Preparedness of Construction SMEs for climate adaptation-related renovation services

An analysis of companies in the Kronoberg region

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Master’s Thesis, 2023
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Master’s thesis in master’s programme Sustainable Energy Process and Systems

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Examensarbete 2023 Institutionen för byggd miljö och energiteknik,
Linnéuniversitetet 2023

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Acknowledgment

This thesis was conducted from January 2023 to August 2023 as part of the Sustainable Energy Processes and Systems program at Linnaeus University, Växjö campus.

I am grateful to my supervisor, Georgios Pardalis at Linnaeus University, for his guidance throughout the process and assistance in conducting the interviews.

I also extend my appreciation to all interviewees for their valuable time and expertise, which made this thesis possible to complete.

Växjö, June 2023

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Abstract

Climate change presents a significant global challenge, affecting various aspects such as rising sea levels, extreme weather events, and altered precipitation patterns. Climate adaptation and climate mitigation are two fundamental strategies for addressing climate change. While mitigation focuses on reducing greenhouse gas emissions, adaptation involves adjusting to climatic changes and their consequences. Both strategies are essential for a comprehensive response to climate change. For construction SMEs in the Kronoberg region, recognizing the importance of this dual approach is vital when offering climate adaptation-related renovation services.

The construction sector plays a crucial role in shaping the built environment and has a substantial impact on greenhouse gas emissions, making it a vital area for addressing climate change. This study focuses on assessing the readiness and challenges faced by construction small and medium enterprises (SMEs) in the Kronoberg region of Sweden in providing climate adaptation-related renovation services. The study aims to evaluate the current state of preparedness of SMEs, identify specific challenges, and develop strategies to support their transition towards sustainable and resilient climate adaptation renovations. The findings reveal a growing awareness among construction SMEs regarding climate adaptation needs, with strategies emphasizing the use of wooden materials, energy efficiency, and sustainable practices. The outcomes provide valuable insights and recommendations for construction SMEs operating in the Kronoberg region, facilitating their long-term viability in supporting sustainable and resilient communities. However, challenges such as limited resources, absence of regulations, and standardized guidelines hinder implementation.

Despite these challenges, the study highlights opportunities for growth and innovation through stakeholder collaboration, technological advancements, and sustainable strategies. The implications for construction SMEs include the need for continued awareness, adoption of sustainable practices,
overcoming challenges, stakeholder collaboration, and embracing innovation and technology. Overall, construction SMEs in the Kronoberg region have the potential to contribute to a sustainable future by prioritizing climate adaptation, engaging in knowledge sharing, and actively participating in collaborative efforts. Their actions can drive positive change in the construction sector, mitigating the environmental impact of buildings and fostering a more sustainable and resilient built environment. Moreover, this research lays the foundation for further investigation in other regions or countries, fostering the global transition towards sustainable and resilient built environments.

**Key words**

construction sector, buildings, Small and Medium-sized Enterprises (SMEs), climate change, Kronoberg region
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1. Introduction

In this chapter, you will find information about the background of the thesis study, the objectives and research questions, as well as the limitations of the project. The background section provides an explanation for conducting this thesis study, while the objectives and research questions section highlights the significance of the study and outlines the specific details that will be covered.

1.1. Background

Climate change is one of the most pressing global challenges of our time, with its impacts ranging from rising sea levels and more frequent extreme weather events to altered precipitation patterns (Francart et al., 2019). The global construction sector plays a crucial role in shaping the built environment. It has a significant impact on greenhouse gas emissions and has become a significant challenge in the modern era (Sadri et al., 2022). The construction industry plays a crucial role in meeting sustainability and environmental targets, particularly in the face of climate change (Francart et al., 2019). The complexity of this problem has resulted in the implementation of various actions at different levels, ranging from small-scale popular movements to large-scale intergovernmental measures. The management of greenhouse gas (GHG) emissions has always been a critical factor in climate protection, and it is often used as a criterion for setting both short-term and long-term climate goals. The regulation of GHG emissions is achieved through various measures, including reducing the amount of GHG emissions through the adoption of cleaner energy sources, increasing energy efficiency, and implementing policies that encourage emission reductions (Sadri et al., 2022). To measure the impact of GHGs, they are evaluated based on their carbon dioxide (CO\textsubscript{2}) equivalent. This involves multiplying the GWP coefficient of the gas, which represents its global warming potential, by the amount of the gas emitted. The GWP coefficient is used to compare the warming potential of various GHGs relative to CO\textsubscript{2}. This is important because different gases have different effects on global warming, and some have a much greater impact than CO\textsubscript{2} (Sadri et
In recent years, the urgency of addressing climate change has led to a greater focus on the control of GHG emissions. This has resulted in an increased investment in research and development of new technologies to minimize GHG emissions. In addition, there has been a growing awareness of the need to adopt sustainable lifestyles and reduce energy consumption. With the cooperation of governments, industries, and individuals, it is possible to achieve significant progress in mitigating the impact of climate change by controlling GHG emissions (Sadri et al., 2022).

Fig 1: Cycle of emissions and resilience in the building industry (Saberi and Beykan, 2022)

Buildings are frequently mentioned as a substantial factor in climate change. The building sector is responsible for approximately 51% of global electricity consumption, 51% of district heat energy usage, and 19% of energy-related greenhouse gas (GHG) emissions. As a result, a crucial element of sustainable development involves extensively renovating buildings to effectively lower energy consumption and the subsequent emissions (Mainali et al., 2021).
Climate adaptation and climate mitigation are two fundamental strategies for addressing the complex challenges posed by climate change. These strategies are essential components of a comprehensive response to the evolving climate crisis, each with its distinct focus and purpose. Mitigation primarily centres on reducing the sources of greenhouse gas emissions or enhancing the capacity of natural systems to absorb these gases. This approach aims to tackle the root causes of climate change, which include the buildup of greenhouse gases in the Earth’s atmosphere. By limiting emissions and promoting sustainable practices, mitigation endeavours to slow down the process of global warming. On the other hand, adaptation involves adjustments made in natural and human systems to respond effectively to current or anticipated climatic changes or their consequences. The goal of adaptation is to moderate the adverse impacts of climate change and harness potential opportunities it may bring. Unlike mitigation, which targets the causes, adaptation addresses the consequences and vulnerabilities that communities, ecosystems, and industries face as the climate continues to evolve.

