Is there any space for compact housing in sustainable development? – Insights from Sweden

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Abstract

The Earth's population is steadily increasing and there is a fast growing urbanization as people move from rural areas to cities. Lack of housing is a big issue in many cities. At the same time, dwellings are growing in size demanding more land and natural resources, a development which is not sustainable in the long run. That is problematic as it occupies land and requires natural resources, which is not necessarily sustainable.

The aim of this study was to examine the prerequisites for compact housing in Sweden and whether it is a widespread phenomenon or not. Case studies were carried out in three 'sustainable' housing and city planning projects (BoKompakt, Hållbarheten and Brunnshög) and in-depth interviews conducted with responsible actors. The impact of the building regulations was also identified as an important issue and therefore Boverket, the Swedish Housing Authority, was included in the investigation.

The case studies show that it is more common to implement aspects like sustainable materials and energy efficiency rather than downsizing the dwellings in sustainable housing projects. When compact housing is considered it is mainly due to economical rather than ecological reasons. One obstacle for compact housing are the strict building regulations, BBR, and the requirements of accessibility. So far, the regulations have only been questioned for student housing. The conclusion is that compact housing is not especially widespread in Sweden but as the prerequisites are getting more supportive, it could hopefully spread more.

Acknowledgements

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1. Background

1.1. Problematisation

The Earth's population is steadily increasing and is expected to reach 9.7 billion by 2050 (UN, 2014). Currently, 54 percent of the world population is living in cities and this number is expected to increase to 66 percent by 2050 (UN, 2015). While an increasing number of people move from rural areas to cities, searching for better job opportunities and living conditions, the fast growing urbanisation is putting stress on already strained natural resources and ecosystems. The fast urban population growth also requires land for different uses but particularly for housing (Aggrey Daniel Maina, 2013).

A growing consumption is unavoidable as an increasing population needs material that inescapably requires production (Grimm *et al.*, 2008). Transportation, food as well as house building and demolition of houses are all having big environmental impacts. It has been known since the 1980s that the use of resources is unsustainable, but little has been done to reduce the problem (Tukker, Cohen, Hubacek & Mont, 2010).

In many Western countries, private house and apartment sizes have increased in the past sixty years. As size increases, more land is occupied and the energy consumption increases. In the United States, for instance, the average size of new single-family houses has more than doubled since 1950, even though the average family size has shrunk. More area, per family member, is being used than ever before and projections indicate that the trend will continue (Wilson & Boehland, 2005). As house size increases, the environmental impacts associated with buildings and development do so too. A great deal of attention is paid to material selection and energy detailing in creating environmentally friendly houses, but far too often, the important consideration of size is overlooked (Wilson & Boehland, 2005). Not taking

house or apartment size into consideration might become a problem in the future, especially if the urbanisation leads to overcrowded cities.

1.2. Purpose and Research Questions

As stated previously, it is well-known that material selection and energy use is of great importance when constructing housing in a sustainable way, but that little attention is paid to the impacts of size. Considering that, this qualitative study aims to investigate the prerequisites of compact housing and how common it is in the pursuit of sustainable development in a Swedish context. This will be done by examining the following research questions;

***RQ 1**: What are the prerequisites for compact housing in a Swedish perspective?*

***RQ 2**: How widespread is compact housing, as a sustainable measure, in Sweden?*

1.3. Scope

This thesis will mainly focus on downsizing homes and not on materials and energy use as these factors, in correlation with sustainability, are a lot more explored than the question of size.

Three different cases were selected in an attempt to reach a broad picture of sustainable housing measures and to investigate whether the size of dwellings is taken into consideration. Boverket, the Swedish housing authority, is also put in a central role and investigated due to the responsibility for building regulations in Sweden. The authority is therefore not considered a case study in the same way as the other three.

The requirements of the cases were that they should have built or planned for so-called sustainable housing in some way. Another requirement was variation which lead to a sustainable city district and dwellings for both students and other groups of tenants.

Compact housing/dwelling is frequently being used in this study as a term, and meant to cover housing less than 20 square meters (approximately 215 square feet) for single-person apartments and any separate housing less than 40 square meters (roughly 430 square feet).

1.4. Disposition

Chapter 1 presents background information, the aims and research questions. It also states relevant limitations.

Chapter 2 presents an introduction to sustainable housing and possible benefits.

Chapter 3 gives an introduction to the analytical framework used to analyse the findings.

Chapter 4 presents the research methods for data collection, methodological limitations and how the theory was used.

Chapter 5 presents the three case studies (BoKompakt, Brunnshög and Hållbarheten) followed by findings drawn from the investigation of Swedish housing authority Boverket.

Chapter 6 includes the analysis of the findings to evaluate potential implementation issues. It also seeks to answer the research questions.

Chapter 7 discusses the findings and gives considerations on the research methods and proposes topics for further research.

Chapter 8 presents key findings drawn from the research.

2. Introduction

This chapter shortly introduces sustainable development and the need for sustainable consumption. It concludes how compact housing contributes to that.

2.1. Benefits of sustainable housing

The concept of sustainable development first appeared on the international agenda around 30 years ago (Holden, 2004). The UN report entitled Our Common Future, also known as the Brundtland Report, pointed out that mankind now faces such major problems with respect to the depletion of, inter alia, natural resources that something must be done (WCED, 1987). The Brundtland Commission's standard definition of sustainability is to meet the needs, now and in the future, for human, economic, and social development within the restraints of the life support systems of the planet (Kates, Parris & Leiserowitz, n.d.).

Agenda 21, which is one of several follow-up reports to Our Common Future, states that environmental problems are being increasingly linked to the use of non-sustainable products and services. Efforts must be made on the consumer side to lead us onto a sustainable path (Holden, 2004).

Nevertheless, certain areas of consumption are more relevant than others when talking about physical planning and sustainable development. Housing is a key concept in this context (Holden, 2004). People living in single-family houses have a significantly higher housing consumption than people in all other types of housing. Second, the houses are generally larger in sparsely populated areas, which again influences consumption patterns significantly (Holden, 2004). Dense and concentrated housing design is one attribute that seem to produce the best results in reducing the ecological footprint (Holden,

2004). As we have greatest control of our circumstances in our own environments, housing is a good place to start (Hayles & Dean, 2015).

In a world with a rising population, resources currently taken for granted are becoming harder to obtain (Vale & Vale, 2009). Land is not a resource that can be increased, there is a fixed supply. It will, as a result, be essential to find ways to make the best use of the pre-existing built environment (Vale & Vale, 2009).

The footprint on housing could, according to Vale & Vale (2009), be eliminated by smaller houses and more sharing. Hagbert (2014) states that the last years have shown an increase in 'green' residential development in Sweden. It is, however, still a need to explore ways of living smaller, more together and in less material overflow.

It is evident that policy needs to steer this development and set the absolute limits on the amount of energy, material and land resources used in both new residential construction, as well as renovation of the existing housing stock. A key aspect is to shift the focus, one example being to explore resource use per capita rather than per square meter (Hagbert, 2014).

