



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY



# Attics Conversions as an Environmental and Profitable Urban Strategy

From Empty Attics to Sustainable Homes

Master's thesis in Architecture and Civil Engineering

Lina Engelbrektsson  
Selma Karlsson Inde

MASTER'S THESIS 2025

Attics Conversions as an Environmental and Profitable Urban Strategy  
From Empty Attics to Sustainable Homes

Lina Engelbrektsson  
Selma Karlsson Inde



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY

Department of Architecture and Civil Engineering  
CHALMERS UNIVERSITY OF TECHNOLOGY  
Gothenburg, Sweden 2025



Attics Conversions as an Environmental and Profitable Urban Strategy

From Empty Attics to Sustainable Homes

*Master's Thesis in the Master's Programme Design and Construction Project Management*

LINA ENGELBREKTSSON

SELMA KARLSSON INDE

© Lina Engelbrektsson, Selma Karlsson Inde, 2025

Supervisor: Dimosthenis Kifokeris, Docent, PhD Civil Engineer

Examiners: Dimosthenis Kifokeris, Docent, PhD Civil Engineer

In collaboration with: Sweco Sverige AB

Master's thesis ACEX30

Department of Architecture and Civil Engineering

Chalmers University of Technology

SE-412 96 Göteborg

Sweden

Telephone: + 46 31 772 1000

Printed by Chalmers Reproservice

Gothenburg, Sweden, 2025



# Attics Conversions as an Environmental and Profitable Urban Strategy

## From Empty Attics to Sustainable Homes

Lina Engelbrektsson

Selma Karlsson Inde

Department of Architecture and Civil Engineering

Chalmers University of Technology

### ABSTRACT

As cities grow and sustainability demands increase, the construction sector faces the challenge of meeting housing needs while minimizing environmental impact. This thesis explores attic conversions as a strategic form of adaptive reuse, offering a dual potential: reducing carbon emissions and generating economic value. The study compares attic conversions to new construction, based on semi-structured interviews with industry professionals, a national resident survey and a literature review.

Findings show that attic conversions can lower carbon emissions by up to 71% compared to new builds, primarily due to the reuse of existing structural elements. However, the profitability of these projects is heavily influenced by factors such as location, ownership models, volume and the experience of each project team. Furthermore, the study identifies regulatory gaps and inconsistent measurement standards as barriers to broader adoption of attic conversions, despite their strong alignment with national sustainability goals.

The thesis concludes that attic conversions should be recognized not only as a technical solution but as a powerful urban development strategy – one that requires coordinated public policy, targeted support and cross-disciplinary collaboration to unlock its full potential in the Swedish housing context. Additionally, attic conversions represent a unique market niche due to their rare combination of modern functionality and historic architectural charm.

Key words: Adaptive Reuse, Attic Conversions, New Construction, Project Management, Urban Housing, Sustainability, CO<sub>2</sub> Emissions, Life Cycle Assessment, Profitability, Renovation vs New Construction

Vindskonvertering som en miljömässig och ekonomisk strategi för urban förtätning  
Från tomma vindstrymmen till hållbara hem

Lina Engelbrektsson

Selma Karlsson Inde

Institutionen för arkitektur och samhällsbyggnad

Chalmers tekniska högskola

## SAMMANFATTNING

I takt med att städer växer och kraven på hållbarhet ökar står byggsektorn inför en utmaning att minska den miljömässiga påverkan och samtidigt möta bostadsbehoven. Den här uppsatsen undersöker vindskonvertering som en strategisk form av adaptiv återvändning, med den dubbla potentialen: att minska koldioxidutsläpp och samtidigt skapa ekonomiskt värde. Studien jämför vindskonverteringar med nyproduktion, baserat på semistrukturerade intervjuer med branschaktörer, en nationell enkätundersökning bland invånare samt en litteraturstudie.

Resultaten visar att vindskonverteringar kan minska koldioxidutsläppen med 71% jämfört med nyproduktion, främst tack vare återanvändningen av befintliga bärande byggnadsdelar. Däremot påverkas lönsamheten i dessa projekt i hög grad av faktorer såsom läge, upplåtelseform, projektets omfattning samt projektgruppens erfarenhet. Studien identifierar även brister i regelverk och inkonsekventa mätstandarder som hinder för en bredare tillämpning av vindskonvertering – trots dess tydliga koppling till nationella hållbarhetsmål.

Uppsatsen drar slutsatsen att vindskonvertering inte bara bör ses som en teknisk lösning, utan som en kraftfull strategi för hållbar stadsutveckling – en strategi som kräver samordnad offentlig policy, rätt kompetens och tvärdisciplinärt samarbete för att fullt ut realisera dess potential i det svenska bostadssammanhanget. Dessutom utgör vindskonverteringar en unik marknadsnisch med sin eftertraktade kombination: modern funktionalitet och äldre arkitektonisk charm.

**Nyckelord:** Adaptiv återanvändning, Vindskonvertering, Nyproduktion, Projektledning, Urbant boende, Hållbarhet, Koldioxidutsläpp, Livscykelanalys (LCA), Lönsamhet, Renovering vs nyproduktion

## **Acknowledgements**

This master's thesis has been conducted within the field of Design and Construction Project Management at Chalmers University of Technology. The study explores environmental sustainability and profitability of attic conversions, focusing on adaptive reuse as a strategy for urban housing development.

We would like to express our sincere gratitude to our academic supervisor, Dimosthenis Kifokeris, for his insightful feedback, valuable guidance, and never-ending support throughout the entire thesis process. His expertise has been of great importance to us.

We also extend our appreciation to Sweco AB, particularly the Management Buildings division, for the opportunity to collaborate and gain access to valuable industry knowledge.

Lastly, a special thank you to all the professionals who participated in interviews and generously shared their time, insights, and experience. Your contributions were invaluable to the outcome of this thesis.

Lina Engelbrektsson and Selma Karlsson Inde,  
Gothenburg, June 2025

# Contents

<b>Acknowledgements.....</b>	<b>III</b>
<b>1 Introduction.....</b>	<b>1</b>
1.1 Background .....	1
1.2 Aim .....	2
1.3 Research Questions .....	2
<b>2 Methodology .....</b>	<b>3</b>
2.1 Research Approach .....	3
2.2 Research Context.....	4
2.3 Participants and Sampling .....	5
2.3.1 CO <sub>2</sub> Comparison: Attic Conversions vs. New Builds .....	6
2.4 Literature Review .....	7
2.5 Survey Design and Purpose.....	7
2.6 Data Analysis .....	7
2.7 Ethical Considerations.....	8
2.8 Limitations and Delimitation .....	8
2.9 Case Studies.....	9
2.10 Use of AI.....	11
2.11 Trustworthiness.....	11
<b>3 Literature Review .....</b>	<b>13</b>
3.1 Adaptive Reuse: Challenges and Advantages.....	13
3.1.1 The Potential of Adaptive Reuse: Environmental, Social and Economic Benefits.....	13
3.1.2 Challenges and Regulations in Adaptive Reuse: Technical, Legal and Preservative Perspectives.....	14
3.2 Renovation vs Newly Built.....	17
3.2.1 The Renovation Process .....	18
3.2.2 The Newly Built Process.....	18
3.2.3 How the Processes Differ .....	19
3.3 Environmental Sustainability.....	21
3.3.1 Life Cycle Assessment (LCA) and Climate Declarations.....	21
3.4 Economy and Profitability .....	29
3.4.1 Comparison of the Profitability of Renovation vs Newly Built .....	29
3.4.2 Dialogue with Residents.....	30
3.4.3 Financing Condominiums vs Rental Apartments .....	30
3.4.4 Cost of Land and Production .....	31
3.4.5 Contracting Model and Procurement Method .....	33
3.5 Social and Cultural Sustainability in the Built Environment.....	33
3.5.2 Cultural Values .....	35
<b>4 Empirical Data.....</b>	<b>39</b>
4.1 Challenges and Advantages of Adaptive Reuse and Attic Conversions.....	40
4.1.1 Challenges of Attic Conversions.....	40

4.1.2	Advantages of Attic Conversions .....	41
4.2	<i>Comparison of Attic Conversion to Newly Built Apartments</i> .....	41
4.2.1	Environmental Sustainability .....	42
4.2.2	Financial Profitability Factors .....	44
4.3	<i>Impact of Social Sustainability and Cultural Values</i> .....	46
4.3.1	Survey Results: Evaluation of Residential Environments and Culturally Historic Buildings.....	46
4.3.2	Interview Insights: The Impact of Social and Cultural Values on the Demand for Attic Apartments .....	52
4.4	<i>Future Aspects</i> .....	53
<b>5</b>	<b>Analysis and Discussion .....</b>	<b>55</b>
5.1	<i>Process Differences: Attic Conversion and Newly Built</i> .....	55
5.1.1	Adaptive Reuse Challenges .....	55
5.1.2	Adaptive Reuse Advantages.....	56
5.2	<i>Environmental Sustainability – CO<sub>2</sub> emissions and LCA</i> .....	56
5.2.1	Comparative Emissions Analysis: Attic Conversions vs. New Construction .....	56
5.2.2	When Sustainability Is Invisible: Regulatory Barriers to Reuse .....	59
5.2.3	No Building Is Alike: Project-Specific Variables.....	59
5.3	<i>Conditions for Profitability in Attic Conversion Projects</i> .....	60
5.3.1	Connection between Location, Demand and Profitability .....	60
5.3.2	Ownership Type and Profitability .....	60
5.3.3	Cultural Heritage as an Economic Asset .....	61
5.4	<i>Urban Density Meets Social and Cultural Sustainability</i> .....	62
5.4.1	Cultural and Historical Preferences in Housing Choices .....	62
5.4.2	Future Changes in PBL .....	64
5.5	<i>Achieving Profitability and Sustainability when Executing Adaptive Reuse</i> .....	64
5.6	<i>Future research</i> .....	65
5.6.1	Broader Typologies of Adaptive Reuse .....	65
5.6.2	Comprehensive Life Cycle Assessments (LCA).....	65
5.6.3	Economic Profitability Over Time.....	66
5.6.4	Stakeholder Perspectives and Social Value .....	66
5.7	<i>Methodological Reflections</i> .....	66
<b>6</b>	<b>Conclusion .....</b>	<b>67</b>
6.1	<i>Challenges and Advantages of Adaptive Reuse and Attic Conversions</i> .....	67
6.2	<i>Key Differences Between Attic Conversions and New Construction</i> .....	67
6.2.1	Process Differences and Project Planning .....	67
6.2.2	Determinants of Profitability in Attic Conversion .....	68
6.2.3	Impact of Social and Cultural Values .....	68
6.3	<i>Balancing Both Sustainability and Profitability Through Adaptive Reuse</i> .....	69
<b>7</b>	<b>Bibliography .....</b>	<b>Error! Bookmark not defined.</b>
	<b>Appendix A: Interview Questions.....</b>	<b>77</b>
	<b>Appendix B: Production Steps .....</b>	<b>78</b>
	<b>Appendix C: Questionary Social Values.....</b>	<b>80</b>



## **Preface**

This master's thesis marks the final stage of our five-year Civil Engineering program at Chalmers University of Technology, within the Master's track in Design and Construction Project Management. The idea for this study emerged from a curiosity about how existing buildings can be leveraged to meet environmental sustainability goals while remaining economically profitable in the context of urban housing development. It was also inspired by our personal interests in residential architecture and the cultural and social value of buildings and their surrounding environments.

In a time where the construction sector faces increasing demands to reduce emissions and resource consumption, we saw attic conversions and adaptive reuse as promising strategies. Our collaboration with Sweco AB provided valuable insight into real-world challenges and opportunities in this area and enabled us to ground our research in practice.

Throughout the process, we have gained a deeper understanding of the complexity behind reusing existing structures – from building permits and design limitations to social values and profitability. The project has given us the opportunity to combine theory with industry knowledge and explore sustainability through a multidisciplinary lens.

Writing this thesis has been both rewarding and intellectually enriching. It challenged us to navigate uncertainty, ask critical questions, and engage with professionals across different parts of the construction industry. We hope our findings contribute meaningfully to the ongoing conversation about how cities can grow more sustainably – by valuing what is already built.

Gothenburg, June 2025

Lina Engelbrektsson and Selma Karlsson Inde



# 1 Introduction

This chapter introduces the background, purpose, and scope of the study. It presents the research questions of the investigation and explains the motivation behind exploring attic conversions as a sustainable and economically possible solution for urban housing.

## 1.1 Background

The construction industry is one of the largest contributors to global carbon emission, responsible for nearly 40% of global output of CO<sub>2</sub> (United Nations Environment Programme, & Yale Center for Ecosystems + Architecture, 2023). This is due to e.g. energy-intensive production of materials, transportation and construction processes. As the climate crisis escalates, efforts to reduce emissions have placed intensified pressure on the construction sector to adopt more resource-efficient solutions.

One of the most effective ways to reduce the environmental impact is to reuse existing buildings instead of demolishing and rebuilding, as one of the main drivers of CO<sub>2</sub> emissions are the production of steel and concrete – significant components of new constructions in comparison to renovation (Hasik et al., 2019). Renovation offers a sustainable alternative to demolishing and rebuilding. Traditional renovation mainly focusses on restoring existing buildings rather than adopting them for new type of use.

However, needs change over time. To meet the contemporary needs, adaptive reuse is a form of renovation that transforms a building from a particular use to a different use type, offering both a functional and sustainable solution (Hasik et al., 2019). For example, a factory can be transformed into an office building. A Life Cycle Assessment (LCA) case study on adaptive reuse in comparison to new construction by Hasik et al (2019) showed a reduction of 53-75% in major environmental impacts using adaptive reuse. Additionally, IPCC (Intergovernmental Panel on Climate Change by the U.N) declared adaptive reuse as a crucial strategy for reducing the greenhouse gas emissions caused by the construction sector and mitigate the impacts of human-induced climate change (Biro, 2023).

Additionally, Adaptive Reuse also conserves the architectural, social, cultural and historical values of a building – making adaptive reuse a form of heritage conservation (Bullen & Love, 2011). Further explained by Bullen & Love, while adaptive reuse may serve many benefits – it also faces challenges, such as today's building codes and to meet eventual preservation requirements.

One increasingly relevant form of adaptive reuse is attic conversions, where underutilized attic spaces in existing buildings are transformed into new housing units (Aldana et al., 2024). Attic conversions are not only environmentally beneficial but also a practical response to housing shortages in high-demand neighborhoods, where space for new developments is limited.

## 1.2 Aim

This thesis aims to explore the potential for the adaptive reuse of attics in terms of environmental impact, economic profitability and social value, in comparison with new construction projects. Regarding these criteria, attic conversions will be compared to new construction. Using what already exists and renovating instead of building new is a powerful way to reduce carbon dioxide emissions.

By examining both challenges and advantages of adaptive reuse, the study seeks to understand under what conditions attic conversions can become a sustainable and profitable urban development strategy. Through a combination of qualitative interviews with industry professionals and a survey focusing on social values, the study investigates in the key factors influencing the success of such projects, such as technical, regulatory, financial and cultural dimensions.

Furthermore, the goal is to identify barriers, drivers, and necessary shifts within the construction and housing sectors to enable broader adoption of adaptive reuse practices, more specifically in the context of attic conversions.

## 1.3 Research Questions

The aim is concluded in three main research questions below.

- What are the challenges and advantages of adaptive reuse, such as attic conversions?
- How does a conversion of an attic differ from new housing construction in terms of economic and sustainable perspectives?
  - How do the processes differ?
  - Which factors influence the profitability of attic conversion the most?
  - Is there an impact of social and cultural values?
- Is it possible to effectively execute adaptive reuse of attics to achieve both sustainable and economic benefits?

## 2 Methodology

This chapter includes the research methodology and provides the chosen approach's rationale. It presents the overall research design, the data collection process and the analytical strategies used to explore the differences and challenges between attic conversions and new construction from the perspectives of sustainability, economy, and building standards. The chapter also discusses the ethical considerations involved in the study and reflects on the methodological limitations. The methodology is visually presented in figure 1 below and every step of it will be explained in detail later in this chapter.

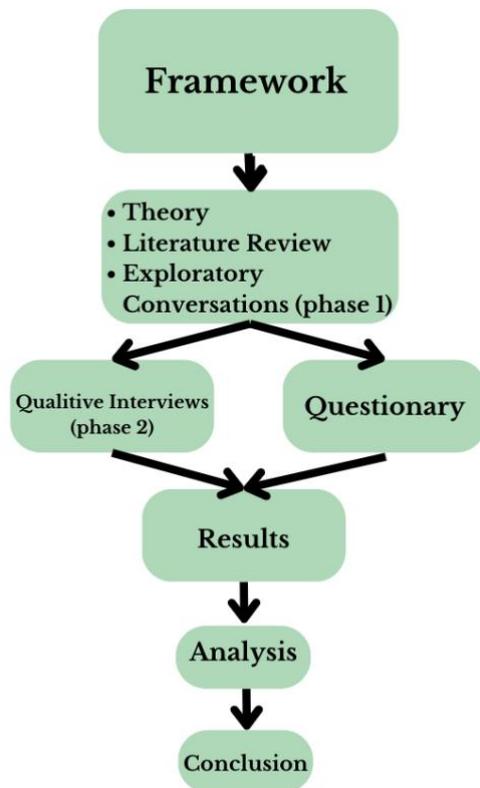


Figure 1. The methodology visually presented.

### 2.1 Research Approach

This study follows an abductive research approach, a combination of theory frameworks and empirical observations (Kovács & M. Spens, 2005). The research began with exploratory conversations with industry experts to gain initial insights and identify relevant research gaps. These initial interviews helped identify central themes and practical challenges connected to renovation and new construction. These early insights guided the first round of literature review, helping to set the research focus and identify relevant theories.

When the first round of literature review was finalized, some of the themes were identified and those helped shaping the interview questions, for the semi-structured interviews. Parallel with the second round of interviews, the second and deeper round of literature review was made. This review ended in a result that could be compared to

the empirical data from the survey. Parallel with the second literature review, a survey was published. When the survey results were analyzed, a further literature review was needed. In the end all the results were compared and analyzed to achieve an answer to the research questions.

To analyze this abductive methodology deeper, the work can be interpreted into abductive loops (Y. Ren et al., 2018). The loops involve a combination of theory and empiric data. When reviewing this work, the loops can be interpreted as relatively tight, where theory and empirical data was developing parallel. The abductive approach was particularly suitable for capturing the complexity of adaptive reuse in the construction industry.

Furthermore, a literature review was conducted to support and shape the understanding of the field. The literature review is systematic where the chosen method involves searching and finding accurate data and scientific academic literature in a structured and transparent way (Karolinska Institutet, 2024). The purpose of the systematic literature review is to be objective and precise, so that it is possible to exactly repeat the process in the same way again.

The steps in a systematic literature review will be presented accordingly (Karolinska Institutet, 2024). The first step includes a selection of topic. In this study, the selection of topic included choosing the research questions, while conducting initial conversations to frame the topic. The next step includes conceptualizing and searching for studies within the chosen topic. Furthermore, the screening for studies begin – where the relevant ones will be studied. In summary, the following steps includes analyzing the data, putting it together and comparing it – while, in the end, the process of interpreting the results will take place.

A case-based strategy was used through focusing on comparative insights between attic conversions and newly built housing projects. The reason to a case-base strategy is due to the potential for deeper understanding (Heale & Twycross, 2018). The cases studied are not compared to each other, but the respondents were asked to refer to their case. This is because all the cases differed and were not suitable for comparison, but for the respondents to relate to when answering the interview questions. The study includes a mixed-methods design, combining qualitative data from semi-structured interviews with quantitative input from a survey distributed to residents all over Sweden.

## **2.2 Research Context**

The research is situated in the Swedish housing context, more specifically in Gothenburg, and involves collaboration with a variety of stakeholders, including architecture and engineering consultancies (Sweco and Vindshem), public housing companies (Bostadsbolaget and Familjebostäder) and a construction company (4D Gruppen). The focus is on understanding sustainability, practical challenges, and lived experiences associated with converting attics into apartments. The reason for this geographical limitation is that the respondents in both the interviews and the survey are based in Sweden, with the majority located in Gothenburg.

## 2.3 Participants and Sampling

The study was carried out in two phases, all this to widen the knowledge about attic conversions before conducting more structured interviews. Initially, exploratory interviews (phase 1) were conducted with seven professionals, including environmental coordinators, architectural heritage specialists, and project managers, to define the scope and framework of the study. These early conversations helped identify key challenges in attic conversions and enabled more detailed interviews in the second phase. The participants in this early phase, phase 1, are presented in table 1 below.

In addition, in phase 1, one meeting was held with an external actor whose input was excluded from the final analysis due to concerns over source reliability. While Annika Kaas was not included in the later formal interviews, her heritage perspective played a critical role in shaping the cultural dimension of the survey design and the overall framing of social values in the study. These early discussions formed the selection of formal interviewees and the thematic scope of the research.

The second phase, phase 2, consisted of semi-structured interviews with seven key actors with practical experience from attic conversion projects, presented in table 1 below. The semi-structured interview questions for phase 2 are attached in Appendix A. Semi-structured interviews provide deeper understanding by allowing the conversation to stay focused while also offering the flexibility to follow up on interesting topics that emerge during the interview (Adeoye-Olatunde Pharm.D & Olenik Pharm.D., 2021).

NAME	JOB TITLE	TENURE TYPE	COMPANY	Phase
John Kåwert	Project Manager	Rentals and condominiums	Sweco	1
Robert Koprowicz	Project Manager	Condominiums	Vindshem	1
Carolina Jogner	Whole Life Carbon Consultant	Rentals and condominiums	Bostadsbolaget	1
Ellen Klein	Environmental Coordinator	Rentals	Bostadsbolaget	1
Ellen Johnsson	Project Manager	Rentals	Familjebostäder	1
Annika Kaas	Architectural Heritage Specialist	Rentals and condominiums	Sweco	1
John Kåwert	Project Manager	Rentals and condominiums	Sweco	2
Christian Holmström	Project Manager	Both, mostly condominiums	Sweco	2
Ellen Johnsson	Project Manager	Rentals	Familjebostäder	2
Per Orshammar	Project Manager	Rentals	Bostadsbolaget	2
Robert Koprowicz	Project Manger	Condominiums	Vindshem	2
Karin Hallingström	Environmental and Reuse Coordinator	Both, mostly condominiums	Sweco	2
Alexander Sandqvist	Site manager and Project manager	Rentals and condominiums	4D Gruppen	2
Jaana Kapuli	Architect	Rentals and condominiums	Forum Arkitekter	2

*Table 1. Presenting the respondents, their title, tenure type specialization and company, for each phase (1 and 2).*

The interviews were mostly held on site and lasted approximately 1 hour. Interviewees were encouraged to reflect on real-life projects they had managed or contributed to.

### **2.3.1 CO<sub>2</sub> Comparison: Attic Conversions vs. New Builds**

One of the key questions of the interviews was to obtain expert estimations comparing the production process of attic conversions to that of new residential construction, with a specific focus on material-related CO<sub>2</sub> emissions. It is important to note that individual projects differ significantly, and respondents were therefore asked to provide general estimations based on their professional experience, rather than exact figures.

To achieve a coherent basis for comparison, the interviewees were first presented with a standardized breakdown of typical construction stages in new residential buildings. They were asked to estimate, for each stage, the corresponding extent of construction activities and related emissions during an attic conversion project, expressed as a percentage relative to new construction.

It was emphasized that, for building-level factors (such as structural work, roof construction and facade work), respondents should provide estimations based on the entire building's needs – not only the additions or modifications directly linked to the attic space. For apartment-level factors (such as HVAC, electrical installations and interior works), the comparison was focused solely on one individual apartment in an attic conversion versus one apartment in a newly built building.

In Appendix B, a table outlines the standard construction stages for new residential buildings, serving as the reference framework for the comparison.

## **2.4 Literature Review**

The literature review was conducted continuously throughout the research process. Initial searches were guided by key concepts such as "adaptive reuse", "attic conversions", "renovation versus new construction" and "renovation process", using databases like Scopus and Google Scholar. Technical building information was also conducted through using course literature including "Bygga Hus" by Bengt Strandberg and "Byggledning – Produktion" by Radhlinah Aulin et al. (Strandberg & Lavén, 2021; Aulin et al., 2021). Additional guidance came from our supervisor at Chalmers and professionals at Sweco's "Management Buildings" department.

## **2.5 Survey Design and Purpose**

To complement the interview findings with a more nuanced picture of the social values, a survey was distributed to residents in Sweden to capture perceptions of their living environment - particularly related to social and cultural values (Scheuren, 2004). The survey aimed to understand how people evaluate housing quality related to technical or economic factors through 15 questions. To better frame the survey's purpose, as mentioned, a semi-structured interview was held with the expert architectural heritage specialist at Sweco with Annika Kaas, whose insights informed the cultural framing of the questionnaire. The questionnaire can be found in Appendix C.

## **2.6 Data Analysis**

All interviews were summarized and analyzed using thematic analysis (Clarke & Braun, 2016). The first interview phase was summarized with notes during the sessions, while the second phase was recorded and more detailed described in notes. Transcription was not needed when the records were used as a compliment to the notes taken. During the interviews, notes were taken by one of the author and questions were asked by the other author – providing the interviews with a structured approach to reduce the risk of missing important information.

Common themes, patterns and differences across stakeholder responses were identified to conduct accurate challenges and unique perspectives on attic conversions. The survey data was analyzed quantitatively, focusing on the distribution of responses per question to detect overall trends and social preferences.

