Sharing Sustainability

The concept of sharing in collaborative housing for more sustainable cities

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Abstract

Recent societal developments, as well as environmental problems like global warming, demand more socially, environmentally, and economically sustainable lifestyles and dwellings. Collaborative housing describes a possible path to meet those demands by sharing spaces and goods. To determine how the concept of sharing in collaborative housing can contribute to more sustainable cities, the following research question is posed: 'How does the concept of sharing in collaborative housing increase the sustainability of cities?'. It is explored, what the theoretical and practical impacts of sharing in collaborative housing on social, environmental, and economic sustainability are. These questions are answered by an explorative literature review and by studying two cases of collaborative housing in Vienna in detail. Collaborative housing as an umbrella term for different types in the research context is explained, as well as the scope of sustainability within the work. Furthermore, the concept of sharing is introduced in the context of collaborative housing. The findings from literature and the collaborative housing projects are reviewed for their possibility to make urban living, and therefore cities, more sustainable. Sharing in collaborative housing serves as a catalyst for more sustainable cities, not only by its presence, but also as role model and experimental space for housing and urban development projects.

Keywords: collaborative housing, sharing, urban development, social, environmental, economic sustainability

Preface

This is the final report on the graduation research that marks the end of my life as a student at TU Delft. An exciting future ahead, I would like to reflect on how my journey led me here.
I began studying architecture in Regensburg, Germany, because I loved how many architects combine the beautiful with the practical. For me, a good design incorporates the aspects of aesthetics, use, technology, sustainability, culture and society into a whole which delights humans by its overall beauty. An exciting adventure began during which I could learn professional skills, grow personally, and gain practical experience. This broadened my horizon by excursions, studying abroad, and listening to inspiring persons and so, I got increasingly curious about the wider context in which architectural designing is placed.

The journey led me to Delft, a charming Dutch small town with a renowned university that offers a master study program called Management in the Built Environment. During this stage, I was provided that broader perspective that I was seeking, started applying my skills during pro bono work, and established a lot of inspiring contacts. For my graduation, I had the chance to focus on two issues of my very personal interest: affordable homeownership and the question of how to treat our environment more cautiously. I hope that you find this report on sharing in collaborative housing as interesting as I found writing it and that you get excited to learn more about how sharing might benefit you personally.

Like during all journeys, there were ups and downs on my way to where I am today, and I am thankful for all challenges and rewards. Any trip involves 'coming home' after some time. In this sense, I will slow down my pace, unpack my luggage, and prepare for the next adventure. I am looking forward to a future in project management in urban area development and I am excited for this journey to start.

My gratitude goes out to all survey respondents, but especially to all interviewees of both projects. They generously shared their experience and helped me fill in knowledge gaps and took pictures of the spaces. I highly appreciate this extraordinary effort.
Thank you to my supervisors for accompanying me on the journey, and all the dear ones that showed interest in my work and supported me with their prayers. I was not alone in this.

It remains to wish you a pleasant time reading!

Annalena Meixner
Delft, 18. June 2020

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Reading Guide

This work consists of six chapters of which chapters. The following paragraphs give a brief outline of the chapters and their content.

CAUSE

INVESTIGATION

DELIVERY

Chapter 1
The introduction confronts the reader with the problems that led to the research questions. Furthermore, it displays the scientific and social relevance of the topic and the research limitations. Finally, the research output, personal study targets and the graduation outline are shown

Chapter 2
Methodology and research design are being elaborated on in this chapter in three parts. First, the research design is being explained, which afterwards leads to the methodological approach for the theoretical framework and the empirical research. Here, the method of case studying is being explained.

Chapter 3
This chapter concerns the theoretical framework of the research. It is structured into four main points of interest: collaborative housing, sustainability, sharing and the impact to be measured. The chapter is concluded by a synthesis that serves as the necessary input for the empirical research.

Chapter 4
As introduced by the previous section, this chapter contains the empirical research. The case studies are being described in the remainder of the chapter by their characteristics, and the individual study design. The study findings are displayed in this chapter and synthesized in the end.

Chapter 5
Here, the cross-case analysis can be found, which relates the findings of both case studies to each other and draws conclusions thereof by using the assumptions derived from literature and relating the findings to the urban context.

Chapter 6
Chapter six concludes the thesis work and discusses the main findings. Here, recommendations can be found for further research, future development and the people of collaborative housing communities. The chapter ends with a reflection on the work.

Executive Summary

The Concept of Sharing in Collaborative Housing for more sustainable Cities.

Introduction

Sustainability in all forms is one of the challenging topics of current times. The 17 Sustainable Development Goals for 2030 by the United Nations General Assembly in 2015 manifest the global urgency for more sustainable behaviour of the human population (United Nations, 2019).
In research, collaborative housing (CH) usually has a positive notation regarding social inclusion, affordability, and environmental sustainability while there may be downsides as exclusivity, gentrification and economic risks for residents as well (Lang et al., 2018). Many of those communities do not only share spaces, devices and tools but also share meals, communal responsibilities and administrative tasks within their community. Such aspects have a direct and indirect influence on the social, environmental and economic sustainability of collaborative housing projects (Daly, 2017; Lang et al., 2018; Williams, 2005b).
The following chapters summarize the master thesis on sharing practices in collaborative housing in theory as well as in practice by studying two cases in greater detail.

To determine how the concept of *sharing* in collaborative housing can contribute to more sustainable cities, the following research questions are considered.
Research question B is based on the findings answering Research question A and the assumptions thereof. Question C considers the findings of B, relates them back to A, and positions them within the urban context.

How does the concept of sharing in collaborative housing increase the sustainability of cities?

> **A: What are the theoretical impacts of *sharing* in collaborative housing on social, environmental, and economic sustainability?**
>
> **B: What are the practical impacts of *sharing* in collaborative housing on social, environmental, and economic sustainability according to Viennese case studies?**
>
> **C: What effects of *sharing* in collaborative housing impact the sustainability of cities in a positive way?**

Sharing in the context of this research regards the sharing of spaces and goods within collaborative housing exclusively. It is investigated, how the internal sharing practices contribute to the sustainability of the community.
Collaborative Housing is defined according to individual selection criteria, due to the huge variety of overlapping terms and concepts. To be considered for the study, a community must be intentional and have a strong focus on the community. Furthermore, it must consist of autonomous housing units, as well as shared spaces and facilities. It is investigated how the sharing practices impact the sustainability of the collaborative housing project in the local context of Vienna, Austria.
The **sustainability** is being assessed in three-fold: social, environmental, and economic. For the feasibility of the empirical research, the concepts are cut down to focal areas. The research investigates how the sustainability of the community is impacted by the practice of sharing.
The **city** refers to an urban area that forms the major metropolitan centre of a region. This thesis focuses on the sustainability of projects in urban areas that possibly increase the sustainability of the city by their existence within the city boundaries, and on how the concept could be relevant in different contexts.

Theoretical framework

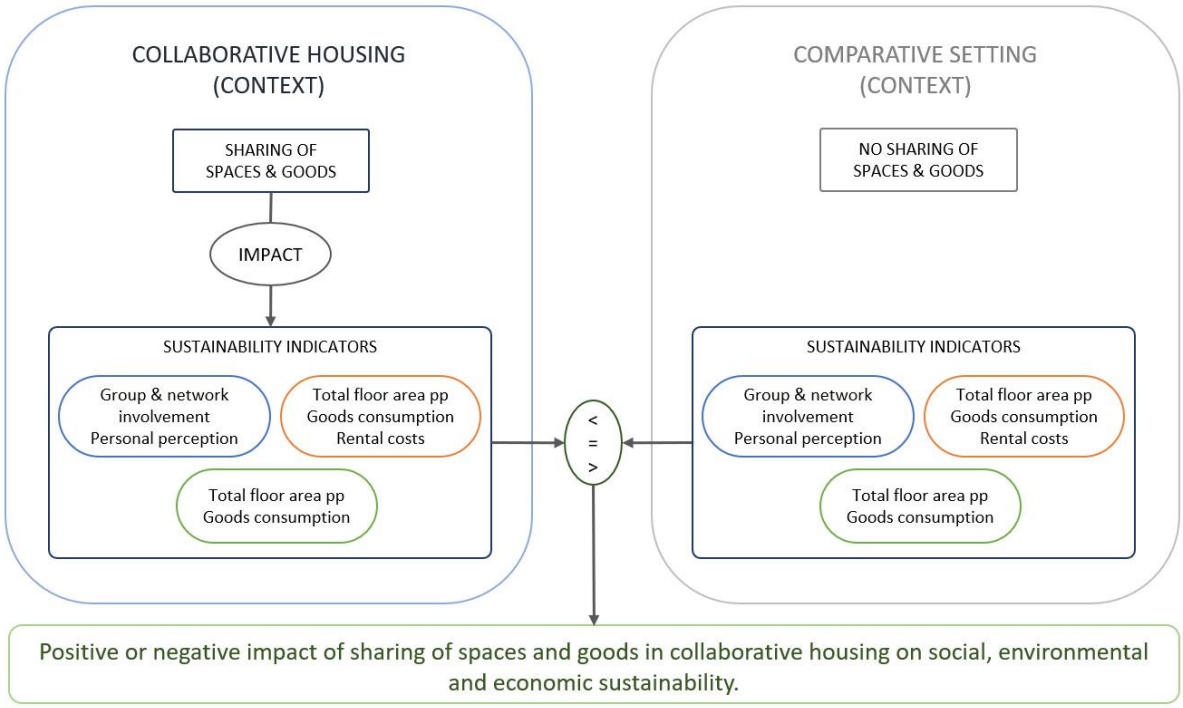

Figure 12. Theoretical framework II (own ill.)

Figure 12 shows the theoretical framework derived from the literature. Essentially, the cases of collaborative housing are explored for the impact of sharing on their sustainability, by comparing them to an alternative situation in which the sharing of spaces and goods is not practised.

The theoretical framework is based on the literature review on collaborative housing, sustainability, sharing, and the measurement of sustainability within CH communities. The subjects listed in the coloured shapes in Figure 12 are derived from literature and serve as the focus points throughout the empirical part of the research project.

In theory, sharing has positive, as well as negative effects on the sustainability of collaborative housing communities. Overall, the positive consequences seem to be predominant.

Methodology

Starting by initial desk research on the background and relevance of the topic, an exploratory literature review is carried out on the topics of collaborative housing types and the specific types that are of relevance for this research. This is complemented by exploring the idea of sharing, and the concept of social, environmental, and economic sustainability in collaborative housing and how those factors influence each other positively or negatively.

After exploring the existing theory and conducting a pilot case study, two exemplifying case studies are carried out to answer the research questions from a practical viewpoint. The case studies utilize document reviews, group interviews, and a resident survey to discover the impact that sharing has on the sustainability of contemporary CH communities. The two cases that match the selection criteria and responded to the researcher's contact approach are the Baugruppen Pegasus and LiSA in Vienna's 22nd district Seestadt Aspern.

A cross-case analysis links the findings of both cases back to literature and put in the context of the city to formulate the overall conclusions.

Empirical Research

Both studied cases are located in Vienna's 22nd district Seestadt Aspern, which is currently under development. The residents of both communities moved in in 2015 and collaboratively share spaces and goods to certain extents.

The case studies showed that sharing impacts the social, environmental, and economic sustainability of collaborative housing communities both, in a positive and negative way. The findings for each focus point differ between the case studies.

The cross-case analysis focused on the positive effects of sharing on the sustainability of cities. The main points are as follows:

Sharing **promotes frequent and intimate interactions** through group participation, which increases social capital and therefore social sustainability. Sharing spaces and goods efficiently can reduce consumption and consequently costs.

Conclusion and Recommendations

Sharing can impact the social, environmental, and economic sustainability both, in a positive and negative way, dependent on the sharing efficiency. The sustainability of cities can be increased by effective sharing measures within CH communities. Furthermore, collaborative housing projects showcase possibilities of sharing and test their impact on sustainability in practice. Lessons can be drawn for the urban context by looking at the experiences on the community scale. For implementing sharing practices in other residential projects or at the urban scale, the citizen's understanding and participation are essential.

The community members and their behaviours change over time. It is therefore interesting to conduct studies like this on a regular basis with particular CH projects.
On top of this, it is recommended to relate the scale of existing housing communities to bigger scales and determine how the small-scale experience might be used beneficially.

For future urban development, sharing should be implemented purposely. Existing practices, like in collaborative housing, should be considered role models for further development. Regarding overall sustainability, the developed infrastructures must be flexible and adaptable since the needs of users change over time.

CH communities should take on the challenge to improve their sustainability performance by efficiency of sharing. This could be done by making the topic part of the priorities and carefully weighting benefits and downsides of new ideas. Residents are advised to share their experiences with sharing.
Furthermore, it is advised to prevent social exclusion by catching up with your neighbours and making sure that everyone can get involved in some activity. Support each other's initiatives, take on responsibility for the shared spaces and goods, and encourage others to do the same.

1 Introduction

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1. Introduction

The 17 Sustainable Development Goals for 2030 by the United Nations General Assembly in 2015 manifest the global urgency for more sustainable behaviour of the human population (United Nations, 2019). The set goals address the global sustainability issues regarding people, planet, prosperity, peace and partnership. The human population worldwide spends most of the time inside buildings and the majority of this time at home. This indicates that the built environment has a huge impact on human behaviour and therefore on the sustainability of cities, particularly on the social, environmental and economic aspects.

In research, collaborative housing (CH) usually has a positive notation regarding social inclusion, affordability, and environmental sustainability while there may be downsides as exclusivity, gentrification and economic risks for residents as well (Lang et al., 2018). Considering that many scientific authors are collaborative housing residents or –activists themselves, especially calls for critical views on the impact of social housing. Scholars like Williams (2005b) mention design factors, operational structures, and resident groups that enhance social interaction within Cohousing[1]. On the other hand, Czischke (2017) found not only 'social inclusion' but also 'affordability' as benefits of collaborative housing, while Daly (2017) focuses on the lower environmental impacts. There are several characteristics of collaborative housing that potentially make those new ways of housing more sustainable than conventional models. One of them is the concept of 'sharing'. Many communities do not only share spaces, devices and tools but also share meals, communal responsibilities and administrative tasks within their community. Such aspects have a direct and indirect influence on the social, environmental and economic sustainability of collaborative housing projects (Daly, 2017; Lang et al., 2018; Williams, 2005b). This master thesis researches the sharing practices in collaborative housing in theory as well as in practice by studying two cases in greater detail. In this way, it is determined to what extent these housing types actually are more sustainable than traditional types, and it is investigated how the concept and practice of sharing potentially could increase the sustainability of housing, neighbourhoods, urban areas, and cities (Figure 2).

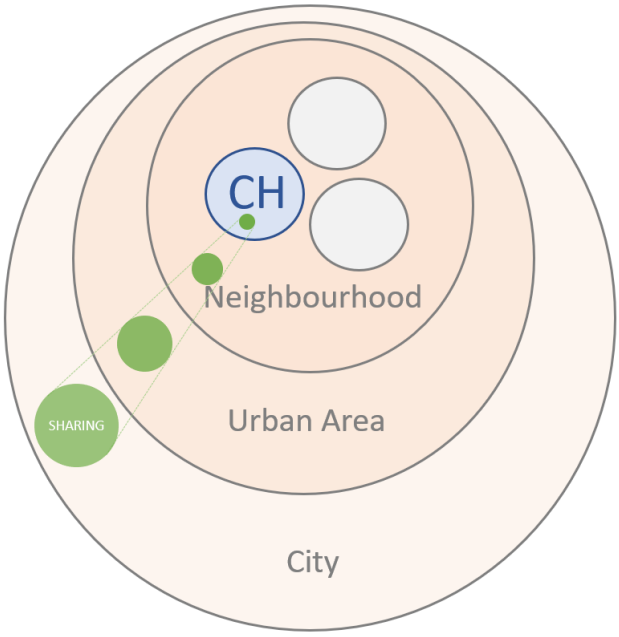

Figure 2: Conceptual position of 'sharing' in collaborative housing in the urban context (own ill.)

1.1 Problem Statement

Despite the obvious relevance and significance (see below), it remains unclear what the effects of sharing in collaborative housing on sustainability are.

[1] Williams (2005b) Defines *Cohousing* in a way that is translated to *Collaborative Housing* in this research: 'Cohousing combines the autonomy of private dwellings with the advantages of community living. It has private units, semi-private space, indoor and outdoor communal space. It is built at low, medium and high densities and in a variety of layouts and locations, thus communities are very diverse. Communities can be new build or retrofit. The design and processes operating in cohousing encourage a "collaborative" lifestyle and greater interdependence between residents. Thus, the signature characteristic of Cohousing is its strong and vibrant communities'

1.2 Research Questions

To determine how the concept of *sharing* in collaborative housing can contribute to more sustainable cities, the following research questions are considered. Questions A to C build up on each other and aim at answering the main question.
Research question B is based on the findings answering Research question A and the assumptions thereof. Question C considers the findings of B, relates them back to A, and positions then within the urban context.

How does the concept of sharing in collaborative housing increase the sustainability of cities?

> **A: What are the theoretical impacts of *sharing* in collaborative housing on social, environmental, and economic sustainability?** (Page 32)
>
> **B: What are the practical impacts of *sharing* in collaborative housing on social, environmental, and economic sustainability according to Viennese case studies?** (Page 61)
>
> **C: What effects of *sharing* in collaborative housing impact the sustainability of cities in a positive way?** (Page 71)

1.2.1 Question Delimitation

The terms *sharing, collaborative housing, and sustainability* are being defined in the section *Theoretical Framework* (page 17).
Sharing in the context of this research regards the sharing of spaces and goods within collaborative housing exclusively. It is investigated, how the internal sharing practices contribute to the sustainability of the community.
Collaborative Housing is defined according to individual selection criteria due to the huge variety of overlapping terms and concepts. To be considered for the study, a community must be intentional and have a strong focus on the community. Furthermore, it must consist of autonomous housing units, as well as shared spaces and facilities. It is investigated how the sharing practices impact the sustainability of the collaborative housing project.
The **sustainability** is being assessed in three-fold: social, environmental, and economic. For the feasibility of the empirical research, the concepts are limited to focal areas, as explained in section *2.4 Impact and Measurement*. The research investigates how the sustainability of the community is impacted by the practice of sharing.
The **city** refers to an urban area that forms the major metropolitan centre of a region. This thesis focuses on the sustainability of projects in urban areas that possibly increase the sustainability of the city by their existence within the city boundaries.
The **theoretical** impact is being assessed through an explorative literature review. The purpose is to determine from existing research and other literature, whether and how sharing in CH possibly impacts its sustainability.
The theoretical framework provided, the **practical** impacts of sharing on the sustainability of a CH community is assessed by examining CH projects according to the set focal areas.
Positive effects of sharing are achieved by efficient sharing practices within the community.

1.3 Limitations

The considered literature for this research includes not only collaborative housing in Europe but also from the United States. The specific exemplifying cases that will be studied in the empirical part of this thesis exclusively focus on Viennese projects, due to language constraints and the scope of the research. To gain appropriate insights to answer the research questions, the focus is set on one particular city. The outcomes cannot be generalized for the entire European CH sector, or a bigger scale. The examined cases need to comply with the requirements set in chapter *2.1 Definition and local Context of Collaborative Housing*. Sustainability in the context of this thesis is only viewed as its social, environmental and economic aspects, as explained in chapter *2.2 Definition and Scope of Sustainability in Collaborative Housing (page 20).*

1.4 Relevance

1.4.1 Scientific Relevance

Research in the field mostly focuses partially on social, environmental or economic aspects within co-housing communities (Lang et al., 2018). The relationship between these three kinds of sustainability and the urban area scale is examined rarely. Tummers (2016) states that, partly due to the lack of verifiable quantitative data, it remains unclear whether co-housing initiatives contribute to socially coherent and healthy cities. After researching the measurable environmental factors of some intentional communities, Daly (2017) states that the field offers lots of research opportunities concerning the ecological and social aspects of intentional communities. Williams (2005a) mentions the need for further research on the economic costs and benefits of living in different forms of CH as well as for solutions to the conflict between social cohesion and inclusion in CH communities. Finally, Jarvis (2011) stresses that collective housing[2] and its role for a more sustainable future should not only be prioritized for further research, but also in future planning and policy.
This research does not exclusively focus on sustainability but also on how the sharing of spaces and goods influences it. In the context of Sharing Economy and Collaborative Consumption, sharing is a very current topic, intersecting with other fields like the internet or urban planning (Agyeman et al., 2013; Belk, 2013; N. M. Davidson & Infranca, 2016; Teubner, 2014; Wahlen & Laamanen, 2017).
Research on collaborative housing in the context of Austria is not yet extensive due to the usual focus on social housing in general like large-scale housing cooperations, and furthermore, it often focuses on a small area in the field, like on 'Baugruppen', only (Lang & Stoeger, 2018).

1.4.2 Societal Relevance

The societal relevance of the sustainability aspect of this thesis topic is obvious by the amount of attention that climate change and sustainability currently attract, partially through the 'Fridays for Future' movement and activists like Greta Thunberg. Other societal and economic issues like loneliness and affordability of housing further depict the demand for more social, environmental and economic sustainability of the housing sector. Furthermore, cities nowadays do not only lack the desired 'neighbourhood unity' but also face environmental and economic challenges like change and crises (Delendi, 2017). Overall, the new driving forces behind collaborative housing are 'affordability' and 'inclusion' (Czischke, 2017). All those issues might be solved through more sustainable ways of housing and followingly more sustainable lifestyles. The relevance of sustainability manifests in the Sustainable Development Goals (SDGs) for 2030 set by the United Nations General Assembly in 2015 (United Nations, 2019). The relevance of sharing in today's context becomes obvious if one considers the sheer amount of ideas, concepts and businesses like Airbnb, Uber, Zipcar, Swapfiets or eBay, that appeared during the recent years. Teubner (2014) concludes by stating that ‚sharing meets the pulse of the time' and that the evident benefits should drive politicians to actively support it.

[2] Jarvis uses the term collective housing as the 'North American model of purpose-built cohousing' which is considered a type of collaborative housing.

The scientific and societal relevance of collaborative housing, sharing and sustainability are therefore undoubted. This thesis contributes to the field of research by providing an understanding of the concepts and giving indications of how the concept of sharing could foster more sustainable housing and cities.

1.5 Research Process

1.5.1 Goal, Objectives, and Target Group

The goal of this research is to receive and provide more insight into the possibilities for sustainability in housing. The possible target group consists of private persons, as well as of policymakers, real estate investors and developers. To reach the primary goal, several objectives are considered. Firstly, the contemporary concepts of collaborative housing and sustainability are being explored and then related to the impact of sharing in this specific context. Based on those theories, the real-life practices are being consulted according to their application, absence, or potential melioration. Since housing not only regards the unit level but often originates from a context of bigger-scale visions, regulations, and plans, it is worthwhile to investigate the possible impact of sharing on the sustainability of urban areas. This is the third and last objective that illustrates the possibilities for more sustainable cities.

1.5.2 Personal Study Targets

My motivation for studying the impact of sharing in collaborative housing on social, environmental and economic sustainability and how this can possibly increase the sustainability of cities derives from the current significance of two topics: More sustainable lifestyles of individuals and new forms of living. My personal goal is to understand both areas more and especially, to understand their relationships and interdependencies and how they might complement each other. I hope to achieve this through critically reviewing both areas and relating them through the practical aspect of sharing.

1.5.3 Coaching

To reach the mentioned goals and targets, I am supported by two mentors from Delft University of Technology. My first mentor is Darinka Czischke from the faculty of Architecture and the Built Environment, department Management in the Built Environment. Her main area of research is Housing Management which includes extensive experience in collaborative housing. Secondly, I am mentored by Yawei Chen from the Department of Management in the Built Environment, researching on Urban Development Management.

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2 Theoretical Framework

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2. Theoretical Framework

The theoretical part of answering the research questions is built on some assumptions. The sustainability of collaborative housing is impacted by diverse factors, one amongst which is sharing. Through a literature review, it is investigated whether sharing possibly impacts the sustainability performance of collaborative housing communities in a positive or negative way. The comparative situation is a setting that does not promote sharing, why sharing is practised to a much lesser extent than in the collaborative housing cases (see Figure 3).

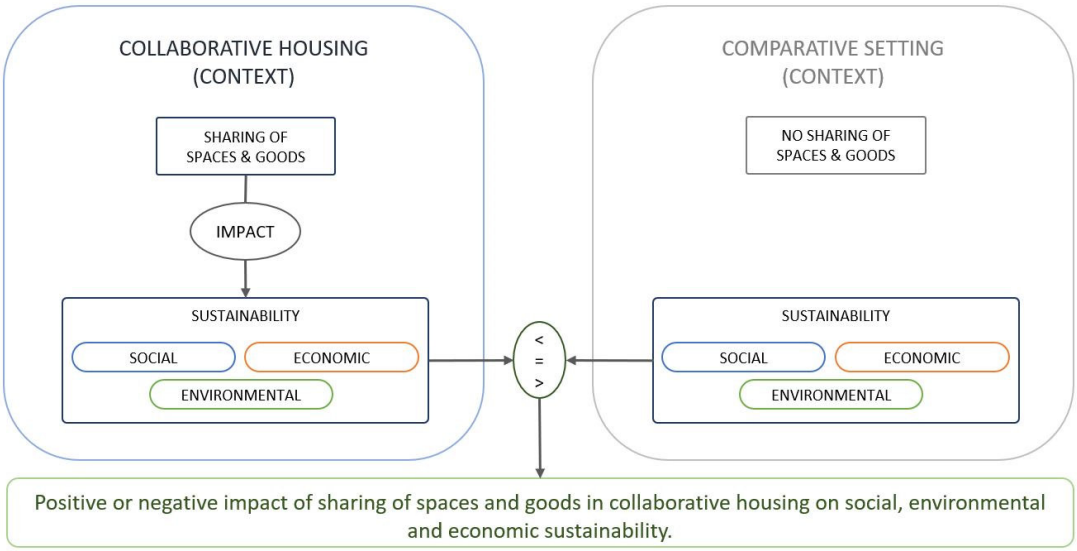


Figure 3. Theoretical framework I (own ill.)

2.1 Definition and local Context of Collaborative Housing

2.1.1 Definition of Collaborative Housing

This research draws conclusions from collaborative housing projects in the European context. The term '*Collaborative Housing'* and its definition comes with plenty of possible variations, and many of those are interchangeable. This chapter aims at giving an overview of the field and determines the scope of the term collaborative housing in this thesis.