The interest for sustainability and compact housing looks to be growing and The Washington Post (2012) wrote an article on the subject tiny homes in the US:

> The small homes, some on wheels, don't warrant many trips to the Container Store. There are no kitchen islands, three-car garages or living rooms that are never lived in. In fact, their increasing popularity could be seen as a denunciation of conspicuous consumption and a rejection of the idea that more is, well, more (The Washington Post, 2012).

The Guardian brought up compact housing in 2014 and stated it looks the same in the US, a nation with large houses:

> Micro-apartments tricked out with scaled-down, adaptable furniture and decor could make urban dwelling more compatible with the way people increasingly live now – and help cities as they attempt to absorb more people in the future (The Guardian, 2014).

3. Analytical framework

In this chapter the analytical framework is presented. It is based on results from previous research on barriers to implement sustainable housing (section 3.1.) followed by why we do not see more of something considered good in section 3.4.

3.1. Barriers to implementing sustainable housing

The research presented is not a total review of all that has been made in the area but a selection of studies which are relevant and important for the investigation made in this study.

Winston (2010) states in the academic journal *Regeneration for Sustainable Communities? Barriers to Implementing Sustainable Housing in Urban Areas* that there are several different aspects of housing that might have negative environmental impacts. There are furthermore ecological limits to housing, for instance shortage of land and the use of non-renewable construction materials. Sustainable building and design techniques are required to reduce the non-renewable materials, increase the energy efficiency and utilize local sources of renewable materials. According to Winston (2010), demolition should, if required, recycle as much material as possible. He also suggests that construction on brown-field sites is a better option than on green-field sites.

Further, sustainable housing means different things to different people (Winston, 2010). One barrier to the implementation of sustainable housing is limited resources for the task. It is, however, not clear where resources should be targeted.

Winston (2010) is claiming that there seems to be limited knowledge and expertise in green building methods. There is also a high degree of scepticism among many relevant professional groups about the effectiveness of some of the green building measures (Winston, 2010). On the other hand, some local

authorities and housing associations have been incorporating green building methods into their housing as they mean that it makes both environmental and economic sense (Winston, 2010). Some professionals pointed out that it was difficult to reach an agreement when there were multiple stake holders involved.

The communication between different sections of a local authority is also described as a barrier (Winston, 2010). Issues like these must, according to Winston (2010), be addressed in order to reach an implementation of sustainable communities (see Table 1). There are problems concerning the negative attitudes and limited knowledge of sustainable construction methods and products.

Table 1. Selection of the most common barriers
Based on Winston (2010)

IMPLEMENTATION BARRIERS
Lack of conceptual clarity on nature of sustainable housing
Inadequate building regulations
Non-compliance with regulations
Negative attitudes to higher density and infill

Williams & Dair (2007) have conducted a study, *What Is Stopping Sustainable Building in England? Barriers Experienced by Stakeholders in Delivering Sustainable Developments*, based on five recently completed development projects in England. Their aim was to find out what had been achieved in terms of sustainability and identify barriers to the implementation of sustainable measures. Their results were similar to the ones presented in Winston's (2010) research (see Table 2). According to Williams & Dair (2007), there was a perception in England in 2003 that the progress in sustainable building was insufficient. There was an awareness of the sustainability issues to be achieved but a majority of the new developments in the country had incorporated few sustainability features (Williams & Dair,

2007). Even though there was a strong policy drive, it was not clear what was actually stopping sustainable developments.

Williams & Dair (2007) also found that one problem was that regulations prescribed 'minimum' standards rather than promoting the best practice in energy and efficient design and construction (Williams & Dair, 2007). The most common explanation for the lack of achievement of sustainability objectives was that they were simply not considered by the stakeholders involved. Sustainability issues were in fact never on the agenda (Williams & Dair, 2007).

Williams & Dair (2007) also showed that even though architects or developers wanted to incorporate sustainability features, it was not likely to happen if the clients did not show interest in the measures. There are established best practices in sustainable design but the study showed that regulators in many cases said that they lacked powers to enforce the best practice (Williams & Dair, 2007). It also appeared that sustainability objectives, when implemented, could conflict with one another. Further, Williams & Dair's (2007) study showed that one sustainability objective could get 'traded' in order to achieve another, just because one option was more desirable than the other.

In many other cases, stakeholders were unable to implement objectives that were sustainable due to the fact that the measures they proposed were not allowed or restricted by regulators (Williams & Dair, 2007). It was furthermore shown that stakeholders were keen on introduce sustainable measures, but with limited power to do so due to regulations. Stakeholders did also, in some cases, lack the information that they needed to make choices about which development options that would be more or less sustainable (Williams & Dair, 2007).

Table 2. Selection of the most common barriers
Based on Williams & Dair (2007)

BARRIERS TO ACTING SUSTAINABLY
Sustainability measure was not considered by the stakeholders
Sustainability measure was not required by client (purchasers, tenants and end users)
One sustainability measure was forgone in order to achieve another (traded)
Stakeholder lacked information, unawareness or expertise to achieve sustainable measure

3.2. Why do we not see more of something considered good?

Yang & O'Neill (2014) are, in their research, stating that compact and mixed-use urban development[1] have become a symbol of growth in the recent planning dialogue. Not least due to the thought to benefit a community economically, environmentally and socially (Yang & O'Neill, 2014). There is, however, no correlation between the number of compact and mixed-use projects and the enthusiasm that has been expressed in discussions (Yang & O'Neill, 2014).

According to Downs (2005) even places that actually embraces the idea seems to be doing more lip service than an effective implementation. That raises the question; if compact and mixed-use development is so smart, why don't we see more of it? (Yang & O'Neill, 2014; Downs, 2005). Several explanations have been offered to answer the question, e.g. developers' unwillingness to adapt to new market demand, planning and development

[1] Mix of housing, employment, education and recreational use in urban neighbourhoods

policies that discourage higher-density and mixed-use projects (Downs, 2005).

4. Method

The following chapter presents the methods used in the study. The sections 4.1. and 4.2. presents the mapping of the multiple case studies followed by a description of how the interviews were conducted. Method limitations are also presented as well as how the analytical framework was used to analyse the findings.

This study builds upon qualitative research due to the emphasize of words rather than numbers in the collection and analysis of data (Bryman, 2012; Maxwell, 2005). It is primarily this, in combination with the inductive approach and focus on specific situations and people, that gives the qualitative research its strength. This type of research is typically studying a relatively small number of individuals (Maxwell, 2005).

The qualitative research method has an inherent openness and flexibility which allows modification of the design and focus during the whole process (Maxwell, 2005). It is all about the understanding of the social world through an examination of the interpretation of the world by its participants (Bryman, 2012; Kvale, 1997).

4.1. A multiple case study approach

The case study is suitable when "*how*" and "*why*"-questions are to be answered in the study (Yin, 2009). It can involve single or multiple cases (Meyer, 2001). According to Yin (2009), single-case studies are vulnerable as they are not as robust as the evidence from multiple case studies. The number of cases should be few rather than many as there is a desire for depth (Meyer, 2001). Due to the possible difficulties of drawing conclusions and generalizations from single case studies (Eisenhardt, 1989; Meyer, 2001), a multiple case

study was chosen in this study to deepen the understanding of sustainable housing and the question of size.