## **2.7 Ethical Considerations**

The research follows ethical standards including the General Data Protection Regulation (GDPR). All participants provided informed consent prior to recording and participating in the study. Interviewees were also asked for explicit permission to be named in the report. Where necessary, anonymity and company confidentiality were maintained.

## **2.8 Limitations and Delimitation**

Several limitations and delimitations were identified for the study. To begin with, the study focuses on attic conversions as a subcategory of adaptive reuse and does not include extensions or other reuse typologies. This delimitation arises from our decision to exclude other types of adaptive reuse projects, as including them would create an overly broad focus area and hinder a clear comparison with newly built structures.

The project is geographically limited to Sweden with case studies from Gothenburg, despite the availability of global literature. This delimitation minimizes the risk of including too many countries.

In this study, CO<sub>2</sub> emissions are calculated using standardized proxy values, which may be biased or overly optimistic since these values only take limited parts of the building into account. This is not something that can be controlled in the context of this study, therefore it is a limitation. To avoid this limiting the study's potential, the comparison between CO<sub>2</sub> emissions will be made in percentage. A percentage comparison will minimize this risk for big differences, since all renovations differ a lot in preconditions and in numbers. Since percentage values are used, the respondents will more likely be able to estimate percentage values in a span.

Furthermore, only the production phase of the building lifecycle is analyzed, while the user phase and demolition phase impacts are excluded. Since data is not required for these stages concerning the climate declaration, companies do not have much to share about the user phase and demolition phase in life cycle analysis. This is a delimitation since we have chosen to exclude certain data to obtain valid research.

At last, the findings represent the perspectives of the selected respondents, which do not encompass the full spectrum of stakeholders. However, efforts were made to broaden the view by including professionals from various roles in the early research framing and formal interviews. This can be viewed as a limitation, because the respondents were chosen but without knowing their fully background and knowledge.

## 2.9 Case Studies

To better understand the practical implementation of attic conversions in Gothenburg, a series of case studies were conducted across different housing companies (Heale & Twycross, 2018). The selected projects represent a mix of rental and condominium housing and include both early-stage and more established attic conversions. These examples were chosen based on their relevance to the thesis timeline, accessibility for site visits and the variety of actors involved – such as municipal housing companies, private developers and experienced project managers. As written before, the cases have not been compared to each other, but the respondents were frequently asked to refer their answers to their specific case, to achieve concrete examples. The following summaries provide an overview of each case and a map showing the location of each project.

### Familjebostäder (Rental Apartments)

- **Kortedala (1 in figure 5):** The project was carried out by the contractor 4D-gruppen, with Christian Holmström from Sweco as the external project manager and Ellen Johnsson as the internal project manager. A total of 15 studio apartments were created, each between 30–35 sqm.
- **Lorensberg (2 in figure 5):** Also managed by 4D-gruppen with the same project management setup – Christian Holmström (Sweco) as external project manager and Ellen as internal project manager. Five studio apartments were built, each 30–35 sqm.

These two projects were among the company's first experiences with attic conversions. However, Christian Holmström had led similar conversion projects prior to these and the contractor 4D-gruppen also had previous experience in the field.

### Vindshem (Condominium)

- **Örgryte (3 in figure 5):** Two identical buildings, each housing six two-room apartments. The project was managed by Robert Koprowitz, who also documented the process with photos. A site visit was conducted during the case study period.

This was one of many attic conversions carried out by Vindshem and was chosen as a case study since it was ongoing during the thesis work. Furthermore, the identical buildings were at two different stages of production, which provided a broad overview of the process. Pictures of this project are provided below in figure 2, figure 3 and figure 4. Figure 2 shows an attic apartment during the insulation phase, figure 3 shows the building from the outside and figure 4 shows an attic apartment where only painting remains to be done.



Figure 2. Picture of the attic conversion production in Örgryte by Vindshem. (Authors' own picture).



Figure 3. Picture of the attic conversion production in Örgryte by Vindshem. (Authors' own picture).



Figure 4. Picture of the attic conversion production in Örgryte by Vindshem. (Authors' own picture).

## Bostadsbolaget (Rental Apartments)

- **Haga (4 in figure 5):** Project led by Per Orshammar as project manager, with Ellen Klein as environmental coordinator. The development was divided into two phases: 12 apartments completed and an additional 12 currently in progress. All are studio apartments, 30–35 sqm in size.

This was Bostadsbolaget's first attic conversion project.

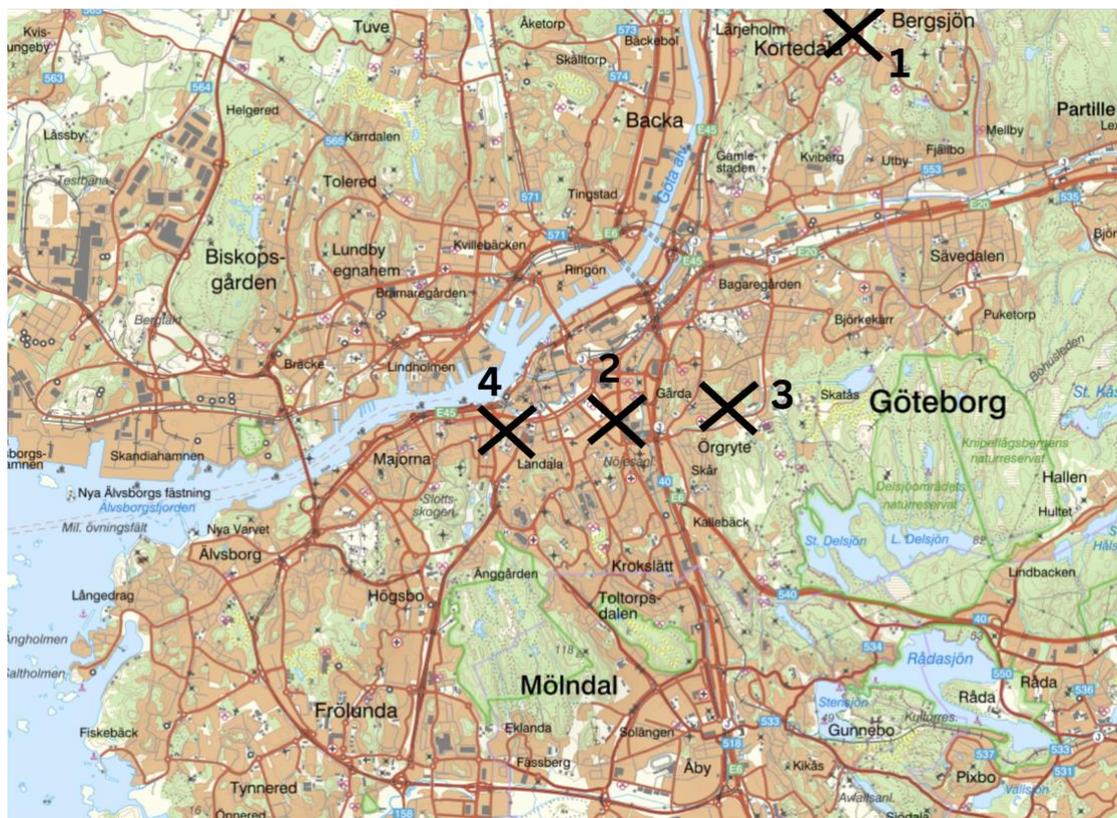


Figure 5. Approximate location of the four case study sites in Gothenburg: 1. Kortedala, 2. Lorensberg, 3. Örgryte, 4. Haga (Lantmäteriet, 2025).

## 2.10 Use of AI

AI has been used in the study and has primarily served two functions. The first area of use is proofreading and improving the language, to streamline the wording and make the report more readable. The second area of use is that the structure has been planned with support and input from AI. To achieve a logical and coherent order in the document, the structure has been double-checked to receive suggestions on which parts should be placed where. It is important to be cautious when using AI, as suggestions and answers may be incorrect. Therefore, it has been used with great care, to increase the chances of time and language efficiency.

## 2.11 Trustworthiness

To define what makes qualitative research credible and reliable, a study has outlined the four key pillars of trustworthiness (Ahmed, 2024). Credibility is the first pillar and this includes making sure the findings truly reflect the respondents experience. To

achieve credibility, after the interviews, summaries and interpretations were shared with participants to confirm their views and ensure their perspectives were accurately.

Furthermore, the second pillar is transferability (Ahmed, 2024). This means making the results useful in other context by giving detailed descriptions of the respondents, the process and the places. By combining a selection of experts and stakeholders while, at the same time, developing the theoretical framework, different perspectives have been generated, resulting in a broad theoretical foundation. By interviewing various actors, some with the same position, others with different roles, some from different organizations and others from the same – a diverse selection of individuals was created, each able to express their own view of the research problem.

Dependability, the third pillar, involves making the research process consistent and well-documented, so others can repeat the process (Ahmed, 2024). All decisions and steps in the literature review is documented and therefore the report is dependable. In the last step, to achieve confirmability, the report has been peer reviewed, checked by the respondents and in the end reviewed by the supervisor. All this, to ensure that the results of the study are trustworthy.

### 3 Literature Review

The literature review explores the key aspects of attic conversions in relation to sustainability, economics, regulations and feasibility. In the beginning, adaptive reuse is presented and compared to new construction in terms of processes and outcomes. Connected to this, the “Swedish Building Regulations” (BBR in Swedish) and the “Planning and Building Act” (PBL in Swedish) will be explained based on what is technically and legally possible. Furthermore, the chapter includes environmental sustainability through life cycle assessments explanations and climate declarations. For projects, financial profitability is one of the most crucial aspects. Therefore, a comparison between adaptive reuse and newly build projects will be made from an economic perspective. Also, the difference between tenant type will be analysed. Lastly, the social and cultural dimensions of attic conversions will be examined, focusing on how these projects, compared to a new construction, can influence community identity, housing diversity and long-term urban development.

#### 3.1 Adaptive Reuse: Challenges and Advantages

The following chapter will investigate in the opportunities and challenges associated with adaptive reuse and more specific attic conversions, with focus on sustainability and the regulatory frameworks. By analysing the benefits and challenges through an economic, social and environmental perspective a comprehensive overview will be presented. By examining the technical, legal, and logistical challenges, particularly in relation to BBR, PBL and the protection of historic buildings, a deeper understanding of the complexities involved can emerge.

##### 3.1.1 The Potential of Adaptive Reuse: Environmental, Social and Economic Benefits

**Adaptive reuse** of buildings is a form of **environmental urban design**, as it extends the building's lifespan and avoids demolition (Tam & Hao, 2018). By making use of existing structures and reuse strategies, it also generates **social and economic benefits** for society. According to Tam & Hao (2018), adaptive reuse is defined as maximizing the lifespan of a building by changing its use. When a building is reused, a significant amount of energy is saved, as large parts of the original structure are preserved. This means that much less energy is required compared to constructing a new building.

In addition to the environmental benefits of reusing buildings, it is also clear that such projects often aim to preserve structures with strong architectural expression (Douglas, 2011). Douglas further explain that **Heritage buildings** can offer a sense of psychological reassurance, as they have a recognizable and unique character. As a result, **adaptive reuse** projects can contribute to both **social and cultural values**.

There are several key factors that influence whether the reuse of a building is perceived as positive (Bullen & Love, 2011). First, it is about giving the building a new life and function from a **lifecycle perspective**. Secondly, it concerns changing perceptions of buildings, where their **cultural and social values** are increasingly emphasized. Adaptive reuse is also more likely to succeed when there is **support from the state**, both through **legislation** and **financial incentives**.

One practical example of adaptive reuse in the housing sector is attic conversions (Vindshem, 2025). These projects represent a specific form of building transformation that saves the existing structure while adding new residential space. For a housing cooperative, an attic conversion offers several potential benefits that can strengthen both the financial situation and the long-term management of the property (Vindshem, 2025). When the raw attic is purchased, the housing cooperative receives an immediate capital injection. As more residents move into the attic apartments, the number of fee-paying members in the cooperative increases, leading to higher ongoing revenue. Often, the roof is insulated in the attic, which results in reduced heating costs for the entire building.

### **3.1.2 Challenges and Regulations in Adaptive Reuse: Technical, Legal and Preservative Perspectives**

It is becoming a global trend to upgrade old buildings to reach their full potential, but reusing buildings presents a wide range of challenges that cannot be avoided and it requires varying levels of effort depending on the building's condition and circumstances (Tam & Hao, 2018). Several obstacles need to be addressed in order to succeed with adaptive reuse (Sugden, 2017). These can include limited zoning plans, building regulations, laws, pollution, as well as technical and financial challenges.

Bullen and Love (2011) present several challenges associated with reusing buildings. This can, among other things, involve the perception that building regulations and laws are difficult to adapt to the new use, inertia in development processes, as well as the risks and uncertainties associated with older buildings.

#### **3.1.2.1 Boverket's Building Regulations (BBR)**

Boverket's Building Regulations (BBR) is a collection of rules and regulations issued by Boverket, Sweden's national agency for community planning, building and housing (Boverket, 2024d). These regulations establish mandatory requirements for new construction, renovation and maintenance of buildings in Sweden. The purpose of BBR is to ensure safety, accessibility, energy efficiency and sustainability in the built environment.

BBR includes specific guidelines in the areas of "Load-bearing capacity and stability," "Fire protection," "Health and indoor environment," "Energy efficiency," "Accessibility," and "Building materials and sustainability" (Boverket, 2024d). BBR serves as a legal framework that all new constructions and major renovations must comply with. It ensures that buildings are safe, functional and environmentally friendly while meeting modern societal needs. To obtain a building permit from the municipality, BBR must be followed.

##### **3.1.2.1.1 Regulations from BBR Regarding Attic Spaces**

Attic conversions present challenges and requirements that differ from standard renovation projects or newly built structures. While both a regular renovation of an existing apartment and an attic conversion involve modifying existing structures, an attic conversion project is more complex. It often requires significant changes to the roof, additional windows and structural components to meet modern building

standards and regulations, as attic spaces were not originally designed for residential use (Göteborgs Stad, n.d a).

One of the primary considerations in attic conversions is the impact on the building's exterior. According to Swedish building regulations, modifications must be designed to fit within the existing urban and cultural landscape (PBL 2010:900 2 kap. 6 §).

Changes such as roof windows and dormers are common solutions to ensure adequate daylight access while minimizing the visual impact on the streetscape (Göteborgs Stad, n.d a). In some cases, more extensive modifications, such as rooftop terraces, must be carefully positioned to maintain the historical integrity of the façade.

Another major factor is structural adaptation (Göteborgs Stad, n.d a). Unlike typical renovations, attic conversions often require reinforcement of floors and roof structures to accommodate new loads. Additionally, integrating modern installations such as plumbing, ventilation and heating into previously uninhabited spaces presents technical challenges. Accessibility requirements, including elevator installations, must also be considered according to 8 chapter 2 § 3 PBL (2010:900).

Furthermore, attic spaces must meet specific regulatory requirements set by BBR to ensure that new residential units are both safe and functional (Göteborgs Stad, n.d a). In historic buildings, these adaptations must be carefully balanced with preservation efforts to ensure that modern upgrades do not compromise the building's cultural and historical value. The following sections will explore the specific regulatory aspects governing attic conversions in more detail.

#### **3.1.2.1.2 Attic Spaces**

According to the Boverket's Building Regulations (BBR), the minimum ceiling height in residential spaces must be 2.40 meters (BBR 3:311) (Göteborgs Stad, n.d a). In attics, basement levels and semi-basements, a reduced ceiling height of 2.30 meters is allowed (BBR 3:311, second paragraph). In limited areas, an even lower ceiling height may be permitted, but there must be at least 2.10 meters of standing height under horizontal ceilings and 1.90 meters under sloped ceilings (BBR 3:311, third paragraph).

#### **3.1.2.1.3 Accessibility and Elevator Requirements**

For major renovations in multi-family buildings with more than two floors, an elevator must be installed according to BBR 3:143 (Göteborgs Stad Stadsbyggnadskontoret, 2022). This requirement is particularly relevant when converting attics into residential spaces. Exceptions to the elevator requirement may be granted in cases of significant justification, such as if an elevator would have severe consequences for a historically valuable building or if it is technically impossible to integrate an elevator while ensuring safe evacuation (BBR 3:143, fourth paragraph). However, there are exceptions for apartments that are no larger than 35 square meters. For these units, deviations from accessibility requirements are permitted if the apartment does not exceed 35 sqm. This also means that an elevator does not need to be installed, as the requirements for accessibility within and to the apartment are waived.

#### **3.1.2.1.4 Residential Design**

When converting attics into residential units, the spaces must be designed for long-term use and meet residential design standards according to BBR 3:2 (Göteborgs Stad, n.d a). When a commercial space (e.g., an office or school) is converted into housing, stricter requirements apply according to PBL 8:4. However, certain exceptions may be granted for student housing and historically valuable buildings (BBR 3:221, third paragraph).

#### **3.1.2.1.5 Fire Safety**

Fire safety requirements for attics are regulated in BBR 5:5 (Göteborgs Stad, n.d a). Attics and roof structures must be designed to limit fire spread (BBR 5:53). Larger attics must be divided into smaller fire compartments to prevent rapid fire propagation (BBR 5:534). Smoke ventilation must be installed in stairwells that rescue services may need to use in the event of a fire (BBR 5:71). When repurposing attic spaces, evacuation routes must be adapted to comply with current fire protection standards (BBR 5:3).

#### **3.1.2.1.6 Energy Efficiency**

When making changes to the building envelope, such as adding insulation to the roof in attic spaces, energy efficiency must be improved according to BBR 9:9 (Göteborgs Stad, n.d a). However, these measures must not cause moisture problems or reduce the attic's usability (BBR 9:91). Sealing windows and doors is recommended to reduce energy losses, but sufficient air supply must be ensured according to BBR 6:251.

#### **3.1.2.1.7 Historic Buildings**

When renovating older buildings in Sweden, it is important to consider both the cultural and historical value of the building and current legal requirements (Göteborgs Stad, n.d a). According to the PBL, alterations to buildings must be carried out with care to preserve their cultural significance. Particularly valuable buildings must not be distorted and the demolition of such buildings is prohibited.

Through the inclusion of protective provisions in zoning plans, municipalities can ensure the preservation of particularly valuable built environments, buildings, structures and properties (Göteborgs Stad, n.d a). These provisions may require, for example, that specific materials or architectural details be preserved or that renovations be carried out in a way that maintains the building's cultural value.

Regarding zoning plans (PBL 4:16), protective provisions may include requirements that (Göteborgs Stad, n.d a):

- The building's façade materials and details be preserved.
- The building's color scheme and architectural design not be altered.
- Only certain construction techniques or materials be used for maintenance and renovation.

According to PBL 8:17, careful consideration must be taken when renovating, meaning that original materials and methods should be used where possible (Boverket, 2023a). Modernization must not alter the building's cultural and historical character. Additionally, extensions and alterations should be adapted to the building's original appearance.

PBL 8:13 states that buildings of cultural and historical value must not be altered in a way that distorts their character through careless renovations or conversions (Boverket, 2023a). This means that the building's distinctive features, such as architecture, materials and period-specific details, must be preserved. Prohibited changes may include replacing original windows with modern, non-period-appropriate alternatives, plastering façades that were historically brick or wood and making major façade changes that affect the building's character.

Municipalities have the right to require property owners to comply with the requirements for careful renovation and the prohibition against distortion (Boverket, 2023a). If a building is maintained in violation of protective provisions, the municipality can issue an order to correct the deficiencies. If property owners fail to comply with the regulations, they may face penalty fees or be required to restore the building to its original appearance.

To support owners of culturally and historically valuable buildings, government grants are available (Länsstyrelsen Stockholm, n.d). These grants aim to cover additional costs that may arise when renovating or restoring using traditional materials and methods.

#### **3.1.2.1.8 PBL 1<sup>st</sup> of July 2025**

In February 2025, the Swedish Government, announced their proposal of simplifying the building permits in order to reduce administrative burdens and expensive costs for builders (Boverket, 2025b; Regeringskansliet, 2025). The new rules aim to simplify construction by removing the need for building permits in more cases. For example, it will be possible to construct accessory buildings and extensions of up to 30–50 square meters without a permit, including on multi-family buildings. Owners of single-family homes will no longer need a permit for façade changes, which facilitates measures such as installing solar panels. It will also be allowed to convert attics into residential space, even if this conflicts with existing zoning regulations. In rural areas, up to 50 square meters in existing buildings can be adapted for business use without a permit and small sports facilities under 1,500 square meters will also be exempt from permit requirements.

## **3.2 Renovation vs Newly Built**

In this chapter the processes for renovation and new construction will be described in detail. According to IVL, the standard calculation period for a building's life cycle assessment (LCA) should be set to **50 years** (IVL Svenska Miljöinstitutet, 2024). For a renovation, other measurements can be used, depending on what kind of renovation that it is. The crucial steps in the planning process and production process will be explained detailed.

### **3.2.1 The Renovation Process**

Depending on the extent of the renovation, different steps are crucial also, because the preconditions usually vary a lot (Boverket, 2018). A typical renovation process begins with a feasibility study and planning. This stage includes a needs analysis, where the potential of the space is evaluated based on the building's structure and layout. Additionally, regulations and permits play a significant role at this stage. In Sweden, Boverket provides comprehensive building regulations (BBR) that must be followed during renovations.

In the beginning of the renovation process, a technical investigation should be conducted, including a structural assessment to evaluate the building's load-bearing capacity and identify necessary reinforcements (Boverket, 2018). Accessibility requirements should also be considered at this stage. When designing drawings and plans, aspects such as ventilation, aesthetics and natural light must be properly accounted for. All technical systems, including electricity, plumbing and insulation, should be carefully planned to ensure functionality and energy efficiency.

The next step is to submit a building permit application to the municipality (Boverket, 2018). Collaboration with the urban planning department may be required to address potential questions or additional documentation requests. Before construction begins, a procurement process is initiated, where bids are obtained from contractors with relevant experience in similar renovation projects. Clear agreements should be established, specifying the scope of work, timeline and costs.

The execution of the renovation consists of three main phases: preparatory work, construction phase and quality control (Boverket, 2018). Preparatory work involves strengthening the building's structure and ensuring that the construction site meets all safety requirements. The construction phase varies depending on the type of renovation but generally includes the installation of technical systems and interior elements. Quality control involves continuous inspections to ensure compliance with relevant standards and specifications. Finally, an independent inspector reviews the completed work to identify any deficiencies.

### **3.2.2 The Newly Built Process**

The construction process of a new residential building in Sweden follows regulations set by PBL, the Planning and building Act and the Swedish National Board of Housing, Building and Planning (Boverket) (Sveriges Riksdag, 2010). The process consists of several key stages. The initial phase is characterized by a pre-study which involves the municipality, site investigation (such as geotechnical and environmental studies) and then a preliminary design and feasibility study. In the design study, architects and engineer develop initial sketches and analyze the technical and financial feasibility of the project.

Further on, the process includes permits and potential approvals where the building permit application is submitted to the municipality and reviewed based on the PBL, zoning plans and BBR (Boverket, 2024b). Once the permit is approved, a technical consultation is held with the municipality and an inspection plan is established. Then the municipality can give a start approval before construction can begin.

The construction phase for a newly built include mandatory general steps where the first is “Groundwork and Foundation” (Boverket, 2020a). This part contains excavation, piling and pouring of the foundation slab or basement. Further on, the structural framework is established with walls, floors and roofs using materials such as wood, concrete or steel. Parallel to this, the installations of electricity, plumbing, ventilation and other technical systems are installed. Then the interior work includes insulation, flooring, wall finishes, kitchens and bathrooms. From this, an inspection and a potential final approval will happen and the occupancy and maintenance will take place.

After the production phase, the residential will occupy their new apartments and during the first 2-5 years there is typically a warranty period where the contractor is responsible for correcting any defects (Boverket, 2021). The building owner assumes responsibility for ongoing maintenance, operations and potential future renovations.

### **3.2.3 How the Processes Differ**

To summarize sections 3.2.1 and 3.2.2, the differences in processes between an attic conversion and new construction are outlined below. While many aspects of the processes are similar, there are also significant differences.

In the initial phase, a needs assessment and technical investigation are conducted for a renovation to evaluate the future potential and structural conditions. In the case of new construction, the preliminary study includes a geotechnical analysis and environmental studies. Here, the preliminary study is more extensive due to the higher level of detail required, especially when it comes to planning the foundation in detail.

For renovation projects, such as attic conversions, a permit assessment is required if the building holds cultural or historical value. In terms of permits, a building permit is required for renovations involving major reconstruction, depending also on whether the building itself requires renovation. For new construction, a building permit and construction start notice are always required. Moving on to the construction process, renovation often involves adapting and upgrading existing systems and may also require structural reinforcements. In new construction, everything is built from the ground up, from earthworks and foundation to structure and installations. Standardized building methods are often used in new builds to improve efficiency.

After the construction phase, the processes differ between renovation and new construction. When a renovation is completed, there are often fewer maintenance requirements initially, provided the building has been properly upgraded. The maintenance plan depends on the building’s age and the measures carried out. In a new build, all apartments and spaces enter a warranty period, during which any defects must be addressed by the construction contractor. Long-term operation and maintenance are then taken over by the property owner. In conclusion, the timeline and scope of renovation and new construction projects can vary greatly depending on the specific type of project.