These strategies serve distinct but complementary roles in our response to climate change. Even with robust mitigation efforts, the world will still experience ongoing changes in the climate over the coming decades, necessitating adaptation measures. Conversely, (Locatell, 2011) adaptation alone cannot eliminate all negative impacts. To achieve a sustainable future, both adaptation and mitigation must work in tandem. For construction SMEs in the Koronoberg region in Sweden, recognizing the importance of this dual approach is vital when offering climate adaptation-related renovation services. By understanding and preparing for the impacts of climate change while also contributing to emission reduction efforts, these companies can play a crucial role in building a more resilient and sustainable future for the region.
The initial version of the European Energy Performance of Buildings Directive in 2002 and its recast in 2010 mandate that all European member states establish a framework for achieving high energy efficiency in new or renovated residential buildings, aiming to ultimately achieve "nearly zero-energy buildings." This goal necessitates innovations at the building system level. According to European commission, the housing sector is expected to benefit from research that explores the barriers and drivers of innovation, providing the necessary motivation to progress towards sustainability, particularly in terms of energy efficiency. However, one of the key priorities in achieving the decarbonization targets for the building sector by 2030 and 2050 is the renovation of existing buildings to a zero-carbon-ready standard. The building energy renovation not only contributes to climate resilience but also addresses energy security concerns and job creation (IEA, 2022). The construction industry relies significantly on small and medium-sized enterprises (SMEs), which hold a pivotal role in mitigating the climate impact of building construction. These SMEs achieve this by advocating for the use of building products with minimal climate change impact and implementing additional environmental standards for new constructions. Moreover, they contribute by providing economic and administrative incentives, along with offering training, software tools, and databases for assessing climate change impact. Additionally, they foster dialogue and innovation, creating awareness among stakeholders about climate-related concerns (Francart et al., 2019). For instance, in order to comply with the Environmental Product Declarations for buildings, which must adhere to the core rules and life cycle assessment (LCA) method, SMEs can choose to establish environmental performance requirements based on either the entire life cycle or specific phases, such as the construction phase (Francart et al., 2019). However, to set and monitor these environmental performance criteria, specific LCA tools and databases must be utilized, which requires construction SMEs to be familiar with LCA procedures. Additionally, By implementing additional environmental standards for new constructions, providing training, software tools, and databases for assessing climate change impact, encouraging dialogue and
innovation, and enhancing stakeholders' awareness of climate issues, they have the capacity to encourage the adoption of building products with minimal climate change impact (Francart et al., 2019).

Sweden’s efforts to tackle climate change have made it a role model despite its relatively small population. The municipalities of Sweden have a significant role to play in the planning and development of construction projects, and construction SMEs must be aware of the legal requirements and regulations set forth by municipalities in order to effectively provide climate adaptation-related renovation services (Francart et al., 2019). In line with its commitment to the Paris Agreement, Sweden aims to achieve zero greenhouse gas (GHG) emissions by 2045 and eventually pursue negative emissions (EPA, 2022). However, this is a challenging task as the construction industry is one of the most significant contributors to environmental damage. Governments, policymakers, researchers, and industry practitioners are all actively involved in addressing the environmental impacts of the industry. In accordance with Global Alliance for Buildings and Construction the construction sector are particularly responsible for approximately 40% of final energy use and CO₂ emissions (IEA, 2019). In Sweden, about one-fifth of annual CO₂ emissions result from the construction and transportation processes in the construction and infrastructure industries. Therefore, achieving Sweden's climate goals requires significant reductions in emissions from these sectors. Measures such as transitioning to cleaner energy sources, improving energy efficiency, and encouraging sustainable practices in these industries are critical in reducing emissions and achieving Sweden's climate targets (Karlsson et al., 2020).
By better understanding the legal requirements and regulations set forth by municipalities in Kronoberg region in Sweden, construction SMEs can improve their capacity to provide high-quality renovation services that are aligned with environmental and sustainability targets. Ultimately, this will contribute to the development of a more sustainable and resilient built environment. However, the law in Sweden remains vague on several aspects related to environmental requirements on building construction, which have significant implications for the preparedness of construction SMEs for climate adaptation-related renovation services. Therefore, this analysis will shed light on the legal considerations that are necessary for construction SMEs to successfully operate in the context of climate adaptation-related renovation services in the Kronoberg region in Sweden. This study is an important step towards ensuring the long-term viability of the structures and infrastructure that support our communities.
1.2. Purpose and Objectives

The purpose of this study is to assess the readiness and identify the challenges faced by construction SMEs in the Kronoberg region of Sweden in providing climate adaptation-related renovation services. The objective is to evaluate the current state of preparedness of SMEs in the construction sector, examine the specific challenges they encounter, and develop strategies to support their transition towards a sustainable and resilient future for climate adaptation-related renovation services. By addressing legal considerations and providing recommendations, this study aims to enhance the capacity of SMEs to deliver high-quality renovation services aligned with environmental and sustainability targets, ultimately contributing to the development of a more sustainable built environment in the Kronoberg region.

1.3. Research question(s)

The focus of the study will be to examine the following research questions.

RQ1. How do construction SMEs in Kronoberg balance climate adaptation and mitigation efforts in their renovation services to effectively build a more resilient and sustainable future in the context of climate change, and what challenges do they encounter in doing so?

RQ2. What strategies and support mechanisms can be identified and implemented to assist construction SMEs in the Kronoberg region in transitioning towards a more sustainable and resilient future while offering climate adaptation-related renovation services?

1.4. Study Limitations

The limitations of the study include the potential for bias in the responses provided by the SMEs in the Kronoberg region, as well as the limited scope of the study to a specific geographic area. In addition, the data collected may not
reflect the full range of challenges and opportunities faced by SMEs in the construction sector, as it is based on self-reported information. The study may also be limited by the lack of reliable data on the current state of climate adaptation-related renovation services offered by SMEs in the region. Furthermore, the results of the study may not be generalizable to other regions or countries, and further research may be needed to expand the scope and ensure broader applicability. Despite these limitations, this study represents an important first step in understanding the preparedness of SMEs in the Kronoberg region for offering climate adaptation-related renovation services, and the results will provide valuable insights into the challenges and opportunities faced by the sector.
2. Existing Literature on the Subject

In this section, an overview of the existing literature is presented. It encompasses the key topics such as climate adaptation-related renovation and the role of small and medium-sized enterprises (SMEs) in construction. It also indicates the factors that influence how prepared construction companies are to handle climate adaptation-related renovation projects. This literature review highlights the importance of understanding the barriers to deep renovation, homeowners’ attitudes, and enhancing the knowledge and expertise of construction SMEs in developing a robust market for climate adaptation services. It also helps to gain a better understanding of these important areas and their significance.