Mixed methods are well suitable when conducting multiple case studies (Yin, 2009), in this study preferred as triangulation. It is a social research process that refers to the combination of two or more methods for increased validity allowing researchers to be more confident of their results (Yeasmin & Rahman, 2012). A combination of methods and data sources were combined in this study in order to address the objectives; case studies, interviews, literature review, webpages and publications.

4.2. Mapping the cases

It was of great importance to choose case studies that were considered relevant and could help answering the research questions. It was also necessary to deepen the knowledge of eventual examples of compact housing in Sweden. A new student housing project was therefore suitable. Furthermore, the supervisor gave the advice to include a city district in Lund and a housing project in Malmö. Both of them are profiled as 'sustainable' but on the other hand not too similar. It was never an intention to compare the cases, but to investigate how common downsizing is.

When the selection of cases was done, the question was whom to interview. It was considered best to interview the project leaders and managers (see Table 3) to get as much information as possible.

Table 3. List of interviewees

INTERVIEWEE & PROFESSION	PLACE OF WORK	PERFORMED
Eva Dahlman, project manager	Lund Municipality, Brunnshög	13th of October
Per Rosén, responsible for Monitoring & Evaluation	E.ON, Hållbarheten	16th of October
Magnus Cederberg, property development manager	AF Bostäder, BoKompakt	4th of November
Lena Hagert Pilenås, head of sustainable buildings and construction products	Boverket	10th of November

They were mapped easily as the names were often mentioned in the literature on the different projects. Having picked cases that are all within the boarders of Skåne (see Figure 1) was not planned in advance but felt natural as they were already known to either the author of this study, or the supervisor.

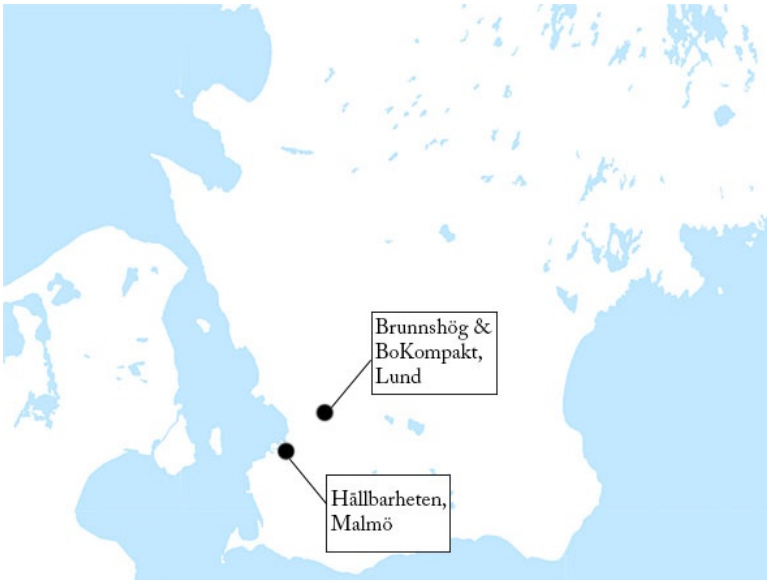

Figure 1. Map of southern Sweden and the locations of the selected cases

A literature review was conducted both before and after the mapping of case studies. First to get an understanding of the problem and secondly to gain deeper understanding of the selected case studies and to prepare interviews question on the information. Web pages, reports and scientific literature has been reviewed. The search tools LUB Search and Google Scholar were used searching for e.g. "sustainable future", "sustainable consumption", "sustainable housing" and "sustainable dwelling". This also showed to be useful when searching for a fitting analytical framework used to analyze the results.

4.3. Interviews

According to Kvale (1997, p. 97), you should "interview as many as needed to find out what you want to find out". It is, however, always important to make the interviewee feel comfortable enough to easily talk about experiences and feelings (Kvale, 1997).

The flexibility of the interview makes it attractive and probably the most widely employed method in the qualitative research (Bryman, 2012). It tends to be much less structured than in quantative research and there is an emphasis on the interviewees' own perspectives and point of view (Bryman, 2012). There are two types of frequently used interviews in the qualitative research; the *almost totally unstructured* and the *semi-structured interview* (Bryman, 2012). The second type was used in this study, namely four in-depth interviews. In-depth interviews were suitable as they provide detailed information about the interviewee's thoughts and behaviours (Kvale, 1997), which is also important for depth.

An interview guide is, as described by Bryman (2012), a list of questions or fairly specific topics to be covered during the interview. The questions do not have to follow the outlined way very strictly and things said by the interviewees may generate new questions that was not included in the guide from the beginning (Bryman, 2012). Due to that, four interview guides were created before the actual meetings. The reason for preparing more than one version was that the questions differed due to the differences among the interviewees and the need to 'custom make' questions suitable for each case. The base of the guides was although the same.

The interview guides (see Appendix 1 and 2) were made with intention to help direct the conversations towards the topics and issues that were important do discuss. The guides were asking about background information about the interviewees followed by questions that were categorized. The order of the questions was not always followed strictly and additional questions could pop up during the meeting, as the questions were of an open nature and allowed the interviewee to talk without any limitations.

Two interviews were conducted by phone and the other two were held in person. The interviewees were informed about the purpose of the interview

and it was recorded only if permission was given. Supporting notes were undertaken during the interviews in order to complement the recordings. The interviewees were given the opportunity to be anonymous if someone would prefer that. The spoken language during the interviews was Swedish but the used material was translated into English. The whole or almost the whole interviews were transcribed directly afterwards to ensure that nothing was forgotten. It is, as Bryman (2012) states, often encouraged that the interviewee 'rambles' which was allowed in the interviews. Although, e.g. laughs, coughs and repetitions were not included as that would not contribute to answer the questions. The raw material of the transcribed interviews was emailed to each of the interviewees as some of them mentioned that it would be valuable to make sure that the answers e.g. were not misunderstood.

The open answers of an unstructured interview have to be coded in some or another way (Bryman & Nilsson, 2011; Maxwell, 2005). Bryman & Nilsson (2011) argues that it is important to categorize the answers by grouping them into different categories. The given answers must often be read multiple times before the actual identification of themes. This was done by reading and rereading the raw data and underlining parts that were important to the study. Patterns were identified and tentative categories made based on that. The raw data was finally sorted under the created categories.

4.4. Method limitations

None of the interview guides were tested before the actual meetings, meaning that it was not confirmed whether the questions were easy to understand or if they could give enough sufficient responses. Semi-structured interviews were the most fitting method as they provided open answers. The answers were sometimes considered too broad and not relevant to the actual questions, even though 'rumbling', according to Bryman (2012), is encouraged. That was solved by asking the question yet again with other words or by repeating the answers and asking if it was the final answer.

Two out of four interviews were conducted by phone but the intention from start was to meet all of the interviewees in person. One of them had to reschedule due to a heavy workload and could therefore only help by phone. The interviews by phone went on as smoothly as they in person but it would have been a benefit to see the interviewees.

