding minimum environmental requirements and the consultant perceives the demands as the desirable levels.
- Everyone holds different actors responsible for the environmental work. The individual companies hold the individual tenant and the political ambitions responsible, while the policy instruments developed by the political ambitions call for responsibility taken by the individual companies.
- It is suggested that efficiency measures will not be enough in order to reach energy targets and that lifestyles needs to change. A conflict to this suggestion is the strong discourse identified that one should not tell anyone how to live his or her life. An attitude which clearly influence the possibility to change people's lifestyles.

7 Comparing the findings with a factual platform

7.1 The importance of giving the whole picture

To be able to discuss the consequences of the current discourses present in the housing and building sector it is important that the characteristics of the existing housing stock is described. In this section the discursive patterns identified and described in previous chapters are put into context by a factual platform describing the Swedish housing stock.

7.2 Characteristics of the existing housing stock in Sweden

7.2.1 Building and ownership types of the housing stock

As concluded in the analysis many environmental measures are targeting multi-dwelling buildings, and it is therefore important that the composition of the housing stock is further explained. Table 7-1 summarises how many buildings, and of which type, the Swedish housing stock consists. In total there are almost 5 million dwellings in Sweden, of which around 2 million are in one- or two-dwelling buildings and 2.4 million dwellings are in the multi-dwelling buildings. These two types of buildings are thus clearly the dominant types of dwellings (SCB, 2016) and one can conclude that dwellings in multi-dwelling buildings only constitute around half of all dwellings in Sweden.

Table 7-1: Number of dwellings in the Swedish housing stock

| Number of dwellings according to building type, 2015 | | | | |
|--|--------------------------|--------|-------------------|-----------|
| One- or two-dwelling buildings | Multi-dwelling buildings | Others | Special dwellings | Total |
| 2,018,064 | 2,388,571 | 78,932 | 231,001 | 4,716,568 |

Source: (SCB, 2016)

In order to discuss consequences of the individual responsibility identified in the analysis, tenure forms are of great importance. This is because the owner of a building is the one with the direct influence of the conducted environmental work. The distribution of the different dominant tenure forms present in the Swedish housing stock is shown in Figure 7-1 and Table 7-2. The tenure forms for the vast majority of the housing stock are of three types; private owners, cooperative tenant-ownership (BRF) and municipal housing companies. Owner-occupation is the dominating tenure form for one- or two-dwelling buildings, representing 92% of all dwellings of that type. For the multi-dwelling buildings, the picture is more divided. The three main tenure forms are BRFs, which represents 41%, municipal housing company rental tenancy, which represents 29% and joint-stock-company rental tenancy which represents 19% of all dwellings.

Other tenure forms, that only represents marginal parts of the housing stock, are buildings owned by public authorities, cooperative tenancy associations and other

legal entities. However, they only account for a small share of all buildings and will hence not be the focus of the statistics presented.

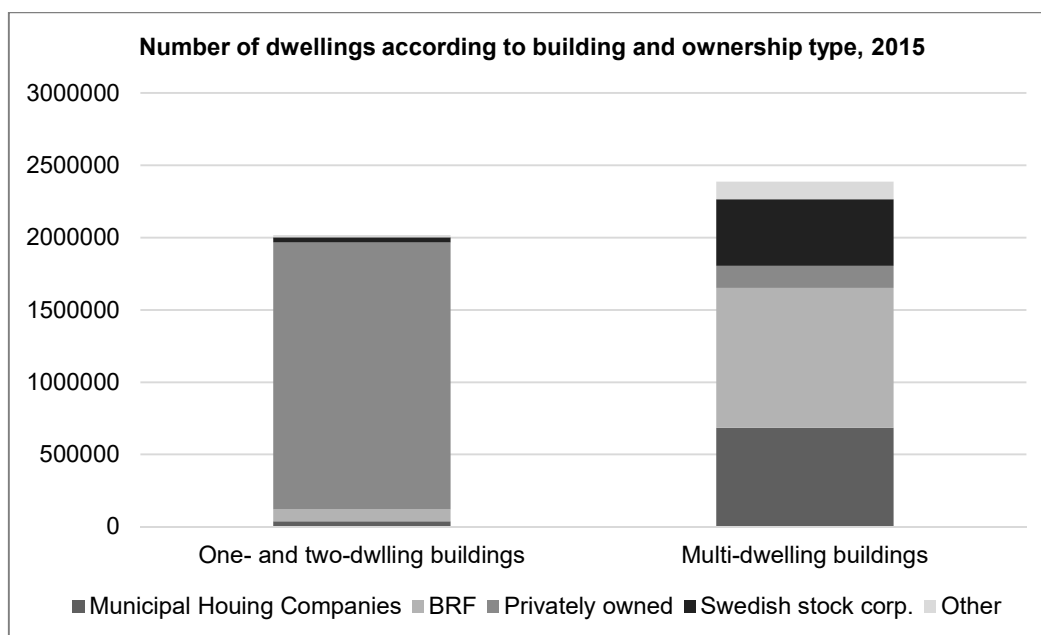


Figure 7-1: Number of dwellings in the Swedish housing stock
Source: (SCB, 2016)

Table 7-2: Number of dwellings in the Swedish housing stock

| Number of dwellings according to building and ownership type, 2015 | | | | | | |
|--|-----------------------------|---------|-----------------|---------------------|---------|-----------|
| | Municipal housing companies | BRFs | Privately owned | Swedish stock corp. | Others | total |
| One- or two-dwelling buildings | 37 280 | 82 107 | 1 848 484 | 33 648 | 16 545 | 2 018 064 |
| | 2% | 4% | 92% | 2% | 1% | 100% |
| Multi-dwelling buildings | 685 282 | 967 953 | 151 085 | 461 797 | 122 454 | 2 388 571 |
| | 29% | 41% | 6% | 19% | 5% | 100% |

Source: (SCB, 2016)

7.2.2 Renovation need of the existing housing stock

A constantly changing housing stock

Through renovation, maintenance and the addition of new buildings, the existing housing stock is constantly changing. It is concluded that addition of new environmentally sound buildings will not be enough in order to reduce the environmental impact to desirable levels. As the existing buildings make up a large part of the total stock, environmental measures need to be applied on them as well, if the environmental objectives and goals are going to be reached. It is therefore relevant to highlight the renovation need which can be seen in the existing housing stock, and the factors which most commonly initiate renovations.

When renovations are being performed it is common to discuss how they can help reducing the operational energy use and through that the environmental impact. However, the primary goal with renovations is seldom to reduce the environmental impact from the building or create a positive environmental impact. Instead are renovations commonly performed either to restore an inadequate technical function of a building, changed use of the building, or in order to increase the standard.

Reasons behind renovations

Expiring technical life lengths

Even though damages and failing function of building components are the most common reasons for renovation among housing companies (Thuvander, et al., 2016), it is not always damages which initiate maintenance and renovation work. Around 50 years after construction building installations, such as water and sewage pipes, ventilation and electricity systems, are approaching the end of their technical life-length. At this time extensive refurbishment is needed in order to prevent major damages, extend the user phase of the building, reducing operational costs, fulfilling the current building standards and increase the living quality (Thoresson, 2013; Högberg, 2014). It is therefore the buildings built 50 years ago which will determine the need for major renovations today.

Going back 50 years from now one ends up in the mid 60ies, the post war record years, and the beginning of the so called million homes programme. A programme which was the result of the Swedish parliament's decision to build one million dwellings between the years 1966 and 1975. The programme resulted in that, during the record years of 1961 to 1975, 1.4 million dwellings were built in Sweden. Around one third of those dwellings were in one- and two dwelling buildings and the rest where in multi-dwelling buildings. (SABO, 2009). It is not only that the buildings from the record years now have outdated technical systems, but the buildings from that period are also suffering from other difficulties. During the million homes programme building speed was of highest priority which led to that new and untested construction techniques and materials were used. Also, the work performance sometimes was not according to best practices. This have led to that many buildings have damages on balconies, facades and roofs that are not related to normal aging (Högberg, 2014).

Very little information regarding the need of renovation in the one- and two-dwelling housing stock can be found. It is, however, very clear that a large portion of our multi-dwelling housing stock needs to be renovated during the coming years. The way in which the renovations are done will have a large impact on the characteristics of the future housing stock. In relation to the empirical findings which show a strong focus on municipal housing companies it is important to highlight that out of the 850,000 dwellings which exist in the multi-dwelling

buildings from the record years today are not all owned by municipal housing companies (SABO, 2009). As can be seen in Table 7-3, 46% of those are owned by municipal housing companies, 28% by BRFs and 26% have private owners (Byman & Jernelius, 2013).

Table 7-3: Number of dwellings in multi-dwelling buildings from the record years in Sweden

| Number of dwellings in multi-dwelling buildings from the record years according to ownership type | | | | | |
|---|----------------|-----------------------------|---------|------|--|
| | Ownership type | number | share | | |
| | 1 | Municipal housing companies | 391 000 | 46% | |
| | 2 | BRFs | 238 000 | 28% | |
| | 3 | Private owners | 221 000 | 26% | |
| | | total | 850 000 | 100% | |

Source: (Byman & Jernelius, 2013)

Out of the 391,000 dwellings owned by municipal housing companies 20% have been refurbished and the remaining 300,000 are in the need of extensive refurbishment (SABO, 2009). No similar statistics have been found for the other ownership types. However, in a study made by *Industrifakta* in 2007 it was estimated that 650,000 dwellings from the record years still needed to be renovated (Byman & Jernelius, 2013).

Also, in addition to all the buildings from the record years, with outdated technical systems and building components, there are the buildings from older building periods which still not have been renovated. Among the buildings which were built during the period before the record years, from 1941- 1960, many buildings are worn down, have a high energy consumption, low accessibility and inadequate indoor climate. The buildings, which comprises 26% of all the multi-dwellings in Sweden, have different characteristics than the buildings from the record years. In contrast to the mass-produced buildings of the sixties they are considered to hold many valuable building qualities (Thuvander & Femenías, 2014).

With these facts it is evident that there exists a great need for renovation of multi-dwelling buildings from the million homes programme. It is however also shown that all these buildings not are municipal housing and that that the million homes programme is not the only part of the housing stock where a renovation need have been identified. It can also be concluded that very little is said about the need for renovation of one-and two-dwelling buildings.

Damages in the existing housing stock

In relation to the extensive renovation which are needed it is important to highlight all the damages in the existing housing stock which also need attention. According to a study made by Boverket in 2010 69% of the one- or two-dwelling buildings and 45% of the multi-dwelling buildings have some sort of damage which needs attention (Boverket, 2010). Figure 7-1 below shows the percentage of buildings with damages on different parts of the building according to building type. All damages requiring an estimated repair cost exceeding 10k SEK for one- and two-dwelling buildings, and 50k SEK for multi-dwelling buildings, were included. An exception was measures related to background noise, which were omitted. It is worth noticing that the one- or two-dwelling buildings have a higher portion of damaged buildings than the multi-dwelling buildings in all categories except one.

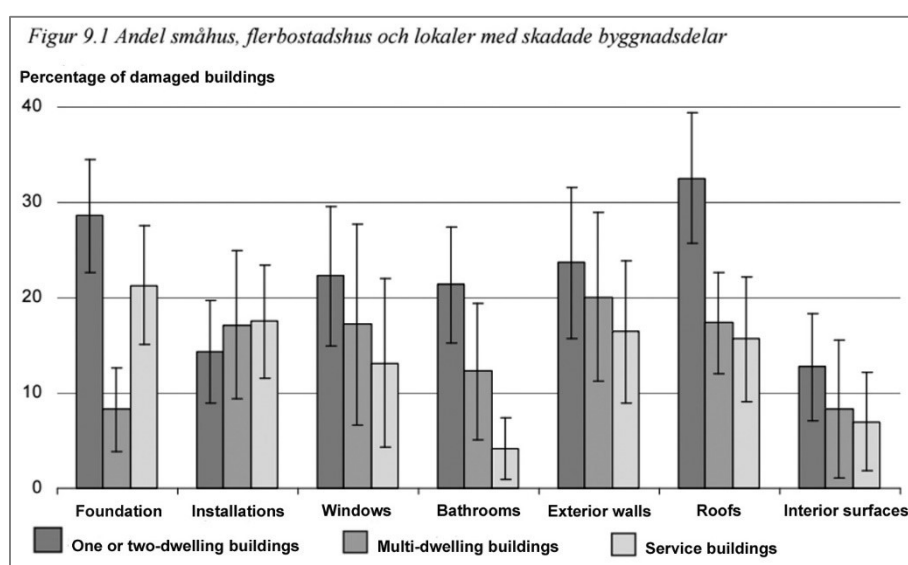


Figure 7-2: Number of buildings with damaged building components
Source: (Boverket, 2010)

The estimated cost for material and labour for the measures required in order to fix the damages are presented in Figure 7-3, and as can be seen the costs for fixing the damages in the one- and two-dwelling buildings are significantly higher than the costs for fixing the damages in the multi-dwelling buildings. Considering the fact that the number of dwellings in one- and two-dwelling buildings and multi-dwelling buildings are around the same, see Table 7-1, also the estimated cost per dwelling are significantly higher for the one- and two-dwelling buildings.

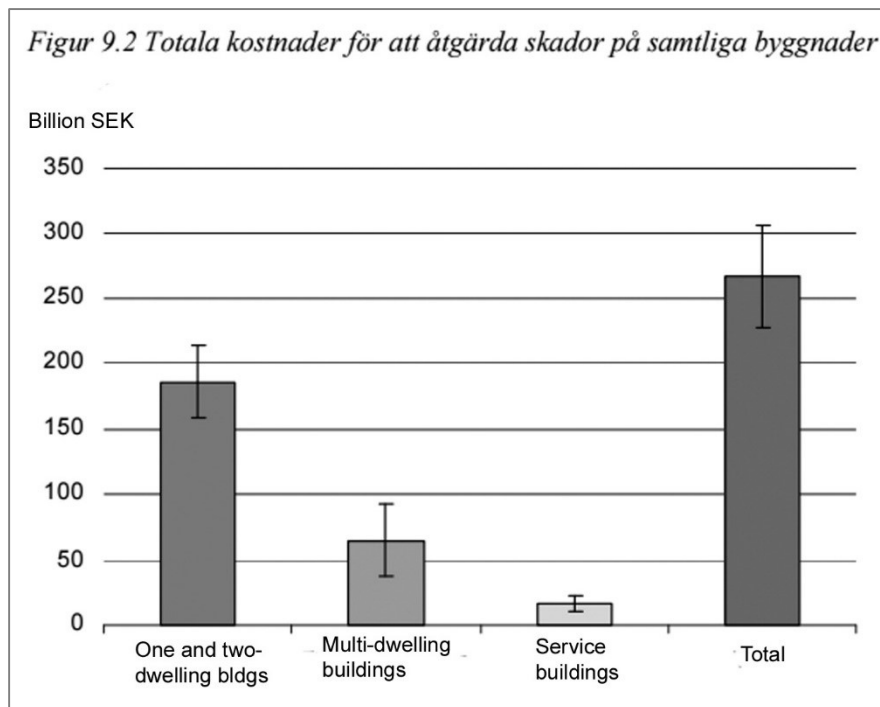


Figure 7-3: Total costs for repairing damaged building components
 Source: (Boverket, 2010)

Upgrading or changing functions

Sometimes are parts of buildings renovated before the technical life length of the building components have been reached. This is usually done as interior renovations and in BRFs arguments such as “making it more personal”, “wear and tear” and failing quality of the original material are commonly mentioned as the main reasons for the renovations. Not seldom are also the floorplans of apartments changed with the motivation of new needs (Jonsdotter, et al., 2016). A trend where apartment interiors are replaced long before their life length have been reached and a short term thinking can be seen in the sector (Hagbert & Femenias, 2015). A trend which is encouraging high material flows and environmental impacts.

Considerations during renovation

For owners of multi-dwelling buildings with rental apartments, the most prioritised aspects during renovation are costs and energy efficiency (Thuvander, et al., 2016). Initiating factors for renovations are failing technical function and reaching the life length of building components. In connection to those renovations it is common that also kitchens and bathrooms are being renovated and that the tenant gets the add-on-options of kitchen and bathroom appliances. Few are certifying their buildings according different environmental assessment systems, but it is common to consider environmental aspects in the material selection (Thuvander, et al., 2016). The empirical findings confirmed that few companies certify their buildings while renovating. However, a higher use of certification schemes among private companies was identified.

Profitability is a very important factor for which renovation measures that are suggested among all housing owners. This is indicated by the empirical findings and confirmed by the researchers, who agree to the fact that economic incentives are important for creating a more energy efficient housing stock (SABO, 2009; Högberg, 2014; Fresk Aspegren, 2016). Decision to renovate is seldom taken based on the desire to prevent future costs caused by environmental impacts, as these costs are very difficult to determine. Instead, energy measures are done if it is cost efficient with respect to purchased energy, and renovations to reduce toxic or otherwise dangerous substances are done if required by law or company goals. This creates a situation where energy prices, the cost of the measures and the investment capacity of the owners or dwellers decide which measures that will be taken. There are a lot of studies on how to integrate energy efficiency measures while renovating in a cost efficient way but the arguments differ regarding which building and tenure type where it is the most difficult to find economically feasible solutions.

The Swedish Association of Public Housing Companies (hereafter denoted SABO, the Swedish acronym), which is the organisation of the municipality owned public housing companies in Sweden, argues that the economical prerequisites for extensive refurbishments of the municipal multi-dwelling buildings from the record years are bad. They state that this is something which leads to limited refurbishment measures and affects the possibility to go through with energy efficiency measures (SABO, 2009). Also, as many of the buildings in the need of renovation are located in weak socio-economical areas, it is difficult for both private and municipal housing owners to motivate the business case for renovation investments (Högberg, 2014). Boverket is sharing this opinion, and puts a lot of effort in developing policy instruments for energy efficient renovations of multi-dwelling buildings.

In relation to this it is important to highlight the fact that the empirical findings show that municipal housing companies are renovating more than private (Interview 6). It is also argued that economic incentives for energy efficiency measures are more important for one- and two-dwelling buildings than for multi-dwelling buildings, and if environmental objectives are going to be reached we also need to focus on the one- and two-dwelling buildings (Fresk Aspegren, 2016).

As described previously, few publications and little information can be found regarding renovations of one- and two-dwelling buildings. Very few studies investigating the performed renovations and energy efficiency measures in one- and two-dwelling buildings have been done (Fresk Aspegren, 2016). It is therefore not clear which factors that initiate renovations in one- and two-dwelling buildings.