Lang et al. (2018) define collaborative housing as the new umbrella term for a wide range of housing types with shared facilities, replacing the term 'Collaborative Communities' which was introduced by Dorit Fromm (1991). An overview was created of (most) of the different collaborative housing types in the context of English, French, Dutch and German literature according to Lang et al. (2018), combined with further examples (CollaborativeHousing.org.au, n.d.; CollaborativeHousing.uk, n.d.; Fromm, 2012; L. Tummers, 2016). The remaining terms, after applying the exclusion criteria described in the following paragraph, are shown in Figure 4.
This work does not exclusively assess the 'Co-housing' projects which label a particular type of collaborative housing projects. Co-housing mostly describes the genuine form of collaborative housing that originated in Denmark during the 1960s, which is mainly defined by social contact design and residents that participate strongly in the development process, manage their community entirely, and usually share dinner on a weekly basis (Fromm, 2012; Lang et al., 2018). Focusing on Co-housing only would exclude other developments that do not fulfil those requirements entirely but also provide important insights into the aspects that make collaborative housing more sustainable than conventional housing. Therefore, this research analyses different types of collaborative housing that fulfil the following criteria:

- Intentional community
- Strong focus on community
- Autonomous housing units
- Shared spaces and facilities

No grounds for exclusion provide:

- Size and typology of the buildings
- The precise ownership form, financing strategy, and development process
- Type and mix of resident groups (age, race, beliefs, income, etc.)

All kinds of squatting are not considered in this research, as well as rural developments like most eco-projects since this research focuses on urban developments that lie within legal frameworks. Furthermore, cooperative housing as described by Tummers (2016) as buildings of cooperative ownership without common spaces or shared facilities are excluded since the focus of this thesis lies in the aspect of sharing. All kinds of student housing and communal housing (also the German Wohngruppen) with no autonomous housing units are excluded according to the criteria. The French, Italian, Spanish, Swedish and Danish terms are disregarded as well.

Despite all those exclusion criteria, a large amount of terms remains, as shown in Figure 4. This is mainly caused by the large overlap of concepts and the manifold possible definitions of most terms. Therefore, it might be possible that projects that are labelled by one of the terms nevertheless need to be excluded according to the criteria mentioned above.

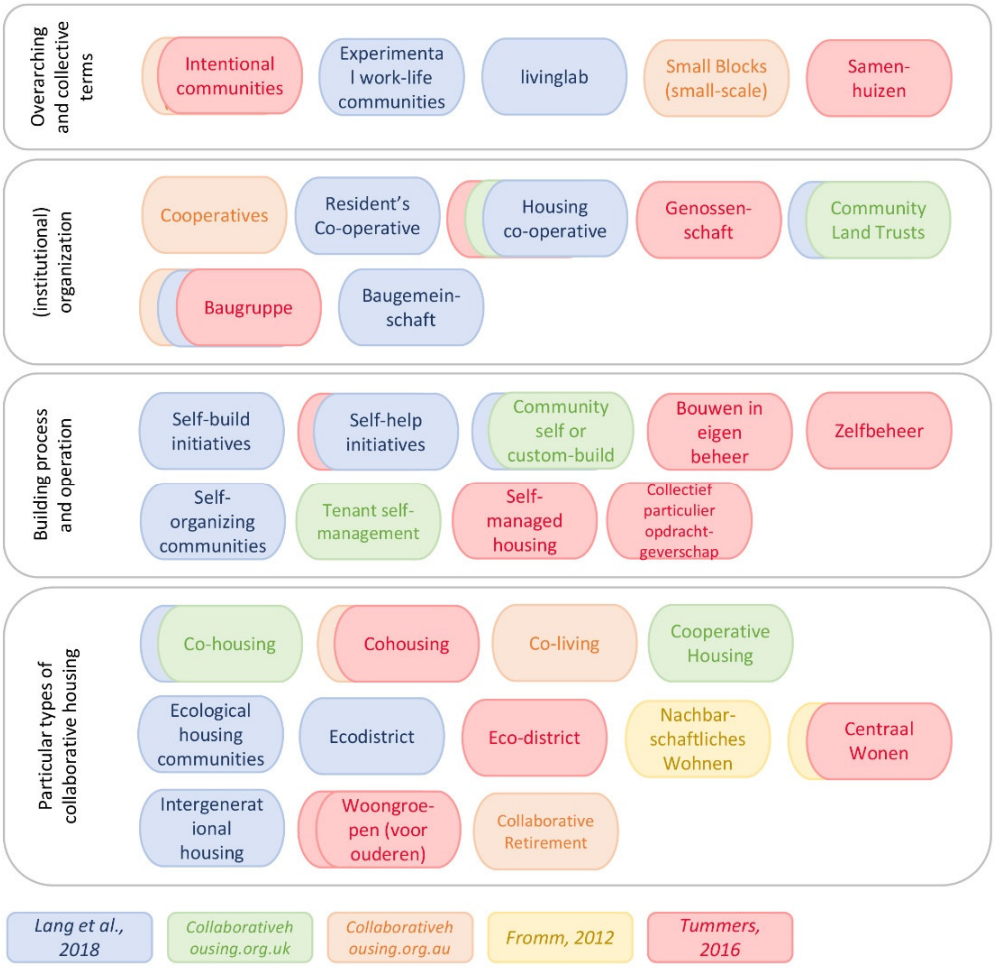


Figure 4: Relevant concepts of collaborative housing (own ill.)

2.1.2 Local context of Collaborative Housing

The geographical context of the empirical part of this research is the city of Vienna in Austria due to the following reasons. This research looks at European CH models since the researcher is based in the Netherlands and has her main interest and experience in this area. She is fluent in the German language and therefore suitable to select a German-speaking country for the research. As the development of collaborative housing projects is highly dependent on national and regional legislation and subsidies, it is obvious to focus on a research radius that is rather local. Furthermore, the urban context of collaborative housing is explicitly being researched, which brings Vienna as the Austrian capital into the picture.
Vienna is a showcase city for sustainable housing policies demonstrated in a large amount of publicly funded or supported social housing (Groschopf & Trojan, 2013). Due to the high level of experience and innovative concepts, the IBA WIEN 2022 (International Building Exhibition Vienna 2022) will be all about 'New Social Housing' (neues soziales Wohnen).
The city has a rich, about 100-year-long history of social housing development, beginning with the so-called 'Red Vienna' in the 1920s named after to the social democratic government, when 60.000 local authority apartments were realized in only 15 years (Ludwig, 2017; Prudic-Hartl, 2017). The history continues in the 1960s and 1970s according to the principles of public housing, and other more recent models, so that 60% of the Viennese live in publicly funded dwellings in the city area (Ludwig, 2017). Developer competitions for new projects are being decided according to the 'Vier-Säulen-Modell', a model involving the four columns of social sustainability, architecture, ecology, and economy (Groschopf & Trojan, 2013). The focus on social sustainability in social housing policies drives social innovation in housing and promotes new initiatives (Keivani & Shirazi, 2019).

Lang & Stoeger (2018) explain that the established housing cooperatives[3] in Austria are distinct from collaborative housing, as defined as the research context. Cooperatives usually facilitate "large-scale, top-down housing provision" (Lang & Stoeger, 2018, p. 2). The authors see collaborative housing like cohousing and self-help initiatives as a consequence of cooperatives, especially due to the promotion of 'Baugemeinschaften'. This is crucial since the institutional context with regulations and subsidies is the essential driver for innovative housing development (Lang & Stoeger, 2018). The Viennese institutional environment is unique since Vienna is one of Austria's provinces and therefore, as opposed to the other regional capitals, does not have to comply with regionally set regulations.
To guarantee this availability of affordable housing, a new regulation, regarding the re-designation of land areas into land for building, came into force in 2019 (wien.at, 2020a). The introduced dedication category '(publicly) subsidized housing' (Geförderter Wohnbau) dictates two-thirds of of the usable floor area for housing must be dedicated as subsidized housing (wien.at, 2020a). Geförderter Wohnbau in Vienna, besides others, restricts the rent per square meter, so that those dwellings are affordable for persons and groups of persons below a certain income threshold (wien.at, 2020b).

The current wave of 'Baugruppen' in Vienna started around the year 2000 (Lang & Stoeger, 2018). Baugruppen activity here is defined as intentional communities that are co-initiated, co-planned, and co-constructed. The showcase area in Vienna for different approaches for developing this kind of housing is the 'Seestadt Aspern', where both case studies of this thesis are being located.

[3] The large-scale housing cooperatives in Vienna are not categorically excluded from the empirical part of the research but it must carefully be assessed whether they comply with the set criteria to be relevant. Especially the criteria for being an 'intentional community' and having a 'strong focus on community' should exclude most of the cooperative housing projects.

2.2 Definition and Scope of Sustainability in Collaborative Housing

The relevance of the term 'sustainability' shows a significant increase from the 1990s onwards which can be derived from the Ngram Viewer of Google[4] (Figure 5). It is used excessively today to wrap policy concepts and programs nicely, to present businesses as more appealing or to promote the sale of products.

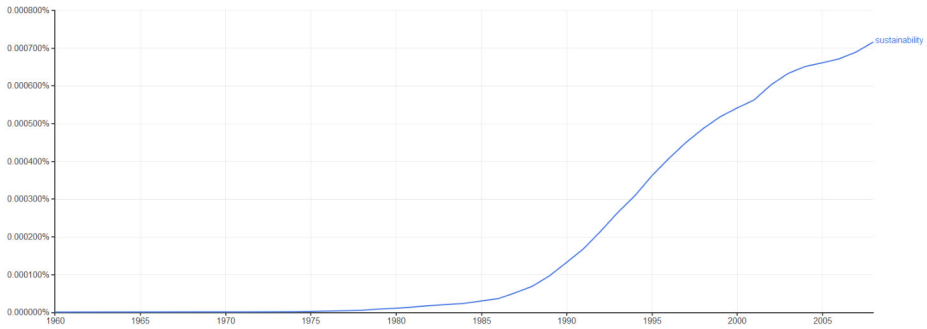


Figure 5: Screenshot for the search results for 'sustainability' between 1960 and 2008

3.2.1 Three Dimensions of Sustainability

Most commonly, sustainability is being defined in three dimensions, social, environmental and economic sustainability. These 'three pillars of sustainability' are also referred to with the concept of the 'triple bottom line' for sustainable businesses or in the '3Ps', namely people, planet, and profit (Heinberg, 2010; Kuhlman & Farrington, 2010). Although the concept of sustainability has been around much longer, the term was first introduced in the German forestry sector as 'Nachhaltigkeit' in 1713, meaning that one cannot harvest more than the forest can yield in new growth (Kuhlman & Farrington, 2010). After the publication of the so-called Brundtland Report 'Our Common Future' by the United Nations' World Commission on Environment and Development in 1987, Sustainable development was defined as 'development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs' (Kuhlman & Farrington, 2010; World Commission on Environment and Development, 1987). This concept faces criticism, not only due to the blurred definition of the boundaries between different terms. Nevertheless, it is the most commonly used definition of sustainability (M. Davidson, 2010; Heinberg, 2010; Scheller & Thörn, 2018; Vallance et al., 2011).

Sustainability in the scope of this work is being reviewed in three-fold: On the social, environmental and economic level. This approach is particularly chosen because scholars criticize that the three pillars of sustainability are often examined apart from each other, while the concept of sustainability must be viewed as a whole (M. Davidson, 2010). Other existing types of sustainability are not regarded separately but are assumed as part of one of the three categories. In literature, there exists a wide approval that collaborative housing scores better than conventional housing when those three levels of sustainability are regarded (Williams, 2005b).

[4] Derived from: https://books.google.com/ngrams/graph?content=sustainability&year_start=1960&year_end=2008&corpus=15&smoothing=3&share=&direct_url=t1%3B%2Csustainability%3B%2Cc0#t1%3B%2Csustainability%3B%2Cc0 [2019-10-21]

2.2.2 Social Sustainability

Social sustainability is agreeably not only the least examined but also the least tangible branch of sustainability due to the lack of normative content (M. Davidson, 2010). Especially the social aspect of sustainability has become more ambiguous, according to Scheller & Thörn (2018). Mark Davidson (2010) even argues through a literature review that, due to various definitions of this term in different contexts, social sustainability operates as a container: 'a fashionable conduit for a set of long-standing and in-vogue social policy discourses'. This is reflected in the application of the term that oftentimes works as a pretty package for policy concepts and programs. Three terms are often used to define social sustainability: social capital[5], social cohesion, and wellbeing (Dixon & Woodcraft, 2013).

Social Sustainability in Collaborative Housing

Yiftachel and Hedgcock stated in 1993 that 'social sustainability is marked by vitality, solidarity and a common sense of place among its residents (Yiftachel & Hedgcock, 1993). Williams (2005a) uses strong social networks, social cohesion, social inclusion, and well-being as indicators of socially sustainable housing. This is being complemented by Davidson (2010) and Scheller & Thörn (2018) who mention, amongst others, social equity, social mix, liveability, affordability, community services, street life, quality of life, social capital and social cohesion as indicators for social sustainability in cities. Williams (2005a) found in her literature study that, due to the social focus of cohousing, the 'mutual support networks and social relations are stronger and more developed in cohousing than in standard residential areas'. Collaborative housing has the potential to positively affect the aspect of social sustainability within itself, as well as by its positive impact on the neighbourhood. Fromm (2012) for example researched through case studies the potential impact of CH on neighbourhood repair. Furthermore, collaborative housing offers a promising way for refugee integration, which demands further research (Czischke & Huisman, 2018).

On the other hand, it is stressed that the frequent exclusion of ethnic and low-income groups is a down-side (Williams, 2005a). Social exclusion occurs either because CH is unaffordable for those people, or because of personal preferences for traditional housing or to live with likeminded people. Williams (2005a) nevertheless concludes that those issues can be overcome by fi. mixed-tenure schemes for better affordability and by targeted recruitment and integration of underrepresented groups.

2.2.3 Environmental Sustainability

When talking about sustainability in the present time, the environmental or ecological aspects are concerned first and foremost. According to Davidson (2010), environmental sustainability can be normatively judged by whether 'the consumption of environmental resources' respects 'the needs of future generations'. Environmental sustainability can, opposed to social sustainability, be measured by adding up the environmental impacts of a development up to an ecological footprint. Daly (2017) summarizes that those are mostly the categories of food, home energy, transport energy, and waste disposal. Furthermore, the emitted carbon, as well as the future carbon emissions of a development can be added up to a so-called carbon footprint.

Environmental Sustainability in Collaborative Housing

Daly (2017) found in her research on intentional communities (including eco-villages and co-housing) that the most significant factors on ecological and carbon footprints are housing, food, and transport. The ecological footprint is reduced through smaller physical building footprints (higher density) which often is a consequence of shared communal spaces. This fact makes CH communities potentially more sustainable, as Williams (2005a) concluded that US-co-housing communities save on average 31%

[5] Social capital: "Local social capital is the 'glue' which binds people together in a neighbourhood and encourages them to cooperate with each other. It is the local networks together with shared norms, values and understandings that facilitate cooperation within or among groups in a neighbourhood." (Williams, 2005b)

space compared to conventional housing. Another aspect that makes CH potentially more sustainable is the ability to collectively afford 'equipment and building tech' that performs better (I. L. Tummers, 2017). The author exemplifies this with the Swiss housing coop Equilibre in Geneve, with the ecological footprint of its residents of 50% of the average Swiss person. Krokfors (2012) summarizes that it is more energy and resource-efficient for more people to live together, but also that co-housing communities[6] are more able and willing to implement sustainable technologies. Regarding the environmental impact of shared meals, one has to consider the lower energy use for cooking on one hand but also the higher energy use for storing food, on the other hand (Carlsson-Kanyama, 2004).
Other scholars argue that personal consumption choices and behavioural patterns during the operation of the building make the difference. Williams (2005a) found evidence that collaborative housing residents are more likely to adopt pro-environmental behaviour regarding the use of energy for lighting, heating and cooling, due to the social structure and design of the developments. Household behaviour is heavily influenced by the observed behaviour at home and in the neighbourhood (Goldsmith & Goldsmith, 2011). Therefore, it is assumed that if a community is socially more sustainable, as defined previously, the social influence[7] of peers must be stronger. Social influence proved in studies to play a significant role in the change of user behaviour (Goldsmith & Goldsmith, 2011).

2.2.4 Economic Sustainability

Economic growth is considered the main definition of economic sustainability, but this can be contradictory to the aspect of ecological and social sustainability. To integrate all three pillars of sustainability, the concept of 'smart growth' was introduced for market-based land and housing development (Scheller & Thörn, 2018).

Economic Sustainability in Collaborative Housing

Collaborative housing communities can be more economically sustainable and affordable if they use or improve existing infrastructure and share facilities (Delendi, 2017; Scheller & Thörn, 2018). This requires different and more individual development approaches as compared to conventional developments. The economic justice of cohousing is questionable because of the affordability threshold and selection processes that usually exclude the lower-income groups (Scheller & Thörn, 2018; L. Tummers, 2016). This can furthermore cause gentrification through the displacement of economically weaker groups with few economic and cultural capital (Jarvis, 2011; Scheller & Thörn, 2018). Also, Fromm (2012) found through case studies that the possibility of participation and collaboration in CH projects can be significantly minimized through economic circumstances.

On the contrary, CH projects can also exemplify affordability in housing through tenure and income mix and by making use of the existing local housing support mechanisms, as to be found in case studies (Czischke, 2017; Williams, 2005a).

This chapter showed how collaborative housing communities perform either good or bad in terms of social, environmental and economic sustainability. Overall, it must be considered that the researchers in the field are often biased through being residents or supporters of collaborative housing themselves. This might be reflected in the mainly supportive literature on sustainability in collaborative housing, which requires special attention to the negative aspects. This is supported by Lang et al. (2018) who demand more quantitative research as well as more critical reflection on the topic.

[6] Co-housing communities as used by Krokfors is covered by the definition of collaborative housing in the context of this research (Krokfors, 2012)
[7] Social Influence 'provides individuals with the information and the motivation to form new attitudes and adopt new behaviours' (Goldsmith & Goldsmith, 2011)

2.3 The Idea of Sharing and Sharing in Collaborative Housing

'Sharing' is a broad term with various definitions and meanings. Most of them also occur in the context of collaborative housing. The following paragraphs aim at giving an overview of the currently used terms and concepts related to sharing and at narrowing the topic down to the scope of this research.

An overview of what is possibly being shared is provided in Table 1, according to Agyeman, McLaren & Schaefer-Borrego (2013). Looking at those themes, it becomes obvious that sharing already surrounds you in your daily life.

	Things	Services	Experiences
Individual	Swapping, bartering	Ridesharing, AirBnB	Skill sharing
Collective	Car clubs, Tool Banks	Childcare, credit unions, time banks	Sports clubs, social media
Public	Libraries, Freecycling	Health services, public transit	Politics, public space

Table 1. The broad territory of sharing (Agyeman et al., 2013)

2.3.1 Origin and Development of the Concept of Sharing

'Sharing is a phenomenon as old as humankind … .' (Belk, 2013, p. 1595). It is therefore interesting to investigate the origin and development of the term. Agyeman, McLaren & Schaefer-Borrego (2013) locate sharing in society throughout the evolution, all the way back to our hunter-gather ancestors. Their lives depended on sharing and cooperation and therefore this played an important part in the evolution (Agyeman et al., 2013; Tomasello & Warneken, 2008). Tomasello and Warneken (2008) interestingly found that children between 3 and 4 years of age mostly behaved self-centred and Agyeman et al. (2013) adds that they do not apply principles of sharing, although they do understand them. Cultural learning motivates how children develop the practice of sharing (Agyeman et al., 2013). This is being impacted by the culture in which the child grows up, while collective cultures that value relationships show higher levels of sharing behaviours than individualistic cultures that value things. In a study on the behaviour of Swiss school children, it was found that indeed the children between 7 and 8 years of age seek equality especially for people of their own group, like classmates (Tomasello & Warneken, 2008).
So, sharing is rooted in human history, but the practice of sharing is to be learned, depending on the type of culture that the person lives in. In the western societal context, sharing experienced a historical decline as a consequence of numerous factors like consumer capitalism, self-reliance culture, transformed consumption patterns and over-privatization (Agyeman et al., 2013). This established culture of 'you are what you own' is currently challenged by the post-ownership economy of 'you are what you can access', as Belk (2013) titles his article about sharing and collaborative consumption online.

The question remains, where this mind shift comes from. Some individuals desire more sustainability, anti-consumption, and generosity, others follow specific consumption ethics like minimalism (Agyeman et al., 2013). The same authors argue that the demand, as well as the supply of shared resources and facilities, is driven by three factors: population density, highly networked physical space and new internet technologies. Indeed, many researchers see the shift in attitudes towards free sharing as caused by the development of the internet, particularly of Web 2.0 (Agyeman et al., 2013; Belk, 2013). In their research on why people participate in collaborative consumption, Hamari, Sjöklint and Ukkonen (2016) found that economic benefits motivate to participate in collaborative consumption and that the consumers mostly have an environmentally sustainable mindset. A positive attitude towards collaborative consumption is created through perceived sustainability, enjoyment and economic gains.

Sharing Economy and Collaborative Consumption

Recently, sharing is often found in the context of the sharing economy and collaborative consumption. To clarify those terms, they are briefly explained in this section.

Scholars widely agree that the *sharing economy* is an 'umbrella concept' (Hamari et al., 2016), emerging from technological (mostly ICT) developments that facilitate shared consumption of physical and nonphysical goods and services through online platforms (Agyeman et al., 2013; Belk, 2013; Hamari et al., 2016; Wahlen & Laamanen, 2017).

Hamari et al. (2016) further describe *collaborative consumption* as a new way of consumption and a 'technological phenomenon' developed through the sharing economy. The peer-to-peer (P2P) or customer-to-customer (C2C) aspect, described as the provision of a good or service by a non-professional person by Teubner (2014) manifests in the following definition by Belk (2013). 'Collaborative consumption is people coordinating the acquisition and distribution of a resource for a fee or other compensation'.

Governance of the Commons

The governance of common resources was deeply researched in case studies by Elinor Ostrom, mostly considering natural resources in economic fields like fishery, pastureland and forest areas. Her 1990 publication 'Governing the Commons – The evolution of institutions for collective action' introduces that communities present a way of managing common resources besides privatization (market failure) and government regulation (Ostrom, 1990; Ostrom et al., 2012). It must be considered that no way of governance offers the perfect solution to all situations, as *"[…] we cannot simply say that the community is, or is not, the best; that the government is, or is not, the best; or that the market is, or is not, the best. It all depends on the nature of the problem that we are trying to solve"* (Ostrom et al., 2012, p. 70). Sustainable resource management is ensured by a set of variables which Ostrom named design principles. There must be clearly defined boundaries, rules that are congruent to local conditions, collective-choice arrangements, behaviour monitoring, graduated sanctions, conflict-resolution mechanisms and a minimal recognition of rights to organize. Furthermore, in common-pool resource institutions that are part of a larger system, nested enterprises include organisation on multiple layers (Ostrom, 1990, p. 90).

The considered collaborative housing communities that are run collectively are expected to work under similar conditions.

2.3.2 Categories, Types, and Typologies of Sharing

Various authors introduce ways to divide sharing or its applications into categories, types or typologies. Most enterprises do not only match one of those labels but several of them. The considerations nevertheless help to understand the topic more deeply.

Botsmann and Rogers (2010) in their manifest on collaborative consumption 'what's mine is yours' differ three particular systems within collaborative consumption: product-service systems, redistribution markets, and collaborative lifestyles. The three systems can be global or local in context, market- or non-market mediated, and economizing or politicizing ways of living, facilitated by connective technologies (Wahlen & Laamanen, 2017). It must be noted that the systems often blur into each other as some businesses offer services that fit more than one category. A brief description of those systems and an example can be found in Table 2.

Product service systems	Redistribution markets	Collaborative lifestyles
Challenge the concept of ownership by sharing or renting of corporately or privately owned products. Offer the service instead of the product.	Supporting recycling and reusing of products by exchanging pre-owned products for free or by sale.	Satisfy similar (physical or virtual) needs by sharing space, skill, time, currencies.
Zipcar	eBay, flea markets	Airbnb

Table 2. Systems within collaborative consumption[8]

The shared goods can also be categorized in a matrix according to their exclusivity (whether the use is limited to a particular group) and rivalry (whether the good can only be consumed by one person at a time), as shown in Table 3 (Agyeman et al., 2013; Lamberton & Rose, 2012).

	Lower exclusivity	Higher exclusivity
Lower rivalry	Public Goods Sharing (public parks, roads, TV, open-source software)	Club/Access Goods Sharing (country clubs, gated communities, church recreation facilities)
Higher rivalry	Open Commercial Goods Sharing: Rental and Reuse (tool banks, Freecycle, car sharing)	Closed Commercial Goods Sharing (Health maintenance organizations, frequent flyer mile sharing schemes)

Table 3. Rivalry & Exclusivity matrix after (Lamberton & Rose, 2012)

This different perspective on sharing helps thinking about the limitations of public sharing according to rivalry and exclusivity and links back to the different levels of sharing (individual, collective, public) in Table 1.

Agyeman et al. (2013) introduce a sharing spectrum that is supposed to incorporate co-production and also co-consumption and therefore not only focuses on goods and services but also on the inputs (like materials) and outputs (wellbeing and capability to participate in society)

	What is being shared	Concept	Examples	Participants (typically)
INTANGIBLE <-----> TANGIBLE	Material	Recovery and recycling	Glass and paper banks, scrapyards	Many suppliers, few users
	Product	Redistribution markets	Flea markets, charity shops, freecycle	Single provider to Single user
	Service	Product service systems	Zipcar, Netflix, Fashion and toy rental, libraries	Singe provider to Many users
	Wellbeing	Collaborative lifestyles	Errand networks, peer to peer travel like AirBnB	Many single providers to Many single users P2P
	Capability	Collective commons	The internet, safe streets, participative politics	Collective providers to Collective users

Table 4. Sharing spectrum (Agyeman et al., 2013)

[8] Definitions and examples are taken from Agyeman et al., 2017; Teubner, 2014; Wahlen & Laamanen, 2017 and summarized by the author.

While the classifications help with viewing the aspect of sharing from different angles, the empirical part of this thesis work will focus on the sharing of spaces and goods within collaborative housing (individual and collective). Sharing of spaces includes shared kitchens, community rooms, gardens and other facilities that are free to use for either the collective only or the public as well. Sharing of Goods refers to washing machines, gardening tools, cars, etc. Within collaborative housing, they are usually shared with the collective but may also be open to the public. Individual sharing (from one household to another) of other Goods is possibly promoted by collaborative housing but not the focus of the research.

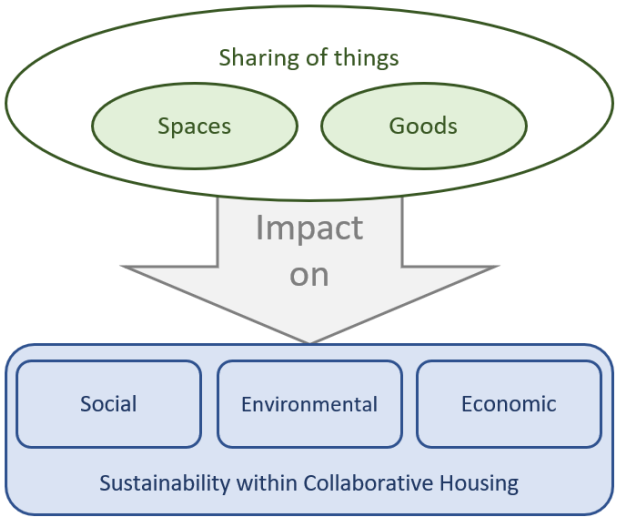


Figure 6. Sharing in the context of the research (own ill.)