The interviews were, as stated, held and transcribed in Swedish. Transcription is a time consuming activity as known, but it would probably have taken even longer if not written in Swedish and after the coding and categorization translated in English. It saved a lot of time not translating every single word but the quotes and parts that would fit and be valuable. A disadvantage of translating the data is the risk of losing the value of expressions and terms that are not necessarily translatable.

4.5. How the analytical framework was used in the study

The qualitative research method in this study goes hand in hand with the inductive research approach (see Figure 2). It was developed after data had been gathered and patterns were clear. An inductive approach was suitable as it was not clear from start which theory to use (Blackstone, 2012). With a focus on the goal, an analytical framework was grounded on the data (the case studies and Boverket).

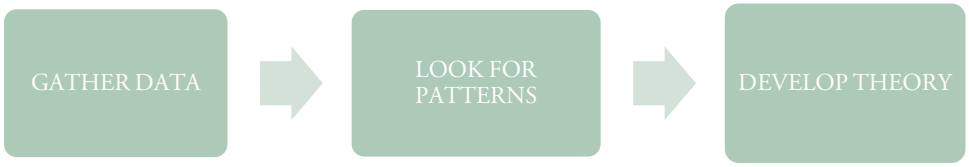

Figure 2. The inductive research approach
Based on Blackstone (2012)

The selection of research findings that forms the base for the analysis serves as the part commonly called 'theory' or 'theoretical framework' (Bryman, 2012).

Finding a theory that perfectly explains the relation between housing size and sustainability was not an easy task and especially not in the very beginning of this process. The solution was to start with gathering data and after conducting the transcriptions categorize it in order to see patterns. It then felt natural to build an analytical framework on possible problems with implementation of sustainability measures in the housing sector. Even though the presented research has a broader scope than just downsizing, it was nevertheless fitting as the problems still could be the same.

The research presented in the analytical framework was conducted in England and Dublin but is although not different to Swedish implementation issues. Several barriers were discussed in the research but mainly the most common and relevant ones were used in the framework.

Additionally, research discussing why we do not see more of something considered positive was added.

5. Findings

This chapter presents the results of the selected case studies (BoKompakt, Brunnshög and Hållbarheten) and whether or not downsizing is implemented as a sustainability measure. Finally, the result of Boverket is also presented.

5.1. Case Studies

5.1.1. BoKompakt

BoKompakt (see Figure 3) is a student housing development project situated in Lund, described as Sweden's "smallest and coolest housing" (AF Bostäder, n.d.). It is developed and owned by AF Bostäder (AFB); a foundation that provides student accommodation in Lund. The aim of the project is to challenge the current building regulations in order to build housing of high quality and lower rents by cutting down the size significantly (AF Bostäder, n.d.).

The apartments have a wood frame construction and plenty of smart energy saving solutions. The size of the apartments are as follows; 16 apartments for single households of 10 square meters (108 square feet), four apartments for two persons of 20 square meters (215 square feet), one apartment for three persons of 30 square meters (323 square feet) and one for four persons on 40 square meters (430 square feet). The development project received economical support from Delegationen för hållbara städer (The delegation for sustainable cities) and an exemption from the building regulations for not being accessible for wheelchairs (AF Bostäder, n.d.).

As the apartments are considerably smaller than what is common, the traditional furnishing has given way to new smart and environmental friendly solutions that are permanent. There is also a lot of simple storage and several open shelves (AF Bostäder, n.d.)

Figure 3. The exterior of housing project BoKompakt's apartments in Lund
Picture source: BoKompakt, AF Bostäder

5.1.2. Brunnshög

The new city district Brunnshög in Lund (see Figure 4), is planned in direct connection to the international research facilities ESS and MAX IV. The expansion time is estimated to take 40 years and as many as 40 000 people will be able to live and work in the area when completed (Dahlman, personal communication, October 13, 2015). The vision is to make the district one of the world's leading research and innovation environments, inter alia by being a European model for sustainable urban planning (Hållplatsen, 2013).

There are several sustainability goals for the new district of Brunnshög and the principles to minimize the environmental impact and to conserve the high quality agricultural land are included in these
(Hållplatsen, 2013; Lunds kommun, 2015). The district will be densified but it does not seem like compact housing is included in the sustainability vision.

Figure 4. City district of Brunnshög in northern Lund
Picture source: Business Port, September 26 2015

5.1.3. Hållbarheten

E.ON[2] wants to take the next step into the future of sustainable housing and to investigate which aspects that work, and which ones that do not work. Hållbarheten is, as a result of that, a dwelling with a test system meant to measure and control energy use (Rosén, personal communication, October 16, 2015). It is, stated by E.ON (2013), Sweden's most advanced one. Figure 5 shows the house that is energy-smart and holding eight apartments (E.ON, 2013).

Due to the special features, all tenants had to apply if interested to live in the new testing apartments and they were also required to be interested in technology and the environment. They must also test all the features and answer questionnaires (E.ON, 2013; Rosén, personal communication, October 16, 2015).

Each apartment is equipped with over 50 measurement points that provides information on temperature and consumption of electricity. The intention is to let the tenants control and be in charge of their personal consumption (E.ON, 2013).

All the solutions are meant to be tested by the tenants and developed to become more frequently used in future housing, as an effort to build a sustainable city (E.ON, 2015a). The smallest apartments are 115 square meters (1238 square feet) big and the biggest 130 square meters (1399 square feet) (Rosén, personal communication, October 16, 2015).

[2] E.ON provides the Nordic market with energy in form of electricity, gas, heating, cooling and waste treatment and energy-related services (E.ON, 2015b)

Figure 5. Exterior of Hållbarheten in Västra hamnen, Malmö
Picture source: Hållbarheten i Västra hamnen, E.ON

5.2. Boverket

The Swedish National Board of Housing, Building and Planning[3] is a central government authority assorted under the Ministry of Enterprise and Innovation (Boverket, 2015). The field of activities is regulated by a general instruction issued by the Swedish parliament (Boverket, 2015). Boverkets main fields of activities are to; analyze the housing market, issue building regulations and supervise the town and country planning (Boverket, 2015).

Boverket is working to stimulate the development of a sustainable society by a proactive work based on knowledge and expertise given from the citizens. The work with sustainability is dealt with by mainly working broadly with living conditions (Boverket, 2014b).

As in charge of construction and housing, there are several regulations as well as a building code. The last contains mandatory provisions and general recommendations which have to be followed when building and constructing. The regulations depend on what is built or altered. The building regulations of Boverket are called BBR[4] (Boverket, 2014a). The BBR's are very comprehensive but one part; *Accessibility, dwelling design, room height, and utility rooms* is in strong relation to dwelling size. Not everything is relevant to this study, like regulations according, for instance public buildings, but the regulations in BFS 2011:26 on dwellings are definitely of relevance:

> "Dwellings with a residential area greater than 55 square meters (592 square feet) shall be designed to suit the number of people for which they are intended. However, they shall always have room for a double bed in at least one room or a separable part of a room for sleep and rest".