Also when it comes to interior renovations, a reduced environmental impact is very seldom the initiating factor. Interior renovation could lead to more efficient appliances and an adaption to new needs and by that have a positive result for the

environment. However, it is rather that environmental concern is taken while renovating and that the initiating factor is something else (Jonsdotter, et al., 2016).

A housing shortage

Another factor, important to mention in relation to the existing Swedish housing stock, is the present housing shortage that is now experienced in Sweden (Boverket, 2015:1). 700 000 dwellings need to be built in Sweden until the year of 2025 and it will be a challenge to realize that number without increasing, but rather reducing, the environmental impact of the housing and building sector and at the same time keep the building costs at an affordable level (Boverket, 2015:1). This study is focussing on the existing stock, but it is inevitable that such a demand for increased number of new dwellings will impact the strategies for maintenance and renovation of existing buildings. Measures taken in the existing housing stock will affect the need for new dwellings. If the existing housing stock is used more efficiently less new dwellings are needed, and at the contrary, if parts of the existing housing stock is torn down more new dwellings are needed.

Environmental impact of renovations

Renovations generating a positive environmental impact

Renovations of buildings can lead to a reduced operational environmental impact by reducing the energy use, changing the type of energy source, adding ecosystem services or extending the life length of the building. What also could be achieved through a renovation is a change in function of the building encouraging a more sustainable lifestyle, or a change in the use of buildings reducing the need for new buildings. If the functional unit used, when the environmental impact of a building is calculated with a life cycle perspective, was changed from one square meter floor area to a certain function, one could claim that if the use and function of a building is doubled, its environmental impact is halved.

Researchers are talking about a “window of opportunity” to renovate the multi-dwelling buildings from the million homes programme (Högberg, 2014). A window of opportunity which cannot be missed as the opportunity we have today, to reduce the energy use and increase living standard of such a large share of our housing stock, will not return within the next 50 years (Högberg, 2014). It is emphasized that the gap between the political visions and the real pace in which energy-efficient technologies are applied in practice is far too large if environmental and energy targets are going to be reached (Quitau, et al., 2012; Högberg, 2014). It is discussed how energy efficiency improvements could be integrated within renovations in a cost efficient way and it is argued that new forms of organisation, instruments, initiatives and experiments are needed in order to close this gap (Högberg, 2014; Thoresson, 2013).

The window of opportunity discussed by researchers have been rooted within environmental strategies. The empirical findings show a dominant attitude which emphasise the importance of integrating environmental measures while renovation multi-dwelling buildings from the million homes programme. Important to remember is that not only the multi-dwelling buildings from the million homes programme are in the need of renovation. As was shown in the previous section the housing stock is offering many open windows.

Renovations generating negative environmental impacts

Important to remember is that every renovation measure done is generating new material flows and new environmental impacts. Common is that the environmental indicators “energy use” and “emissions to air” are considered when the environmental impact of renovation measures are calculated. Estimations of how much embodied energy that would be required to reduce the energy consumption in the residential housing stock with 50% have been made. In one study it was concluded that the payback time, considering Global Warming Potential (GWP), of the energy efficiency measures proposed were just over three years. What the study also highlighted was that the different suggested energy efficiency measures had very different embodied energy, and by that environmental impact. E.g. decreasing the indoor air temperature of the housing stock to 20°C contributed with 27% of the total energy reduction, but only with 4% of the embodied energy (Brown, et al., 2014).

The result from another study, which also emphasise the importance of the embodied environmental impact of renovation measures, is shown in Figure 7-4. By using LCA it is shown that purchased operational energy is not the only aspect important to consider when the environmental impact is being discussed. Figure 7-4 shows that a renovation which reduced the purchased operational energy with 65% reduced the GWP with 47% and the primary energy with 7% (Blomsterberg & Nilsson, 2015). This clearly indicates that an energy reduction, a GWP reduction and a primary energy reduction is not the same thing. The size of the GWP reduction depends on the type of energy used and the embodied GWP of the renovation measures.

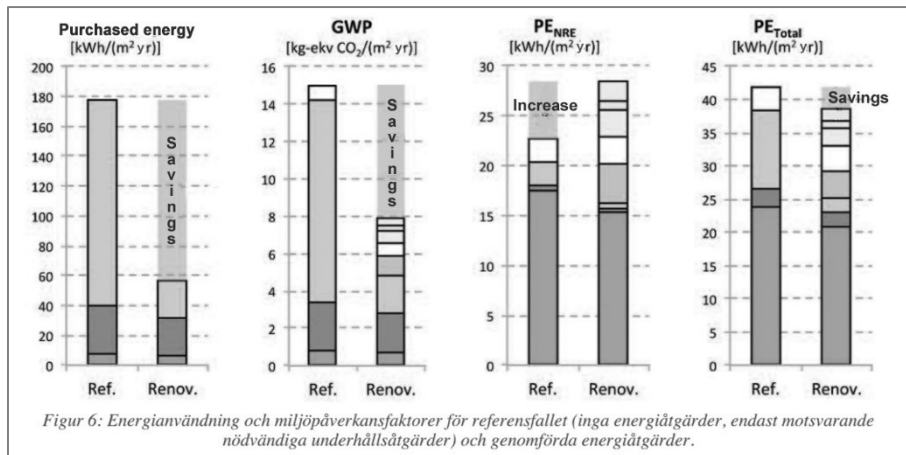


Figure 7-4: Energy and GWP reduction in the renovation project *Backa Röd*
Source: (Blomsterberg & Nilsson, 2015)

In relation to negative environmental impacts generated by renovation interior renovations are important to highlight. When an interior renovation is being done usually neither the heating system nor the building envelope are affected, and the possibilities of a positive change of the environmental impact are therefore limited. Appliances could be replaced with more energy efficient ones and energy consumption could therefore be reduced. However, the primary environmental impact is a negative one caused by the material flows required by the interior renovation. The visible trend of an increasing number of interior renovations, causing an increase in bulky waste, is further increasing the environmental impact from the housing and building sector. The knowledge of the environmental impact of interior material flows is limited, and they are therefore seldom included in environmental impact calculations (Jonsdotter, et al., 2016). However, studies of interior renovations in BRFs are indicating that white goods, bathroom interior and surface layers such as flooring and walls, are being replaced long before their expected life length have been reached (Jonsdotter, et al., 2016).

7.3 The environmental impact from the housing stock

7.3.1 The complexity of the environmental impact

As was identified in the analysis it is common to equate the environmental impact from the housing sector with operational energy use, household waste and the presence of hazardous substances. To be able to discuss the consequences of such a one-eyed conceptualisation of environmental work it is needed to investigate what the environmental impact from the housing stock truly consists of. Also, as there is such a strong focus on only one of the phases of a building's lifecycle, the operational, it is important to highlight all the phases and their contribution to the aggregated environmental impact. It is also important to explain the difference between national emissions and emissions from imported goods to show the relevance of putting demands in the supply chain.

7.3.2 How to structure and quantify the impact

Environmental indicators

This section describes in detail the environmental impact from the housing stock, as well as the means that are commonly used to quantify that impact. As can be seen in Figure 7-5 the building lifecycle has different phases; the construction phase, where the “upstream” environmental impact is generated, the operational phase, where the “downstream” environmental impact is created, and a recycling phase. All of the different phases have an impact on the environment and in order to describe the total impact from the housing and building sector certain environmental indicators are used. The indicators have been developed by Boverket and are used to follow up on the environmental quality objectives. The idea is that they should cover the main environmental impact from the sector and have a lifecycle perspective. The environmental indicators are the following (Boverket, 2015:1):

- Emissions to air – greenhouse gases, nitric oxide, particulate matter
- Energy use – fossil fuels, bio fuels
- Use of hazardous and toxic substances
- Produced waste

No indicators are used to follow up on how the ecosystem services are being affected, as quantitative data of ecosystem services are many times missing on national level. This is a significant limitation in the indicators, as the ecosystem impact can be large. Buildings uses land, affects the ground structure, vegetation, water runoff and have the ability to increase the load of toxic emissions and create barrier effects in the landscape (Boverket, 2016:1). This limitation is also present in current practices. The empirical findings indicated that both positive and negative impacts on ecosystem services are many times neglected from the environmental work.

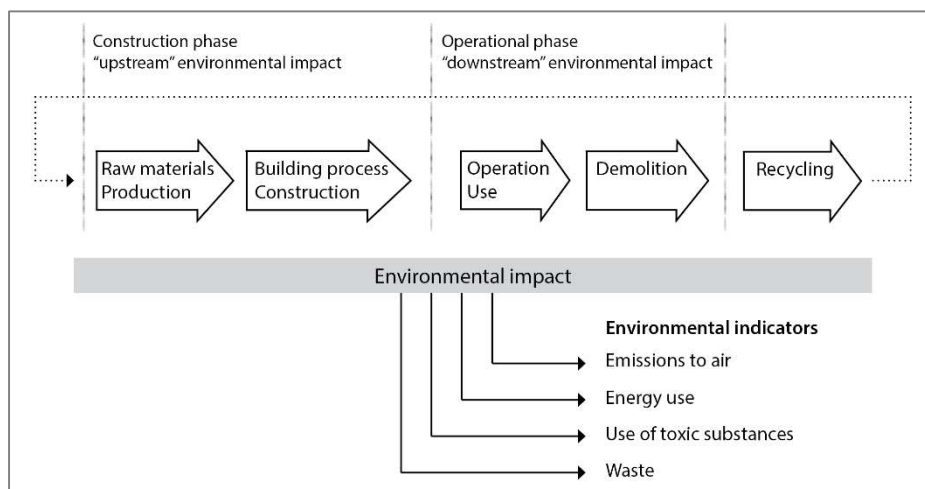


Figure 7-5: A building's lifecycle phases and their environmental impact

7.3.3 The actual impact

The environmental impact from the housing and building sector can be declared in two different ways using either the indicator “domestic effects” or the indicator “domestic effects plus import”. (Boverket, 2015:1). The indicator “domestic effects” covers the environmental impact from domestic production in Sweden from a lifecycle perspective. When also the import is included the environmental impact from imported goods is set to the value that equals the emissions that would have been generated if the product was produced domestically. As Sweden have a clean energy mix this will lead to that the indicator “domestic effects plus import” will state an underestimated environmental impact (Boverket, 2014:2).

The empirical findings show that the actors very seldom apply a lifecycle perspective in their environmental work. Most often is only the operational phase in focus and environmental impacts from domestic production or environmental impacts from imported goods are seldom considered. One could still state that domestic impacts are being considered as Swedish industries are constantly working with reducing their environmental impacts. The impact from imported goods, however, are even less controllable and considered to a very low extent. In order to get an idea of the relation between environmental impacts from domestic production and from imported goods the statistics are presented in both ways. This to show what the relevance of putting demands far back in the supply chain is.

The environmental impact from the building and housing sector is substantial. During 2013 the housing and building sector emitted 11.3 million tonnes (Mt) of carbon dioxide equivalents in Sweden, which corresponds to 18% of the total domestic emissions (Boverket, 2014:2). Also the imported goods in the sector create large emissions of greenhouse gases. In statistics from 2012 it is shown that the emissions from the building sector increased by a factor of three, from 3,1 Mt to 10,6 Mt, when emissions from imported goods are included. For the total emissions of the building and housing sector together the emissions are doubled, from 10.4 Mt to 23.5 Mt when the emissions from imported goods are included (Boverket, 2015:1).

The emissions of nitrogen oxides from the housing and building sector were on average 41 thousand tonnes (kton) per year during the period 2008-2011 if import and export were included and 25 kton if not included. The emissions of particulate matter during the same period were on average 11.4 kton per year if import and export were included and 7.9 kton if not included.

Of the total fuel consumption in Sweden the building and housing sectors are responsible for 26%. The building sector is also responsible for one third of all produced waste and one quarter of all dangerous waste in Sweden (not calculated with a lifecycle perspective) (Boverket, 2014:2). The use of chemical substances hazardous to human health in the building sector was estimated to 1,200 kton during

2011, representing around 5% of the total use in the Swedish industry. The use of chemical substances hazardous to the environment was estimated to 30kton during the same year, representing 0.02% of the total use in the Swedish industry. The use of hazardous chemical substances during the period 2008-2011 show a slowly increasing trend with a minimum during the financial crisis of 2009. Information of the use of hazardous chemical substances in the housing sector is not known.

7.3.4 The different phases of the life cycle

General

The different phases of the life cycle

The lifecycle of a building which was shown in Figure 7-5 in section 7.3.1 can roughly be divided into two parts, one where the production and construction of the building occur, and one where the operational phase and also the demolition are included (Boverket, 2015:1). As already have been mentioned several times in this study the operational phase is usually in focus. In this section that will not be the case and the environmental impact from a building will be described for both upstream and downstream processes. Upstream is referring to all the processes which occur before the building user phase begins, and downstream is referring to all the processes which occurs after the building user phase have begun, see Figure 7-5 in section 7.3.1. Also the terms “embodied energy” and “embodied environmental impact” will be used when the environmental impacts are discussed. It does not exist one single definition of those terms (IVA och Sveriges Byggindustrier, 2014), but in this study it will refer to the energy use and the environmental impact generated by material production, transports and construction.

Assessing the impact from all phases using life cycle assessment (LCA)

In order to understand and analyse the total environmental impact from buildings, a lifecycle perspective is needed. Life cycle assessment, also called LCA, is a method used to analyse the environmental impact, e.g. climate impact, health effects, resource use, impact on ecosystems, of all the different phases in the lifecycle of a product (Boverket, 2015:1). With LCA it is possible to evaluate the environmental impact over the buildings lifecycle for different impact categories and the cumulative use of different resources. The most common aspects to consider in LCA for buildings are GWP, also referred to as carbon dioxide equivalents, and cumulative energy demand (CED).

What is included in the system boundaries and which assumptions that are made in the LCA study differs between different studies. In order to make comparisons of the results possible a functional unit, usually one square meter floor area of a building, normalized per year, with an operation period of a specified amount of years (e.g. 50 or 100), is being used.

Environmental impact from upstream processes

General

The environmental impact from the construction phase has generally not been considered to any great extent. The empirical findings are confirmed by researchers stating that regulations and actions have had focus on building's energy use and climate impact during the operational phase (Liljenström, et al., 2014). To be able to analyse the consequences of that focus the environmental impact from the construction phase is presented. The impacts are both presented in relation to national impacts and in relation to impacts from the operational phase.

As this study is focusing on the existing housing stock it could be argued that the only relevant lifecycle phase to consider would be downstream processes. However, the upstream processes are also of importance and the environmental impact of refurbishment measures and new construction will therefore be presented in relation to the environmental impact from the operational phase. This is because an optimal use of the existing housing stock will influence the need of new buildings and all renovation measures performed will also generate negative environmental impacts. Also, if only the operational phase is considered it might seem beneficial to tear down old energy inefficient buildings, and build new energy efficient ones. But taking the environmental impact from construction into account transforming existing buildings it may be a more preferable alternative.

Energy use and emissions to air

The strong focus on the operational phase has historical reasons. Around 1995 it was concluded that the operational energy use accounted for the majority of the greenhouse gas emissions from a buildings' lifecycle. The numbers, 85% for one- and two dwelling buildings and 70-90 % for multi-dwelling buildings (Adalberth, 1995; Adalberth, et al., 2001), have been dominating in the debate and literature (IVA och Sveriges Byggindustrier, 2014). The idea that the operational energy use accounts for the majority of the environmental impact have led to a development of measures and strategies with the operational energy use in focus. Saving energy through energy efficient housing has been presented as the solution for how the energy and environmental problems in Sweden are going to be fixed (Brunklau, et al., 2010).

It is, however, shown that the greenhouse gas emissions from building processes in Sweden sum up to almost half of the amount of carbon dioxide emissions of all the private cars in Sweden, see Figure 7-6 (IVA och Sveriges Byggindustrier, 2014). Thus the environmental impact from construction needs attention, irrespective of the relation between the environmental impact from the construction phase and the operational phase of a buildings life cycle.

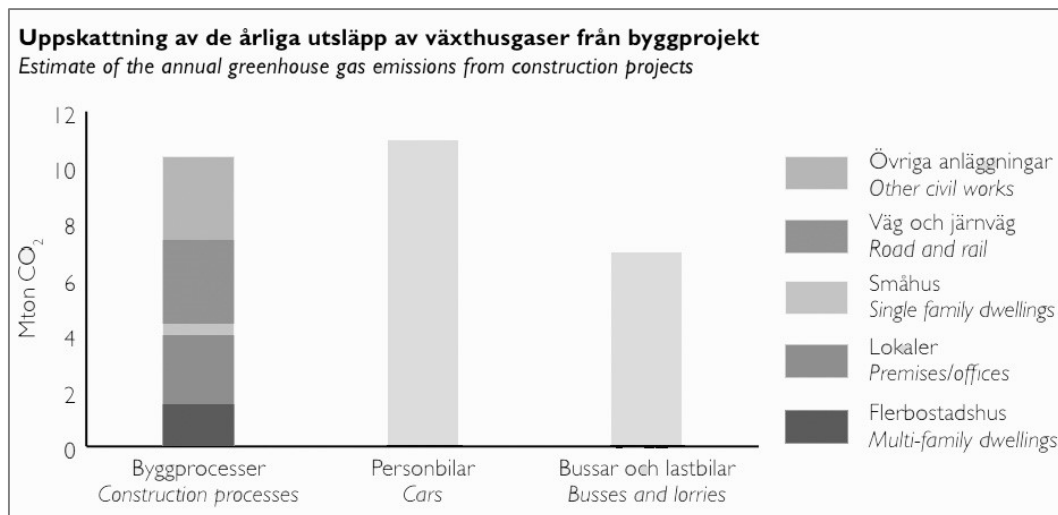


Figure 7-6: Estimate of the annual greenhouse gas emissions from construction projects
 (IVA och Sveriges Byggindustrier, 2014)

Research indicates that the environmental impact from the construction phase also is significant in relation to the other phases of a buildings life cycle (Sveriges Byggindustrier, 2015:1). The numbers presented by Adalberth were based on numbers before both electricity and district heating in Sweden were mainly provided by renewable energy sources and nuclear power (Toller, et al., 2011). The impact from the operational energy use was thus considerably higher at that time. Today the relation between the energy use and the up-stream process is very different and several LCA studies published during the recent years indicate a more equal relation (IVA och Sveriges Byggindustrier, 2014; Boverket, 2015:1).