Referring to Table 1, the sharing of services and experiences is covered by sharing tangible spaces and goods. For example, the sharing of a car can promote shared rides and a common room can facilitate collective childcare (service). Experience sharing, on the other hand, might be supported by the accessibility to a piano in the common room. This all happens under the precondition that there is an initial willingness to live a 'sharing lifestyle' as well as the social influence to promote the desire to share spaces and goods.

The focus lies in sharing and therefore, gift-giving and marketplace exchange, as described by Belk (2013) are excluded from the definition of sharing in this research.

2.3.3 Sharing in Collaborative Housing

In chapter *2.1 Definition and local Context of Collaborative Housing,* it was clarified that one main component of the examined collaborative housing communities is the aspect of sharing. In this sense, they all share certain spaces and facilities, and, in most cases, meals are shared regularly. Additionally, different goods are being commonly used. 'Sharing' is also reflected by the physical design of the buildings. Not only shared rooms and outdoor spaces are considered, but also shared walkways and transition zones between private, collective, and public spaces. It was also mentioned before that the sharing of spaces in some cases minimizes the building footprints which directly impacts the environmental and economic sustainability of living in a collaborative housing community.

One of the reasons for people practising sharing is the assumption that it makes their lifestyles more sustainable. Collaborative consumption platforms purposely optimize the social, environmental and economic consequences of consumption to meet the needs of the current and future generations (Hamari et al., 2016). Furthermore, Belk (2013) concludes that sharing makes 'practical and economic sense for the consumer, the environment and the community'. This directly links to the definition of sustainability within the focus of this research. On the three levels of social, environmental and economic sustainability, the following aspects become obvious.

Social Sustainability of Sharing in collaborative housing

From a social perspective, sharing can foster community and create certain synergies (Belk, 2007). This development again promotes 'social Influence' (Goldsmith & Goldsmith, 2011), that fosters more sustainable behaviour not only environmentally, but also socially. Furthermore, sharing offers enjoyment through the activity of sharing (Hamari et al., 2016).

The aim for higher densities and therefore smaller individual unit sizes to the benefit of shared rooms demand specific design solutions that result in high social interaction and cohesion, according to Williams (2005a). Daly (2017) found that shared gardens, that facilitate gardening and sharing the produce, are builders of community. The same goes for shared meals, as they "bind and endow meaning to community relations" (Daly, 2017; Jarvis, 2011, p. 561).

Environmental Sustainability of Sharing in collaborative housing

Sharing through participation in collaborative consumption is expected by the research community to be highly ecologically sustainable (Hamari et al., 2016). This is supported by the saving of resources as mentioned by Belk (2007). The practice of sharing requires personal contact with other households. This enables 'social influence' to happen, as described by Goldsmith & Goldsmith (2011), to increase the sustainability effort of households.

Delendi (2017) states in this context that sharing helps to 'enact good practices of recycling and abatement of wastefulness'. The possibly higher density and therefore smaller physical building footprint per person saves energy (electricity and heating) and diminishes land consumption (Hagbert et al., 2020, Chapter 9; Marckmann et al., 2012; Williams, 2005a). The possibilities to produce food in gardens reduce packaging, distribution and industrial farming, while co-working spaces reduce travel requirements (Daly, 2017). The saving of goods in CH by pooling of resources (cars, washing machines, tumble dryers, freezers, DIY and gardening tools, lawnmowers) brings environmental benefits, especially for small households (Daly, 2017; Williams, 2005a). Hagbert (2020) researched degrowth as "the equitable downscaling of the economic throughput of society to keep within environmental limits". She found that sharing spaces and living as "convivial and collaborative" is essential for the process of degrowth (Nelson & Schneider, 2018, Chapter 5). Shared community meals are often vegetarian and therefore have a lower environmental impact than meals with meat (Daly, 2017). Shared meals also require fewer shopping trips, and reduce the use of private stoves and the need for private kitchen equipment (Hagbert et al., 2020; Vestbro, 2013). This saves resources and therefore effects the environmental footprints, just like less car ownership by sharing a (second) car (Daly, 2017; Williams, 2005a).

Economic Sustainability of Sharing in collaborative housing

Economic sustainability in the form of economic gains motivates participation in sharing through collaborative consumption (Hamari et al., 2016). In this form of utility-maximizing behaviour, the exclusive ownership is replaced by the cheaper option of sharing. Motivations for open source development are for example future economic benefits (Hamari et al., 2016).

A higher building density is also reflected in economic benefits. Not only are maintenance costs lower, but space is also more efficient in energy consumption (Marckmann et al., 2012; Vestbro, 2013). Goods savings by sharing results in financial savings (Williams, 2005a). Shared meals also come with cost savings, as mentioned in the previous paragraph. Overall, the economic sustainability of CH for households, especially for young and ageing persons, enables them to enjoy spaces and goods that they could not afford otherwise (Delendi, 2017; L. Tummers, 2016; Williams, 2005a)

Most researchers agree that sharing indeed helps to live in a more sustainable way. Nevertheless, the sharing of tangible and intangible goods it is practised very little and requires encouragement. The progress of this research will show to what extent sharing is practised in the CH communities of Vienna.

2.4 Impact and Measurement

Answering the research question about the *impact* of sharing on sustainability in collaborative housing in practice, requires a definition of the indicators whose impacts will be researched. The following chapter declares what the focal areas of the case studies are. Essentially, the sustainability of collaborative housing through sharing is being contrasted to the same setting, not practising sharing of spaces and goods. The following frameworks are being used to assess, quantify and compare the performance of collaborative housing communities.

2.4.1 Measurement of Social Sustainability

Social sustainability can hardly be measured directly. Nevertheless, the defining aspects of social sustainability like education and training, social justice, social cohesion and safety (Dempsey et al., 2011) can be represented in measurable consequences like lower crime rates and higher education levels. A framework for social sustainability assessment of urban area developments, subdivided into non-physical and predominantly physical factors, as presented by Dempsey et al. (2011) helps to consider the important aspects of comparison.

Since social sustainability is an ambiguous term and its definitions largely overlap, this paragraph explains the matter in which it is being used throughout the rest of this work. Acknowledging the many different facets of socially sustainable development, including quality of life, liveability or vitality, social Sustainability is being reviewed in terms of social capital. This concept can also be explained in multiple ways, one of which is that it comes in three-fold: as bonding, bridging and linking capital.

Linking capital is about power in vertical social relationships with regard to governance and institutional aspects (Keivani & Shirazi, 2019, Chapter 10). Since this study focuses on the aspect of sharing within collaborative housing, those vertical relationships between different levels of power must be disregarded.

According to Lang (Keivani & Shirazi, 2019, Chapter 10), **bonding** within social capital is dependent on the **cohesion** of the community. This usually is revealed by trusting, but inward-looking relationships. Those can be indicated by equal demographic characteristics, such as education, income, ethnicity, and social identity, as well as by frequent & intimate interactions of the residents (Keivani & Shirazi, 2019, Chapter 10). Dempsey et al. (2011) list 'social interaction/social networks in the community', the 'participation in collective groups and networks in the community', and the 'community stability' as measurable aspects of community sustainability.

This study aims at determining the impact of sharing on the social sustainability (social capital). The socio-demographic characteristics of a community are usually set, which, as previously stated, might conclude in social exclusion due to affordability or resident preferences (Williams, 2005a). If collaborative housing is more affordable due to sharing, lower-income groups and therefore people of different education levels, ethnicities, etc. could enter the community, which would change the socio-demographic context. In this case, nevertheless, sharing does not take immediate impact on bonding social capital. The same is assumed for the aspect of residential (or community) stability, defined by the turnover of residents. The socio-demographics of a community as well as its residential stability are being disregarded as indicators, whereas the focus is set to the frequent and intimate interaction of residents. Those aspects can be measured by reviewing the social interaction and the strength of the networks within the community by the participation of the residents in collective groups and networks in the community. Bonding social capital (social cohesion) facilitates safety and security, sense of community, pride, place attachment, as well as strong mutual support networks (Dempsey et al., 2011; Williams, 2005a).

Bridging, according to Lang (Keivani & Shirazi, 2019, Chapter 10) regards social **inclusion**, which comes with a potential contradiction towards bonding. Bridging capital is associated with "heterogeneous, less cohesive, and outward-looking relationships" and it can be indicated by the connection of residents with different socio-demographic characteristics and less frequent and intimate interactions among residents (Keivani & Shirazi, 2019, Chapter 10). Striving to determine the impact of sharing on the social sustainability of a community, social inclusion cannot be ignored. Nevertheless, with bonding social capital present for the entire community, it is assumed that social inclusion, and therefore bridging capital, attributes the community.

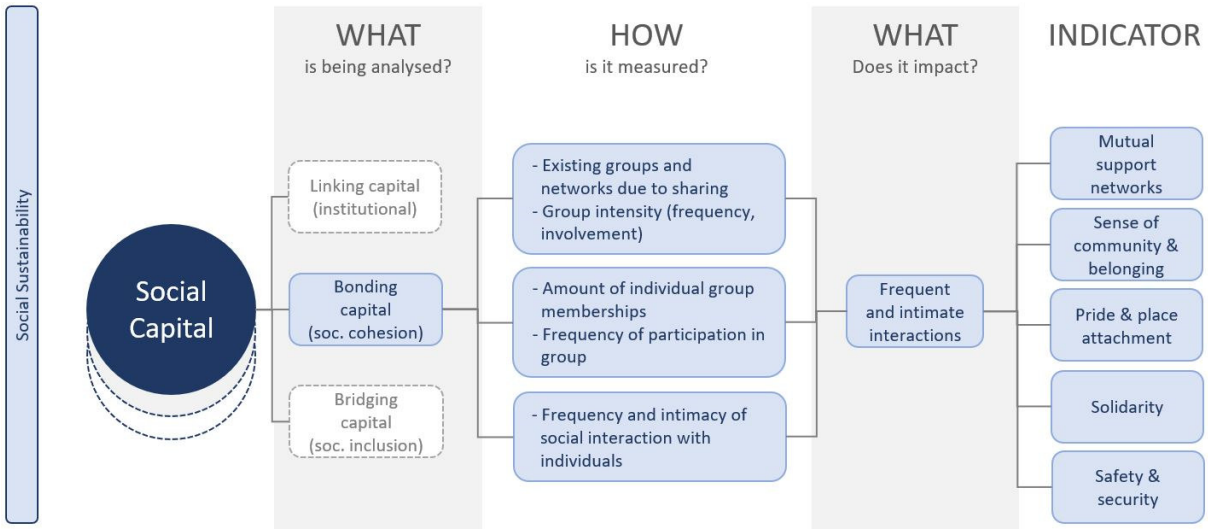


Figure 7. Social Sustainability Indicators (own ill.)

To determine whether the frequency and intimacy of interactions within the housing group are impacted positively by sharing spaces and goods, the existing groups and networks are being observed. Preconditions are that the groups potentially exist due to sharing. The frequency of the meetings and the required level of involvement is contrasted with the individual amount of group memberships and frequency of participation. This indicates the sharing-related group involvement. Furthermore, individuals are being asked to what extent the frequency and intimacy of social interaction with individuals are impacted by group participation or sharing directly.

The indicators shown in *Figure 7* are used to assess how the social sustainability is affected by sharing spaces and goods within the collaborative housing communities. The attention rests exclusively on whether sharing impacts the aspects and if it does, whether this impact is positive, negative, or both.

2.4.2 Measurement of Environmental Sustainability

The environmental sustainability of buildings and their users can be measured as an environmental footprint (EF) and the carbon footprint (CF) as done by Daly (2017). Carlsson-Kanyama (2004) measured food-related energy use and waste flows to find out whether sharing food in a community is more sustainable than in conventional households.
The purpose of this research is to find out whether the practised sharing generates enhanced environmental sustainability of the community, as proposed by literature. The goal is not to carry out calculations for a detailed impact assessment. Therefore, the field research (case studies) aims at determining whether certain factors were enabled or enhanced by sharing spaces and goods, or not.

In a nutshell, environmental sustainability of a collaborative housing community can be reviewed in two ways: the (physical) building characteristics, and the resident behaviour.

Pro-environmental resident behaviour is on the one hand facilitated by the building and the community practices (e.g. sharing), as common gardens make gardening possible and co-working spaces reduce the travel requirements to a distant physical workplace (Daly, 2017; Hagbert et al., 2020, Chapter 9). On the other hand, certain behaviour is created by the social influence of peers. Social influence grounds on a socially sustainable community and can so shape environmentally friendly behaviour. This includes making choices for energy consumption and recycling (Hagbert et al., 2020, Chapter 9). The common spaces clearly provide an increased utility level to the residents which arguably can rectify a higher building floor area due to a certain occupancy level. The efficiency of common space use (occupancy) is not being assessed in the study.

"Sharing of both stuff and spaces can minimize the need for private consumption" (Hagbert et al., 2020, Chapter 9). In this study, it is being reviewed whether the collaborative way of living is more environmentally sustainable through sharing spaces and goods. This impact is measured by the actual consumption as opposed to the likely consumption when no sharing is practised.
As exhibited by literature, there are many aspects that influence the environmental performance of a community, that could be used to determine the sustainability level. Those are e.g. the implementation of more sustainable technologies, lower travel requirements or more sustainable resident behaviour in general. While these and other aspects cannot be ignored, they must be disregarded due to the timeframe of this work.

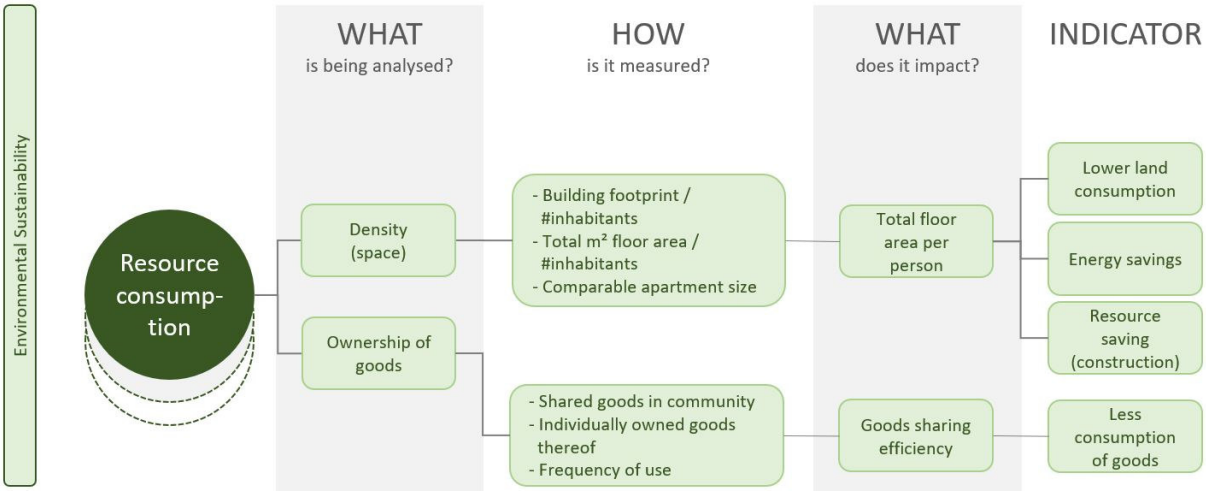


Figure 8. Environmental Sustainability Indicators (own ill.)

Figure 8 shows the crucial indicators in the context of environmental sustainability. Regarding resource consumption, two aspects are considered: The density in terms of the used space, and the ownership of goods. Regarding the spaces, the total building floor area per person is measured which indicates energy savings and resource savings and therefore efficient use of space. The density is furthermore expressed in terms of the building footprint per person which specifies land consumption. To indicate whether the impact is positive or negative, residents are asked if they would have chosen a larger individual unit if there were no shared spaces available. Additionally, the density is being contrasted with the average apartment size per person in Vienna. A smaller floor area per person (higher density) furthermore results in a possibly smaller building footprint which results in lower land consumption.
Regarding the ownership of goods, an inventory of the shared tools and devices of the CH community is created. To define the sharing efficiency, the recipients of the survey are being asked for the goods they own individually, despite the possibility of using them commonly, and how frequently they use them. This will indicate the efficiency of sharing goods and whether it indeed causes less consumption of goods or more.

2.4.3 Measurement of Economic Sustainability

Economic sustainability, in the broader sense, is usually associated with growth, optimal resource management, and consumption increase (Moldan et al., 2012). Scheller & Thörn (Hagbert et al., 2020, Chapter 5) review affordability in the institutional context as a definition of social, rather than economic sustainability. Nevertheless, they conclude that, within their research, "economic sustainability was for the groups all about affordability" (Hagbert et al., 2020, Chapter 5). In the search for economic sustainability of collaborative housing communities, this position is adopted, and the focus is therefore set on the affordability of housing. Sharing spaces may produce higher density and so may have the effect of lower costs for the land and the building as well as savings on energy and maintenance.

As mentioned previously, the sharing of goods possibly comes with economic benefits in terms of cost savings. This is only provided if the goods are being shared efficiently, meaning that residents do use the common tools and devices instead of purchasing and owning them individually.

For this study, it will be disregarded that the households in collaborative housing usually enjoy a higher utility level by access to shared tools and devices, as well as to shared spaces (sauna, library, kitchen, etc.). For most of the households, this accessibility would just be unaffordable individually. The first goal, therefore, is to find out whether the households' expenditure on housing (including the shared spaces) is lower than it would be in an alternative setting. Secondly, it is being investigated whether the goods savings and the benefits of having certain tools and devices available for free decrease the household's expenses. The overview of the researched economic indicators is displayed in Figure 9.

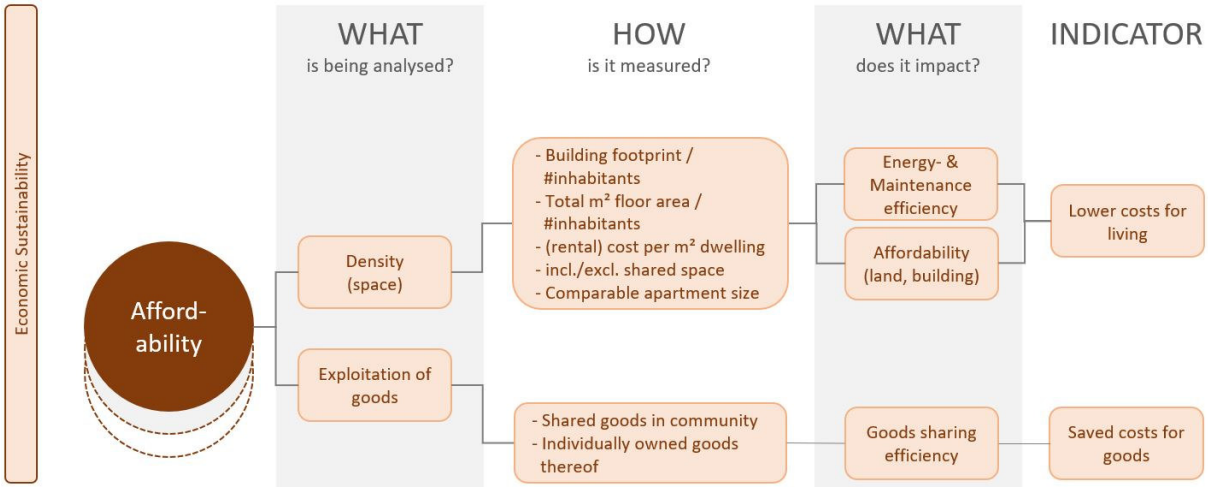


Figure 9. Economic Sustainability Indicators (own ill.)

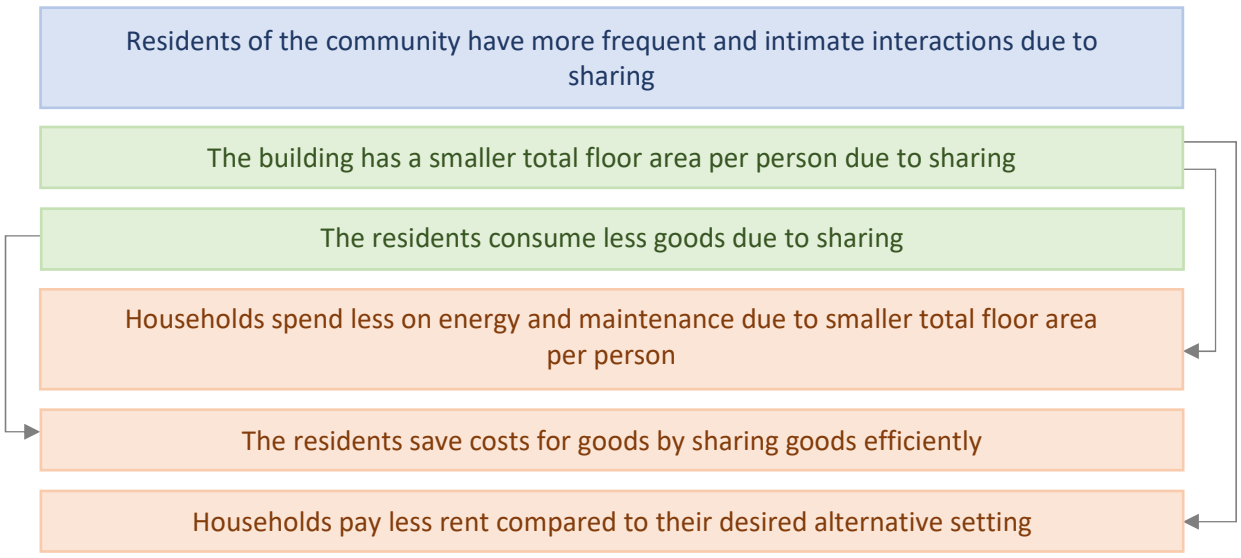
Regarding the Density, the total building square meters and the building footprint per person are calculated as done previously to determine the resource consumption. Furthermore, the costs per dwelling unit are determined including, respectively excluding the cost for shared spaces. These findings are compared to the hypothetical case, where no sharing of spaces takes place (survey), as well as by statistical data of apartment size and cost in Vienna. Thereby, conclusions on the costs of living are being drawn.

In order to determine the saved costs by sharing goods, the exploitation of the common goods is being reviewed. An inventory of all shared tools and devices is made which is used to determine the economic efficiency by asking the residents whether they own the listed tools individually despite the possibility to borrow them.

By case studies, it is researched, to what extent applied sharing practices impact the sustainability performance of collaborative housing. The case studies do not draw a holistic image of every indicator that can be impacted by sharing. Rather, the studies review an embedded part of the information, which is why 2 cases are studied, instead of one. The research aim is not to quantify or measure all the aspects, but to compare the performance of collaborative housing households to the hypothetical case in which sharing certain spaces and goods is not practised.

2.5 Synthesis A

The question of whether sharing in collaborative housing impacts its sustainability needs to be answered with 'yes' from the viewpoint of literature. It was clarified that sharing in collaborative housing potentially makes this form of housing more sustainable than other forms. While some negative impacts of sharing are known to be possible, a big number of authors report collaborative housing communities to be more sustainable on the social, environmental, and economic level. It must be considered that those outcomes might derive from a biased attitude towards collaborative housing. Therefore, the potentially bad performance of collaborative housing regarding sustainability must be taken seriously. For example, the sharing practices can be exclusive (in a negative way) or they improve environmental sustainability on the costs of economic aspects. Furthermore, the social interdependence that comes with sharing, might have negative effects like a feeling of inferior in the social arrangement. Overall, there is no proof for or against the statement that CH communities are the more sustainable option.
As introduced in the chapter on sustainability in collaborative housing on page 20, it is important to review sustainability in all three aspects since they are interrelated. In this research within the context of collaborative housing, the three concepts are particularly correlated as they all are components of sustainability. They are not only interdependent but also impacted by the concept of sharing spaces and goods, as shown in the theoretical framework in Figure 3. Sharing of spaces and goods in collaborative housing impacts the sustainability of collaborative housing projects.
The empirical research aims at answering the question of whether the impact of sharing practices in collaborative housing communities, in fact, is positive or negative, as opposed to comparable housing forms. The assumptions derived from the theoretical framework and therefore are being tested in the empirical research, are the following:



1 2 3 4 5 6

Methodology & Research Design

3. Methodology and Research Design

3.1 Research Design

Figure 10 summarizes the research design which is organized in three rows and three columns. The rows CAUSE, INVESTIGATION, and DELIVERY describe the research phases with regards to their content. The three columns represent the two main sources of data for this research - desk research and field research – as well as the outcome of those methods. Desk research (theory) and field research (practice) are further explained in the following two chapters.

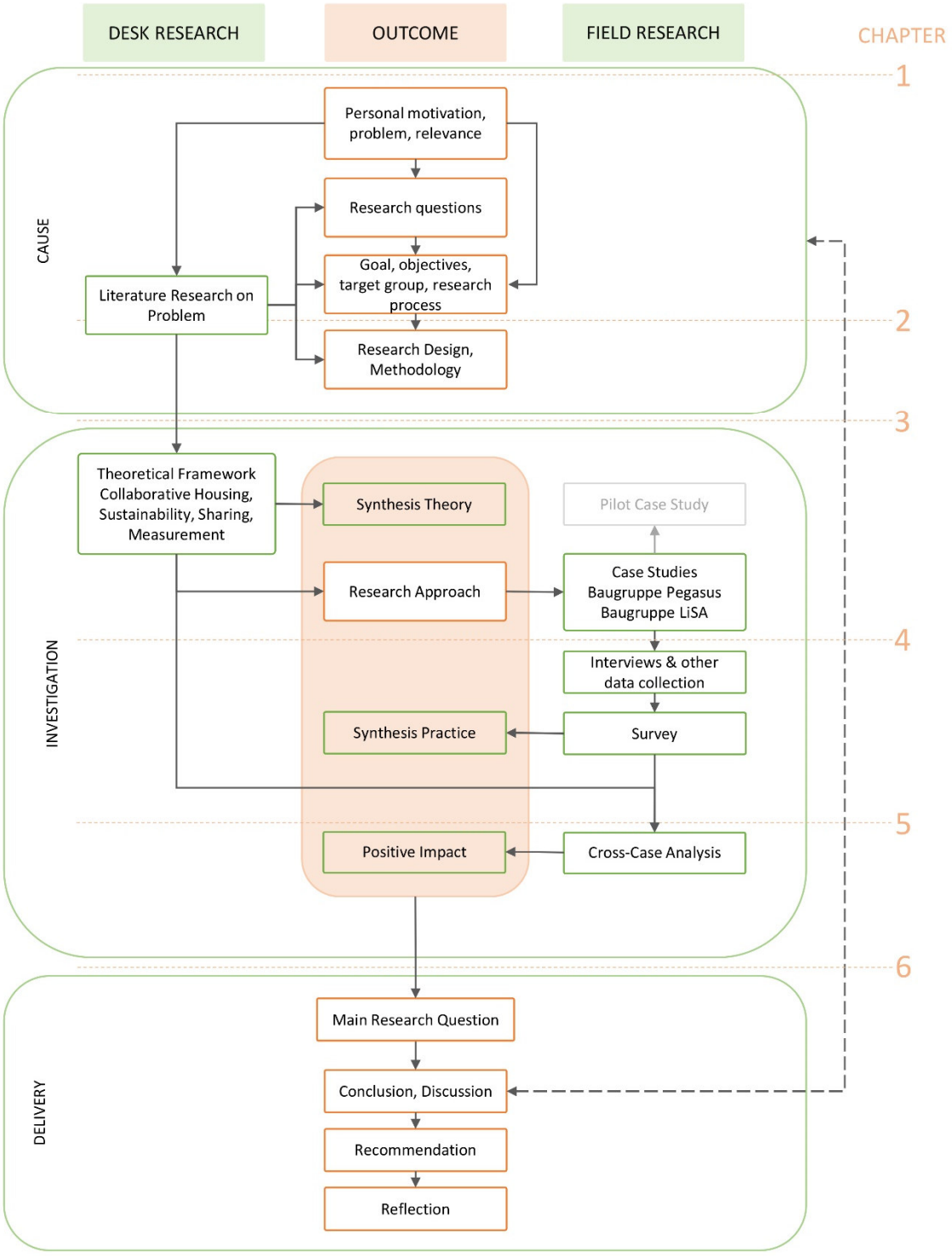


Figure 10: Research Design (own ill.)