From Emission Reduction to Climate Resilience: The Evolution of Climate Action in Sweden: Climate change adaptation, from previous studies (Olsson, 2018), involves adjusting to cope with the impacts of climate change, emerged more slowly than efforts to reduce climate-changing emissions, both globally and in Sweden. The official definition of climate change adaptation by the United Nations in 2001 marked a turning point, but discussions had started earlier. Initially, some were concerned that focusing on adaptation might shift attention away from efforts to reduce emissions. In Sweden, adaptation gained prominence around 2007, especially at the local level, following a decade of emphasis on emission reduction. Mitigation efforts, aimed at reducing greenhouse gas emissions to combat climate change, are vital for preventing further warming. However, adaptation (Olsson, 2018) is crucial because we know that climate change, driven by human activities, will persist and have mostly adverse effects on people, the environment, and wildlife. Even if we could suddenly revert to pre-industrial levels of emissions, we would still face challenges due to past and current emissions. In Sweden, we anticipate more frequent and severe floods, landslides, droughts, and heatwaves, all posing risks to society. Moreover, climate change can disrupt ecosystems, communities of living things and their surroundings, pushing them beyond a point of no return, leading to harmful changes that cannot be
reversed. Changes in one ecosystem can impact others as well, with severe consequences for both people and nature, resulting in the loss of crucial ecosystem functions we depend on. In Sweden, adaptation aligns with the broader concept of sustainable development, where local areas like municipalities play a pivotal role in ensuring effective adaptation strategies. This is essential for addressing climate change impacts and complements efforts to reduce emissions, emphasizing the interconnected nature of mitigation and adaptation in tackling the challenges posed by climate change.

Climate-change (Stagrum et al., 2020) presents significant challenges to sustainable urban development in Sweden due to climate change. This includes increased hazards such as higher mean warming, more extreme temperatures, greater precipitation, and landslides and erosion. The construction industry, especially small and medium-sized enterprises (SMEs), plays a critical role in providing climate adaptation-related renovation services (Persson and Grönkvist, 2015). However, there is a lack of knowledge regarding the adaptive capacities of these firms and the individual households they serve. Existing research has primarily focused on design strategies and mitigation measures for new buildings, with limited studies exploring energy-efficiency measures specifically for renovation projects under climate change (Stagrum et al., 2020). Additionally, climate adaptation-related renovation services are considered radical innovations in Sweden due to marketing discontinuity at the macro level (Mlecnik, 2012). Understanding the organizational capability and external factors affecting innovation adoption is crucial, including the availability of resources, business environment, network influences, and policy environment (Bossle et al., 2016). Barriers to deep renovation in the context of detached houses include a lack of information and expertise among homeowners and small local companies responsible for renovation, along with burdensome housing regulations (Rohdin et al., 2007).

**Economic aspects of deep renovation:** Several studies have examined the economic aspects of the deep renovation market (Mata et al., 2015) assessed the cost-effectiveness of retrofit alternatives under different energy price
scenarios and discount rates, highlighting the upfront costs involved. However, (Ekström et al., 2018) demonstrated that installing a heat pump can be a cost-effective measure, particularly for houses with electric heating systems, making deep renovation economically viable.

**Barriers and Strategies for innovation and sustainable renovation in construction SMEs:** Construction SMEs face distinct barriers compared to larger firms when it comes to adopting innovation and implementing sustainable renovation practices. Limited resources and the capacity to invest in research and development initiatives pose challenges for SMEs (Jung and Andrew, 2014). SMEs to effectively implement climate adaptation-related renovation services. Previous studies (Pardalis et al., 2020) have shown that SMEs often lack the necessary resources, expertise, and support networks to adopt innovative solutions for climate adaptation. Therefore, it is crucial to identify strategies to enhance the capacity of SMEs to effectively implement climate adaptation-related renovation services. (Pardalis et al., 2019) cultural and institutional barriers exist in the construction industry, and the adoption of energy-efficient measures is influenced by economic, behavioral, physical, and social factors. Research (Bossle et al., 2016; Mlecnik, 2012) has explored various approaches such as collaboration with larger firms, knowledge sharing through industry associations, and support from governmental and non-governmental organizations have been proposed as strategies to enhance SMEs' capacity for climate adaptation-related renovation. It is crucial (Pardalis et al., 2020) to acknowledge that innovation patterns for larger construction firms may not always be suitable for SMEs, and collaboration among small firms on whole-building solutions can be challenging.

**Stakeholder Engagement, Collaboration, and Policy Environment in Climate Adaptation-related Renovation Services:** Stakeholder engagement, collaboration, and the policy environment play essential roles in the successful adoption of climate adaptation-related renovation services by construction SMEs. (Mlecnik, 2013) Swedish municipalities have the authority to promote low climate change impact in building construction.
However, implementing environmental performance requirements faces obstacles such as the need for dedicated software, staff training, or third-party experts. Various scholars (Buyle et al., 2013) have highlighted that Municipal officials should be familiar with life cycle assessment (LCA) procedures for setting and monitoring environmental performance criteria. Although technical knowledge is available, connecting it with qualitative studies is necessary to understand how critical environmental decisions are made in the construction industry. (Dulaimi et al., 2003) improving current practices related to environmental requirements is crucial to effectively limit the climate change impact of buildings. Strong stakeholder engagement and collaboration among homeowners, SMEs, larger construction firms, local authorities, and policymakers are essential for successful implementation. In accordance with (Rogers, 1995) the policy environment significantly influences SMEs' preparedness for climate adaptation-related renovation services. Moreover, (Hwang and Ng, 2013) indicates that establishing communication channels, sharing knowledge, and creating synergies among stakeholders are important for enhancing the overall preparedness of the construction industry. The research also indicates that investigating stakeholder dynamics and exploring potential incentives and guidelines can facilitate the adoption of climate adaptation-related renovation services by construction SMEs.

**Sustainable Project Management in Construction:** Sustainable project management plays a vital role in the construction industry, with project managers serving as key players in the success of sustainable projects. Effective project planning and controlling, as well as stakeholder collaboration, are crucial for achieving sustainability goals in construction projects (Hwang and Ng, 2013). Project managers should emphasize sustainable practices and ensure efficient coordination among stakeholders to achieve positive outcomes.
3. Methodology

The current study methodologically follows a qualitative research approach, to explore the preparedness of construction SMEs for climate adaptation-related renovation services in the Kronoberg region, employing different methods to answer the research questions comprehensively. In addition, this study employed different approaches to analyze data and answer the research questions. Regarding the literature review, a descriptive approach has been employed, using a scoping literature review method. In relation to the interviews, an exploratory approach has been followed. Those methods are described comprehensively in the sub-sections to follow.