[3] Boverket in Swedish
[4] Boverkets byggregler (2011:6) – föreskrifter och allmänna råd

> "Dwellings with a residential area of not larger than 55 square meter (592 square feet) shall be designed in accordance with their size. However, in these dwellings it is sufficient that either the room for sleep and rest, or the room with fittings and equipment for cooking is separable. They do not need to have space for a double bed".
>
> "In individual dwellings for students or young people with a residential area of not larger than 35 square meters (377 square feet), the room for everyday social contact, the room for sleep and rest, or the room with fittings and equipment for cooking do not need to be separable. If dwellings for students have separable parts of rooms for cooking, the separable parts do not need to have windows facing the open. For a group of students or young people, the individual dwelling with fittings and equipment for cooking and for everyday social contact and space for meals, or parts thereof, may be grouped into communal spaces. In cases where the room with fittings and equipment for cooking is shared, no more than 12 dwellings may share it. The communal spaces shall be large enough and adequately equipped to ensure they provide reasonable compensation for the limitations in the individual dwelling".

The meaning of these regulations is to ensure that dwellings are not too crowded and to reassure that people with impaired mobility can access them too. People having impaired mobility might need wheel chairs (both in- and outside wheelchairs) and the accessibility requires enough wheelchair turn space.

6. Analysis

In this chapter the findings are analysed in an attempt to answer the research questions. Section 6.1. seeks to answer whether there are prerequisites for compact housing in Sweden and section 6.2. how widespread it is.

6.1. Prerequisites for compact housing?

This section seeks to answer the Research Question 1: *What are the prerequisites for compact housing in a Swedish perspective?*

Compact housing is in fact a growing issue as housing shortage is increasing in Sweden. Drawn on that, the Swedish government is willing to take action and come up with measures that could increase the construction of housing meant for students and young persons (Boverket, 2013). The government has also asked Boverket to propose changes in the regulations in order to stimulate this development (Boverket, 2013; Hagert Pilenås, personal communication, November 10, 2015).

Section 5.2. showed not much of possibilities for compact housing except from the regulations regarding individual dwellings for students and young people. It is not longer a must to have separated areas for different activities (BFS 2011:26; Hagert Pilenås, personal communication, 2015) which in theory could make it easier to downsize. Another considerable change is that residences up to 35 square meters (377 square feet) no longer need to include washrooms as they can be moved out to common areas, like kitchens and other functions for socializing. Moving bathrooms could reduce the size of a single room with 3 square meters (32 square feet) (Boverket, 2013).

As Holden (2004) argues, effort has to be made on the consumer side if ever to lead us to a sustainable path and changes like these underway is most likely to push that in the right direction.

An explanation to why all changes are concentrated to student and youth housing is that this kind of housing only lasts for a limited time of life (Hagert Pilenås, personal communication, November 10, 2015; Cederberg, personal communication, November 4, 2015). It is also very likely that it will become easier to turn already existing construction into student housing, which is probably saving resources. The accessibility requirements will not change as Boverket (2013) argues that disabled students should be able to participate in student activities like everyone else and not feel excluded.

It is evidently challenging to combine accessibility and compact housing, but as Hagert Pilenås (personal communication, November 10, 2015) puts it, even new technology could help facilitate that:

> "I heard the other day that wheelchairs have started to get developed with a Segway method that could reduce the need of space significantly. It would mean that one can turn around on the spot, so to speak, and make it possible to build smaller without affecting the accessibility". (Hagert Pilenås, personal communication, November 10, 2015)

Research is showing that people living in single-family dwellings are responsible for a higher consumption than others in all types of different housing (Holden, 2004), and that there is a need to be open to explore different ways of living smaller. It is not necessarily good enough just to consider materials and energy efficiency (Hagbert, 2004). That is, however, not easy if not allowed and without small dwellings available.

It is without any doubt very positive that Boverket is already starting to consider smaller homes, not least as it would be hard to implement for others if the housing authority itself was not willing to direct towards such a development. The knowledge is probably getting stronger as time goes and hopefully among constructors, planners and other relevant groups. Winston's (2010) study, however, shows that some professionals felt that it was difficult to reach an agreement on sustainability measures when multiple stakeholders were involved. The communication among the groups could sometimes also

be seen as a barrier and the same problems could become reality in Sweden. It, not least, necessary that Boverket communicates in a straight and forward way. Interested and relevant stakeholders should not have problems understanding and reaching desirable information.

It is clear that Boverket has begun to broaden the look at other aspects of sustainability. The economic aspect is currently interesting and important:

> "The starting point, so to speak, for Boverket and the national building regulations, was more focused on social sustainability by putting citizens in centre. No one should be at risk; nor by toxic materials or fire. But then we came to the burdensome point where we are right now and the current situation… how the situation looks right now... with housing shortage. Due to that, we have to start thinking about the economic sustainability. We must produce housing for students that they can afford. It is harder than you might think to change this, it is not a fast process. It is useless having building regulations if nobody can afford". (Hagert Pilenås, personal communication, November 10, 2015)

Hagert Pilenås (personal communication, 2015) acknowledges that the three aspects of sustainability could collide and that is precisely what the economic and ecological is doing right now. Fortunately, it is possible to combine both of them and the economy would be favoured if that was not possible. The combination is possible due to smaller housing and cut rents. A bonus is that less land and resources are needed:

> "That is really how it started… if someone should be able to afford to live there… in these expensive areas, then it is natural to build smaller and to consider how to use the square meters in the smartest way". (Hagert Pilenås, personal communication, November 10, 2015)

Winston (2010) showed that 'green building methods' have been incorporated in housing projects due to the discovery that it made both environmental and economic sense, that would most probably never had happened without the economic profit:

> "The building regulations for example requires space enough for a full family but we do know that this has changed and that single households are increasing. The driving force in this is indeed often economical because land prices are so high and people would of course also want to live in cities. It is therefore an economic force but as I have said, compact housing is also good for the environment. It had been worse if the two aspects were in conflict with each other". (Hagert Pilenås, personal communication, November 10, 2015)

The quote above is interesting since it really states how severe the current situation is and even forcing Boverket as an authority to adapt.

The Swedish prerequisites for compact housing seems to grow bigger in the near future. It has been a slow progress but the reasons are well described in Winston's (2010) and Williams & Dair's (2007) studies. One interesting aspect is that Boverket, responsible for housing regulations, as an authority actually transforms in that sense. The future might be hard to predict but BoKompakt is one clear example of downsizing that is popular. Compact housing as an idea is somewhat a new way of thinking in a Swedish context.

There is no expressed lack of clarity regarding sustainable housing in Sweden since green measurements have been adopted (Hagbert, 2014), but it could mean different things too different people (Winston, 2010) and some might see downsizing as a measure while some do not. There is, however, a consensus among the interviewees that higher density is necessary, in contrast to Winston's (2010) results.

It is not unusual, according to Yang & O'Neill (2014), that something that sounds promising in theory never gets fulfilled in practice and only time can tell how this will evolve.

6.2. Widespread or not?

This section seeks to answer the Research Question 2: How widespread is compact housing in Sweden?

AFBs experiment BoKompakt is the only case in this study that clearly focused on downsizing the dwellings. It is certainly making the experiment quite unique in a Swedish context. The ideas of Brunnshög and Hållbarheten are more concentrated on other measures of sustainability, not least materials and energy efficiency (Rosén, personal communication, October 16, 2015; Dahlman, personal communication, October 13, 2015). That is normal in this kind of construction but not enough according to Hagbert (2014).