In a study made by IVA and Sveriges Byggindustrier (2014) it was shown that the greenhouse gas emissions from the upstream processes are in the same size as the emissions from the downstream processes (Sveriges Byggindustrier, 2015:1), see Figure 7-7. It is also shown in statistics presented by Boverket that emissions of nitrogen oxides and particulate matters are equally big from upstream and downstream processes (Boverket, 2014:2).

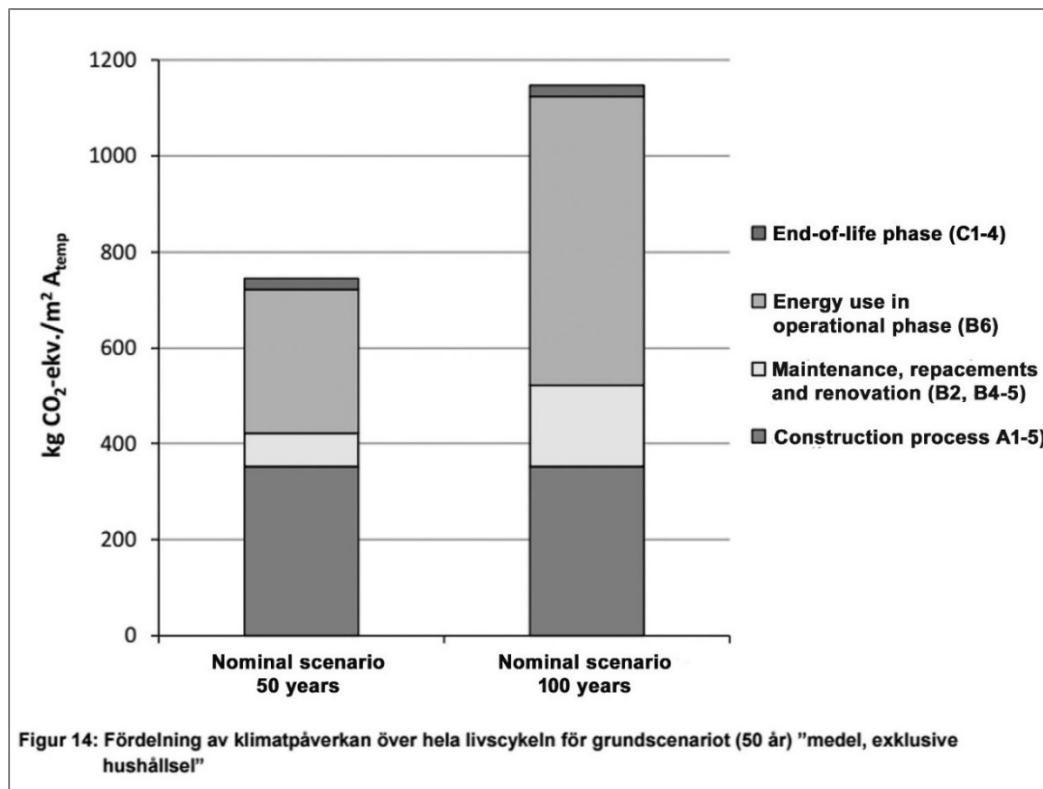


Figure 7-7: Distribution of climate impact over the entire lifecycle of a building
Source: (Sveriges Byggindustrier, 2015:1)

It has been shown that the upstream environmental impact from a building is increasing as the buildings are being made more energy efficient and that downstream environmental impact are decreasing as a consequence of higher energy efficiency (Boverket, 2015:1). Regarding the environmental indicator "emissions to air", greenhouse gas emissions, it is shown that the total emissions of greenhouse gases from buildings have been reduced during the previous years, see Figure 7-8. However, if the energy used for heating is excluded the indicator shows that the greenhouse gas emissions from the housing and building sector has been constant during the same period of time (Boverket, 2015:1).

Diagram 2 Utsläpp av växthusgaser Mton koldioxidekvivalenter inhemska utsläpp (exklusive utsläpp från importvaror)

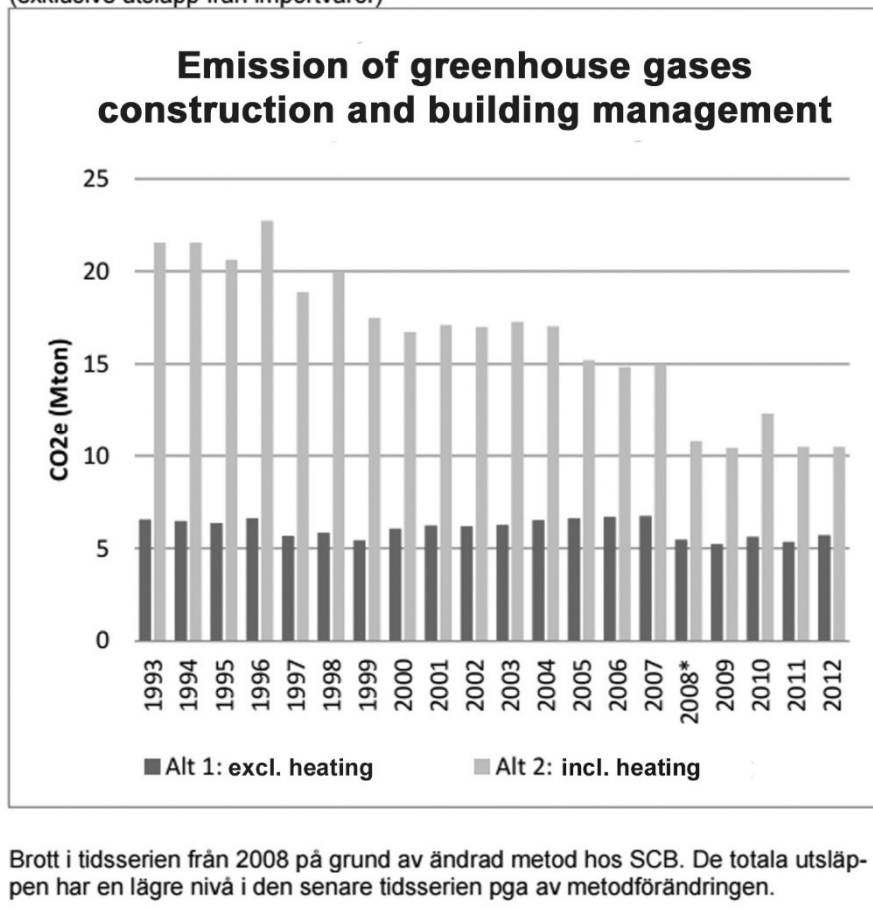


Figure 7-8: Domestic greenhouse gas emissions from the housing and building sector
Source: (Boverket, 2015:1)

Research is also indicating that different materials used for the same function can generate very different amounts of greenhouse gas emissions (Larsson, et al., 2016).

Use of hazardous and toxic substances and waste production

In this section the energy use and greenhouse gas emissions from the construction phase have been presented in relation to the operational phase. It has been highlighted that one by only focusing on the operational phase does not include all relevant aspects of the environmental impact. However, the statistics presented only represent two environmental indicators, energy use and emissions to air. Statistics impact for other environmental indicators is not well represented for the construction phase.

The statistics of building and demolition waste in Sweden is limited (Naturvårdsverket, 2016:3) even though it can be concluded that the waste from construction sites is substantial (Maskinentrepenören, 2014). Also for hazardous chemicals no official statistics of how the use is distributed over the different phases of a buildings lifecycle can be found (Boverket, 2014:2). However, according to the

statistics presented in this study the use of hazardous chemicals in the building sector is low compared to the total use in Sweden.

Environmental impact from downstream processes

General

The environmental impact from the operational phase is in this section presented thoroughly and for all four environmental indicators developed by Boverket. The environmental impact from the operational phase is determined both by the performance of the building and the people living in the building. As previously discussed the demolition phase is also a part of the operational phase. However, the demolition phase generates a small impact relative the total environmental impact (Liljenström, et al., 2014).

When discussing the environmental impact from the operational phase it is usually through the indicator purchased energy needed for keeping a certain comfort in the building. Other environmental impacts generated by e.g. transportation back and forth to the building, or the resource consumption due to the lifestyle of the people living in the building are usually not included. Household electricity consumption is sometimes included in environmental impact calculations. However, as it mainly depends on individual lifestyle and individual choice of electricity supplier it will not be discussed to any great extent in this chapter.

Energy use

The most common way to measure the environmental impact from the operational phase is through energy use. Usually it is energy per square meter living area and year that is measured, and the environmental impact from a building will then only be determined by the size of its heated floor area, and its energy efficiency.

Important to highlight is the fact that the statistics presented in this section are for purchased energy and not the amount of energy the buildings actually use. E.g. by using heat pumps the heat generated and used by the building is larger than the amount of purchased energy. Also what is not considered when purchased energy is being measured is the primary energy needed to deliver the energy to the building. E.g. if using electricity the losses in the production and distribution system are resulting in the energy required for the building being much higher than the purchased energy. The real figure of how much energy the building consumes in order to preserve a certain indoor climate is thus higher than the purchased energy, which only is a measure of how much energy that is delivered to the building.

In the following graph, Figure 7-9, the relative portion of heated floor area per building type is shown. For the multi-dwelling buildings the values are divided between the different tenure forms. As shown in the graph, around 60% of the heated floor area is located in one-and two-dwelling buildings and the rest is rather

evenly distributed over the three different dominante tenure types in the multi-dwelling buildings.

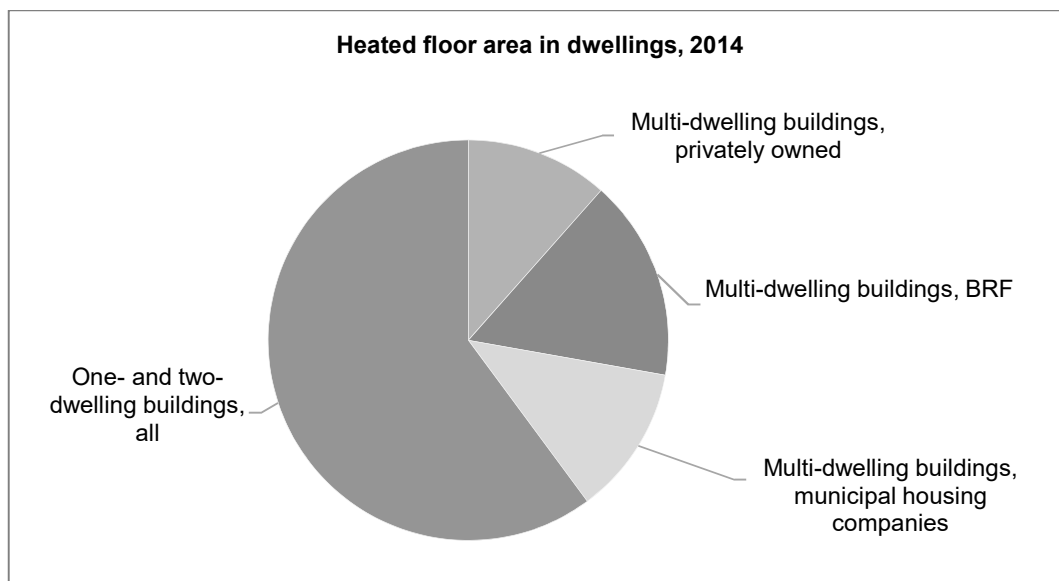


Figure 7-9: Heated floor area of different building types in 2014
Source: (Energimyndigheten, 2015:1; Energimyndigheten, 2015:2)

Table 7-4 shows the average use of energy, per dwelling and per square meter, for heating and hot water in multi-dwelling and one- and two-dwelling buildings in 2014, in MWh/dwelling and kWh/m². In addition to the energy use the average number of people per dwelling is presented. Through that a very rough average of how much energy every person consumes can be calculated. An average that shows that in the least energy efficient buildings people are using the least amount of energy per person and therefore have a smaller environmental impact, if the same type of energy source is used.

Table 7-4: Different units for the average use of energy in building in 2014

| Average use of energy, 2014 | | | | |
|---------------------------------|-----------------------------|--|-----------------|------------|
| | Per dwelling (MWh/dwelling) | Average per square meter (kWh/m ²) | People/dwelling | MWh/person |
| Multi-dwelling buildings | 10 | 134 | 2,6 | 5,4 |
| One- and two-dwelling buildings | 16 | 106 | 1,9 | 6,1 |

Source: (Energimyndigheten, 2015:1; Energimyndigheten, 2015:2; SCB, 2016)

In Figure 7-10, and Table 7-5, the average use of energy is shown again, per square meter, for heating and hot water in multi-dwelling and one- and two-dwelling buildings in 2014, in kWh/m². For the multi-dwelling buildings values are now given for different tenure types.

Table 7-5: Average use of energy per square meter in different building types in 2014

| Average use of energy per square meter, 2014 [kWh/m ²] | | | | |
|--|--|-------------------------------|---|---------------------------------|
| 1 | 2 | 3 | 4 | 5 |
| Multi-dwelling buildings, Public authorities | Multi-dwelling buildings, Private owners | Multi-dwelling buildings, BRF | Multi-dwelling buildings, Municipal housing companies | One- and two-dwelling buildings |
| 155 | 137 | 134 | 132 | 106 |

Source: (Energimyndigheten, 2015:2; Energimyndigheten, 2015:1)

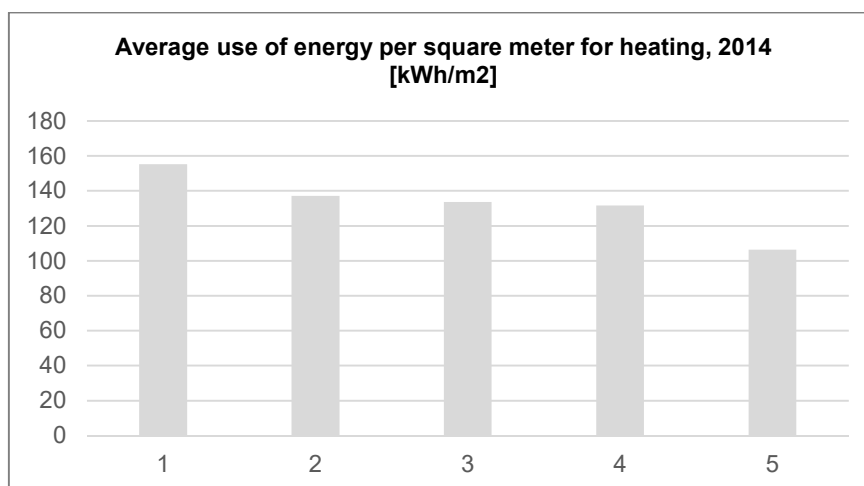


Figure 7-10: Average use of energy per square meter in different building types in 2014

Source: (Energimyndigheten, 2015:2; Energimyndigheten, 2015:1)

In the following graphs (Figure 7-11 to Figure 7-16) different parameters of the existing Swedish housing stock is presented with respect to year of construction. The normally presented figures of number of dwellings and energy use per square meters and year is here complemented with total heated floor area, total use of energy per year, number of occupants and finally energy use per occupant and year. This is done in order to enable a discussions of the way we discuss energy efficiency today really target the right parts of the housing stock and labels the right buildings as environmental villains.

In the first graph, Figure 7-11, the average energy use per square meter is presented. This is a very common way of showing the energy use of buildings and for all building periods the multi-dwelling buildings are performing worse than the one- and two-dwelling buildings.

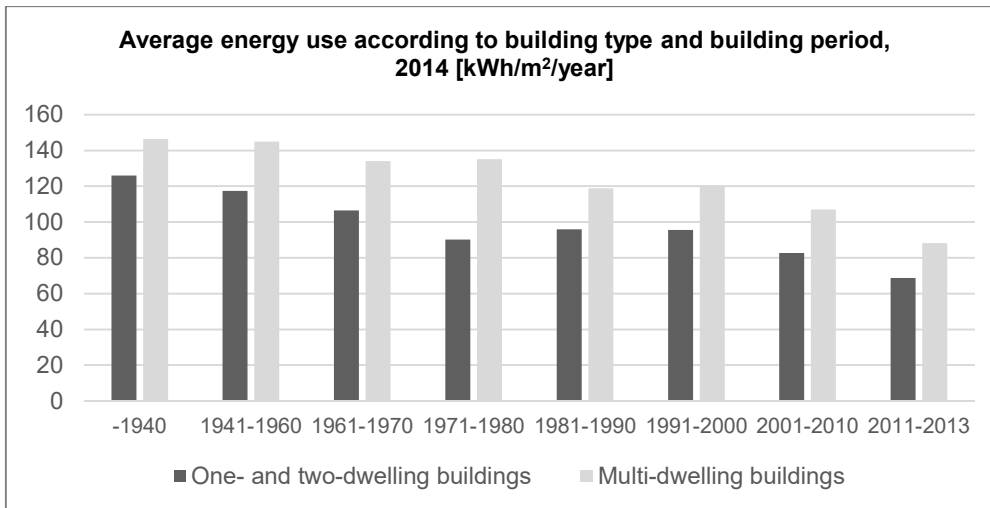


Figure 7-11: Average use of energy per square meter for buildings from different building periods
 Source: (Energimyndigheten, 2015:2; Energimyndigheten, 2015:1)

In the second graph, Figure 7-12, the heated floor area is presented. The graph shows that the heated floor area located in one- and two-dwelling buildings are larger than the area located in multi-dwelling buildings.