3.1. Scoping literature review

The scoping literature review is a comprehensive method used to map the existing knowledge and research landscape on a specific topic or research question (Harris, 2020). The scoping literature review approach is employed when the objective of the research is to provide an overview and understanding of the available evidence on a particular topic. Unlike systematic reviews, which aim to synthesize and assess the quality of a subset of studies, scoping reviews focus on mapping the breadth of existing literature without necessarily evaluating the individual study quality. This approach is especially valuable in emerging research areas where the body of literature may be vast and diverse (Harris, 2020).

The scoping review offers several benefits. Firstly, it allows researchers to identify the range of research questions, methodologies, and theoretical frameworks employed in the field. This information helps in understanding the different perspectives and approaches taken by researchers. Secondly, scoping reviews can reveal existing gaps and areas where research is lacking, which can guide future investigations and inform the formulation of research objectives. Additionally, scoping reviews can assist in identifying potential biases or discrepancies within the literature, highlighting areas for further exploration or investigation (Harris, 2020)
The literature review in this study was delivered following a series of steps that allowed the author to identify, select, and analyze relevant studies in a rigorous manner. The process of this literature review involved the following steps, as proposed by (Ballard and Montgomery, 2017).

**Identification of relevant studies:** A comprehensive search strategy was developed to identify relevant studies. Detailed searches were run in platforms like Scopus, ScienceDirect, and Google Scholar, as well as searches for gray literature sources (studies by government agencies, non-profit organizations, research institutions, and other entities), and conference proceedings. The focus of this comprehensive search was on keywords (construction sector, buildings, SMEs, climate change, Kronoberg region), study aims (to evaluate the readiness and challenges of construction SMEs in Kronoberg region, in providing climate adaptation-related renovation services, with a focus on enhancing their capacity for sustainable and resilient practices), and results relevant to the scope of this study. A set of inclusion and exclusion criteria have been established to guide the final selection of studies.

**Inclusion and exclusion criteria:** The study was limited to academic publications (articles, review studies, theses and dissertations, reports from research institutes, and conference papers). Such studies could provide relevant information from the international perspective. There was no time limitation for the selection of studies. Additionally, book chapters, website information and studies conducted by government organizations, non-profit organizations, white papers etc., were excluded. Furthermore, studies conducted in a language other than English were excluded.

**Screening and selecting studies:** The studies that were identified underwent a thorough screening process, which involved evaluating their titles, abstracts, and full texts according to pre-established inclusion and exclusion criteria. This meticulous approach was implemented to ensure that only studies directly relevant to the research question were included in the review.
Data extraction and analysis: Relevant data from selected studies was extracted and organized to identify key concepts, themes, or patterns. Data extraction involved the use of standardized frameworks (to evaluate readiness & challenges of Kronoberg's construction SMEs in providing climate adaptation-related renovation services, facilitating their transition to a sustainable & resilient future for a greener built environment) to ensure consistency. The collected data was then analyzed and synthesized to generate an overview of the literature.

Reporting the results: Finally, the scoping literature review findings have been reported in the literature chapter in a structured manner, providing an overview of the state of knowledge, identifying gaps.

3.2. Semi-structured interviews

Thematic analysis will be employed to analyze the qualitative data collected from the semi-structured interviews (Cohen and Crabtree, 2006). This method will help to develop a comprehensive understanding of the practices, challenges, and opportunities related to climate adaptation and sustainability within the construction industry in the Koronoberg region.

In qualitative research, interviews play a crucial role in gathering in-depth insights and understanding the experiences, perspectives, and opinions of participants (Merriam, S.B. and Grenier, R.S., 2019). Semi-structured interviews, in particular, offer a flexible and adaptable approach to data collection, enabling researchers to explore a specific research topic while allowing for spontaneity and open-ended discussions (Agarwal, 2019). Semi-structured interviews are characterized by a predefined set of open-ended questions or topics, which provide a loose structure for the interview while allowing participants to expand on their responses (Agarwal, 2019). Unlike structured interviews that follow a rigid format with fixed questions, semi-structured interviews offer flexibility and the opportunity for participants to share their unique perspectives, experiences, and narratives (Agarwal, 2019).
The main objective of these interviews is to obtain comprehensive information and insights into how small and medium-sized enterprises (SMEs) in the construction sector manage international business, their current strategies concerning climate adaptation and sustainability, and their readiness to embrace innovative practices for climate adaptation. The semi-structured format of these interviews enables a degree of flexibility, where only a general outline is established beforehand, and questions do not need to be asked in any sequence. This approach grants the interviewee considerable freedom in providing responses and allows the interviewer to pose follow-up questions as they arise during the conversation (Bryman, 2016).

In this study, a total of 5 of semi-structured interviews were conducted with small- and medium-sized construction companies in Kronoberg region in Sweden. The interviews were conducted during the period (March 2023 – August 2023). Prior to the interviews, the key questions will be formulated, but the specific questions will not be shared with the interviewees in advance. Instead, a summary of the topics to be discussed during the interview will be provided. Careful consideration was given to sampling strategies to ensure the selection of participants who can provide diverse perspectives relevant to the research question. The semi-structured interview format is advantageous, especially when the interviewer has just one opportunity to conduct the interview. These questions will be designed with open-ended responses in mind, giving the interviewees the chance to engage in an in-depth discussion about their answers. A purposive sampling technique will be employed to select companies that have experience or interest in climate adaptation-related renovation services. The sample size will be determined by the saturation point, where no new insights or themes emerge from the data collection.
The selection of companies for interviews in this study is based on several key factors to ensure a comprehensive and relevant analysis. First, the chosen companies were directly involved in climate adaptation-related renovations in the Kronoberg region, ensuring their relevance to the research topic. Additionally, a diverse representation of companies was considered, including varying sizes, specialties, experiences, and approaches, to capture a comprehensive view of preparedness in the construction SME sector. The expertise and innovative practices of these companies were also considered, as they could provide valuable insights and lessons for the industry. Availability and cooperation were important factors, ensuring the willingness of the companies to participate and share their experiences. Finally, geographic considerations were taken into account, focusing on companies operating within or having significant projects in the Kronoberg region. By considering these factors, the selection was aimed to gather insights from relevant stakeholders, providing a comprehensive understanding of climate adaptation preparedness among construction SMEs in the Kronoberg region of Sweden.

The recruitment of interviewees was conducted with utmost ethical consideration, emphasizing voluntary participation and informed consent. Whenever feasible, interviews were recorded to enable later transcription. In instances where recording was not permitted, comprehensive notes were taken throughout the interviews.

Analysing data from semi-structured interviews requires a systematic and rigorous approach (Galletta, A., 2013). The process of analysing the data from the semi-structured interviews involved the following steps:

**Transcription:** The first step was to transcribe the interview recordings (for recorder interviews) into written text. Transcription involves accurately converting the spoken words of the participants into written form. This was done manually.
**Familiarization**: The author read and re-read the interview transcripts to become familiar with the content and gain an overall understanding of the data. This step helped the author to immerse herself in the participants' narratives, capturing the context, nuances, and themes that emerged.

**Coding**: This step involved systematically labelling and categorizing segments of data with descriptive codes. The codes used for this study were readiness assessment, challenges identification, climate adaptation-related renovation services, SMEs preparedness evaluation, sustainable and resilient future, strategies for transition, legal considerations, recommendations for high-quality renovation services, environmental and sustainability targets, sustainable built environment in Kronoberg region. The codes were both deductive (predefined based on the research objectives) and inductive (emerging from the data itself). This process helped towards identifying patterns, themes, and key concepts within the data.

**Theme Development**: Once the coding process was complete, the author identified recurring patterns and themes by grouping related codes together. Themes are overarching ideas or concepts that capture the essence of the participants' responses. The themes in this study were Strategies for climate adaptation, awareness of climate adaptation needs, Challenges in implementing climate adaptation renovations, impact on performance and growth, resources for improving climate adaptation capabilities, stakeholder collaboration for sustainable practices, role of innovation and technology, and contribution to a sustainable future. The author ensured that the themes were grounded in the data and supported by rich examples.

**Data Exploration**: The author delved deeper into the identified themes, exploring connections, relationships, and variations within and across themes. This exploration involved examining the data for similarities, differences, and associations, which could lead to the discovery of sub-themes or new insights. For that purpose, the analytical technique of constant comparison was utilized, to compare and contrast data across participants and interviews.
**Interpretation and Analysis:** This phase of the analysis involved interpreting the themes and making sense of the data in relation to the research objectives or questions. The author, critically examined the data, considered different perspectives, and developed explanations or theoretical frameworks to explain the findings. The identified themes were related back to existing literature.

**Triangulation:** To enhance the credibility and reliability of the findings, triangulation was employed by cross-referencing with participant observations, and seeking input from the thesis supervisor. Triangulation of data sources, such as interviews, company information, and existing literature, will be used to enhance the credibility of the research findings.

**Reporting:** The final step was to report the findings of the data analysis. This involved organizing the results in a coherent and structured manner, using quotes and/or excerpts from the interviews to support the themes and findings. The results of the analysis are presented in a clear and concise way in a following chapter.

### 3.3. Ethical Considerations

Ethical aspects in research are very crucial in general since the outcome of the research does impact society in one way or another. This study is being conducted keeping sustainable development and the environment into consideration. National and international regulations on ethics and safety while conducting research as suggested in National Committee for Research Ethics in Science and Technology (NENT, 2008) will be followed. This research is fully aware of the obligations of a researcher towards the protection of research subjects, obligation to respect human dignity, obligation to respect individuals' privacy, therefore the specific participants’ names in the semi-structured interviews and other information will be kept anonymous while conducting the analyses of the data.
4. Observational Findings

Semi-structured interviews were conducted with five construction SMEs at various companies in the Kronoberg region. The interviews followed a well-prepared framework and questionnaires that were shared with the companies in advance via email. This approach allowed the supervisors and representatives of these companies’ ample time to familiarize themselves with the questions and prepare for the interviews. During the interview’s, detailed notes were taken to record the responses, ensuring accuracy, and facilitating later transcription. This method of data collection enabled a comprehensive exploration of the companies’ perspectives, insights, and experiences regarding climate adaptation-related renovation services.

In interviews with knowledgeable industry experts from various organizations in Kronoberg, Sweden, the preparedness of construction SMEs for climate-adaptation related renovation services was a central topic. Experts emphasized key strategies, such as the use of wooden materials and energy-efficient construction solutions, to address climate adaptation in renovations. They highlighted research findings supporting the benefits of wooden buildings with lower carbon balance and reduced energy consumption compared to traditional materials. However, challenges were noted, including the need for further research, pilot projects, prioritizing Life Cycle Assessments, and tools to calculate life cycle costs for wooden buildings. Experts saw these challenges as opportunities for long-term growth and improved sustainability through research, collaboration, and innovation. Stakeholder collaboration was stressed as vital in supporting sustainable practices and knowledge sharing.

Another important aspect discussed was the significance of digitalization in the construction sector, enabling new ways of working, services, and markets. Minimizing waste and transitioning towards circular resource usage were highlighted to reduce carbon emissions. Kronoberg construction companies exhibited increasing awareness of climate adaptation needs, actively participating in carbon-neutral and competitive initiatives. However,
challenges remained, such as the need for long-term regulations and access to bio-based raw materials. Despite these challenges, experts saw opportunities for innovation, new business models, and enhanced competitiveness by addressing climate adaptation needs. Stakeholder collaboration and innovation played key roles in effective climate adaptation renovations.

Energy-efficient buildings, particularly passive buildings, were also discussed as significant strategies for climate adaptation in renovations. Regional programs were credited for raising awareness among Kronoberg construction companies. Challenges included securing funding resources, meeting passive building targets, and increasing players in the energy-efficient buildings market. Overcoming these challenges presented opportunities for growth and specialization in the industry. Stakeholder collaboration, innovation, and technology were emphasized as critical factors in effective climate adaptation renovations, with advancements in construction techniques, materials, and renewable energy integration contributing to sustainability.

Moreover, the adoption of wood as a sustainable construction material and setting targets for wood-based projects were highlighted. Collaboration with research institutions played a crucial role in enhancing climate adaptation capabilities. Awareness among Kronoberg construction companies varied, presenting implementation challenges. Access to resources, including research projects and funding opportunities, was considered crucial for promoting performance and growth in the industry. Stakeholder collaboration and innovation were seen as essential for effective climate adaptation renovations.

Lastly, discussions touched upon environmental performance requirements in construction. Efforts were often limited to prescribing technical solutions rather than assessing environmental performance. Overcoming barriers involved setting appropriate targets, securing resources, and establishing dialogue with developers and Constructors. The use of bio-based products with lower environmental impact was emphasized in climate adaptation renovations. Limited awareness among Kronoberg construction companies
regarding climate adaptation needs was seen as a challenge, necessitating knowledge dissemination. Resource limitations, high initial costs, and the lack of standardized guidelines for conducting life cycle assessments on renovation projects were challenges faced by companies. Stakeholder collaboration and innovation were seen as crucial in effective climate adaptation renovations, with the adoption of eco-friendly practices and energy efficiency contributing to a more sustainable built environment.

In parallel, the perspective of homeowners regarding building renovations for climate adaptation was explored. Homeowners in Kronoberg displayed increasing awareness of the importance of climate adaptation measures. Many now prioritize eco-friendly materials and energy-efficient solutions during their renovation projects. Homeowners seek measures to enhance their homes' resilience to extreme weather events, such as reinforcing structures and incorporating rainwater harvesting systems. Long-term cost savings and occupants' well-being are essential considerations, driving homeowners to invest in sustainable renovations that improve energy efficiency and overall comfort. However, challenges, including financial constraints and lack of information, need to be addressed to encourage broader adoption of climate-adaptive measures among homeowners. Overall, homeowners' growing awareness and engagement can play a significant role in promoting a more sustainable and climate-resilient built environment.
5. Results and Analysis

The Swedish national climate adaptation strategy (Govt. Bill 2017/18:163) aims to improve municipalities’ preparedness for climate change to mitigate or adapt the climate-related risks to the built environment, e.g., flooding, landslides, and erosion, and on how such risks can be reduced or eliminated. Furthermore, according to Sweden's long-term strategy for reduction of GHG emissions (Government Offices of Sweden, 2020), it is a stated goal “firstly, to establish a building inventory that excels in energy efficiency, completely eliminating the reliance on fossil fuels by 2050 at the latest and secondly, to simplify and make affordable the process of transforming current buildings into nearly self-sufficient, ultra-energy-efficient structures”, a goal that becomes relevant in the effort to mitigate the catastrophic effects of climate change.

This study is highly relevant, as it aims to analyze the preparedness of companies offering renovations services to detached houses in Sweden to offer renovations services with climate adaptation thinking. Such renovations are closely related to mitigation of the harmful consequences of climate change, and to the pathway towards the creation of an energy efficient building stock in Sweden. Understanding how these companies perceive climate adaptation and how they include it in the services they offer might be useful for the formulation of effective strategies on a municipal and regional level towards preventing potential catastrophic future events caused by climate change related events.

5.1. Qualitative Findings: Thematic Analysis of Interviews

The interviews with knowledgeable industry experts from various organizations in Kronoberg, Sweden, provided valuable insights into the preparedness of construction SMEs for climate-adaptation related renovation services. The discussions highlighted key strategies and challenges faced by the construction industry in addressing climate adaptation needs.
### Table 1: Summary of interviews

<table>
<thead>
<tr>
<th>Interviews</th>
<th>Key points</th>
</tr>
</thead>
</table>
| **Organization A** | - Utilization of wooden materials and energy-efficient construction solutions.  
- Lower carbon balance and energy consumption.  
- Need for research, pilot projects, and tools to calculate cost.  
- Growth, improved sustainability, research, collaboration, innovation, technology.  
- Embracing wooden materials, LCA, and research |
| **Organization B** | - Digitalization, circular resource usage.  
- Increasing awareness between Kronoberg construction companies  
- Long-term regulation, access to bio-based raw materials.  
- Collaborative efforts, sustainability focused-initiatives, innovation, technology. |
| **Organization C** | - Energy-efficient buildings, passive buildings  
- Increased awareness between Kronoberg construction companies  
- Funding resources, target percentage for passive buildings.  
- Collaboration with project owners, participation in regional programs.  
- Energy, efficient practices, climate strategies. |
| **Organization D** | - Alignment with X municipality’s approach, promoting wood as a sustainable construction material.  
- Varying awareness between Kronoberg construction companies.  
- Stakeholder collaboration, innovation, technology.  
- Supporting sustainable practices, effective climate-adaptation renovation. |
| **Organization E** | - Bio-based products, Life cycle assessments  
- Environmental performance requirements, limited knowledge resources.  
- Proposed strategy: appropriate targets, securing resources. |
One of the primary strategies emphasized by experts was the use of wooden materials and energy-efficient construction solutions in climate adaptation renovations. The experts cited research findings supporting the advantages of wooden buildings, including lower carbon balance and reduced energy consumption compared to traditional materials. This indicates that construction companies are actively exploring eco-friendly alternatives to enhance the sustainability of their projects. However, the interviews also revealed several challenges hindering climate-adaptive renovations, particularly in relation to wooden buildings. These challenges include the need for further research, pilot projects, and tools to accurately calculate life cycle costs. The experts recognized these challenges as opportunities for long-term growth and improved sustainability, suggesting that addressing them through research, collaboration, and innovation can drive progress in the industry.

Stakeholder collaboration emerged as a vital aspect in supporting sustainable practices and knowledge sharing. The experts stressed the importance of involving various stakeholders to promote effective climate adaptation renovations and facilitate the dissemination of sustainable practices. Another crucial aspect discussed was the significance of digitalization in the construction sector. The experts highlighted how digitalization enables new ways of working, services, and markets, leading to reduced waste and a transition towards circular resource usage to mitigate carbon emissions. The increasing awareness among Kronoberg construction companies regarding climate adaptation needs and their active participation in carbon-neutral initiatives demonstrate the industry's commitment to sustainability. Despite these positive developments, the interviews also identified challenges that the construction sector faces in its pursuit of climate adaptation. These challenges

| - Addressing limited awareness among construction companies regarding climate-adaptation needs.  
- Implementing climate-adaptation strategies, promoting sustainable practices. |

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include the need for long-term regulations and access to bio-based raw materials. However, the experts recognized these challenges as opportunities for innovation, new business models, and enhanced competitiveness by addressing climate adaptation needs. The discussions also highlighted the significance of energy-efficient buildings, particularly passive buildings, as a significant strategy for climate adaptation in renovations. The role of regional programs in raising awareness among Kronoberg construction companies regarding climate adaptation needs was acknowledged. The challenges of securing funding resources, meeting passive building targets, and increasing participation in the energy-efficient buildings market presented opportunities for growth and specialization in the industry. In addition, the interviews emphasized the importance of collaboration with research institutions to enhance climate adaptation capabilities. However, varying levels of awareness among Kronoberg construction companies presented implementation challenges. Access to resources, including research projects and funding opportunities, was considered crucial for promoting performance and growth in the industry. Stakeholder collaboration and innovation were seen as essential factors for effective climate adaptation renovations. Discussions also touched upon environmental performance requirements in construction. Efforts were often limited to prescribing technical solutions rather than assessing environmental performance. Overcoming barriers involved setting appropriate targets, securing resources, and establishing dialogue with developers and constructors. The use of bio-based products with lower environmental impact was highlighted as a significant aspect of climate adaptation renovations. The perspective of homeowners regarding building renovations for climate adaptation was also explored. Homeowners in Kronoberg displayed increasing awareness of the importance of climate adaptation measures, prioritizing eco-friendly materials and energy-efficient solutions. They seek measures to enhance their homes' resilience to extreme weather events and invest in sustainable renovations to improve energy efficiency and overall comfort. However, challenges, including financial
constraints and lack of information, need to be addressed to encourage broader adoption of climate-adaptive measures among homeowners.

Overall, the interviews provided comprehensive insights into the construction industry's growing awareness and engagement in climate-adaptive renovations. The emphasis on eco-friendly materials, energy efficiency, stakeholder collaboration, and innovation reflect the industry's commitment to promoting a more sustainable and climate-resilient built environment. Addressing the identified challenges and fostering stakeholder collaboration will be crucial in driving meaningful progress in climate adaptation efforts for construction SMEs in Kronoberg, Sweden. Additionally, homeowners' increasing awareness and engagement present opportunities for further sustainability initiatives and resilience in the region’s-built environment.

*Table 2: Summarized key findings.*

<table>
<thead>
<tr>
<th>Key points</th>
<th>Implications and Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Emphasis on wooden materials and energy efficiency</td>
<td>- Advantages of wooden buildings: lower-carbon balance, reduced energy consumption</td>
</tr>
<tr>
<td><strong>Challenges and Opportunities</strong></td>
<td><strong>Strategies for growth and sustainability</strong></td>
</tr>
<tr>
<td>- Need for further research and tools</td>
<td>- Opportunities for long-term growth and sustainability</td>
</tr>
<tr>
<td>- Stakeholder collaboration vital for support</td>
<td>- Research, collaboration, and innovation can address challenges</td>
</tr>
<tr>
<td><strong>Significance and Digitalization in construction</strong></td>
<td><strong>Increasing awareness of Climate-adaptation needs</strong></td>
</tr>
<tr>
<td>- Enables new ways of working and services</td>
<td>- Koronoberg construction companies actively participate in initiatives</td>
</tr>
<tr>
<td>- Transition towards circular resources usage</td>
<td>- Commitment to minimize waste and reduce carbon emissions</td>
</tr>
<tr>
<td><strong>Challenges and innovation in energy-efficient buildings</strong></td>
<td><strong>Collaboration with research institutions</strong></td>
</tr>
<tr>
<td>Challenges in securing funding and meeting targets</td>
<td>Collaborating with research institutions enhances capabilities</td>
</tr>
<tr>
<td>- Opportunities for growth and specialization</td>
<td>- Access to resources and funding crucial for industry performance</td>
</tr>
<tr>
<td><strong>Focus on environmental performance requirements</strong></td>
<td><strong>Homeowner’s perspective</strong></td>
</tr>
<tr>
<td>- Overcoming barriers via setting targets</td>
<td>- Homeowner’s prioritize eco-friendly materials and efficiency</td>
</tr>
<tr>
<td>- Emphasis on bio-based products for sustainability</td>
<td>- Investments in resilience and comfort drive sustainable renovations</td>
</tr>
<tr>
<td></td>
<td>- Addressing financial constraints and information gaps is essential.</td>
</tr>
</tbody>
</table>

### 5.2. Outcomes

The interviews with industry experts from various organizations in Kronoberg, Sweden, yielded valuable insights into the preparedness of construction SMEs for climate-adaptation related renovation services. The outcomes highlight several key points that have significant implications for the construction industry and homeowners in the region.

**Emphasis on Sustainable Practices:** The experts' emphasis on using wooden materials and energy-efficient solutions in climate adaptation renovations reflects a growing trend towards eco-friendly and sustainable construction practices. This focus on sustainable materials and technologies can lead to reduced carbon emissions and energy consumption in the built environment, contributing to broader climate adaptation efforts.

**Challenges as Opportunities for Growth:** The challenges identified, such as the need for further research, pilot projects, and tools for calculating life cycle costs, present opportunities for long-term growth and improved sustainability. By addressing these challenges through research, collaboration, and innovation, construction SMEs can enhance their climate adaptation capabilities and become leaders in the industry.
Stakeholder Collaboration and Knowledge Sharing: The experts stressed the importance of stakeholder collaboration in supporting sustainable practices and knowledge sharing. This finding highlights the significance of partnerships between industry players, government entities, research institutions, and homeowners in driving effective climate adaptation renovations.

Digitalization for Enhanced Efficiency: The significance of digitalization in enabling new ways of working, services, and markets indicates the industry's commitment to enhancing efficiency and reducing waste. Digitally-driven practices can streamline construction processes, optimize resource usage, and contribute to overall sustainability goals.

Increasing Awareness Among Construction Companies: The rising awareness of climate adaptation needs among Kronoberg construction companies and their active participation in carbon-neutral initiatives indicate a positive shift towards sustainability in the industry. This growing awareness lays the foundation for further progress in climate-adaptive renovations.

Opportunities for Innovation and Competitiveness: Overcoming challenges related to long-term regulations and access to bio-based raw materials can lead to innovation, new business models, and enhanced competitiveness. The construction industry can position itself as a frontrunner in sustainability by addressing climate adaptation needs.

Energy-Efficient Buildings for Resilience: The recognition of energy-efficient buildings, particularly passive buildings, as significant strategies for climate adaptation underscores the importance of resilience in the face of climate change. Regional programs and initiatives are essential in raising awareness and encouraging energy-efficient practices.

Collaboration with Research Institutions: The collaboration with research institutions to enhance climate adaptation capabilities emphasizes the value of
knowledge exchange and expertise sharing. Such partnerships can result in more informed and sustainable renovation practices.

**Homeowners' Growing Awareness and Engagement:** The increased awareness among homeowners regarding the importance of climate adaptation measures and their prioritization of eco-friendly materials and energy-efficient solutions signify a shift towards more environmentally conscious renovation choices.

**Addressing Challenges for Broader Adoption:** The identification of challenges faced by homeowners, such as financial constraints and lack of information, highlights the need for targeted initiatives and supportive policies to encourage broader adoption of climate-adaptive measures among homeowners.

In conclusion, the outcomes of the results and analysis underscore the industry's commitment to sustainability, resilience, and innovation in climate-adaptive renovation services. The focus on eco-friendly materials, stakeholder collaboration, digitalization, and energy efficiency signify a positive direction towards a more sustainable and climate-resilient built environment in Kronoberg, Sweden. Addressing challenges and embracing opportunities can lead to further progress in the region's efforts to combat climate change and promote long-term environmental sustainability.

6. **Discussion**

The discussions conducted with various construction SMEs in the Kronoberg region of Sweden provide valuable insights into their strategies, awareness, challenges, resources, stakeholder collaboration, innovation, and technology related to climate adaptation in renovations.
6.1. Interpretation of Findings

The interviews conducted with construction SMEs in the Kronoberg region shed light on several important aspects related to climate adaptation in renovations. The findings reveal that there is a growing awareness among these companies regarding the need for climate adaptation in the construction sector. Strategies employed by the organizations include the use of digitalization, circular resource usage, energy-efficient solutions, and the promotion of sustainable materials such as wood and bio-based products.

However, challenges such as the lack of long-term regulations, limited access to resources, tools for calculating life cycle costs, and the absence of standardized guidelines for conducting Life Cycle Assessments (LCAs) on renovation projects hinder the implementation of climate adaptation measures. Despite these challenges, the interviews highlight the potential for innovation, collaboration, and stakeholder engagement to address climate adaptation needs. Furthermore, the findings emphasize the role of technology in enabling more efficient construction practices and the importance of stakeholder collaboration in supporting sustainable practices and climate-resilient future in adaptation renovations.

6.2. Implications for Construction SMEs

The findings have several implications for construction SMEs operating in the Kronoberg region:

**Awareness and Education:** The increasing awareness among construction SMEs regarding climate adaptation needs indicates the importance of continued education and knowledge dissemination. Companies should actively engage in training programs and workshops to enhance their understanding of sustainable practices and climate-related challenges.

**Adoption of Sustainable Strategies:** The strategies employed by organizations, such as the use of energy-efficient solutions and sustainable...
materials, can serve as best practices for other construction SMEs. Implementing these strategies can contribute to reducing carbon emissions, improving energy efficiency, and enhancing overall sustainability.

**Overcoming Challenges:** Construction SMEs need to address the challenges faced during the implementation of climate adaptation renovations. This includes advocating for long-term regulations, exploring alternative resource options, and collaborating with research institutions and industry associations to develop standardized guidelines for conducting LCAs on renovation projects.

**Collaboration and Stakeholder Engagement:** The findings highlight the importance of stakeholder collaboration in supporting sustainable practices. Construction SMEs should actively engage with government entities, research institutions, suppliers, and clients to foster knowledge sharing, innovation, and collective efforts towards sustainability.

**Embracing Innovation and Technology:** The role of innovation and technology in effective climate adaptation renovations cannot be overlooked. Construction SMEs should explore opportunities to adopt advanced building materials, energy-efficient technologies, and digitalization to enhance their resilience, reduce carbon emissions, and improve overall performance.

**Proactive Approach:** The interpretation of the findings highlights the construction industry's proactive approach towards sustainability and climate adaptation. Construction SMEs are willing to address challenges, invest in research, foster collaboration, and adopt innovative practices to contribute to a greener future.

Overall, the findings suggest that construction SMEs in the Kronoberg region have the potential to contribute to a sustainable future through adaptation renovations. By raising awareness, adopting sustainable strategies, overcoming challenges, collaborating with stakeholders, and embracing
innovation, these SMEs can play a vital role in driving positive change in the construction sector and mitigating the environmental impact of buildings.

7. Conclusion

The interviews with industry experts in the Kronoberg region have provided valuable insights into the preparedness of construction SMEs for climate-adaptation related renovation services. The findings emphasize the growing awareness among construction companies regarding the significance of climate adaptation in the industry. Experts have identified key strategies, such as using wooden materials and energy-efficient solutions, to enhance the sustainability of projects. Research supporting the benefits of wooden buildings, along with the recognition of challenges as opportunities for long-term growth through research and innovation, highlights the industry's commitment to eco-friendly alternatives. Stakeholder collaboration is crucial in promoting effective climate adaptation renovations and disseminating sustainable practices, while digitalization offers new ways of working and circular resource usage to reduce carbon emissions. Despite challenges in securing funding and meeting passive building targets, experts acknowledge the potential for innovation and competitiveness by addressing climate adaptation needs. The interviews also highlight the importance of collaboration with research institutions and the increasing awareness of climate adaptation needs among homeowners, presenting further opportunities for sustainability initiatives in the region’s-built environment. In conclusion, construction SMEs in Kronoberg have demonstrated a commitment to sustainable practices and climate adaptation. The industry's focus on eco-friendly materials, energy efficiency, and stakeholder collaboration reflects a dedication to a more sustainable and resilient built environment. By addressing the identified challenges and fostering collaboration, construction SMEs can drive meaningful progress in climate adaptation efforts. Prioritizing climate adaptation, knowledge sharing, and participation in collaborative initiatives
with various stakeholders will pave the way for a greener future in the construction sector in Kronoberg and beyond.

8. Aspects of Sustainable Development

This study has the potential of becoming instrumental in meeting a variety of Sustainable Development Goals (SDGs). The study aims to identify the preparedness of companies active in the delivery of renovation services regarding renovation of detached houses with climate adaptation thinking. Renovated houses in general, with improved structural characteristics and improved indoor environment, leading to better health and well-being for their occupants, which are associated with SDG 3. Through energy renovation, energy efficiency and the use of renewable energy technologies in buildings is promoted, factors associated with SDG 7. Moreover, the whole study is related to act towards lowering GHG emissions and energy consumption, and thus stopping global warming and mitigate climate change, which are related to SDG 13 (The sustainable development goals report 2016, n.d.)

![Fig 3: The World Green Building Council's vision for sustainable development goal (World Green Building Council, 2016)](image_url)
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