### **3.2.3.1 Production Phase**

The production stage includes a lot of technical steps (Strandberg & Lavén, 2021) (Aulin et al., 2021). In this part, the focus will be on conducting the detailed technical steps included in new construction project, since this will be a reference point when comparing with attic conversions. Renovations can be either big or small, depending on their size and the preconditions in the building – which means that for renovation projects, the production stages are unique to each individual project.

#### **3.2.3.1.1 New Construction**

The first step in new construction is groundwork (Strandberg & Lavén, 2021). This involves preparing the site for building, including excavation, drainage and foundation work. In short, the land is adapted to meet the building's requirements by stabilizing the soil, redirecting water and ensuring sufficient load-bearing capacity. Common methods include shallow foundations (built directly on load-bearing soil) and deep foundations (such as piling for weak ground conditions).

The second step is the erection of the building frame, which involves assembling load-bearing structures, often made of concrete or steel (Strandberg & Lavén, 2021). Structural systems can be classified as heavy, medium, or light and may be constructed using in-situ concrete, prefabricated elements, or wooden beams. Typical solutions include timber or concrete frames, semi-prefabrication (such as slab panels combined with shell walls) and steel frame column-beam systems.

The next phase is roof installation, which involves mounting roofing materials such as concrete tiles, sheet metal, or timber (Strandberg & Lavén, 2021). Machines are also used for assembly and sealing to ensure energy performance. Roofs can be classified as warm, where the entire structure maintains the same temperature, or cold, where ventilation keeps the outer roof surface cool. Over-insulating the roof is often cost-effective, although adding insulation to older buildings may lead to moisture problems.

For façade construction, materials such as insulation, brick, precast concrete panels, or timber cladding are commonly used (Strandberg & Lavén, 2021). Emissions vary depending on the choice of materials and production, transport and installation all contribute to the building's environmental impact. Exterior walls require thermal insulation and may also be load-bearing, particularly when constructed from concrete. Plaster is often used as an outer layer to protect brickwork and provide an aesthetic finish.

When it comes to windows and doors, glass production is the most energy-intensive component (Strandberg & Lavén, 2021). Aluminum and plastic elements also contribute to environmental impact. According to BBR 6:322, the window area must be at least 10% of the room's floor area to ensure adequate daylight access.

In plumbing and HVAC work, the installation of pipes, pumps and heating systems generates emissions, especially due to materials like copper and plastic (Strandberg & Lavén, 2021). Heating systems such as district heating, heat pumps and gas boilers also influence the building's climate footprint. To ensure quality and reduce the risk of water damage, installations must comply with the industry's "Safe Water"

regulations, where both execution and documentation are critical.

Electrical installations contribute to CO<sub>2</sub> emissions through the production of cables, switchboards and lighting fixtures – particularly due to the extraction of metals like copper and aluminum (Strandberg & Lavén, 2021). These processes require significant energy and cause environmental impact through both manufacturing and transportation.

Finally, the last step involves interior finishing work (Strandberg & Lavén, 2021). This includes installing plasterboards, paint, flooring materials (such as concrete, laminate, or vinyl) and kitchen and bathroom furnishings. These tasks contribute to emissions through the production, transport and installation of materials. Waterproof and water-resistant layers are essential for protecting surfaces from moisture and preventing damage to building materials, especially in wet areas such as kitchens and bathrooms.

### **3.3 Environmental Sustainability**

In recent decades, environmental sustainability has emerged as a central focus within the construction sector, driven by increasing awareness of the built environment's contribution to climate change. The building and real estate sector accounts for a significant share of global greenhouse gas emissions, both through energy consumption during a building's use phase and through emissions embedded in materials and construction processes (Naturvårdsverket, 2025). In response, regulations such as Sweden's climate declaration requirement have been introduced to quantify and reduce the climate impact of new buildings.

The content in this chapter is grounded in current national policy initiatives. Specifically, the Swedish government has commissioned Boverket to propose how the introduction of emission limits for buildings' climate impact can be accelerated and how the application of climate declarations can be expanded (Regeringskansliet, 2022).

This chapter outlines key theoretical perspectives on environmental sustainability in construction, with a particular focus on Life Cycle Assessments (LCA), emission sources in new residential development and proposed regulatory developments. It also examines how adaptive reuse – such as attic conversions – can serve as a lower-emission alternative to new construction, supporting both national climate goals and long-term environmental responsibility within urban development. The content provides a foundation for later comparisons with the empirical results presented in chapter 4.

#### **3.3.1 Life Cycle Assessment (LCA) and Climate Declarations**

The environmental sustainability in the construction sector can be framed through the lens of **Life Cycle Assessment (LCA)**, which provides a structured method for quantifying a building's total environmental impact (Boverket, 2024c). According to the European standard EN 15978 (2011), a building's life cycle is divided into four main phases as shown in figure 6 and 7: the product stage (A1–A3), construction

process stage (A4–A5), use stage (B1–B7) and end-of-life stage (C1–C4) (Swedish Institute for Standards, 2011).

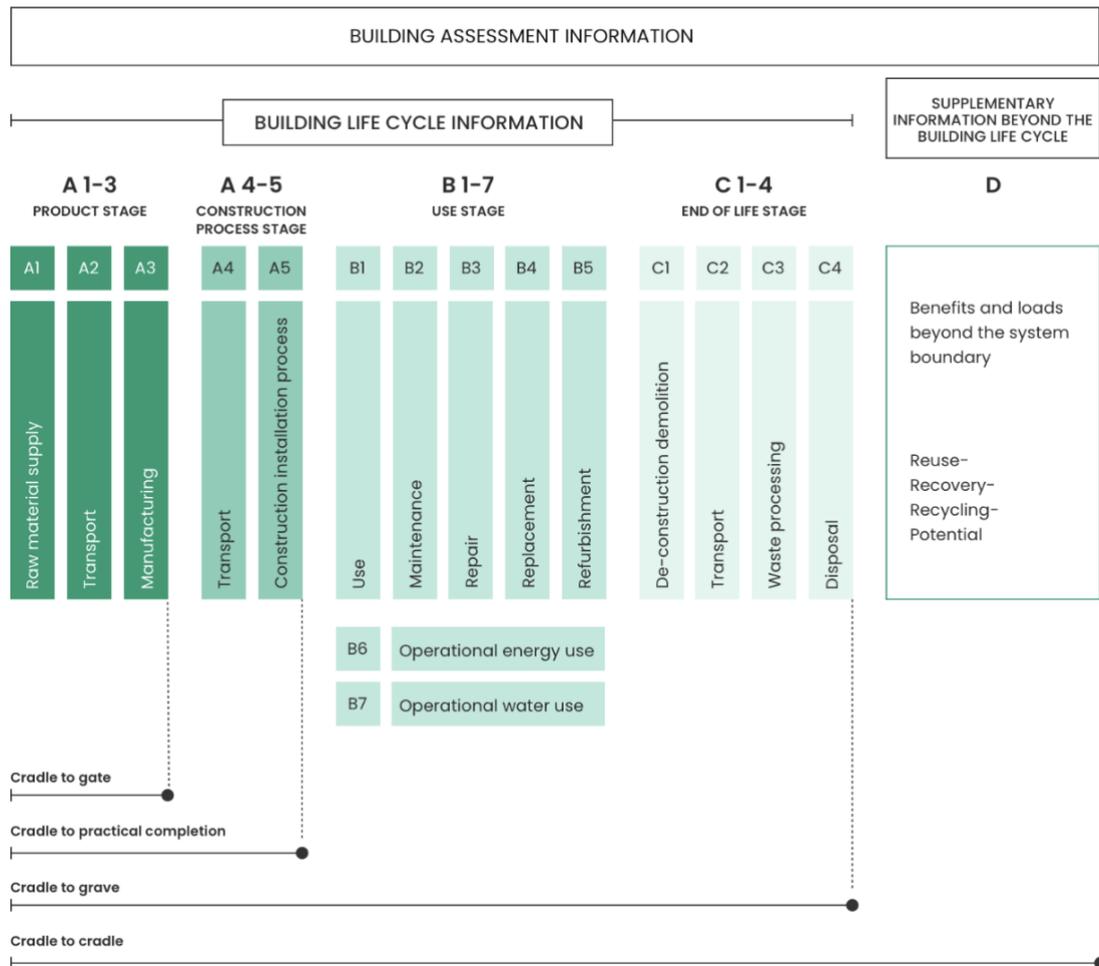


Figure 6. All of the stages of LCA according to EN standards (Swedish Institute for Standards, 2011). Illustration: Shaun (2025).

Since January 2022, Swedish law requires climate declarations for all new buildings (IVL Svenska Miljöinstitutet, 2024; Boverket, 2023b). These declarations focus solely on the construction stage A, phases A1 through A5. This stage includes raw material extraction, manufacturing, transportation and on-site construction processes. These regulations currently apply only to new construction, leaving a gap in climate reporting for renovation and reuse projects such as attic conversions.

## Sources of embodied carbon across the construction lifecycle

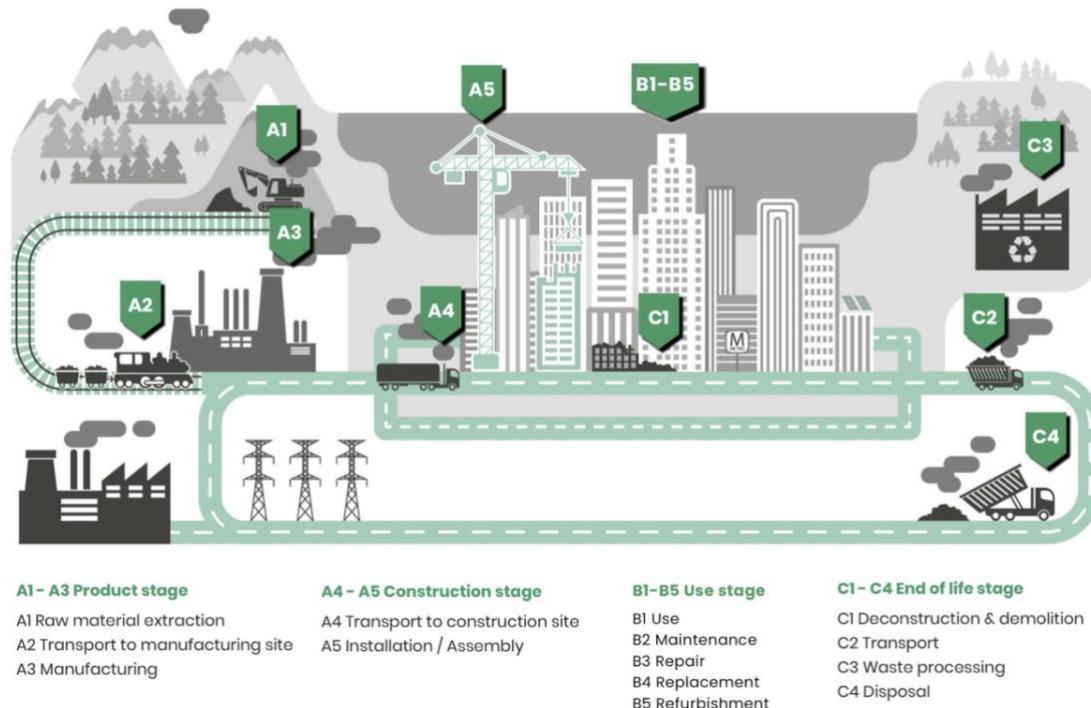


Figure 7. Illustrative cycle of the stages of LCA according to EN standards (B6 and B7 excluded as these are operational energy and water use). Illustration: Shaun (2025).

### 3.3.1.1 Climate Impact in New Construction

According to recent national data compiled by KTH Royal Institute of Technology, in collaboration with the Swedish Environmental Institute and industry stakeholders, and commissioned by Boverket and the Public Procurement Agency's government assignment (Malmqvist et al., 2023), the average climate footprint of a newly constructed multi-family building in Sweden is approximately **300 kg CO<sub>2</sub>e/m<sup>2</sup> BTA** under the current system boundary (modules A1–A5). When the extended boundary proposed for 2027 is applied for stage A, including the building elements interior surfaces and technical installations, the average rises to about **360 kg CO<sub>2</sub>e/m<sup>2</sup> BTA**.

The **product stage (A1–A3)** remains the dominant contributor to total emissions, accounting for **roughly 85%** in multi-family buildings, as shown in the figure 8 below (Malmqvist et al., 2023). This includes extraction and processing of materials such as **concrete, steel and aluminum**, which are commonly used in substructures and load-bearing frames. The heavy reliance on these high-emission materials is particularly evident in structural systems, where the **frame and substructure** alone can contribute between **60–70%** of the building's total embodied emissions.

The **construction process stage (A4–A5)**, covering material transport to the site and on-site assembly, adds an additional **15–17%** (Malmqvist et al., 2023). Although not as emission intensive as material production, this stage is still significant due to fuel

consumption by machinery and emissions from handling construction waste. In urban areas with restricted access, logistics can further increase emissions during these phases.

To mitigate the climate impact of these phases, the sector is increasingly exploring **climate-improved construction materials** and methods (Malmqvist et al., 2023). For example, the use of **low-carbon concrete and recycled reinforcement steel** has shown the potential to reduce emissions in the structural frame by up to **25%**, though average reductions across full projects remain closer to **12%**. Furthermore, **wood-based components** and hybrid structures are being investigated for specific building elements, particularly in lighter weight applications.

Despite these advances, the **baseline climate impact of new multi-family construction remains high**. As the sector transitions toward stricter emission limits and more ambitious sustainability targets, comparisons with alternative development approaches – such as adaptive reuse and attic conversions – become increasingly relevant (Boverket, 2023b). These alternatives, which build on existing structures and limit new material demand, offer a potential pathway to substantially lower emissions per square meter while still addressing urban housing needs.

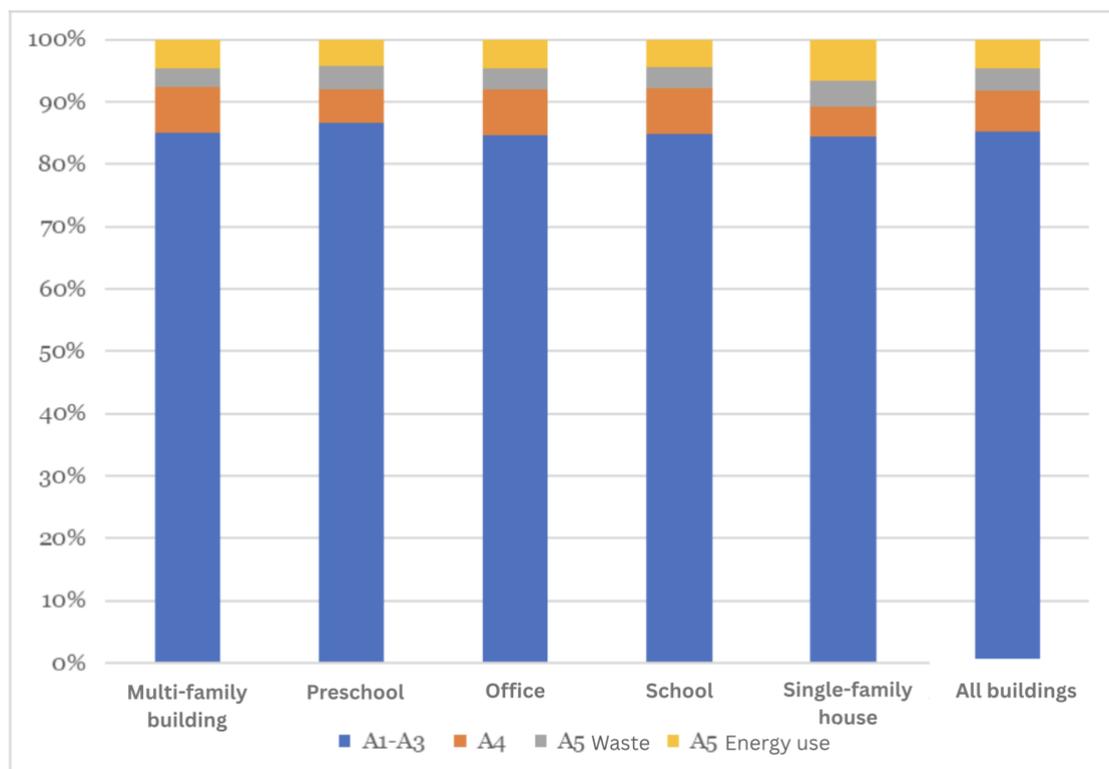


Figure 8. Share of climate impact per LCA stage: A1–A5, per module based on average values. Multi-family buildings: 19; all buildings: 68 (Malmqvist et al., 2023).

### 3.3.1.2 Environmental benefits of Adaptive Reuse: Case Studies and LCA

Adaptive reuse is increasingly recognized as a sustainable approach that prolongs the lifespan of existing buildings and supports broader sustainable development goals (Hu & Świerzawski, 2024). Different case studies have been carried out with LCA, however, the integration face challenges as there is a noticeable lack of a standardized

methodology for conducting such LCAs (Frossard & et al., 2023). Nevertheless, a LCA case study carried out by Hu & Świerzawski (2024) showed that adaptive reuse, by preserving structural elements like masonry walls and foundations, can significantly reduce environmental impact. Reported reductions include up to 82% in global warming potential and notable decreases in other categories such as smog formation (52%), acidification (27%) and eutrophication (21%). The study follows the EN 15986 standard and covers life cycle stages from material production (A1–A3) to construction (A4–A5), use (B1–B5), end-of-life (C2–C4) and potential future benefits beyond the building's lifespan (D).

Supporting this, Hasik et al. (2019) presents another case study on adaptive reuse demonstrated a 53-75% reduction in key environmental impacts. The case study compared new construction to renovation and the result is presented in figure 9 below.

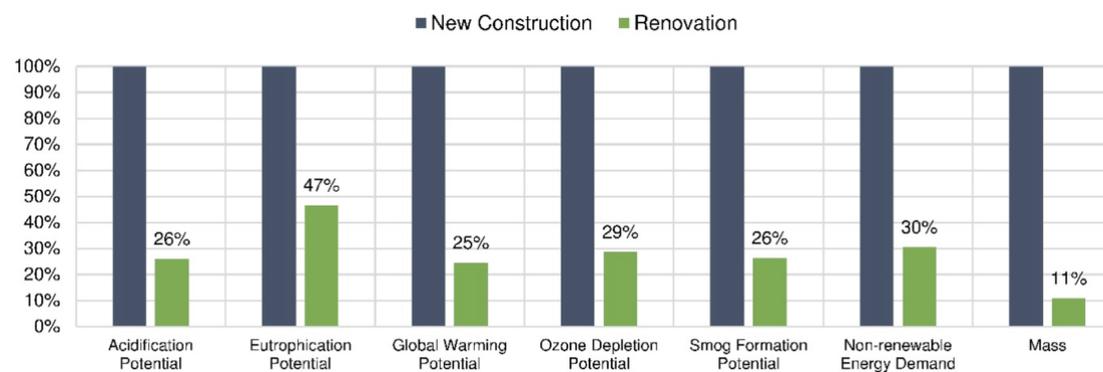


Figure 9. The overall comparison of the new construction and renovation. In this case, renovation helped avoid between 53% and 75% of the impacts from the new construction scenario (Hasik et al., 2019).

Furthermore, other observations by several authors acknowledged that adaptive reuse enhance energy efficiency during use and reusing embodied energy (Akande et al., 2023; Bullen & Love, 2011). This means improving the building's energy performance through upgrades like better insulation, while also preserving original materials and structures to avoid waste and save resources. By combining these approaches, we can reduce environmental impact and contribute to sustainable development in the reuse of heritage buildings (Lidelöw et al., 2019).

### 3.3.1.3 Contribution of Building Components to Climate Change

Environmental challenges linked to the construction sector are largely driven by carbon emissions (Chou & Yeh, 2015). A more detailed breakdown of the climate impact in new multi-family buildings reveals that individual building components vary significantly in their contribution to total emissions. Data from Malmqvist et al. (2023) indicates that **the structural frame is the single largest source of embodied carbon**, often accounting for up to **60%** of the total climate impact in the construction phase (A1–A5) as shown in figure 10 and 11. This is especially true for multi-story buildings such as multi-family which require more extensive load-bearing elements (Malmqvist et al., 2023).

**Material choices play a crucial role** in shaping this impact, as a significant part of CO<sub>2</sub> emissions comes from the materials themselves (Ghayeb et al., 2020). On

average, **concrete, steel, reinforcement materials and metals** account for approximately **60%** of the total emissions across a typical building (Malmqvist et al., 2023). These materials are particularly used in foundations and structural systems, for example according to research by Malmqvist et al. “*The vast majority of newly constructed multi-family buildings have concrete as the dominant material in the structural frame (85% in 2018) and this has been the case for a long time*”. Even when climate-improved variants of these materials are used, such as low-carbon concrete or recycled steel, the emissions from the structure remain the dominant factor.

While the **facade, interior finishing and technical installations** account for a smaller share of total emissions (figure 10 and 11), their relative importance is to be included in the upcoming 2027 regulation, which broadens the system boundary (Malmqvist et al., 2023). For buildings with fewer floors or wooden frames, the **foundation** often represents a relatively larger share of emissions.

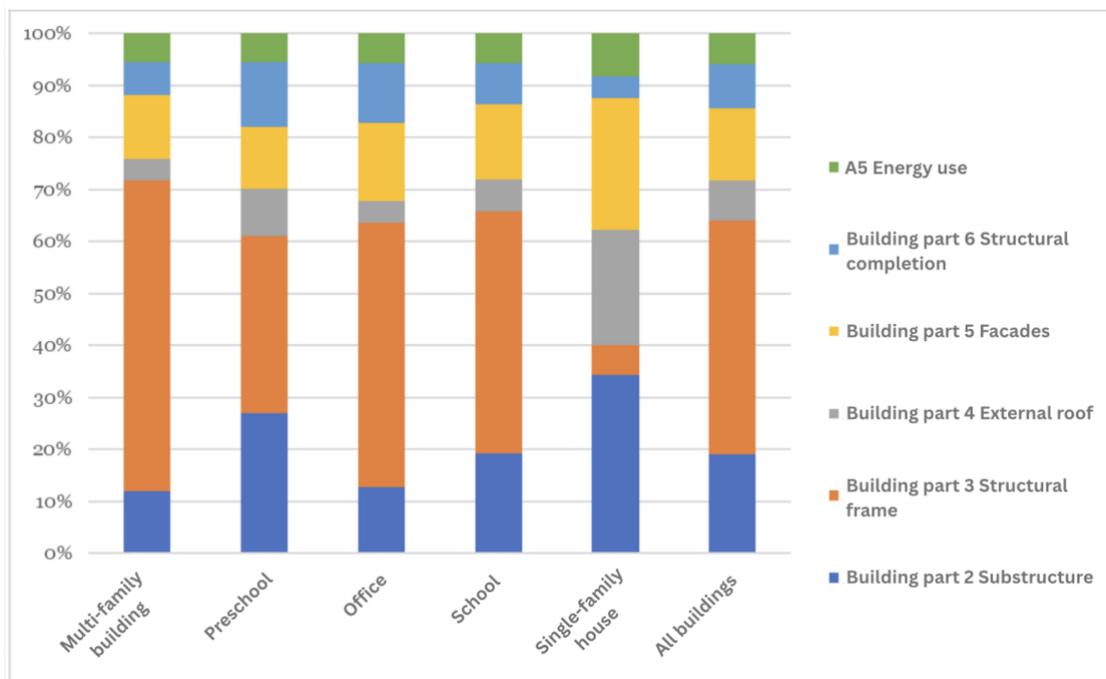


Figure 10. Share per building part according to the 2022 system boundaries, which excludes installations and room completions (Malmqvist et al., 2023)

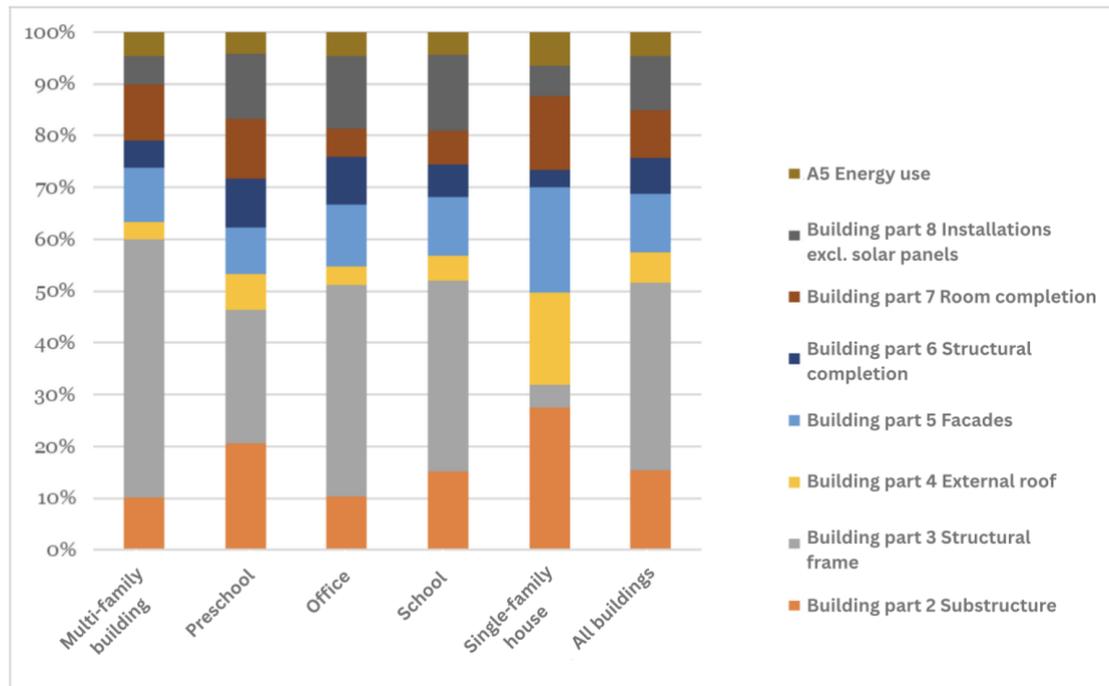


Figure 11. Share per building part according to the 2027 system boundaries, which includes installations and room completion (Malmqvist et al., 2023)

There is also a noted **variation in total emissions across buildings of the same type**, particularly among multi-family housing (Malmqvist et al., 2023). This is largely due to differences in structural systems and material choices. Buildings that use higher proportions of **timber** tend to show significantly lower embodied emissions compared to those dominated by concrete and steel. However, timber is not always a viable structural option for multi-story residential buildings due to regulatory and fire safety constraints.