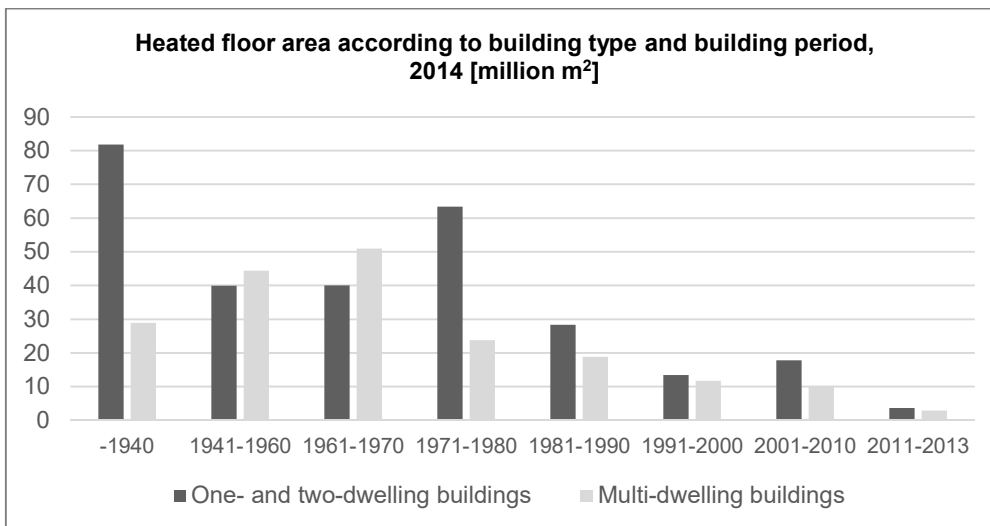


Figure 7-12: Heated floor area in buildings from different building periods
 Source: (Energimyndigheten, 2015:2; Energimyndigheten, 2015:1)

In the third graph, Figure 7-13, the actual amount of energy used is presented. The graph has been generated by multiplication of the average energy use per square meter presented in Figure 7-11 with the heated floor area presented in Figure 7-12. The graph clearly shows that multi-dwelling buildings not always use more energy than the one- and two dwelling buildings, which not was as clear in Figure 7-11.

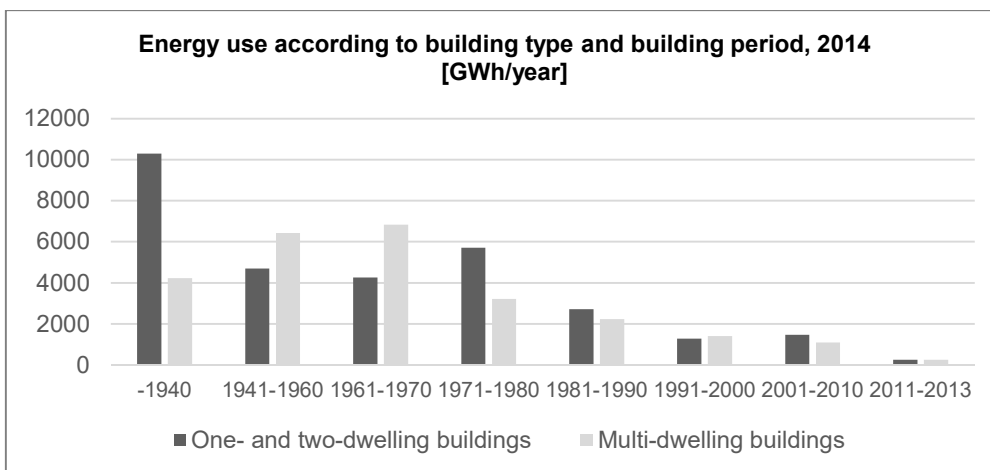


Figure 7-13: Average use of energy for buildings from different building periods
Source: (Energimyndigheten, 2015:2; Energimyndigheten, 2015:1)

In the fourth graph, Figure 7-14, the numbers of dwellings in the housing stock are presented.

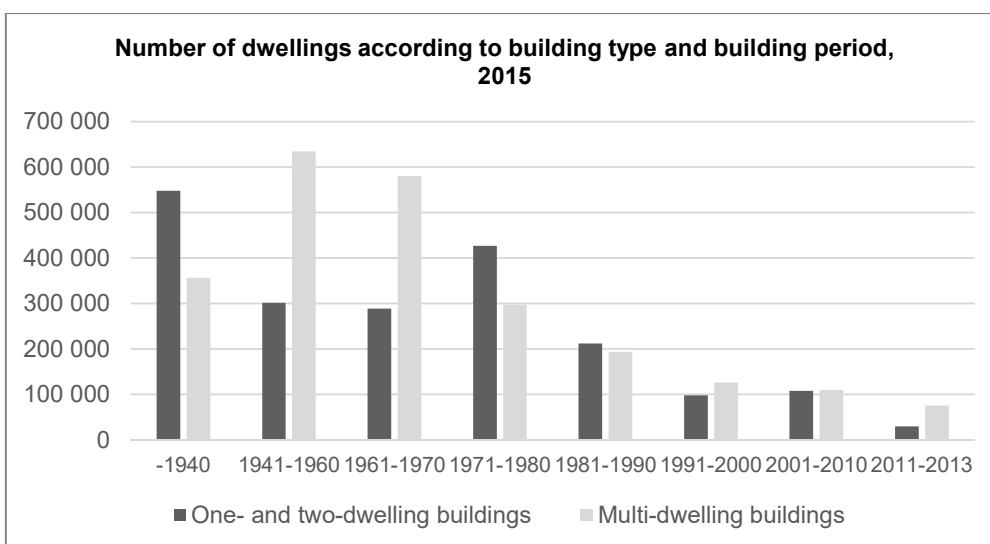


Figure 7-14: Number of dwellings in buildings from different building periods
Source: (SCB, 2016)

In the fifth graph, Figure 7-15, the number of persons living in different types of buildings from different building periods is presented. The numbers presented in the graph have been generated by multiplying statistical numbers of the amount of persons living in a dwelling, presented in Table 7-5 with the amount of dwellings presented in Figure 7-14

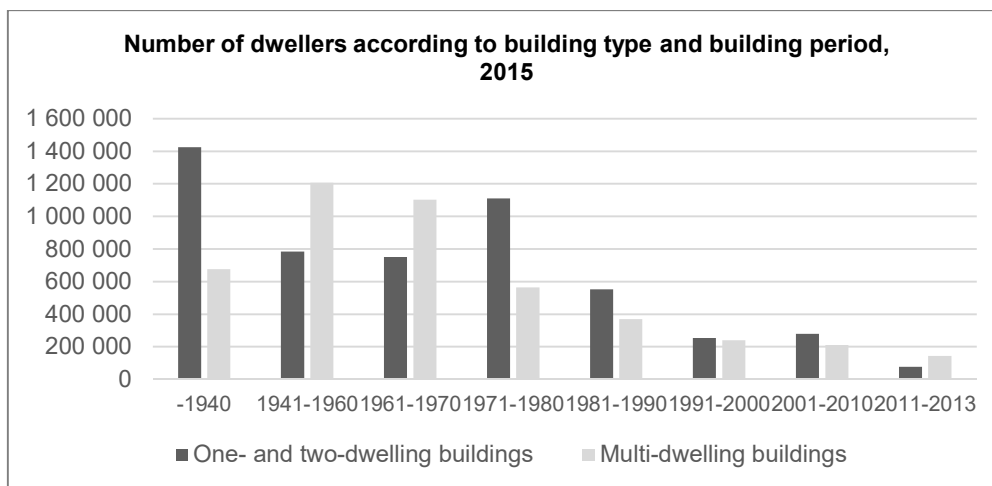


Figure 7-15: Number of dwellers in buildings from different building periods
Source: (SCB, 2016)

In the sixth and last graph, Figure 7-16, the actual amount of energy used per person is presented. The graph has been generated by dividing of the actual amount of energy used presented in Figure 7-13 with the number of dwellers presented in Figure 7-15.

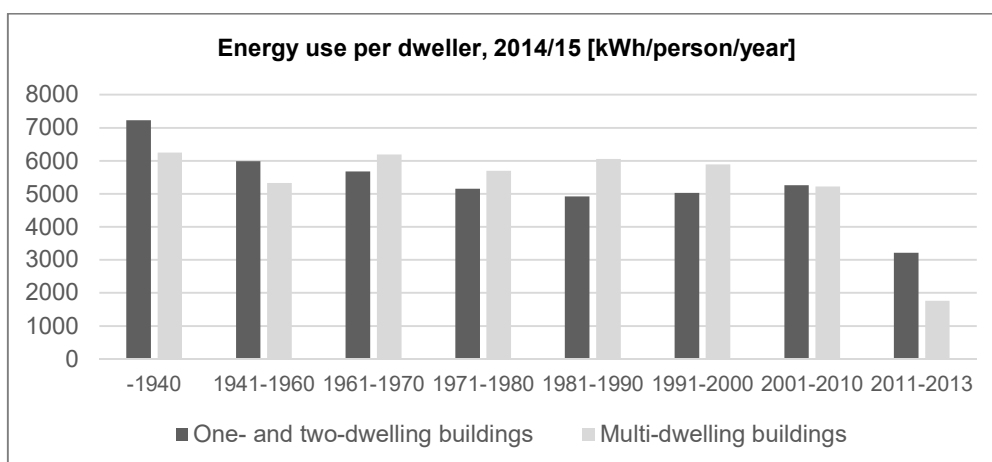


Figure 7-16: Average energy use per dweller in buildings from different building periods
Source: (Energimyndigheten, 2015:2; Energimyndigheten, 2015:1; SCB, 2016)

Emissions to air

When emissions to air are being discussed it is often the greenhouse gas emissions as a result from the source of energy used, that are considered. While the energy use in the building sector only have been reduced with 7% since 1983 (Boverket, 2015:1), the emissions to air give a completely different picture. The building and service sector has reduced its greenhouse gas emissions with 83% between 1990 and 2012 (Boverket, 2015:1). The reduction can primarily be explained by a reduced use of oil and an increase of bio fuels, heat pumps, electricity and district heat (Boverket, 2015:1), as shown in Figure 7-17. Another reason for the greenhouse gas reduction is the change of energy mix in the district heating system (Byman & Jernelius, 2013).

The improvements are substantial but important to remember is that fossil fuels still are included in the energy mix. The average national portion of fossil fuels in the district heating is 18%, with a large geographical variation, and also the electricity production uses some, mostly during cold winter days (Byman & Jernelius, 2013).

The nitrogen oxide emissions from combustion in district heat and electricity production had been reduced with one third in 2014 compared to the levels of 1990. This mainly because of the nitrogen oxide tax, but also in connection with that the district heat have replaced the individual combustion heating in buildings (Naturvårdsverket, 2016:1).

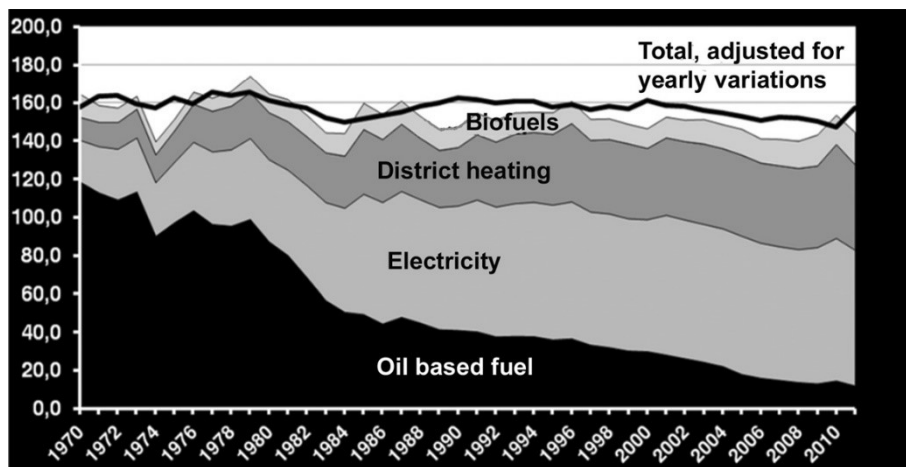


Figure 7-17: The energy use in the Swedish housing stock
Source: (Byman & Jernelius, 2013)

The type of heating system used differs a lot between multi-dwelling buildings and one- and two-dwelling buildings. As can be seen in Figure 7-18, district heating is the most common type of heating system used in multi-dwelling buildings.

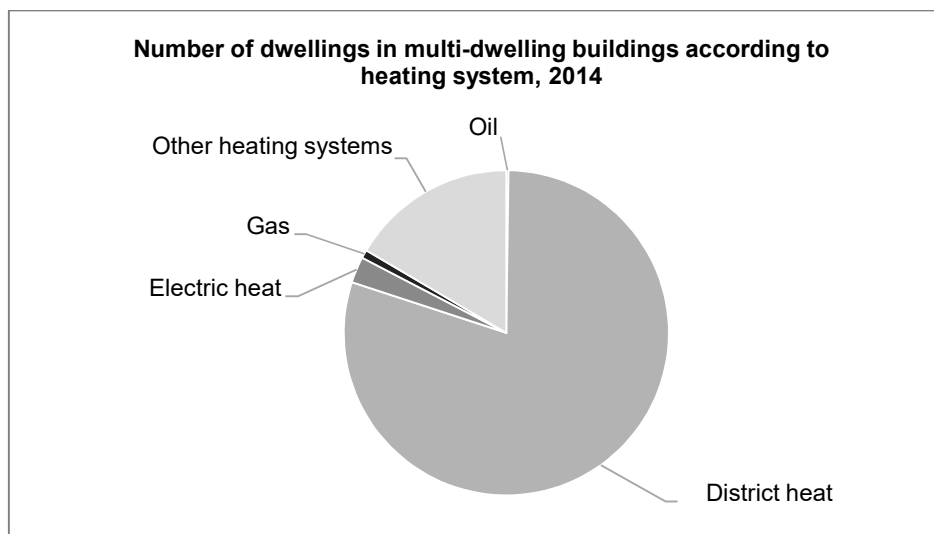


Figure 7-18: Different types of heating system in multi-dwelling buildings
Source: (Energimyndigheten, 2015:1)

Looking at the heating system in buildings according to building period one sees that there are some differences in heating systems in the housing stock depending on the age of the buildings (Energimyndigheten, 2015:1). In the buildings built during recent years a higher share of alternative heating systems can be seen. In the category of alternative heating systems falls the combinations of different heating systems, such as district heat in combination with a ground heat pump and solar power in combination with electric heat, which has increased since the seventies and especially during the recent years (Energimyndigheten, 2015:1).

Figure 7-19 shows a much greater diversity of energy systems used for heating in one- and two-dwelling buildings. Very few buildings are using oil, but there is still a substantial part of the housing stock of one- and two-dwelling buildings that only uses direct electricity heating.

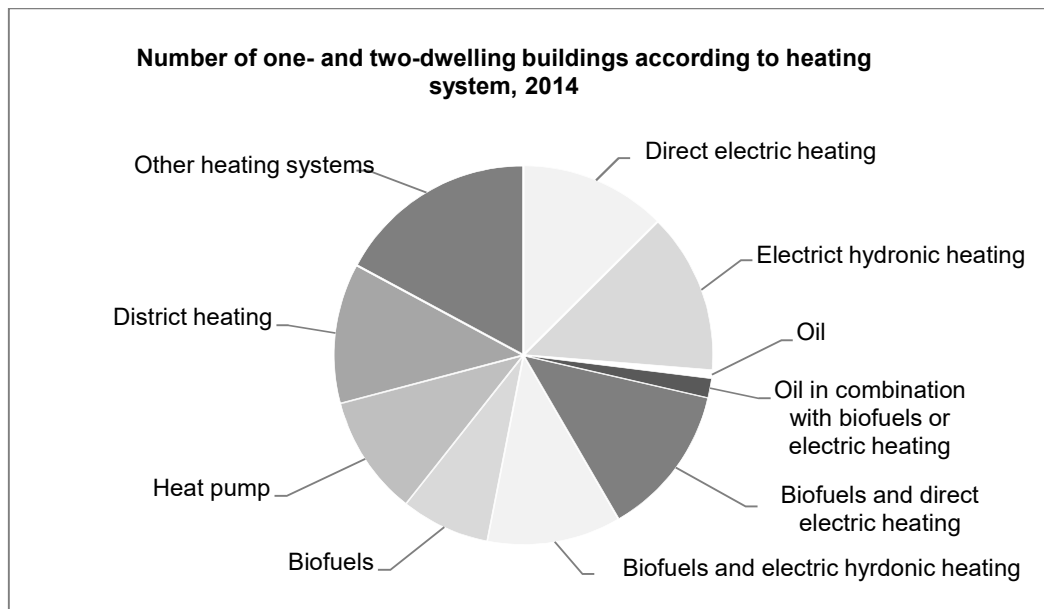


Figure 7-19: Different types of heating system in one- and two-dwelling buildings
Source: (Energimyndigheten, 2015:2)

This section has shown that it is not only the amount of energy used which matters, but that also the type of energy source used is of great importance for the environmental impact created. The result from a study, Figure 7-20, comparing conventional housing with energy efficient housing both with respect to energy use and environmental impact, confirm that statement. The graph clearly shows that a lower energy use does not have to result in a lower environmental impact and that energy efficient housing can have a larger environmental impact than conventional housing (Brunklaus, et al., 2010).

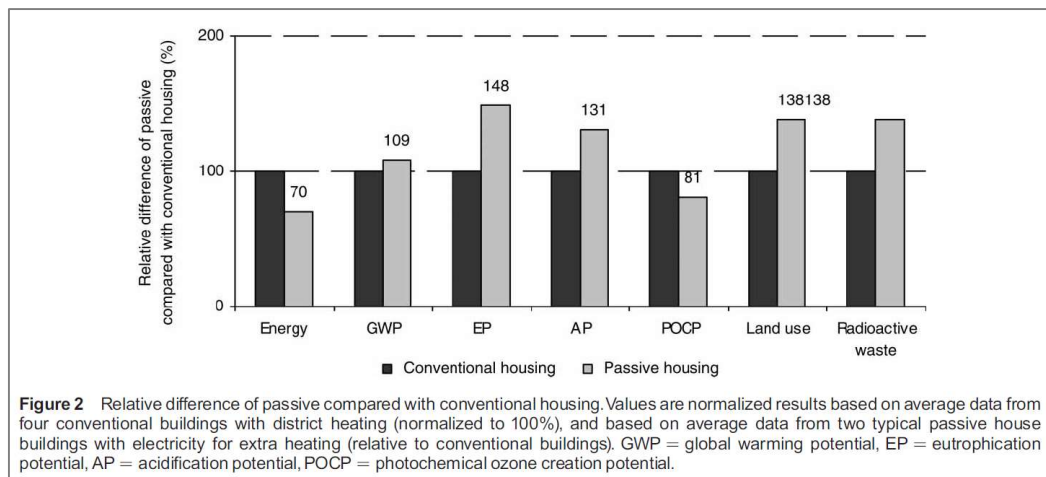


Figure 7-20: Relative difference in energy use and environmental impact of passive compared with conventional housing

Source: (Brunklaus, et al., 2010)

Use of hazardous and toxic substances and waste production

As mentioned in section 7.3.4, where the environmental impact from the construction phase was discussed, it is difficult to distinguish the use of hazardous chemical and the waste production from the different phases of a building's lifecycle. Which phase that has the largest impacts is not possible to determine. However, for the housing and building sector in general it can be concluded that hazardous chemicals are being used, but in small amounts compared to the total national use, and that the waste production is substantial in relation to national production.