3.2 Theory

Following the initial research interest, the literature is consulted to formulate the research questions, goals, research design and methodology in the first phase CAUSE.
In the second phase INVESTIGATION, an explorative literature review is carried out on the topics of collaborative housing types and the specific types that are of relevance for this research. This is complemented by exploring the idea of sharing, and the concept of social, environmental, and economic sustainability in collaborative housing and how those factors influence each other positively or negatively. The synthesis answers research question A by connecting the findings within the four concepts of collaborative housing, sustainability, sharing and impact. The literature review provides the theoretical framework for the case studies as the empirical research approach.

The research method of an explorative literature review was chosen over a quantitative approach because the topics are not the main concern of this research and therefore only require basic insight and understanding. Nevertheless, the findings of the explorative method build upon qualitative, as well as quantitative research and literature reviews on collaborative housing (Lang et al., 2018) and sustainability in collaborative housing (Daly, 2017).

The literature research considers different written sources that are relevant to the purpose of the research. Those include scientific and peer-reviewed papers and journal articles, books, other articles, as well as grey literature like reviews and conference papers that could be found online, mostly through Google Scholar. The non-scientific literature plays an important role in the investigation because it can be the source of new and more recent knowledge and data, which is also being stressed by Bryman (2015). This information must always be reviewed more critically and should be supported by reliable sources.

3.3 Practice

With the scientific basis provided, the analysis gets more detailed regarding the findings in practice.
Therefore, case studies of 2 collaborative housing communities are carried out to determine sharing practices. Beforehand, a pilot study is carried out to determine the appropriateness of the methods and feasibility of the study. This paragraph describes the research methods which are being applied in carrying out the case studies in the phase of INVESTIGATION.
The findings from the different research methods within one case study are triangulated to answer research question B. Triangulation in this sense is applied by combining the findings of different sources for higher validity and a clearer understanding of the problem (Bryman, 2015, Chapter 17). Question C is answered by a cross-case analysis resulting from the literature review and case studies.

Studying cases is considered an appropriate methodology to explore the CH practice because it facilitates the combination of quantitative and qualitative research techniques and is therefore ideally employed in this applied research.
Primarily, this research is qualitative since it aims at discovering and understanding the impact that the concept of sharing on the sustainability performance. To gather the required information, qualitative, as well as quantitative data-collection methods are used for two different cases likewise.
The cases are being studied with the help of academic literature (if applicable), online sources and provided other documents like floor plans and personal communication with other persons by phone or email. The physical building attributes can only be observed by plans and personal contact, due to the travel restrictions at that time. The practices within the community are being observed by semi-structured online interviews with at least two residents of the community. The interviewees are to be selected randomly from different households of the community to get possibly thorough insights. This is followed up by a resident survey to all households that derives from the previous findings (see chapter *3.3.2 Case Study Design and Methods for individual Cases*).

3.3.1 Case Studies

Case studies are the main research design to answer the research questions. This study aims at gaining a possibly deep insight into the sharing practices of the community - to not only detect the formal and organizational preconditions for sharing but also discover the community practices and therefore the real benefits of sharing rooms and goods. The existing literature suggests that sharing potentially makes CH communities more sustainable than comparable dwelling types without sharing. Therefore, the actual practice must be reviewed in detail.

The chosen projects are considered exemplifying cases for collaborative housing in the defined contexts. The selection criteria can be found below. Detailed information and reasoning for the selection criteria are exhibited in the sections *2.1.1 Definition of Collaborative* Housing and *2.1.2 Local context of Collaborative* Housing.

After studying the issue (theory) and defining the themes of the study, the first step is to determine the possible cases. An overview of Austrian projects is provided on the website of the 'Initiative Gemeinsam Bauen & Wohnen'[9]. The listed projects are reviewed by existing literature and websites for suitability according to the selection criteria. Afterwards, the communities are contacted for further information and to determine their willingness to participate in the study.

Number of Cases

Although the case studies in this sense aim at deriving qualitative information, the view on CH sharing practices gains external validity (generalizability) by considering multiple cases. The sample population consists of all CH communities in the city area of Vienna that comply with the selection criteria. Accordingly, the review of the cases listed by 'Initiative Gemeinsam Bauen & Wohnen' resulted in 8 possible cases (Appendix 1). To gain broader objectivity, while also ensuring in-depth analysis within the set time frame, two communities are being reviewed.

Selection Criteria

Location

The study looks at urban collaborative housing communities within the city boundaries of Vienna, Austria. This area was chosen due to the exceptional institutional environment of the city-state and the rich experience and high level of innovation in housing provision.

Housing Type

The chapter *2.1.1 Definition of Collaborative* Housing explores recent forms of collaborative housing. For this study, the following selection criteria apply:

- Intentional community
- Strong focus on community
- Autonomous housing units
- Shared spaces and facilities

Additionally, the project should not be older than 10 years (residents moved in 2010 or later) to ensure that the majority of the current inhabitants are the initial residents of the building. Also regarding the age, the community should be operating for two years, meaning that the majority of residents moved in at least two years ago (2017).

The two cases that match the selection criteria and responded to the researcher's contact approach are:

- Baugruppe Pegasus
- Baugruppe LiSA - Leben in der Seestadt Aspern

[9] http://inigbw.org/wohnprojekte [2020-01-20]

Data Processing

The transcribed interviews and other collected data are sorted out and structured according to the measurable indicators described in the theoretical framework. The survey data analysis is carried out by referring to the same indicators. Both steps of data collection and data evaluation are carried out in Microsoft Office Excel. The findings on the actual situation are compared to the findings on the alternative settings (both provided by the survey respondents), as well as to market data. Finally, the findings are interpreted to answer the research question and present the lessons learned from the case and the data.

Generalizability

The exemplifying case studies cannot be generalized for each European CH project. First of all, the CH type with all its aspects (building-specific, communal, administrative, etc.) must be considered carefully to apply the case study findings to other contexts. Then, the regulative, institutional. and national context of the community play a role. Finally, the projects may greatly differ in many details from the studied cases, which instantly makes them incomparable.
Studying the selected cases should provide deep insight into the practice and show, exemplified, whether sharing impacts the performance of the community in terms of sustainability. The buildings and practices are viewed through a critical lens, and the findings not only display if CH is the more sustainable alternative but also what exactly makes it more sustainable and what does not.

Validity & Reliability

Yin (2017, Chapter 2) defines four tests for judging the quality of research designs: Internal-, external-, and construct validity and reliability.
To strengthen the **internal validity** of the case studies, the associated research methods are chosen to acquire the research data from different viewpoints.
The **external validity** of qualitative research might be questionable according to Bryman (2015, Chapter 17) because they usually employ small samples in case studies. To diminish this consequence, rich descriptions are used and furthermore, the findings are being peer-reviewed (by one fellow student) and inspected by the supervisors of this thesis project. Furthermore, a report on the findings per case is provided to the case community. This serves, besides others, the purpose of key informants reviewing the findings. Different research methods within the case studies and the triangulation of findings aim at increasing validity in the research context.
To ensure **construct validity**, Yin (2018, Chapter 2) advises using multiple sources of evidence, which is achieved by the applied mix of methods.

Reliability is regarded as the result of minimizing errors and biases in the study (Yin, 2018). By this, it is theoretically possible for a different researcher to draw identical conclusions by conducting the same research at a different point in time. Therefore, a case study protocol is kept per case for documentation and the collected data are visualized and saved digitally (Microsoft Excel & Word, audio files). The student carrying out the research does not have pre-existing personal relationships with the residents of the studied collaborative housing projects, nor does she have personal experience in living in a similar community. Nevertheless, possible researcher bias must be considered and handled carefully.

3.3.2 Case Study Design and Methods for individual Cases

The data collection is initiated by a general online research on the case studies. Documents such as floor plans, sections and pictures are derived from online publications and personal communication before the interviews are carried out. Further information on the cases is generated by personal contact with the interviewees and representatives of involved institutions.
The data sources shown in Figure 11 lead to the resident survey. In the survey, the residents of the case study project are questioned about their current situation, behaviors, and opinions. For proper comparison, the respondents are also asked to consider an alternative situation of accommodation if they did not live in a collaborative housing community with shared spaces and goods.

The considered alternative situation must be

- A realistic alternative and not only wishful thinking.
- Located in the same or a comparable area of the city.
- No form of collaborative housing.
- Without access to shared spaces or goods (disregarding standards like shared hallways, storage spaces, technical installations, etc.).

These boundaries set, the survey participants are being asked what size in square meters the alternative apartment would have to have, and whether they would own specific goods individually, which they currently access through sharing.

Both survey findings are evaluated and summarized in the cross-case analysis to confirm or disprove the assumptions in the three branches of sustainability found in the literature review.
The applied Methods per case study is explained in the particular chapter.

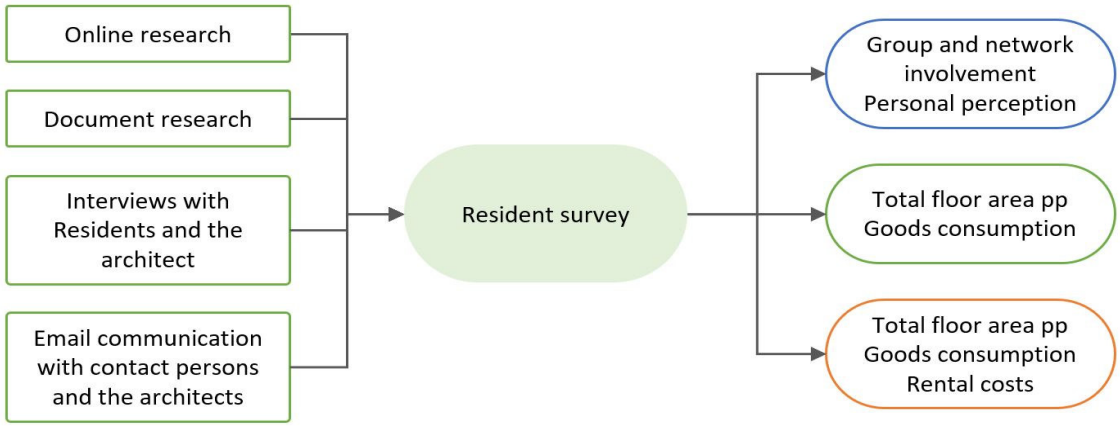


Figure 11. Data Sources for Case Studies (own ill.)

3.4 Conclusion

The third research phase DELIVERY deals with the outcome of the desk research and field research. It answers the main research question of whether the concept of sharing in collaborative housing increases the sustainability of cities. The outcome is being set into the context of the city to conclude the work and envision to what extent more sustainable cities can be created through sharing in collaborative housing.

1 2 3 4 5 6

4 Empirical Research

4. Empirical Research

The empirical part of the research builds upon the findings within the literature review. The previous chapter showed that sharing, besides other factors, indeed impacts the social, environmental, and economic sustainability of collaborative housing communities. To determine this impact in practice, the three kinds of sustainability were redefined to sustainability indicators that can be compared to an alternative setting which is not collaborative housing, where sharing of spaces and goods is practised much less. Figure 12 shows the theoretical framework with the sustainability indicators.

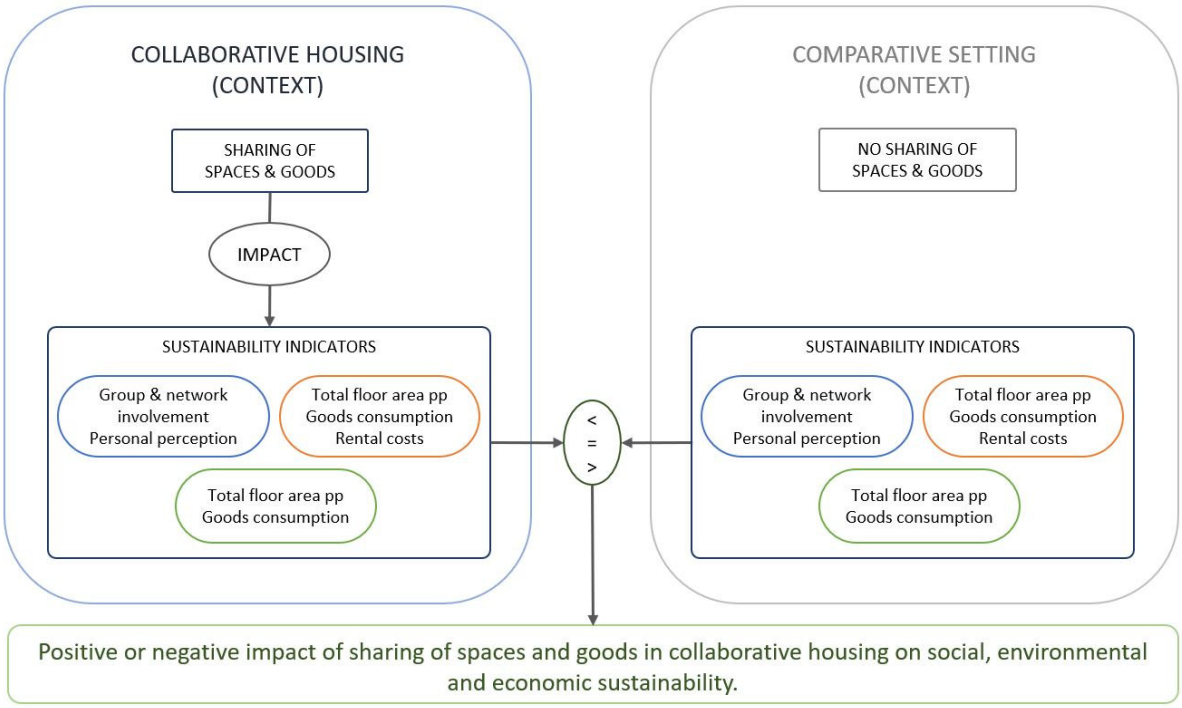


Figure 12. Theoretical framework II (own ill.)

4.1 Pilot study

A pilot study refines the research methods and the content of the data (Yin, 2018, Chapter 3). Therefore, the pilot case study of Centraal Wonen Delft was conducted to determine the appropriateness of the methods to measure the variables. Additionally, it helps to detect survey questions that may easily be misunderstood, and the participants get the chance to give their opinion on their experience with the survey. The findings of the pilot study can be found in *Appendix 2 – Pilot Case Study*.

4.2 Case 1: Pegasus

4.2.1 The Case

Pegasus is an example of collaborative housing in the current development area Seestadt Aspern in Vienna's Donaustadt district (Figure 13). The development area is one of Europe's largest of its kind. Until 2028, the area should host 20.000 residents and the same amount of workplaces (*Welcome to Seestadt!*, 2020). The combination of 'urban flair and laid-back peace' promises an ideal place to settle down, according to the website.

Figure 13. Location of Pegasus (www.snazzymaps.com)

The project Pegasus won the competition for building as one of five groups on a land parcel that was dedicated to collaborative housing projects of different kinds. After the project initiators mostly left the group, the consultants of wohnbund:consult, selected new members and those teamed up with the non-commercial property development cooperative SGN Wohnen (gemeinnützige Wohunungs- und Siedlungsgenossenschaft Neunkirchen) and the architects from Baldassion Architektur (Verein Baugruppe Pegasus, 2020).
The building was finished in April 2015 and currently hosts 26 individual residential units with 38 adults and 15 children of diverse family models. (A. Pissarek, personal communication, September 4, 2020). Besides some shared spaces that are accessible to all residents, the building also contains an apartment hotel as a commercial unit.

The legal form of the group is cooperative rental housing with the option to buy the apartment after ten years. Then, the options must be negotiated since the developer SGN did not purchase the land, but only the right to build. The construction was financially subsidized by the municipality which was quite common in the first building period of the development area (A. Pissarek, personal communication, April 22, 2020). Due to the financial support of the municipality, tenants of one-third of the apartments are assigned by the municipal social housing institution 'Wiener Wohnen'. All apartments in the building are publicly subsidized housing and therefore, access is restricted by an income limit and a maximal rentable floor area.

Pegasus was awarded 'klimaaktiv silver' in 2016 and 'ÖNGB gold' for its outstanding performance (A. Pissarek, personal communication, April 22, 2020).

4.2.2 Justification and Restrictions

The 'Baugruppe' Pegasus complies to all case study selection criteria.

Criterion	Comply	Reasoning
Intentional community	Yes	The initiating group formed to participate in the competition for building on the plot. Through time, most of the group constellation changed, but it stayed an intentional community.
Strong focus on community	Yes	The initiating thought was to live collaboratively. This is reflected by the building layout, the sharing practice and the activities in formal and informal groups.
Autonomous housing units	Yes	All units are independent in the sense that they have individual kitchens and bathrooms.
Shared spaces and facilities	Yes	Various spaces are shared in the community.
Shared goods	Yes	Residents share all things within shared spaces, as well as other goods.
Move-in between 2010 and 2017	Yes	The residents moved in in the April of 2015.

Table 5. Pegasus. Case study requirements

Sharing of spaces and goods is practised intentionally but only to a small extent, compared to other collaborative housing projects. The residents moved in within the required timespan, but two units already changed tenants at present. Furthermore, the operator of the hotel recently changed.

4.2.3 Case Study Characteristics

Baugruppe Pegasus consists of 26 independent residential units with bathrooms and kitchens which host 53 persons at the present point in time.
The building has one underground level, as well as six levels above ground. All apartments of the sixth floor include an internal staircase to the level below because those units consist of two levels.
The residents access the building by the main entrance facing the street. One central stairway and one elevator lead to all apartments through a central hallway on each level. Pegasus is furthermore accessible by the hotel entrance facing the street, as well as the kids' playroom, and a back entrance, both facing the garden.

Factsheet Pegasus Vienna	
Gross building floor area	4.034,43 m²
Usable floor area individual space (Pegasus)	1.900,35 m²
Usable floor area shared space (Pegasus)	296,28m²
Gross floor area Pegasus	3.251,32m²
Usable floor area commercial space	529,08 m²
Gross floor area Commercial space	783,11 m²
Year of construction	2015
Residents	53 (including 15 children)

The residents of Pegasus share certain spaces on different building levels.

Level	Room
-1	Bicycle storage space
-1	Room to store children's pushchairs and to exchange unneeded goods
-1	Gym (equipped fitness room)
0	Kids' playroom
6	Common room
6	Rooftop terrace

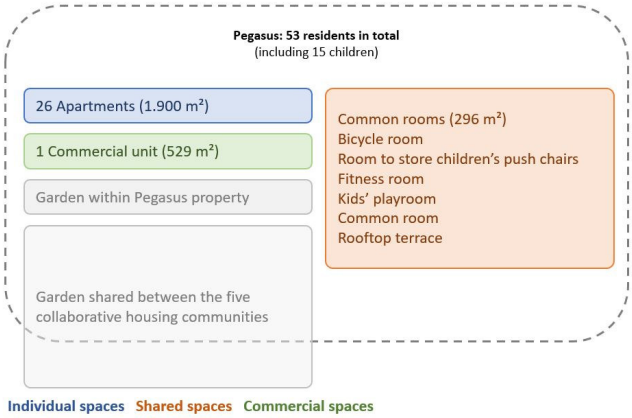


Figure 14. Pegasus. Spaces within the Building (own ill.)

The basement floor, besides the spaces for the technical installations and the private storage cells dedicated to the individual apartments, hosts a bicycle storage space as well as a room to store children's pushchairs, other child equipment, goods that are not needed anymore for exchange.
The ground floor is partly dedicated to the hotel and hosts the kids' playroom which is accessible from both, the hotel, and outside (Figure 15). The terrace on the southern end is dedicated to hotel use and is currently not used frequently by the residents of Pegasus. The sixth floor hosts the common room equipped with kitchen and toilet, as well as a rooftop terrace. The rooms were and are equipped through the monthly membership fees paid by the residents.

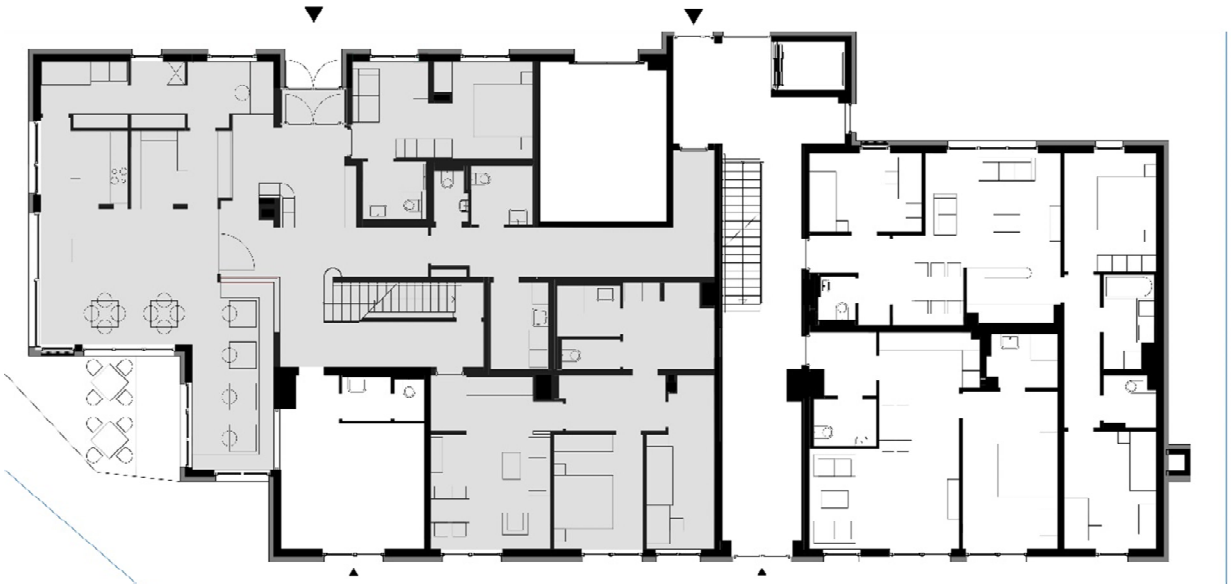


Figure 15. Pegasus. Floor Plan Ground Floor (own ill. after architect's floor plans)

Figure 21. Pegasus. View from south-east (from architect)

Figure 19. Fitness room (from resident)

Figure 20. Kid's playroom (from resident)

Figure 18. Shelf to give unneeded things away (from resident)

Figure 17. Common room with shared kitchen (from resident)

Figure 16. Rooftop terrace (from resident)

4.2.4 Study Design

After contacting the group via the contact address on their website, an informative relationship with the main contact person was established. This initial touch led to email contact with the architect of the building and four other residents, out of which three were interviewed. Two group interviews were organized online with a total of four Pegasus residents and the architect. The meetings were prepared and followed-up by email communication with documents and photographs. The resulting resident survey was essentially distributed by the interviewees who sent digital invitations, but also verbally invited their neighbours to participate. This commitment led to the satisfying response rate which is described in the following passage.

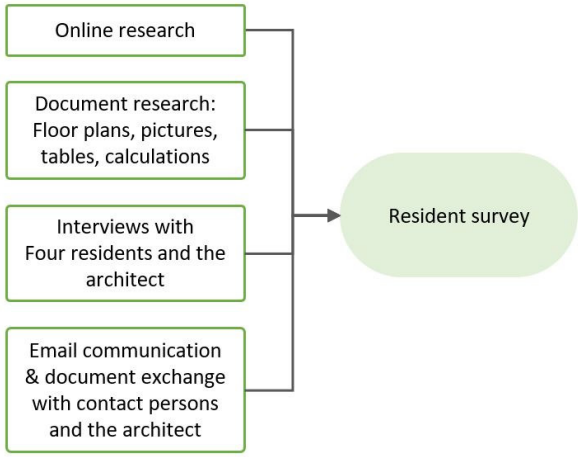


Figure 22. Survey Sources Pegasus (own ill.)

4.2.5 Survey responses

Baugruppe Pegasus consists of 26 households whereof 12 responded to the survey (46,15%). Amongst the respondents are six single-households, two households each with two and three members, and one four- as well as one five-person household. The average working time per week of the employed residents is 32 hours.

Group Participation

The interviews and other personal communication resulted in an inventory of groups that exist as a consequence of sharing spaces and goods. The formal and informal groups in Pegasus correspond to sharing the building, rooms, things, and interests. Membership is not mandatory for any of them.

Activity/Group	Participants %	Participants (x out of 12)	Hrs per week
Association of members of Baugruppe Pegasus (Verein der Baugruppe Pegasus)	100,0	12	
Head of the member association	16,7	2	
Workgroup community (Gemeinschaft)	25,0	3	
Workgroup rooftop terrace	16,7	2	
Workgroup gym	8,3	1	
Workgroup children	8,3	1	
			0,67
Group of residents that sport together outside of Pegasus	33,3	4	
Visitors of privately organized movie nights	8,3	1	
Visitors of activities organized by the workgroup community	66,7	8	
Users of the rooftop terrace	58,3	7	
Users of the gym	58,3	7	
Participator in events that are organized for families with children	41,7	5	
Cat-owners that jointly purchase pet supply	16,7	2	
			1,08
Total			1,75

Table 6. Pegasus. Group membership

Table 6 shows if, and to what extent, the survey respondents participate in the groups that formed by sharing spaces and goods. While everyone belongs to the member association and therefore pays the monthly fee of € 5, not everyone is equally involved in the groups. Two respondents stated that they do not participate in any of the other groups, while one person is active in 8 groups besides the general association membership. The sum of hours spent with people or activities of the groups ranges equally between zero and twelve.

The survey answers include several comments regarding group participation. One remark compared the time of when everyone moved into the building to today's situation. Over five years, participation in – and the intensity of – group activities diminished. Furthermore, the needs changed during the period, as children are growing older and families, therefore, are less involved in activities for children. Even though the needs change, spontaneous small meetings may happen occasionally between people that befriended each other in a previous common activity. Another reason to be less involved in the community groups is having many networks outside of the community and therefore too little time to become more involved.