### 3.3.1.4 Proposed expansion by Boverket of Climate Declaration Scope

Boverket (2020), on behalf of the Swedish government, proposes that by 2027, not only should the included building components in stage A be expanded – as described in the previous subchapter – but the scope should also cover stage B2 (maintenance), B4 (replacement), B6 (operational energy use) and stages C1–C4 (end-of-life). The figure 12 below illustrates the proposed changes in terms of system boundary and threshold (Boverket, 2020b).

	A1-A5	B2, B4, B6	C1-C4
Load-bearing structural components			
Building envelope and internal walls			
Interior finishes and fixed furnishings			
Installations, excluding solar panels			
Solar panels, including building-integrated systems			
Groundworks and soil stabilization			

Figure 12. The system boundary for the extended climate declaration from 2027 includes the climate impact from all green-marked components. The emissions threshold, by contrast, only considers the components marked in dark green (Boverket, 2023b).

Boverket (2023b) additionally recommends that **reconstructions**, such as adaptive reuse and attic conversions, be included within the regulatory framework. The reason behind this proposal is grounded in the fact that **property management – including renovation, reconstruction and extension – accounts for 55% of the total (domestic and imported) emissions from the construction and real estate sector** (Boverket, 2023b). Under the European standard EN 15978, major alterations to a building are methodologically treated as new construction (A1–A5). However, the structural components that remain during the renovation are considered “free” in terms of climate impact for the new investment period. This effectively encourages circularity: a careful renovation will result in significantly lower emissions than demolishing and replacing large amounts of materials.

In the evaluation of the proposal, there was majority of stakeholders supporting the introduction of mandatory climate declarations for reconstruction, including adaptive reuse – these projects often involve both large-scale demolition and installation of new materials (Boverket, 2023b). It was suggested that these new requirements could promote reuse of building components and reduce premature demolition of buildings. If emission thresholds for reconstruction were set at the same level as those for new construction, it would **clearly demonstrate in most cases that renovation and reuse of existing building structures result in lower climate impact than demolition and new development**. This is because, in climate terms, the existing structure is considered to have zero emissions, making it significantly easier to meet future

carbon thresholds. Furthermore, according to the International EPD System (n.d) climate declarations help raise awareness about carbon emissions and can serve as supporting data for decision-making, improved climate strategies, and more sustainable purchasing.

Boverket (2023b) notes, however, that imposing climate declarations on all reconstruction activities would not be appropriate, as minor interventions would be disproportionately affected. Instead, they suggest targeting the declaration requirements to specific types of alterations that generate notable environmental impact as previously mentioned. Boverket further discusses the challenges associated with reconstruction, noting that many of the existing definitions within the Planning and Building Act (PBL) are difficult to interpret and apply in practice. Ultimately, the aim of the proposed changes is to guide the construction sector towards climate-smart product choices and solutions that promote low-emission design across both new and existing buildings.

Furthermore, Boverket (2023b), suggests, as a consequence of this expansion, that “a competence enhancement is deemed necessary for all actors in the construction process, in order to understand how design and material choices affect emissions (developers, contractors, product manufacturers, small and medium-sized enterprises and designers)”.

### **3.4 Economy and Profitability**

This chapter explores the key economic factors that influence decisions between renovating existing buildings and construction new housing. When deciding to change something with a building many factors, such as profitability, financing structures, land and production costs, rent-setting system and procurement strategies must be considered. In this chapter, various aspects to consider before starting a renovation or new construction project are presented.

#### **3.4.1 Comparison of the Profitability of Renovation vs Newly Built**

In a study, the discussion centered around the renewal of city centers (Alba-Rodríguez et al., 2017). The study focuses on multi-family residential buildings in Spain that have suffered significant damage due to poor maintenance and construction defects. The need for upgrading is evident and renovation and new construction have been discussed as two separate options. The researchers examined both the costs and environmental impact.

The study aimed to develop a model that analyzes both environmental impact and economic factors (Alba-Rodríguez et al., 2017). When the model was tested, the researchers discovered several key findings. Approximately 83% of the building’s total environmental footprint during renovation came from the manufacturing, transport and installation of building materials. Cement and steel accounted for half of the emissions, particularly in foundation reinforcement. When comparing demolition and new construction with renovation, the renovation proved to be 21% cheaper. The environmental impact was 58–68% lower, depending on the chosen energy standard. The results thus showed that even when a building is heavily damaged, renovating it is still cheaper and better for the environment than demolishing and building anew.

Another study has examined how renovation and demolition affect the environment, social values and economic stability in society (Leichter & Piccardo, 2024). The study investigates in how different studies compare renovation and demolition from the environmental, social and economic perspective.

Looking at an economic perspective many studies show that renovation is often cheaper than building something new (Leichter & Piccardo, 2024). But this depends on the lifespan of the building. When the building has a shorter future lifespan, renovation is more profitable. When the building will last a long time, new construction can sometimes be better because it allows for modern and energy-efficient solutions. Furthermore, the article describes that from a social point of view, renovation can help protect cultural heritage and keep communities together.

In an additional study, the ideal and most cost-effective technical solution for renovation projects was investigated (Liao et al., 2023). It is stated that renovating old buildings is an important way to save energy and reduce emissions, while also costing less money. Since there are many different renovation techniques to choose from, these are examined in the study.

The conclusion was that there are economic barriers behind why renovations are not carried out (Liao et al., 2023). Many households cannot afford to make energy renovations, even if they own their home. And even if they can afford it, they often still choose not to renovate. Customers who want to renovate focus mostly on price, timeframe, function and appearance, rather than climate benefits. The study mentions politics as a barrier, where fear of risks and legal disputes leads the industry to stick to what it already knows. Contract models also make collaboration and shared responsibility more difficult.

### **3.4.2 Dialogue with Residents**

In a report, the importance of dialogue with current residents before planned work is carried out in a building is described (Nobs, 2015). Madeleine Nobs, from NCC, explains that dialogue is a key to successful renovations. To create involvement and the possibility of influence, it is important to involve the residents early.

Dialogue reduces the risk of complaints and creates a sense of security among the residents (Nobs, 2015). This is because the people living in the building have their home and private life close to the renovation site, which makes it important to communicate what is happening and when.

### **3.4.3 Financing Condominiums vs Rental Apartments**

Regarding the financing of condominiums, its structure and function need to be reviewed. A condominium association is an economic association that grants the right to use dwellings to its members (Lidberg, 2008).

The association is run according to the cost price principle, where the monthly fees for all residents cover the association's expenses such as loans, maintenance and operations (Bostadsrätterna, 2024). The board is responsible for financial stability

and, in the event of rising costs, the fee may be raised. Decisions are made at the general meeting, where each member has one vote. The priorities of the condominium association are the members' financial interests and the goal is not large profits (Hyresgästföreningen, n.d).

Rental apartments are owned by a landlord who is responsible for maintenance. The rent is often negotiated between the landlord and the "Hyresgästföreningen", Swedish Union of Tenants and is based on factors such as standard and location (Hyresgästföreningen, n.d).

"Hyresgästföreningen", the Swedish Union of Tenants, is a member-driven organization whose goal is to create secure housing and contribute to societal development (Hyresgästföreningen, n.d). Tenants have limited influence over the rent and major rent increases are uncommon (Lind, 2014). Investment calculations are used by the property owner to assess property-economic decisions, for example energy efficiency improvements.

Municipalities in Sweden are responsible for housing planning, but many report a housing shortage, particularly regarding rental apartments (Eklund, 2014). This contributes to further upward pressure on prices for detached houses and condominiums. Since 1990, the number of newly built rental apartments has remained virtually unchanged, while the number of condominiums has increased by about 50%. A trend that has emerged since 1997 is to convert rental apartments into condominiums, which has led to an even smaller supply of rental apartments.

According to Hans Lind (2016), professor at KTH, there are several causes of the problems such as regulations and few incentives to build affordable rental apartments (Lind, 2016). In addition, he states that "Hyresgästföreningen" often needs to accept high rents on new construction because they want to stimulate the construction of more rental apartments.

#### **3.4.4 Cost of Land and Production**

The production costs for condominium in Sweden have increased with approximately 190% during the period of 1998-2022 (Byggföretagen, 2024). The total production cost consists of the production costs (the costs of the entrepreneur), the land cost, the developer cost and the construction cost. During 2022 about 80% of the total production cost were production costs and the remaining 20% were land cost. The total land costs have increased by 4,2 times since 1998 while the production cost has increased by only 1,6 times.

The main reason to why the land costs have increased is due to the landowner charging (Byggföretagen, 2024). In SCB it is possible to spot a difference between the land cost for tenant-owned apartments and rental apartments. In 2022, the land cost was about 12,600 SEK per square meter of apartment area for tenant-owned apartments, while it was 5,316 SEK for rental apartments. A corresponding comparison for 1998 shows that the difference was much smaller.

### 3.4.4.1 Pricing Rental Apartments

In 1968 the legislated rent control system “Bruksvärdessystemet” was introduced, which means that all rents must be set with regard to the properties and the apartment’s standard, equipment, common areas, proximity to transport (Ramboll, 2021). The parties on the rental market negotiate the reasonable rent and judicial review can be carried out if a dispute arises. It is assessed based on the pricing of similar apartments.

Since 2006 it has been possible to exempt new construction from utility value reviews through presumption rents, “Presumtionshyror”, negotiated between the property owner and the Swedish Union of Tenants (Ramboll, 2021). Presumption rents apply for 15 years and are based on the production cost, that is more connected to market-level rents. After 15 years, a utility value review can be conducted.

It is argued that the utility value system creates security and predictability for tenants through tenancy protection and regulated rents (Ramboll, 2018). It ensures that more can afford housing and counteracts income segregation. A transition to market rents could lead to higher rents, reduced disposable income and social divides.

Arguments for freer rent setting hold that regulated rents lead to excess demand, long housing queues and low mobility, which particularly affects young and low-income households (Ramboll, 2021). It can also create incentives for fraud, such as black contracts (Mangolda et al., 2023). In addition, freer rent setting can stimulate new construction by giving property owners a better return on their investments. According to the same study by Ramboll (2021), calculations show that if market rents were introduced, rents would increase by about 51%.

The study compares the square meters a buyer gets in different districts for a monthly cost of SEK 10,000. Figure 13 below shows how many sqm you get for 10k per month (Ramboll, 2021). There is a big difference between the various areas in Gothenburg. For SEK 10,000 per month, you get 102 sqm in Gunnared, while 61 sqm in Linnéstaden.

Gunnared, 102	Bergsjön, 91	Backa, 81	Torslanda, 77	Högsbo, 73	Askim, 72
Lärjedalen, 101	Tynnered, 88	Kortedala, 80	Härlanda, 67	Örgryte, 66	Majorna, 65
Biskopsgården, 94	Tuve-Säve, 87	Frölunda, 78	Lundby, 67	Centrum, 62	Linnéstaden, 61

*Figure 13. Average size of a rental apartment for the cost of SEK 10 000 per month, per area in Gothenburg (Ramboll, 2018).*

### **3.4.5 Contracting Model and Procurement Method**

When planning an attic conversion, selecting the right **contracting model** and **procurement method** for your specific project is essential for ensuring efficiency, cost control and compliance with building regulations (Boverket, 2024a). The choice affects how responsibilities, risks and decision-making are distributed between the client and contractors.

The two main contract models in Sweden are Design-Build Contracting (DB), where the contractor is responsible for both the design and the execution of the project (Boverket, 2024a). The other main contract model is Design-Bid-Build (DBB) contract, where the client is responsible for the design instead and prepares complete drawings before hiring a contractor to build. There are pros and cons with both models and should be evaluated for each client and projects circumstances.

Effective construction management systems are important to ensure that these projects are economically sustainable. In an article the comparison between DB and DBB was made regarding preservation construction projects (Patrick, 2013). He analyzed budget, design, schedule, risk assessment and the client's experience. In two studied projects, the conditions looked good regarding financing, established design, schedule and risk analysis. In one project, DB was used and in the other, DBB. Both projects encountered problems in the form of delays, increased costs and unexpected issues. In the project where DBB was used, asbestos was discovered, which could have been identified earlier and better access to the building could have been provided. In the project with DB, demolition work was required to discover structural problems.

The choice of DBB in one project was appropriate because the project was completed and the client was satisfied, but a DB setup could possibly have detected hazardous materials earlier. In the other project, DB was a good choice because it made it possible to start the construction phase before the design was fully completed, which allowed for quick handling of unexpected problems. The conclusion of the study is that the choice between DB and DBB in preservation construction should be based on the specific needs of the project.

The contracting model should not be mistakes with the procurement method, which explains how the client chooses to sign contracts (Boverket, 2024a). The two main methods are Divided Contracting and General Contracting. In a general contract, a single contractor is hired, who then engages subcontractors. In a divided contract, the clients signed parallel agreements with multiple contractors and often manages the construction process themselves.

## **3.5 Social and Cultural Sustainability in the Built Environment**

Since the built environment will be occupied by the community, full of people with values, opinions and preferences, it is important to not forget the social and cultural values. Considering social and cultural sustainability can be seen as a tool to plan a

city so it creates value and, in the long run, financial sustainability. In this chapter social sustainability will be evaluated and defined according to the living environment. Urbanization and inclusion are two aspects that are important when it comes to social sustainability. Moreover, cultural values and preservation are mentioned as other crucial aspects to consider when planning a city.

### **3.5.1.1 Urbanization, Land Constraints and Housing Shortage**

Urbanization is one of the most significant societal trends in today's global development and Swedish cities are no exception. Cities like Gothenburg and Stockholm are experiencing rapid population growth and changing demographics, leading to an increased demand for housing. However, housing construction has not kept pace with demand, resulting in a housing shortage (Nijskens et al., 2019; Hansson, 2017).

The housing shortage affects not only individuals looking for a place to live but also limits urban development and economic growth (Stockholms Stad, n.d). One of the biggest challenges in metropolitan areas is the limited availability of land combined with high demand, which drives up housing prices (Nijskens et al., 2019). Increasing housing supply is necessary but must be done in a way that considers sustainable urban development, the preservation of historic city centers and the creation of vibrant, socially mixed environments.

#### **3.5.1.1.1 Solutions for Housing Development in Urban Areas**

One of the key takeaways stated by Nijskens (2019) is that we need to build smarter as cities are increasing in popularity all over the world. To meet the housing demand in major cities, a multifaceted strategy is required. According to Edward Glaeser (2021) an increase in housing supply can be achieved with the use of limited land and minimal disturbance of historical buildings and city centers, if higher rise buildings can be built (Glaeser, 2021). The concept of “good density” has been highlighted as a model for creating mixed use urban environments with high quality green spaces and public areas that are well-integrated, making the cities pleasant to live in (Nijskens et al., 2019).

#### **3.5.1.1.2 Social Values of Mixed-Use Housing Solutions**

A global social problem with the urbanization is the delayed housing supply contra the growing demand for homes (Nijskens et al., 2019). One of Nijskens (2019) main points is that we need to improve the supply by building smarter. Because at this time, limited land area in a combination of high demand will result in high housing prices.

According to Nijskens (2019) housing growth is possible with limited land use and minimal impact on preservation buildings, if higher-rise buildings are allowed. The definition of a good density is a combination of mixed-use environments, high-quality green and public spaces, strong connectivity and inclusivity for different income and demographic groups. In addition, modern construction techniques and off-site manufacturing can accelerate the building speed.

### 3.5.2 Cultural Values

A study conducted on houses in Halland examines how the cultural classification of a property can influence the valuation of neighboring buildings (Andersson et al., 2018). It also investigates how the classification itself affects the value of the property in question.

When drafting legislation for the preservation of cultural heritage, policymakers must weigh the protection of historic buildings against the potential for alternative land use. According to Andersson et al. (2018), decision-making should be based not only on the value of the individual building but also on any positive effects it may have on surrounding properties.

The results clearly show noticeable price increases, varying depending on the type of classification (Andersson et al., 2018). The authors divide the properties into three categories: A, B and C. Class A refers to buildings of national historic significance (often protected by law), Class B includes those of regional importance and Class C covers buildings of local historic value. Class A properties show a price premium of around 36%, Class B properties about 19% and Class C properties see a smaller increase of around 4%. As for neighborhood effects, a property located near a Class A building experiences a value increase of roughly 1%, which gradually decreases with distance.

The study concludes by emphasizing that preserving cultural heritage not only supports the development of a sustainable society but also generates clear economic value. The potential impact on neighboring properties should always be considered when making decisions regarding cultural preservation.

#### 3.5.2.1 Cultural Historical Buildings

Can a building be more or less valuable? According to Eriksson et al. (2019), it is possible to connect cultural values to a building's material and immaterial aspects. It can either be memories and emotions or concern the choice of materials. As previously mentioned, reuse is a relevant theme today, as there is a much greater need to use what has already been built, with a focus on preserving current cultural values.

In Gothenburg, buildings of cultural and historical value have been preserved according to the municipality's conservation program since the 1960s (Göteborgs stadsmuseum, 1999). This is because many areas were redeveloped around this time. Many different types of conservation programs have been established, but they share the same objective – to preserve the built environment that is seen as culturally and historically significant, as this is considered a contributing factor to people's well-being. It is also important that the preserved built environment represents the local history within each district in Gothenburg. Whether a building is considered to have conservation value is related to its architectural value, patina, artistic quality, symbolic value, as well as how genuine, qualitative and rare it is perceived to be.

According to (Bond & Worthing, 2016), cultural value depends on many factors that are not always relevant in every case. One factor can be how the site or landscape

looks today, what views exist towards, from and over the building or site, how visible the building or site is from different parts of the surrounding area, how the surrounding landscape looks and what feeling it conveys. The relationship between buildings and nature in the area also has great significance for how a cultural value is expressed.

The first conservation program for buildings of cultural and historical value in Gothenburg was established in 1975 (Göteborgs stadsmuseum, 1999). In 1987, the Planning and Building Act (PBL, “Plan- och bygglagen”) was introduced, which often states that a building should be handled with care during construction work. Distortion is not permitted when a building has cultural and historical value.

There are three main laws in Sweden that protect valuable building (Riksantikvarieämbetet, 2023). The first is the Planning and Building Act, (*SFS 2010:900*), which includes the requirement of care, meaning that changes to buildings must be made with respect to their original character. The second is the Cultural Environment Act, “Kulturmiljölagen”, (*SFS 1988:950*), which protects cultural heritage, including listed buildings, but only a limited number of buildings fall under this protection. Lastly, the Environmental Code, “Miljöbalken”, (*SFS 1998:808*), which protects cultural environments of great national interest through national interest classification.

Cultural values are what make something valuable to the past, present and future generations (Armitage & Irons, 2013). This can be due to various expressions related to, for example, history, symbolic meanings, religion, or archaeological purposes. The surroundings are important for context, as a building's cultural and historical value can be connected to its environment.

The quote “Heritage is important because people think it is” gives a good picture of why people value cultural heritage and that it can be experienced from many different perspectives (Armitage & Irons, 2013). Much of what is found in cultural values is seen as added value and benefits. In the study, the benefits of preserving culturally and historically valuable buildings are divided into two categories: “Owner benefits” and “Community benefits.” In “Owner benefits,” it is explained that there are aesthetic advantages for the owner in preserving buildings. There are also economic benefits for the owner, as the buildings are preserved and money is saved. Another advantage is described as convenience, since the building is preserved and only requires maintenance.

In “Community benefits,” the advantages are described as significant (Armitage & Irons, 2013). Contributing to the preservation of the already built environment leads to many neighborhoods gaining a historical character, which can be seen as a major benefit for society. It can also increase tourism and open for educational opportunities, as many people get the chance to learn about history.

In a study by Licciardi & Amirtahmasebi (2012) the relationship between economic value and cultural value of culturally and historically significant buildings is discussed. According to the authors, culturally and historically valuable buildings

have both use values, such as tourist fees and rental income and non-use values, such as existence value and the original value of the building. Unlike economic value, cultural value is therefore difficult to quantify. As previously mentioned, the authors argue that cultural value can be divided into different dimensions, such as aesthetic, spiritual, symbolic, social, historical, authenticity and scientific value. These influence how society weighs economic and cultural value against each other.

#### **3.5.2.1.1 Trends in Sustainable Construction and Reuse**

The interest for sustainable development and efficient use of resource have increased drastically (Owojori et al., 2021). In a report the research has focused on analyzing how “adaptive reuse” have increased. From the analyze it was clear that during 2006 to 2021 the research on “adaptive reuse” had increased sharply. The articles have a focus on environmental science and new techniques such as reuse of building components, materials and the environmental footprint of the building during the whole life cycle.

Another research focused on analyzing previous literature, more specifically 177 scientific articles about strategies aimed at reducing construction and demolition waste (Zhu & Feng, 2024). The analysis focused on comparing approaches such as material reuse, recycling levels and other circular economy practices. The findings show that interest in this area of research has grown steadily. The “three R” were also analyzed (reduce, reuse and recycle), where reuse seemed to appear less frequently compared to recycling. Moreover, while environmental and economic aspects of sustainability have been widely explored, social sustainability has received comparatively little attention.

#### **3.5.2.1.2 Forecast Regarding Urbanization**

In Gothenburg, it is estimated that 4,000 to 5,000 new homes per year will be needed until 2030 to meet both growing demand and reduce the current housing shortage as shown in figure 14 (Göteborgs Stad, n.d b). Stockholm has set an even higher target, aiming for 8,000 approved housing units per year through urban planning processes (in 2023–2024) to support more sustainable urban development (Stockholms Stad, n.d).

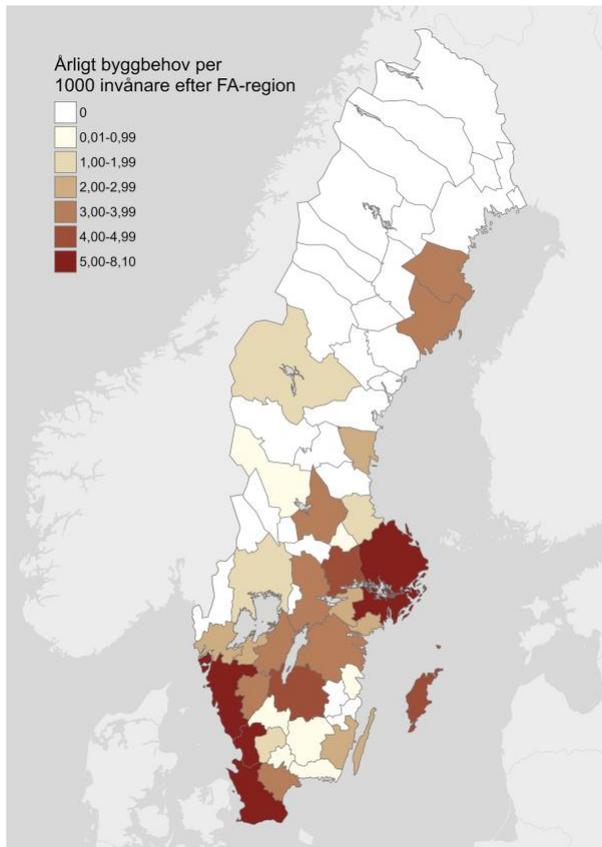


Figure 14. Estimated annual construction need per thousand inhabitants 2024–2033 (Boverket, 2025a).

## 4 Empirical Data

This chapter presents the empirical findings based on semi-structured qualitative interviews with professionals engaged in housing development projects, specifically project managers with experience in attic conversions. The results are organized thematically to align with the study's research questions and allow for clearer comparison between attic conversions and new housing construction.

The interview sample consists primarily of five project managers with direct experience in attic conversion projects. To broaden the perspective and capture a more comprehensive understanding of the process, the study also includes insights from an environmental and reuse coordinator as well as a contractor and architect with many years' experiences within the area, all shown in table 2 below. These complementary viewpoints contribute valuable input regarding sustainability, material reuse and construction challenges.