Including the lifestyle of people in the environmental impact

The lifestyle of people living in a building will to some extent affect the environmental impact of a building's operational phase. A lot of things concerning the dwellers preferences and actions can be included in this. The previously discussed renovation decisions, the choice of transportation back and forth to the building, recreation travelling, consumption patterns, household electricity use and waste handling are all things which are affected by buildings. However, due to its complexity very few, or none, of these factors are included in the system boundaries of LCA studies investigating the environmental impact of a building. Usually only the choices concerning the energy and electricity use are included.

For new areas and buildings, the lifestyle of people is considered to a greater extent, possibly due to requirements in certification schemes together with local goal and ambitions. Several building projects during the previous years have included measures for encouraging an environmentally sustainable lifestyle through e.g. encouraging sustainable transport e.g. bicycling and commuting, a more efficient use of appliances and space, reuse and recycling and a reduced consumption, e.g. see (MKB, 2016). However, for the existing housing stock similar ideas and measures in renovation projects are not present to any significant extent.

8 Exclusionary effects of discursive patterns

In this chapter the findings from the analysis are compared with the factual platform described in the previous chapter. By studying the discursive patterns and compare their focus with the actual characteristics of the housing stock it has been possible to identify the aspects which are excluded from current discourses. The following items and aspects have been identified as excluded from the dominant discourses present in the housing and building sector.

- **New and unconventional solutions**

The overarching discourse includes a resistance against new and alternative techniques and a desire to only use well known methods in order to minimise risks. For example, in one of the interviews a resistance, without motivation, towards timber structures in construction of new multi-dwelling buildings was mentioned (Interview 4).

The risks that are going to be minimised are safety risks for humans rather than environmental risks for ecosystems. New approaches are suggested to be tested in special pilot projects rather than in ordinary projects, and radical solutions challenging the current way of doing things are rare.

- **Sufficiency measures**

The empirical findings have indicated a strong focus on efficiency measures for making the sector reduce its environmental impact. While efficiency measures propose solutions within normal practice, sufficiency solutions require a lifestyle change. The unwillingness to tell others how to live their lives therefore excludes sufficiency solutions from the discourse. For example, the environmental impact is measured per square meter living area, and the number of people using that living area is not included in the discussion. By measuring the environmental impact per square meter it will not be the ones using the most resources per capita that will be the main target for the environmental reduction measures and solutions of using floor space differently will be excluded from the discourse.

Sufficiency measures, like living smaller and by that decrease the need of new buildings, or to optimise the use of existing systems instead of performing major renovations, are not discussed to a great extent. Some of the few sufficiency measures which are mentioned are reducing the indoor air temperature and use less water, measures directly related to costs for the housing companies.

- **Environmental impact reducing measures for upstream processes**

One very dominant discourse is the one where environmental impact from the housing and building sector is equated with certain factors of the sector's operational environmental impact. The building owner is responsible for the

operational phase and therefore that phase is in focus. This creates a situation where other impact categories from the operational phase, and the environmental impact from other phases of the lifecycle, are left out from the discourse.

- **The things one cannot control**

The empirical findings indicate that only what one has the mandate to control is included in the strategies developed. E.g. the municipality only has ability to steer municipal housing companies and therefore private buildings and BRFs are often left out from their strategies. This excludes large parts of the housing stock and its created environmental impacts. Also synergies between different sectors are not considered to any great extent, e.g. reducing the emissions from the transport sector in the built environment, as that is not considered to be one's role.

- **Aspects difficult to measure**

Measurability is of high importance within the dominant discourse. Factors that cannot be measured are not considered and therefore excluded from the discourse. An example of this is the ecosystem services which are difficult to measure and seldom are discussed.

9 Discussion

9.1 Possible consequences of the discursive patterns

By analysing discursive patterns in the management of the existing housing stock several insights have been gained. The discursive patterns identified in the analysis of the empirical findings have shown to have a large impact on the performed environmental work. By linking values and ideologies, level of knowledge, conflicting and dominating discursive patterns to the environmental work performed, discourse patterns have emerged. By comparing those patterns with a factual platform the exclusionary effects of the current dominant discourses have been identified. The exclusionary effects have shown to have a major impact on the performed environmental work, as certain possible solutions will never be suggested, or even thought of.

In this section possible consequences of the identified discursive patterns will be discussed through four statements. It cannot be concluded from the findings that the statements hold true, but many factors are indicating that at least part of them do. The idea with the statements is to elaborate with the consequences of the discursive patterns identified, and to open up for discussion. The statements are the following:

- Poor integration of environmental work creates additional costs
- Unclear responsibilities create a too slow system
- A one eyed focus makes us forget important aspects
- The municipality's limited mandate to steer leaves large part of the housing stock out

• **Poor integration of environmental work creates additional costs**

From the empirical findings and the analysis, it is evident that environmental concern is not an integral part of normal practice. Some measures taken in order to reduce the environmental impact, such as a reduced use of energy and prevention of the use of certain hazardous substances, have become an integral part of project management. However, it is not the environmental concern that is integrated but those specific measures. Environmental work is still perceived as something which lies on top of what you normally do. This leads to a situation where additional environmental consideration is perceived as more work that needs to be done. The perception is one of additional costs and work that you can choose not to prioritise if you have many other important things to do.

If the environmental work was performed as an integral part of normal business it would be easier to receive all the possible benefits out of it. If environmental concern was the starting point of every project, instead of an additional measure, it would not be perceived as an extra cost.

- **Unclear responsibilities create a too slow system**

The study indicates that actors often hold someone else then themselves responsible for an increased environmental work. Project managers, which are the ones that have the final saying in the environmental actions taken, are due to their rather low knowledge in environmental issues not perceiving any urgency to increase their environmental work. This does not necessarily have to be a problem, but it requires that the regulations and strategies they work according to leads to a desirable result. The responsibility for an increased environmental work among project managers is thus moved to regulators and environmental strategist within the company.

When it comes to the regulators strict regulations are avoided due to a fear of regulating to hard, hitting actors and increasing building costs. Regulations and strategies are put at a level that is possible to reach and the regulators see regulations as minimum requirements. For more ambitious work information is seen as the key, and by not being too strict freedom and responsibility are assigned to the individual actors at every company. The idea is that they with the right information will find the solutions most suitable for them. However, as project managers feel low urgency to increase their environmental work, the information will not make any difference and the minimum levels set by the regulators will be perceived as the desirable levels.

If regulations fail to initiate ambitious environmental work among project managers, the only way left to influence the performed environmental work is through the environmental strategist within the companies. Environmental strategists have a deeper knowledge in environmental issues and perceive a higher urgency than the ones with a lower awareness. They are therefore more susceptible for information and are actively searching for new solutions. However, to be able to develop strategies the environmental strategists are dependent on measurability and evidence for proposed actions. Strategies that are not possible to calculate the cost of, or show the use of, are often dismissed. By relying on tools showing which solutions to choose, and pilot projects showing what is possible, the responsibility for an increased environmental work is thus moved to the ones developing those.

This system, which is built on actors waiting for someone else to take responsibility for an improved environmental work, is very slow. That would not have been a problem if actors took an individual responsibility for an improved environmental work. Indications from the empirical findings show that ambitious individuals have managed to performed a lot and integrate environmental work in normal practice. The problem is therefore not that it is impossible to increase the environmental work within the system, but it is rather the system that does not initiate ambitious work by itself. During one of the interviews it was suggested that instead of prohibiting hazardous materials one way forward could be that architects designed buildings without the elements containing the hazardous substances. However, as no one is

taking the responsibility to suggest it or demand it, and as regulations do not require it, it simply is not done.

- **A one eyed focus makes us forget important aspects**

Environmental issues are very complex, the impact categories are many and the phases and moments where environmental impact is created are even more so. In order to get the issue more comprehensible environmental impacts from the housing and building sector have been translated to, and equated with, certain aspects. It has been shown that environmental work often is equated with a reduced use of energy and hazardous substances during a buildings operational phase. The aspects do have substantial effects on the environment and the achievement of integrating them in normal practice of the housing and building sector should be seen as a success.

However, by only focusing on certain environmental indicators and one phase of a building's lifecycle a risk of forgetting other impacts is created. When the environment no longer is in focus, but only those specific aspects, burden shifting is at risk. It will be difficult for the actors with less knowledge to evaluate the benefit from the performed actions. Even though the particular aspects in focus have been selected based on thorough investigations every situation is unique and targeting other parts would in some cases certainly be more preferable.

- **The municipality's limited mandate to steer leaves large part of the housing stock out**

Most of what has been discussed so far have treated municipal housing companies and it is often there the national and local environmental strategies end up. Voluntary initiatives taken by private companies are not to be forgotten. It is, however, clear that both national and local strategies value the freedom of private companies high and that the only part of the existing housing stock they try to steer is the municipal housing companies.

When an improved environmental work is discussed it is usually in terms of how to affect the buildings which one has the power to control. Discussions of how to change which buildings one has the power to affect are not as common. This may lead to that a small share of the housing stock needs to take responsibility for reducing the environmental impact from the entire sector. As the municipality mostly have the power to influence the buildings they own, those buildings are the ones in focus. Private buildings, BRFs and one- and two-dwelling buildings are many times excluded from the strategies. It is, however, shown that these building types contribute to a large share of the environmental impact from the housing and building sector. This fact is seldom mentioned in local and national strategies, or in research publications.

9.2 Lessons learned from discourse analysis

This study has been a journey, learning more about the environmental work in the housing and building sector, but also learning more about discourse theory. By “just” studying what is said and done discursive patterns have emerged. Patterns that not only describe the current situation, but also give ideas and a deeper understanding of why certain things are done in a certain way. The initial idea with this thesis was to investigate which things that are needed for a more holistic mindset to be applied in the housing and building sector. However, at an early stage of the research it was realised that in order to know what is needed to improve current practices one has to understand them.

The initial idea therefore developed into an ambition to embrace all aspects of the environmental impact from the housing and building sector, in order to identify discursive patterns of the entire sector. In reality it is not possible to succeed with embracing every aspect and every discourse there is, and the results must be analysed in the light of this. What also is important to highlight is the fact that also the researcher is part of a discourse, and that no such thing as an objective research exist. All steps throughout the research have been influenced by the researcher, and additional analysis is needed in order to validate the results.

9.3 Suggestions for future research

Many aspects have been included in the research, and some aspects have most likely been missed. To confirm the findings from this study and further investigate the subject additional analysis would be needed. The discourse analysis in this study has been made at an overarching level. Patterns have been identified but no in-depth analysis has been made. For special areas within current discourses, or within areas aiming to change current discourses, this could be of interest to do.

Working within current discourses future research is proposed to investigate how environmental work can be increased, despite the identified exclusionary effects. Special areas of interest, with direct connection to the exclusionary effects identified in chapter 8, are the following:

- How can new solutions and innovation be diffused in a conservative sector?
- Which economical models are needed to make sufficiency measures become economic profitable?
- How can a lifecycle perspective be applied in a system where the environmental impact is equated with very specific factors?
- How to take responsibility for the things we cannot control?
- How can the unmeasurable be measured?

Another possible way to proceed would be to challenge the current discursive patterns. To investigate what would be needed in order to change current discourses, making them include what previously was excluded. Special research areas of interest, with direct connection to the statements listed in section 9.1, are the following:

- How can we further integrate environmental concern in normal practice and make actors within the sector work with a continuous improvement of their environmental work?
- How can we make it clearer which responsibility that is assigned to which actor?
- How can we apply a more holistic mind-set in the housing and building sector and make its actors looking broader?
- How can we change which parts of the housing stock national and local authorities feel that they have the mandate to steer and influence?

As a final remark it is important to highlight that there are discourses deliberately not covered by the study. The performed work has a strong municipality focus, and many other perspectives do exist. One special area that could be of interest to analyse is the forerunners within industry. It does exist housing companies, which are not included in this study, that perform a lot of environmental work. Investigating their work and their relation to developed strategies, goals and regulation would be of interest.

10 Conclusion

In this study the conceptualisation of environmental sustainability in the housing and building sector has been investigated by the means of discourse analysis.

Firstly, the study has concluded that the environmental impacts are substantial and generated both from upstream and downstream processes. Different types of impacts are created and measured in different ways, and according to different indicators. The most dominant conceptualisation of environmental work is to equate environmental impact with operational energy use and with the reduction of hazardous substances in materials.

Secondly, the study has concluded that the dominant discourses in the sector have exclusionary effects, excluding certain aspects from environmental practice. All impacts are not considered and all possible solutions are not used. It is shown that new solutions, sufficiency measures, environmental impact from upstream processes, things one cannot control, and aspects difficult to measure often are excluded from environmental work and discussions.

Thirdly, the study also elaborates with possible consequences of the identified exclusionary effects. It is discussed if poor integration of environmental work makes it perceived as an additional cost, if unclear responsibilities slow down the environmental innovation, if a one eyed focus make actors forget important aspects, and if the municipality's limited mandate to steer leaves large part of the housing stock out from performed actions.

Finally, this study has contributed with an improved knowledge of how current discursive patterns are influencing the environmental work in the housing and building sector. More needs to be done in order for the sector to reduce its environmental impact to desirable levels. Hopefully, this study has increased the understanding of how strongly discursive patterns influence what we perceive as possible, and shed some light on possible ways forward.

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Appendix 1 - National and local environmental ambitions

Abstract

In this appendix to the report *The meaning of Environmental Work in Building Management – an Analysis of Current Discourses in the Swedish Housing Sector* is the concept of environmental sustainability used in the study defined. National environmental objectives are explained together with local objectives in Göteborg.

Abbreviations

| | |
|------|---|
| BBR | Boverket's Building Regulations |
| BRF | Cooperative Tenant-Ownership |
| EU | European Union |
| GDP | Gross Domestic Product |
| IEA | International Energy Agency |
| IPPC | Intergovernmental Panel on Climate Change |
| LCA | Life Cycle Assessment |
| PBL | Planning and Building Act |

Swedish denotations

| | |
|--------------------------|--|
| Bostadsförsörjningslagen | The Housing Act |
| Boverket | Swedish National Board of Housing, Building and Planning |
| Energimyndigheten | The Swedish Energy Agency |
| Miljöbalken | The Environmental Act |
| Naturvårdsverket | Swedish Environmental Protection Agency |

1 Sustainable development

1.1 Definition of the concept and its ecological dimension

Among many different meanings of sustainable development, the most common definition is the so called the Brundtland definition, stated in the report *Our Common Future* from 1987, which reads (Hedenus, et al., 2015):

“Sustainable development is development that meets the needs of the present without compromising the ability for future generations to meet their own needs”

Sustainable development has been formed from the compromise between the environmental movement and the development movement. The development movement focuses on the needs of the ones living today and the environmental movement focuses on managing the limited resources and preserving the natural ecosystems in such a way that future generations can meet their needs (Hedenus, et al., 2015). Sustainable development in the housing sector would therefore be to provide homes with sufficient standard for everyone, without depleting resources and impinging the natural ecosystems in such a way that they are not preserved for future generations.

Brundtland is clear about that it is basic needs which first and foremost need to be fulfilled. But what are our basic needs and what do we need in order to increase our welfare and what are really the key elements of a good life? The answer is not evident and it is even more difficult when it comes to determining what would be needed for future generations to meet their needs. We may know how the ecosystem will respond to our environmental impact, but we do not know how technology and development will form our future needs. If we apply the idea of sustainable development these will be the questions to answer, how to meet the needs of today and in the future. One very common way of dealing with those questions is to divide the requirements of the answer into three dimensions, the ecological, the economical and the social.

In this study it is primarily the ecological requirements which are studied, and therefore the ecological dimension is the one in focus. However, one needs to remember that none of the dimensions stands for themselves, but that they are interlinked and that all three are needed in order to create sustainable development. The ecological dimension can be understood as a boundary which we cannot cross, because if the natural system cannot provide us with what we need, we cannot simply live. (Hedenus, et al., 2015) is defined it as the following:

“The ecological dimension involves sustaining natural systems that can keep providing humans with important utility. The dimension can be divided into the environmental production capacity and the environmental assimilative capacity.”

However, where this boundary lies and what is considered to be a sustainable development is normative. Environmental sustainability will therefore be defined differently depending on our belief in technology developments and the substitutability of ecosystem services (Hedenuš, et al., 2015).

Even if this study has a focus on the environmental dimension on sustainability there is one link to the economical dimension which needs to be emphasized. In order to explain this further we have to go back to the definition of sustainable development and the obvious conflict between economic growth and environmental interests and the definition of economic growth. Economic growth is usually referred to as the change in gross domestic product (GDP) and can be increased in two different ways. Either it can be made by an increased use of finite and renewable resources or by increased productivity. As the latter is the way of which economic growth can be achieved without an increased environmental impact, it has been the dominant way of the conducted environmental work, to do things more efficient. Work has also been done to replace the use of non-renewable resources with renewables in order to decrease the environmental impact from our resource use, but the efficiency mind-set has still been the dominating approach.

1.2 Environmental sustainability in the housing stock

Today the environmental work in the building sector is an integral part of the businesses, however conflicts about the definitions do exist (Hagbert & Femenias, 2015). Domestic energy use is seen as a key for reaching the national energy saving goals, something which is done primarily through efficiency measures. However, there are researchers that claim that there are limitations in those types of measures. That they will not be enough to achieve absolute consumption reduction and that they do not address issues of growing housing consumption and demand (Hagbert & Femenias, 2015). It is argued that if we want to reach further we need to go beyond parametric improvements within current system and with a more holistic view find new forms of living within the finite ecological limits (Hagbert & Femenias, 2015).

2 Environmental sustainability in national policies

2.1 The Swedish environmental objectives

2.1.1 The hierarchy of the objectives

Within the Swedish environmental objectives lies one generational goal, 16 environmental quality objectives and 24 milestone targets. The generational goal is the overall goal of Swedish environmental policy and reads (Swedish Environmental Protection Agency, 2016):

The overall goal of Swedish environmental policy is to hand over to the next generation a society in which the major environmental problems in Sweden have been solved, without increasing environmental and health problems outside Sweden's borders.