Architects were hired to help make Brunnshög and Hållbarheten sustainable and the fact that downsize never was an option could depend on lack of information on how size contributes to that (Williams & Dair, 2007).

Even though AFB promotes the experiment as 'sustainable', it was actually not an intention from the beginning as the matter mainly was to cut the rents by making the dwellings smaller. The fact that it could qualify as sustainable could be seen as a bonus and nothing else (Cederberg, personal communication, November 4, 2015). The downsizing additionally made it easy to make the dwellings energy efficient.

Cederberg (personal communication, November 4, 2015) is making clear that BoKompakt is a development project and that AFB do not see it as they have found the one future solution for student housing. One motivation is to learn more about the consequences of building smaller and if it is possible to obtain sufficient quality of accommodation on such small areas. The following quote speaks for the small opportunity that made the project possible:

> "There is a clause in the planning and building regulations saying that you can get an exemption from the building regulations if you have a 'specific reason' which we felt that we had with the current housing situation and the difficulties of finding a solution for students with limited finances". (Cederberg, personal communication, November 4, 2015)

There is a broad consensus among both Boverket and AFB that student housing is suitable for downsizing due to its nature of a temporary accommodation. Requirements of accessibility seems, however, not to be affected by the changes in regulations as it is important not to exclude anyone (BFS 2011:26). It is not necessarily an obstacle in student housing since toilets e.g. can be moved from the rooms allowing more space to be saved.

Another reason for making the dwellings of BoKompakt so small was the fact that resources, costs, rent, energy consumption was planned per person and not per square meter. That is a substantial difference according to Cederberg (personal communication, November 4, 2015) and also an obstacle in the regulatory framework. Everything is built around square meters as that is considered the most practical solution (Cederberg, personal communication, November 4, 2015). Hagbert (2014) is also arguing that focus should be moved from resource use per square meters to resource use per capita as a way of saving resources and avoiding unnecessary consumption.

A lot has been done in order to make the dwellings not feel like cells. It is of great importance that they are experienced and felt as a thoughtful and good housing (Cederberg, personal communication, November 4, 2015). It is probably helping the students to cut down their consumption which according to Holden (2004) and Hagbert (2014) is necessary for a sustainable future. That is probably a result either or not the students want it or not as they simply can not consume as much due to the lack of size.

> "I do not think that planners and constructors plan to build sustainable housing in order to be environmental friendly in the first place. It is more common to do it in order to reduce costs, and then maybe call it sustainable too". (Dahlman, personal communication, October 13, 2015)

Brunnshög is another case featured in this study and not just one housing project, but a planned city district. The developers are in charge of determining how large and how many the apartments will be. They are now, due to the shortage of housing and high construction costs, considering young professionals as tenants (Dahlman, personal communication, October 13, 2015) hopefully meaning than they will be smaller if to be afforded and sustainable in that matter too:

> "To construct a giant apartment and call it energy-efficient is not especially sustainable". (Dahlman, personal communication, October 13, 2015)

Dahlman (2015, personal communication, October 13, 2015) argues that construction costs are adversely affected by the housing size. The really expensive areas are kitchens and bathrooms and if they have a larger percentage in a small housing, which they normally do due to accessibility, it could get really expensive because of the high percentage.

E.ON wanted to fit eight apartments in Hållbarheten and received a proposal from an architect that called him self a 'sustainability architect'. The size of the apartments was included in the proposal and nothing that E.ON had an impact on. E.ON's aim was mainly to build a house where the users easily could monitor and control their energy from an app. The over all focus was on trying to make the complex parts steerable and on creating the app (Rosén, personal communication, October 16, 2015).

The tenants are high income-earners and a question is how it had turned out if the apartments were given to others and holding 16 apartments instead of just eight. The tenants all said that they were interested in sustainability and want to live sustainably, but were actually not prepared to make some sacrifices (Rosén, personal communication, October 16, 2015):

> "They are families and it seems like other things in life are more important, making it interesting to ask yourself how students engaged in environmental issues would have acted". (Rosén, personal communication, October 16, 2015)

Rosén (2015) is in other words also mapping students as a suitable group for this kind of experiment, but without knowing if they would behave in a more sustainable way than the families did. A lower income could of course have an impact.

The case studies conducted in this study shows that compact housing is not especially widespread at all, not even among sustainable housing projects. The cases are build upon examples that are new constructions but as land definitely not is a resource that will increase, it is stated by Vale & Vale (2009) that it will be essential to look over pre-existing built environment and

not only paying attention to new construction, something that Boverket also considers.

Williams & Dair (2007) claimed that sustainability measures were unlikely to be incorporated, even though developers and architects wanted to, if the clients did not show interest and it is quite clear that either Brunnshög nor Hållbarheten were planned to be projects of compact housing. Other measures were 'traded' over the matter of size, if ever considered, and this is probably due to both Boverkets regulations, BBR, and the fact that it is not as desirable as the much more common material selection and energy efficiency. It could also be linked to Winston's (2010) argument that it is not unusual that relevant professional groups are sceptical about the actual effectiveness of downsizing as a measure.

7. Discussion

This chapter discusses the results, the research methods and proposes further research ideas.

7.1. The results

Living small is not for everyone, not least due to changes in the building regulations that only affects student housing. There is nothing really saying that other individuals or groups would not like to downsize if they had the opportunity. Students are not necessarily the only ones in need of affordable housing and other groups also need to reduce their ecological footprints. We all need to contribute to sustainable development, regardless who we are. Although it is true that student accommodation is a temporary form of housing (Cederberg, personal communication, November 4, 2015; Hagert Pilenås, personal communication, November 10, 2015), it could be an advantage to consider permanent housing as well. Young people are often facing difficulties to even to enter the housing market in the large cities in Sweden. It is therefore quite natural to imagine smaller housing as a way to solve or at least reduce the problem.

Housing types are normally based on the traditional family constellation in the suburbs; man, wife and their children. The modern society has changed a lot since then. The number of single-person households have increased rapidly in Swedish cities (SCB, 2012). Boverket is aware of that shift and is currently investigating the matter as housing has not kept pace with the speed of change (Hagert Pilenås, personal communication, November 10, 2015).

Hopefully, that would motivate the construction of smaller homes instead of large dwellings with three or four bedrooms.

Hagert Pilenås (personal communication, November 10, 2015) stated that changes, like the ones underway, takes a lot of time to implement. It is also of great importance to communicate the changes to all relevant groups, e.g. in the housing sector, in order to avoid misunderstandings.

Dahlman (personal communication, October 13, 2015) argued that bathrooms and kitchens are the functions in dwellings that are the most expensive to produce. The smaller the dwelling is, the higher is the percentage of these functions as they need to be accessible. That is not a good condition for lower rents. Boverket's idea to place bathrooms in the shared areas with other functions, as kitchens, is probably only an option in student's dorms and not all students are living in shared accommodations. Shared bathrooms is furthermore intruding on student's personal life as the private areas are getting smaller. If that is necessary, considerations on design gets more important.