For measuring the impact of sharing spaces and goods on social sustainability within Pegasus, the survey respondents were asked to rank the statements listed in Table 7, that refer to bonding capital, as explained on page 28. The table displays the average score ranging from 1 (I do not agree at all) to 10 (I strongly agree). The individual answers range from 1 to 10 for almost every statement.
Sharing seems to affect proudness of the place and the attachment to it in a rather negative way, overall. Having said that, the perception of safety and security is stronger due to sharing. The overall average is 6,19.

Statement	Range	Score
Sharing makes me feel like I am surrounded by a strong social support network.	2-10	6,25
Sharing creates a sense of community and makes me feel belonging to this community.	2-10	6,08
By sharing, I feel proud of my pace and I feel attached to it.	1-8	4,58
Sharing increases the solidarity between the residents.	1-10	6,25
Sharing increases the safety and security in the community.	1-10	7,08
Overall, I think that sharing fosters frequent and intimate interactions between the residents, compared to housing models where spaces and things are not shared.	1-10	6,92

Table 7. Pegasus. Rating of statements on social sustainability

Three respondents stated that they consider the benefits and downsides of sharing in equal balance, but nine respondents voted that the benefits of sharing spaces and goods outweigh the downsides thereof.
Respondents of the survey were given the opportunity to address what they consider the downsides of sharing spaces and goods. Besides the notion of possible unavailability of shared spaces and goods and the concern that too much closeness of the residents might blur the border to private lives, the main issue seems to be the participation and involvement of community members. One respondent stated that he/she sometimes feels forced to help, knowing that few people do so. This corresponds with a different answer, stating that there is no general pressure to help, but wishing that others got engaged more voluntarily and happily, without being asked particularly. 'Sometimes, the easiest way is doing it yourself', responded someone else. One resident describes the personal learning process of clearly stating if - and how much - you want to get involved in certain activities. There seems to be a lack of formal responsibility for taking care of certain shared spaces like the common room, which looks like it was neglected. Another resident feels that the formation of 'cliques' (groups of people with a certain strong interest or opinion) appears. In the end, the consensus is reached to maintain peace in the community.

Floor Areas

In 2018, the average usable floor area per person in Vienna was 36,3m² (Statistik Austria, 2020b). Compared to the Viennese average, inhabitants in Pegasus occupy 41,4 m² each (including individual and shared spaces). The percentage of single households in Vienna was 44,3 in 2018 and the average apartment size was 74 m² (Statistik Austria, 2020b). The usable floor area per apartment in Pegasus, according to the architectural plans, is 84,49 m² and 46,15 % of the households are single households. The residents of Pegasus were asked whether they would require an apartment of bigger surface area if they could not access shared spaces and goods. All respondents, except for one, stated that they would like to rent an apartment of exactly the same size as their current apartment in Pegasus. Only one household consisting of an adult and a child stated that they would require a place that was 115% of the current apartment size.

For clarity, only two kinds of floor area expression were used: The **gross floor area**, which describes the entire building area, including the structure, functional areas and circulation areas, measured until the outside face of the outer building walls (Figure 23). The **usable floor area** describes the net surface of the individual units, respectively the shared spaces. It excludes the building structure (exterior and interior walls, columns), functional areas (shafts, vertical ducts, mechanical rooms), and stairways, corridors, and other commonly used spaces.

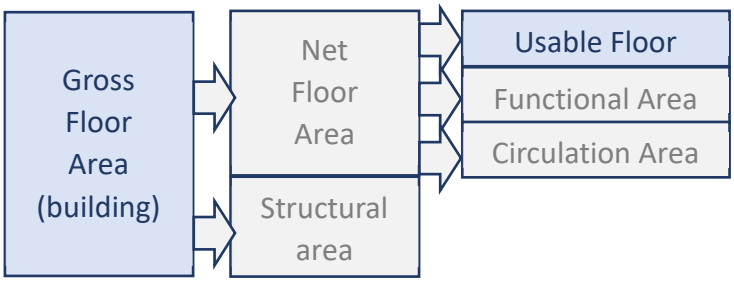


Figure 23. Floor Area Definition (own ill.)
(figure adopted from https://assetinsights.net/Glossary/G_Net_Floor_Area.html)

The usable floor area per household is the sum of individual UFA per household and the product of the number of household members and the shared space per Pegasus resident.

Individual UFA per household		UFA_i
Shared Spaces within Pegasus per household member	+	$(UFA_s/M)*M_h$
UFA per household	=	UFA_h

Household members	Average Apartment Size in m²	Average UFA per person (incl. shared spaces) in m²	Apartment size incl. shared spaces in m²		Desired apartment size in m²
1 person	65,67	71,26	**71,26**	>	**65,67**
2 person	73,50	42,34	**84,68**	>	**78,50**
3 person	100,00	38,92	**116,77**	>	**100,00**
4 person*	116,00	34,59	**138,36**	>	**116,00**
5 person*	150,00	35,59	**177,95**	>	**150,00**
Average UFA	83,92	55,02	**95,56**	>	**84,75**
Total UFA			**1.146,75**	>	**1.017,00**

Average GFA			**140,53**	>	**124,63**
Total GFA			***1.686,40***	>	***1.495,59***

Table 8. Pegasus. Current and desired apartment size compared

* Only one response of a household of this size was collected. Therefore the value is absolute and no average.

Table 8 compares the amount of usable floor area that each household currently occupies including the proportionate of the shared spaces, to their desired UFA.
Only one household stated that they would require a bigger apartment if no shared spaces were accessible for them. Nonetheless, on average all households would occupy less space if their apartments had the desired size but no access to shared spaces. Residents occupying a smaller usable floor area per person results in a smaller gross floor area of the building. In Table 8, the GFA was calculated for both scenarios by dividing the sum of UFA by the factor of 0,68. The ratio of usable floor area / gross floor area (UFA/GFA) is 68 %[10] for the entire building. Subtracting the area of the hotel (GFA: 783,11 m²), the GFA of Pegasus is 3.251,32 m² in total.

UFA per household		UFA_h
UFA/GFA ratio	/	0,68
GFA per household	=	GFA_h

Goods Consumption

During the group interviews, an inventory of shared tools and devices was created. Those are accessible to all residents of Pegasus. It is assumed that the shared items would be enough to satisfy the residents' needs and there is no necessity to own them individually. Table 9 displays the findings from the survey.
The second column indicates how often the specific good exists as a shared object. A value is '0' when the good is not officially shared but owned by a private person that offers it to other residents to borrow. Together with the number of items that are owned individually, it adds up to the number of existing items (# existing). This value is being compared to the number of goods all residents of Pegasus would own if they had no access to them by sharing. This percentage in the last column is below 100 if there are indeed fewer items of a kind due to sharing.

Good	# shared	Owned privately*	# existing		Needed privately*	%
Equipment in the gym	1	7	8	<	9	88,9
Qualitative electronic barbecue grill	1	2	3	<	9	33,3
Table tennis table	1	2	3	>	0	-
Electric drill	0	13	13	<	15	86,7
Ladder, steps	0	11	11	<	15	73,3
Car	0	15	15	=	15	100,0
Crops from own cultivation or from rooftop terrace	0	13	13	=	13	100,0
Equipment for children (clothes, toys, furniture, etc.)	0	7	7	=	7	100,0

Table 9. Pegasus. Shared Goods

Regarding the gym equipment, the question was formulated more generally, asking whether a household would own one of the shared things individually. One table tennis table found a place in the bicycle storage room of the building (A. Pissarek et al., personal communication, April 16, 2020). Two more residents stated to own one privately. It is assumed that they are somewhere in store because of previous possession, but that they would not be purchased in the alternative dwelling situation. Cars, crops and child equipment are sometimes shared and sometimes used privately exclusively. The survey evaluation showed interestingly that not solely all residents that currently share or receive things like crops, would do so in the alternative situation and vice versa.

[10] The entire surface area of the hotel within the building is not considered for this calculation.
* Values extrapolated and rounded to whole numbers

Rent and Costs

Household rental expenses in Vienna and the particular case of Pegasus are usually divided as follows.[11]

English	German	Explanation
Actual rent	Miete, Nettomiete, Mietzins, (Annuität)	Bare rent (sometimes includes parts of other costs separately) max. €4,97/m² (WWFSG 1989, 2019)
Fee for maintenance and improvement work	Erhaltungs- und Verbesserungsarbeiten	Max €0,74/m² (WWFSG 1989, 2019)
Operating costs	Betriebskosten	Fees for drinking water, sewerage, general cleaning, waste disposal, (insurance), (maintenance), administration, etc. Costs for common spaces like lifts, sauna, green space, playground
Energy costs	Energie	District heating, electricity, hot water
Construction loans	Kredite zur Schaffung von Wohnraum, Baurechtszins	Applicable for rent cooperatives and ownership
Membership fee	Vereinsmitgliedschafts-beitrag	€ 5 per member
(Additional costs)	(Weitere Kosten)	(parking, storage, etc.)
Costs for living	Wohnkosten	Sum of components

Table 10. Pegasus. Rental expense division

The costs for constructing the common spaces, as well as for maintaining them and the costs for energy and water used in those rooms are split between the households. Every apartment unit has a particular 'Nutzwert' (use-value or utility value), according to its size and position in the building. The shared spaces are included in the Nutzwert calculation of each unit. According to the Nutzwert, the costs for constructing and running the shared spaces, just as for hallways and staircases, are apportioned for each household (A. Pissarek et al., personal communication, April 16, 2020).

The statistical yearbook of the city of Vienna (Dezernat Statistik Wien, 2019) states that Viennese households on average spend €697,00 on living and energy consumption, which is 26,2% of the average monthly consumption expenses. According to the same report, the average Viennese household spends less in this category than the average Austrian household. The average rent per m² of 2018 was €8,25 in Vienna (incl. operating costs), which was higher than the average of €7,85 in Austria (Statistik Austria, 2019).

The apartments of Pegasus underly the regulations of subsidized housing (geförderter Wohnbau) and therefore are only accessible to Austrian citizens that lived in Vienna for at least two years and whose annual income is lower than certain thresholds (according to the household size) (Ludwig, 2017). According to Viennese legislation, the actual monthly rent per square meter must not be higher than €4,97 and a separate fee for maintenance and improvement works must not be higher than €0,74 (WWFSG 1989, 2019, para. 63). Next to those costs, the residents of Pegasus pay back the public loan and pay the pro-rata fee for the right to build. Finally, operating and energy costs must be considered, as well as other costs on the monthly bill (A. Pissarek, personal communication, April 16, 2020).

[11] Composed of the document on glossary and methods of the Statistic Austria census and personal rental costs of Pegasus residents (A. Pissarek, personal communication, April 16, 2020; Statistik Austria, 2019, 2020a)

The total monthly rent of the households that participated in the survey ranges between €8,11 and €13,33 per square meter with an average of €9,56.

Household Members	Average Rent in €	Membership Fee in €	Total costs in €
1 person	568	5	573
2 person	700	5	705
3 person	1.147	5	1.152
4 person*	922	5	927
5 person*	1.800	10	1.810

Table 11. Pegasus. Total Household Expenses for Living in Pegasus

The rents being paid in Pegasus will not be compared to market rents but to the average rent within the subsidized housing sector in Vienna. All inhabitants of Pegasus are entitled to subsidized housing and therefore not likely to live in an alternative apartment of the commercial housing market. The defining criteria of the alternative situation can be found in on page 38. (To exemplify this, immopreise.at (2020) states that the average rent per square meter for apartments offered on their online platform in Donaustadt in May 2020 are € 16,36 for 80 m² or less and € 13,95 for bigger places, while the Pegasus inhabitants pay € 8,91 for 80m² or less and € 10,09 for bigger apartments.)

The current average rent of the survey participants is being compared to the rent they would likely have to pay on the free market.

Apartment Size in m²	Average apartment size (incl. shared spaces)	Desired Apartment Size	Total monthly costs in €	Market rent [12]
Up to 80m²	71,96	67,00	585,00	1.096
81 to 129m²	116,27	99,50	996,25	1.388
130m² and more	178	150,00	1.810,00	Not specified

Table 12. Pegasus. Comparison to market prices

When asked for their ideal apartment size if they had no access to shared spaces, only one respondent stated to require 115% of the current apartment size, while all other respondents would be content with the current size of their individual space. This indicates that residents do (almost) not consume less space due to the sharing of spaces and goods.

4.2.6 Summary Pegasus

The impact of sharing on social capital seems to be subjective, sometimes even opposing. Group participation and the number of group memberships show a wide range and seem to be very much dependent on the individual. The same goes for the responses on mutual support networks, sense of community & belonging, pride & place attachment, solidarity, and safety & security.
The survey results show that inhabitants of Pegasus live on a relatively large floor area which, on the environmental side, indicates high land consumption, energy costs and resource use. On the other hand, a slightly positive impact is obvious when looking at the shared goods within the community.
Affordability is guaranteed by the fact that all apartments in Pegasus are publicly subsidized housing. The monthly membership fee only has a little impact on the total costs for housing. Nevertheless, Pegasus inhabitants would likely pay less rent if they occupied an alternative apartment of the same size with no access to shared spaces. In the case of Pegasus, cost savings due to the sharing of goods are present, if to a small extent.

* Only one household of this size participated. Therefore, the values are absolut and no average values.
[12] Market rent assumed for May 2020 from website (*Der Preisspiegel für Immobilien in Österreich. Aktuelle Immobilienpreise. Wohnungen Miete Neubau*, 2020)

4.3 Case 2: LiSA

4.3.1 The Case

LiSA - Leben in der Seestadt Aspern is a second example of collaborative housing in the Seestadt in Vienna's 22nd municipal district Donaustadt (Figure 13). The project was initiated by future residents in Collaboration with the non-commercial property developer Schwarzatal. The group won the competition for one of the five plots in the development area that were assigned to collaborative housing. Finished in November 2015, the building contains 52 units for private and commercial use. By close resident involvement and with help of the experience of an existing Viennese project (Verein Sargfabrik Wohnprojekte), the future residents decided on the building design, as well as on the apartment layouts and the arrangement of the shared spaces.

The project is legally built as a 'Wohnheim' (this term is usually translated with dormitory, hostel, or residential home). In the Viennese context, this term broadly describes a building for a certain group of people with different individual units. This definition typologically includes classical student dormitories with shared facilities, as well as apartment buildings, like in the case of LiSA (WWFSG 1989, 2019, § 2: 5). Building a Wohnheim made it possible to benefit from municipal subsidy (Wohnbauförderung) without having tenants assigned by the municipal social housing institution Wiener Wohnen.

The project received numerous prizes, such as the public's choice award of wohnfonds_wien, the award for Sustainable Renewable Energy Projects (Österreichischer Solarpreis 2017) and the Climaaktiv prize in 2016, as well as in 2019 for the building ensemble (C. Schwegelbauer, personal communication, April 24, 2020).

4.3.2 Justification and Restrictions

The 'Baugruppe' complies to all case study selection criteria.

Criterion	Comply	Reasoning
Intentional community	Yes	The initiating group formed to participate in the competition for building on the plot.
Strong focus on community	Yes	The initiating thought was to live collaboratively. This is reflected by the building layout, the sharing practice and the group activities.
Autonomous housing units	Yes	All units are independent in the sense that they have individual kitchens and bathrooms.
Shared spaces and facilities	Yes	Various spaces are shared in the community
Shared goods	Yes	Residents share all things within shared spaces, as well as other goods.
Move-in between 2010 and 2017	Yes	The residents moved in at the end of 2015

Table 13. LiSA. Case study requirements

Most of the initiating group members live in the building and there was no change of residents since the initial occupation. The purposely constructed shared spaces are used frequently and fit the needs of the residents well. Sharing is practised both on a formal and informal level.

4.3.3 Case Study Characteristics

LiSA consists of 42 independent apartments, all fully equipped with kitchens and bathrooms. Additionally, it hosts two shared apartments for elderly people, so 44 residential units in total. The residential units are all reached by an access balcony of three meters width that also serves as private outdoor space, dedicated to each apartment unit. The modularly built main structure is compact and flexible, as it allows for adding smaller units up to bigger units or dividing bigger units into smaller ones, depending on future needs (Figure 25). The main building is accompanied by two smaller buildings on the same property, the atelier house and the kids' playroom with roof terrace, as shown in Figure 27.

Factsheet LiSA Vienna		
Gross building floor area	5.598,17 m²	
Usable floor area individual space (LiSA)	3.050,40 m²	(excl. 7 % of loggia)
Usable floor area shared space (LiSA)	455,75 m²	
Gross floor area LiSA	4.889,71 m²	
Usable floor area commercial space	508,00 m²	
Gross floor area Commercial space	708,46 m²	
Year of construction	2015	
Residents	98 (including 27 children)	

The residents of LiSA share several spaces in different areas of the building.

Level	Room
-1	Band practice room
-1	Workshop
-1	Bicycle storage
-1	Creative room
-1	Wellness area
-1	Foodcoop
0	Common room with foyer & kitchen
0	Laundry room
0	Kids' playroom
1	LiSA office
6	Common kitchen
6	Rooftop terrace

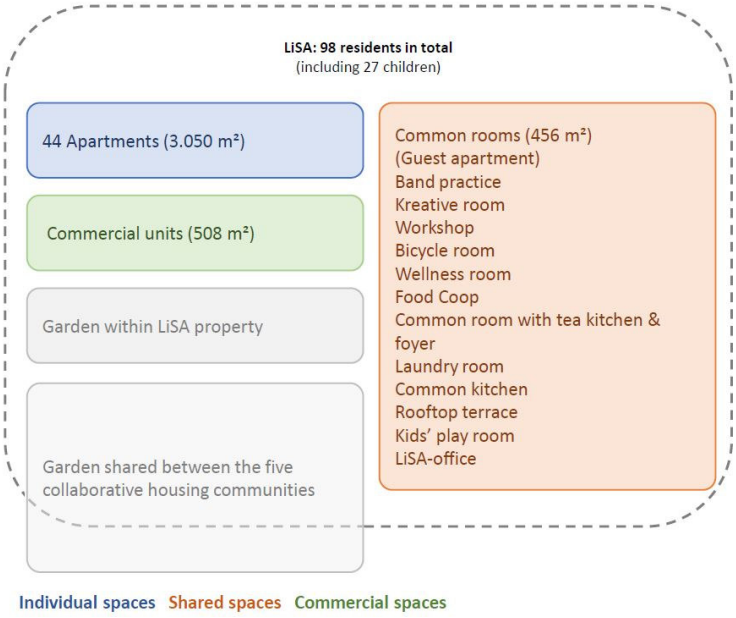


Figure 24. Spaces within the Baugruppe LiSA (own ill.)

All shared spaces were initially equipped for more than 150.000€ and are accessible to all residents of LiSA at any time (C. Schwegelbauer et al., personal communication, April 24, 2020). The LiSA community runs a foodcoop (food coop), where groceries are purchased in bulk (fresh and non-perishable foods) and can be picked up by the residents whenever it suits. The common room on the ground floor is used by the resident for all kinds of activities like community gatherings and dance classes but is also rented-out to external users. On the first floor of the atelier house, the LiSA office is located, which can be used by all residents and is equipped with a printer. The guest apartment located on the second floor in the bigger of the two pavilion buildings, the atelier house, is used to accommodate visitors of LiSA-inhabitants but is also open for residents of the other four collaborative projects to rent. Since residents pay for its use and it is also rented-out externally, it counts as

commercial space. The second, smaller pavilion accommodates the kid's playroom and a terrace on the first floor. The outdoor space of LiSA extends to the so-called D13 garden, the outdoor space which is shared by the five surrounding collaborative housing projects.

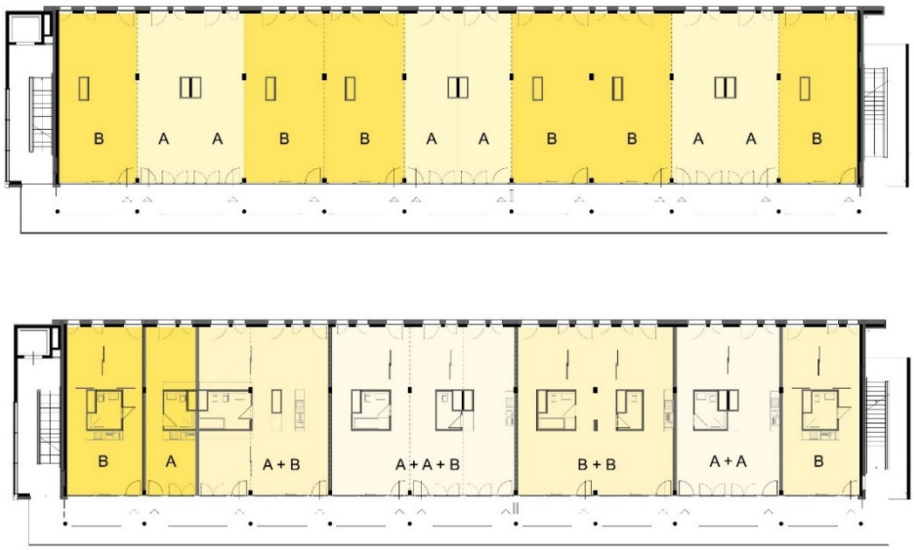


Figure 25. Load-bearing structure and permanent installations (top) Possible combinations and apartment layout (bottom)

Figure 27. LiSA from D13 garden. Ateilierhouse (left) kids' playroom (www.openhouse-wien.at)

Figure 26. Kids' play house (from resident)

Figure 28. Common room (from resident)

Figure 29. Band practice room (form resident)

Figure 31. Common kitchen (from resident)

Figure 30. Rooftop terrace (from resident)

The residents of LiSA feature a wide social mix. From small children with their families, up to elderly people in the two shared apartments for elderly, every age group is represented. The community also includes people of a certain handicap level and originating from foreign countries. The financial threshold for entering the group was, in comparison to other Baugruppen-projects extraordinary low, since no private capital resources were necessary. This created the resident group with a certain income-mix (C. Schwegelbauer et al., personal communication, April 24, 2020).

4.3.4 Study Design

The contact with one member of the Baugruppe was initiated via the address on the community's webpage. Emails provided the basic insights to the project, and with some delay due to the COVID-19 restrictions, the online interview could be carried out with two other residents of LiSA. The information derived from emails and personal communication could be evaluated and narrowed down to produce the survey questions. The online survey was personally shared by the contact persons to generate as many responses as possible. The following chapter describes the findings and how they are reviewed.

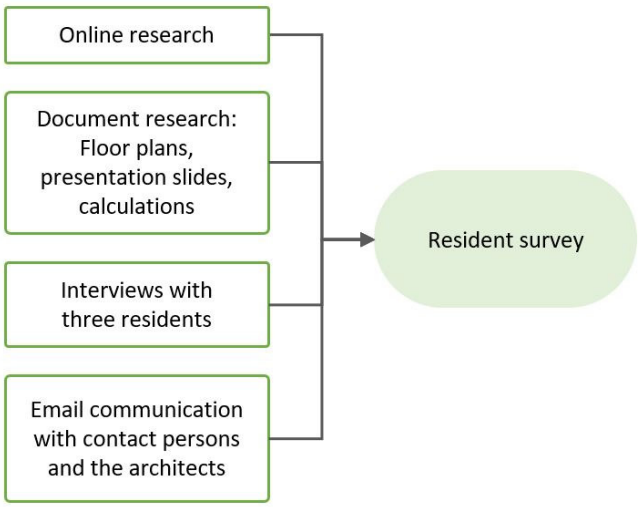


Figure 32. LiSA. Survey Sources (own ill.)

4.3.5 Survey Responses

The survey sent to all 42 regular households within LiSA generated 21 responses (50 %). The respondents consist of eight single-households, seven households with two, four with three, and two with four members. The employed survey respondents work an average of 36 hours per week.

Group participation

The personal communication and the interviews with LiSA residents resulted in an inventory of groups that exist in consequence of sharing spaces and goods collaboratively. The assessed groups are formal and informal and their membership is not obligatory.

The organizational groups are supported by workgroups, permanent groups that take care of particular tasks. Project groups within LiSA are temporary to solve certain issues of the community or building. The common spaces are accessible to all residents and a dedicated person or group takes voluntarily care of the particular space.

Activity/Group	Participants %	Participants (x out of 21)	Hrs per week
Association of members of Baugruppe LiSA (Verein der Baugruppe LiSA)	95,2	20	
Administrative team (Hausverwaltung)	19,0	4	
(Steuerungsgruppe)	57,1	12	
Financial administration	14,3	3	
Workgroup institutional development (Organsiationsentwicklung)	9,5	2	
Workgroup communication	19,0	4	
Workgroup IT	4,8	1	
Workgroup Community	4,8	1	
			2,27
Project group Participation	33,3	7	
Project group resolving construction defects (Mängelbehebung)	23,8	5	
			0,82
Users of common spaces	100,0	21	**3,93**
Maintaining the common spaces as 'Raumpate' (responsible for a certain space)	61,9	13	**0,75**
Total			**7,77**

Table 14. LiSA. Group membership

Almost all residents that responded to the survey stated that they are a member of the members association, and all of them use the shared spaces, some to a very little, others to a big extent. The average time per week that respondents spend with the tasks and activities of the above-mentioned groups ranges between 0 and 17,5 with an average of 7,77.

One comment regarding group participation was that not all workgroups were named. Other groups were not mentioned by the interviewees for some reason.

To measure the impact of sharing spaces and goods on social sustainability in the case of LiSA, the survey asked for ranking the same statements about social sustainability (Table 15). The table displays the average score, ranging from 1 (I do not agree at all) to 10 (I strongly agree). The individual rankings ranged from 1 to 10, with an overall average of 8,21. Residents seem to interpret the influence of sharing on place attachment and proudness rather low why they are overall very satisfied with the community life.

Statement	Range	Score
Sharing makes me feel like I am surrounded by a strong social support network.	5-10	8,43
Sharing creates a sense of community and makes me feel belonging to this community.	1-10	7,90
By sharing, I feel proud of my pace and I feel attached to it.	1-10	7,33
Sharing increases the solidarity between the residents.	3-10	8,48
Sharing increases the safety and security in the community.	4-10	8,43
Overall, I think that sharing fosters frequent and intimate interactions between the residents, compared to housing models where spaces and things are not shared.	4-10	8,71

Table 15. LiSA. Rating of statements on social sustainability

Finally, the residents were asked whether they feel that the benefits and downsides of sharing spaces and things were in equal balance, or if one side outweighs the other. 18 respondents (85,7%) see the benefits predominate, while the others opted for the balanced situation.

Nevertheless, many statements were made, regarding the downsides of sharing within LiSA. Most of them are connected to the shared space or good itself, why they will be addressed in the following chapters. Someone stressed that some groups took decisions internally, while the entire community should be involved. Some people engage a lot, others do less, while everyone is equally involved in the decision-making. This may provoke a perception of injustice since the people that participate less in community life have equal power in decision-making processes. This matches the statement that many views and opinions collide, which can be demotivating for initiatives of other residents. One person stated that it was especially hard to find supporters and participants when you are leading and managing an initiative within LiSA. To maintain peace in the community, all possibly evolving conflicts must be solved, which again is time-consuming and emotionally challenging.
One respondent reported the danger of social exclusion, for example, if one is not invited to a particular (informal) group meeting.