The environmental quality objectives describe the desirable and sustainable state in which the generational goal is fulfilled and which the environmental work has the ambition to lead to. The environmental quality objectives also have specifications that clarify the goals and are used for follow-ups on the environmental work (Swedish Environmental Protection Agency, 2016). Out of the 16 environmental quality objectives there are seven which are of particular relevance for the building and housing sector and they are; A Good Built Environment, Reduced Climate Impact, Clean Air, Natural Acidification Only, A Non-toxic Environment, Zero Eutrophication and A Rich Diversity of Plant and Animal Life (Boverket, 2015:2).

2.1.2 The environmental quality objectives

General

The seven environmental quality objectives mentioned in the previous section are all relevant for the building and housing sector as the environmental indicators developed by Boverket can be used to follow-up on them. All them are interconnected and relevant, there are however two of them which will be specially highlighted in this section. They are “Reduced Climate Impact” and “A Good Built Environment”. “Reduced Climate Impact” is one of the top prioritized questions by the government and therefore influences the national and local environmental goals and strategies to a great extent (Romson & Löven, 2015). “A Good Built Environment” is directly related to the housing and building sector and have been mentioned by Boverket to have high relevance (Boverket, 2015:2)

Reduced Climate Impact

"In accordance with the UN Framework Convention on Climate Change, concentrations of greenhouse gases in the atmosphere must be stabilized at a level that will prevent dangerous anthropogenic interference with the climate system. This goal must be achieved in such a way and at such a pace that biological diversity is preserved, food production is assured and other goals of sustainable development are not jeopardized. Sweden, together with other countries, must assume responsibility for achieving this global objective."

Goals which have been adopted globally and within the European Union (EU) constitute the frames for the Swedish climate policies (Romson & Löven, 2015). The government claims that reducing the climate impact is one of their most prioritized questions (Romson & Löven, 2015). The current situation, in which 70% of the total national greenhouse gas emissions can be derived from the Swedish energy supply, closely connect the goal of reducing our climate impact with our energy supply system (Romson & Löven, 2015). In order to reduce the climate impact from the energy use four climate and energy policy objectives for 2020 have been adopted by the parliament and reads (Regeringen, 2016:2):

-
- *By 2020 at least 50 per cent of total energy consumption should come from renewable energy sources.*
 - *By 2020 the transport sector should meet the renewable energy target of at least 10 per cent.*
 - *By 2020 energy efficiency should increase by 20 per cent. This is expressed as a cross-sectoral target of a 20 per cent reduction in energy intensity by 2020 relative to 2008.*
 - *By 2020 a 40 per cent reduction in emissions of greenhouse gases should be achieved relative to 1990.*
-

The building and housing sector is responsible for a large part of the energy use, both globally and locally. 33% of the global carbon dioxide emissions are related to energy use in buildings and in the EU are production and use of buildings responsible for around 50% of the material extraction and 50% of the energy use. Also in Sweden the energy used in buildings is a large part of the total amount of energy used. The sectors buildings and services are responsible for 35% of the total final energy consumption (Boverket, 2015:1) and the domestic energy use accounts for nearly one fourth of the total energy use (Hagbert & Femenias, 2015).

At a global level, energy and material efficiency is frequently mentioned as an important mean to achieve reductions in greenhouse gas emissions for low reduction costs, by actors such as the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) (Boverket, 2015:1). The global and European climate policies therefore have a strong focus on reducing climate impact by a reduction of material and energy use in the building sector, which in turn are influencing the Swedish policies.

One of the most prioritised national environmental goals with relation to the housing and building sector is the governmental ambition to reduce the operational energy used in buildings with 20% until 2020 and with 50% until 2050 (Byman & Jernelius, 2013). Even though the operational energy used in buildings is mainly produced from renewable sources (Toller, et al., 2011), the ambition is that the goal will lead to a reduced climate impact. This is because a reduction in renewable energy use in this sector could help phasing out non-renewable sources where efficiency measures are more difficult, as it would leave more renewable energy for other sectors and countries (Byman & Jernelius, 2013).

A good built environment

"Cities, towns and other built-up areas must provide a good, healthy living environment and contribute to a good regional and global environment. Natural and cultural assets must be protected and developed. Buildings and amenities must be located and designed in accordance with sound environmental principles and in such a way as to promote sustainable management of land, water and other resources."

The Swedish government have adopted ten specifications of the environmental quality objective, of which Boverket highlights four that they think are of extra importance and where their environmental indicators can be used (Boverket, 2015:2). They read:

- A sustainable urban landscape – The urban landscape and the buildings it consists of should be sustainable
- Health and safety – Humans should not be exposed to unacceptable health and safety risks
- Conscious use of energy and natural resources – Resources should be used in an efficient and environmentally adopted way. Resources use should be reduced and based on renewable sources
- Sustainable waste management – Waste should be reduced, recycled and reused to highest extent possible and the environmental impact from the waste should be reduced

2.1.3 Milestone targets

General

To facilitate achieving the generational goal and the environmental quality objectives certain milestone targets have been adopted by the government. The milestone targets are defining steps on the way towards the generational goal and one or more of the environmental quality objectives (Swedish Environmental Protection Agency, 2016). Today 24 different milestone targets have been adopted for the environmental quality objective, reduced climate impact, and within the areas air pollution, toxic substances, waste and biodiversity.

Milestone targets for the objective Reduced Climate Impact

The government have adopted one milestone target for the environmental quality objective “Reduced Climate Impact” (Swedish Environmental Protection Agency, 2016). The target, which is a part of the Swedish climate and energy policy objectives for 2020, addresses the amount of greenhouse gas emissions in Sweden in year 2020. The target reads that the emissions in Sweden should be 40% lower than the emission in year 1990.

Milestone targets for the objective A Good Built Environment

In 2012 two milestone targets for the environmental quality objective “A Good Built Environment” was adopted by the government (Boverket, 2014:1). The targets address a reduced resource use in the food chain and in the building sector. It is stated that substantial reductions in waste generation will be achieved through a reduction in food waste and an increase in reuse and recycling of building and demolition waste.

In parallel with the realization that the environmental quality objectives will be difficult to reach, additional milestone targets can be adopted. Boverket have suggested four new milestone targets, to be achieved in 2020, for the environmental quality objective “A Good Built Environment” (Boverket, 2014:1). The first two goals address structural systems and states that regional platforms for collaboration between local, regional and national key actors should be established and that at least 15 municipal, inter-municipal or regional urban environment agreements should be signed. The third goal states that the private car traffic in urban areas should be reduced with 10% and replaced by public transport, cycling and walking. The fourth goal states that the life cycle approach should be a starting point for all new constructions and renovations, as well as for the management of the existing housing stock. (Boverket, 2014:1)

2.2 The government’s draft budget

It is the 18th area of expenses in the Swedish budget bill which have the biggest influence on the environmental work in the housing and building sector, as this is

the area where expenses for urban planning, housing and building are included. This area of the budget bill mainly focuses on how to provide buildings in a sustainable way and a lot of focus is on new buildings. However, the importance of reducing the energy use in the existing housing stock is mentioned as an important measure for creating a national energy system completely based on renewable sources. The performance of the current housing stock and new buildings are declared in yearly energy use per square meter. Operational energy use is in focus but it is also stated that a bigger focus needs to be on reduce greenhouse gas emissions from building materials and the construction process. Life cycle assessments (LCA) is mentioned as a good tool for this, but that more knowledge is needed. Boverket is therefore commissioned to investigate the climate impact from buildings in a life cycle perspective. (Regeringen, 2015)

In the area of urban planning, housing and building there are three different expenses in the (draft) budget from this year, which to different extent are spend on environmental sustainable building and housing.

- First of all, Boverket gets money every year to be able to fulfil their commission. In their commission lies a lot of research and investigating work of how to develop a more environmental sustainable building and housing sector. More of their work will be described later in this chapter.
- Secondly FORMAS, the Swedish research council for sustainable development, have gotten an increased allocation for research within sustainable development from 25 million SEK/year 2013 to 100 million SEK/year from year 2016. The council promotes and supports research within the areas Environment, Agricultural Sciences and Spatial Planning.
- Thirdly one billion SEK per year will be allocated to renovate and increase energy efficiency of multi-dwelling buildings in socio-economical weak areas. The allocated money will also be spent on improvements of the outdoor space that lies in connection to the buildings.

In the draft budget for the next year, 2017, new investments for a reduced climate impact have been suggested. The investments are made within four areas, local climate adaptation, fossil free travels, renewable energy and international climate investments. For the building and housing sector it is primarily the area local climate adaptation that will make a difference. In this area 3.5 billion SEK will be allocated to concrete climate impact reducing measures at regional and local level. Municipalities, companies, BRFs, etc. can apply for investment support for different measures which will lead to a reduced climate impact. (Regeringen, 2016:1)

2.3 The role as a forerunner

2.3.1 Who should be the forerunner?

Strategies and policy instruments are developed in order to remedy market failures and to steer the development in the desired direction. However, sometimes actors step in and take the role as a forerunner pushing forward the development in a certain area. This kind of initiative can be taken by e.g. companies in industry, municipal companies or by municipalities.

2.3.2 Forerunners in the public sector

General

The public sector has the possibility to integrate the environmental objectives in their work with things that are not directly related to the environment, but that will have a large influence on the environmental impact (Swedish Environmental Protection Agency, 2016). Obvious examples are infrastructure projects and the organisations of cities. The facts that the public sector is a big employer and purchaser of goods and services, and that their choices will make a huge difference, also motivate them being forerunners. In the public sector it is also possible to find pilot projects which are not immediately profitable, but which may lead to long term profitability.

Applicable areas

Energy efficiency

An important principle in EU's Energy Saving Directive is that the public sector should take responsibility within the energy efficiency field and be leading examples for other actors (Högberg, 2014). This is, however, not something which is being applied in Sweden, as the Swedish government has decided that local political authorities should not be required to lead by example. They still have the opportunity to sign voluntary agreements and if the public sector should be a forerunner or not have therefore become a local political question. It is decided in the local steering directives if the municipal housing companies should act as forerunners in making the housing sector more energy efficient or not (Högberg, 2014)

Public procurement

Another area where it is discussed whether the public sector should act as a forerunner or not is in the public procurement sector. The public sector in Sweden is a big consumer, spending 500 billion SEK every year. If the sector used its consumer power and produced goods and services with low environmental impact and based on renewable resources the reduction in environmental impact would be substantial and strong incentives for low environmental impact production would be created. There are today no requirements that environmental concern needs to

be taken in the public procurement process but local initiatives to be forerunners have been taken. (Naturvårdsverket, 2016:2)

2.3.3 Forerunners in industry

General

Environmental work in industry is done for different reasons. Some see the economic profit in being environmentally sound, others a business opportunity, some have ideological reasons and others only do what they have to. The possibilities for industry to be forerunners could be less than for the public sector as they in some sense have less resources and are more governed by profit maximization. However, if a business opportunity is seen in environmental concern, industry may have greater possibilities than the public sector.

Applicable areas

Environmental assessment systems

One way in which the industry are forerunners is when they certify their buildings according to voluntary environmental assessment systems and by that reach further than what the regulations require. The certification schemes are primarily used for marketing. Also the public sector works with environmental assessment systems, but not to the same extent as the industry does.

Influencing the policy instruments

The industry is sometimes taking the role as a forerunner in order to influence the policy instruments developed by regulators. Voluntary agreements can be made in order to avoid stricter regulations. More ambitious environmental work can also be done to push for stricter regulations and by that create a business advantage in relation to other companies in the industry.

2.4 Creating a good built environment

2.4.1 Boverket's commission

The authority responsible for the environmental quality objective a good built environment is Boverket. Boverket works according to instructions issued by the Swedish parliament and additional commissions issued by the government and primarily with things related to urban planning, building and housing. Their instruction's main content is to work for diffusion of knowledge, follow-up on the environmental quality objective "A Good Built Environment" and participate in international collaborations. The starting point of their work is the planning and building act (hereafter denoted "PBL", the Swedish acronym), parts of the environmental act (hereafter denoted "Miljöbalken", the Swedish name) and the housing act (hereafter denoted "Bostadsförsörjningslagen", the Swedish name). Boverket develops regulations and guides, is responsible for inspection of energy

declarations and the planning and building act enforcement, administrates governmental subsidies and investigates and analyses issues within their field. Their sustainability work is defined by three focus areas with one strategical goal respectively. One of the focus areas are buildings, with the strategical goal of a reduced total environmental and climate impact from the buildings lifecycle perspective. (Boverket, 2015:2)

2.4.2 Policy instruments and strategies for the housing/building sector

Market failures

When Boverket is investigating if and which policy instruments that could be needed in order to enhance the environmental work in the building and housing sector they analyse market failures (Boverket, 2016:1). A market failure is a situation where the market is incapable to allocate resources in an efficient way with inefficiently high socioeconomic costs as a result. In such a situation market intervention in form of policy instruments could be needed from a socioeconomic point of view (Sterner & Coria, 2012). The market failures Boverket are working with are (Boverket, 2016:1):

- Public goods – ecosystem services
- Externalities - environmental impact, e.g. from greenhouse gas emissions
- Asymmetric information – Uneven distribution of knowledge between builder and producer

Policy instruments

In order to solve market failures different policy instruments are used and a common division of them is the following (Boverket, 2016:1).

- Informative (information, counselling and guidance)
- Regulatory (laws and regulations)
- Economic (i.e. taxes and subsidises)
- Research and Development

• Informative instruments

Environmental informative policy instruments aim at creating understanding and participation among actors in the environmental work. The instruments are used to create understanding of other policy instruments to increase their effect. Examples of environmental informative policy instruments in the building and housing sector are municipal climate and energy counselling, energy declarations, eco-labelling, environmental product declarations and different informative materials (Boverket, 2016:1).

Boverket is continuously investigating if the existing knowledge regarding environmental measures and policy instruments are enough, or if more informative instruments are needed. Earlier this year they published a report which stated that the knowledge concerning LCA and the life cycle perspectives of buildings was insufficient and informative instruments to increase that knowledge are needed (Boverket, 2015:1). During the recent years Boverket has also concluded that an insufficient knowledge about the profitability of energy efficient renovations are leading to that the potential of energy efficient renovations is not being fully utilized (Boverket och Energimyndigheten, 2015).

• **Regulatory instruments**

Environmental regulatory policy instruments used in Sweden for the building and housing sector are the environmental laws and the laws for building, housing and planning. The regulating laws, related to environmental work are the following:

- Requirement of energy metering in buildings (*Lag (2014:267) om Energimätning i Byggnader*)
- PBL (Plan- och Bygglag (2010:900))
- Requirement of energy declaration of buildings (*Lag (2006:985) om Energideklaration för Byggnader*)
- Miljöbalken (Miljöbalken (1998:808))

In addition to this an important document which is regulating the built environment in Sweden, Boverket's Building Regulations (hereafter denoted BBR, the Swedish acronym), must be mentioned. BBR are Boverket's regulations and recommendations for the Planning and Building act, and out of its sections it is three which have regulations that will affect the environmental impact of the building.

First there is the section about Sanitation, Health and Environment which puts demand on building products and materials in order to create good sanitation, health and environment in and around the building. However, the technical requirements are limited to only consider the local environment and no requirements linked to more general and global environmental concerns exist (Boverket, 2015:1).

The second section is the section about Energy use. In the section the maximum allowed energy consumption per square meter floor area and year is described and for the buildings where electricity is used for heating there is a power requirement. Also requirements for insulation, installations, effectivity and metering systems are stated here.

The third section which also affects the environmental impact of the building is the section about building products. The section states that only approved products are allowed to be used and focus is on the completed building meeting expectations. The requirements are focusing on things such as load bearing capacity, fire safety

properties, energy use and protection against moisture and noise. However, the environmental performance of building products is not being investigated to any large extent in the certification marking system used for approving products. To be able to put stricter demands of the environmental performance of buildings, a European system for environmental assessments, which results could be integrated in product declaration and certification marking systems for building products, is needed (Boverket, 2016:1).

Another important section relevant for this study is the section about modification and change of a building. In the section it is stated that the regulations and recommendations in BBR are for new buildings but that they also should be the starting point when existing buildings are being modified. However, the section clearly states that for existing buildings changes according to the specific building and situation need to be made, taking the prerequisites and qualities of the building into account.

(Boverket, 2016:2)

The building regulations are today focusing on the completed building and to ensure that it provides a healthy and well-functioning living environment. What however seems to be lacking in the building regulations, seen from an environmental perspective, is regulations regarding the environmental impact of the building in other phases of the lifecycle than the operational one.

Today areas of LCA, ecosystem services and climate adaptation are not represented in the regulations and current research is investigating whether regulatory policy instruments within those focus areas are needed (Boverket, 2016:1).

- **Economic instruments**

Economic policy instruments adjust the cost of products and services so that they, in addition to monetary costs, also include all costs and benefits produced e.g. environmental damage. The economic policy instruments could be both subsidies and taxes.

Examples of environmental economic policy instruments in the building and housing sector are carbon taxes, which affects transports, energy taxes (and carbon taxes) on the energy used for building and housing and the European Union Emissions Trading Scheme which affects steel and cement manufacturing and greenhouse gas emissions. Subsidies for renovations, energy mapping and energy efficiency measures in new buildings and during renovations are other examples. Policy instruments used for waste reduction are the tax on landfill and the fee for household waste (Boverket, 2016:1).

- **Research and Development**

In addition to the policy instruments described could Research and Development be used as an instrument to enhance the development of the environmental work in the building and housing sector. By founding research projects and pilot projects regarding environmentally sustainable renovations new solutions can emerge on the market and creating new opportunities.

2.5 Reducing operational energy use in the housing sector

2.5.1 The commission of Energimyndigheten

As shown above, the energy efficiency ambitions are a large and important part of the Swedish environmental work. An important role in this work has Energimyndigheten which works according instructions issued by the Swedish parliament. They develop and distribute knowledge, participate in international collaborations, administrate policy instruments and generate statistics, do analysis and projections in connection to energy usage.

Energimyndigheten works mainly with administration of economic policy instruments and informative policy instruments through development of and distribution of information. Some of the information they are distributing is:

- Energimyndigheten provides information about how you can reduce your household electricity consumption through a change in lifestyle and by choice of appliances.
- For private owners of one- and two-dwelling buildings and smaller multi-dwelling buildings Energimyndigheten is referring to the energy and climate counselling at the municipal offices. As a complement, information and a tool for energy consumption calculations can be found at their webpage.
- Energimyndigheten is founding different networks for different types of buildings with the focus of reducing the energy use for heating and electricity. The purchaser groups and networks are the following:
 - LÅGAN Programme for buildings with very low energy use
 - Belok Procurement group for premises
 - BeBo Procurement group for housing
 - HyLok Tenants for energy efficient premises
 - BeLivs Procurement group for premises for food handling
 - BeSmå Procurement group for one- and two-dwelling producers
- Energimyndigheten is providing Energilyftet, a web based, free of charge, education for procurers, architects, engineers, project managers, property managers och technicians with the aim to increase the knowledge in passive housing.