Both Cederberg (personal communication, November 4, 2015) and Hagbert (2014) stress that there are some problems connected to resource use per square meters rather than per capita. It is e.g. leading to unnecessary space that is most likely not used anyway. It will be interesting to see if Boverket considers this in the near future when overlooking the changed patterns in people's living situation. However, this will presumably be a slow process.

BoKompakt is an example of compact housing that is successful in making the inside space cosy and not feeling like cells (Cederberg, personal communication, November 4, 2015). It is not more complicated than just cutting down space and making it more efficient. If we want to build in a more sustainable way, saving both land and other resources is absolutely essential, as well as not taking everything for granted (Vale & Vale, 2009).

A number of barriers to implement sustainable measures, including compact housing, have been addressed in this study. Several of them applies to the Swedish situation as well. An interesting and major difference is in fact the change for student housing in BBR. Without this change, downsizing would not be possible at all. The motivation is, unfortunately, more of an

economic than ecological nature but the most important is that the two of them are possible to combine.

There were not much of prerequisites for compact housing just a couple of years ago. Even if the BBR is adjusted to the present composition of the households in new construction and reconstruction, it does not necessarily mean that the old housing stock is compact either. It is probably the opposite due to the history of families.

Urbanization brings several challenges to a head. One of them is to make space for all people seeking for opportunities in the cities. The density will likely increase whether we want it or not and it could be hard to obtain all this without compact housing.

Some of the interviewees called large apartments, despite energy efficiency, less sustainable and that is clearly indicating that size matters and needs to be considered. 'Hållbarheten' is only one example of housing projects that have been designed in a sustainable way, but although confirming that bigger space needs more energy for heating – how sustainable is that?

The spread of compact housing has a strong link to the prerequisites. Previously, it has not been allowed to build tiny houses but the changes will hopefully pave the way for more than just student housing, as the benefits are crucial for a sustainable future. Boverket as an authority determining the building regulations should be more proactive in the future and not only support projects that are not challenging the regulations.

7.2. Thoughts on the research methods

It is difficult to make general conclusions from this study as a too small number of sustainable housing projects were investigated. The results can, however, still give an indication which is meaningful too.

In-depth interviews were very suitable as a way to gain deeper understanding of what sustainable housing actually means and why it is important. Moreover, it was a very effective way to find out more about the interviewees thoughts on downsizing.

If more housing projects had been investigated, a survey could have been a fitting way to examine the questions since that would save time and effort.

7.3. Further research

It would be interesting to examine the attitudes that young Swedes have regarding the idea of compact housing and living small. This study shows that young persons are targeted in first hand and the question is if the group is positive or negative to that. It is possible that some would experience it all like a constraint while others actually could appreciate it, not least if there is a willingness to reduce the ecological footprints. It is, in addition, also interesting to cover other groups and their interests – as an incentive for Boverket to consider them as well.

Furthermore, as this study could indicate that downsizing is not especially common or widespread in Sweden, it could be interpreted that there is a knowledge gap. E.g. materials and energy efficiency are, in comparison, popular measures that are traded, probably due to more available and understandable information. Downsizing must be measured in a way that is concrete. The benefits of both materials and energy efficiency might be much more apparent than of downsizing. An easy possibility to somehow motivate the positive effects to relevant groups that are e.g. negative or lack expertise, like calculations of reduced carbon dioxide might be necessary.

8. Conclusions

This chapter will present the main findings drawn from this study.

The prerequisites appear to change thanks to the alterations in Boverket's building regulations, but it is a slow process and it is so far only affecting student housing. The temporary accommodation is a main reason for Boverket to only focus on students.

Compact housing is not widespread in Sweden according to this study. Other sustainability measures seem to have been traded, since downsizing was never even an option, and the accessibility requirements are another natural reason.

When downsizing occurs, it is primarily motivated by economic sustainability. The environmental, on the other hand, is seen more as a welcome bonus.

The future of downsized housing is, although, getting brighter – there is space for compact housing in a sustainable development. The urbanization will presumably force Boverket and other professional groups to consider downsizing if desired to accommodate all people. It is stated that the amount of single-households has increased and both Boverkets building regulations and construction has to adapt to that.

9. References

AF Bostäder. (n.d.). *BoKompakt*. Retrieved October 12, 2015 from https://www.afbostader.se/lediga-bostader/bostadsomraden/bokompakt

Aggrey Daniel Maina, T. (2013). Impacts of Urbanization On Land Use Planning, Livelihood and Environment in The Nairobi Rural-Urban Fringe, Kenya. *International Journal of Scientific & Technology Research* Volume 2, Issue 7, 2013.

BFS 2011:26 – BBR 19. *Boverkets föreskrifter om ändring i verkets byggregler (2011:6) – föreskrifter och allmänna råd*. Karlskrona: Boverket. Retrieved December 2, 2015 from http://www.boverket.se/globalassets/publikationer/dokument/2012/bbr-engelsk/bfs-2011-26-eng-avsnitt-3.pdf

Blackstone, A. (2012). *Principles of Sociological Inquiry – Qualitative and Quantitative Methods*. University of Maine, 2012.

Boverket. (2013). Förslag på regeländringar för fler bostäder åt unga och studenter. Karlskrona: Boverket.

Boverket. (2014a). *Building regulations*. Retrieved October 1, 2015 from http://www.boverket.se/en/start-in-english/building-regulations/

Boverket. (2014b). *Så bygger vi ett hållbart samhälle*. Retrieved October 1, 2015 from http://www.boverket.se/sv/om-boverket/boverkets-uppdrag/var-vardegrund/

Boverket. (2015). *About Boverket*. Retrieved October 4, 2015 from http://www.boverket.se/en/start-in-english/about-boverket/

Bryman, A., & Nilsson, B. (2011). *Samhällsvetenskapliga metoder*. Malmö : Liber, 2011 (Spanien).

Bryman, A. (2012). *Social research methods*. Oxford : Oxford University Press, 2012.

Downs, A. (2005). Smart Growth: Why We Discuss It More than We Do It? *Journal of the American Planning Association* 71 (4): 367.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4), pp. 532-550.

E.ON. (2013). *Experimentglada hyresgäster sökes till E.ONs smarta hus i Malmö.* Retrieved, October 5, 2015 from http://www.mynewsdesk.com/se/eon/pressreleases/experimentglada-hyresgaester-soekes-till-e-ons-smarta-hus-i-malmoe-825560

E.ON. (2015a). *Västra hamnen - en del av ett hållbart samhälle*. Retrieved September 30, 2015 from http://www.eon.se/om-eon/Om-energi/Hallbara-initiativ/Vastra-Hamnen/

E.ON. (2015b). *Om företaget*. Retrieved October 2, 2015 from http://www.eon.se/om-eon/Om-foretaget/

Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X. & Briggs, J. M. (2008). Global Change and The Ecology of Cities. *Science,* (5864). 756-760.

Hagbert, P. (2014). *Interpreting the sustainable home. Bridging discourses on home and sustainability in the housing sector*. (Doctoral thesis, Department of Architecture), Chalmers University of Technology. Available: http://publications.lib.chalmers.se/records/fulltext/197668/197668.pdf

Holden, E. (2004). Ecological footprints and sustainable urban form. *Journal Of Housing & The Built Environment*, *19*(1), 91.