Floor Areas

Residents of LiSA occupy 39,9 m² per person (including individual and shared spaces), while the average value for Vienna in 2018 was 36,3 m² pp. The average apartment size in LiSA is 79,7 m² (excluding loggia, including shared space p.p.), the share of single households in LiSA is 38,6 %, below the Viennese average of 44,3 % in 2018.
As part of the resident survey, it was asked what size of an apartment they would require if they were living in an alternative situation with no access to shared spaces and goods. 11 respondents would need just the same size as their current individual unit, while 10 stated that the alternative apartment would have to be bigger.

The usable floor area per household consists of the sum of individual space and the product of the number of household members with the shared space per person. (An overview and definition of gross- respectively usable space is found next to Figure 23 on page 47)

Individual UFA per household		UFA_i
Shared Spaces within LiSA per household member	+	$(UFA_s/M)*M_h$
UFA per household	=	UFA_h

Household members	Average Apartment Size in m²	Average UFA per person (incl. shared spaces) in m²	Apartment size incl. shared spaces in m²		Desired apartment size in m²
1 person	46,27	50,92	**50,92**	<	**56,47**
2 person	70,36	39,83	**79,66**	>	**75,00**
3 person	90,21	34,72	**104,16**	<	**108,5**
4 person	104,16	30,69	**122,76**	>	**117,50**
Average UFA	68,18	42,21	**77,48**	<	**78,37**
Total UFA			**1.627,12**	<	**1645,78**
Average GFA			**107,61**	<	**108,85**
Total GFA			***2.259,89***	<	***2.285,81***

Table 16. LiSA. Current and desired apartment size compared

The table compares the amount of usable floor area of each household, including the share on common spaces, to the required apartment size in the alternative situation (Table 16). Many households stated that their individual unit would need the exact same size, even though they would

not have access to shared spaces. This indicates that they would occupy a smaller floor area in the individual setting. 10 respondents stated that the alternative apartment would have to be bigger and indicated this with the desired apartment size. Table 16 shows that the sum of the gross floor areas of all responses is currently smaller than in the individual setting. The GFA was calculated by dividing the UFA by the factor of 0,72. The factor was calculated by dividing the entire building UFA by the total GFA. Since the commercial units are not considered in the calculations, they were subtracted, which leaves a GFA for LiSA of 4.953,78 m² (apartments + shared spaces) (see fact sheet LiSA).

UFA per household		UFA_h
UFA/GFA ratio	/	0,72
GFA per household	=	GFA_h

Survey comments included a statement that an additional guest room within the private apartment would be necessary if there was no shared guest apartment. Other respondents emphasized the extreme usefulness and utility of the foodcoop, workshop room and wellness area.

Goods consumption

During the online interview, an inventory of shared tools and devices was created. All things are accessible to each inhabitant of LiSA. It is therefore assumed, that each good must only exist a single time to be sufficient.

Table 17 shows the survey findings and whether sharing results in more or fewer goods that are being consumed. The second column indicates how often the specific good exists in the community for sharing, while the third column is the sum of all people who stated that they own the tool or device individually. The numbers are added up in the fourth column which describes the number of existing items of the same kind. This amount is compared to the number of items that the residents would own if they had no access to them by sharing. The last column shows the percentage of the currently existing items to the alternatively necessary amount. A value below 100 % states that fewer goods are consumed due to sharing, and a value above 100 % states the opposite. If there is no value calculated, this means that there is no need for the tool or device regarded.

Good	# shared	Owned privately*	# existing		Needed privately*	%
Washing machine	3	12	**15**	<	**21**	71,4
Laundry dryer	2	6	**8**	>	**5**	160,0
Printer	1	26	**27**	>	**20**	135,0
Instruments (available in band practice room)	X (8)	8	**16**	>	**5**	320,0
Sewing machines	3	14	**17**	>	**8**	212,5
Electric drill	2	20	**22**	>	**18**	122,2
Bench saw	1	2	**3**	>	**0**	-
Planing & milling machine	1	2	**3**	>	**1**	300,0
Welding machine & equipment	1	2	**3**	>	**0**	-
Other tools & equipment	1	30	**31**	>	**19**	163,2
Sauna or Saunarium	2	4	**6**	>	**0**	-
Movie projector or television screen	1	26	**27**	>	**13**	207,7
Tabletop football	1	4	**5**	>	**0**	-
High-quality (gas) barbeque	1	4	**5**	=	**5**	100,0
Gardening tools	1	4	**5**	<	**7**	71,4
Equipment for children (clothes, toys, furniture, etc.)	0	6	**6**	>	**4**	150,0

Table 17. LiSA. Shared Goods

* Values extrapolated and rounded to whole numbers

‘0’ in the second column indicates informal sharing by private ownership. This exemplifies all items that are shared informally between neighbours within LiSA. ‘X’ states that the item exists in an uncountable amount. Regarding the example of instruments, it was stated how many of them existed in private households despite the possibility to share them. Comparing the columns ‘owned privately’ and ‘needed privately’, one can assume that more people own a thing that they do not actually need. This might be due to a previous necessity of the item that is currently not required anymore. The assumption that surplus things are owned impacts the comparison of Table 17 and it is therefore expected that the numbers indicated in orange would be lower if the residents would only own what they currently need. Some tools and devices turn out to not be needed at all but do exist in collaborative - as well as private ownership.

A respondent to the survey emphasized the generous informal sharing, lending, and donating between residents, from household supply to decoration items. This is seen as a consequence of bonding capital (frequent and intimate interactions) as found in the previous chapter. Furthermore, the equipment of the band practice room and the creative room was praised for offering all tools and supplies that one could neither afford, nor find space for. The well-equipped workshop space is used frequently to build furniture, amongst others (C. Schwegelbauer et al., personal communication, April 24, 2020). Table 17 shows that many shared goods exist more often than necessary. The ability to purchase things collaboratively that one could not afford and host individually displays the additional value gained from collaborative living.
The foodcoop represents a way of sharing food by bulk-purchasing it. This kind of cooperative is a promising trend for the future, but not the focus of this research.

The survey respondents were given the opportunity to address downsides that they experience through sharing. The main notion is the problem that some people have a different understanding of use, care and maintenance, regarding shared goods or tidiness of spaces. Some things were damaged or break as a consequence of wrong use, other things ‘disappear’ because someone did not return them. There is also a potential for conflict if certain things or rooms are used by someone for a long time and therefore not available or accessible if one needs them. As a consequence of this, social tension and even conflicts may appear. This requires a clear feeling of responsibility of all users of a space and of the persons and groups that are assigned to each space. Therefore, clear and extensive communication and interaction are necessary which results in a high administrative effort, which can turn into an exhausting, emotional and time-consuming burden for individuals.

Rent and Costs

English	German	Explanation
Private capital contribution	Eigenmittelanteil	Initial contribution for financing the project (individual for each household)
Recompense (Debt retirement, interest, tax)	Bestandsentgelt (Darlehenstilgung, Zinsen, Umsatzsteuer)	Monthly payment, to pay the loans back, including interest payments and local turnover tax.
Fee for maintenance and improvement work	Erhaltungs- und Verbesserungsarbeiten	Max € 0,74/m² (WWFSG 1989, 2019)
Operating costs	Betriebskosten	Fees for drinking water, sewerage, general cleaning, waste disposal, insurance, maintenance, administration, savings, etc. Costs for common spaces like lifts, sauna, green space, playground Calculated per m² usable floor area
Energy costs	Energie (heating, electricity, use)	Electricity and hot water of households is measured individually District heating of households is divided by apartment surface area Electricity, hot water, and heating for the common spaces are divided by apartment surface area
Membership fee	Vereinsmitgliedschaftsbeitrag	€ 25 per member
(Additional costs)	(Weitere Kosten)	(parking, storage, etc. not considered)
Costs for living	Wohnkosten	Sum of components

Table 18. LiSA. Cost division

The costs for living in LiSA are different for each household. For financing the project, additionally to the municipal loan with a low and constant interest rate and a bank loan at regular conditions, residents could bring in a certain contribution of own capital. To not create a financial threshold for entering the project, this contribution was not obligatory but could be chosen according to the possibilities of each household. Table 18 provides an overview of the monthly payments of each household, according to its surface size. Costs for recompense, maintenance and improvement work, and operating costs are to be paid per usable floor area of the household. Individual costs for electricity and hot water are counted for each unit, while costs for heating as well as all other energy costs are divided equally per square meter individual usable floor area. (C. Schwegelbauer et al., personal communication, April 24, 2020)

The average investment share of this kind was € 595 /m², while the total construction costs per square meter usable floor area were € 2743 (C. Schwegelbauer, personal communication, May 14, 2020). For determining the representative monthly household cost, these average values are assumed, and all costs are spread out across the pay-back period of 35 years. For calculation matters, the investment share is spread over 35 years as well, which makes € 1,42 /m²/month. It is assumed that all households paid the same initial contribution and therefore pay the same monthly recompense. Including an average value for energy costs, the monthly costs are € 11,04 plus the share in initial contribution and the membership fee. Since some households include two persons that are a member of the association, the fee differs but the total monthly costs per square meter in 2020 are on average € 11,67.

Household Members	Average private capital contribution	Average recompense	Membership Fee in € (25€/person)	Total costs in €
1 person	70,48	481,08	25,00	576,56
2 person	107,18	731,59	42,86	881,63
3 person	137,42	937,99	50,00	1.125,41
4 person	158,67	1.083,04	50,00	1.291,71
Average	103,86	708,94	38,10	850,90

Table 19. LiSA. Comparison to market prices

All apartments in LiSA underly the regulations for subsidized housing and are therefore only accessible to a certain group of people. The costs all comply with Viennese legislation but the overall costs are higher than for rental apartments. The cooperative and subsidized form of homeownership is not directly comparable to average rents in Vienna, because they are naturally higher. It must be assumed that all residents would alternatively live in a publicly subsidized apartment since they are entitled to. Nevertheless, average costs of 11,67 €/m² than the monthly rental costs for market price apartments (*Der Preisspiegel für Immobilien in Österreich. Aktuelle Immobilienpreise. Wohnungen Miete Neubau*, 2020).

The Residents were asked whether they would require a bigger apartment floor area if they were not living in a collaborative housing project with shared spaces and goods. The survey showed that they would require a slightly bigger apartment size than what they currently access. This bigger floor area involves proportionally higher monthly costs. Nevertheless, this difference is less than one square meter, and therefore rather insignificant.

In the case of LiSA, the initial private capital contribution was assumed to be equal for all households, and the payback period is 35 years. This was done for reasons of feasibility of calculating comparable monthly expenses per household. The validity of this technique is questionable, as households with a high initial capital investment will finish the payment of mortgage and loan far before 2050, while others will take just 35 years.

4.3.6 Summary LiSA

There is a wide range of residents' perception of the elements of social capital, which suggests that they differ subjectively. This relates to the individual difference of group membership and weekly engagement in groups, as well as to the frequency of use of shared spaces. The values are spread widely but are high on average. Similarly, the responses for rating the bonding capital elements range from 1 to 10 but are overall high. This suggests a generally high level of social sustainability, although it is perceived subjectively different. The gross floor area of LiSA is relatively small due to the building design and apartment sizes, although the difference to the alternative size is marginal. Numerous goods are shared within the community either formal as equipment of the common spaces, or informally between the residents. Nevertheless, it seems like the community consumes more items of certain kinds through sharing, which results in additional costs for individual households. The monthly costs for living in LiSA are determined by collaborative ownership and therefore higher than comparable rental expenses, but still below market rents. Further savings are made because the occupied floor area of the household is smaller due to the use of shared spaces.

4.4 Synthesis B

Research question B addresses the practical impacts of sharing in collaborative housing on sustainability in two Viennese case studies. Both cases were investigated regarding social capital, resource consumption and affordability. All those areas are impacted by the sharing of spaces and goods. Regarding the social dimension of sustainability, sharing creates groups in which the community residents get involved, which again fosters frequent and intimate interactions between the residents. This is supported by the overall agreement that sharing promotes strong social support networks, sense of community and belonging, safety and security, as well as solidarity.

Sharing impacts the floor area of the case study projects. In the case of Pegasus, shared spaces increase the total floor area. The same goes for LiSA, while the size of the common spaces is counteracted by smaller individual units and open access balconies that diminish the total floor area. It furthermore is obvious that the presence of shared tools and devices increases the building size since these take up space as well. On the other hand, the presence of an occasionally used shared space reduces the need for additional individual rooms which impacts the overall floor area more. This is exemplified by the guest apartment in LiSA, because of which residents do not require an extra guest room within their apartment.

Goods consumption is clearly impacted by sharing, both positively and negatively. Some residents use certain shared items and do not own or purchase them individually. For other goods, this impact is rather negative since items are available for sharing additionally or unnecessarily.

Sharing does impact the costs of living regarding rents or ownership costs. The studied cases exemplify different payment models a rental model with the option to buy after ten years, and a model of collaborative ownership. Both are subsidized by the municipality, which shows that it can be economically beneficial to live in a collaborative housing community. The two cases showed different findings regarding the question of whether residents would require a bigger individual floor area if they did not have access to shared spaces and goods. If this was the case, rental costs would be accordingly higher, but this could be prevented by sharing efficiently.

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Cross-Case Analysis

5. Cross-Case Analysis

This chapter aims at comparing and relating the survey findings from both case studies to each other by using the five assumptions concluded on page 32 as a framework. The cross-case analysis helps to review the findings critically and to confirm and support findings from one case by the findings of the other. In this way, similarities and contradictions can be detected and evaluated to draw conclusions. This chapter aims at answering research question C about the effects of sharing in collaborative housing that impact the sustainability of cities in a positive way.

5.1 Case Context Comparability

The cases must be contextually comparable. Therefore, the individual context of both cases is being reviewed in the following paragraphs.

Location

The projects are located literally next to each other in a new development area in the 22nd municipal district of Vienna. The utility level of the neighbourhood for residents both projects can, therefore, be considered as identical. The two buildings nevertheless offer different utility satisfaction to their residents.

Group and residents

Both projects were initiated by applying for permission to build on one of the five plots within the development area that had been assigned to collaborative housing. Five groups were chosen, two of which are the considered case studies, Pegasus and LiSA.
The construction of both projects finished in 2015 when all initial residents moved in. During the design phase, the initiating group of people in Pegasus fell apart and new group members were selected. Since 2015, two apartments changed tenant. The majority of the current inhabitants of LiSA were involved from early on and the constellation of residents is currently identical to the one of 2015.

Legal & institutional context

Both projects are subject to the Austrian and Viennese legislation and regulation and planned and constructed as publicly subsidized housing of different forms. All apartments in Pegasus are legally built and run as subsidized housing, why the municipal institution for social housing (Wiener Wohnen) assigns the tenant for every third apartment that becomes available. LiSA, on the other hand, is legally considered a 'Wohnheim', why all future tenants can be chosen by the community.

Rent & ownership

The two projects are run in different ways. Pegasus was developed and financed by SGN, to whom the tenants pay a certain rent, depending on the use-value (Nutzwert) of their dwelling. After 10 years, the tenants receive the option to buy their apartment. LiSA was partly financed by private capital of future residents, at various rates. The remaining loans are being paid back throughout a planned period of 35 years.
The internal administration of the projects differ since Pegasus is run by the housing provider SGN and mainly organizes community life. LiSA, on the other hand, is entirely self-administrated by its residents.

Size

The communities differ in usable floor area, excluding the commercial units. Nevertheless, they both consist of one main building and are therefore being considered as comparable in size.

	Pegasus		**LiSA**
Apply with case study selection criteria	Yes, fully	=	Yes, fully
Location	Vienna, 22nd district, development area Seestadt Aspern, plot D13	=	Vienna, 22nd district, development area Seestadt Aspern, plot D13
- *Utility level neighbourhood*	All necessities nearby (services, food supply, public transport, etc.)	=	All necessities nearby (services, food supply, public transport, etc.)
- *Utility level within the project*	Shared spaces and goods		Shared spaces, goods, and services
Initiation	Group formation and application for construction site	=	Group formation and application for construction site
- *Group members*	Mostly initiating members		Almost no initiating members
Legal & institutional context	Austrian and Viennese	=	Austrian and Viennese
- *Form*	Subsidized housing Apartments with 1/3 social housing		Subsidized housing 'Wohnheim'
Rent & ownership	Rental with option to buy after 10 years		Pay-back of construction loans additional to different rates of initial capital investment
- *Internal administration*	Only regarding community life		Self-administrated in all aspects
- *UFA*	2.196,63 m²	<	3.505,15 m²
- *Floor Area UFA per person*	41,45 m²	>	37,65 m²
- *Floor Area UFA per apartment*	84,49 m²	>	83,86 m²
- *UFA/GFA ratio*	0,68	<	0,72

Table 20. Case study context comparison

5.2 Sharing of spaces and goods in the case studies

The following paragraphs relate the results of both case studies according to the five assumptions.

> Residents of the community have more frequent and intimate interactions due to sharing

Referring back to the chapter on *Social Sustainability in Collaborative Housing* (p. 21), numerous terms and definitions describe social sustainability in housing. As argued on page 26, sharing can promote community building, create certain synergies, and foster more socially sustainable behaviour by social influence. Buildings that are designed for sharing spaces and goods can promote social interaction and cohesion and build community and relationships.
This research focussed on bonding capital as part of social capital as defined by Lang (Keivani & Shirazi, 2019, Chapter 10) with special attention to the frequency and intimacy of resident interactions. The frequency and intimacy of interactions in both case studies were assessed according to the group participation and the personal perceptions of mutual support networks, sense of community & belonging, pride & place attachment, solidarity, and safety & security in the context of sharing spaces and goods.
More frequent and intimate interactions are promoted by participating in groups that exist due to sharing spaces and goods. Those formal and informal groups exist in both communities, but the residents spend a different amount of time in them. Residents of Pegasus spend less time during

activities of the groups (1,75 hours/week) than residents of LiSA (7,77 hours/week). The participation time shows a wide range between all respondents. Participation is voluntary in all cases and either recommended in the case of Pegasus or expected by the statutes of LiSA. The difference in personal engagement can result in a perception of injustice and a feeling of frustration since some people only benefit from the effort of others. Thereby, some people feel forced to help, knowing that many people do not do so. Relating participation to the intentionality of living in the community is not reasonable, as it was stated in one interview that the assigned residents that could not be chosen by the community seem to be more involved currently than the persons that intentionally joined the community (A. Pissarek et al., personal communication, April 16, 2020). Group participation is not dependent on the number of groups that exist or the number of group memberships since they widely differ in intensity. Persons that hold higher functions (administration, organization, representation) typically invest more time in the community life in both cases. Participation is dependent on many personal factors such as employment and working hours, engagement outside of the community that restrict the free time, or generally a smaller personal need for group interaction. Despite the need of being able to say 'no' to certain tasks, one person mentioned the danger of too much closeness, which blurs the border to private life. In the Pegasus survey, it was mentioned that the participation and intensity of group activities diminished since the beginning. This is also substantiated by the change of needs and community expectations during the years. The shift is towards small and spontaneous meetings. This bears the problem of social exclusion, as mentioned by a resident of LiSA, and may also promote the formation of cliques – groups with a certain strong interest or opinion – that oppose other opinions. Another reason for diminishing group participation is the fact that people start engaging with people from their neighbourhood and are less dependent on social contact within their CH community over time.

The ranking of the statements on the impact of sharing on certain aspects, furthermore, represents a wide variety of perceptions where some persons strongly agree with one statement, while others strongly disagree with the same. Lowest-ranking in both cases was the statement that by sharing, one feels proud of the place and attached to it. The aspect was much lower rated by Pegasus than by LiSA. It, therefore, is concluded that sharing rather diminishes proudness and place attachment, probably because of compromises that are made with the community and dissatisfaction about other people's care for common spaces and goods.
The residents agreed on the statements that sharing increases safety and security and fosters frequent and intimate interactions. The other suggestions on solidarity, sense of community & belonging and a strong social support network were also mainly agreed on. Those outcomes are supported by the comment that people share, lend and donate informally in LiSA

Despite all conflict potential in decision making, a consensus is reached at the end of the day. Frequent and intimate interactions involve challenges and possible frictions. Those can range from disappointment about how others treat the common goods to frustration about the stagnation of projects or opposition. The conflicts require time-consuming and emotionally exhausting efforts.
Facing the possible downsides of sharing, the majority of residents from both projects agree that the benefits outweigh the disadvantages. The enjoyment of the activity of sharing is finally represented by the popularity of informal sharing in both communities (Hamari et al., 2016).

The building has a smaller total floor area per person due to sharing

The ecological footprint of a community can be reduced by higher density. This means that the floor space per person is smaller the literature review suggested that this is the case in some CH projects, but this is not generalizable. Within the topic of resource consumption, this thesis analyses the building floor area compared to the sum of its residents (density) and compares it to an alternative situation,

where no spaces and goods are shared. A lower floor area per inhabitant indicates lower land consumption, as well as energy savings and resource savings by the construction.

Regarding this, an interesting finding is that the residents of Pegasus occupy more floor area per person than the average Viennese and that the average apartment size is bigger than the Viennese comparison. In the case of Pegasus, this might be related to the slightly higher amount of single households, but also to the building location and construction period, for which no recent statistical data are available. Households of all size would have a smaller physical footprint if they could not access shared spaces in the alternative dwelling form. Therefore, the alternative situation would have a smaller GFA (89 % of the current GFA), why the assumption is disproven.

Also, LiSA inhabitants occupy slightly more floor area per person and access a larger usable floor area than average. Nevertheless, the households currently occupy less floor area than they would if they had no access to shared spaces and goods. The GFA is currently 99 % of the GFA of the desired alternative apartment. Comparing both cases, it becomes obvious, that the building design plays a role in the calculations. The current ratio of UFA/GFA is 0,72 in the case of LiSA and 0,68 in Pegasus. The higher value indicates a smaller share of constructional and technical space, compared to a lower value. The main factor here is, that the apartments are reached by access balconies which do make part of the gross building floor area, while the staircase and hallways in Pegasus do. Next to the pure apartment size per person and the size of the common spaces, the design plays a crucial role in the size of the total building floor area.

The residents consume less goods due to sharing

Sharing might reduce resource consumption due to social influence. Especially the use of packaging, distribution and industrial farming can be reduced by collaborative crop growing and food cooperatives. The pooling of resources especially benefits the impact of small households and is essential for reducing the economic throughput of society (see chapter *Environmental Sustainability of Sharing in collaborative housing* on page 27). Environmental sustainability is concerned as resource consumption in the form of goods. Are the sharing practices in the CH communities efficient and are therefore fewer goods consumed?

Both communities share tools and devices on a formal and informal basis. The survey findings show that, in some cases, this results in less resource consumption, like in the case of the barbeque, electric drill and gym equipment in Pegasus, or the case of washing machines and gardening tools in LiSA. Nevertheless, the surveys found that many goods exist either unnecessarily or in addition to actual needs. Many things are unnecessary because the households owned them before they moved into the community where they could and would use a shared object. Examples for this are the table tennis table or printers. More goods are present in LiSA, where many goods are owned additionally to the necessary, partly due to personal preference, like laundry dryers, instruments or sewing machines. To another part, additional ownership results from the opportunity to share the costs between the residents, and the possibility to host them in a space of appropriate size. For example, none of the survey respondents would own a bench saw, a welding machine or a sauna individually, but in LiSA, they have access to those things.

It is therefore difficult to state whether sharing of goods saves resources. Some goods are possessed unnecessarily, but on the other hand, they can be used to create things like furniture and sewing projects, or they are used for recreational reasons. The food coop of LiSA deserves to be mentioned here, referring back to theory. It especially impacts environmental sustainability by its distribution efficiency and the purchase of qualitative goods, featuring products that are bio-certified and are produced nearby.

Households spend less on energy and maintenance due to smaller total floor area per person

Resulting from the finding that the floor areas are not significantly smaller due to sharing, this assumption is disproven. More surface area generally involves more expenses on heating, electricity and maintenance, as found in the literature review. The low costs should rather be explained with the high construction and insulation standards, the efficiency of energy use, and pro-environmental behaviour of the residents. This behaviour might be promoted by social influence which derives from the social aspects of sustainability.

The residents save costs for goods by sharing goods efficiently

For determining whether costs are indeed saved by efficiently sharing goods, some points must be considered. Firstly, most things do currently exist in private ownership although people stated that they do not need them. This results in a high number of existing items of one kind which is even higher than the required number. Secondly, one needs to consider the cost of purchasing the collaboratively used item. Sharing something within the community means that the costs are also shared and therefore affects households financially. Thirdly, many things are shared informally, which were not entirely considered for investigation.
Despite these points, some things are not owned privately because of the opportunity of sharing them, which clearly saves costs. For some things, it does not make any difference, but some things exist way more often than necessary.
The survey outcomes suggest that the latter occurs predominantly although the mentioned concerns must be kept in mind.
It, therefore, remains hard to analyse whether households save significant sums of money because they can access services they would have to pay for. Furniture, for example, could be produced for a cheaper price in LiSA's workshop, but the costs for purchasing the equipment cannot be ignored. In the case of Pegasus, the fitness room was mostly equipped through donations of by the residents, which would make the argument on investment costs invalid. The costs for the accessibility to the room and its equipment could, therefore, outweigh the sum that all users would pay for a public gym subscription or for purchasing the equipment individually.
Whether goods sharing decreases household expenditures depends on whether the household needs access to the item, as well as on the costs for the shared item.

Households pay less rent compared to their desired alternative setting

'Rent' must be viewed as monthly household expenses for dwelling. Residents of both case studies pay less than the market price, which is usual for subsidized housing in Vienna. Pegasus residents would occupy less floor area in the comparable setting and could, therefore, save costs. Residents of LiSA, which has smaller individual units but at the same time more shared space, would demand bigger individual units which involved higher costs.
The assumption is therefore not proven, because the two case studies showed opposing outcomes. It is, nevertheless, possible to save accommodation cost in Vienna by living in a collaborative housing project.

5.3 Further Indications and Reflection on Theory

This chapter aims at linking the case study findings back to the contents of the literature review that was conducted at the beginning of the research process. Many aspects fell out of the research scope and therefore did not receive further attention, while they mostly were notable in the case studies, or help to explain the findings further.

Collaborative housing selection criteria

Collaborative housing in the context of this research was defined as intentional communities with a strong focus on community, that consist of autonomous housing units as well as shared spaces and facilities. Both studied projects were initiated by an intentional community, but in the case of Pegasus, this community changed entirely before the residents moved in. It seems obvious from the interviews that this event influenced the community formation and further aspects such as the social strength of the community and the sharing behaviour. One interviewee described Pegasus as the Baugruppe of the five that represents the typical characteristics of a Baugruppe the least, regarding financing, administration and cost division[13]. In both projects, spaces and goods are being shared since the beginning, but residents of LiSA practice sharing to a greater extent, and continuously refine and extend those practices. This is being exemplified by ideas and wishes that the interviewees had for the future, like implementing carsharing, installing additional electricity-generating solar panels, and using an efficient cooling system (C. Schwegelbauer et al., personal communication, April 24, 2020). The inhabitants of LiSA use the shared spaces and goods more intensively than residents of Pegasus, which, on one hand, relates to the higher number and variety of shared spaces and goods but, on the other hand, might also correspond to the fact that the current inhabitants are responsible for the present building design and its future development according to their actual needs.