National strategy for energy efficiency improvements through renovation

The government has commissioned Energimyndigheten and Boverket to develop the Swedish strategy for energy efficiency measures in connection to renovations of multi-dwelling buildings (Claesson, 2016).

2.5.2 Local and regional capacity for climate and energy adaptation

The government has commissioned Energimyndigheten to allocate 25 million SEK per year to local and regional actors with the purpose to enhance energy and climate adaptation. Half of the amount can be applied for through different announcements. The announcements related to buildings are within the areas “Integration of Energy Aspects in Physical Planning” and “Energy Efficiency Measures in Buildings”.

3 Environmental ambitions and goals in Göteborg

In this paragraph we will turn the focus towards the city of Göteborg and their goals and strategies for an environmentally sustainable development. Göteborg has several steering documents, project and processes influencing the environmental work of the city, but it is the budget of the city, which city council decides on every year, that is superior all other steering documents (Miljöförvaltningen, 2014). In the budget it is written that reducing the climate impact is one of the most important questions of our time, that the climate emissions in Göteborg have been reduced, but that a lot more needs to be done in order for the city to reach its targets and create a sustainable development. The budget also states that Göteborg should be a forerunner within environmental work and one of the world’s most progressive cities with respect to addressing climate and environmental issues, and that environmentally friendly behaviour and actions should be encouraged (Göteborg Stad, 2016).

The environmental work in the city is aiming at achieving its 12 environmental objectives, which are developed based on the 16 Swedish national environmental quality objectives. With Göteborg as starting point, the most important parts of the national objectives are picked and rephrased to fit the local setting (Göteborg Stad, 2016). For the city to be able to reach the targets an Environmental Programme has been developed. The environmental programme contains an action plan with 212 concrete measures divided into seven different action strategies (Miljöförvaltningen, 2013).

The first of the 12 environmental objectives, “A Reduced Climate Impact”, is mentioned in the city’s budget as a prioritized goal. The reduced climate impact should be achieved through a 40% reduction of carbon dioxide emissions in 2020 compared to the levels in 1990, and the consumer based greenhouse gas emissions

should be below 3.5 tonnes carbon dioxide equivalents per inhabitant (Göteborg Stad, 2016). Due to its importance a strategic climate programme (klimatstrategiska programmet) have been developed based on the goal “A Reduced Climate Impact”

Other environmental objectives which are related to the building and housing sector are the following objectives (Miljöförvaltningen, 2013):

- A Non-toxic Environment – Humans and the environment should not be affected negatively by toxic substances, something which will be achieved by a reduced use of toxic substances.
- A Good Built Environment – A good built environment should be offered through a sustainable use of resources, something which will be achieved through a reduction in waste and energy use. It is stated in one of the sub goals that the energy use in buildings should be reduced with 30% and the electricity use with 20% until 2020 compared to the use in 1990, industry and transport excluded.

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Appendix 2 – Findings from document study

1 Qualitative text analysis

1.1 General

In this chapter are the corpora analysed in the qualitative text analysis presented together with the results from the analysis.

1.2 National level

Corpus 1 - Information published by Energimyndigheten

The corpus consists of the information published by Energimyndigheten at their webpage. Only information regarding energy use in the building sector is being included in the corpus. Energimyndigheten are working with knowledge diffusion and administrative policy instruments in the area of energy efficiency and it is therefore relevant to get an idea of their focus.

Table 1-1: Corpus 1 – Information published by Energimyndigheten

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|------------------------------|---|------------------------|---|------------------------------------|---|
| Energy | 1 | Efficiency | 1 | Multi-dwelling | 1 | Material production | |
| Emissions to air | 1 | Sufficiency | | One- and two-dwelling | 2 | Construction | |
| Waste | | Lifestyle changes | 2 | BRF ¹ | | Operational | 1 |
| Hazardous materials | | Technology fix | | Private | | All phases (LCA approach) | |
| Ecosystem services | | Exceed regulations | | Municipal | | Procurement process | |
| Resource use | | Cost reduction | 1 | | | | |

* rental tenancy and cooperative tenant-ownership (hereafter denoted "BRF", the Swedish acronym)

Corpus 2 - Information published by BeSmå,

The corpus consists of the information published at the webpage of BeSmå, a network with 5 member companies founded by Energimyndigheten with the purpose to drive development projects for reducing the energy use for heating and electricity of one- and two-dwelling buildings (BeSmå, 2016). The corpus is relevant as it can be used to see if there is a difference in the energy efficiency work performed in the one- and two-dwelling building sector and the multi-dwelling building sector.

Table 1-2: Corpus 2 – Information published by BeSmå

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|------------------------------|---|------------------------|---|------------------------------------|---|
| Energy | 1 | Efficiency | 1 | Multi-dwelling | | Material production | |
| Emissions to air | | Sufficiency | | One- and two-dwelling | 1 | Construction | |
| Waste | | Lifestyle changes | | BRF | | Operational | 1 |
| Hazardous materials | | Technology fix | 1 | Private | 1 | All phases (LCA-approach) | |
| Ecosystem services | | Exceed regulations | | Municipal | | Procurement process | |
| Resource use | | Cost reduction | 1 | | | | |

Corpus 3 - Information published by BeBo

The corpus consists of the information published at the webpage of BeSmå, a network with 27 member companies founded by Energimyndigheten with the purpose to drive development projects for reducing the energy use for heating and electricity of multi-dwelling buildings (BeBo, 2016). The corpus is relevant for comparisons with energy efficiency measures in other parts of the housing stock and to see the focus of the energy efficiency measures performed.

Table 1-3: Corpus 3 – Information published by BeBo

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|------------------------------|---|------------------------|---|------------------------------------|---|
| Energy | 1 | Efficiency | 1 | Multi-dwelling | 1 | Material production | |
| Emissions to air | 1 | Sufficiency | | One- and two-dwelling | | Construction | |
| Waste | | Lifestyle changes | | BRF | | Operational | 1 |
| Hazardous materials | | Technology fix | 1 | Private | 1 | All phases (LCA-approach) | |
| Ecosystem services | | Exceed regulations | 1 | Municipal | 1 | Procurement process | |
| Resource use | | Cost reduction | 1 | | | | |

Corpus 4 - Information about the municipal energy and climate counselling

The corpus consists of the information provided by the municipal energy and climate counselling service when they were approached with questions regarding their work. The energy and climate counselling service is a guiding service provided by municipalities with the purpose to help building owners to find the right solutions for reducing the energy use, and the climate impact, of their buildings. The material included in the corpus is the information they provide at the webpage of Energimyndigheten (Energimyndigheten, 2015:3).

Table 1-4: Corpus 4 – Information about the municipal energy and climate counselling

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|-------------------------------|---|------------------------|---|------------------------------------|---|
| Energy | i | Efficiency | i | Multi-dwelling | i | Material production | |
| Emissions to air | i | Sufficiency | | One- and two-dwelling | i | Construction | |
| Waste | | Lifestyle changes | | BRF | i | Operational | i |
| Hazardous materials | | Technology fix | | Private | i | All phases (LCA-approach) | |
| Ecosystem services | | Exceed regulations | | Municipal | | Procurement process | |
| Resource use | | Cost reduction | | | | | |

1.3 Local level

Corpus 5 – Göteborg’s environmental action plan

The corpus consists of the environmental action plan of Göteborg (Miljöplanen in Swedish). The action plan consists of measures developed to succeed with the fulfilment of the local environmental programme. It clearly shows the focus of the environmental work of the city and the ideas of how the local environmental goals are going to be achieved.

Table 1-5: Corpus 5 – Göteborg’s environmental action plan

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|-------------------------------|---|------------------------|---|------------------------------------|---|
| Energy | 1 | Efficiency | | Multi-dwelling | 1 | Material production | 1 |
| Emissions to air | 1 | Sufficiency | | One- and two-dwelling | i | Construction | 1 |
| Waste | 2 | Lifestyle changes | n | BRF | | Operational | 2 |
| Hazardous materials | 1 | Technology fix | | Private | i | All phases (LCA-approach) | 1 |
| Ecosystem services | n | Exceed regulations | | Municipal | 1 | Procurement process | |
| Resource use | | Cost reduction | 2 | | | | n |

Corpus 6 – Göteborg’s Environmentally Sound Building Programme

The corpus consists of Göteborg’s Environmentally Sound Building Programme (Miljöanpassat Byggnande in Swedish), which is a programme developed by Fastighetskontoret with the aim to facilitate environmentally sound construction in the city. The purpose of the programme is to give guidelines for environmentally sound building and it is foremost developed for new buildings. However, it is stated that the ambition is that it also should be applicable for renovation projects.

Table 1-6: Corpus 6 - Göteborg's Environmentally Sound Building Programme

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|-------------------------------|---|------------------------|---|------------------------------------|---|
| Energy | 1 | Efficiency | 1 | Multi-dwelling | n | Material production | |
| Emissions to air | 2 | Sufficiency | | One- and two-dwelling | n | Construction | 2 |
| Waste | 2 | Lifestyle changes | 2 | BRF | n | Operational | 1 |
| Hazardous materials | 1 | Technology fix | | Private | n | All phases (LCA-approach) | 3 |
| Ecosystem services | 2 | Exceed regulations | | Municipal | 1 | Procurement process | |
| Resource use | 2 | Cost reduction | | | | | |

Corpus 7 - Steering directives and environmental action plan of Framtiden AB

The corpus consists of the steering directives of Framtiden AB, the owner of the municipal housing companies in Göteborg. As municipal housing companies are mentioned frequently in environmental strategies in the housing and building sector it is relevant to analyse which environmental work their steering directives require them to conduct. In total Framtiden AB owns around 72,000 apartments, and one fourth of all people in Göteborg live in an apartment owned by Framtiden AB. Their environmental work will therefore have a large impact on the environmental impact from the building and housing sector in Göteborg.

Table 1-7: Corpus 7 – Steering directives and environmental action plan of Framtiden AB

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|------------------------------|---|------------------------|--|------------------------------------|---|
| Energy | 1 | Efficiency | 1 | Multi-dwelling | | Material production | |
| Emissions to air | | Sufficiency | | One- and two-dwelling | | Construction | |
| Waste | | Lifestyle changes | i | BRF | | Operational | |
| Hazardous materials | | Technology fix | | Private | | All phases (LCA-approach) | 3 |
| Ecosystem services | | Exceed regulations | 2 | Municipal | | Procurement process | |
| Resource use | | Cost reduction | | | | | |

1.4 Industry

Corpus 8 - Environmental ambitions at construction firms

The corpus consists of the environmental ambitions expressed by the four biggest construction firms in Sweden. The information included in the corpus is the information each company provides on their webpages. All of their actions will thus not be covered in the corpus, however their way of communicating their environmental work will. The corpus is relevant to analyse at it will bring a rough idea of what is considered to be environmental sustainable building in the industry.

The four biggest construction firms have been taken from a list published by Sveriges Byggindustrier (Sveriges byggindustrier, 2015:2), and are the following:

- A. PEAB (PEAB, 2016)
- B. Skanska (Skanska, 2016)
- C. C. NCC (NCC, 2016)
- D. D. JM (JM, 2016)

Table 1-8: Corpus 8 – Environmental ambitions at construction firms

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|------------------------------|---|------------------------|---|------------------------------------|---|
| Energy | 1 | Efficiency | 1 | Multi-dwelling | 1 | Material production | |
| Emissions to air | 1 | Sufficiency | | One- and two-dwelling | 1 | Construction | |
| Waste | 2 | Lifestyle changes | 2 | BRF | 1 | Operational | 1 |
| Hazardous materials | 2 | Technology fix | | Private | 1 | All phases (LCA-approach) | 3 |
| Ecosystem services | | Exceed regulations | 2 | Municipal | | Procurement process | |
| Resource use | 2 | Cost reduction | | | | | |

The construction firms are mainly working with new buildings. However, they also do major renovations and no distinction between the measures taken for existing and new buildings is found.

Corpus 9 - Environmental ambitions at housing companies

The corpus consists of the environmental ambitions expressed by the four biggest housing companies in Sweden. The information included in the corpus is the information each company provides on their webpages. All of their actions will thus not be covered in the corpus, however their way of communicating their environmental work will. The corpus is relevant to analyse as it will bring a rough idea of what is considered to be environmental sustainable housing in the private sector. The four biggest housing companies, not municipal housing companies included, have been taken from a list published by Fastighetsvärlden (Fastighetsvärlden, 2013), and are the following:

- E. Akelius (Akelius, 2016)
- F. HSB (HSB, 2016)
- G. Stena Fastigheter (Stena Fastigheter, 2016)
- H. Rikshem (Rikshem, 2016)

Table 1-9: Corpus 9 – Environmental ambitions at housing companies

| Environmental impact indicator reduced | | Through this type of measure | | For this building type | | During this phase of the lifecycle | |
|--|---|------------------------------|---|----------------------------------|---|------------------------------------|---|
| Energy | 1 | Efficiency | 1 | Multi-dwelling | 1 | Material production | |
| Emissions to air | 1 | Sufficiency | 2 | One- and two-dwelling | | Construction | 2 |
| Waste | 2 | Lifestyle changes | 2 | BRF | | Operational | 1 |
| Hazardous materials | 2 | Technology fix | | Private | 1 | All phases (LCA-approach) | 3 |
| Ecosystem services | | Exceed regulations | 2 | Municipal | | Procurement process | |
| Resource use | | Cost reduction | | | | | |

2 Quantitative content analysis

2.1 General

In this chapter are the corpora analysed in the quantitative content analysis presented together with the results from the analysis.

2.2 Corpora and findings

Corpus 10 - Reports published by Boverket

The corpus consists of all the reports which can be found and downloaded at Boverket's webpage with the label 'health and environment' or 'energy'. Boverket develops many of the policy instruments which influence the environmental work in the housing and building sector, and it is therefore relevant to get an understanding of their focus.

Corpus 11 - Articles published by real estate branch magazines

The corpus consists of articles published by branch magazines for real estate owners. The included articles are published in the magazine Fastighetsnytt during the period 2014-05-26 till 2016-05-26 with a title that indicates that the article treats existing housing and the environmental aspect of sustainability. Articles from the magazine Fastighetstidningen published during the period 2014-05-26 till 2016-05-26 with the themes renovation, sustainability and environment will also be included.

Table 2-1: Findings from the quantitative content analysis

| | Corpus 10 | | Corpus 11 | |
|-----------------|-----------|-----|-----------|----|
| | N | D | N | D |
| total | | 225 | | 51 |
| energi* | 36.784 | 192 | 130 | 30 |
| material* | 2.807 | 197 | 17 | 9 |
| effektiv* | 2.866 | 191 | 6 | 6 |
| boyta* | 89 | 18 | 0 | 0 |
| LCA | 310 | 17 | 4 | 1 |
| livscykel* | 891 | 55 | 7 | 5 |
| | | | | |
| bostadsrätt* | 817 | 73 | 2 | 2 |
| hyresrätt* | 686 | 55 | 3 | 2 |
| småhus* | 5.183 | 120 | 4 | 1 |
| flerbostadshus* | 3.771 | 124 | 12 | 8 |
| lägenhet* | 4.197 | 126 | 42 | 13 |
| villa*/villor* | 493 | | 1 | 1 |
| miljonprogram* | 446 | 49 | 14 | 5 |
| rekordår* | 55 | 14 | 0 | 0 |
| | | | | |
| nya | 5.561 | 205 | 55 | 27 |
| befintliga | 2.051 | 187 | 10 | 7 |
| | | | | |
| kommun* | 23.579 | 203 | 29 | 17 |
| privat* | 1.029 | 147 | 11 | 9 |
| | | | | |
| fastighetsägar* | 2.557 | 144 | 89 | 25 |
| hyresgäst* | 1.667 | 81 | 89 | 20 |
| boende* | 6.528 | 166 | 42 | 15 |

N=Number of the words in the analysed documents

D=Number of documents in which the analysed word can be found

**=All different endings are included (Wildcard)*

Appendix 3 – Findings from the interview study

1 Interviews

In this chapter are the findings from all the conducted interviews categorised according to previously defined categories.