Several of the respondents referred to case studies, mentioned in the method section, while answering the interview questions. The interviewees are the following professionals:

NAME	JOB TITLE	TENURE TYPE	COMPANY
John Kåwert	Project Manager	Rentals and condominiums	Sweco
Christian Holmström	Project Manager	Both, mostly condominiums	Sweco
Ellen Johnsson	Project Manager	Rentals	Familjebostäder
Per Orshammar	Project Manager	Rentals	Bostadsbolaget
Robert Koprowicz	Project Manger	Condominiums	Vindshem
Karin Hallingström	Environmental and Reuse Coordinator	Both, mostly condominiums	Sweco
Alexander Sandqvist	Site manager and Project manager	Rentals and condominiums	4D Gruppen
Jaana Kapuli	Architect	Rentals and condominiums	Forum Arkitekter

*Table 2. Presenting the respondents, their title, tenure type specialization and company for phase 2, semi-structured interviews.*

Furthermore, one part of the results (chapter 4.2.1 social sustainability and cultural values) was gathered through a questionnaire examining citizens' valuation of living environments and culturally historic buildings. The questionnaire contained 15 questions (to be found in appendix C), developed with input from Cultural heritage building specialist Annika Kaas from Sweco.

## 4.1 Challenges and Advantages of Adaptive Reuse and Attic Conversions

Attic conversions and adaptive reuse offer significant benefits, such as sustainability and cost savings, but also come with challenges. These include technical complexities, regulatory challenges and logistical issues - particularly when working with older buildings. This section outlines the main challenges and advantages identified by the interviewees.

### 4.1.1 Challenges of Attic Conversions

All interviewees emphasized **technical complexities** as a challenge in attic conversions, building in existing and often old buildings. For example, structural load-bearing capacity, fire safety regulations, accessibility standards and ensuring proper escape routes were identified as major technical barriers. These elements often demand complex design solutions and close collaboration with other professions within the area. As a consequence of the challenges, the **cost to produce** attic apartments compared to newly build is much higher per square meter – frequently mentioned by the interviewees as a challenge. Furthermore, Ellen Johnsson highlighted the **unpredictability** – not knowing what challenges you will face in these projects.

All interviewees also raised concerns about the **building permit and planning process**. Unclear and constant **changing municipal guidelines** (BBR and PBL) and lengthy review times were cited by Robert Koprowicz, Jaana Kapuli and other interviewees as major sources of frustration that could delay or jeopardize the projects – due to the associated risks. However, as Koprowicz highlights the challenges with building permit and planning – he almost never experiences any unpredictability's on-site during production. According to the architect Kapuli, the single most difficult challenge in attic conversions is the municipal permit process. Outcomes vary significantly depending on which official is assigned to the case.

**Logistical issues** during construction were frequently mentioned, especially in urban areas. Working in already inhabited buildings, often in dense inner-city locations with limited site access, poses difficulties in terms of noise and scheduling construction deliveries and materials. The environmental and reuse coordinator Karin Hallingström raised issues about the presence of **hazardous building materials** in older buildings, which can impact the project timeline or even halt the project entirely.

#### 4.1.1.1 Critical Steps of Attic Conversions

Connected to the challenges previously stated, one of the most critical steps stated by all interviewees was the work conducted before building permit – **a profound planning process**. Being able to hand as much reliably info to the entrepreneurs as possible according to Johnsson or as stated by Alexander Sandqvist – include the entrepreneur as early as possible in the process. For example, identified the structural assessments and reinforcements of the existing building, coordination with authorities for **permits and fire safety** and integration of ventilation, plumbing and electrical systems. Explained by Koprowicz, tiny miscalculations could cause major problems in these kinds of project as you can't change the existing building in comparison to

newly build. Kapuli confirmed that precise measurements are often unavailable during early design stages, which may result in errors later. Some accessibility elements – like terrace thresholds – are difficult to resolve once construction is underway. She further emphasized the importance of **engaging architects early** in the planning process. Initial design starts with calculating usable volume, which is crucial due to height constraints and meeting accessibility standards in complex projects like attic conversions.

As part of the planning process, **the floor plan** of each unit was highlighted by Holmström, Sandqvist and Koprowicz as one of the most critical steps in condominium projects, as it has a significant impact on the selling price of the apartments. Furthermore, communication with and preparation for the existing tenants and residents was also emphasized as a crucial factor by Per Orshammar and Johnsson.

### 4.1.2 Advantages of Attic Conversions

By far the most frequently noted advantages is the **sustainable use of existing buildings**, mentioned by all interviewees. Furthermore, as stated by Orshammar “attics are the best part of the building” referring to the highest location in buildings. Johnsson explains the opportunities with attic conversions as one of the **only ways to produce more homes where there is no room for more buildings**. Koprowicz highlights that attic conversions reduce the need for land exploitation. Furthermore, Kapuli emphasized the design process efficiency – once the usable volume is defined, the drawing and design process can move quickly and efficiently.

From an economic perspective, according to Koprowicz converting attics **can be very profitable** - both for companies producing the projects as the building where attic conversions are most common are in high-demand locations and for **housing cooperatives** that can generate cashflow or finance other needed renovations by selling raw attics. Sandqvist and Kapuli highlights the long-term profitability, as the roof becomes insulated saves energy and the addition of new apartments strengthens the housing cooperatives economy for example, by spreading the fixed costs across more residents.

John Kåwert also explains the **sustainable advantages** that utilizing the existing infrastructure reduces the average operational cost per apartment. Adding new units lowers the overall carbon footprint and improves the property’s net operating income. The need for additional heating is minimized, as the system can support the new apartments with minimal extra demand. As states by Sandqvist “When it comes to CO2 emissions, there are only advantages”.

## 4.2 Comparison of Attic Conversion to Newly Built Apartments

This section presents the findings from the interviews regarding the factors influencing environmental sustainability and financial profitability. The environmental sustainability is examined through a comparison of the production process of newly build and attic conversion, in terms of CO2 equivalent. It also

presents the interviewees thought whether both objectives can be successfully achieved within attic conversion.

#### 4.2.1 Environmental Sustainability

This section evaluates the environmental sustainability of attic conversions in comparison to new residential construction. Based on expert interviews, estimations were collected for each major stage of the construction process, with a focus on relative carbon emissions. Interviewees were asked to estimate the emission related factors impact of attic conversions as a percentage of the same phase in a typical new construction project. Note: As mentioned in the method chapter (2.3.1), for building-level elements (such as site work, structural frame, roof and facade), respondents considered the entire building, while apartment-level elements (such as HVAC, electrical installations and interiors) were assessed per individual unit.

In the table 3 below, if a range is presented (e.g., 0–5%), the midpoint of the range was calculated by averaging the two values, for instance,  $(0+5)/2 = 2,5\%$ . Subsequently, the mean of all participants' responses for each row was computed. The values have been rounded to whole percentages to enhance clarity and readability. For this part of the interview, six out of eight interviewees were included due to relevant expertise in the area.

	Estimation for Attic Conversion per Interviewee Average Estimation (Percentage, %)						Average estimation (%)
Production Steps for New Residential Construction	John Kåwert (Sweco)	Ellen Johnsson (Familjebostäder)	Robert Koprowicz (Vindshem)	Christian Holmström (Sweco)	Alexander Sandqvist (4D Gruppen)	Per Orshammar (Bostadsbolaget)	
<b>1. Site Work</b>	0-5%	0%	0%	0%	0%	1%	<b>1%</b>
<b>2. Structural Frame Assembly</b>	0-2%	0-5%	15%	0-20%	10%	25%	<b>11%</b>
<b>3. Roof Construction</b>	5-10%	5%	0-100%	0-5%	30%	4%	<b>10%</b>
<b>4. Facade Work</b>	0%	0%	0-5%	0-2%	0%	0%	<b>1%</b>
<b>5. Windows and Doors</b>	100%	100%	100%	80-100%	100-150%	100%	<b>103%</b>
<b>6. HVAC Works</b>	100-110%	30-70%	100%	50-100%	120%	100%	<b>92%</b>
<b>7. Electrical Installations</b>	100%	70-80%	100%	100%	120%	100%	<b>99%</b>
<b>8. Interior Works</b>	100%	100%	100%	100%	120%	100%	<b>103%</b>

*Table 3. Comparison of estimated CO<sub>2</sub> emissions per construction step between new residential construction and attic conversions. Estimates are based on interview responses and reflect typical or case study projects. Building-level factors were assessed for the entire building, while apartment-level factors were assessed per apartment. Koprowicz's 0-100% roof estimate was excluded in average estimation, as it related to general roof renovation needs.*

The comparison between new residential construction and attic conversions highlights notable differences in material needs and associated CO<sub>2</sub> emissions across different construction stages. Based on the interview responses, attic conversions generally offer a substantial reduction in climate impact during early and structural phases of the building process, while installation and interior phases tend to match or even exceed emissions from new-build equivalents due to the technical and spatial complexities involved.

**Site Work** was unanimously regarded as negligible in attic conversions. Since no new ground is developed and existing foundations are retained, all respondents estimated the emission levels to be between 0–5% of those in new construction. This minimal impact stems from the fact that ground stabilization, excavation and drainage work are largely unnecessary – apart from minor exterior additions such as bicycle storage or accessibility improvements.

**Structural Frame** estimations varied depending on the scale of the conversion and the structural condition of the existing building. Most respondents estimated 0–5%, suggesting minimal need for reinforcement. However, Koprowicz, Holmström and Orshammar estimated a higher up to 15-25%, noting that certain projects require strengthening of existing beams, new stairwells, or vertical extensions such as elevator shafts, which contribute significantly to emissions in this phase.

**Roof Construction** revealed the widest range of responses. Depending on the building's condition and design intentions, this phase can involve simple insulation and waterproofing or a complete roof rebuild. Estimates ranged from as low as 0–5% (Holmström) to as high as 30% (Sandqvist), with Koprowicz noting that specific additions such as dormers or roof terraces could push this figure even higher in some cases. However, Koprowicz's estimate of up to 100% – based on projects where the entire roof was reconstructed – was only applicable in cases where the roof already required renovation, regardless of the attic conversion. For this reason, his estimate was excluded from the average calculation but an important insight.

**Facade Work** was consistently estimated at close to 0%, as attic conversions rarely require changes to the outer envelope beyond minor adjustments or maintenance. This aligns with planning regulations that often restrict modifications to historically or architecturally significant facades. Additionally, facade work remains negligible as long as it does not involve alterations to openings for windows or other glass elements

In contrast, **Windows and Doors** in attic projects often require completely new installations to meet daylight requirements and safety regulations. This phase was consistently estimated at 100% or more compared to new builds. In some cases, particularly in high-end condominium projects, larger or custom-designed windows increase both material use and environmental impact according to Sandqvist

(contractor).

**HVAC Systems and Electrical Installations** also showed high relative emissions. Since these systems must often be completely new in attic spaces that were not previously habitable, estimates ranged from 70–120% compared to new construction. Respondents also highlighted technical challenges such as limited vertical space for ducting or routing through existing structures, which may increase complexity and waste.

**Interior Works** were universally estimated at 100% or higher. Attic spaces require complete interior finishing, including insulation, flooring, partition walls, bathrooms and kitchens. Furthermore, due to the irregular shapes, sloped ceilings and heritage restrictions often associated with attics, customized or non-standard solutions are frequently necessary – driving up both material use and emissions according to Sandqvist.

In summary, the interviews indicate that attic conversions generally achieve **substantial reductions in emissions for foundational and structural phases**, while later-stage works such as **installations and interiors remain equally**, or even more, resource-intensive than in new construction. This duality highlights both the **environmental potential** and **technical demands** of adaptive reuse projects.

## 4.2.2 Financial Profitability Factors

This section examines the financial aspects of attic conversion projects, focusing on the key factors that influence profitability. It highlights the role of location, building conditions and scale in determining the economic success of such projects.

### 4.2.2.1 Most Decisive Factors for Achieving Economic Profitability

Respondents such as Kåwert, Sandqvist and Koprowicz, who work with condominium projects, generally agreed that **location** is one of the most crucial factors for profitability. They stated that attics in central and attractive neighborhoods are more likely to generate high sale prices that outweigh the additional costs associated with structural and technical challenges. Koprowicz and Sandqvist also emphasized the **initial purchase price** of the raw attic space as a decisive factor. However, Sandqvist highlighted the different conditions of each building as important connecting to the challenges with attic conversions. In terms of rentals, Orshammar pointed out the **rental negotiation** as one of the most important factors regarding profitability of the projects. In comparison with condominiums – several interviewees state that location is not as important for rental projects, as their profitability is assessed using entirely different criteria.

Other important factors according to Johnsson include the initial condition of the building and existing infrastructure. However, all interviewees agree that the **volume of the project is the single most important factor for profitability**, primarily in terms of floor area (square meters) – but also in relation to any additional work required on the property, such as roof replacement. Kapuli and Koprowicz pointed out that **two-room apartments and those with terraces** are key to achieving profitability as these unit types are the most attractive to buyers and renters, resulting in higher

profit margins.

Several interviewees also emphasized the importance of the **right expertise**. Such complex projects are more complicated in terms of planning and execution which requires experience according to Koprowicz and Holmström explains that “there are no 90-degree angles” in these kinds of projects. He further highlights that the complexity of fire safety, acoustics and structure are the most expensive aspects and can be difficult to estimate in early stages.

#### 4.2.2.2 Is Profitability and Environmental Sustainability Achievable?

When asked whether attic conversions can realistically achieve both economic and environmental sustainability, the **professionals expressed nuanced but largely positive views**. The majority emphasized that **financial success depends heavily on early planning** and precise structural assessments, as previously mentioned: insulation, fire safety, condition and integration of existing infrastructure etc. Although all interviewees agreed that attic conversions are generally more expensive than other projects – Holmström estimated up to **30% higher** – many argued that this investment can be justified by the added **value of converting unused space** into unique, high-demand housing units in urban areas (Holmström, Johnsson, Kåwert, Koprowicz). Holmström and Johnsson also noted that such projects increase the overall property value. However, as a rental company, Johnsson pointed out that while this profit **may not be visible in the short term**, it would still be considered profitable when compared to the market value.

Furthermore, as mentioned in chapter 4.1.2, all respondents agreed that attic conversions offer **clear environmental advantages**. By building on existing structures and avoiding new groundworks or land exploitation, these projects **significantly reduce CO2 emissions** – particularly due to minimized use of concrete and steel according to Sandqvist and Hallingström. Densification through attic home use can also improve energy efficiency per unit, as heating and utilities are shared more effectively (Kåwert).

As the environmental sustainability factor checks the boxes – the **economically achievability perspectives were more divided**. While the interviewees stated that attic conversions **CAN BE** highly profitable, especially when units are sold rather than rented, they highlight that achievable profitability depends a lot on the **qualification of each individual building**, such as scale, conditions and timing. **Risk factors** such as regulatory delays, unstable housing markets and fluctuating material costs were seen as limiting factors. Sandqvist pointed out that broader economic viability may depend on long-term strategies and **which factors that are included in the calculations**, for example lower energy costs of the total building among others, as mentioned in previous sub chapter.

Sandqvist continued by highlighting **smaller factors that are often overlooked** but can have a significant impact on project calculations – such as parking fees and the lack of available parking spaces in central urban areas. “Three cars for nine months become a major expense,” he noted. Another profitability insight, brought up by Holmström, was that although the rental company initially requested the cheapest bathroom materials, fulfilling this required hiring a different contractor. In the end, it

proved more cost-effective to use high quality materials and let the existing contractor do the job.

However, all interviewees emphasized that before starting an attic conversion extensive calculation and evaluation are carried out. They all stated that **no project proceeds unless profitability is achievable** – although the acceptable profit margins vary. Rental projects, for example, often operate under commitments to Göteborg Stad to deliver a certain number of attic conversions, which allows for lower profit margins. In general, **location plays a more critical role in condominium projects compared to rentals**, as the financial models differ significantly. While rental developments can still be profitable in more sub urban areas, condominiums generally need to produce in central areas to achieve sufficient profitability. Both rental projects on Hedåsgatan (central) and Sjusovaregatan (suburban) were reported as profitable, though with narrower margins compared to Vindshem's centrally located condominium projects.

### 4.3 Impact of Social Sustainability and Cultural Values

The following subchapters present the results related to social sustainability and cultural values. These results are conducted from two sources: a public questionnaire distributed to a general audience and the interviews with professionals involved in attic conversion projects. Together, these perspectives help illustrate how social and cultural factors influence the perception, design and implementation of attic conversions.

#### 4.3.1 Survey Results: Evaluation of Residential Environments and Culturally Historic Buildings

This section presents the findings from a public questionnaire aimed at understanding how individuals value different aspects of residential environments, with a particular focus on cultural and historical buildings. A total of 71 respondents participated, offering insights into current living conditions, housing preferences and their views on cultural heritage.

##### 4.3.1.1 Background of Respondents: Demographic and Current Housing

As shown in figure 15 and 16, most participants were **age 20–30 (63,4%)** and live two persons (57,7%) in each accommodation. The majority currently live in **multi-family apartments (64,8%)**, with others in row houses (18,3%) or detached houses (16,9%). Housing type distribution in figure 17 shows a wide representation across **older buildings (built before 1960 – 47,9%)**, **mid-century buildings (1960–2000 – 31%)** and **newer buildings (built after 2000 – 21,1%)**.

Your age

71 respondents

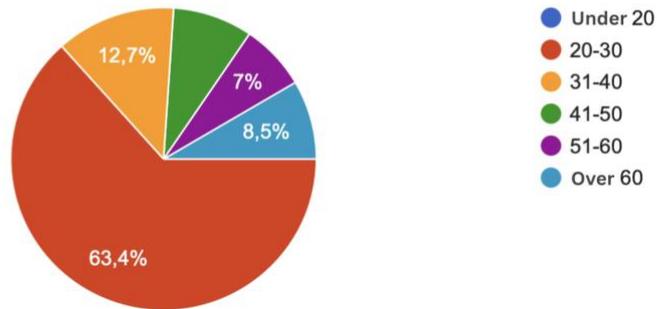


Figure 15. Age distribution of respondents

Current housing type

71 respondents

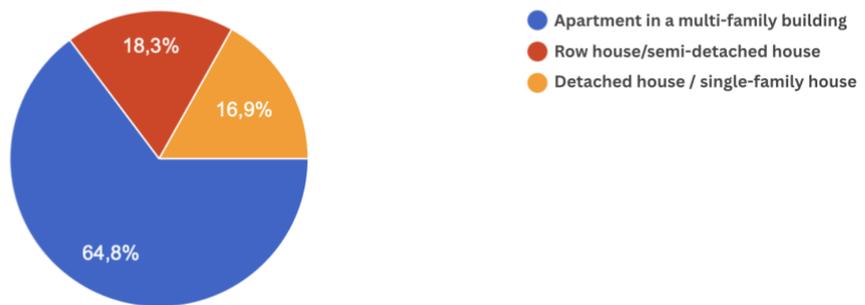


Figure 16. Current housing type of respondents

Year of construction of current residence

71 respondents

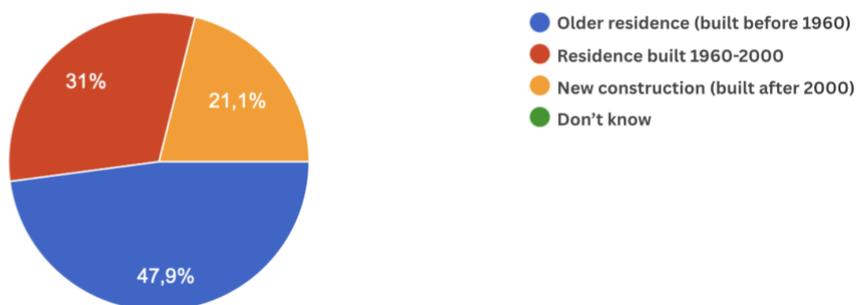


Figure 17. Year of construction of current residence

### 4.3.1.2 Attitudes and Valuation of Cultural Heritage Housing and Location

When asked **how important it is to live in a culturally historic building**, 31% of respondents rated it as not important at all, while only 7% found it very important as shown in figure 18. However, 25,4% rated it as important (score 4 on a scale to 5). Additionally, 21,1% responded with a 3 of out 5 in importance, while the last 15,5% stated not important.

Importance of living in a culturally historic building (built before 1960)

71 respondents

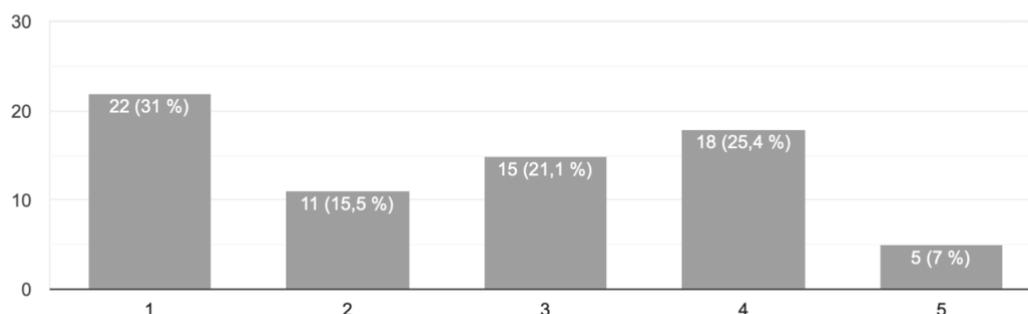


Figure 18. Importance of living in a culturally historic building on a scale 1-5 were 5 presents “very important”.

When asked whether they would prefer to live in an older or a newer building, the **majority of respondents (60,6%) indicated a preference for older buildings**. In comparison, 22,5% preferred newer constructions, while 16,9% expressed no clear preference between the two options, as shown in figure 19 below.

Preference for new vs. old buildings

71 respondents

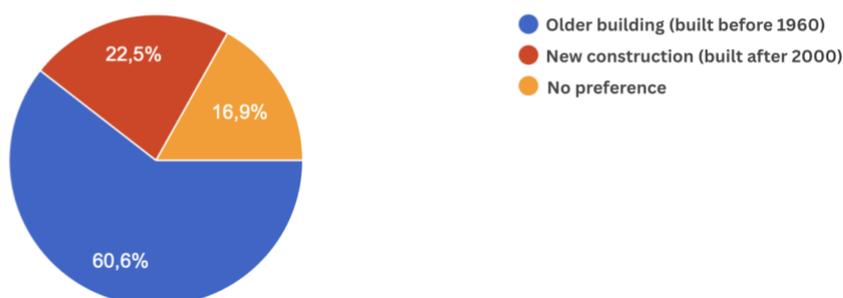


Figure 19. Preference for new vs. old buildings

Furthermore, respondents were also asked to choose between combinations of **building age and location**. To minimize the interpretation of “central location”, figure 20 was shown to the respondents and the circle represented an approximate central location (where people outside of Gothenburg were guided to use the figure as a reference to their own cities). As shown in figure 21, **over half (55,7%) preferred an older building in a central location, while only 8,6% preferred a newer building in a central location**. This indicates a clear preference for historical architecture, even when compared to the advantages of newer construction.



Figure 20. Associated map of Gothenburg to figure 21 below - where the circle represents the central part according to the authors (Lantmäteriet, 2025).

#### Preferred combination of location and building age

70 respondents

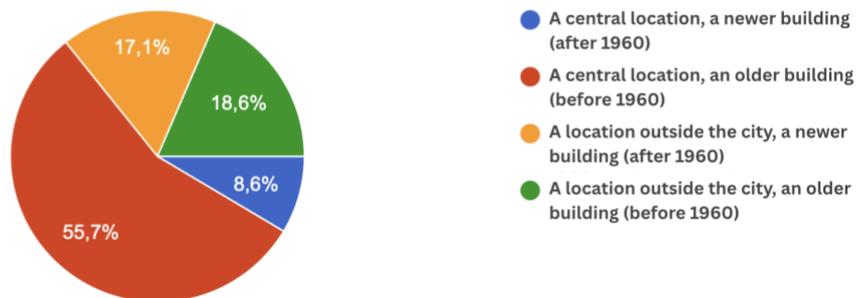


Figure 21. Preferred combination of location and building age

When asked to rate the importance of **preservation of historical buildings in urban development**, a **significant majority of 70%** rated it as very important (5 out of 5). Notably, none of the 70 respondents selected “not important.” An additional 25,7% rated it as important (4 out of 5), meaning that 95,7% of participants considered preservation to be either important or very important. As shown in figure 22 below, the remaining 4,3% rated it as 3 out of 5 in importance.

### Importance of preserving historical buildings during urban development

70 respondents

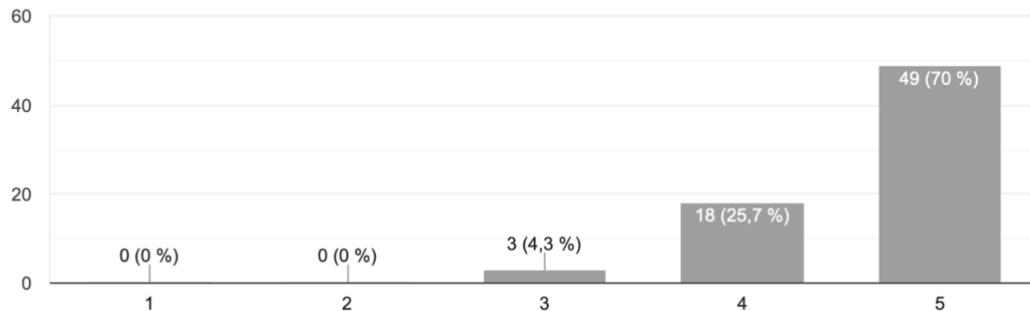


Figure 22. Importance of preserving historical buildings during urban development on a scale 1-5 were 5 presents “very important”.