Size and typology of the buildings provide no grounds for exclusion of cases, but differences between the two projects were noticed. The building size and the number of inhabitants seems to impact the sharing behaviour in the way that the bigger community provides more and a greater variety of shared spaces and goods that satisfy individual needs of residents better, and therefore are utilized more. The building layouts differ majorly in their entrance and access areas which create different opportunities for encountering other residents.

The projects differ in ownership form, financing strategy and development process. These aspects obviously impact community building. As mentioned above, (the majority of) LiSA's residents initiated the project, financed it, designed the building (together with external advisors like the architects), and own it collaboratively. In the five years of its existence, the occupants did not change. Pegasus was initiated by a group different to the first residents and the project was financed by a developer for subsidized housing, but the group members (initial group, as well as actual inhabitants) did participate in the design process. Two apartments changed tenant since the building's occupation.

A socio-demographical mix of residents is present in both communities, while both are subsidized housing and therefore exclude households above a certain income level.

Although these aspects were not researched in particular, it is concluded that whether the intentional community designed, built and self-administrates the building, impacts the extent to which sharing takes place and therefore how large the impact of sharing on the sustainability is.

[13] Translated from German "Unsere Baugruppe ist, im Vergleich mit den anderen hier, die wenigste ‚baugruppige' Baugruppe." (A. Pissarek et al., personal communication, April 16, 2020)

Local Context

The regional context of the housing communities was chosen because of the particular Viennese experience in affordable housing provision, and the recent CH development in the Austrian capital. Indeed, both projects were realized on a plot that was explicitly assigned to collaborative housing communities by the planners of the Seestadt Aspern area development. It is unlikely that the groups would have formed otherwise, and it is questionable if they could have found a suitable different plot to build. The local institutional context and particularly the subsidized housing practice that provide low-interest construction loans impact the financial feasibility of both projects while ensuring their affordability.

Although the large-scale housing cooperatives are established well in the City, bottom-up collaborative housing projects emerged, like the flagship project 'Sargfabrik' which was developed in the 1990s. This project is, just like LiSA, legally run as a 'Wohnheim' which accentuates another aspect of promoting collaborative living models. The variety of households and tenure structures in collaborative housing require diverse legal models that enable the development.

Finally, both Baugruppen were co-initiated, co-planned, and co-constructed (to a great extent, in the case of Pegasus), which classifies them a Viennese Baugruppe according to Lang & Stoeger (2018).

Sustainability

The studied cases were accessed regarding their social, environmental, and economic sustainability. This broad scope was chosen intentionally, since the three concepts are highly interdependent, and it is often criticised that research only focuses on one of the aspects. Nevertheless, to make the scope of the research work feasible, the scope of the individual points needed to be narrowed down extremely.

Social sustainability was defined as social capital (bonding capital) and assessed by the frequency and intimacy of resident interaction in the community. Analysing the case studies, the interdependencies of different aspects of social sustainability and the vagueness of the borders between different terms, became evident. Vitality, solidarity and a common sense of place, according to Yiftachel & Hedgcock (1993) could be assessed, as well as strong social networks, social cohesion, social inclusion and wellbeing according to Williams (2005a). This explains the accuse that *social sustainability* became an ambiguous term that gives a positive notation in all kind of context.

The case studies furthermore reveal the problems like social pressure, disappointment or a lack of privacy that seem to be handled and resolved through the high level of social capital within the community.

Environmental sustainability in practice is not only about the set focus areas of population density and resource consumption. The studied cases were built recently according to current sustainable construction standards and therefore were both awarded for their energy efficiency. By collaborative investment, sustainable technologies could be implemented. The individual consumption behaviour must be assessed by numerous aspects, but the case study findings suggest that social influence fosters environmentally sustainable behaviour of the individuals, as found by several other scholars. Two main factors impacting environmental performance according to Daly (2017), are food and transport. The implementation of the food coop in LiSA exemplifies environmentally friendly grocery supply by purchasing and redistributing organic and other high-quality foods and at the same time, reducing transport by less required shopping trips.

Economic sustainability was only reviewed in terms of household expenses for the occupied floor area and the consumption of goods. Referring to economic justice, both communities are accessible to a wide range of households of low and medium income since they are classified as affordable housing. Thereby, households can even afford (collaborative) homeownership as shown by LiSA. Nevertheless, this model is distinct from social housing in Vienna, which is provided to households with very low or no regular income. The category furthermore excludes households above a certain income threshold. The provided subsidies for developing affordable housing impact the financial feasibility of the project, while maintaining affordable monthly costs for the households.

Sharing

Sharing was considered as spaces and goods within the CH community only. The literature review displayed various categorizations of sharing, referring, for instance, to Agyeman et al. (2013). Besides things, one can also share services and experiences on different levels, which was also practised by the studied communities like the service of a food coop for the collective, public events, or skill-sharing on the individual or collective level.

The practice of sharing is being learnt by children that are growing up. Similarly, persons that moved to a CH community adjust their behaviours gradually. This change is visible when looking at the five years during which the residents have lived there. If residents accustom to sharing, the number of additionally owned goods should decrease, as things break and are not replaced because you can use a shared item, or private things are sold or donated because you don't use them anymore. This must be considered when proposing collaborative consumption in other contexts, for example in car-sharing. The target group must adjust its expectation and behaviour to the possibility of using a shared car. Once the personal benefits of sharing (e.g. sustainability, financial savings, service quality) outweigh the downsides (e.g. restricted accessibility, feeling of inferiority), the private car is being sold and the person starts using a shared car. Reasons of households to share were not researched in particular, but it is obvious from personal communication, that the majority of the residents did rather decide for CH because of the communal focus and other benefits like the affordability or the high utility level, rather than for the desire to share. This reflects the statement by Hamari et al. (2016) that a positive attitude towards collaborative consumption is created not only through perceived sustainability but also through enjoyment and economic gains.

The design principles by Elinor Ostrom to govern shared resources sustainably are present in collaborative living, although they seem to rather be a set of social rules and common sense, than strict regulations. Boundaries, rules, and procedures are set in the statutes of the community which you acknowledge by being a member of the association or by signing the tenancy agreement. Living together closely by sharing spaces and goods also requires social rules. Cases of sanctions for breach of rules were not researched in particular, but there are conflict-resolution mechanisms like assigned mediators. The group organizes and manages itself, more or less, independently and choices are made collectively, mostly consensus-based, by the association members.

The assessed sharing practices include product-service systems, redistribution markets and collaborative lifestyles, according to Botsmann & Rogers (2010), exemplified by the food-coop as service, selling, borrowing, or gifting items to community members as a redistribution market, and sharing spaces and goods in a collaborative lifestyle.

The rivalry and exclusivity of the shared spaces and goods within the particular communities range from low to high on both sides. Sharing under low exclusivity and rivalry is exemplified by the outdoor space. Sharing under higher exclusivity or rivalry is practised by the members' access to shared spaces, goods, and services, like the building access or the right to use the tool banks in the shared spaces. The gained insights were not deep enough to validate sharing on the level of high exclusivity and rivalry, which is possibly also practised within the community.

5.4 Synthesis C: Positive impact of sharing

This chapter answers research question C in the quest for the positive impacts of sharing on sustainability in collaborative housing.

Sharing **promotes frequent and intimate interactions** through group participation, which increases social capital. This closeness of the residents and their interdependence and common responsibility naturally bears conflicts. It requires immense administrative and communicative effort to solve such conflicts and take decision based on the consensus of everyone. Most residents agree that the benefits outweigh the downsides of living collaboratively.

Sharing spaces does not impact the density in a positive way because of the construction of shared spaces. Rather than by sharing**, density is impacted by building design and user preferences** regarding the size of the apartment and the shared spaces.
Goods sharing does not reduce resource consumption since it offers the opportunity to access more things than necessary. Nevertheless, this increases the utility level of the residents and, furthermore, promotes resident interactions that impact the social aspects of sustainability.
Since the population density is not increased by sharing, **no cost savings** can be expected thereof.
Sharing goods does not necessarily save costs but increases the utility level and resident interaction. Cost savings depend on if (and how many) households need a specific thing and on how much the collaborative purchase costs.
Similarly, the **costs for accommodation** are dependent on user preferences regarding the size of the individual space, and the offered shared facilities. Although it cannot be generalized that living in a collaborative housing community is cheaper than in an alternative subsidized apartment, the two examples show that it is possible to build in this price range and even pay less money than for an alternative subsidized house. User preferences should lead the design development, to make the building as efficient as possible for its users.

The study looked particularly at urban examples of collaborative housing and resulted in two main findings on how collaborative housing communities that practice sharing effectively act as catalysts for making future cities more sustainable.

1. Collaborative housing is one specific form of various housing forms that exist within a neighbourhood (Figure 2). Assumed that this community is more sustainable by practising sharing, the neighbourhood and therefore the entire urban area can be considered as more sustainable than a compared area that does not include such a CH community.
2. The current (or optimized) sharing practices can not only benefit existing and planned residential projects but also bigger-scale developments. For example, a food-coop that redistributes local and organic food on the neighbourhood level exists in the Seestadt Aspern (C. Schwegelbauer et al., personal communication, April 24, 2020). Furthermore, a car-sharing service could be initiated for residents of a certain building or community, as well as on a neighbourhood- or city level. Such services could also be scaled-up from small initiatives.

No matter how great the impact of a specific measure might possibly be, the effectiveness will remain dependent on the citizen's ability and willingness to participate. Drivers for participating in sharing and therefore adjusting current behaviour patterns are for example the desire for a more environmentally sustainable lifestyle, more social interdependence, and economic benefits. Such desires change the user preference from owning individually to participating in sharing. Nevertheless, users naturally consider downsides like restricted accessibility, interdependence, and inconvenience that must be outweighed by the perceived benefits of sharing. Slowly but steady, as exemplified by the five-year existence of the studied CH communities, behaviour patterns can be adjusted.

1 2 3 4 5 6

Conclusion

6. Conclusion

The main research question is: How does the concept of sharing in collaborative housing increase the sustainability of cities? Existing literature on the topics of sustainability and sharing in collaborative housing was consulted and provided insights into the possible effects of sharing on sustainability. Those findings were narrowed down to key arguments that were tested by two particular case studies in Vienna. The collaborative housing communities exemplified different ownership models, and a variety of sharing practice and therefore provided diverse indications of sustainability increase by sharing. Finally, this was put into the context of the urban area, as suggested in the introduction.

Sharing can impact the social, environmental, and economic sustainability both, in a positive and negative way. **Social sustainability** was found to increase by sharing spaces and goods since it promotes frequent and intimate interactions and therefore social capital. The effects on social sustainability are furthermore enhanced by a joint initiation and planning process, collaborative (private) ownership, and self-governance of the community.
The case studies showed that sharing offers no automatism of a smaller surface area but showed that aspects like the building layout and the user preference can positively impact space consumption.
The impact of sharing tools and devices on sustainability is dependent on how many of them were owned by the residents before moving to the community - or are owned privately despite the opportunity of using the shared one. Sharing of goods can also result in the presence of additional goods that none of the households would own individually. Sharing provides, therefore, no automatism for more sustainability but bears the unused potential to make living more **environmentally sustainable**.
Monthly costs for the households are below the market rent as they qualify for Viennese subsidized housing. This also goes for other affordable housing projects, so it is not clearly attributed to sharing. The resource consumption is impacted by the kind of tools and devices that are shared. The question here is, how many of them are present within the community above the necessary number. User preference and resident involvement in equipping and furnishing are the key concepts to an efficient building structure. The studied communities do not display **economic sustainability** particularly through sharing, but present possibilities to reduce expenses by sharing.

Sharing in CH showcases applications of sharing and tests their impact on sustainability in practice. Lessons can be drawn for the urban context by looking at the experiences on the community scale. For implementing sharing practices in other residential projects or at an urban scale, the citizen's preference and participation are essential. Overall, the extent to which sharing practices are purposefully utilised defines the degree of the positive impact that the measures have on sustainability.

Discussion

The research shows how sharing can increase the sustainability of cities based on collaborative housing communities. Urban CH communities exemplify how to live more sustainably by sharing spaces and goods. Residents of such projects decided for this lifestyle due to different reasons, like the desire for community, previous positive experience, or they get accidentally involved in search of a subsidized home (C. Schwegelbauer et al., personal communication, April 24, 2020; K. Themeßl-Huber & B. Keceli Meszaros, personal communication, April 18, 2020). The aspects of a more socially, economically, but especially environmentally sustainable life are usually involved, but not the main reason. Although it is appreciated by many, it seems like the effective sustainability of sharing is achieved rather by coincidence by desiring a higher standard of living through sharing.
This poses the idea that deliberately choosing the concept of sharing for contributing to urban sustainability brings forward even more sustainable communities. Referring to recent developments as collaborative consumption and its impact on society, sharing seems to shape the future of society. Its benefits should be utilized in housing development and would, therefore, be a crucial element of future urban development in the quest for more sustainable cities. An urban development area, besides the Seestadt Aspern, aiming at increasing sustainability by collaborative consumption is the Binckhorst area in The Hague, Netherlands. For instance, the individual mobility provider Hely currently opened a branch there, where subscribers can rent (electrical) bikes, cargo bikes, and cars (Hely.com, 2020).

Each individual household has different requirements and priorities regarding its accommodation, besides the size and amenity level. The case studies displayed two different models of use: renting an apartment and collaboratively owning a building. Those models influence the household's perception of the place, their integration in the community and the utilization of shared spaces and goods. Research on this specific indicator with regards to sharing could provide further insights into the motivation for – and effects of – sharing on the overall sustainability. Comparing the two groups shows that the project initiation highly impacts the formation of community and therefore the sharing practices and their impact on community sustainability. The case study that was initiated by most of its current members and is entirely run by them, implements more sharing practices than the other community with later community formation, which is developed and run by a housing provider.

The community life and the effectiveness of sharing are shaped by personal involvement and group integration of individuals. This is influenced by multiple aspects as the socio-cultural context and demographic compositions of households and the character traits of individuals. Individuals must be willing to share and collaboratively extend and improve the practices. The extent to which effective sharing is practised makes the difference. Despite the heterogeneity of household composition, the local institutional and cultural context must be considered. The Viennese government particularly supports subsidized housing, while other governments impact the market developments in a different way. Other cultural preconditions also influence resident behaviour and the possible implementations of sharing practices differently.
It must not be overlooked that the collaborative lifestyle requires a certain level of participation and engagement, which consumes time and money. On top of this, trade-offs must be considered, as you can never be sure whether the required space or good is available at the moment in which you need it. Therefore, other subsidized models should be considered when looking for one's ideal household accommodation, as collaborative housing and sharing is not the best option for everyone.

In their briefing of sharing cities, Agyeman et al. state that "A reinvention and revival of sharing in our cities could enhance equity, rebuild community and dramatically cut resource use" (Agyeman et al., 2013). The findings of this research on sharing in collaborative housing in 2020 emphasize on the word 'could'. Agyeman et al. (2013) seem to be right when they state that the opportunities for more sustainable cities provided by modern technologies are currently being overlooked.

Recommendations

Recommendation for research

The community behaviour, as well as the sharing practices, developed over 5 years and will change in the coming years. In this way, the community discovers what is crucial for them and what has less significance. It might, therefore, be beneficial to study the same cases again in five or ten years, or to study the development of sharing practices of other cases.

This project provided interesting insights into the practice and effect of sharing spaces and goods in collaborative housing. This sort of research should be conducted within the same local context to determine different possible ways of pursuing a collaborative lifestyle. Furthermore, it is worthwhile to consider other local and cultural contexts, how sharing practices occur within them, and how effective they are.
On top of this, it is recommended to relate the scale of existing housing communities to bigger scales and determine how the small-scale operating experience might be used beneficially.

Sustainable resource management is ensured by a set of variables which Ostrom named design principles (Ostrom, 1990, p. 90). From the research, they all seem to apply to sharing in CH. This connection should be tested by assessing CH communities according to those factors.

Recommendation for future development

To ensure sustainable future urban development, it is suggested to purposely implement sharing practices and mechanisms. Sharing is rooted in modern society but fell into oblivion in times of societal welfare and individualism. Sharing Economy currently gains popularity and can likely improve the sustainability of future cities.
Sharing in collaborative housing showcases contemporary practice with downsides and benefits that can be optimized and implemented in further housing projects, as well as on other scales as neighbourhoods and districts. To ensure economic sustainability, cost and use should be weighed carefully. Implementation of sharing services (supply) and user preference (demand) seem to develop concurrently since the market players influence each other. Regarding overall sustainability, the developed infrastructures must be flexible and adaptable since the needs and preferences of users change over time. (Future) user preferences should lead the design process.

Recommendation for CH communities

Consider the CH sharing practices as a real-live experiment and keep on improving efficiency. Add it to the agenda of your community to improve sustainability, especially regarding the use of shared tools and devices. If some new item is required, consider whether it already exists within a household that does not use it. In this way, sharing can effectively minimize costs and consumption. Share your positive and negative experiences with others and try to involve a variety of people into the community by low financial thresholds and a welcoming and helping environment.
Look out for your fellow community members. Social exclusion is not automatically resolved by living in a community or sharing spaces and goods. Catch up with people that might feel excluded and organize a variety of activities that are appealing to many people. Support each other's initiatives, especially when it is difficult to get things moving. Finally, value the benefits you have through sharing and take the responsibility that everything is properly taken care of. Take this responsibility out of gratitude and in service for the other community members that try to do the same.

Reflection

Position

This work at hand is the final step of graduating from TU Delft's study program Management in the Built Environment (MBE). This program was chosen out of personal interest as it describes itself, amongst others, as working 'towards a sustainable built environment where the interests of the end-user and other stakeholders are key', and the department educates the 'next generation of managers in the built environment' (Delft University of Technology, 2020). While the skills in the field of management are beneficial in any personal or professional stage of life, this work was mainly concerned with the topic of sustainability. The department of MBE includes the chair of Housing Management, which connects the topics of socio-economic and environmental sustainability to the housing market, with an increasing interest in collaborative housing initiatives.
Contrasting to the established focus on strong and important stakeholders and institutions, the topic of this thesis purposely deals with the built reality of medium-scale resident-initiated housing developments. Building on contemporary theory on sustainability in collaborative housing (CH), it is investigated how realized projects perform with regards to social, environmental and economic sustainability. The purpose is to provide insights to a wide audience of different institutional levels into possible and functioning solutions that may benefit housing development in the long term.

Scientific Relevance and limitations

Besides a personal interest and societal relevance, the topic regards various fields of scientific interest. The concept of sharing is as old as modern humans, but it recently receives increased interest, especially in the sense of sharing economy and collaborative consumption (Agyeman et al., 2013; Hamari et al., 2016). Sharing spaces and goods is one of the key underlying concepts of collaborative housing projects and it, therefore, seems likely that there is a connection to the oftentimes praised sustainability of CH projects (Lang et al., 2018; Williams, 2005a). The importance of looking at all three aspects of sustainability - social, environmental and economic – simultaneously and the uncertainty about how sustainable collaborative housing really is, suggests the need for further research and prioritization in future planning and policy (Daly, 2017; Jarvis, 2011; L. Tummers, 2016; Williams, 2005a). The research topic is furthermore supported by scholars who demand more research and critical reflection on sustainability in collaborative housing (Lang et al., 2018).

Limitations occur in the form of the restricted research scope, weakness within the methodology and problems in the data collection, as well as in the transferability.
To keep this work within an appropriate timeframe with a manageable workload, it was only possible to look at one specific focus area within the three sustainability aspects. This restriction naturally weakens the overall work due to possibly disregarded aspects in a strongly interrelated research field. This goes not only for the three-fold sustainability but also for the concept of sharing and the context of collaborative housing.
Consequently, the research methodologies are limited to the necessary to efficiently answer the research questions. In this sense, it was not possible to apply supportive methodologies simultaneously to determine answers from various viewpoints. Those restrictions are reflected in the data collection. Oftentimes, a different angle comes in handy for filling a specific gap in the found data. Within the case studies, gaps within the desktop research could be filled by the interviewees, while the thereof resulting problems could be clarified by personal communication via email and telephone. The resilience of the research strategy was proven by the sudden event of a global pandemic that resulted in the cancellation of all site visits and personal interviews. The physical presence and experience on-site would have been beneficial to understand the project better and deeper than by the online interviews. This shifted the data collection methods from personal contact to online communication. In some situations, the data collection would have been easier and more direct by sitting together and discussing solutions. A visit to both projects is planned as soon as the travel restrictions allow for it.

A limitation in the variety of viewpoints is apparent. The persons that volunteered to be interviewed all belong to the group of residents that is rather involved in community activities and therefore may have biased positions. Persons with opposing experiences or unsatisfaction about the situation did not take the word. Those people should equally be addressed by the resident survey, that was distributed to everyone. The possibility remains that persons that are less involved did not take the chance to fil in the survey why the outcome might still not reflect the average opinion. Therefore, the answers should not be generalized for all residents of the two case studies.

Additionally, it is not possible to generalize findings to all collaborative housing communities in Vienna or on a bigger scale. Each project is individual (in context, structure, administration, etc.) and requires an individual approach of research. The presented case study findings show possible outcomes for a different setting, but do not grant any of them.

Regarding the application of the research findings, it is referred to the recommendations for future development and collaborative housing communities. The whole of this report at hand should not only provide insights regarding future urban planning and development but also inspire forming and existing communities to apply efficient sharing practices to contribute to more sustainable cities.

Reflection on ethical concerns

Research on housing and resident behaviour can easily get personal since the researcher tries to get a deep insight into the private lives of interviewees and survey respondents. During this work, some social issues were encountered that challenged the researcher in staying professional and nonbiased.

As mentioned above, there is a risk to mainly consider the opinions of persons that actually raised their voice in the interview or survey. This results in biased and subjective findings that do not reflect the common opinion like it is assumed. This issue was tried to be overcome by particularly addressing all residents with the survey. Nevertheless, there could be done more by getting in personal contact, for instance.

Questions on life in the community and especially on the involvement as well as on the sharing habits require a willingness of the residents to answer freely and honestly. Even though one cannot imagine any reason for not sharing certain content, a respondent might feel uncomfortable, humiliated, or as if he might betray someone else with his/her answer. Aiming to respect the free will, dignity and privacy, and expecting honest answers, it was clearly stated in the beginning that any answer can be denied, without giving any reason. Furthermore, all interview respondents receive an extract of the P4 report to check whether any statements humiliate their reputation or are otherwise not to be shared.

Conducting the group interviews, some clash of experiences or opinions was recognized. Topics like group involvement and personal engagement were charged with emotions like a feeling of injustice, compulsion or disappointment. Even though the interviewed persons were rather homogenous regarding their community engagement, they had slightly opposing positions regarding sensitive issues. An example would be opposing perceptions about how group participation looks like and the resulting possibility to automatically blame people that engage differently. The interviewer tried to understand each personal perception from a neutral standpoint and see where the opposing ends meet. Not wronging anyone, but at the same time getting a good understanding of the situation and the issues, took effort and was tried to achieve by attentive listening and asking careful questions that are critical, but also respecting dignity and privacy. By listening back to the interview recording, it was tried to draw conclusions that were as objective as possible.

The case studies aimed at discovering the sharing practices that foster sustainability in collaborative housing communities. Most people actively chose for this way of living, including the aspect of sharing

certain spaces and goods collaboratively. This is a personal decision that would not equally be taken by every other person out of a free will and according to their individual expectation towards living. Sharing in collaborative housing offers one path towards more urban sustainability but is not the one-fit-all solution and, therefore, cannot be imposed upon every person living in an urban environment. It is emphasized that this was not the goal of this study as it is assumed that people have different desires and needs, and different expectations from living together in a pleasing and dignified way.

Reflection on the research process

Starting the work was difficult due to a wide range of interest and countless options for focussing a one-year research on. It took most of the time, numerous research questions, methodological frameworks and plenty of literature research to define the final path to be taken. For a person with many interests, it is helpful to choose a research topic with tight restrictions or according to one pre-set research question. The process was longsome and cost a lot of writing and reflecting but finally led to a clear plan for action. Of course, the entire process was overshadowed by the sudden restriction of public life which not only impacted the research methods but also the communication with the supervisors. Communication was possible via email which delays the responses. Scheduling video calls proposes a good alternative but requires planning and therefore does not immediately answer relevant questions that are necessary for moving on. Instead, fellow graduating students, the internet, and literature on research methods were consulted. Knowing that the circumstances were not convenient for anyone, it would have been helpful to receive more frequent and detailed feedback than only the necessary comments and advice after a presentation.

This graduation process had phases of less and more intensity, mainly due to own time management because of the involvement in some projects next to graduation. The freedom was perceived as pleasing and involved the learning effect of setting priorities and work effectively on different projects at the same time.

References

Agyeman, J., McLaren, D., & Schaefer-Borrego, A. (2013). *Briefing Sharing Cities*. Friends of the Earth. https://friendsoftheearth.uk/sites/default/files/downloads/agyeman_sharing_cities.pdf

Belk, R. (2007). Why Not Share Rather Than Own? *The ANNALS of the American Academy of Political and Social Science*, *611*(1), 126–140. https://doi.org/10.1177/0002716206298483

Belk, R. (2013). You are what you can access: Sharing and collaborative consumption online. *Journal of Business Research*, *67*(8), 1595–1600. https://doi.org/10.1016/j.jbusres.2013.10.001

Botsman, R., & Rogers, R. (2010). *What's mine is yours: The rise of collaborative consumption* (1st ed). Harper Business.

Bryman, A. (2015). *Social Research Methods* (5th edition). Oxford University Press.

Carlsson-Kanyama, A. (2004). Collaborative housing and environmental efficiency: The case of food preparation and consumption. *International Journal of Sustainable Development*, *7*(4), 341. https://doi.org/10.1504/IJSD.2004.006413

CollaborativeHousing.org.au. (n.d.). *Explore stories*. Collab Housing. Retrieved October 18, 2019, from https://www.collaborativehousing.org.au/stories-explore-stories

CollaborativeHousing.uk. (n.d.). *Types of Community-led Housing*. Retrieved October 24, 2019, from https://collaborativehousing.org.uk/about/clh-types.html

CW Delft. (n.d.). Retrieved February 2, 2020, from https://www.cwdelft.nl/

Czischke, D. (2017). Collaborative housing and housing providers: Towards an analytical framework of multi-stakeholder collaboration in housing co-production. *International Journal of Housing Policy*, *18*(1), 55–81. https://doi.org/10.1080/19491247.2017.1331593

Czischke, D., & Huisman, C. J. (2018). Integration through Collaborative Housing? Dutch Starters and Refugees Forming Self-Managing Communities in Amsterdam. *Urban Planning*, *3*(4), 156. https://doi.org/10.17645/up.v3i4.1727

Daly, M. (2017). Quantifying the environmental impact of ecovillages and co-housing communities: A systematic literature review. *Local Environment*, *22*(11), 1358–1377. https://doi.org/10.1080/13549839.2017.1348342

Davidson, M. (2010). Social Sustainability and the City: Social sustainability and city. *Geography Compass*, *4*(7), 872–880. https://doi.org/10.1111/j.1749-8198.2010.00339.x

Davidson, N. M., & Infranca, J. J. (2016). The Sharing Economy as an Urban Phenomenon. *Yale Law & Policy Review*, *34*(2), 66.