Table 1-1: Interview 1 with Environmental Strategist, MHC A

| | |
|--|--|
| For the actor is environmental work comprising the following | Efficiency solutions are being highlighted. The indicators energy use, toxic substances in building materials, household waste, indoor climate and environmental management systems are mentioned. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | Only the operational phase is being considered. A lifecycle perspective is being discussed. However, LCA is considered to be too difficult and a simple tool is requested. There is also an opinion that what happens in material production and at the construction site is someone else's responsibility. |
| How well is environmental work integrated in normal practice | It is highlighted that project management and environmental work should not be two separate things, however no strategy for integrating the environmental strategies in the project work exist. |
| Needed incentives and tools for an improved environmental work | Pilot projects are a good way to try new things. Actions and possible ways forward needs to be easy, measurable and possible to follow up on. New ways of doing things needs motivations and tools which provide that are therefore requested. |
| Is enough environmental work done? | No, we have to do more and with small steps we can become better. |
| Who has the responsibility for reducing environmental impacts? | Municipal companies are explained as an actor expected to be a forerunner. On the other hand, an attitude that there is someone else's responsibility to raise the ambitions and that one cannot tell people how to live their lives present. Something which moves the responsibility to someone else. |
| Most influential factors for the environmental work | The local environmental work is influenced by the demand to fulfil a certain environmental quality for the tenants while the more global environmental work is influenced by the environmental goals of the city. However, the ambitions initiated by the city mainly target new buildings, for existing buildings it is only BBR, and the building permit which is influential. The desire to use well-known techniques and the fear of doing something wrong influence the solutions used and the environmental work performed. |

Table 1-2: Interview 2 with Project Manager, MHC A

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| For the actor is environmental work comprising the following | To reduce the operational energy use and to work according to Sunda hus, a tool used to avoid hazardous building materials |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | Only the operational phase is being considered. No knowledge about the life cycle perspective of a building, and little understanding of the environment, is present |
| How well is environmental work integrated in normal practice | It is highlighted that environmental work needs to be integrated in ones every day work. However, due to low level of knowledge regarding environmental issues does the respondent not realised that there is much environmental aspect which is not integrated at all in the normal practice. |
| Needed incentives and tools for an improved environmental work | Pilot projects are a good way to try new things. Actions and possible ways forward needs to be simple, easy, rational and possible to follow up on. Additional environmental work needs to be useful and profitable. |
| Is enough environmental work done? | Yes, we follow regulations and strategies, therefore is enough done. There is no hurry, one should not increase demands too quickly, it can generate problems for the contractors. As they put the highest demands in Sunda Hus it is not possible to reach further as the situation is today. |
| Who has the responsibility for reducing environmental impacts? | The respondent follows the strategies of the company and regulations. Responsibility for reaching further needs to be taken by the ones that develop environmental strategies, the experts. |
| Most influential factors for the environmental work | Owner directives, information from the environmental strategist and strategies of the company, together with the law is influencing the environmental work. The desire to use well-known techniques also influence the solutions used and the environmental work performed. |

Table 1-3: Interview 3 with Sustainability Strategist, MHC B

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| For the actor is environmental work comprising the following | Environmental work is to reduce operational negative environmental impact and operational energy use and to avoid hazardous building materials by working according to the tool Sunda hus and the certification scheme Svanen. It is also about supporting tenants to reduce their environmental impact by reduction of water use and household waste. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | Only the operational phase is being considered and the knowledge of the environmental impact from a buildings entire life cycle is low. Today only social and ethical, and no environmental, demands are put in the procurement process. |
| How well is environmental work integrated in normal practice | It is highlighted that environmental ambitions should be integrated in the business plan and not be a side track to the usual business. However, environmental work is still something which may not be prioritised when a lot needs to be done, which shows that it is not fully integrated. Also, even though environmental ambitions are integrated in the business plan they are not integrated in the normal practice. |
| Needed incentives and tools for an improved environmental work | Measurability and the possibility to follow up on goals are important for communication and for creating a movement. Different actors need to collaborate and profitable solutions need to be identified. Sufficiency solutions in terms of lifestyle changes are needed as efficiency solutions will not be enough to reach targets. |
| Is enough environmental work done? | No, more needs to be done and it will be difficult. The phrase in the best of worlds is used frequently and it is obvious that we are not there yet. There is a potential in the procurement process environmental demands could be formulated. |
| Who has the responsibility for reducing environmental impacts? | Regulations and political decisions are needed to steer the environmental work of the company. Also the company has responsibility as they can prerequisites for the tenants to have sustainable lifestyles. However, as it is being discussed that we all need to change, a lot of responsibility is put on the individual. |
| Most influential factors for the environmental work | The national and local environmental objectives, owner directives, the political will and local budget is influencing the environmental work. The importance of being backed up by goals and local authorities is highlighted. |

Table 1-4: Interview 4 with Environmental Project Manager, MHC B

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| For the actor is environmental work comprising the following | Environmental work for the respondent is prevention of hazardous materials with Sunda Hus and to be ready for future demands and regulations. Also carbon emissions, both caused by energy use and material production is mentioned. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | Embodied energy has not been considered yet, but discussions have started. LCA could be used for putting demands on certain products which are shown to have a big environmental impact and an opportunity in using it partly is seen. |
| How well is environmental work integrated in normal practice | The work of choosing the best solutions among conventional practice according to the strategies of the company seem to be integrated in normal practice. However, environmental work and collaborations which include finding new ways of doing things does not seem to be integrated. |
| Needed incentives and tools for an improved environmental work | More collaborations and unified demands are needed. It is also highlighted that not only the property owner but also the consultants need to have a holistic approach. Architects with deeper knowledge in environmental issues and sustainability is requested. E.g. architects with the ability to design buildings where no hazardous materials are needed. |
| Is enough environmental work done? | No, we need to reach further, put stricter demands and collaborate more. We need to build buildings which clarifies the challenges of our time. |
| Who has the responsibility for reducing environmental impacts? | Everyone has a responsibility and we need to work together, the city and the companies owned by the city. The private housing companies are doing what they want and take no responsibility. The purchasers have the power to influence, therefore they are the ones which have to take the lead. |
| Most influential factors for the environmental work | The property owner has the power to influence and develop the demands and by that the environmental work. The city has formed strategies which are influential. It is however the municipal housing company which has shown what is possible and by that influenced the developed strategies. A resistance towards new techniques also influence the solutions used and the environmental work performed. |

Table 1-5: Interview 5 with Project Manager, MHC B

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| For the actor is environmental work comprising the following | The use of material, energy efficiency, carbon dioxide emissions and the use hazardous substances in building material are mentioned as aspects which is being considered. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | Only the operational phase is being considered. The respondent believes that they work with LCA but when more questions about it are asked no answers are given. The understanding is low. |
| How well is environmental work integrated in normal practice | The environmental strategies of the companies seem to be well integrated in the work of the project managers, however a strategy of continuous improvement does not seem to be well integrated |
| Needed incentives and tools for an improved environmental work | A strategy and a standard seem to be needed to achieve something. |
| Is enough environmental work done? | Yes, they do what they can. For smaller renovation and maintenance measures they have standards and for bigger projects they make investigations. |
| Who has the responsibility for reducing environmental impacts? | No one in particular is mentioned as someone with more responsibility than someone else, but it is clear that the responsibility to reach further does not lie at the respondent. |
| Most influential factors for the environmental work | The strategies and standard used by the company are clear and influence the environmental work in the projects. Also there is the law and funding from national projects which steer and influence the work. |

Table 1-6: Interview 6 with Property Analyst, MHC B

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| For the actor is environmental work comprising the following | For the respondent are things which last over time, high quality and being thrifty closely related to environmental sustainability work. It is also highlighted that, in industry, environmental work is often equated with energy efficiency, recycling and certified buildings. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | No full lifecycle approach is being applied and the understanding of the environmental impact during a building's lifecycle is low. However, the ideas emphasised, that things should be built to last and that long term investments are needed, sort of adopt a lifecycle approach. |
| How well is environmental work integrated in normal practice | Environmental work is not well integrated in normal practice as it is related to trends. However, true sustainability is something you only achieve if it is a part of who you are, your way of reasoning and making long term decisions. It therefore needs to be integrated in every person's way of taking decisions. |
| Needed incentives and tools for an improved environmental work | A new type of thinking is needed in order to improve the environmental work. New economic models which make investments that last, and are sustainable, profitable. Pilot projects which can test new ideas, a long term thinking, thoughtfulness and collaborations between different actors are also mentioned as things which are needed. It is important that decisions can be motivated by results acquired from a model or knowledge generated by experiences and that suggested solutions are profitable. |
| Is enough environmental work done? | No, the quality of materials used today is not durable, it is not sustainable over time. |
| Who has the responsibility for reducing environmental impacts? | Regulations need to be formulated so that the right prerequisites are given and then it is up to the company to make long term investments and go for quality. It is everyone's responsibility to think long term. |
| Most influential factors for the environmental work | Economic models used and regulations affecting the possibilities to invest are influencing the environmental work performed. Also the mind-set is very important and steering for the environmental work. The fact that the tenant's association is rewarding material qualities in favour of building qualities is influencing the environmental impact of the buildings. |

Table 1-7: Interview 7 with Fastighetskontoret in Göteborg

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| For the actor is environmental work comprising the following | Environmental work is mainly seen as applicable for new buildings and then it comprises energy use, materials, construction and household waste management, handling of storm water and durability of installations. Also effect need is mentioned in relation to the environmental work, and the difficulties of getting housing owners to fulfil the effect demands are highlighted. Working with the existing housing stock is perceived as difficult and it is therefore leaved as it is with the exception of energy efficiency measures and reduction of hazardous substances. Ambitious environmental work is defined as reaching further than regulations and it is targets rather than the environment which is in focus. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | The market is not ready for demands on embodied energy and to consider other phases than the operational phase. If a lifecycle perspective is going to be applied a clear tool for it is needed. |
| How well is environmental work integrated in normal practice | Working with development of environmental plans the measures have taken over and the holistic view of the environmental impact is not well integrated in the work. E.g. the effect of the environmental impact reducing measures worked with are never questioned. |
| Needed incentives and tools for an improved environmental work | The only way to influence the existing housing stock is to work with the municipal housing companies. Solutions need to be profitable, possible to follow up on and new ways of doing things need to be motivated. If new demands are put, we need to know what we are doing and that the requirements are reasonable in order to preserve trust. In order to reduce the energy consumption efficiency solutions will not be enough and sufficiency solutions e.g. a change in lifestyle to reduce water use, are needed. Information is a good way to open up eyes for profitable environmental work and it is not until a financial gain can be seen that it gets interesting for the actors. |
| Is enough environmental work done? | No. In order to rise the ambitions tools and synchronised methods are needed. It needs to come from someone else, someone else need to create the conditions so that ambition levels could be raised without companies getting hurt. |
| Who has the responsibility for reducing environmental impacts? | We only provide advice and a remainder and it is not possible to control what the builders do, that is up to them. Information is seen as the key to increase environmental work and individuals are expected to take responsibility if they get the sufficient information regarding their opportunities. The existing housing stock is difficult to reach and it is only possible to influence and take responsibility for the municipal housing companies. For more ambitious work political decisions and stricter regulations would be required. |
| Most influential factors for the environmental work | Regulations are developed based on what is achievable by the producers and builders, e.g. only regulations which will be profitable to fulfil will be suggested as one does not want to harm the market or loose trust. Only things which are possible will be required, e.g. the fractions required for recycling of construction waste will be determined by the available space at the construction site. Also, which aspects that are worked with are based on and influenced by a general awareness. |

Table 1-8: Interview 8 with Stadsbyggnadskontoret in Göteborg

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| For the actor is environmental work comprising the following | The environmental work conducted is the follow up on operational energy demands according to BBR. To go further than regulations and building certifications schemes are seen as ambitious environmental work. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | The operational phase is the one considered in BBR and no lifecycle perspective is present. The respondent's knowledge and interest regarding the environmental impact from the building's entire lifecycle is low. |
| How well is environmental work integrated in normal practice | Low and they only demand what is required by the law. The environmental goals of the city are not integrated in their work. Even though they have the opportunity to give recommendations in line with the environmental programme of the city no strategy of how to do that exists. |
| Needed incentives and tools for an improved environmental work | Environmental work needs to be profitable and possible to follow up on. Information to housing owners about possible solutions is seen as a key. There are many technical aspects to consider, yet another one would maybe be too much, and it is therefore important that additional demands are integrated in the existing systems. |
| Is enough environmental work done? | There is no hurry to increase the environmental work. As they are following up on regulations they consider that enough is done. Opportunities to increase awareness of environmentally sound building is not used. |
| Who has the responsibility for reducing environmental impacts? | Regulations should not be too strict. They are minimum demands and reaching further is the housing owner's responsibility. They have no power to reduce environmental impacts, all they can do is following the law and then it is the responsibility of the individual to do more. It is also highlighted that the environmental authority maybe can do something. |
| Most influential factors for the environmental work | The law is the only influencing factor. The environmental strategies of the city could be influential, but they do not seem to be that. |

Table 1-9: Interview 9 with Miljöförvaltningen in Göteborg

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| For the actor is environmental work comprising the following | Environmental work is mainly seen as applicable for new buildings and for them the operational energy use has been the main focus. Regarding materials and chemicals are the opinion that more can more be done. For the existing housing stock, it is mostly energy use for the municipal housing companies which are mentioned. One aspect which is mentioned is the effect need of building and it is highlighted that the aspect is not considered to any great extent by housing owners. The formulated environmental goals at national and European level is the main focus, and reflection regarding the use of fulfilling the goals is not questioned. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | The operational phase has been the main focus. However, embodied energy of materials, and consideration of a building's entire lifecycle, is being discussed as a big area of development. |
| How well is environmental work integrated in normal practice | Environmental work is not well integrated. It is perceived as a choice and as something which is done in addition to normal practice. Something which can be left out when other priorities are perceived more important. Environmental impact reducing measures in other sectors, e.g. transport, are integrated in new areas to some extent, but not in the existing housing stock. Even though knowledge is perceived as important no strategy of how to gathering and increase knowledge exists. |
| Needed incentives and tools for an improved environmental work | As environmental work is a long process patience is needed. Everyone must realise that they need to change and adopt a new way of doing things. Pilot projects are a key as new things only are affordable in small projects. It is also important that environmental work is measurable and possible to follow up on. |
| Is enough environmental work done? | No, we constantly need to work on becoming better and developing new strategies. We all need to change. |
| Who has the responsibility for reducing environmental impacts? | Everyone needs to work together. Environmental goals and action plans developed are voluntary and meant to work informative. Through that a lot of responsibility is given to the individual to take the right decisions. The environmental act (Miljöbalken) could be used to demand a certain environmental performance of existing buildings. However, that possibility is not used as one does not want to regulate to that extent. |
| Most influential factors for the environmental work | Environmental strategies are developed according to what is possible to achieve and which ones that they have the possibility to affect. This lead to that the existing housing stock only is influenced in the municipal housing companies. The environmental work is also influenced by political ambitions, economical resources (e.g. national founding to certain projects) and the general awareness of different issues and aspects. |

Table 1-10: Interview 10 with Boverket

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| For the actor is environmental work comprising the following | Environmental work is including energy efficiency, hazardous substances and indoor air quality. New buildings seem to be the starting point for much of the work performed. |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | Today a more holistic perspective on environmental work is present, but it is however still the operational phase which has the main focus. A trend where the environmental impact from a building's entire lifecycle more frequently is being discussed can be seen. Applied lifecycle perspectives and LCA studies are increasing and discussion of how the approach could be used exist. It is highlighted that data and guidance are needed for LCA tools to be possible. |
| How well is environmental work integrated in normal practice | The awareness that environmental impacts need to be reduced is well spread, however the knowledge about what to do and how are in general low. It is investigated if environmentally adopted building laws could be a future possibility but so far is the only integrated environmental aspect energy use and indoor air quality. Only efficiency measures are seen as possible solutions and sufficiency measures are left out from the discussions. |
| Needed incentives and tools for an improved environmental work | New tools need to be adaptable with existing systems and tools. Knowledge is many times missing and information therefore needs to be spread within the sector. As the suggested solutions need to be profitable could a change in the financial preconditions be a good incentive. We should not rush and before a new instrument is initiated it is important that the consequences are well known. |
| Is enough environmental work done? | No, the speed needs to be higher. Enough environmental work is not done, a market failure is observed and policy instruments are needed in order to increase the environmental work. It also exists a discussion if we always do the things in the right way. E.g. instead of trying to make major renovations sustainable we should maybe avoid the major renovations in order to be sustainable. |
| Who has the responsibility for reducing environmental impacts? | Individual responsibility is highlighted and informative instruments are seen as the most powerful as it communicates that people are capable of taking their own decisions. However, the ones with knowledge are responsible to share that so that the individual can make the right decision and take responsibility. Sometimes regulations and market interventions are needed, however the law should leave room for interpretation and demands should not be too strict. This in order to avoid negative consequences for the market. |
| Most influential factors for the environmental work | EU-directives, governmental ambitions, general awareness and research are influencing the environmental work. EU-directives are not questioned and form the work to a large extent. |

2 Quantitative analysis of the interview findings

In Table 2-1 are the results from a quantitative analysis of the interview findings shown.

Table 2-1: Quantitative analysis of interview findings

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| For the actor is environmental work comprising the following | Energy use | 10 |
| | Toxic substances in building material | 8 |
| | Household waste (and recycling) | 4 |
| | Building certification schemes | 3 |
| | Long term thinking | 2 |
| | Carbon dioxide emissions | 2 |
| | Effect need | 2 |
| | Indoor climate | 2 |
| | <i>Mentioned one time: Ecosystem services, EMS, Material Production, EU-directives, Reaching further than regulations</i> | |
| Knowledge and understanding of the environmental impact and the life cycle perspective of a building | Operational phase | 10 |
| | No/low understanding of what it means to have a life cycle perspective (LCP) | 5 |
| | It is too difficult and complex to have a LCP | 3 |
| | The possibilities to have a LCP is discussed | 3 |
| | Mostly new buildings are considered even though the existing housing stock is being discussed | 3 |
| How well is environmental work integrated in normal practice | Well integrated in business plan but innovative environmental work is still separated from project management | 5 |
| | Aiming for integration | 4 |
| | Only integration of what is required by law | 2 |
| | <i>Mentioned one time: It needs to be a part of who you are</i> | |
| Needed incentives and tools for an improved environmental work | Profitable solutions | 7 |
| | Measurability and possibility to follow up | 5 |
| | Easy solutions / adaptable with existing tools and systems | 4 |
| | Tools which can motivate decisions | 3 |
| | Concrete examples/pilot projects | 3 |
| | Information and knowledge diffusion | 3 |
| | Lifestyle changes | 3 |
| | Collaborations | 3 |
| <i>Mentioned one time: Strategies/Standards, New economic models, A holistic approach, Long term thinking</i> | | |
| Is enough environmental work done? | Yes | 3 |
| | No | 7 |
| Who has the responsibility for reducing environmental impacts? | Housing owners / Individuals | 6 |
| | Municipal housing companies should be forerunners | 4 |
| | Political will and authorities developing environmental strategies | 5 |
| | Regulations | 3 |
| | A shared responsibility | 2 |
| | Someone else | 2 |
| Most influential factors for the environmental work | Environmental strategies and goals based on political will | 7 |
| | The law (regulations / building permits / BBR) | 6 |
| | General awareness / knowledge / gut feeling | 4 |
| | The desire to only use well-known techniques and solutions | 4 |
| | Funding from national and European projects | 2 |
| | What is possible to achieve by companies | 3 |
| | <i>Mentioned one time: Tenant association, Demands on the local environment, Economical models</i> | |

Environmental objectives in Sweden are very far from being met. A contributing factor to this might be that all viable measures to reduce the environmental impact from the housing and building sector are not being considered. This study shows that the current environmental practice within the sector focuses on a few aspects while several others are left out. Through an analysis of the current discourses, based on both a document and interview study, this rather one-eyed environmental approach has been identified. It is shown that these effects lead to that important aspects and possible measures are missed in the environmental work, and that this can be attributed to exclusionary effects caused by the overarching discourses. This study is not only guiding the reader through the environmental practice of the housing and building sector today by presenting current discourses and their effect, but it is also discussing the possible consequences of them.