#### 4.3.1.2.1 Valuation of Residential Areas

When asked what factors they value most in a residential area, respondents emphasized a clear set of priorities, listed below in descending order of preference:

- **Access to green areas** (87,3%)
- **Safety and a calm environment** (85,9%)
- **Good public transport access** (76,1%)
- **Close access to shops and services** (47,9%)
- **Architectural and historical identity** (35,2%)
- **Close access to the city center** (32,%)
- **Good parking availability** (23,9%)

Each respondent could choose multiple alternatives. The results demonstrate that **environmental and practical factors dominate residential preferences**. Access to green areas and safety/calmness were ranked highest, reflecting a widespread desire for environments that promote well-being, recreation and a sense of security. Good public transport access was also considered highly important, highlighting the role of mobility in urban living.

More functional amenities, such as proximity to shops and services, followed by cultural aspects like architectural and historical identity, were also important to a significant portion of respondents. Although factors such as proximity to the city center and parking availability were less prioritized, they still represent notable considerations for many when choosing a place to live.

#### 4.3.1.3 Perceived Benefits of Older vs. Newer Buildings

Among the most attractive qualities of older buildings, respondents highlighted the following, in descending order of preference:

- 1 **Architectural details** (85,9%)
- 2 **High ceilings and spacious layouts** (71,8%)
- 3 **Solid craftsmanship and materials** (54,9%)
- 4 **Character of the area** (56,3%)
- 5 **Character and history of the building** (23,9%)

Respondents also recognized advantages in newer constructions, in descending order:

- 1 **Better sound insulation** (78,6%)
- 2 **Elevators and modern amenities** (72,9%)
- 3 **Modern layouts** (54,3%)
- 4 **Energy efficiency** (50%)
- 5 **Lower operating costs** (47,1%)
- 6 **Good parking availability** (21,4%)

However, respondents were also given the opportunity to share additional attractive qualities for each building type in their own words. And each respondent could choose multiple alternatives. For older buildings, common themes included apartment **layout** – for example, “living quality due to well-planned spaces” – and the ability to **blend historical charm with modern living**. One respondent noted that “restorations in a traditional style rarely evoke the same feeling.”

For newly built apartments, respondents mentioned benefits such as having a **balcony**, the **absence of hazardous materials** like radon and the convenience of **not facing any major renovation** needs in the near future.

#### 4.3.1.4 Willingness to Pay More for Heritage Housing

Finally, **38% of respondents were willing to pay more** to live in a culturally historic building, with another 31% saying “maybe” as presented in figure 23 below. Among those willing to pay extra, figure 24 present that the most common premium was **20-25%**, with one respondent suggesting up to 50%.

Willingness to pay more for living in a culturally historic building

71 respondents

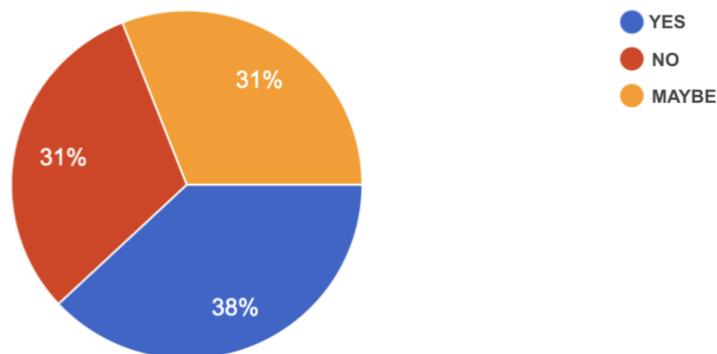


Figure 23. Willingness to pay more for living in a culturally historic building

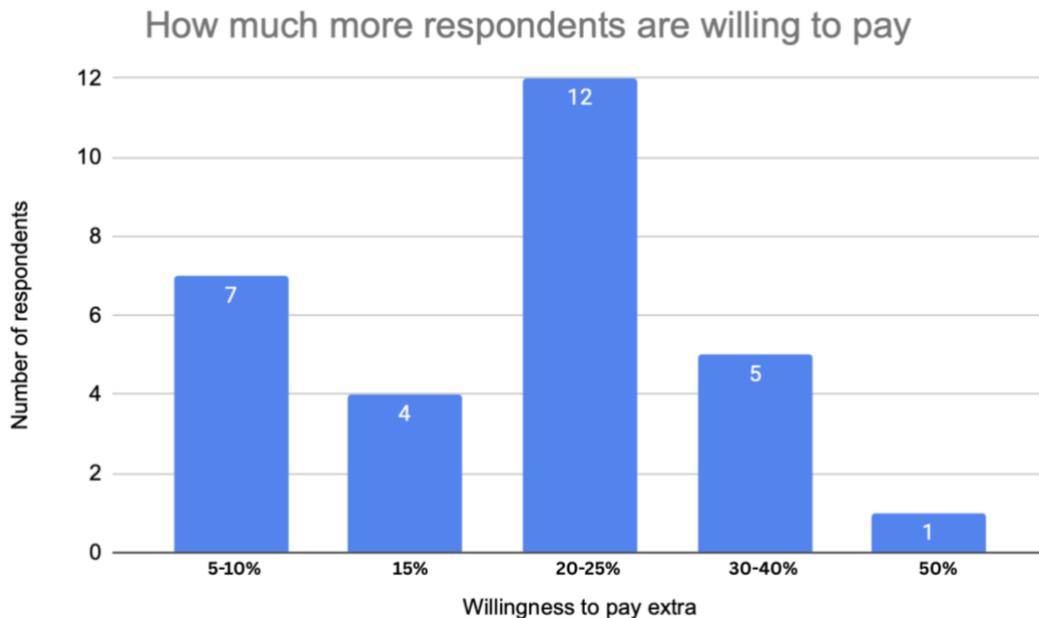


Figure 24. How much more respondents are willing to pay (percentage) out of 29 answers.

#### 4.3.1.5 Open-Ended Responses

Open-ended responses highlighted a desire for **well-lit, well-planned apartments with historical charm**, combined with **modern functionality**. Most emphasized the value of **central locations, functional layouts and high-quality materials**. Several respondents noted that older buildings tend to be more attractive when **carefully renovated and well maintained**, reflecting a strong appreciation for the **blend of old and new**.

Other factors mentioned included **limited visibility** into the apartment (privacy), **scenic views** and the overall beauty of **older neighbourhoods** compared to newer developments. One respondent commented that “new areas often suffer from cluttered urban planning and create dull or uncomfortable public spaces.” Another emphasized the value of **architectural uniqueness**, stating: “Slanted walls, nooks and crannies! These are features that are virtually impossible to replicate under today's building regulations and standards.” Finally, **price** and **overall costs** were highlighted as important factors influencing the choice of an apartment.

#### 4.3.2 Interview Insights: The Impact of Social and Cultural Values on the Demand for Attic Apartments

All interviewees agreed that attic conversions are in high demand and several participants highlighted how they support social sustainability by **increasing the variety of housing options in central areas** (Johnsson, Sandqvist, Hallingström, Kapuli). However, Holmström pointed out that it is difficult to determine whether the demand stems from the apartments themselves or simply from the general housing shortage in Gothenburg, particularly in the rental sector.

Regarding condominiums, Koprowicz did not associate social value with diversification, as condominiums must be sold at a high price per square meter to achieve profitability – resulting in a narrow target group. Nevertheless, he acknowledged other social value aspects, such as the uniqueness of the apartments and the appeal of older buildings for buyers, as well as the financial benefits for the condominium association and its existing residents.

Kåwert and Johnsson explained the high demand by noting that residents appreciate the **combination of old charm and new finishes and functions**, making the apartments highly sought after. However, he emphasized the social responsibility involved in engaging current residents early in the process, as attic conversions impact their living conditions. These include living on a “construction site” for several months, sharing common areas with more people and for top-floor residents – having new neighbours above them after construction. Kåwert among other interviewees stressed the importance of **preparing existing tenants** and suggested enhancing their experience through measures such as improved lighting in shared spaces to increase their quality of life and sense of inclusion.

The cultural dimension was also central to many responses. Attic conversions were viewed as a way to preserve and enhance the architectural identity of historically valuable buildings, which several interviewees considered a form of social value. Orshammar described the project in Haga as being in a favorable setting, with a beautiful courtyard, surroundings and building that contributed positively to residents’ experience.

While most respondents saw these aspects as beneficial, some were more reserved. Sandqvist noted that although social and cultural values are important, they often take a back seat to economic feasibility. Nevertheless, the majority agreed that thoughtful design and respectful reuse of space can promote social cohesion and contribute positively to the broader urban environment.

#### 4.4 Future Aspects

The interviewees expressed a cautiously **optimistic outlook** on the future of attic conversions, although their responses highlighted the complexity and evolving nature of the field. Most agreed that **as long as suitable attic spaces remain, the potential for conversions will continue to be strong**. These projects are increasingly viewed as a way to densify central urban areas without additional land use, while supporting broader sustainability and heritage preservation goals (Hallingström, Johnsson, Kapuli). Hallingström also emphasized the need for creativity among developers to fully utilize the potential of such projects. However, Jaana expressed concern about the long-term availability of convertible attic spaces, noting that opportunities will eventually diminish. In her experience, rental attic conversions have rarely been economically viable.

Most participants noted that **economic considerations are expected to become even more central** in the coming years. Rising construction costs may make converting existing buildings more cost-effective than initiating new developments, particularly in dense or historically valuable areas (Kåwert, Koprowicz). Still, the economic viability of each project depends heavily on factors such as location, the condition of

the building and regulatory requirements. Kåwert suggested that **attic conversions located farther from the city center are likely to become more common** as the demand continues to grow. Meanwhile, Johnsson stressed the significant influence of municipalities in either facilitating or limiting these projects – particularly in cities like Gothenburg, where public housing companies are guided by political priorities.

Furthermore, Koprowicz and other interviewees pointed to the entrance of new market players as a potential driver of future growth, especially if the **knowledge improved of involved disciplines and streamlined permit processes** can be achieved. Kapuli notes that the upcoming adjustments to the PBL this autumn may impact attic conversion practices going forward. Furthermore, Orshammar highlighted that **strong project leadership and deep technical understanding will be critical** for successfully managing the complex logistical challenges that these projects often present.

Sandqvist offered a forward-looking perspective on the intersection of sustainability and feasibility. He expressed hope that housing cooperatives and property developers will find common ground in negotiating reasonable purchase and sale prices. With rising energy costs, he believes that **optimizing insulation will become a key driver in decision-making**. He emphasized that the CO<sub>2</sub> footprint of attic conversions is very low and remarked that **if economics were not a constraint, attic conversions would be the preferred choice over newly built**. He further suggested that **introducing incentives**, such as energy credits, could significantly improve the financial viability of these projects.

The overall consensus was that although attic conversions come with considerable technical, legal and economic obstacles, the market is likely to expand as actors gain more experience and as regulations become clearer. However, the future of the market will remain highly dependent on multiple shifting factors, including policy direction, construction costs and stakeholder competence.

## **5 Analysis and Discussion**

This chapter analyses and discusses the results, chapter 4, in relation to the theoretical framework and literature insights presented in chapter 3. By integrating empirical findings from interviews, survey responses, and case comparisons with existing literature – the following chapter aims to answer the research questions and provide a deeper understanding of the potential and limitations of attic conversions as a sustainable and economically viable urban strategy. The analysis is structured according to the key areas: process differences, environmental impact, profitability conditions, and socio-cultural aspects.

### **5.1 Process Differences: Attic Conversion and Newly Built**

Reusing existing spaces is referred to, as previously mentioned, as adaptive reuse and it is a topic frequently discussed in this study. In the theoretical framework, the climatic, economic and social advantages and disadvantages are highlighted. To understand the background of both the opportunities and limitations, it is important to shed light on the process-related differences between a renovation, more specifically an attic conversion and a new construction.

New construction and attic conversions differ significantly in their planning, permitting and construction processes. A new build requires extensive preliminary investigations during the planning phase, as much needs to be developed from scratch – unlike an attic renovation, where the structure already exists. For renovations involving culturally or historically significant buildings, a special permit assessment is required to determine whether the conversion could distort the building and cause it to lose its cultural value. This type of assessment is not typically needed for new constructions. In new builds, steps such as earthworks, foundation laying, structural framing and full installation systems must be carried out. In contrast, a renovation involves adapting and upgrading existing systems and structural elements.

Regarding the workspace, attic conversions often include construction in dense, inhabited urban areas with more logistical challenges - such as noise, limited access and delivery issues. At the same time, newly built projects may still face similar issues, though they typically offer more space for construction activities.

#### **5.1.1 Adaptive Reuse Challenges**

In theory, it is noted that renovation often involves conflicts between modern regulatory requirements, such as the BBR, accessibility standards, fire safety, elevator requirements and the limitations of existing buildings. According to Bullen and Love (2011), numerous rules and laws frequently lead to major adaptations, prolonged planning processes and risks associated with renovation. This is something that many respondents confirmed in the interviews. Small measurement errors in the attic during the planning phase can cause problems later. In line with this, Sugden (2017) writes that challenges can arise when creating drawings, which in turn can result in technical and economic obstacles.

All respondents agree that there are technical challenges when building within already existing structures. These can relate to the load-bearing capacity of the structure, fire

safety, accessibility requirements and evacuation routes. To overcome these challenges, the respondents explain that close collaboration with experts is necessary – and that this is why it will cost more per square meter to produce these apartments compared to apartments in a new building.

Regarding the building permit and planning process, this is something all respondents express concern about. Unclear and constantly changing regulations in the BBR and PBL were particularly emphasized by Koprowicz and Kapuli. However, once on-site during construction, Koprowicz is the only one who believes that no setbacks or unforeseen problems arise. This stands in contrast to Johnsson, who identified the uncertainty in renovation projects as the greatest challenge – since problems can arise that have never occurred before. This likely stems from the fact that Koprowicz has extensive experience with attic conversions and has already encountered the potential unforeseen risks and learned to account for those in earlier stages. Johnsson and other respondents have only carried out a few attic projects previously and therefore have not accumulated enough experience with unpredictable events.

### **5.1.2 Adaptive Reuse Advantages**

Using existing spaces is a way to maximize a building's lifespan. When a building is reused, a significant amount of energy is saved since large parts of the building's original structure remain. The most mentioned advantage of adaptive reuse in the interviews is the sustainability of utilizing buildings that already exist. In summary, attic conversions and adaptive reuse are generally described as an intelligent way to densify the city by creating more living spaces in already well-integrated areas.

Significant benefits also include the economic gain from not having to construct an entire building, as well as the considerable sustainability aspect. These factors, along with the social aspect, will be discussed in more detail in the following chapters.

## **5.2 Environmental Sustainability – CO<sub>2</sub> emissions and LCA**

The following subchapter compares and analyses CO<sub>2</sub> emissions associated with attic conversions vs new construction, based on LCA principles. Using literature review, case studies and expert interviews, the analysis explores the material and energy-related carbon footprints of both building methods.

### **5.2.1 Comparative Emissions Analysis: Attic Conversions vs. New Construction**

The table 4 below presents a comparative analysis between new construction and attic conversions based on average carbon emissions per building part. Data for new construction is derived from figure 11 by Malmqvist et al. (2023), where each building part's share of total CO<sub>2</sub> emissions is calculated according to the 2027 system boundary (as these included room completion and installations, as our study). The attic conversion estimates are based on interview responses, where professionals were asked to approximate the relative material use and CO<sub>2</sub> impact of attic conversions compared to new construction, table 3 earlier presented.

To ensure consistency, certain building parts have been grouped (e.g., room

completion and installations) and the presented values represent the average across interview responses. The final column shows the estimated carbon emissions of attic conversions as a percentage of emissions in new construction, calculated by multiplying the share of each building part in new construction by the average attic conversion estimate.

#### Assumptions and Clarifications:

- **Energy Use (A5):** Assumed equal between both cases, as operational energy use during construction was not included in this study.
- **Grouped Categories:** Where multiple parts for attic conversions were combined (e.g., installations – 6 and 7 in table 4), average values were used.
- **Example Calculation:** For structural work, attic conversions were estimated to require 11% of the material relative to new construction. Since structural work accounts for 55% of CO<sub>2</sub> in new buildings, attic conversions would generate 11% of 55%, i.e., 6,05%.

Building Part	Share in New Construction (% of total)	Average Attic Conversion Estimate (% of new build)	Estimated CO <sub>2</sub> in Attic Conversion (% of new build)
Site work/substructure (1)	10%	1%	0,1%
Structural work (2)	55%	11%	6,05%
External Roof (3)	3%	10%	0,3%
Facades (4)	10%	1%	0,1%
Room Completion (8 and 5)	11%	103%	11,33%
Installations (6 and 7)	6%	95,5%	5,73%
Energy Use (A5)	5%	100%	5%
<b>TOTAL</b>	<b>100%</b>		<b>28,61%</b>

Table 4. Estimated CO<sub>2</sub> emissions from attic conversions compared to new construction, by building part. The comparison is based on average interview estimates and emission shares from Malmqvist et al. (2023), where 100% represents the emissions of a new-built apartment.

The results show that attic conversions account for approximately **29% of the total CO<sub>2</sub> emissions** compared to new residential construction. This corresponds to a **71% reduction** in CO<sub>2</sub> emissions. The most significant emissions savings were observed in building parts that typically dominate the climate impact in new builds – particularly the structural frame and substructure, which together account for around 65% of total emissions in new construction but are used far less extensively in attic conversions. While certain components such as installations and interior works approach or even exceed the levels seen in new construction (since entirely new apartments are being added in existing buildings and its systems), the overall impact remains substantially lower.

### 5.2.1.1 Environmental Benefits of Adaptive Reuse

Environmental sustainability was consistently identified by all interview participants as one of the most significant advantages of adaptive reuse - primarily due to the preservation and continued use of existing building structures. As stated by Sandqvist “when it comes to CO<sub>2</sub> emissions, there are only advantages”. This strong emphasis is understandable given the significant reduction in environmental impact that adaptive reuse offers compared to new construction. According to the empirical results (table 4), attic conversions in particular result in approximately 71% lower CO<sub>2</sub> emissions than newly built apartments. This reduction is substantial, even though it reflects only LCA stage A emissions, which is currently the only mandatory component in Swedish climate declarations (Boverket, 2020b). Nonetheless, this percentage shows a notable environmental advantage.

Looking more broadly, (Malmqvist et al., 2023) found that the average emissions for newly constructed multi-family buildings are around 360 kg CO<sub>2</sub>e/m<sup>2</sup> BTA when including a broader range of building components such as interior surfaces and technical installations (figure 11). A 71,39% reduction from this number would result in emissions as low as 103 kg CO<sub>2</sub>e/m<sup>2</sup> BTA for adaptive reuse projects as shown in figure 25 below. This implies that adaptive reuse not only reduces embodied emissions but also sets a clear benchmark for what a low-impact construction process can look like in practice.

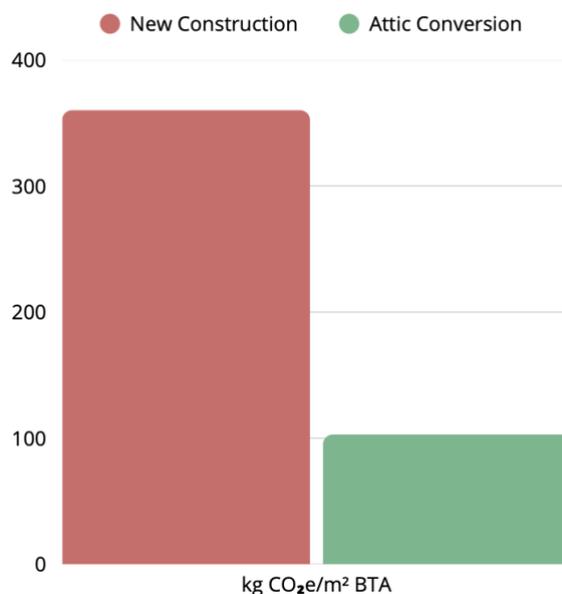


Figure 25. Comparison of multi-family building apartments, new construction vs attic conversion, in terms of kg CO<sub>2</sub>e/m<sup>2</sup> BTA.

These findings are supported by international case studies. For example, Hu & Świerzawski (2024) demonstrated that adaptive reuse can reduce global warming potential by up to 82% by preserving structural elements like masonry walls and foundations. Similarly, Hasik et al. (2019) found a 75% decrease in global warming potential when comparing adaptive reuse to new construction. Although the later study includes additional LCA stages not currently required in Swedish declarations, these stages are expected to become mandatory from 2027 according to Boverket (2020). Because of these findings, the environmental benefits of adaptive reuse may

actually be understated in official metrics in the empirical results. Since stages beyond A (e.g., use phase and end-of-life) are not accounted for, the full environmental advantage of reuse is not formally recognized, despite its relevance.

Even though stages such as the use phase are not yet included in current climate declarations, both theory and interviewees emphasized the long-term environmental benefits of adaptive reuse. Bullen and Love (2011) and others, as well as Kåwert, noted that reusing existing structures contributes to sustainability not only by avoiding demolition waste, but also by preserving embodied energy and enhancing energy performance during the operational phase of a building. Upgrades such as improved insulation and ventilation systems allow reused buildings to become more energy-efficient over time, which leads to extending a buildings lifespan while minimizing resource consumption.

### **5.2.2 When Sustainability Is Invisible: Regulatory Barriers to Reuse**

Notably, neither the literature nor the interviewees identified any environmental disadvantages of adaptive reuse. However, several challenges were highlighted by Carolina Jogner (Whole Life Carbon Consultant, phase 1) – particularly in terms of inconsistent assessment methods and the current regulatory gap in Sweden that excludes most renovation projects from mandatory climate declarations. This gap in current regulations creates additional challenges. If climate declarations do not include renovation projects such as adaptive reuse, it becomes difficult to communicate and quantify their environmental value. As a result, policymakers and developers may lack incentives to prioritize adaptive reuse, even when it clearly leads to lower emissions. In other words, the lack of holistic measurement contributes to a misalignment between environmental potential and regulatory focus. According to Boverket (2023b), this is a critical shortfall, especially since property management accounts for approximately 55% of emissions from the real estate and construction sector and has suggested implementing climate declaration for major renovation projects as well.

The lack of clear and comprehensive assessment methods thus weakens regulatory pressure and hides the full environmental benefits of adaptive reuse. Without this benchmark for how low climate impact can actually be when reusing existing structures, new construction projects may appear more climate-friendly than they are. This creates a distorted picture that can hinder policy development and undermine environmental priorities in planning. And at the end of the day, deprioritize environmental values when economic or technical challenges arise – especially in the absence of robust measurement tools that highlight the full value of reuse.

### **5.2.3 No Building Is Alike: Project-Specific Variables**

However, it is important to acknowledge that no two projects are identical. CO<sub>2</sub> emissions vary significantly, as illustrated in table 3, where the interviewees each referred to different attic conversion projects with differing scopes, materials and design strategies. This variation underscores a key point: sustainability is shaped by the sum of many decisions. Every design and material choice – whether in new construction or adaptive reuse – can dramatically influence the overall environmental outcome (Malmqvist et al., 2023). This is particularly true for structural work

(substructure, structural frame and structural completion), as this alone accounts for approximately 65% of a building's CO<sub>2</sub> emissions. In other words, the environmental footprint hinges on how responsibly these high-impact elements are addressed. For instance, applying best-in-class environmental strategies to new construction may result in relatively low emissions, just as poor choices in adaptive reuse can undermine its potential benefits. Yet, the overarching principle remains: *the most sustainable building is the one that does not need to be built*.

This idea highlights the inherent advantage of adaptive reuse – it utilizes what already exists, thereby avoiding the carbon-intensive processes associated with demolition and new construction. As Johnsson noted, attic conversions are one of the few viable strategies to add new housing in dense urban areas where no space remains for additional buildings. In such contexts, adaptive reuse becomes not only a sustainable choice but also a practical necessity – one that aligns environmental benefit with urban development needs.

### **5.3 Conditions for Profitability in Attic Conversion Projects**

In the literature review, renovation is cheaper than new construction (Leichter & Piccardo, 2024). The theory shows that renovation can, in some cases, be up to 21% cheaper than demolition and rebuilding. Furthermore, many of the respondents emphasize that attic apartments have great economic potential, but that profitability in practice is influenced by more factors than just the choice of construction method.

#### **5.3.1 Connection between Location, Demand and Profitability**

Several interviewees, such as Kåwert, Sandqvist and Koprowicz, argue that location is important, where attic projects in central and attractive areas generate higher profit, which in many cases compensates for the potential technical difficulties. In practice, profitability seems to be more depending on location and project-specific conditions, rather than renovation costs. According to the market analysis scenario made by Ramboll, areas in Gothenburg have significantly higher market rents than others, which confirms what the respondents also states (Ramboll, 2021). In summary, it is the demand for the location that determines the profitability of an attic conversion, since the renovation cost is consistent regardless of where it takes place. At the same time, other factors, such as ownership type, will affect this profitability even more.

#### **5.3.2 Ownership Type and Profitability**

In addition, project economics are strongly affected by the form of ownership. In condominium projects, the housing association can profit from selling the attic space, while a company can benefit from purchasing and converting it. In rental housing, however, the profit is more limited by the utility value system, which makes the negotiation of future rent levels an important factor. This is confirmed by Orshammar, who highlights that rent negotiation is a very critical point when it comes to profitability. On the other hand, in comparison with condominiums, many respondents state that the profitability for rental apartment is not connected to their location, since there always are people that want to find a home.