Delendi, M. L. (2017). Sustainable Living Models. *International Journal of Sustainable Development and Planning*, *12*(04), 772–779. https://doi.org/10.2495/SDP-V12-N4-772-779

Delft University of Technology. (2020). *Management in the Built Environment*. TU Delft. https://www.tudelft.nl/en/architecture-and-the-built-environment/about-the-faculty/departments/management-in-the-built-environment/

Dempsey, N., Bramley, G., Power, S., & Brown, C. (2011). The social dimension of sustainable development: Defining urban social sustainability. *Sustainable Development*, *19*(5), 289–300. https://doi.org/10.1002/sd.417

Der Preisspiegel für Immobilien in Österreich. Aktuelle Immobilienpreise. Wohnungen Miete Neubau. (2020, May). immopreise.at. https://immopreise.at/Wien/Wohnung/Miete/Neubau#cl252

Dezernat Statistik Wien. (2019). *Statistisches Jahrbuch der Stadt Wien 2019*. Magistrat der Stadt Wien.

Dixon, T., & Woodcraft, S. (2013). Creating strong communities – measuring social sustainability in new housing developmen. *Town & Country Planning*, 8.

Fromm, D. (1991). *Collaborative Communities: Cohousing, Central Living and Other New Forms of Housing with Shared Facilities*. Van Nostrand Reinhold.

Fromm, D. (2012). Seeding Community: Collaborative Housing as a Strategy for Social and Neighbourhood Repair. *Built Environment*, *38*(3), 364–394. https://doi.org/10.2148/benv.38.3.364

Goldsmith, E. B., & Goldsmith, R. E. (2011). Social influence and sustainability in households: Social influence and sustainability in households. *International Journal of Consumer Studies*, *35*(2), 117–121. https://doi.org/10.1111/j.1470-6431.2010.00965.x

Groschopf, D., & Trojan, M. (2013). Der geförderte Wiener Wohnungsneubau. *Planerin 4/13: Wohnungspolitik. Positionen - Instrumente - Beispiele*, *4/13*, 3.

Hagbert, P., Gutzon Larsen, H., Thörn, H., & Wasshede, C. (Eds.). (2020). *Contemporary co-housing in Europe: Towards sustainable cities?* Routledge.

Hamari, J., Sjöklint, M., & Ukkonen, A. (2016). The sharing economy: Why people participate in collaborative consumption. *Journal of the Association for Information Science and Technology*, *67*(9), 2047–2059. https://doi.org/10.1002/asi.23552

Heinberg, R. (2010). What is Sustainability? *The Post Carbon Reader: Managing the 21st Century's Sustainability Crisis*. http://www.fusbp.com/wp-content/uploads/2010/07/What-is-Sustianbility.pdf

Hely.com. (2020). *Hely*. Hely Hub The Hague. https://www.hely.com/denhaag/?lng=en

Jarvis, H. (2011). Saving Space, Sharing Time: Integrated Infrastructures of Daily Life in Cohousing. *Environment and Planning A: Economy and Space*, *43*(3), 560–577. https://doi.org/10.1068/a43296

Keivani, R., & Shirazi, M. R. (Eds.). (2019). *Urban social sustainability: Theory, practice and policy*. Routledge, Taylor & Francis Group. https://books.google.nl/books?hl=de&lr=&id=09mEDwAAQBAJ&oi=fnd&pg=PA193&dq=vienna+co-housing&ots=aWU7d2aiAx&sig=Im0F-XfzTA3MBtEpD1iSXgYfnvw&redir_esc=y#v=onepage&q=vienna%20co-housing&f=false

Krokfors, K. (2012). Co-Housing in the Making. *Built Environment*, *38*(3), 309–314. https://doi.org/10.2148/benv.38.3.309

Kuhlman, T., & Farrington, J. (2010). What is Sustainability? *Sustainability*, *2*(11), 3436–3448. https://doi.org/10.3390/su2113436

Lamberton, C. P., & Rose, R. L. (2012). When is Ours Better than Mine? A Framework for Understanding and Altering Participation in Commercial Sharing Systems. *Journal of Marketing*, *76*, 17.

Lang, R., Carriou, C., & Czischke, D. (2018). Collaborative Housing Research (1990–2017): A Systematic Review and Thematic Analysis of the Field. *Housing, Theory and Society*, 1–30. https://doi.org/10.1080/14036096.2018.1536077

Lang, R., & Stoeger, H. (2018). The role of the local institutional context in understanding collaborative housing models: Empirical evidence from Austria. *International Journal of Housing Policy*, *18*(1), 35–54. https://doi.org/10.1080/19491247.2016.1265265

Ludwig, D. M. (2017). Das Wiener Modell – der soziale Wohnungsbau in Wien. *Jahrbuch 2017 mit Sachverständigenverzeichnis. Berlin 2017 p. 22-35*, 12.

Marckmann, B., Gram-Hanssen, K., & Christensen, T. H. (2012). Sustainable Living and Co-Housing: Evidence from a Case Study of Eco-Villages. *Built Environment*, *38*(3), 413–429. https://doi.org/10.2148/benv.38.3.413

Moldan, B., Janoušková, S., & Hák, T. (2012). How to understand and measure environmental sustainability: Indicators and targets. *Ecological Indicators*, *17*, 4–13. https://doi.org/10.1016/j.ecolind.2011.04.033

Nelson, A., & Schneider, F. (2018). *HOUSING FOR DEGROWTH: Principles, models, challenges and opportunities.* ROUTLEDGE. https://books.google.nl/books?hl=de&lr=&id=XLZoDwAAQBAJ&oi=fnd&pg=PT69&dq=Rethinking+home+as+a+node+for+transition&ots=TicYkFEber&sig=bypGA_hcnfcygJXeSHuk4NkTihg&redir_esc=y#v=onepage&q=sharing&f=false

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press.

Ostrom, E., Chang, C., Pennington, M., & Tarko, V. (2012). *The Future of the Commons—Beyond Mrket Mailure and Government Regulation*. Institute of Economic Affairs Monographs, 2012;

Indiana University, Bloomington School of Public & Environmental Affairs. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2267381

Pissarek, A. (2020, April 16). *Vortschreibung Miete, D13 plan* [Personal communication].

Pissarek, A. (2020, April 22). *Wohnform und Gebäudefinanzierung* [Personal communication].

Pissarek, A. (2020, September 4). *Pegasus Überblick WNF und Bw Stand 2020_04* [Personal communication].

Pissarek, A., Baldass, G., & Schnepf, D. (2020, April 16). *Pegasus interview I* [Zoom].

Prudic-Hartl, S. (2017). *Programme for the International Building Exhibition Vienna 2022*. IBA_Wien 2022 - Neues soziales Wohnen. https://www.iba-wien.at/fileadmin/user_upload/documents/IBA_Wien_Programmatik/IBA_Memorandum_en_online.pdf

Rijksoverheid. (2020). *Wat is de huurliberalisatiegrens?* Rijksoverheid. https://www.rijksoverheid.nl/onderwerpen/huurverhoging/vraag-en-antwoord/huurliberalisatiegrens

Scheller, D., & Thörn, H. (2018). Governing 'Sustainable Urban Development' Through Self-Build Groups and Co-Housing: The Cases of Hamburg and Gothenburg: GOVERNING 'SUSTAINABLE URBAN DEVELOPMENT' THROUGH SELF-BUILD GROUPS AND COHOUSING. *International Journal of Urban and Regional Research*, *42*(5), 914–933. https://doi.org/10.1111/1468-2427.12652

Schwegelbauer, C. (2020, April 24). *Weiner Wohnbaupreis, Klimaaktivpreis 2015, Solarpreis 2017, Klimaaktivpreis 2019 als Teil des Ensembles Hannah Arrendt Platz* [Personal communication].

Schwegelbauer, C. (2020, May 14). *Baukosten* [Personal communication].

Schwegelbauer, C., Oladejo, A., & Kargl, H. (2020, April 24). *LiSA interview* [Zoom].

Statistik Austria. (2019). *Durchschnittliche Miete (incl. Betriebskosten) von Hauptmietwohnungen nach Bundesland (Zeitreihe)*. Statistik.at. http://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/wohnen/wohnkosten/079261.html

Statistik Austria. (2020a). *Wohnen 2018 Glossar*. Statistik Austria. http://www.statistik.at/wcm/idc/idcplg?IdcService=GET_NATIVE_FILE&RevisionSelectionMethod=LatestReleased&dDocName=079364

Statistik Austria. (2020b). *Wohnungsgröße von Hauptwohnsitzwohnungen nach Bundesland (Zeitreihe)*. Statistik.at.

Teubner, T. (2014). *THOUGHTS ON THE SHARING ECONOMY*. 6.

Themeßl-Huber, K., & Keceli Meszaros, B. (2020, April 18). *Pegasus interview II* [Zoom].

Tomasello, M., & Warneken, F. (2008). *Share and share alike. The happy tendency to share resources equitably—At least with members of one's own social group—Is a central and unique feature of human social life. It emerges, it seems, in middle childhood.* 2.

Tummers, I. L. (2017). *Energy transition and co-housing: Opportunities for collaborative self-management*. 12.

Tummers, L. (2016). The re-emergence of self-managed co-housing in Europe: A critical review of co-housing research. *Urban Studies*, *53*(10), 2023–2040. https://doi.org/10.1177/0042098015586696

United Nations. (2019). *Transforming our world: The 2030 Agenda for Sustainable Development*. Sustainable Development Goals Knowledge Platform. https://sustainabledevelopment.un.org/post2015/transformingourworld

Vallance, S., Perkins, H. C., & Dixon, J. E. (2011). What is social sustainability? A clarification of concepts. *Geoforum*, *42*(3), 342–348. https://doi.org/10.1016/j.geoforum.2011.01.002

Verein Baugruppe Pegasus. (2020). *Unsere Partner*. Baugruppe Pegasus. http://baugruppe-pegasus.at/joomla/index.php

Vestbro, D. U. (2013). *Saving by Sharing—Cohousing for Sustainable Lifestyles*. Responder. Linking SCP and Growth Debates.

Wahlen, S., & Laamanen, M. (2017). Collaborative consumption and sharing economies. In M. Keller, B. Halkier, T.-A. Wilska, & M. Truninger (Eds.), *Routledge Handbook on Consumption* (1st ed., pp. 94–105). Routledge. https://doi.org/10.4324/9781315675015-10

Welcome to Seestadt! (2020). Aspern Die Seestadt Wiens. https://www.aspern-seestadt.at/en

wien.at. (2020a). *Neue Flächenwidmung für geförderten Wohnbau*. Stadt Wien. https://www.wien.gv.at/bauen-wohnen/bauordnungsnovelle-gefoerderter-wohnbau.html

wien.at. (2020b). *Voraussetzungen zur Erlangung einer geförderten Eingentumswohnung*. Stadt Wien. https://www.wien.gv.at/wohnen/wohnbaufoerderung/wohnungssuche/voraussetzungen-eigentum.html

Wiener Wohnbauförderungs- und Wohnhaussanierungsgesetz, Pub. L. No. 20000049, LWI40013186 (2019). https://www.ris.bka.gv.at/eli/lgbl/WI/1989/18/P63/LWI40013186

Williams, J. (2005a). Sun, surf and sustainable housing—Cohousing, the Californian experience. *International Planning Studies*, *10*(2), 145–177. https://doi.org/10.1080/13563470500258824

Williams, J. (2005b). Designing Neighbourhoods for Social Interaction: The Case of Cohousing. *Journal of Urban Design*, *10*(2), 195–227. https://doi.org/10.1080/13574800500086998

Winter, K., & Smits, R. (2020, February 26). [Personal Interview and Visit].

World Commission on Environment and Development (Ed.). (1987). *Our common future*. Oxford University Press.

Yiftachel, O., & Hedgcock, D. (1993). *Urban social sustainability: The planning of an Australian city*. 19.

Yin, R. K. (2018). *Case study research and applications: Design and methods* (Sixth edition). SAGE.

Appendix

Appendix 1 – Possible Cases

The overview of collaborative housing communities in Vienna was taken from http://inigbw.org/wohnprojekte.

Project	Why, why not
Wonprojekt Wien http://www.wohnprojekt-wien.at/	
Bikes & rails https://www.bikesandrails.org/wp/	Residents move-in in Spring 2020
Gleis 21	Completion in summer 2019
Grätzelmixer	Move-in in march 2019
Kolokation Sonnwendviertel	Only one level of the building; Move-in in Nov. 2019
Allgemeinnützige loftgmbh	Finished in 2020
Frauenwohnprojekt [ro*sa] im Elften http://simmering.frauenwohnprojekt.info/	
Wohnen im Grünen Markt	Move-in in June 2019
Frauenwohnprojekt [ro*sa] KalYpso https://www.rosa-kalypso.at/	Move-in in August 2009
Mi[e]tgestalten	Construction until summer 2020
Rose Garden	Move-in in February 2020
Que[e]rbeet Wildgarten	Construction begins in spring 2020
Willdawohnen	Move-in in autumn 2020
Wohnprojekt Grundsteingasse https://www.raum-komm.at/project/wohngruppe-grundsteingasse-32/#txt-wrapper	Move-in in June 2012
Frauenwohnprojekt [ro*sa] Donaustadt	Move-in December 2009
Kolokation am Seebogen	Move-in in June 2021
Baugruppe Seeparq	Completion in 2020
JAspern	Incomplete information and no response
Leuchtturm Seestadt	Move-in in summer 2021
OASE.inklusiv	Finished in 2021
Mischa	Completion in autumn 2019
Seestern Aspern http://www.seestern-aspern.at/	Move-in in August 2015
B.R.O.T. Aspern https://www.brot-aspern.at/das-haus/geschichte/	Finished December 2014
Pegasus http://baugruppe-pegasus.at/joomla/index.php/layout/unsere-partner/communit	Finished in April 2015
Qu[e]erbau Seestadt https://queerbaudotat.wordpress.com/welcome/willkommen/wohnen-im-queerbau-stadthaus-seestadt-aspern/	Move-in in June 2017
LiSA Leben in der Seestadt Aspern https://lisa.co.at/index.php/das-haus/	
Mauerseglerei http://mauerseglerei.wixsite.com/gennesaret/blank-5	Move-in in September 2019

Appendix 2 – Pilot Case Study

Centraal Wonen Delft (CWD) is an example of collaborative housing in Delft Tanthof which was built in 1981 in cooperation of its future inhabitants and a housing corporation (*CW Delft*, n.d.).
The case of Centraal Wonen Delft (CWD) was chosen to test the methodological approach because of the convenient geographical location in the south of Delft, and due to the outstanding professional connection of Darinka Czischke, one of the supervisors in this research project, to residents of the community. The advantage of taking this project as a pilot study is that the group is interested in reviewing their own performance and have established good cooperation with the researchers of TU Delft.

Case Study Characteristics

Cluster 'blue' is studied as one of the four group clusters within CWD. It consists of 28 households that have a rental contract, no children, but two partners that live in the household of a person with a rental contract. This results in a total of 30 residents.
Within these groups, tenants rent a certain amount of individual rooms. The use of all shared spaces is included in the rent of the individual spaces. The spaces in CWD are rented out by DUWO, a social housing corporation with its main business in student housing. All apartments or rooms with a monthly rent of maximal 737,14€ are considered social rent in the Netherlands (Rijksoverheid, 2020). To stay below this limit, it is allowed to rent a maximum of three rooms within CWD (K. Winter & R. Smits, personal communication, February 26, 2020).

Restrictions

The pilot study of CWD deviates in some points from the case studies that are to be conducted in Vienna. Referring back to the selection criteria for case studies, it indeed is an intentional community with a strong focus thereon. On the other hand, CWD does not consist of autonomous housing units but of groups of individual households that share a common kitchen and living area. Some inhabitants do indeed have their own kitchenette in their room while they use the shared kitchen. The shared spaces again are established - whether within the group, the cluster, or the entire community. Regarding the construction date, CWD is much older than the sought case studies. Only one founding member still lives in the community and composition of inhabitants changed during the years of its existence.
Due to the unusual letting system, it is difficult to comparable market data. The calculation of Comparisons is explained next to the survey responses.

The pilot study aims at testing the methods with a case that complies to the selection criteria and is therefore comparable to the real cases. The pilot case does not entirely fulfil those criteria, as displayed in the table (Table 21).

Criterion	Comply	Reasoning
Intentional community	Yes	The project was purposely built by its future inhabitants. Nevertheless, the residents changed since the establishment
Strong focus on community	Yes	Events and activities are organized on different levels (living groups, cluster, project, interest groups, etc)
Autonomous housing units	Partly	Not every household has access to an individual kitchen and bathroom
Shared spaces and facilities	Yes	Shared kitchen, laundry room, bicycle storage, etc.
Shared goods	Yes	Shared washing machine, kitchen equipment
Move-in between 2010 and 2017	No	The community is much older (established in 1981)

Table 21. Case Selection Criteria applied to CWD

For this deviation from the case selection criteria, the case study was more complex compared to the real cases. Despite the complicated circumstances, the pilot study helps to refine the research methods in the areas in which the pilot case indeed complies to the real case studies.

Study Design

Like for the case studies, the initial contact and the personal interviews were evaluated, in search of spaces and goods that are shared on the multiple levels of the group structures.
This resulted in a resident survey that was distributed via the CWD newsletter due to the wide interest of participates to participate. Only the findings amongst residents of cluster blue are taken into further considerations. The following sections describe the main survey findings.

Survey Responses

The blue cluster consists of 28 households (30 people), of which 7 households (25%) responded to the survey, 5 single-person households and 2 couples.
The results are extrapolated to be compared to the cluster inventory.

Sharing of Spaces and Goods in CWD

Residents of the community have more frequent and intimate interactions due to sharing

The data shows that many groups or networks formed due to the sharing of spaces (e.g. garden) and allocated goods (e.g. gardening tools). All respondents of the survey stated that they participate voluntarily in some of the groups that exist due to sharing spaces. On average, they spend 9,7 hours of their week in such groups, interacting with members that do not belong to their household. It must be considered that they have a full-time job and also pursue individual activities and activities outside of CWD.
The ranked statements about the resident's perception of the impact of sharing on their mutual support networks, sense of community and belonging, pride & place attachment, solidarity and safety & security scored all very high. The ranking on those indicators shows that the residents believe that sharing fosters frequent and intimate interactions between the residents. This merely positive impression is not outweighed by the mentioned negative effects of sharing spaces.

The building has a smaller total floor area per person due to sharing

This assumption was clearly proven valid, as shown in Table 1. The total GFA of the blue cluster divided by 30 inhabitants results in an average GFA that is only 84,38 % of the GFA per person that the residents of CWD would occupy if they did not live in a CH community. It is interesting that the average size of GFA per single households only differs by less than 5m² from the desired GFA.

Households spend less on energy and maintenance due to smaller total floor area per person

As a result of the previous assumption, this statement is proven as well. The literature review showed that the floor area per person is directly related to the use and cost of energy and expenses for maintenance throughout the building life cycle. The usable floor area per household within CWD is smaller than the usable floor area they would demand if they were not living in a collaborative housing project. This smaller floor area again suggests that residents of CWD save rental costs. (Further information below)

The residents consume less goods due to sharing

The assumption is that the residents of collaborative housing projects consume fewer goods then if they would live in an alternative, individual setting. Most goods exist in a smaller number in CWD than if everyone would have an individual household. The hand blender and the tosti maker would exist in an equal amount since many of the residents own those household devices individually.
It is striking that there currently are more fridges and freezers in CWD than there would be if everyone would have an individual household. It must be considered that many residents own a small private fridge in their individual room or kitchenette, additionally to the shared one.

The residents save costs for goods by sharing goods efficiently

The survey data shows that costs for goods are less due to sharing them. This impact would even be higher if the residents did not own certain tools and devices before moving to the community. Exceptions in the case of CWD are small devices like the tosti maker and the hand blender, as well as the fridges. Overall, fewer goods consumption involves cost savings.

Households pay less rent compared to their desired alternative setting

Looking at the currently paid rent and the calculated UFA that each household occupies in the entire CWD, it is clear that the average rents per household are lower than the average monthly rent in social housing. The rental expenses are also low, compared to market prices in South Holland. It is striking that the single-households only desire 3,3m² more UFA than they currently access (incl. common spaces).
Another interesting finding is that the average rent in social housing of € 772 is, in fact, higher than the hypothetical market rent of the average single household. Since no price per square meter is not available for the social housing sector, the market price is the more authentic comparable.

Conclusion

This chapter summarizes the findings with regards to the impact measurement focus points for determining social, environmental and economic sustainability of collaborative housing projects.

Social Sustainability was reviewed as a form of social capital. The assumption that residents have more frequent and intimate interactions due to sharing in CW Delft was confirmed by the majority of the survey respondents. All surveyed residents stated to participate in numerous non-mandatory groups. The researched topics are all considered a consequence of sharing spaces and goods. Nevertheless, downsides such as pressure to participate, lack of privacy and coordination difficulties were stressed.
Regarding environmental sustainability, it was found that the residents of CW Delft consume less floor area per person than they would if they were not living in this kind of collaborative housing. This does not only indicate a less resource consumption due to less required building material but also reduced energy consumption such as for heating and electricity. Regarding the shared goods, living in CW Delft is more sustainable because of sharing tools and devices. Fewer resources are consumed through efficient sharing. This is obvious from the sharing of washing machines within CW Delft, while the use of refrigerators could still be of more efficiency. One downside mentioned was that some people do not have access to all shared goods.
Economic sustainability considers the households' cost for living. Due to the efficient sharing of goods, the residents save costs through not owning everything individually. Evaluating the amount of rent paid by the residents is difficult due to the varying price per square meter within the Dutch

social housing sector. Single households in the blue cluster pay less than the average total rent in social housing (€ 772). The market rent for those households would also be below this average. Couples, on the other hand, pay more for their spaces than the rent of an average social dwelling since they rent more rooms on average than a single person. Overall, living in CW Delft is more affordable, while single households could find a place of a reasonable size for the same price on the market.

Weighing the findings up, it is obvious that the residents of Centraal Wonen Delft live more sustainable than they would in an alternative setting of their choice, where sharing is practised to a lesser extent. This case study shows that collaborative housing is a possible way to make living in urban areas more sustainable. Next to constructive elements, the residents and their behaviour are crucial for improving sustainability.

Lessons from the Pilot Study

This chapter aims at summarizing my main take-aways from conducting the pilot study with respect to following field research. Conducting a pilot case study helped me to accustom to the field of research think through the process and try out various approaches of execution.
I learned how big of a difference the structure of individual households within the groups and the community makes. This structure is much more complicated than in the actual case studies for this research, which consist only of individual households with additionally shared spaces. I often struggled to draw clear lines between different groups and I am glad that the case studies have more clear structures.
The practice also showed me, that group interviews are more effective than single interviews because they are mostly meant to gather information. Also, contradictory information can be avoided if the interviewees discuss their statements immediately. The gathered information provides the input to the resident survey which explicitly aims at individual responses.

The respondents were given the opportunity to give feedback on the survey. This included positive responses on the survey content and interface, but also suggestions to ask demographic and cultural questions. I will include those that are relevant to the research in the case studies. Regarding the time they spend in group interactions within the CH community, for example, it would be interesting, how many hours the person's working week has.

Appendix 3 – Interview Protocol

[The interviews took place online. The interviewer made notes on floor plans and in prepared tables to collect the required data.]

1. **Introduction**
    a. Introduction of interviewer
    b. Goal of the study (theoretical framework)
    c. Goal of the interview
    d. Informed Consent for Research with Human Participants
    e. Do you have any questions regarding the study information or other topics?

2. **Interviewee Background**

- When did you move to [CH community]?
- How did you get involved; what did you find attractive about [CH community]; why did you decide for this lifestyle?
- Do/did you have any specific role within the cohousing community?
- How is your household composed? (Partner, children, etc.)

3. **Detailed Questions**

General information: snapshot (Material: Floorplan)

- Number of households?
- Number of persons?

How are the costs for accommodation composed for each household?

- How were the construction costs distributed?
- How was the project financed?
- How does this impact the monthly costs?

What spaces are shared within the community? [location on floor plans]
Who can access those spaces?
Would you like to add anything on the shared spaces within your community?

What tools and devices are shared and by whom?*
Would you like to add anything on the shared goods?

What groups and networks exist due to sharing?
What shared space or good is responsible for the formation of the group? Who attends the group?
Would you like to add anything on the existing groups and networks?

4. **Closing**

- Living in the cohousing community, why would you say it is more sustainable than different ways of living?
- How would you compare your initial expectations to your current situation, living in [CH community]?
- Do you appreciate sharing and its benefits?
- What are the downsides of sharing for you?
- What would you like to change, what decisions should be taken differently?

Thank you very much for answering my questions! I will contact you regarding the distribution of the resident survey which I will prepare during the coming days.

* definition of goods: tools and devices that are appropriate for sharing. They are available in shared spaces.

Appendix 4 - Survey questions

[These are the plain survey questions without the detailed information and question description which was provided to the survey participants. Questions were asked in German language.]

1. How many adults live in your household?
2. How many children live in your household?
3. (Would you like to add anything regarding your household composition?)
4. If you are employed, how many hours per week do you work?
5. How many square meters usable floor space does your apartment have?
6. What are your monthly expenses for the apartment?
7. How many people in your household hold a membership in the membership association?
8. (Would you like to add anything regarding your apartment or expenses?)
9. Consider the alternative situation. Would your apartment need to be smaller, bigger, or just the same size as your current apartment?
10. How big would it have to be?
11. (Would you like to add anything regarding your desired apartment size?)
12. Do you use the following shared spaces?
    a. Every shared space listed separately
13. (Would you like to add anything regarding the use of shared spaces?)
14. Do you use the following shared goods?
    a. Every shared good is listed separately
15. (Would you like to add anything regarding the use of shared goods?)
16. Would you own the following shared good if it was not accessible to you by sharing?
    a. Every shared good is listed separately
17. (Would you like to add anything regarding the possession of these goods?)
18. Are you a member of – or do you participate in – the following groups and networks that exist due to sharing?
    a. Every group and network listed separately
19. How many hours per week do you spend in the previously mentioned groups?
20. (Would you like to add anything regarding the previous questions?)
21. Please rank the following statements according to your experiences in [CH community]
    a. Sharing makes me feel like I am surrounded by a strong social support network.
    b. Sharing creates a sense of community and makes me feel belonging to this community.
    c. By sharing, I feel proud of my pace and I feel attached to it.
    d. Sharing increases the solidarity between the residents.
    e. Sharing increases the safety and security in the community.
    f. Overall, I think that sharing fosters frequent and intimate interactions between the residents, compared to housing models where spaces and things are not shared.
22. What do you experience as a downside of sharing spaces and goods?
23. Do you think that the bene fits or downsides predominate or that both are balanced?
24. What do you think of this survey?

Sharing Sustainability

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