Hayles, C., & Dean, M. (2015). Social housing tenants, Climate Change and sustainable living: A study of awareness, behaviours and willingness to adapt. *Sustainable Cities And Society*, *17*35-45. doi:10.1016/j.scs.2015.03.007

Hållplatsen. (2013). *Betatestprojekt: Brunnshög*. Retrieved October 14, 2015 from http://hallplatsen.nu/2013/09/betatest-brunnshog/

Kates, R., Parris, T., & Leiserowitz, A. (n.d). What is sustainable development? Goals, indicators, values, and practice. *Environment*, *47*(3), 8-21.

Kvale, S. (1997). *Den kvalitativa forskningsintervjun*. Lund : Studentlitteratur, 1997 ; (Lund : Studentlitteratur).

Lunds kommun. (2015). *Brunnshög*. Retrieved October 6, 2015 from http://www.lund.se/Medborgare/Bygga-bo--miljo/Stadsbyggnadsprojekt/Brunnshog/

Maxwell, J. A. (2005). *Qualitative research design : an interactive approach*. Thousand Oaks, CA : Sage Publications, cop. 2005.

Meyer, C. B. (2001). A Case in Case Study Methodology. *Field methods 13*, pp. 329-352.

Post, R. (2014, August 25). Are tiny houses and micro-apartments the future of urban homes? *The Guardian*. Retrieved December 14, 2015 from http://www.theguardian.com/sustainable-business/2014/aug/25/tiny-houses-micro-living-urban-cities-population-newyork-hongkong-tokyo

Statistiska Centralbyrån (SCB). (2012). *Ensamstående utan barn är Sveriges vanligaste hushåll*. Retrieved December 15, 2015 from http://www.scb.se/sv_/Hitta-statistik/Statistik-efter-amne/Befolkning/Befolkningens-sammansattning/Befolkningsstatistik/25788/25795/Behallare-for-Press/367855/

Tukker, A., Cohen, M. J., Hubacek, K., & Mont, O. (2010). The Impacts of Household Consumption and Options for Change. *Journal of Industrial Ecology*, *14*(1), 13-30. doi:10.1111/j.1530-9290.2009.00208.x

United Nations (UN). (2011). *Sustainability and Equality: A Better Future for All*. New York: United Nations. Retrieved September 5, 2015 from http://www.undp.org/content/dam/undp/library/corporate/HDR/2011%20Global%20HDR/English/HDR_2011_EN_Complete.pdf

United Nations (UN). (2014). *World's population increasingly urban with more than half living in urban areas*. Retrieved September 5, 2015 from http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html

United Nations (UN). (2015). *World population projected to reach 9.7 billion by 2050*. Retrieved September 5, 2015 from http://www.un.org/en/development/desa/news/population/2015-report.html

Vale, R., & Vale, B. (2009). Footprinting urban form and behaviour in New Zealand. *Architectural Science Review*, *52*(4), 254-260. doi:10.3763/asre.2009.0071

Wax, E. (2012, November 27). Home, squeezed home: Living in a 200-square-foot space. *The Washington Post*. Retrieved November 8, 2015 from https://www.washingtonpost.com/lifestyle/style/home-squeezed-home-living-in-a-200-square-foot-space/2012/11/27/e1a02858-2f35-11e2-ac4a-33b8b41fb531_story.html

Williams, K., & Dair, C. (2007). What Is Stopping Sustainable Building in England? Barriers Experienced by Stakeholders in Delivering Sustainable Developments. Sustainable Development 15.3: pp. 135-147.

Wilson, A., & Boehland, J. (2005). Small is Beautiful: U.S. House Size, Resource Use, and the Environment. *Journal of Industrial Ecology*, *9*(1/2), 277-287. doi:10.1162/1088198054084680

Winston, N. (2010). Regeneration for Sustainable Communities? Barriers to Implementing Sustainable Housing in Urban Areas. *Sustainable Development* 18.6: pp. 319-330.

WCED. (1987). *Our Common Future*, The World Commission on Environment and Development, Oxford University Press.

Yang, Y. & O'Neill, K. (2014). Understanding factors affecting people's attitudes toward living in compact and mixed-use environments: a case study of a New Urbanist project in Eugene, Oregon, USA. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability, 7:1, 1-22*, DOI: 10.1080/17549175.2013.827585

Yeasmin, S., & Ferdousour Rahman, K. (2012). 'Triangulation' Research Method as the Tool of Social Science Research. *BUP JOURNAL, Volume 1, Issue 1,* September 2012, ISSN: 2219-4851

Yin, R. K. (2009). *Case study research : design and methods*. London : SAGE, cop. 2009.

Appendix 1: Interview guide, Boverket

Interviewee background
What is your role at Boverket?
How long have you been working there?

Sustainability in general
What is Boverket's attitude towards sustainable building (in comparison with 'conventional' building)?
What does sustainable building mean to you?
Why is sustainable construction, according to you, important?

Compact housing
What is compact housing, according to Boverket?

Is Boverket, as an authority, interested in compact housing?

If densification is necessary in the future, would that mean more of compact housing? How does that work with the BBR's and accessibility requirements?

How do you think that the future construction will look like?
Is downsizing a part of sustainable construction?
If lower rents are desirable – are smaller space part of the solutions according to you? Are there other ways to cut down the rents?

Compact housing typically requires less material – what are your opinions regarding that (in a society where less resources is encouraged)?

Are there prerequisites for compact housing in Sweden? How do they look?

Why is it not more common? / How common is it?

BoKompakt

What is Boverket's opinion regarding the BoKompakt project? Could AFB build more apartments if the evaluation is positive?

Could you give a dispensation for more projects of this type, and not only for student housing?

AFB considers that compact housing is suitable for students due to the short duration, but could other groups live on the same space?

Could the regulations (BBR) change/be more flexible/to make it easier to downsize?

Are there similar building regulations in other countries?

Appendix 2: Interview guide, Brunnshög

About the interviewee
What is your role in the project?
How long have you been part of the project?

Sustainability in general
What is sustainable building, according to you (in comparison with 'conventional' building)?

Why is sustainable building important?

Project background
How did the idea about Brunnshög come up?
What is the purpose / aim with Brunnshög?
What makes the project sustainable (what criteria's have been fulfilled?)?
Are any contractors involved (which demands were required)?

Size
Is downsizing a criterion for sustainability?
If yes: in what way?

Are you considering the size of apartments in Brunnshög?
If yes / no: how / why / why not?

Is the construction cost affected by housing size?
In what ways?

Is housing size affecting the consumption of energy, materials and housing prices?

Is it common to downsize due to sustainability reasons?
If no: why is it not more common?
If yes: in what way? total area? only some areas?

Are there associations between densification and downsizing?
Should downsizing be taken into account more often in the future?
Why / why not? How?

Building materials
Is sustainability an aspect you take into account when selecting building materials in the process?
If yes / no – in what way / why / why not?

Energy
Are any energy saving measures taken into account (both during construction and in the premises?)?
If yes / no – in what way / why / why not?

Other
Is the outcome of the project evaluated in some way?

Is there anything else you would like to add?

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