Condominiums make their profit by people bidding up a price for an apartment while rental apartments are afforded through a rental payment. There are similar factors that influence the profit, but the rental apartments are still limited to the negotiated rent with “Hyresgästföreningen”. The difference inside these apartments is big, since Koprowicz mentioned he can increase the standards high due to the fact that the buyers usually value quality higher and can afford it. For the rental apartments, the standards are more basic, since the rent can't be higher than it already is. Still, people want to rent those apartments, but maybe for another reason than the buyers of the condominiums.

An aspect primarily stated in the results section, but not mentioned in the theory, is the importance of volume for the profitability of an attic project. All respondents agreed that the number of apartments or square meters has a major impact for the profitability, where a certain number of apartments is required to cover the project costs or the expansion of the project, such as timing it with the need for roof replacement, facade renovation, or other maintenance work. The apartment types also matter where two-room apartments with terraces are seen as the most attractive, which increases the margins. This indicates that profitability in attic projects is not only a function of construction costs, but also strongly linked to demand and market strategy.

In a large renovation project, unexpected things can occur, like hidden problems or rules connected to preserving old building (Sugden, 2017). Nearly all respondents highlighted the importance of having the right expertise, to handle the complexity and thereby reduce the risk of economic surprises. As earlier described, as Koprowicz and Johnsson mentioned, it is easy to manage the processes when the projects managers and other involved disciplines have experience of attic conversions and know what to expect. There is a bit of a learning hump, where every new attic is like a new surprise when the experience of attic conversions is limited. But once the knowledge bridge has been established, the possibility of profitability increases.

In connection with potential problem surprises, it is confirmed that early dialogue with current tenants benefits a project (Nobs, 2015). The theory describes that an inclusive process with residents creates a sense of security and engagement, and several interviewees emphasized the importance of communication with tenants to avoid resistance and difficulties during the renovation.

### 5.3.3 Cultural Heritage as an Economic Asset

In the results, in chapter 4.3.1.4, the respondents in the survey were asked to estimate their willingness to pay more for heritage housing. About **38% of respondents were willing to pay more** to live in a culturally historic building, with another 31% saying “maybe” as presented in figure 23, in the chapter 4.3.1.4. Among those willing to pay extra, the most common premium was **20-25%**, with one respondent suggesting up to 50% (figure 24).

In comparison with the results presented in section 3.5.4.1, one area can be more expensive than another, as market rents can indicate the level of demand and land cost in a particular area. In addition, the study by Andersson et al. (2018) concludes by emphasizing that preserving cultural heritage not only supports the development of a

sustainable society but also generates clear economic value. Whether this is due to residents wanting to live in that specific area, or because they perceive the building as more attractive, or if it is a combination of both, is difficult to determine.

All respondents had an optimistic outlook on the future and many expressed that if there are empty attics, there will be potential for conversions. According to theory, there is a growing number of researchers focusing on the topic of “adaptive reuse.” The focus is on developing new techniques and environmental science through reuse, recycling and reducing materials, components and the environmental footprint throughout the entire lifecycle. Many of the respondents in the interviews believed that the economy would become a factor influencing decisions about attic conversions. Rising production costs may further impact the financial viability of such projects. However, as city centers and urbanization continue to grow, Kåwert argues that attics located outside the city center are becoming popular and economically viable to convert.

## **5.4 Urban Density Meets Social and Cultural Sustainability**

Urbanization and a housing shortage, requires smart solutions, especially in cities where space is limited. Attic apartments can help meet the demand for housing without negatively impacting the neighborhoods. Many respondents confirmed that attic conversions are seen as an opportunity to add new housing in central locations without the need to use new land. This is promoting sustainable urban development. At the same time, it’s important that new housing also supports social sustainability – with inclusive neighborhoods, mixed forms of tenure and access to green spaces (Nijskens et al., 2019).

In summary, the respondents in the interviews stated that there is a high demand for attic apartments, precisely because they contribute to social sustainability by introducing a new type of housing in central Gothenburg. However, Holmström was careful to point out that this could simply be because many people are just trying to find any housing and it may not necessarily be attics they specifically seek.

The results show that older buildings in central locations are the most attractive, which reflects the real demand for this type of housing. At the same time, Koprowicz points out that attic apartments are often very expensive and mostly attract people who can afford higher prices, which limits social diversity in these areas.

### **5.4.1 Cultural and Historical Preferences in Housing Choices**

One of the main results from the survey is that respondents value older buildings over newer ones, especially when they are centrally located. Although only 7% of those surveyed consider it “very important” to live in a building of cultural and historical significance, 60.6% still preferred older buildings over new ones, 16.9% had no preference, while 22.5% preferred to live in a new building. When respondents were asked to choose between location and building standard, 55.7% preferred an older building in a central location, compared to only 8.6% who chose a new building in the same location. Meanwhile, 17.1% prioritized a newer building outside the city center. In total, 74.3% want to live in an older building, while 25.7% prefer a newer one. This indicates that older buildings are attractive and relevant to most respondents.

Furthermore, these results suggest that cultural values play an important role, as it is not just about the building's age and design, but likely also its context and historical connection.

Several studies in the theory, including Armitage & Irons (2013) and Licciardi & Amirtahmasebi (2012), states that cultural values are not always measurable, but they do have clear effects such as increased attractiveness, experiential value and tourism potential. This aligns with the survey results, where an older house in a central location is valued higher than a new house in the same area. The idea that the surroundings of a valued house should enhance its appeal also seems to matter in the survey. As mentioned earlier, proximity to culturally classified buildings can influence the value of surrounding properties (Andersson et al., 2018). While a central location does not automatically mean a more historically rich environment, many of the attic apartments studied in this work are surrounded by similar historically buildings. Orshammar gives an example and mention the influence of the area by describing the project in Haga, where the setting, an inner courtyard with cobblestones and beautiful old buildings, made the attic apartments particularly desirable.

Further in the survey, respondents valued the attributes they find most attractive in a home. The majority considered "Access to green areas (87.3%)," "Safety and a calm environment (85.9%)," and "Good public transport access (76.1%)" to be the most important. Only 35.2% valued "Architectural and historical identity" as important. However, when asked what they appreciate about living in an older building, it was "Architectural details" (85.9%), "High ceilings and spacious layouts" (71.8%) and "Solid craftsmanship and materials" (54.9%) that dominated. In terms of newer housing, "Better sound insulation" (78.6%), "Elevators and modern amenities" (72.9%), "Modern layouts" (54.3%) and "Energy efficiency" (50%) were the most highly valued. This shows that there are clear advantages perceived in both building types, benefits that include the physical characteristics of the building as well as how the apartment is constructed inside. Furthermore, this shows that attic conversions are attractive because the cultural value of the building is preserved while modern features and finishes are added. This may explain why attic conversions can achieve such high prices per square meter – they represent a rare and unique niche in the housing market.

At the end of the survey, respondents were invited to share any additional comments. Many expressed a need for well-planned, bright apartments with historical charm combined with modern functionality. A central location, functional layouts and high-quality materials were pointed out as especially important. Many of the respondents appreciated older buildings that have been carefully renovated and are well maintained. Other factors mentioned included privacy, beautiful views and the aesthetic quality of older neighborhoods compared to newer areas. Some respondents criticized newly developed areas, describing them as messy and dull. Unique architectural features such as sloped ceilings and nooks were seen as attractive and difficult to recreate under today's building regulations. Finally, price and total cost were also mentioned as decisive factors when choosing a home.

Much of this confirms that aesthetics plays an important role in why people choose a certain home. Aesthetics can also be tied to sustainable materials and what we define

as aesthetically pleasing varies from person to person. When homes are in well-planned areas with elements of cultural history, respondents seem to feel most at home.

#### **5.4.2 Future Changes in PBL**

The respondents see a challenge in preserving the old while at the same time meeting specific construction requirements to achieve a building permit. Unclear requirements and guidelines in the Planning and Building Act (PBL) and the Building Regulations (BBR) makes developers avoid big changes and be very careful with the design. This becomes a limitation that consumes both time and money – especially when there is a lack of experience or familiarity. As noted by Koprowicz and other respondents, there is potential for the future, as the PBL is expected to be revised in autumn 2025 (Regeringskansliet, 2025). This will likely mean that laws and requirements concerning attic conversions may change. However, as Orshammar emphasizes, the most important factor will be strong leadership and a high level of technical competence to understand complex regulations to successfully lead an attic conversion project in the future.

Despite laws and requirements, as Sandqvist noted, social and cultural values are important they are not always prioritized in front of economic profitability. In the end, thoughtful design and reuse of space are promoting social cohesion and improves the urban environment.

### **5.5 Achieving Profitability and Sustainability when Executing Adaptive Reuse**

It is clear from the theory that there are economic advantages to renovating rather than building new. Since the attic conversion process does not involve any foundation work and requires little to no structural reinforcement, it results in a small climate footprint. As previously mentioned, there are benefits to preserving old buildings, as they hold cultural value for the society and people, which in turn can increase the selling price and rent.

All respondents in the interviews are relatively positive that it is possible to combine social, economic and environmental sustainability in an attic conversion. To make this work, early, careful and thorough planning is needed, especially for technical installations and structural reinforcements. Those respondents with less experience are less hopeful about balancing social, economic, and environmental sustainability. However, the more experienced respondents mention that economic sustainability is possible because they know how to manage the planning and process well and when a project isn't profitable enough to proceed.

As previously mentioned, many of the respondents acknowledge that attic conversions are more expensive than new constructions. Holmström estimated an approximate increase of 30%, yet it is still seen as a unique and highly valued solution for a previously unused space. Regarding the financing of rental apartments, long-term profitability is pointed out as a key factor. It is expensive to build these apartments, especially if they are to be rental units, but in the long term, the project can still be considered profitable.

Regarding climate impact, all respondents mentioned that there are clear environmental advantages, with significantly reduced emissions achieved by avoiding foundation work and land exploitation. By insulating the attic space, the entire building becomes much better insulated, resulting in energy savings.

The economic aspect is the most critical. Attic conversions can be highly profitable, especially when developed as condominiums, but the profit is affected by the type of building, the scale of the project and the current market. When it comes to attic conversions as rental apartments, the profit expectations are lower than for condominiums. Still, profitability can be achieved, especially when the location of the attic conversion is well-considered and central. In comparison to condominiums, even in less attractive areas farther from the city, rental conversions can still be profitable.

Finally, it's important to question how socially sustainable attic conversions are, since they are mostly done in central areas. As many respondents have already pointed out, there is a risk that people with the same socio-economic background will gather in the same area. In some ways, attic conversions as rental units can counteract this, since more groups can afford to rent an attic apartment than to buy a condominium. In addition, preserving culturally valuable buildings by refining them and creating housing in already existing spaces is a smart way of urban development.

## **5.6 Future research**

To further develop this study and capture a broader view of the topic, this sub-chapter presents suggestions for future research. These suggestions are based on the study's limitations and delimitations and focus on exploring more types of adaptive reuse, improving the environmental analysis, studying financial results over longer periods of time and include views from different people and social aspects.

### **5.6.1 Broader Typologies of Adaptive Reuse**

First of all, future research could expand the scope beyond attic conversions to include a wider range of adaptive reuse strategies - such as extensions, conversions of industrial or office buildings. Examining these different approaches gives a better understanding of adaptive reuse – especially when comparing it to new construction in terms of both sustainability and how well it fits into the existing architecture.

### **5.6.2 Comprehensive Life Cycle Assessments (LCA)**

Further studies could aim to perform more refined LCAs using project-specific data rather than generalized or estimated values. This would improve the accuracy of carbon footprint estimations and the comparisons between new and reused structures. Additionally, future research should extend beyond the construction phase (A1-A5) to include the use (B1-B7) and end-of-life phases (C1-C4). By including factors such as operational energy use, maintenance needs and demolition impact, researchers could offer a complete analysis of environmental performance across a building's entire life cycle.

### **5.6.3 Economic Profitability Over Time**

Further research could involve bigger quantitative studies and long-term follow-ups to assess how attic conversions perform over time in terms of financial returns, maintenance costs and resale value. This would provide a stronger empirical foundation for evaluating economic viability and support evidence-based policy and planning.

### **5.6.4 Stakeholder Perspectives and Social Value**

To capture a broader view of adaptive reuse, future studies should include diverse stakeholders – such as residents, developers, investors, municipalities and construction workers. Additionally, exploring how people experience adapted spaces compared to newly built ones could give better insight into cultural meaning, quality of life, and social sustainability.

## **5.7 Methodological Reflections**

The combination of literature review, semi-structured interviews with professionals and a public survey proved effective in capturing both industry insights and resident perspectives. This mix of methods made the study stronger by allowing a comparison between expert opinions and what future residents value. It also allowed the findings to reflect both strategic planning considerations and everyday user preferences.

The study showed that a qualitative approach is especially useful for understanding how people perceive value and how environmental, economic, and social sustainability are connected. Through in-depth interviews, the research captured detailed insights into real-world challenges, decision-making, and the trade-offs people face – factors that are hard to fully understand with only numbers.

Furthermore, using these three types of data increased the reliability of the results and gave a more complete picture of attic conversions as part of adaptive reuse.

However, one methodological consideration is that the percentage estimates provided by the interviewees are based on their perceptions and experiences from specific projects. Which leads to the results reflecting the professionals' judgments rather than precise measurement data, which may affect the accuracy of the comparison. Nonetheless, these estimates offer valuable insight into the general differences between attic conversions and new construction, particularly since they are grounded in real-world project experience.

## 6 Conclusion

The following chapter presents the conclusions drawn from this study in relation to its research questions. It is divided into subchapters that explore each question in more detail: challenges and advantages, differences from new housing construction and finally, whether it is possible to effectively execute adaptive reuse of attics to achieve both sustainable and economic benefits.

### 6.1 Challenges and Advantages of Adaptive Reuse and Attic Conversions

Adaptive reuse in the form of attic conversions offers several advantages. It allows for efficient use of existing urban spaces, reduces the need for land exploitation and promotes sustainability by preserving and upgrading current structures. This makes it a smart way to densify cities without expanding them outward. Housing created through conversion is often of high quality and perceived as attractive. The social added value depends on the context of the building. At the same time, the process comes with challenges. These include structural limitations, construction site space limitations, complex regulations and, in some cases, resistance from existing residents.

### 6.2 Key Differences Between Attic Conversions and New Construction

This section analyses the comparison of attic conversions to new housing construction, the subchapters discuss how the processes of attic conversion differ from new builds, the factors that influence profitability and environmental aspects. Additionally, the social and cultural impact of attic conversions. Each subchapter provides a deeper dive into these considerations.

#### 6.2.1 Process Differences and Project Planning

Attic conversions differ significantly from new construction because they **are based on adapting existing buildings**. As a result, attic conversions **reduce carbon emissions by 71%** compared to new residential buildings, according to the empirical data for stage A in the LCA.

While the use of existing buildings can simplify certain aspects, such as avoiding new foundations or external infrastructure, **it also comes with complexity** related to verifying structural capacity, working within **existing geometries preserving historical value and heritage**. Respondents highlighted that navigating building code compliance and technical standards in older buildings demands more precision and coordination.

Furthermore, several interviewees emphasized that the building permit process is often more challenging in attic conversions than in new construction. Projects are frequently delayed or complicated due to inconsistent interpretations of planning regulations and variation in assigned case officers, **creating a “permit gamble” that adds risk to timelines and profitability**.

New construction typically allows for **greater freedom in design** and layout, which can streamline planning but often comes at higher environmental and financial cost due to land use, infrastructure demands and new material needs. At the same time, **attic conversions can be more expensive in terms of labour hours** and logistics, especially in dense, inhabited buildings, resulting in higher production cost per square meter despite reusing structure.

### 6.2.2 Determinants of Profitability in Attic Conversion

Profitability is largely influenced by factors such as **location and tenure type**. Location is highly relevant, especially for condominiums, where higher square meter prices in central areas can offset construction costs that are relatively constant regardless of location. However, in the long term, attic conversions in less central locations may also become viable due to continued urbanization. For rental projects, location is less critical since financing models and return expectations differ.

In addition, the **size of the project** plays a significant role in profitability. Administrative and overhead costs are often similar whether building one apartment or ten, meaning that a larger volume increases economic efficiency. If sufficient floor area is not achievable, profitability may still be secured by combining the attic project with other work, such as roof replacement or broader renovations.

Furthermore, the profitability of attic conversions is also shaped by the **existing building's condition** and **factors outside the project manager's control** – particularly the unpredictability of the building permit process. Delays or changing municipal requirements can jeopardize financial projections.

At last, **experience and knowledge** significantly influence profitability. A **steep learning curve** is associated with attic conversions due to the irregularities and constraints of working within existing structures. As noted by several professionals, profitability improves when teams gain experience and can anticipate typical challenges, leading to more accurate planning and cost control.

### 6.2.3 Impact of Social and Cultural Values

Attic conversions contribute to **social and cultural values by renewing existing buildings and bringing character to neighborhoods**. While adding new units, the preservation of architectural heritage supports identity and continuity in the built environment. Respondents expressed that carefully designed attic conversions **enhance both the building's value and residents' emotional connection** to their homes.

This cultural preservation often contributes to economic value. Apartments in heritage-rich buildings tend to attract **buyers willing to pay more** for character, location and a sense of uniqueness - linking cultural values directly to project profitability.

In addition, including residents' perspectives in the evaluation of housing projects supports a more holistic understanding of sustainability. The study showed that

housing quality is not only about CO<sub>2</sub> emissions or square meter prices but also about subjective values such as **safety, beauty and a sense of belonging**.

Moreover, constructing rental attic apartments in central, more expensive and attractive neighborhoods allows people from **different socioeconomic backgrounds** to live there, promoting a mixed **and inclusive urban environment**.

### **6.3 Balancing Both Sustainability and Profitability Through Adaptive Reuse**

The findings of this study indicate that attic conversions can indeed achieve both environmental and economic benefits – provided that they are strategically planned and executed. While sustainability is automatically included in the adaptive reuse process, due to the reuse of structures and reduction in material-intensive work, profitability is more conditional. It depends on a combination of factors such as project scale, location, structural feasibility and regulatory efficiency.

When handled thoughtfully, attic conversions present a highly effective solution for urban densification without the need for land exploitation or extensive infrastructure investment. They contribute significantly to carbon footprint reduction, especially when compared to new construction and support long-term sustainability goals through improved energy efficiency and material conservation. In this sense, they are **always environmentally advantageous, but only economically viable when the planning process accounts for technical constraints, local market conditions and existing building characteristics**.

Moreover, attic conversions offer additional value by making better use of spaces and integrating modern housing into historically and architecturally significant buildings. This combination – **preserving cultural heritage while meeting current housing needs – positions attic conversions as a unique and desirable niche in the real estate market**. Their ability to blend traditional aesthetics with contemporary functionality appeals to a growing segment of the population that values both sustainability and character in residential environments – making attic conversions a powerful urban development strategy.

However, achieving the **full potential of attic conversions requires expertise, early-stage coordination and supportive policy frameworks**. Without adequate knowledge, clear regulations, or incentives, projects risk falling short in profitability or facing logistical and bureaucratic barriers. Therefore, attic conversions should not only be recognized as a practical and sustainable strategy for urban development, but also be supported by comprehensive planning, streamlined permitting processes and targeted public policy that make it easier to build sustainable homes.

## 7 Bibliography

- Academic Work. (n.d.). *Intervjuguide: 3 intervjutekniker – vilken väljer du?*  
Retrieved from Academic Work:  
<https://www.academicwork.se/artiklar/arbetsgivare/intervjuguide-3-intervjutekniker--vilken-vljer-du>
- Adeoye-Olatunde Pharm.D, O., & Olenik Pharm.D., N. (2021). *Research and scholarly methods: Semi-structured interviews*. Department of Pharmacy Practice, Purdue University College of Pharmacy, Indianapolis, Indiana.
- Ahmed, S. K. (2024). *The pillars of trustworthiness in qualitative research*. Retrieved from Elsevier, Science Direct:  
<https://www.sciencedirect.com/journal/journal-of-medicine-surgery-and-public-health>
- Akande, O., Odeleye, N.-D., & Coday, A. (2023). *Energy efficiency for sustainable reuse of public heritage buildings: the case for research (Version 1)*. Retrieved from Anglia Ruskin Research Online (ARRO):  
<https://hdl.handle.net/10779/aru.23775417.v1>
- Alba-Rodriguez, D., Martínez-Rocamora, A., González-Vallejo, P., Ferreira-Sánchez, A., & Marrero, M. (2017). *Building rehabilitation versus demolition and new construction: Economic and environmental assessment, Environmental Impact Assessment Review*,. Retrieved from Science Direct:  
<https://doi.org/10.1016/j.eiar.2017.06.002>.
- Aldana, E., Büchler, S., & Rolheiser, L. (2024). The past and future of non-residential-to-residential conversions in New York City. *Science Direct*.  
<https://doi.org/https://doi.org/10.1016/j.cities.2024.105157>
- Andersson, M., Kopsch, F., & Palm, P. (2018). *How cultural values are reflected on the housing market – direct effects and the cultural spillover*. Retrieved from Emerald: <https://www.emerald.com/insight/content/doi/10.1108/ijhma-02-2018-0016/full/pdf?title=how-cultural-values-are-reflected-on-the-housing-market-direct-effects-and-the-cultural-spillover>
- Armitage, L., & Irons, J. (2013). *The values of built heritage*. Retrieved from Emerald:  
<https://www.emerald.com/insight/content/doi/10.1108/02637471311321487/full/pdf?title=the-values-of-built-heritage>
- Aulin, R., Hansson, B., Landin, A., Olander, S., Persson, M., & Persson, U. (2021). *Bygglärdning - Produktion*. Studentlitteratur.
- Biro, A. (2023). *A Complete Guide to Adaptive Reuse in 2023*. Retrieved from MBH Arch: <https://www.mbharch.com/post/a-complete-guide-to-adaptive-reuse-in-2023>
- Bond, S., & Worthing, D. (2016). *Managing Built Heritage - the role of cultural values and significance*. Retrieved from Google Books:  
[https://books.google.se/books?hl=sv&lr=&id=TILKCQAAQBAJ&oi=fnd&pg=PR9&dq=cultural+values+buildings&ots=xKD3PDobI2&sig=\\_buNUI3e6VvgfIlqGzZg9B5x6ug&redir\\_esc=y#v=onepage&q&f=true](https://books.google.se/books?hl=sv&lr=&id=TILKCQAAQBAJ&oi=fnd&pg=PR9&dq=cultural+values+buildings&ots=xKD3PDobI2&sig=_buNUI3e6VvgfIlqGzZg9B5x6ug&redir_esc=y#v=onepage&q&f=true)
- Bostadsrätterna. (2024). *Så ska röstning ske på stämman – detta är reglerna som gäller*. Retrieved from Bostadsrätterna:  
<https://www.bostadsratterna.se/artiklar/2024/sa-ska-rostning-ske-pa-stamman-detta-ar-reglerna-som-galler>
- Boverket. (2018). *Boverket's mandatory provisions and general recommendations, BBR*. Retrieved from Boverket:

- <https://www.boverket.se/globalassets/publikationer/dokument/2019/bbr-2011-6-tom-2018-4-english-2.pdf>
- Boverket. (2020a). *Guide för bygglov och byggprocessen*. Retrieved from Boverket: [https://www.boverket.se/sv/byggande/bygglov-rivningslov-marklov-och-anmalan/guide-bygglov-byggprocess/?utm\\_source=chatgpt.com](https://www.boverket.se/sv/byggande/bygglov-rivningslov-marklov-och-anmalan/guide-bygglov-byggprocess/?utm_source=chatgpt.com)
- Boverket. (2020b). *Utveckling av regler om klimatdeklaration av byggnader Rapportnummer: 2020:13*. Karlskrona: Boverket.
- Boverket. (2021). *Olika skeden i byggandet*. Retrieved from Boverket: [https://www.boverket.se/sv/PBL-kunskapsbanken/teman/ekosystemtjanster/metod\\_byggande/skeden/?utm\\_source=chatgpt.com](https://www.boverket.se/sv/PBL-kunskapsbanken/teman/ekosystemtjanster/metod_byggande/skeden/?utm_source=chatgpt.com)
- Boverket. (2023a). *Bestämmelser om skydd av kulturvärden och rivningsförbud*. Retrieved from Boverket: [https://www.boverket.se/sv/PBL-kunskapsbanken/teman/kulturvarden/kulturvarden-i-plan--och-bygglagen/detaljplan-och-kulturvarden/skyddsbestammelser-och-rivningsforbud/?utm\\_source=chatgpt.com](https://www.boverket.se/sv/PBL-kunskapsbanken/teman/kulturvarden/kulturvarden-i-plan--och-bygglagen/detaljplan-och-kulturvarden/skyddsbestammelser-och-rivningsforbud/?utm_source=chatgpt.com)
- Boverket. (2023b). *Gränsvärde för byggnaders klimatpåverkan*. Boverket.
- Boverket. (2024a). *Boverket*. Retrieved from Entreprenadformer: <https://www.boverket.se/sv/samhallsplanering/arkitektur-och-gestaltad-livsmiljo/arbetssatt/upphandling/entreprenadformer/>
- Boverket. (2024b). *Byggprocessen*. Retrieved from Boverket: <https://www.boverket.se/sv/PBL-kunskapsbanken/lov--byggande/byggprocessen/>
- Boverket. (2024c). *Introduktion till livscykelanalys (LCA)*. Retrieved from Boverket: <https://www.boverket.se/sv/byggande/hallbart-byggande-och-forvaltning/livscykelanalys/introduktion-till-livscykelanalys-lca/>
- Boverket. (2024d). *Om Boverkets byggregler, BBR*. Retrieved from Boverket: [https://www.boverket.se/sv/byggande/regler-for-byggande/om-boverkets--byggregler-bbr/?utm\\_source](https://www.boverket.se/sv/byggande/regler-for-byggande/om-boverkets--byggregler-bbr/?utm_source)
- Boverket. (2025a). *Behov av bostadsbyggande 2024–2033*. Retrieved from Boverket: <https://www.boverket.se/sv/samhallsplanering/bostadsmarknad/bostadsmarknaden/behov-av-bostadsbyggande/behov-2024/>
- Boverket. (2025b). *Nya byggregler börjar gälla 1 juli 2025*. Retrieved from Boverket: <https://www.boverket.se/sv/PBL-kunskapsbanken/regler-om-byggande/byggregelsystemet/nya-byggregler/>
- Bullen, P. A., & Love, P. (2011). *Adaptive reuse of heritage buildings: Sustaining an icon or eyesore*.
- Bullen, P., & Love, P. (2011). *Adaptive reuse of heritage buildings*. Retrieved from Emerald: <https://www.emerald.com/insight/content/doi/10.1108/02630801111182439/full/html#b15>
- Byggföretagen. (2024). *Byggkostnader Byggkostnader för nyproducerade flerbostadshus i Sverig*. Retrieved from Byggföretagen: <https://byggforetagen.se/statistik/byggkostnader/>
- Chou, J.-S., & Yeh, K.-C. (2015). *Life cycle carbon dioxide emissions simulation and environmental cost analysis for building construction*. Retrieved from <https://doi.org/10.1016/j.jclepro.2015.04.001>
- Clarke, V., & Braun, V. (2016). *Thematic analysis*. Retrieved from The Journal of Positive Psychology: <https://doi.org/10.1080/17439760.2016.1262613>

- Douglas, J. (2011). *Building Adaption*. Heriot-Watt University, Edinburgh, UK: Spon Press.
- Eklund, K. (2014). *Bokriskommittén*. Retrieved from En Fungerande Bostadsmarknad - en reformagenda: [https://stockholmshandelskammare.se/wp-content/uploads/2021/04/bokriskommitten\\_slutrapport.pdf](https://stockholmshandelskammare.se/wp-content/uploads/2021/04/bokriskommitten_slutrapport.pdf)
- EPD. (n.d). *EPD Climate declaration*. Retrieved from EPD International EPD System: <https://www.environdec.com/all-about-epds/epd-climate-declaration>
- Eriksson, P., Donarelli, A., & Sonehag, T. (2019). *Kulturvärden och hållbar renovering*. Retrieved from Hållbar renovering ur ett helhetsperspektiv En antologi från forskningsmiljön SIREn: <https://www.diva-portal.org/smash/get/diva2:1377051/FULLTEXT01.pdf>
- Frossard, & et al. (2023). *Reuse practices in building construction: proposition of a life cycle assessment methodology and application to a case study in Switzerland*. Retrieved from IOP Science: <https://iopscience.iop.org/article/10.1088/1742-6596/2600/15/152007>
- Ghayeb, H. H., Razak, H. A., & N.H. Ramli Sulong. (2020). *Evaluation of the CO2 emissions of an innovative composite precast concrete structure building frame*. Retrieved from Journal of Cleaner Production: <https://doi.org/10.1016/j.jclepro.2019.118567>
- Glaeser, E. (2021). *What can developing cities today learn from the urban past?* Retrieved from Science Direct: <https://www.sciencedirect.com/science/article/pii/S0166046221000582>
- Göteborgs Stad. (n.d a). *Inreda lägenhet på vind*. Retrieved from Göteborgs Stad: <https://goteborg.se/wps/portal/start/bygga-bo-och-leva-hallbart/bygga-riva-och-forandra/vad-ska-du-bygga/andra-inomhus/inreda-lagenhet-pa-vind>
- Göteborgs Stad. (n.d b). *Så utvecklas bostäder och bebyggelse*. Hämtat från Göteborgs Stad: <https://goteborg.se/wps/portal/start/goteborg-vaxer/sa-arbetar-staden-med-stadsutveckling/sa-utvecklas-bostader-och-bebyggelse>
- Göteborgs Stad Stadsbyggnadskontoret. (2022, Juni). *Riktlinjer för vindsinredning*. Retrieved from Göteborgs Stad: <https://goteborg.se/wps/wcm/connect/6bb76438-6948-4f15-aa0c-7c22aac7ee79/Riktlinje+f%C3%B6r+vindsinredning.pdf?MOD=AJPERES>
- Göteborgs stadsmuseum. (1999). *KULTURHISTORISKT VÄRDEFULL BEBYGGELSE I GÖTEBORG - Del 1*. Retrieved from Göteborgs stadsmuseum: [https://goteborgsstadsmuseum.se/uploads/2021/05/bevarandeprogram\\_gbg\\_vo1\\_1\\_del\\_1.pdf](https://goteborgsstadsmuseum.se/uploads/2021/05/bevarandeprogram_gbg_vo1_1_del_1.pdf)
- Hansson, A. G. (2017). *City strategies for affordable housing: the approaches of Berlin, Hamburg, Stockholm, and Gothenburg*. Retrieved from Taylor & Francis Online: <https://doi.org/10.1080/19491247.2017.1278581>
- Hasik, V., Escott, E., Bates, R., Carlisle, S., Faircloth, B., & Bilec, M. (2019). *Comparative whole-building life cycle assessment of renovation and new construction, Building and Environment*. Retrieved from Science Direct: <https://doi.org/10.1016/j.buildenv.2019.106218>.
- Heale, R., & Twycross, A. (2018). *What is a case study?* CrossMark.
- Heale, R., & Twycross, A. (2018). *What is a case study?* Retrieved from CrossMark: <https://ebn.bmj.com/content/ebnurs/21/1/7.full.pdf>

- Hu, M., & Świerzawski, J. (2024). *Assessing the environmental benefits of adaptive reuse in historical buildings*. Retrieved from Sustainable Environment, 10(1): <https://doi.org/10.1080/27658511.2024.2375439>
- Hyresgästföreningen. (n.d). *Om oss*. Retrieved from Hyresgästföreningen: <https://www.hyresgastforeningen.se/om-oss/>
- Hyresgästföreningen. (n.d). *Skillnaden mellan bostadsrätt & hyresrätt*. Retrieved from Hyresgästföreningen: <https://www.hyresgastforeningen.se/stod-och-rad/ombildning/vad-ar-skillnaden-mellan-att-bo-i-hyresratt-och-bostadsratt/>
- IVL Svenska Miljöinstitutet. (2024). *Anvisningar för LCA-beräkning av byggprojekt*. Retrieved from IVL Svenska Miljöinstitutet.
- Kallio, H., Pietilä, A.-M., Johnson, M., & Kangesniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, 72, 2954-2965.
- Karolinska Institutet. (2024). *Systematic reviews - for researchers*. Karolinska Institutet, University Library Web Team.
- Kovács, G., & M. Spens, K. (2005). *Abductive reasoning in logistics research*. Swedish School of Economics and Business Administration, Helsinki, Finland.
- Lantmäteriet. (2025). *Min karta - Lantmäteriet*. Retrieved from Lantmäteriet: <https://www.lantmateriet.se/sv/kartor/vara-karttjanster/min-karta/>
- Leichter, M., & Piccardo, C. (2024). *Assessing life cycle sustainability of building renovation and reconstruction: A comprehensive review of case studies and methods*. Retrieved from Elsevier: <https://pdf.sciencedirectassets.com/271434/1-s2.0-S0360132324X00141/1-s2.0-S0360132324006590/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEAkaCXVzLWVhc3QtMSJHMEUCIQCWdUYDU94U6o8WRjQ2HemqFYgBR9A8rjlSoI0ypnP%2FnQIagIrnvh27CsmvNMW8Nqfy%2F7ZhuBX6jAbBPiEAwjp>
- Liao, H., Ren, R., & Li, L. (2023). *Existing Building Renovation: A Review of Barriers to Economic and Environmental Benefits*. Retrieved from MDPI: <https://doi.org/10.3390/ijerph20054058>
- Licciardi, G., & Amirtahmasebi, R. (2012). *THE ECONOMICS OF UNIQUENESS Investing in Historic City Cores and Cultural Heritage Assets for Sustainable Development*. Retrieved from World Bank Group - Open Knowledge Repository: <https://openknowledge.worldbank.org/server/api/core/bitstreams/6c65a257-cc9e-59ec-acac-7399996cec95/content>
- Lidberg, A. (2008). *Ekonomiska kommentarer Bostadsrättsföreningars ekonomi och finansiell stabilitet*. Retrieved from Sveriges Riksbank: <https://www.riksbank.se/globalassets/media/rapporter/ekonomiska-kommentarer/svenska/2018/bostadsrattsforeningars-ekonomi-och-finansiell-stabilitet.pdf>
- Lidelöw, S., Örn, T., Luciani, A., & Rizzo, A. (2019). *Energy-efficiency measures for heritage buildings: A literature review*. Retrieved from Sustainable Cities and Society: <https://www.sciencedirect.com/science/article/pii/S2210670718312435>
- Lind, H. (2014). *Ekonomiska aspekter på renoveringar av bostäder - en översikt*. Retrieved from Sustainable Integrated Renovation Rapport 2014:1 Institutionen för Fastigheter och Byggnad, KTH: <https://www.diva-portal.org/smash/get/diva2:816833/FULLTEXT01.pdf>

- Lind, H. (2016). *Åtkomliga bostäder: Så gör vi det möjligt för hushåll med låga inkomster att hitta en bostad*. Retrieved from SNS förlag:  
<https://sns.se/cdn.triggerfish.cloud/uploads/2020/02/atkomliga-bostader.pdf>
- Länsstyrelsen Stockholm. (n.d). *Bidrag till kulturhistoriska miljöer*. Retrieved from Länsstyrelsen Stockholm:  
[https://www.lansstyrelsen.se/stockholm/samhalle/kulturmiljo/bidrag-till-kulturhistoriska-miljoer.html?utm\\_source=chatgpt.com](https://www.lansstyrelsen.se/stockholm/samhalle/kulturmiljo/bidrag-till-kulturhistoriska-miljoer.html?utm_source=chatgpt.com)
- Malmqvist, T., Borgström, S., Brismark, J., & Erlandsson, M. (2023). *Referensvärden för klimatpåverkan vid uppförande av byggnader*. Retrieved from KTH Royal Institute of Technology website:  
<https://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-339759>
- Mangolda, M., Bohmanb, H., Johansson, T., & Platten, J. v. (2023). *Increased rent misspent? How ownership matters for renovation and rent increases in rental housing in Sweden*. Retrieved from Routledge:  
<https://www.tandfonline.com/doi/full/10.1080/19491247.2023.2232205>
- Naturvårdsverket. (2025). *Klimatet och bygg- och fastighetssektorn*. Retrieved from Naturvårdsverket:  
<https://www.naturvardsverket.se/amnesomraden/klimatomstallningen/omraden/klimatet-och-bygg--och-fastighetssektorn/>
- Nijskens, R., Lohuis, M., Hilbers, P., & Heeringa, W. (2019). *Hot Property The Housing Market in Major Cities: The Housing Market in Major Cities*. Retrieved from ResearchGate: <http://dx.doi.org/10.1007/978-3-030-11674-3>
- Nobs, M. (2015). *SOCIAL HÅLLBARHET MED FOKUS PÅ BOSTADSRENOVERING (SIRen)*. Retrieved from Social hållbarhet handlar om trygghet, dialog och arbetstillfällen:  
[https://www.researchgate.net/profile/Kristina-Mjoernell/publication/377768287\\_SOCIAL\\_HALLBARHET\\_MED\\_FOKUS\\_PA\\_BOSTADS-RENOVERING\\_EN\\_ANTOLOGI/links/65b77ba234bbff5ba7d6971d/SOCIAL-HALLBARHET-MED-FOKUS-PA-BOSTADS-RENOVERING-EN-ANTOLOGI.pdf#page=129](https://www.researchgate.net/profile/Kristina-Mjoernell/publication/377768287_SOCIAL_HALLBARHET_MED_FOKUS_PA_BOSTADS-RENOVERING_EN_ANTOLOGI/links/65b77ba234bbff5ba7d6971d/SOCIAL-HALLBARHET-MED-FOKUS-PA-BOSTADS-RENOVERING-EN-ANTOLOGI.pdf#page=129)
- Owojori, O., Okoro, C., & Chileshe, N. (2021). *Current Status and Emerging Trends on the Adaptive Reuse of Buildings: A Bibliometric Analysis*. Retrieved from MPDI: <https://doi.org/10.3390/su132111646>
- Patrick, N. M. (2013). *PRESERVATION CONSTRUCTION: DESIGN-BUILD VERSUS DESIGN-BID-BUILD*. Retrieved from AB, The University of Georgia, 2010.
- Power, A. (2008). *Does demolition or refurbishment of old and inefficient homes help to increase our environmental, social and economic viability?* Retrieved from Elsevier: <https://doi.org/10.1016/j.enpol.2008.09.022>
- Ramboll. (2018). *SCENARIOANALYS Marknadshyror för hyreslägenheter i Göteborgs Kommun*. Retrieved from SCENARIOANALYS Marknadshyror för hyreslägenheter i Göteborgs Kommun:  
<https://www.hyresgastforeningen.se/globalassets/bilder/regionernas-bilder/vastra-sverige/dokument/marknadshyror-for-hyreslagenheter-i-goteborgs-kommun.pdf>
- Ramboll. (2021). *SCENARIOANALYS MARKNADSHYROR GÖTEBORG*. Retrieved from SCENARIOANALYS MARKNADSHYROR GÖTEBORG:  
<https://www.hyresgastforeningen.se/globalassets/var-politik/marknadshyra/rapport---marknadshyror-i-goteborg.pdf>

- Regeringskansliet. (2022). *Uppdrag att lämna förslag på hur införandet av gränsvärden för byggnaders klimatpåverkan kan påskyndas och hur tillämpningen av klimatdeklarationer kan utvidgas*. Retrieved from Regeringskansliet:  
<https://www.regeringen.se/regeringsuppdrag/2022/03/uppdrag-att-lamna-forslag-pa-hur-inforandet-av-gransvardet-for-byggnaders-klimatpaverkan-kan-paskyndas-och-hur-tillampningen-av-klimatdeklarationer-kan-utvidgas/>
- Regeringskansliet. (2025). *Regeringen föreslår omfattande förenklingar av reglerna för bygglov*. Retrieved from Regeringskansliet:  
[https://www.regeringen.se/pressmeddelanden/2025/02/regeringen-foreslar-omfattande-forenklingar-av-reglerna-for-bygglov/?utm\\_source=chatgpt.com](https://www.regeringen.se/pressmeddelanden/2025/02/regeringen-foreslar-omfattande-forenklingar-av-reglerna-for-bygglov/?utm_source=chatgpt.com)
- Riksantikvarieämbetet. (2023). *Lagar och ansvar för kulturhistorisk bebyggelse*. Retrieved from Riksantikvarieämbetet: <https://www.raa.se/stoddokument-bebr/lagar-och-ansvar/>
- Scheuren, F. (2004). *What is a Survey*.
- Shaun. (2025). *Life Cycle Stages*. Retrieved from One Click LCA:  
<https://oneclicklca.zendesk.com/hc/en-us/articles/360015064999-Life-Cycle-Stages>
- Stockholms Stad. (n.d). *Bostäder*. Retrieved from Stockholms Stad:  
<https://vaxer.stockholm/tema/bostader/>
- Strandberg, B., & Lavén, F. (2021). *Bygga hus : illustrerad bygglära (4:e uppl.)*. Studentlitteratur AB.
- Sugden, E. (2017). Retrieved from The Adaptive Reuse of Industrial Heritage Buildings: A Multiple-Case Studies Approach:  
<https://dspacemainprd01.lib.uwaterloo.ca/server/api/core/bitstreams/379be137-4b14-4b30-9b34-1ed82d982e36/content>
- Sveriges Riksdag. (2010). *Plan- och bygglag (2010:900)*. Retrieved from Sveriges Riksdag: [https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900\\_sfs-2010-900/?utm\\_source=chatgpt.com](https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/plan-och-bygglag-2010900_sfs-2010-900/?utm_source=chatgpt.com)
- Swedish Institute for Standards. (2011). *Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method*. Retrieved from Swedish Institute for Standards:  
<https://www.sis.se/en/produkter/construction-materials-and-building/buildings/other/ssen159782011/>
- Tam, V. W., & Hao, J. (2018). *Adaptive reuse in sustainable development*. Retrieved from International Journal of Construction Management:  
<https://doi.org/10.1080/15623599.2018.1459154>
- United Nations Environment Programme, & Yale Center for Ecosystems + Architecture. (2023, september ). *Building Materials and the Climate: Constructing a New Future*. Retrieved from UN - environment programme:  
<https://wedocs.unep.org/20.500.11822/43293>
- Vindshem. (2025). *Vindshem*. Retrieved from Omvandla lokal till bostadsrätt:  
<https://www.vindshem.se/bostadsrattsforeningar>
- Y. Ren et al. (2018). *Generative Modeling of Human Behavior and Social Interactions Using Abductive Analysis*. IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining.
- Zhu, S., & Feng, H. (2024). *Construction and demolition waste circulation and its sustainability performance in the building sector: current trend and future directions*. Retrieved from Emerald:

[https://www.emerald.com/insight/content/doi/10.1108/ecam-05-2024-0678/full/pdf?casa\\_token=6KnNgo1OLXwAAAAA:t5Tz08CEtVdT3wFO5Pz6ds\\_PeIboaUs3JAo51P2hFadnb\\_efI8MnOOqjekqFKxzzq5VjVEqUH91k2avHrBpcv0gzh8P7swd6jT7lbXtwgkrem2SHlcnm7g](https://www.emerald.com/insight/content/doi/10.1108/ecam-05-2024-0678/full/pdf?casa_token=6KnNgo1OLXwAAAAA:t5Tz08CEtVdT3wFO5Pz6ds_PeIboaUs3JAo51P2hFadnb_efI8MnOOqjekqFKxzzq5VjVEqUH91k2avHrBpcv0gzh8P7swd6jT7lbXtwgkrem2SHlcnm7g)

## Appendix A: Interview Questions

Below, the interview questions, for phase 2, are presented.

Interview questions:

1. **Your role?** Do you work with co-operative or rental apartments?
2. **Difference in construction process:** New construction vs. attic conversion?  
(The newly built process – table (Appendix B) is shown and then use strikethrough and percentage estimation for comparison of each step with attic conversion.)
3. **What are the advantages and disadvantages of attic conversions?**
  - 3.1 **What are the most critical steps in an attic conversion?**
4. **What is the most decisive factor for making the project economically profitable?** (Compare attic conversions with new construction.)
5. **Do you see an impact of social and cultural values on demand?**
6. **Is it possible for you to achieve economic and environmental sustainability with attic conversions, and if so, how?**
7. **What is your perspective on the future of the industry in this field?**

## Appendix B: Production Steps

Table containing the standard construction stages for new residential buildings, where the empty field is supposed to be filled in by the respondents in interview study phase 2:

Production Steps for New Residential Construction	Estimation for Attic Conversion (Percentage, %)
<p><b>1. Site Work</b> – Preparing the ground for construction, including excavation, drainage and foundation work. The ground must be stabilized to support the building, with proper drainage to manage water flow and ensure load-bearing capacity. Common methods include shallow foundations (directly on bearing soil) and deep foundations (e.g., piling on weak soil).</p>	
<p><b>2. Structural Frame Assembly</b> – Installation of the building’s load-bearing structures, often using concrete or steel. Structural systems can be classified as heavy, medium, or light, constructed through in-situ casting, prefabricated elements, or timber framing. Common solutions include timber or concrete frames, semi-prefabricated systems (such as hollow-core slabs and wall shells) and steel frames using column-beam systems. (Elevator installation is included if added in the project.)</p>	
<p><b>3. Roof Construction</b> – Installation of roofing materials such as concrete tiles, metal sheets, or timber. Machines are typically used for assembly and sealing to ensure energy efficiency. Roofs can be either warm (with uniform temperature across the structure) or cold (ventilated to keep the outer surface cool). Over-insulating the roof is often cost-effective; however, additional insulation in older buildings can increase the risk of moisture problems.</p>	
<p><b>4. Facade Work</b> – Use of materials such as insulation, brick, precast concrete panels, or timber cladding, with emissions varying depending on material choice. Production, transportation and installation all contribute to the climate impact. Exterior walls must provide adequate insulation and can be load-bearing, as in concrete structures. Render (plaster) is often applied to protect brickwork and to provide an aesthetic finish to the facade.</p>	
<p><b>5. Windows and Doors</b> – Glass production is highly energy-intensive. Additionally, aluminum and plastic components contribute to environmental impacts. According to BBR 6:322, the glazed area must amount to at least 10% of a</p>	

<p>room's floor area to ensure sufficient natural daylight.</p>	
<p><b>6. HVAC Works</b> – Installation of piping, pumps and heating systems, where materials such as copper and plastics cause emissions during manufacturing. Heating systems like district heating, heat pumps and gas boilers also significantly influence the building's overall carbon footprint. Installations must comply with industry regulations for "Safe Water" standards to ensure quality and minimize the risk of water damage, with careful execution and thorough documentation.</p>	
<p><b>7. Electrical Installations</b> – Electrical work causes CO<sub>2</sub> emissions during the production of cables, switchboards and lighting fixtures, particularly through the extraction and processing of metals like copper and aluminum. These manufacturing and transportation activities contribute to the overall environmental footprint.</p>	
<p><b>8. Interior Works</b> – Interior works include the installation of gypsum boards, painting, flooring materials (concrete, laminate, vinyl) and kitchen and bathroom fittings. These activities generate emissions through the production, transportation and installation of materials. The application of waterproof and water-repellent layers is crucial for protecting surfaces against moisture, especially in wet areas such as kitchens and bathrooms.</p>	

## Appendix C: Questionary Social Values

Below is the published survey:

### Valuing Residential Environments and Culturally Historic Buildings

This survey aims to understand how people value residential environments, particularly in areas with cultural and historical significance. Responses are anonymous and will be used in a study about attic conversions and Adaptive Reuse (the process of finding a new purpose for an existing building).

It takes approximately 5 minutes to complete.

#### 1. Background Questions – Current Living Situation

Your age:

- Under 20
- 20–30
- 31–40
- 41–50
- 51–60
- Over 60

What type of housing do you currently live in?

- Older housing (built before 1960)
- Housing built between 1960–2000
- New construction (built after 2000)
- Don't know

What type of residence do you live in?

- Apartment in a multi-family building
- Row house/semi-detached house
- Detached house/villa
- Other: \_\_\_\_\_

How many people live in your household (total)?

- Just me
- 2
- 3
- 4
- 5 or more

Where do you live? (City and neighborhood)

#### 2. Attitude Toward Culturally Historic Buildings

**Definition of culturally historic buildings:**

Buildings constructed before 1960, such as turn-of-the-century buildings, *landshövdingehus* (a typical Gothenburg building type), functionalist buildings, and older stone houses. These are commonly found in Gothenburg neighborhoods such as Lorensberg, Vasastaden, Linnéstaden, Haga, Bagaregården, and Majorna.

**For the questions below, please assume you would be living in an apartment (multi-family building).**

**How important is it to you to live in a culturally historic building (built before 1960)?**

- Not important at all
- 1
- 2
- 3
- 4
- 5
- Very important

**If you could choose, would you prefer to live in:**

- An older building (before 1960)
- A newer building (after 1960)
- No preference

**Which of the following would you choose?**

(The circle in the image below represents an approximate central location in Gothenburg. Areas outside the circle are considered “Outside the city center.” If you don’t live in Gothenburg, you may use the image as a reference for your own city.)

- A central location, a newer building (after 1960)
- A central location, an older building (before 1960)
- A location outside the center, a newer building (after 1960)
- A location outside the center, an older building (before 1960)

**What do you find most attractive about older buildings?** (Select all that apply)

- Architectural details and charm
- Higher ceilings and spacious rooms
- Solid materials and construction quality
- The building’s history and cultural value
- The character of the surrounding neighborhood
- Other: \_\_\_\_\_

**What do you find most attractive about newer buildings?** (Select all that apply)

- Energy efficiency
- Modern floor plans
- Amenities and elevator
- Better sound insulation
- Lower operating costs
- Good parking options
- Other: \_\_\_\_\_

### **3. Neighborhood and Urban Environment**

**How important is it to preserve older buildings in urban development?**

- Not important at all
- 1
- 2
- 3
- 4

- 5
- Very important

**What do you value most in a residential neighborhood?** (Select all that apply)

- Proximity to green areas and parks
- Good public transportation and connections
- Architectural and historical character
- Safety and a peaceful environment
- Proximity to services and shops
- Proximity to the city center
- Good parking options
- Other: \_\_\_\_\_

**Would you consider paying more to live in a culturally historic building?**

- Yes
- No
- Maybe

**If yes to the previous question, how much more would you be willing to pay (in %)?**

#### **4. Open Question**

**Any additional thoughts or comments?**

For example, what do you value most when choosing an apartment?



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY