



MARKET STUDY
**SUSTAINABLE BUILDING OPPORTUNITIES IN SWEDEN
AND DENMARK**

January 2021
FOG Innovation
For the Embassies of the Kingdom of the Netherlands in
Sweden and Denmark

FOG



Kingdom of the Netherlands

Executive Summary

Sustainability is fast becoming an important topic in the construction sector, fuelled by societal challenges, ambitious targets to combat climate change and increasing client demand. The sector has a large responsibility due to high emissions and resource use during the construction phase and especially during the long lifetime of a building. Denmark and Sweden are, along with the Netherlands, seen as pioneers when it comes to sustainability and sustainable construction.

In the light of the increasing focus on sustainable buildings in Denmark and Sweden, the Regional Business Development Team of the Embassies of the Kingdom of the Netherlands in Sweden and Denmark has the ambition to connect the Scandinavian construction industry with the Dutch market. This ambition is being further developed in partnership with FME and Innovation Quarter in the Netherlands. This market study forms one of its ingredients, aiming to identify tactical opportunities for increased collaboration between Denmark, Sweden and the Netherlands. It is to be used as market intelligence for the business community in the Netherlands as well as for further strategy development.

This market study shows that there are many interesting opportunities for collaboration between the Netherlands and Denmark and Sweden when it comes to sustainable buildings. These are especially connected to the topics of:

- circular and climate neutral buildings, specifically in the areas of reuse, material choices and construction with wood,
- renewable energy systems, specifically in the areas of electricity generation and smart grids and energy saving in renovation,
- well-being in buildings, specifically in the areas of future use of buildings and measuring well-being and
- digitalisation for sustainability, specifically in the areas of digitalisation of the construction process and digitalisation of buildings.

There are large similarities in the opportunities between Denmark and Sweden. However, in Denmark there is more focus on measuring indoor wellbeing with new targets for the construction sector that are being developed and currently more direct opportunities within energy renovation with large investments from the government launched in 2020. In Sweden there is a larger focus on construction with wood and a need for higher productivity: covering the need for many new residential and public buildings at lower costs.

Top business opportunities identified within these areas are:

- solutions for digital marketplaces for reused materials, including the broad implementation thereof,
- technology and processes that efficiently identify and extract materials and products in deconstruction,
- solutions for implementing material banks, material passports and demolition plans,
- innovative and accessible electricity generation and smart grid products and services,
- products and services for energy saving in renovation, and
- technologies and knowledge around industrialisation of the renovation process (standardisation and automation).

Top opportunities for further collaboration identified for this study are:

- how to put circular construction, in a broader sense, in practice,
- renovations with a holistic perspective: that save energy, are well executed and use non-toxic materials with a sustainable financial model,
- knowledge on industrialisation (standardisation and putting production to scale successful elements and products), especially connected to building with wood and energy saving in renovation,
- development of the concept of user centred design and the future role of buildings, and
- experiences in successful implementation of digital tools for sustainability.

These business and collaboration opportunities show that the Netherlands, Denmark and Sweden can use their common ambitions to pioneer and innovate in order to accelerate the transition to sustainable buildings even further. They can do this by learning from each other, collaborate on new developments as well as engage in more trade of products and services within sustainable buildings.

Content

Introduction	4
Scope of the Market Study.....	4
Background – Sustainability and the Built Environment	5
Comparing the Netherlands to Denmark and Sweden	7
Denmark and Sustainable Buildings.....	10
Sweden and Sustainable Buildings.....	13
Market Deep Dives.....	16
EFFICIENT RESOURCE USE AND ZERO EMISSIONS	17
REUSE.....	17
MATERIAL CHOICES AND LIFE CYCLE THINKING.....	18
CONSTRUCTION WITH WOOD.....	19
BUILDINGS WITH 100 % CLEAN ENERGY	20
RENEWABLE ELECTRICITY GENERATION AND SMART GRIDS.....	21
ENERGY SAVING IN RENOVATION	22
BUILDINGS ARE SPACES FOR LIVING, WORKING AND LEARNING	24
FUTURE USE OF BUILDINGS.....	24
MEASURING WELL-BEING	24
DIGITAL TOOLS TO ACCELERATE THE TRANSITION	25
DIGITALISATION OF THE CONSTRUCTION PROCESS	25
DIGITALISATION OF BUILDINGS.....	25
Conclusion and Next Steps.....	26
Appendix 1: Methodology	28
Appendix 2: Sources	30

Introduction

Historically, there have been strong relations between the Netherlands and the Nordics. The trade relations between Denmark and the Netherlands go back as far as 1521 when the King of Denmark invited Dutch farmers to supply vegetables to the Palace of Copenhagen. Sweden and the Netherlands have also traded since the middle ages. These trade relations have influenced the Nordic countries over the centuries. This can be seen in for instance the architecture of parts of cities such as Copenhagen, Stockholm and Gothenburg.

Today, the three countries still have strong trade ties. All three countries are also seen as sustainability and innovation pioneers; they all act as important drivers of the sustainability agenda in the European Union (EU) and have high ambitions to cut greenhouse gas emissions and move towards a renewable and circular economy.

In the light of the increasing focus on the construction sector's important role to meet these ambitions and a wave of new solutions, innovations and companies in the last few years, the Regional Business Development (RBD) Team of the Embassies of the Kingdom of the Netherlands in Sweden and Denmark has identified sustainable building in the construction sector as an interesting market for collaboration between the Nordics and the Netherlands. The RBD Team has therefore formed the ambition to connect the Scandinavian construction industry with the Dutch market. In order to do this, there is a need for additional market intelligence from Denmark and Sweden. This market study is one of the ingredients for this and will be used for further strategy development and market intelligence for the business community in the Netherlands.

Scope of the Market Study

The scope of this market study is to identify tactical opportunities for the Dutch government and Dutch SMEs to export to, invest in and collaborate with companies in the Danish and Swedish sustainable building sector. This by identifying the trends and challenges these markets will face in the next 5 years and in what way collaboration with Dutch partners is most relevant.

The main questions that are answered throughout this report are:

- What are the starting points, e.g. market size, legislation and current trends in the sustainable building sector in Denmark and Sweden?
- What topics in the building sector will be important for the development of sustainability in these two countries the coming 5 years? What are the main challenges within these topics and how could international partners play a part?
- What is good to keep in mind when entering these markets?
- What are the opportunities to set up or intensify cooperation between the countries in (parts of) specific value chains?

The market study focuses on people-oriented buildings, investigates all parts of the building life cycle and different sustainability-topics as well as the impact of digitalisation for sustainability (see Figure 1). The methodology used in the market study and further information can be found in the appendix.

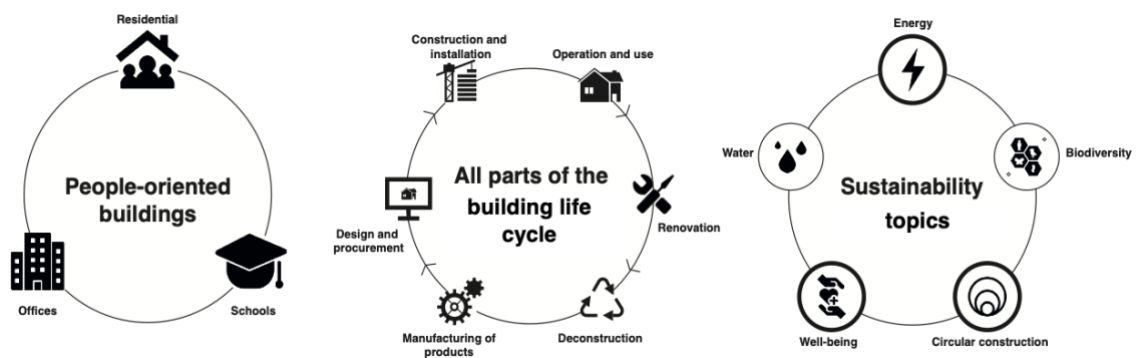


Figure 1. Topics included in the study

Background – Sustainability and the Built Environment

We live in a world of change and our society is facing multiple complex challenges. These changes and challenges can be summarised in eight mega-trends that will affect our future society and that are already affecting our way of constructing our built environment (see Figure 2).



Figure 2. Megatrends that are affecting our future society, our cities and built environment [1]

Globalisation, urbanisation, aging populations and more multi-cultural societies are affecting demographics and thereby the need and expectations for homes, offices and urban planning. In addition to this, there is a broader realisation that the way we plan our built environment is affected by, but can also help to tackle, challenges like polarisation and growing inequality. Furthermore, the current way we construct our societies and buildings are intensifying the challenges posed by the Anthropocene¹, like climate change and resource depletion. Finally, digitalisation and a growing focus on the knowledge economy are posing a great opportunity to face many of these challenges but also means a need for new skills, changes in policy and behaviour. [1]

The global built environment is responsible for up to 40% of global waste and almost 40% of global energy-related CO₂ pollution. At the same time, due to increasing population, demographical changes and urbanisation, the world-wide building stock is set to double by 2050. This will increase the pressure from the built environment on the climate and on material resources and presents an important opportunity for change. [2] [3]

The Paris Agreement and the 17 Sustainable Development Goals (SDGs) are two important frameworks to address the challenges that we are facing. In line with the 11th SDG, affordable and adequate housing for all, promoting clean solutions to make buildings future-proof is crucial. Also, in line with the 7th SDG, there is a need to double the efforts on energy efficiency to bring the needed reduction of energy usage of at least 3% per year globally. [4]

In Europe we spend as much as 90% of our daily lives indoors. We live, learn and work in buildings, and the environment within and around our buildings have a strong influence on our productivity, health and overall well-being. An increasing number of governments are legislating for lowering carbon emissions and there is an increasing demand for ways to design, construct and operate buildings that contribute to sustainability goals and that also improve internal environment for users. [3] Also on the EU level there are several frameworks that are addressing and pushing the agenda for a more sustainable built environment. There is a focus on decarbonizing the energy sector, energy efficient buildings and circular construction through the EU Green Deal and the EU Circular Economy Action Plan. Legislation, regulations and frameworks are driving to implement this. For instance, the framework [Level\(s\)](#) has been developed for a common way of assessing and reporting on sustainable buildings, the [EU Taxonomy](#) (2020) prioritises and simplifies sustainable financing and the [Renovation Wave](#) (2020) aims to boost renovation of the building sector to push energy saving and economic growth. [5]

¹ As humans we are affecting the climate and ecosystems in such a way that the term “Anthropocene” has been coined as a way of describing the current geological epoch. [83]

GLOBAL TRENDS

Sustainability is an important trend in the construction sector and is slowly but steadily becoming mainstream. The World Green Building Council reports growth in green building activity across the globe, with dramatic increases expected across all five continents in 2021 with a growing focus on social factors like creating a sense of community, encouraging sustainable business practices and improving health and well-being in buildings. [6] Also, according to a survey by the consultancy company Ramboll, people in the construction sector increasingly report that current and future projects could be considered sustainable and 57% of respondents stated that they expect that at least half of their coming projects will be sustainable. According to the survey, the top trends within the sustainable building sector globally are

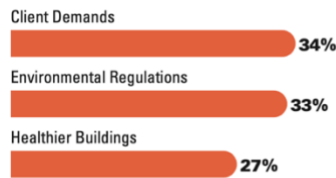


Figure 3. top triggers driving green building activity. [7]

life cycle thinking, increased focus on carbon neutrality, resilience and digitalisation. Also, health and well-being are an important growing trend. [3] Similarly, a global survey by Dodge Data & Analytics confirms this growing trend stating that there are mainly external triggers that drive the development of green buildings. The top triggers stated are to meet client demands and environmental regulations as well as creating healthier buildings (see Figure 3) [7].

Apart from environmental and social sustainability, digitalisation and implementation of e.g. new BIM-systems is expected to be a key part of the development of the construction sector in the coming years. The expectations are that digitalisation could increase the effectiveness of the sector by one fifth. Standardisation for mass production of buildings will contribute to this by making it easier to move part of the production from buildings sites to industrial production facilities and could increase production with 50% and lower costs by 20%. Digitalisation and standardisation are also expected to further facilitate the sustainability transition. Digital tools can improve building design, optimise material use, reduce waste and increase efficiency in energy consumption. [8]

As can be seen throughout this report, these trends and developments are also present in the Danish and Swedish construction sector. With ambitious goals to combat climate change and sustainability increasingly seen as a competitive advantage, these countries are seen as pioneers in the shift to sustainable building practices. [9] [10]

In summary, there is a need for more sustainable buildings to combat climate change, resource depletion as well as increased well-being. The development of policy and trends in the sector shows that there is a drive for change. However, the emissions and material use of the construction sector are still increasing (see Figure 4). Hence, words of warning from academia as well as some parts of the sector itself are being heard more frequently: continuation of the current practice and the minor changes that are happening will not help us get even close to achieve the SDGs by 2030. A larger, more fundamental and rapid shift needs to happen. This means cultural, social and political change, new areas of employment and shifts in education and retaining as well as the rise of new start-ups and innovations. [11]

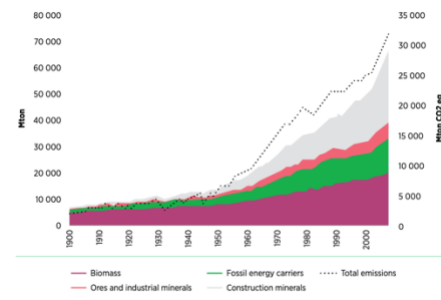


Figure 4. Increase of global material use (left axis) and global emissions CO₂ (right axis) [35]

Comparing the Netherlands to Denmark and Sweden

Before diving into the markets for sustainable buildings in Denmark and Sweden, this chapter covers some important similarities and differences between the Netherlands and these Nordic countries. There are many similarities, including them all being in western Europe, members of the EU and being classified as high-income countries. Also, the three countries typically score high when it comes to innovation and are all seen as “innovation leaders” according to the European Innovation Scoreboard 2020 (see Figure 5). [12]



Figure 5. European Innovation Scoreboard, 2020 [12]

Country sizes and populations

When it comes to country size, population and population density there are large differences:

Country	# of households	# of inhabitants	# of people / km ²	Main cities (# of people)
Denmark	Less than 2.5 million	5.8 million	137	Copenhagen (1.2 mln) Aalborg (240.000)
Sweden	Almost 5 million	10 million	25*	Stockholm (1.5 mln) Gothenburg (600.000) Malmö (320.000)
<i>Netherlands</i>	<i>Almost 8 million</i>	<i>17 million</i>	<i>488</i>	

*) the population density in Sweden varies a lot, in the northern parts there are 3-15, the southern parts 20-100 and Stockholm 360 people per km².

BUILDING STOCK AND OWNERSHIP

Similarities can be seen in the building stock of the three countries. Figure 6 shows the building year of dwellings where a majority in all three countries have been built before 1980 and a large amount in the years 1945-1969.

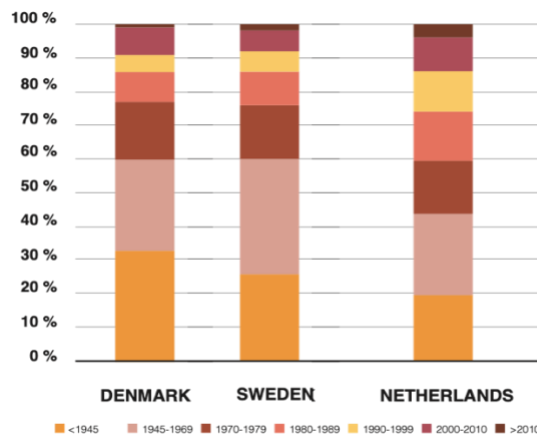


Figure 6. Share of dwellings built in different periods in Denmark, the Netherlands and Sweden [13]

There are also similarities when it comes to ownership. Denmark, Sweden and the Netherlands have the highest mortgage debt to income ratio in the EU and some of the highest percentages of home ownership (see Figure 7) [14]

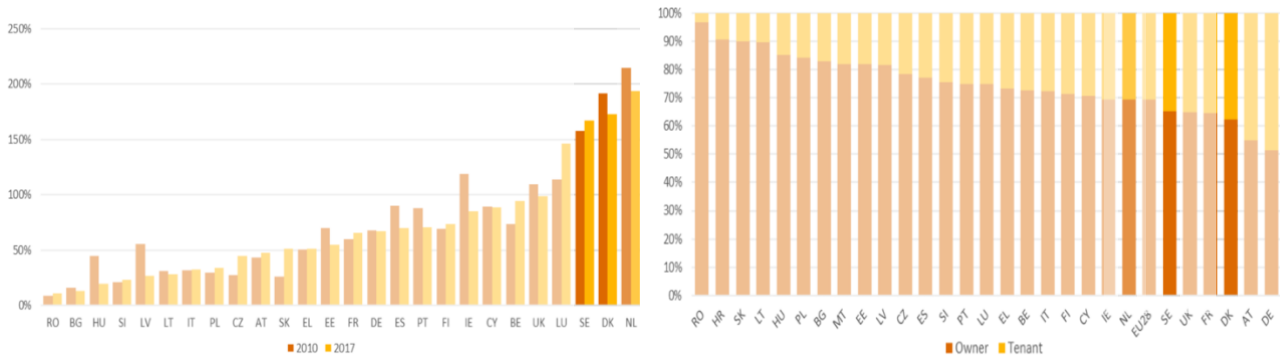


Figure 7. Mortgage debt to income ratio and home ownership in the EU-28 [14]

SOCIAL HOUSING SECTOR

The social rental housing sector is quite different in Denmark and Sweden compared to the Netherlands. In the Netherlands 32% of the total housing stock is social housing whereas this number is 19% and 18% in Denmark and Sweden respectively. In the Netherlands all of the social housing is provided by regulated private non-profits (“woningcorporaties”) and makes up 75% of the rental stock. In Denmark the social housing, or rather “not-for-profit housing”, is run by non-profit housing associations. These dwellings are called “almene boliger” (see more [here](#)). There are around 700 housing associations across Denmark and these are regulated by the state but owned and operated by the members themselves. There are no income ceilings for renting these but there is a limit on construction costs. 7% of the construction costs are financed by the municipality through interest-free loans.

In Sweden, there is officially no social housing anymore. However, public housing does exist with part of the housing sector being municipally owned. There is also cooperative housing in the form of tenant ownership as well as a system of negotiated rent setting for the whole rental sector. Around 30% of Sweden’s residents rent their housing and of this around half is municipally owned (see the website of [Allmännyttan](#)). In Sweden there are no longer general housing subsidies and there are no priorities given to people with lower income. Thus, the municipally owned sector has no benefits compared to the private rental sector. [15]

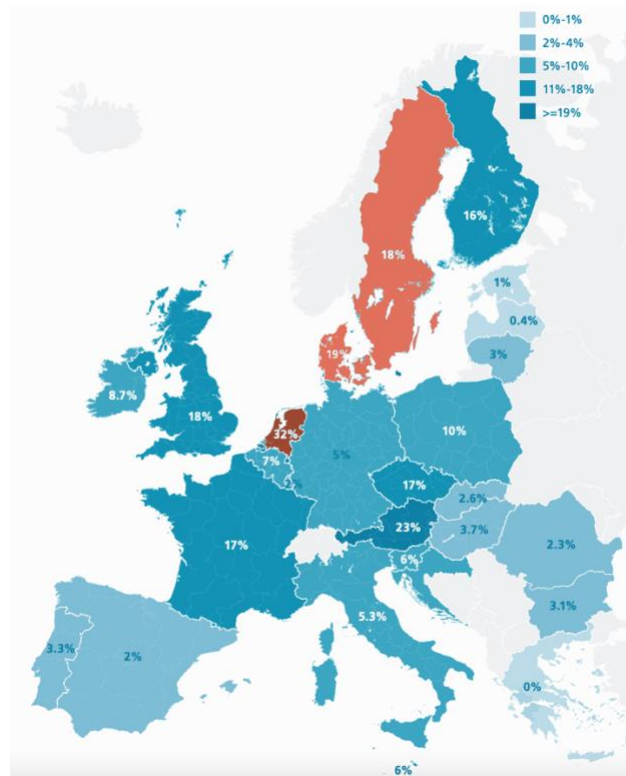


Figure 8. Social rental housing as percentage of total housing stock in the EU. [15]

CULTURE

Denmark and Sweden, all part of Northern Europe, are not considered very different from the Netherlands when it comes to culture. Of course, there are some differences in nuance that will be noticed when doing business and collaborating.

One way of looking at culture is from the definition: “the collective mental programming of the human mind which distinguishes one group of people from another”. Geert Hofstede has been one of the pioneers of the research done on how culture influences the workspace in different cultures. Based on his studies the following can be said about cultural differences between Denmark, Sweden and the Netherlands, see Figure 9 [16]. These are some insights and should not be seen as fundamental truths for all individuals or these societies as a whole.

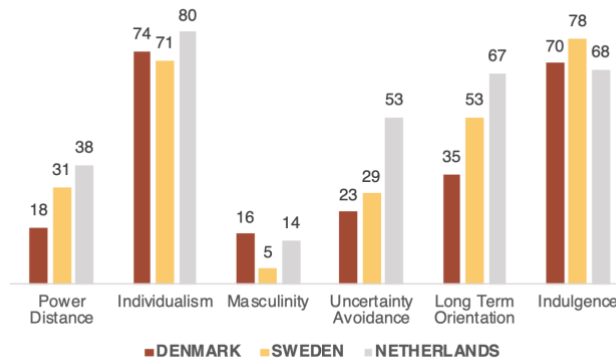


Figure 9. Cultural differences between the countries based on the research by Geert Hofstede [16]

Power distance: “The extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally”. Denmark is at the very low end of this dimension with 18 points. This expresses high autonomy of employees and that Danes “coach” rather than “lead” their employees. Power is decentralised and workplaces have an informal atmosphere. This is similar for Sweden, also ranking quite low in comparison with other countries. As well as in Denmark, in Sweden power is decentralised, superiors are considered accessible and everyone is on a first name basis. In all, there are similarities to the Netherlands, where the workspace also has most of these traits, but the acceptance of power distance and hierarchy is slightly lower in Sweden and lower in Denmark.

Individualism: “The degree of interdependence a society maintains among its members.” Here all three countries score very similar. Individualism is slightly higher in the Netherlands which might mean that people are slightly more prone to expect individuals to take care of themselves and their direct family members only.

Masculinity: A high score on this dimension suggests a society more driven by competition, achievement and success and a low score indicates more focus on caring for others and quality of life. All three countries score low on this dimension, meaning life/work balance is important and decision making is made through involvement and consensus. In Sweden, scoring the lowest of the three, this is more accentuated. Here, “lagom” is an important part of the language meaning “not too much and not too little” and it is important that everybody has enough, and nobody goes without. The differences in this dimension might also be the reason that Danes are known for having a very direct form of communication, similar to that of the Dutch, whereas Swedes are known to be a bit more cautious.

Uncertainty Avoidance: “The extent to which the members of a culture feel threatened by ambiguous or unknown situations and have created beliefs and institutions that try to avoid these”. Sweden and Denmark both score lower than the Netherlands on this dimension meaning that schedules are more flexible, not a lot of structure is needed in the work life and innovation is not seen as a threat. The higher score in the Netherlands suggests leaning towards more structure and that people have more of an inner urge to be busy and work hard, something that is less accentuated in Denmark and Sweden where hard work is undertaken but typically only when necessary.

Long Term Orientation: Low scores indicate societies that prefers to maintain traditions and norms, high scores indicate societies that are more pragmatic and encourage preparing for the future. With an average score, Sweden cannot be said to have a preference whereas the Netherlands, with a higher score, is seen more as a pragmatic society where truth will depend on situation and context. Traditions can more easily adapt to changed conditions and there is more of a long-term view on things. This is different from Denmark which is more bound to traditions and more short term oriented.

Indulgence: “The extent to which people try to control their desires and impulses”. All three countries score high meaning there is a lot of room to realise impulses and desires with focus on enjoying life. Denmark scores similar to the Netherlands, and Sweden a bit higher. This might indicate more focus on leisure time but generally, the countries are very similar when it comes to this dimension.

Denmark and Sustainable Buildings

The population in Denmark reached 5.8 million in 2018 and is projected to increase to 6.2 million by 2030 and 6.5 million by 2050. The working age population made up 64.1% in 2018 is expected to decrease to 60.1% in 2050 when people over 65 will make up almost one fifth of the total population. The number of households in Denmark reached 2.4 million in 2018. [9] The urbanisation in Denmark is one of the highest in the EU at almost 88% and is still increasing. Most people live in the larger cities of Copenhagen (1.3 mln), Aarhus (270.000) and Odense (180.000).

MARKET STARTING POINTS

The construction industry in Denmark has been growing the last few years, but like it's Nordic neighbours the growth is stagnating. The investment in construction industry was 30,1 billion EUR in 2018, a growth of 4,6% from the year before with predictions of a growth of 7% for 2019 and a growth of 1% for 2020 (pre-pandemic). Investments in both residential and business buildings is stagnating as can be seen from the total investments in residential and business buildings in Denmark and Sweden in the period 2015 to 2020 in Figure 10. The number of new residential dwellings built in 2018 were 33,000 whereas for 2020 the prediction was 29,000. [17]

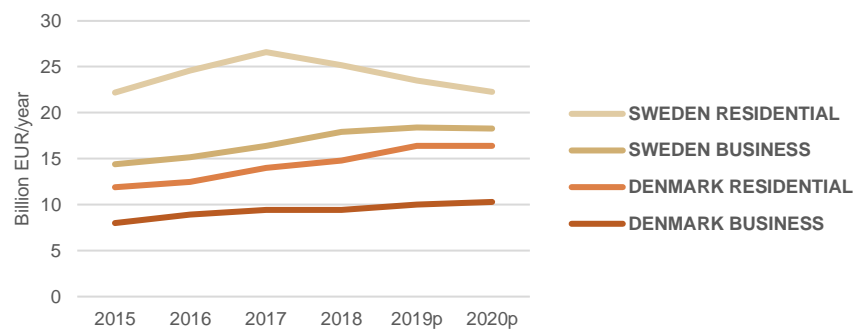


Figure 10. Investments in the construction sector in billion EUR in Denmark and Sweden from 2015 to 2020 (2019 and 2020 predictions)

There is a sense of optimism in the Danish construction sector, even with the covid-19 pandemic. Especially the market for renovations is expected to contribute to economic progress in the industry with an increase in employment expected in 2021 after a slight decline in 2020 and an expected increase in investments in. This is due to a rise in the number of sold dwellings where private homeowners are investing in renovation as well as a larger focus on energy renovations throughout the sector. In addition to this, several policy initiatives have been launched in 2020 that are aimed at helping the construction sector through the covid-19 crisis. Initiatives include an initiative to encourage homeowners to make their homes more energy efficient (the so called "Boligspluje") and a large financial package of 30 billion DKK for renovations in the social housing sector ("almene boliger") from 2020 to 2026 (the so called "Grøn boligafale"). The investment in office buildings is expected to increase moderately with 3,8% in 2020 and 2% in 2021, after an extraordinary growth in investment in 2019. Also, the investment in new public buildings is expected to increase, despite the covid-19 pandemic. In 2019, 400 thousand new square meters of public buildings were added. For 2020 the expectation was a slight increase to 460 thousand new square meters going to 480 thousand in 2021 further. [18]

The house prices in Denmark are high and have been increasing rapidly between 2015 and 2018, despite tighter lending standards and slowing economic growth. This is, among others, due to strict rent control with around 80% of the private rental housing market stock being under rent control. This limits the supply of rental properties and thus drives the demand for home ownership. [9]

SUSTAINABILITY

Denmark is seen as a leader in eco-innovation and sustainable construction. The country has a number of funding schemes to support R&D and efficient use of energy in the building stock. [9] Denmark has high ambitions to fight climate change with the Danish climate act setting the ambition of 70% reduction of greenhouse gas emissions by 2030, reaching zero net emissions by 2050. [19] The country also has a broad sustainability strategy based on 23 objectives for financial, social and environmental sustainability and in 2018 the government agreed on a strategy for circular economy where construction is pointed out as one very important sector [20] [21].

The ambitious goals for climate mitigation and circular economy have sped up the work with sustainability in the construction sector. Developers as well as real estate owners are increasingly seeing sustainability as a competitive advantage. This has led to work with creating a more ambitious sustainability framework for the sector. Its implementation has started with a so called “voluntary framework for sustainable construction” (see Figure 11). This is being tested the coming two years before it is due to be implemented. Some of the 40 construction projects where it is being tested can be found [here](#). In the framework there are demands for the following [19] [22]:

- Life cycle assessment - the building's overall climate impact
- Resource use on the building site
- Total economic analysis - costs for construction, operation and maintenance
- Operation and maintenance plan for maintaining the indoor climate
- Documentation of problematic substances
- Emissions to the indoor climate
- Detailed demonstration of the daylight level
- Noise from ventilation systems in homes
- Room acoustics in homes



Figure 11. The voluntary framework for sustainable construction

To achieve the Danish climate goals and the broader environmental goals, voluntary private sector agreements are broadly applied in the sector. The most used environmental certification for buildings is DGNB (a Danish version of the German DGNB) followed by LEED, BREEAM and the Nordic Swan Ecolabel (see Figure 12). [3]

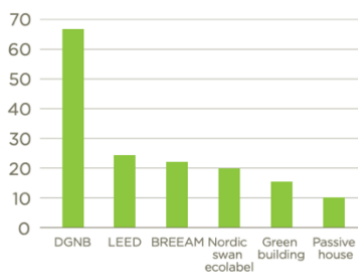


Figure 12. Most used certification schemes for sustainable buildings in Denmark [3]

Another important part of the Danish construction industry to reach the ambitious goals, but also to face growing competition, is [We Build Denmark](#), that took over the work of [InnoBYG](#) in early 2021. This Danish innovation network for the construction sector has members across the whole value chain. It aims to set the agenda for sustainability and innovation in the sector and coordinates and supports initiatives and projects. [23]

Architects are one of the forces driving the transition to more sustainable buildings. In Denmark, like in many other countries, this means the role of the architect is evolving. Software, digital tools and consulting are becoming more important and architects are also becoming material suppliers. One example is Lendanger Group, one of the most well-known architects in Denmark. [24]

THE CONSTRUCTION PROCESS

The general construction process in Denmark, from idea phase to construction is illustrated in Figure 13. For reference, the Danish words are included. Depending on the project developer, the building may be owned and maintained by the same company during the maintenance phase.

The largest construction companies for residential buildings in Denmark, for instance MT Højgaard, NCC Denmark and Huscompagniet with turnovers of 6.8 mln, 3.9 mln and 3.3 mln DKK in 2018 [26], do typically not do maintenance. However, there are many real estate companies who also act as developers that do, the largest property owners being Juedan, ATP, Dades. Apart from some of these larger players, the construction sector in Denmark is quite local.

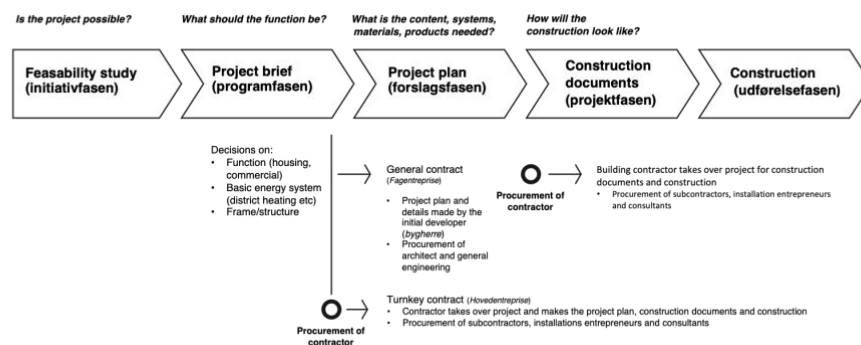


Figure 13. General sketch of construction process in Denmark

The length of the construction procedure in Denmark is shorter than average in high-income countries worldwide. For instance, 7 procedures and 64 days are needed to complete the administrative requirements for building a warehouse. This makes Denmark score 87.9 points out of 100 and ranks 4th of 190 countries when it comes to ease of dealing with construction permits. Sweden scores slightly lower with 78 points (see Figure 14). As a reference, the Netherlands scores 70 points, ranking 88th. [27]

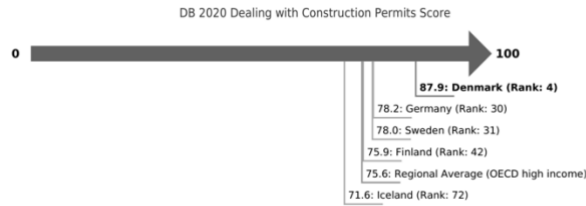


Figure 14. Denmark scores 87.9 points out of 100 and ranks 4th out of 190 countries when it comes to ease of getting a construction permit.

MAIN TRENDS AND CHALLENGES

The main trends and challenges for the Danish construction sector are:

Increasing older population

- With an increasing older population housing and health care facilities for the elderly will be a challenge. The Danish government has set up specific design requirements for age-friendly housing and introduced ambitious funding for construction and renovation of healthcare facilities. [9]

Renovation is getting more attention

- The Danish government puts focus on the need for renovation of existing buildings to meet climate targets and energy saving. This is driven by government strategies as well as subsidies and fiscal measures. [9] [28] [29] One important example is the Grøn boligafale, the large financial package of 30 billion DKK for renovations in the social housing sector ("almene boliger") from 2020 to 2026. [18]

Lack of skills in the construction sector

- Lack of skills is one big challenge as the older generation is retiring. This is seen as the most important investment barrier in for construction firms in Denmark and is also a barrier towards achieving the ambitious energy efficiency target. The shortage is mainly in craftspeople such as carpenters, bricklayers, plumbers and soil and concrete workers. [9]

Productivity not increasing

- Accessing financing and reluctance to invest in new technologies such as BIM and lack of available funds for training is holding back productivity in the construction sector in Denmark. [9] This, even if Denmark is seen as a front runner in adopting BIM in the EU. [30] This might seem contradictory but in fact, adopting digital tools in the construction sector is a challenge globally. What makes Denmark a front runner is taking this challenge seriously with a national strategy and some important sector initiatives that strive to increase digitalisation in the Danish construction sector.

Sustainable buildings a focus

- National legislation and focus of policy as well as current trends and developments in the sector show that sustainable buildings are a focus area of the construction sector in Denmark. The most interesting trends and challenges within sustainability being:
 - o **Circular and climate neutral buildings:** specifically, developments in re-use and life cycle thinking
 - o **Renewable energy systems:** specifically, developments in electricity generation and energy reduction in renovation
 - o **User centred design and well-being and**
 - o **Digitalisation for sustainability**
- These areas of interest and the opportunities for business and collaboration are described in the chapter Market Deep Dives from page 16. For a summary of the trend analysis and interviews conducted for this market study, see Appendix 1: Methodology.

Sweden and Sustainable Buildings

The total population of Sweden a bit more than 10 million and population projections anticipate an overall 32.3% growth in the population to 2050, mainly because of increased net migration. At the same time, the demographic situation will change. In 2018 the working age population was 62.4% of the total, expected to decline to 61.3% of the total in 2050. People over 65 will increase from 19.8% of the total in 2018 to 21.8% by 2050. This is expected to drive the demand for public sector construction, such as hospitals and care facilities and also the demand for housing adapted to the needs of the elderly. [10] Urbanisation in Sweden is widespread with 87.7% living in larger towns and cities and this percentage is increasing. Most people live in the cities in the southern parts with the three largest cities being Stockholm (1.5 mln), Gothenburg (600.000) and Malmö (320.000).

MARKET STARTING POINT

The construction market in Sweden has stabilised after a growth following the 2008-2010 financial crisis. With high housing demand and growing population, the construction sector is expected to stay quite stable (see Figure 15). [31] This growth has triggered growth in employment in the Swedish construction sector which increased by 27.4% between 2010 and 2018, mainly driven by people employed in the architectural and engineering sector (+34.9%), narrow construction (+31.1%), and real estate activities (+14.9%) [10]

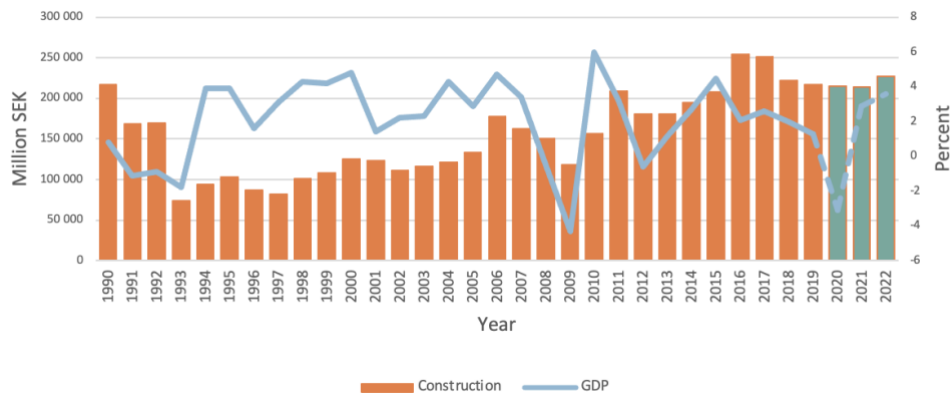


Figure 15. The development of the construction market and GDP in Sweden 1990-2019 with a prediction to 2022. These numbers are updated on 31 January 2021 and take the Covid-19 pandemic into account. [31]

The increase in growth in investments in the construction industry has been stagnating as can be seen in the figure above. This is true for all Nordic countries the last few years, including Denmark as is also shown in Figure 10. [17]

The house price index in Sweden is high and increasing. The rise in house prices is partly due to structural bottlenecks: housing supply (especially in main urban areas), combined with favourable tax treatment of home ownership and mortgage debt. [10]

SUSTAINABILITY

Sweden is one of the European Innovation Leaders and scores high on categories such as Innovation-friendly environment. The country has high ambitions to fight climate change with the goal to have no net greenhouse gas emissions by 2045. This goal was adopted in the Swedish climate act in 2018 [32]. To reach broader environmental sustainability, there are 16 environmental goals in place. These rest on the so called “generational goal” set by the Swedish government: environmental problems need to be solved now and not be left for future generations [33]. In 2020 the Swedish government also launched a national strategy for circular economy [34].

The construction sector accounts for 30% of the emissions and around 30% of all waste in Sweden. To reach Sweden’s climate goal, a green deal with a roadmap for the construction and installation sector has been agreed on by more than 100 public and private organisations in the sector. The goals for the construction sector are in line with the national ambitions, to have net-zero emissions of greenhouse gases by 2045 and a reduction of 50% by 2030. In a survey, 91% of the participants of the green deal think that the climate issue will have a big impact or will be absolutely crucial for their business in the coming five years. [35]

To achieve the climate goals and the broader environmental goals, voluntary private sector agreements are broadly applied in the Swedish construction sector. For certifying that no harmful chemicals or toxic materials are used, the most used certifications are ASTA, Byggarubedömningen and Sunda Hus. The most used environmental certifications for buildings are Miljöbyggnad, BREEAM, LEED (see Figure 16). [36]

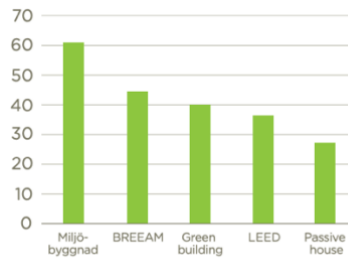


Figure 16. Top five certification schemes for sustainable buildings in Sweden [3]

In 2020 a new certification scheme was launched from Sweden Green Building Council (SGBC), "No!lCO₂" or ZeroCO. This certification can be combined with the most common certification schemes already used in Sweden and aims to lower the CO₂ emissions from the whole life cycle of a building, including materials and building activities. ZeroCO₂ was piloted in projects in 2020, the first building to get the certification being an office building by the construction company Skanska in Malmö. [37]

The construction sector in Sweden is dominated by three large construction companies: Skanska, NCC and Peab. Each with a turnover of between 34 and 44 billion SEK (in Sweden) these companies are far ahead the rest where Veidekke is leading at a more modest 11 billion SEK turnover [38]. In projects where these dominating companies are involved, they are often setting the sustainability agenda. With other, smaller actors, this depends. In the case of municipality owned land, the municipality is often setting the bar whereas in projects with ambitious architects, they will be the driving force of sustainability. There is a push from some architectural firms to try to take a more active role in the early stages of a project. [39] Also the role of architects is evolving and architecture firms like Kaminsky Arkitekter becoming reuse-consultants.

THE CONSTRUCTION PROCESS

The general construction process in Sweden, from idea phase to construction can be seen in Figure 17. For reference, the Swedish words are included. Depending on the project developer, the building may be owned and maintained by the same company during the maintenance phase.

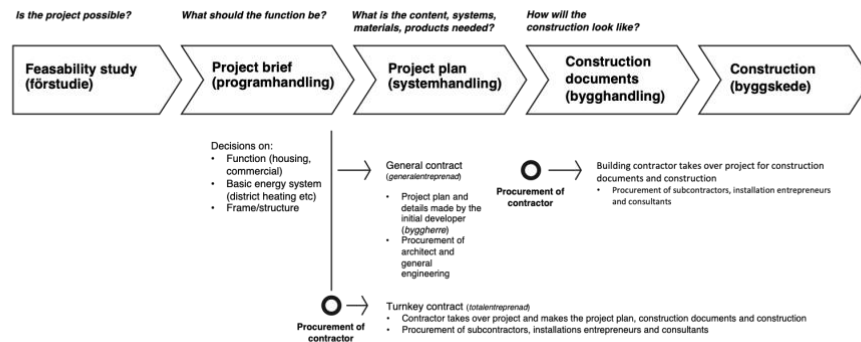


Figure 17. general sketch of the construction process in Sweden

Typically, the three dominant players in the construction sector in Sweden, Peab, NCC and Skanska, do not do maintenance. However, there are many real estate companies who also act as developers that do, the three largest property owners being Vasakronan, Akademiska Hus and Castellum. Apart from these large players, the construction sector in Sweden is, similar to Denmark, quite local.

While longer than in Denmark, the length of the construction procedure in Sweden is shorter than average in high-income countries worldwide. For instance, 8 procedures and 117 days are needed to complete the administrative requirements for building a warehouse. This makes Sweden score 78 points out of 100 and ranks 31st of 190 countries when it comes to ease of dealing with construction permits. Denmark scores higher with 87.9 points (Figure 18). For reference, the Netherlands scores almost 70 points, ranking 88th. [40]

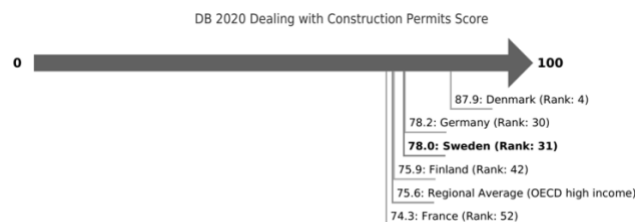


Figure 18. Sweden scores 78 out of 100 and ranks 31st country in ease in dealing a construction permit.

MAIN TRENDS AND CHALLENGES

The main trends and challenges for the Swedish construction sector are:

600 000 new homes in the coming 10 years

- Sweden is facing a housing shortage, mainly in its main urban areas and will need a construction of 600.000 new homes by 2025. 80% of the municipalities face a shortage in housing. [8] [10] Despite this need, the production of new housing has been decreasing the last years. In 2018 more than 52,000 new dwellings were built, for 2020 the prediction was 41,000. [17]

1000 new schools in the coming years

- Connected to the increasing population the number of children attending elementary school will increase with 250 000. This means an increased need for new schools. By one estimation between 800 and 1200 new schools need to be built in the coming 5-10 years. [41]

Renovation needed for up to 1.000.000 homes

- Many multi-dwelling buildings built in the so called "million program" between 1965 and 1974 are in need of renovation [42]. An estimated 250.000 of the 1.000.000 homes built in this time period are in need of large renovations [31]. Also, one of the goals of the road map for a climate neutral construction sector is that to make sure renovations increase more than new construction. [35]

Highest construction costs in the EU and lack of labour and skills

- High construction costs are a key issue in Sweden. Adding to this is the challenge of labour and skill shortages which can drive this further. The number of job vacancies in the construction and real estate sector have increased by more than double between 2010 and 2018. This labour and skills shortage is expected to increase in the coming years, with growing investments and high retirement rates. Investment in education and skills will be crucial to improve productivity growth and address the skills mismatch in some parts of the labour market. [10]

Sustainable buildings a focus

- As in Denmark, national legislation, policies and current developments point to a growing focus on sustainable in the construction sector in Sweden. The most interesting trends and challenges within sustainability are:
 - o **Circular and climate neutral buildings:** specifically, developments in re-use, life cycle thinking and construction with wood
 - o **Renewable energy systems:** specifically, developments in renewable electricity generation and energy reduction in renovation
 - o **User centred design & well-being** and
 - o **Digitalisation for sustainability**
- These areas of interest and the opportunities for business and collaboration are described in the chapter Market Deep Dives from page 16. For a summary of the trend analysis and interviews conducted for this market study, see Appendix 1: Methodology.

Market Deep Dives

In market study, the most prominent trends and developments within sustainable buildings in Denmark and Sweden have been analysed, taking different aspects of sustainability into account (see figure 1). This in order to identify the most interesting topics: those with business opportunities or opportunities for collaboration for Dutch partners. In this part of this report, the selection of topics and specific areas of interest is presented and further explained, and a deep dive is given for each of the different topics. Each market deep dive covers the background of the topic in the two countries, the most important policies and legislation, some of the important actors and in what way Dutch partners can play a role. More information on events, networks and organisations within these topics can be found through access to the online actor map (see [here](#)).

It is important to note that this is one way of looking at the developments in Denmark and Sweden right now and one selection of topics and specific areas of interest that are interesting for Dutch partners. These deep dives give important insights in these markets and interesting topics but does not argue to give the whole picture of business opportunities in sustainable buildings. Also, it should be seen as a snapshot of the market that is relevant the coming years as sustainable building is a topic in development, technologies develop fast, new policies and strategies are drafted continuously and new businesses will continue to change the market.

TOPICS AND SELECTED AREAS OF INTEREST

The topics and areas selected for the market deep dives have been identified through trend analysis and interviews conducted for this market study. The factors that were taken into account when selecting were: where there are developments that could benefit from international collaboration or more competition and where the Dutch market is considered to be have good possibilities to export innovative products, services or share new knowledge. The topics and areas that have been selected for the market deep dives are seen in the table below. Circularity, energy and well-being are the most prominent topics, supported by digitalisation. Water and biodiversity are seen as interesting topics but developments within these topics do not stand out. More information about the selection of areas of interest can be found in Appendix 1: Methodology.

Topics	Selected areas of interest	Collaboration / Business opportunities	Other areas of interest, not selected	
Circularity	“Circular construction and climate neutral buildings”	Reuse Material choices & Life Cycle Thinking Construction with wood (Sweden)	Both Collaboration Both	Flexible design, Circular business models
Energy	“Renewable energy systems”	Electricity generation & smart grids Energy reduction in renovation	Business Business	Energy storage, heat source for buildings, passive housing
Well-being	“User centred design & well-being”	Future use of buildings Measuring well-being	Collaboration Business	Toxicity, ventilation
Supporting topic				
Digitalisation	“Digitalisation for sustainability”	Digitalisation of the construction process Digitalisation of buildings	Collaboration Both	-

The selected areas of interest cover the whole building life cycle, from manufacturing of products to deconstruction but are more focused around the operation and use phase and the renovation phase. In Figure 19 the sustainability topics and selected areas of interest are shown connected to the part of the building life cycle where they have the most impact.

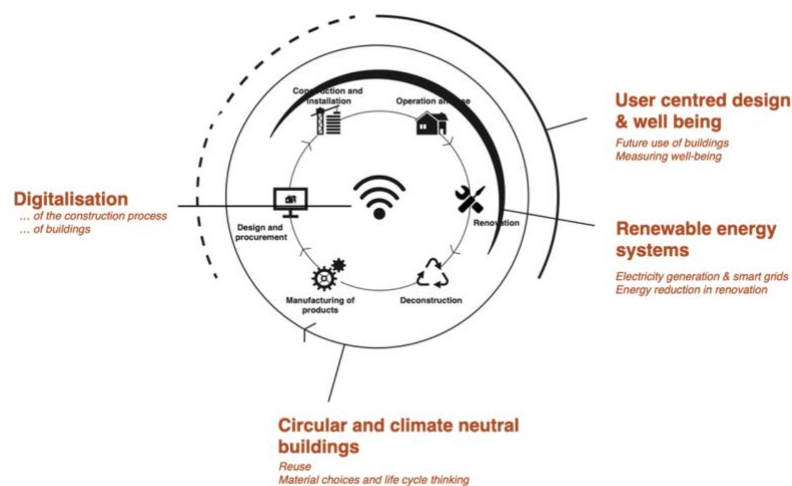


Figure 19. Important topics and selected areas of interest and where in the building life cycle have the most impact.

EFFICIENT RESOURCE USE AND ZERO EMISSIONS

Circular and Climate Neutral Buildings

Creating circular and climate neutral buildings is seen as one key element to achieve the climate goals in both Denmark and Sweden. More than one third of all waste generated in both Denmark and Sweden is generated in the construction sector, making it by far the largest waste source [9] [36]. Also, around a third of all greenhouse gas emissions come from the construction sector with a large part generated by the material use and emissions during the construction phase. Focus on this topic means attention for reduction of emissions from the whole life cycle of a building, understanding how to measure CO₂ emissions from material use and learning to make priorities for design, construction, maintenance, renovation and deconstruction for reduction of both CO₂ emissions and unsustainable material use.

In the Danish Strategy for Circular Economy from 2018, the topic “circular and climate neutral buildings” is pointed out as one of the most important focus areas and has led to targets for implementing life cycle thinking and reducing material use. [21]. In Sweden, a national strategy for circular economy was presented in the summer of 2020 by the Swedish government [34] and a delegation and expert groups for circular economy have been formed for different focus areas. One of the expert groups is working on circular construction [43]. The strategy has no further details on construction so far and has not set any targets yet but will likely follow the fossil free road map of the construction sector. This road map does not set any specific targets for reduction of material use or increased circularity but recognises that these are important topics to address in order to achieve the overall target of zero greenhouse gas emissions by 2045. [35]

There is a lot of development in both Denmark and Sweden when it comes to the topic of circular and climate neutral buildings in general but there are three developments that are particularly interesting when it comes to opportunities for business and collaboration. These are reuse, material choices and life cycle thinking and wood construction.

REUSE

In both Denmark and Sweden, circularity in the construction sector is currently focused on the concept of reuse. However, the broader concept of circular buildings (see e.g. [EEA, 2020](#)) is also getting more attention.

Today, Danish legislation holds “no *real* barriers” for reuse or broader circularity in the construction sector. This is the conclusion of a studies from the Nordic Council of Ministers and the so called “Circle House” project, a flag ship project for circular construction in Denmark. There are, however, a number of hurdles and a lack of incentives for reuse and using circular principles in current regulations. Barriers include lack of (early stage) value chain cooperation and partnerships in the construction sector, lack of economy of scale for reused materials, lack of quality assurance of reused building materials as well as presence of hazardous substances in existing building products currently embedded in buildings. To overcome these barriers, there is a need for; a) supplementary requirements for documentation of the content and quality of building materials, b) requirements for documentation of the use of reused building products and building products with recycled content, and c) requirements for building demolition plans. [36] [44]

In Sweden, like in Denmark, building sector stakeholders generally have a positive attitude towards reuse but the same types of hurdles and needs are seen: a lack of incentives, knowledge and legislation. The current habits and attitudes in the sector and the historic and current use of hazardous materials and low quality of statistics on materials flows are pointed out as specific issues that are hindering the broader implementation of reused materials and products. To overcome these hurdles, it is seen as necessary to support more commercial reference projects where techniques and processes for secondary materials are used and proven, and work for a mature market for reused materials and products. [45] [46]

Circular procurement is one way of promoting reuse and other forms of circular construction. In a project in 2020 there have been efforts to translate Dutch frameworks and knowledge of circular procurement into a Swedish context. This is being tested in 2021, but there is no specific focus on the construction sector. [47]

Important national actors

Throughout the construction value chain there are front runners that are working with reuse as a first step towards reducing waste and more sustainable material use:

- Architects are driving the agenda for reuse a large part in both Denmark and Sweden. Architect firms at the forefront of circularity are for instance: Lendanger Group (DK), 3XN (DK), Kaminsky (SWE), LINK (SWE), EttElva (SWE) and Theory into Practice (TIP, SWE)
- There are also retailers and resellers of reused materials. In Denmark, [Stark](#) is one of the pioneers and there is the market place [Genbyg](#). In Sweden the network CCbuild has set up an initial [market place](#) for reused material. Also, there are companies that buy and sell reused materials like Kompanjonen, ReclaimD and Bruksspecialisten (reused bricks).
- Interesting networks within the area of reuse and circular construction are: VCØB knowledge for Circular Construction (DK), LMF30 in Malmö (SWE), Återbruk Väst in Gothenburg (SWE) and CCBuild (SWE).
- Interesting projects are: [Upcycle Studios](#), [CircleHouse](#), [High6](#)

Business and Collaboration Opportunities

The areas where there is a current “gap” in the Danish and Swedish market on this topic and where Dutch players could play a part are:

Business opportunities:

- Solutions for digital marketplaces, including the broad implementation thereof
- Technology and processes that efficiently identify and extract materials and products in deconstruction
- Solutions for implementing material banks, material passports and demolition plans
- Calculation tools for easy assessment of the impact of reusing building materials

Collaboration opportunities:

- More collaboration on development of circular procurement processes, maybe especially for Denmark where this has not started yet. Learnings can be drawn from the Swedish project [47]
- Information on Dutch successful reuse projects and experiences from projects working more broadly with circular construction (such as Circl in Amsterdam and Hof van Cartesius in Utrecht) and organising exchange between architects and developers in the Netherlands and Denmark/Sweden
- Collaboration around needed policy changes connected to e.g., waste and quality assurances



Featured Project: Circle House

Named "Denmark's first circular housing project", Circle House is a result of lots of research and sought out examples of suppliers for circular products and services. The project is led by Lejerbo Housing Association working together with 3XN. Construction is expected to be completed in 2023.

More information can be found [here](#).

MATERIAL CHOICES AND LIFE CYCLE THINKING

To achieve climate neutral buildings and less environmental impact and CO₂ emissions from construction, life cycle thinking is becoming more important in both Denmark and Sweden. Looking at the impact on the environment across the whole construction process can help identify in what stages decisions are most important. Material choices have been identified as one of the most crucial parts for the construction sector and buildings are more often seen as "material banks", essentially a source for future material flow [48]. Using Life Cycle Analysis (LCA) tools is one way of making priorities.

In contrast to the Netherlands, where the use of LCA has been mandatory for buildings since 2013, this is not yet the case in Denmark and Sweden. In Denmark this could change with the goal to implement a new framework where the use of LCA is mandatory for buildings. This is being assessed now and could be implemented by 2023. Already now, the Danish state provides a free tool for creating life cycle analyses for buildings ([LCAbyg](#)). In Sweden, a first step is being taken with the so-called climate declarations for buildings that will become mandatory from 2022. This is expected to be followed by the implementation of limit values. [49] In parallel, there are other efforts to make material choices more straight forward, like the example of the "construction material pyramid" from the Centre for Industrialised Architecture (CINARK) at the Royal Danish Academy showing the emissions from different building materials. [50]

Currently, LCA is used but there is still research being done on the subject of life cycle analysis for buildings to create better and more accessible tools. This is needed to make it easier to weigh in the factor of material use and emissions in decisions. In both Sweden and Denmark using full life cycle assessment is still not yet business-as-usual. With the coming policy changes in both countries, this is expected to change. The updated targets in Denmark, that will be in place after 2023, and the new law for climate declarations in Sweden in 2022 will make speed up the application of life cycle thinking, analyses and the development of environmental product assessments (EPDs) for assessing building products and elements. [49]

Important national actors

In both Denmark and Sweden, academia is still an important part of the development of this field. Also, the larger consultant firms are starting to do LCAs for (especially the larger) construction companies. Examples of important actors in Denmark and Sweden are; VCØB knowledge for Circular Construction (DK), Teknologisk Institut (DK), Statens Byggeforskningsinstitut, Centre for Industrialised Architecture, the Swedish Life Cycle Center and the Swedish Environmental Institute (IVL). There is also a [Nordic Dialogue Forum for LCA](#), created from the Nordic Council of Ministers that aims to harmonise the work in the Nordics around life cycle assessment of buildings.

Business and Collaboration Opportunities

As this is still an area where academia and pilot projects are playing an important role and the shift is slowly happening in the construction sector itself, the main opportunities lie in sharing good practice.

Collaboration opportunities:

- Share pilot projects, further compare the practices in the Netherlands that have been in place for longer and compare them with the current developments in Denmark and Sweden.

Business opportunities: there are no identified business opportunities in this area



Featured Project: Hoppet Preschool

The construction of this preschool started in the fall of 2020 with the goal of creating the first fossil free building project in Sweden. Looking at all parts of the process and all different materials, the municipality of Gothenburg have gathered a range of partners to deliver fossil free solutions.

More information can be found [here](#).

CONSTRUCTION WITH WOOD

The findings of this market study are that the development and focus on constructing with wood is more prominent in Sweden than in Denmark. Therefore, this deep dive only covers Sweden. At the same time, the construction with wood is getting more attention globally, and therefore also in Denmark. For instance, there are developments in building with wood in one of Copenhagen's new neighborhoods, Fælledby. [51]

In Sweden almost half of all residential buildings, mostly in one- and two-story buildings, are built with wood. In recent years, however, there has been a shift to start working with wood in higher and more complex constructions. The technical and environmental benefits of working with wood are driving this trend. Today the market share is 10-15% and the production is growing for small dwellings (see Figure 20) as well as for multi-story buildings. [8] [52]

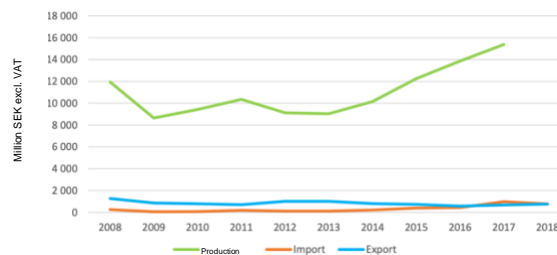


Figure 20. The production, import and export of small wooden dwellings between 2008 and 2018 [53]

Looking at the current investments for raised capacity in the industry, there is a potential to build up to 50% of the new multi-story residential buildings and 35% of the commercial buildings with wood by 2025. This development is expected to not only lower CO₂ emissions, but is also expected to create new jobs and raise the efficiency in the construction sector. Industrialisation and prefabricated elements will be a key factor to achieve this. Growth of local players is expected to cover most of the increase. Imported wood and prefabricated elements could feature to some extent but the opportunity for international business is expected to be more focused on technology solutions. [54]

The Swedish large-scale wood-building industry is still developing. Until now, this development has somewhat happened in the outskirts of the construction sector within small-scale industrial builders. These actors have often also been the ones developing and owning the projects whereas the large, dominating companies in the sector have more or less acted as spectators. In order to increase the share of wood in the market, these large companies also need to start using more wood. This will not be easy due to the, very strong, practice of using cement in the sector. One key factor for the shift to more wood is expected to be producing wooden elements that can substitute concrete more directly. [54]

Important national actors

- The pioneers in building with wood in Sweden today are companies such as Derome, Lindbäcks bygg, Moelven, Stora Enso, BoKlok, OBOS and Martinsons trä
- There are also some national associations like the Swedish association of wood-building (Sveriges träbyggnadskansli) and Swedish Wood.
- Interesting projects are: [Preschool Hoppet](#), [Sara Kulturhus](#), [Kajstaden Tall Timber](#), [Preschool Norrstrand](#)

Business and Collaboration Opportunities

As this market is expected to grow significantly, but the production is expected to be mainly located in Sweden, there is mainly a "gap" in production technology and experiences with building with wood. Specifically, the parts where Dutch players could play a part are:

Business opportunities:

- Production technology that helps in industrialising the wood construction sector
- Import of wooden elements and products (limited)

Collaboration opportunities:

- Collaboration around developing production technology
- Exchange in experiences with building with wood



Featured Project: Sara Kulturhus

This cultural centre is currently being built in Skellefteå in Sweden and supposedly going to be the highest wooden building in the world with its 20 stories. Even the elevator shafts are built made out of wood. The architect White and partners have developed several innovations to make the building possible.

More information can be found [here](#).

BUILDINGS WITH 100 % CLEAN ENERGY

Renewable energy systems

Both Denmark and Sweden are in the top of EU countries when it comes to share of renewable energy in their final energy consumption. Renewable energy production in Denmark has been increasing steadily since the 1990's to account for 35% of the energy consumption today. The Swedish share of renewable energy is the highest in the EU with 55%. This compared to the Netherlands having around 8% renewable energy (see Figure 21). [55]

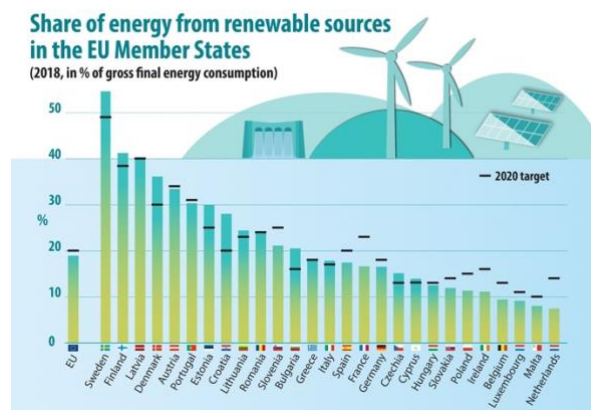


Figure 21. Share of energy from renewable sources in the EU member states, 2018 [55]

The share of dwellings heated by district heating is relatively low in the Netherlands (4%) compared to Denmark (65%) and Sweden (more than 50%) as seen in Figure 22.

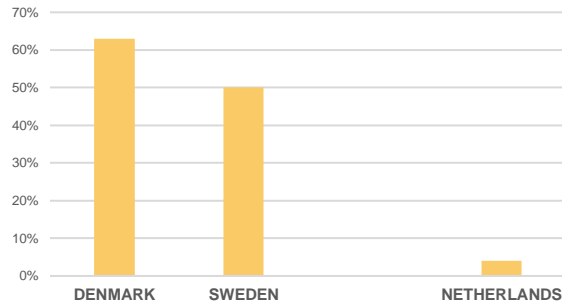


Figure 22. Share of buildings heated by district heating in Denmark, the Netherlands and Sweden respectively [56] [57] [58] [59]

As much as 90% of multi-dwelling buildings in Sweden are heated by district heating whereas for one- and two dwelling buildings this figure is only 17% (the most common way of heating being by electricity). [58] In Denmark, apart from district heating, which is the far most common way of heating, natural gas and oil is also used. The number of homes being heated with natural gas and oil have been declining since the 1980's to around 600.000 homes in 2019. [60]

In summary, it can be good to keep in mind that the starting point for the energy transition in Denmark and Sweden is quite different from the Dutch focus to reduce the use of natural gas and rapidly increase the production of renewable electricity. Nonetheless, both Denmark and Sweden have had a lot of focus on energy reduction and renewable energy production the last decades. This is continuing with new and cheaper technologies, stricter regulation to reduce energy usage for heating and more focus on renovation and energy saving. The most interesting areas within this topic are therefore renewable electricity generation and smart grids and energy saving in renovation.

RENEWABLE ELECTRICITY GENERATION AND SMART GRIDS

In Denmark, currently most renewable electricity comes from wind power. In 2019 the energy generation from wind was more than 16 000 GWh. Especially large-scale wind power plants are on the rise and in 2019 75,5% of the total wind power generation came from plants with a capacity of more than 2 MW. The installation of solar energy is also increasing. In the year 2000 there was hardly any solar energy installed at all in Denmark, in 2018 the energy generation from solar was 960 GWh, 2,5% of the total electricity consumption. [60] [61]

In Sweden most of the electricity generation comes from nuclear (38% of the total) and hydropower (37% of total) but also wind power is increasing steadily (12% of total in 2019). The installation of solar electricity is also increasing rapidly in Sweden: in 2018 the installed capacity was 411 MW, an increase with 178% from the year before. Still, solar only accounts for 0,4% of the total electricity generation. [62]

In both Sweden and Denmark small scale installations on roofs is the most common form of solar power but the installed power per person is 7 times higher in Denmark than in Sweden. This is due to very beneficial financial support systems in Denmark that has been in place in different forms causing a peak in installation in 2012. Also, electricity prices (including taxes) are higher in Denmark than in Sweden.

Denmark still has a number of different financial support systems for renewable electricity from [Energistyrelsen](#). The beneficial support system for solar and "house-hold windturbines" (husstands vindmøller, below 25m) will be changed from year-based to a "flexible" settlement from 2021. This means produced electricity will not be directly set off against the consumption of electricity but sold on the electricity market at market prices. [63]

In Sweden, there was financial support for solar power for private citizens as well as the private and public sectors until 2020. This, together with a growing interest in the technologies and lower prices, has increased the installation of solar panels amongst homeowners. There will be more funds available from 2021 but this is not expected to be enough for the large number of companies and homeowners on the waiting list [64]. However, as of 2021, a new tax reduction scheme for green technology will also be implemented for private citizens. In this scheme there will be a tax reduction for solar panels (-15%), charging stations for electrical vehicles (-50%) and private storage of energy (-50%) [65].

In October 2020 the Swedish government started working on a strategy for electrifying the Swedish energy system. The strategy is expected to be launched by October 2021. One forecast is that the need for electricity will quadruple by 2050, accelerating the need for investment in renewable electricity further. Storage of energy is expected to be a key part of the transition with the electricity network already at maximum capacity in parts of the country. [66] [67] In Denmark there is no national electrification strategy to date, but there is a strategy for electrifying the rail network. Together with electrification of processing industry and the expected increased electrification of heating systems for buildings, the demand for electricity in Denmark is set to increase as well. [68] [69]

There is a lot of potential for the market for renewable electricity generation directly connected to buildings (on the roof or façade) in both Denmark and Sweden as none of the countries are expected to have reached a peak in installations yet. The largest challenges currently are, as in many countries around the world, the lack of knowledge of the benefits by developers and building owners alike as well as an uncertainty due to ever changing financial support systems. The fact that the share of renewable energy in both countries is already high also creates a certain degree of complacency in the energy transition. This means there is no sense of urgency or push to install more capacity but rather a feeling that one "is doing quite well" in terms of renewable energy. This is factually true, by European standards, but causes issues in getting the necessary investments in these technologies to reach the national targets.

These challenges should not be seen as a barrier for entering this market. On the contrary, new products and services in this area, that make it easy and accessible to install and use renewable electricity technologies, are needed to continue to accelerate their adoption. The growth of renewable power in the built environment also puts more pressure on the necessity of continued development and implementation of smart grids and there is a trend towards looking at storage of electricity in different forms.

Important national actors

Most of actors in the renewable electricity market for buildings in both Sweden and Denmark are energy companies and local entrepreneurs. In Denmark there are around 270 certified solar installation companies (see the list at [SparEnergi](#)) and around 60 electricity companies (see the list at [DanskEnergi](#)). In Sweden there are around 400 local energy companies (see the whole list at [Energiföretagen](#)), the largest actors within solar are E-on, Vattenfall, Umeå Energi and Telge Energi. There are also few larger national actors that have their business explicitly solar power for buildings. Examples in Denmark are KlimaEnergi and VivaEnergi and in Sweden El av Sol Nordic, Freebo and Soltech (see more at [Solportalen](#)).

For consumers, there is guidance on installing solar power, in Denmark through the national knowledge portal "[Sparenergi](#)" and in Sweden at "[Solelportalen](#)" and "[Svensk solenergi](#)" (providing solar maps).

In Sweden the largest growth in installation of solar is in the bigger cities. In 2019 Gothenburg, Uppsala, Stockholm and Linköping had the highest total installed solar capacity (all more than 15 MW). In the same year Gothenburg, Uppsala and Västerås installed most new solar power of all Swedish municipalities (around 6 MW). [70]

Business and Collaboration Opportunities

The ambitious goals for renewable energy in both Sweden and Denmark and the still unexplored subjects of household storage and smart grids make this an area with high potential business opportunities. There is a belief the markets need a kick-start with innovative and accessible products and services in this segment.

Business opportunities:

- Export of Dutch electricity generation and smart grid innovations (products and services)
 - o e.g. Vehicle to grid technology and small scale wind
 - o This can be done through getting in contact with project managers of building projects directly (during the project plan phase, see Figure 13 for Denmark and Figure 17 for Sweden) and through public procurement processes for existing buildings

Collaboration opportunities:

- Exchange on experiences and pilot projects to discuss the further development of smart grids and the different options for creating smart and flexible electricity grids. Copenhagen Capacity has done [work](#) on this that can be built on.

To be able to reach these opportunities, a comparison of the smart grid development in the Netherlands and Denmark/Sweden and exploring companies that are currently developing this further, is recommended.



Featured Project: Town hall of Middelfart, Denmark

Crowned the most sustainable public building in Denmark, this town hall also the first building in the country to be DGNB Platinum and Diamond certified. One of the most important aspects that has been praised is the attractive architectural design that is intended to give the building a broader meaning and a role as a landmark for citizens.

A wide range of measures have been implemented to ensure that the building is economically, environmentally and socially sustainable. Energy usage is minimised through a very energy-efficient mechanical cooling system and solar cells on the building's roof. The building has a durable aluminium façade with low environmental impact that requires low maintenance. The interior design is focused on optimising indoor temperature, daylight and acoustics.

More information can be found [here](#).

ENERGY SAVING IN RENOVATION

To achieve the climate targets, the existing building stock is a very important target for reduction of energy in both Denmark and Sweden. Denmark has a variety of funding schemes available to support R&D projects related to the development of innovative eco-efficient technologies and to the efficient use of energy in the building stock. Also, energy efficient renovation of buildings is supported by the strategy 'Road to energy-efficient buildings in the Denmark of the future', as well as subsidies and fiscal measures. However, the current shortage of qualified professionals (mostly skilled craftspeople such as carpenters, bricklayers and concrete workers) constitutes a barrier towards achieving the energy

efficiency targets. [9] The ambitious financial package for renovations in Denmark's social housing sector launched in 2020 is an important part of tackling this. There are 30 billion DKK set aside for renovation projects from 2020 to 2026 and 18,4 billion DKK are already reserved for projects all over Denmark. The scheme is expected to spark a wave of further investment in renovation from the construction industry, estimated to 3.6 billion DKK in 2020 and 9.4 billion DKK in 2021. [18]

In Sweden, there is also a need for investments in energy efficiency in old buildings, especially in those built during the 60's and 70's. There is also an attitude that public buildings should set a good example in terms of sustainability and energy use. [31] The estimation is that up to 1 million homes built in the 60's and 70's (the so called "million-program" or "miljonprogrammet") are in need of renovation and that 250.000 of these are in need of large renovations. This means investments of up to around 500 billion SEK and includes renovations for energy saving such as ventilation, insulation (windows, roofs and walls) but also renovation of the electricity system and balconies and facades. [42] The current average energy usage in these buildings is 155 kWh energy per square meter. This compared to the average of 134 kWh/m² for all multi-dwelling buildings in Sweden. [71]

Important national actors

- Large property owners in Denmark and Sweden will be important actors in the large renovations that need to be made the coming years, especially in buildings that are built in the 60's and 70's. In both Denmark and Sweden the social housing sector is an important player. In Denmark it's the 700 Almene Boliger, 500 of which being represented by [BL](#) and in Sweden the sector is being represented by the joint organisation for the municipal owned housing, [Allmännyttan](#).
- In Sweden, the three dominating construction companies have all created a package for the renovation of "miljonprogrammet": "hållbar renovering" (NCC), "miljonlyftet" (Skanska) and "bolyftet" (Peab)
- In both Denmark and Sweden there are knowledge centres for energy saving: SparEnergi (DK) and ICHB (informationscentrum för hållbart byggande, SW).

Business and Collaboration Opportunities

The need for accessible and inexpensive technology in this area are high in both Sweden and Denmark.

Business opportunities:

- Products and services for energy saving in renovation will be interesting for property owners in Denmark and Sweden, focus on the social housing sector, through the largest Danish organization [BL](#) and the Swedish [Allmännyttan](#) who are hoping for international collaboration to lower prices [72]
- Technologies and knowledge around industrialisation of the renovation process (standardisation and automation)

Collaboration opportunities:

- Developing renovations with a holistic perspective: that save energy, are well executed and use non-toxic materials with a sustainable financial model. As this is also a focus area for the Dutch energy transition: exchange with the Dutch social housing (woningcorporaties) on the topic of products and services for renovation and energy saving
- Information and exchange around industrialisation with the Dutch organisation "Stroomversnelling" and other industrialisation initiatives

To be able to reach these opportunities, further mapping of the maturity of different technologies as well as companies that are already offering products and services in this area in Denmark and Sweden is recommended.



Featured Project: HSB Living Lab

Ongoing innovation projects in a building that works as a hub for innovation and research on the campus of Chalmers in Gothenburg. This living lab explores the future of living and is run by HSB, one of the larger cooperative association for housing in Sweden.

More information can be found [here](#).

BUILDINGS ARE SPACES FOR LIVING, WORKING AND LEARNING

User centred design and well-being

There used to be a distinction of three spaces in society: home as “the first space”, work as “the second space” and places for leisure and other activities as “the third space”. Now, the straight lines that previously could be drawn between these spaces and functions are blurring. With the Covid-19 pandemic this has further accelerated, putting pressure on the discourse of how many office buildings we actually need and how buildings can be more multi-used in the future. [73] At the same time there is more attention brought to the fact that buildings are not mere shelter or a place to put a desk but spaces for living, working and learning. Especially in Europe, where 90% of the time is spent indoors, the indoor climate, emissions and noise and light are rightfully put in the spotlight. [3] These two aspects of user centred design, the future use of buildings, and measuring well-being of buildings, have been identified as areas of interest in the sustainable building sector in Denmark and Sweden.

FUTURE USE OF BUILDINGS

The need is changing for what buildings provide. From the users' perspective, a building can be a home but sometimes also an office, a place for learning and socializing. This notion has accelerated through the Covid-19 pandemic with learning and working from home becoming the new normal, office buildings around the world staying empty and vacancies taking over previously crowded shopping streets. The major shift to working from home, more home-based activities and shopping online has sparked the discussion about how we will use the space in and around buildings in the future. Some analysts suggest that we might see a trend of people moving out of the city centres, where they can afford to buy or rent a place with an extra room and have access to outdoor space. At the same time, offices will probably become more important for periodic social connections with colleagues and creativity will be needed to fill the vacant shopping streets. In all, the future use of different kinds of buildings is shifting and with this the need for more flexible physical planning (and planning legislation) and a new role for real estate owners. [73] [74]

Business and Collaboration Opportunities

This notion of future use of buildings is still a discussion in development but it is an important topic to follow.

Collaboration opportunities:

- For now, it can be interesting to share ideas and knowledge about how the use of buildings could continue to develop in the coming years. For instance, by organising discussions with property developers and real estate owners from the different countries.

Business opportunities: there are no identified business opportunities in this area

MEASURING WELL-BEING

In both Denmark and Sweden, the subject of well-being indoors and measuring this is an area that has gotten renewed attention. The Covid-19 pandemic has brought even more attention to this. In Denmark there is a clear trend towards stricter targets for well-being in buildings with targets regarding operation and maintenance plans for the indoor climate, measuring emissions to the indoor climate, documentation of problematic substances, daylight level, noise from ventilation systems in homes as well as room acoustics in homes. In Sweden, toxicity of materials has long been a very important aspect of the building process and there are several voluntary certifications developed to ensure this. However, there is now a renewed discussion about stricter measurement of emissions to the indoor climate during the use phase.

Business & Collaboration Opportunities

The notion of well-being in buildings has a long history in Denmark and Sweden but has gained renewed importance, especially in Denmark. More information is needed on specific technologies and actors in the market of measurement to say anything about collaboration or business opportunities. To do this, further mapping of the technologies within this area is recommended as there is a lot of Dutch expertise on the subject. The focus should be on measurement of indoor climate during the use phase and connections to the area Energy Saving in Renovation (on page 22).

Featured Project: Parking garage and a playground

Multi-story car park with green facade and an amazing playground on the roof in Copenhagen showing that buildings can have multiple functions – not only for people but also for the environment around it.

More information can be found [here](#).



DIGITAL TOOLS TO ACCELERATE THE TRANSITION

Digitalisation for Sustainable Buildings

Digitalisation is one of the strongest trends in the construction sector as a whole and could increase the effectiveness of the sector by one fifth. [8] One important part of the ongoing digitalisation is the implementation of Building Information Modelling (BIM) and the shift from a general visualisation to full scale digital twins. This possibility of looking at a building, terrain or neighbourhood at a very detailed level will be an important driver for sustainability. Another important part of the ongoing digitalisation are increased possibilities to digitalise buildings: to sensor well-being aspects such as noise and air quality as well as to log important physical aspects of buildings for future renovation and reuse. These two areas have been selected as areas of interest for Denmark and Sweden. Digitalisation developments are directly connected to, and accelerate the development of, the other areas of interest.

DIGITALISATION OF THE CONSTRUCTION PROCESS

Sweden and Denmark are seen as global front runners when it comes to digitalisation and adoption of BIM and also embracing the concept of digital twins. In Denmark, there has been a BIM-requirement in public procurement in place since 2007. This is one of the reasons why a lot of projects use BIM today. By 2016, 78% of Danish design companies used BIM to produce 3D visualisation. [75] However, there is much more potential for this type of technology in the sector and in 2019 the Danish “strategy for digital construction” was launched to put focus on the need for further digitalisation and technological advancement to increase the productivity in the construction sector. The strategy mentions the need for standardisation for better implementation of BIM and the importance of technology neutral implementation. Also, digitalisation for sustainability is an important part of the strategy and there are three initiatives mentioned that will be formed to achieve its goals: 1) development of a connection between Life Cycle Cost (LCC), Life Cycle Analysis (LCA) and BIM in the building sector to be able to better analyse and measure sustainability in the different parts of a building as well as its costs, 2) gather data and experiences from sustainable buildings in a data base and 3) development of digital passports for materials and buildings. [76]

In Sweden, the use of BIM is starting to take hold and in some public organisations such as the Swedish Transport Administration the use of BIM is even mandatory. The national programme “smart built environment” is an important part of Sweden’s plan to embrace digitalisation for sustainable cities but there is no further national strategy in place like the Danish one. [10] The roadmap for a climate neutral construction sector by 2045, an initiative by the construction sector, mentions digitalisation as an important tool for reaching the sustainability targets and mentions the importance of quality of data and open-source development but does not further specify how this will be done. [35]

Implementation of digital tools is the main challenge in both Denmark and Sweden. In Denmark, even if there has been a mandate to use some sort of BIM-tool in place for more than 10 years, the requirements are quite easy to meet. Therefore, the full potential of using digital tools for designing, and especially for maintaining a building has not yet been achieved. [35] [75]

Important national actors

In both Denmark and Sweden, the large consultancy firms are working with BIM. Especially for Denmark there is [DiKon](#), a joint business platform that aims to develop digital standards for the construction industry (not specifically working with sustainability). Also, [We Build Denmark](#), continuing the work of [InnoBYG](#), is driving the implementation of digital tools in the Danish construction sector.

In Sweden, [BIM Alliance](#) is a membership organisation with 200 members driving the digitalisation of the built environment (their members can be found [here](#)). [Nordic Contech](#) is a Swedish platform directed at startups that hosts events and talks about digitalisation in the construction sector.

Business and Collaboration Opportunities

Collaboration opportunities:

- There are already active actors and networks on the subject of digitalisation of the construction process in Denmark and Sweden. As the Netherlands has also come far in the field of digitalisation it is interesting to start with sharing best practice and examples where the use of BIM has gone hand in hand with making more informed choices on for instance material input or output, increased insight in used materials or creating a more energy efficient building.

Business opportunities: there are no identified business opportunities in this area

DIGITALISATION OF BUILDINGS

For the other selected areas of interest, especially reuse, material choices and life cycle thinking, electricity generation and smartgrids, energy saving in renovation and measuring well-being in buildings, the development of digital tools and sensors in buildings is important. New products and services will be needed for everything from putting sensors in place to gathering and analysing the large amounts of data. Digitalisation of buildings is thus a development that should be considered and connected to the opportunities for business and collaboration stated in the other areas of interest in this report.



Featured Project: A Working Lab

Innovation space and co-working place in Gothenburg Sweden. The building as well as its content and partners are committed to innovation and sustainable systems. The building is a result of a large number of ambitious innovation projects and is one of the pioneer projects in Sweden working with BIM.

The building was built and is managed by Akademiska Hus, one of Sweden's largest property owners that builds, develops and manages environments for education, research and innovation.

More information can be found [here](#).

Conclusion and Next Steps

There are many interesting opportunities for collaboration between the Netherlands and Denmark and Sweden when it comes to sustainable buildings. There is a lot to learn from each other, opportunities to collaborate on further development as well as opportunities to spark more trade for products and services within sustainable buildings.

Top business opportunities identified in this market study are:

- solutions for digital marketplaces for reused materials, including the broad implementation thereof,
- technology and processes that efficiently identify and extract materials and products in deconstruction,
- solutions for implementing material banks, material passports and demolition plans,
- innovative and accessible electricity generation and smart grid products and services,
- products and services for energy saving in renovation, and
- technologies and knowledge around industrialisation of the renovation process (standardisation and automation).

Top opportunities for further collaboration identified in this market study are:

- how to put circular construction, in a broader sense, in practice,
- renovations with a holistic perspective: that save energy, are well executed and use non-toxic materials with a sustainable financial model,
- knowledge on industrialisation (standardisation and putting production to scale successful elements and products), especially connected to building with wood and energy saving in renovation,
- development of the concept of user centred design and the future role of buildings, and
- experiences in successful implementation of digital tools for sustainability.

There are large similarities in the opportunities between Denmark and Sweden. However, in Denmark there is more focus on measuring indoor wellbeing with the new targets for the construction sector and currently more direct opportunities within energy renovation with the large investments from the government launched in 2020. In Sweden there is a larger focus on construction with wood and a need for higher productivity: covering the need for many new residential and public buildings at lower costs.

When it comes to doing business in Denmark and Sweden, both countries rank high in terms of "ease of doing business". According to a World Bank report Denmark ranks 4th and Sweden 10th out of 190 countries. [40] In ease in trading across borders both countries are also ranking high. Denmark ranks 1st out of 190 countries together with France and Sweden scores a bit lower and ranks 18th. [27]

There are of course things to think about when entering these markets, establishing contacts and getting to business opportunities is not always straight forward. In the construction sector, the margins are tight, traditions strong and especially small and medium sized companies lean on local businesses and local job creation. At the same time there are challenges, targets and ambitions to continue to be innovative and sustainable and a will to look abroad for new ideas, technologies and knowledge. For instance, the Swedish Allmännyttan, the national association for public housing, has identified international competition as key for reducing the prices of Swedish construction and are trying hard to overcome the barriers. [72] In all, the construction sector in both Denmark and Sweden is generally considered to be doing quite well when it comes to sustainability but acknowledges challenges ahead. This sets the bar high for international players to provide relevant technology and knowledge but also gives the opportunity to grow and develop together.

Tips for entering the markets of sustainable buildings in Sweden and Denmark:

- Focus on selling a solution to a problem, unique value propositions and combining products with relevant, accessible services. Have an answer to the question “why should a customer buy or invest in something from the Netherlands instead of choosing a local company?”.
- Language should not be a barrier as English is widely spoken but can be a challenge when it comes to direct business negotiations.
- Invest in local partners and contact foreign investment promotion agencies (see [actor map](#)).
- Start with building a relationship and exchanging experiences with future customers and partners.
- Keep similarities and differences between the countries in mind, also cultural differences. Take a look at the chapter “Comparing the Netherlands to Denmark and Sweden” that also states some cultural differences to understand some of the basics of these markets.
- Understand how far Denmark and Sweden have come in terms of sustainability, how important the topic is for the company you want to do business or collaborate with and what is happening in the broader market of sustainable buildings.
- As this is a topic in development, keep an eye on new developments.

Following this market study, a group of partners from the RME, FME and Innovation Quarter are continuing to work on connecting the Dutch, Danish and Swedish sustainable building sectors.

The advice on the next steps following this market study is to focus on the following:

- Continue to organise exchanges with different target groups (architects, developers, real estate owners, businesses and municipalities) on the areas of interest in this market study
- Invest in further mapping of the maturity of different technologies as well as companies that are already offering products and services in the areas of smart grids and energy saving in renovation in Denmark and Sweden. Connect this to measurement of well-being in buildings and digitalisation of buildings.
- As sustainable building is a topic in development, keep an eye on new developments. The main topics of this report will stay important but will evolve over time.
- The topics of biodiversity and water might become more important in the coming years. Especially the role of buildings in climate adaptation.
- Going beyond sustainable buildings, other construction topics that might be interesting to investigate further and collaborate on are larger infrastructure projects (climate adaptation, land filling and dealing with water), urban development, building in a dense city, sustainable mobility (promoting cycling), mini-grids of energy from green-houses and energy communities.

Appendix 1: Methodology

This market study was conducted through desk-research and interviews with actors in the Danish and Swedish construction sector. Input, especially to identify interesting topics and specific areas of interest and relevant information from the Dutch point of view, was also gathered during the two digital trade missions on sustainable construction that were organised by InnovationQuarter and FME in partnership with the embassies of the Kingdom of the Netherlands in Copenhagen and Stockholm in October (Denmark) and November (Sweden) 2020. The desk-research and interviews were used to identify interesting topics and areas to investigate further in the market deep dives as well as for input on the market deep dives.

INTERVIEWEES

The interviewees were chosen and contacted through an investigative interview method, starting from the network of FOG Innovation with further contacts gathered along the way.

<i>Organisation</i>	<i>Date</i>	<i>Suggestion for collaboration with NL</i>
Region Midtjylland (DK)	16/10 2020	circular public procurement
Mareld Landskap (SW)	22/10 2020	sustainable mobility in cities
Skanska (SW)	23/10 2020	material passports
Byggföretagen (SW)	27/10 2020	n/a
Dansk Industri (confederation of danish industry)	27/10 2020	n/a
CMB (SW)	28/10 2020	n/a
University of Southern Denmark	28/10 2020	n/a
ZynkaBIM	2/12/2020	digital twins/BIM modelling for sustainable buildings/circular economy
Knowledge center for circular construction	4/11/2020	knowledge around reuse
Chalmers	20/11/2020	n/a
BloxHub	9/12/2020	circular neighbourhoods and smart cities (Dutch context is more data focused)
Bona	14/12/2020	n/a

Organisations that were contacted but unfortunately did not have the possibility to participate or chose not to due to time constraints: Lendanger Group, 3XN, Denmark Green Building Council, Framtiden Byggutveckling, Allmännyttan, Sweden green Building Council and Kaminsky Arkitekter

SELECTION OF AREAS OF INTEREST

Topics and areas of interest were chosen through trend analysis and interviews, the table below shows what topics and areas were mentioned as trends or developments according to different sources.

		selected areas of interest												
source	country	circular construction: reuse/reduction of waste	climate neutral buildings material choices/LCA	circular construction: flexible design	circular business models	energy: reduction in renovation projects	energy: generation	energy: storage	energy: heat source	energy: passive housing	user centred design: the use of buildings	user centred design: focus on designing for well-being	digitalisation for a sustainable construction process	digitalisation of buildings
Creative Denmark / Beyond Buildings	DK	x (reuse)	x			x						x (well being data)		x (well being data)
Climate Partnerships on building and construction	DK		x			x								
BLOXHUB lab	DK	x		x							x			
Voluntary framework	DK		x									x (emissions, daylight & noise)		x (emissions, daylight & noise)
Interviews DK (5)	DK	x	x	x		x					x	x	x	
Digital trade mission Denmark	DK	x	x			x								
Nordic Council of Ministers	DK	x										x (toxicity)		
European Construction Observatory	DK		x			x	x				x	x		x (well-being data)
European Construction Observatory	SW		x			x	x				x	x		x (well-being data)
Nordic Council of Ministers	SW	x										x (toxicity)		
Digital trade mission Sweden	SW	x	x (wood)				x						x	
Interviews SW (7)	SW	x	x			x	x	x			x	x (toxicity)	x (BIM)	x (well-being & toxicity data)
Navet	SW	x	x (wood)	x		x	x						x	
Almega	SW		x (wood)											
Road map sustainable construction Sweden	SW	x	x (also wood)		x				x	x			x (digital climate declarations & BIM)	
Sveriges Arkitekter/ architects declare	SW	x	x	x		x					x		x	

Appendix 2: Sources

- [1] FOG Innovation, *8 Megatrends that affect our future society*, 2020.
- [2] CreativeDenmark, 2020. https://creativedenmark.com/sites/default/files/paragraph/field_pdf/creativedk_book_200x260_digi.pdf.
- [3] Ramboll, "Sustainable Buildings Market Study 2019," 2019. https://ramboll.com/-/media/files/rgr/documents/markets/buildings/sustainable-buildings-market-study-2019_web.pdf?la=en.
- [4] UN Environment Programme, 2019. <https://www.unenvironment.org/resources/publication/2019-global-status-report-buildings-and-construction-sector>.
- [5] European Commission, "Level(s) - The European framework for sustainable buildings," 6 11 2020. <https://ec.europa.eu/environment/eussd/buildings.htm>.
- [6] World Green Building Council, "World Green Building Trends 2018," 2018. <https://www.worlgbgc.org/sites/default/files/World%20Green%20Building%20Trends%202018%20SMR%20FINAL%2010-11.pdf>.
- [7] Dodge Data & Analytics & US Green Building Council, "World Green Building Trends 2018," 2018.
- [8] Almega, "Innovation for byggande," 2020. <https://www.almega.se/app/uploads/sites/6/2020/09/innovation-for-byggande.pdf>.
- [9] European Construction Sector Observatory, "Country profile Denmark," 2019. https://www.buildup.eu/sites/default/files/content/ecso_cfs_denmark_2020.pdf.
- [10] European Construction Sector Observatory, "Country Profile Sweden," 2020. <https://ec.europa.eu/docsroom/documents/23752/attachments/1/translations/en/renditions/native>.
- [11] H. Wallbaum och C. Fudge, "Beyond2020," 2020. <https://beyond2020.se/wp-content/uploads/2020/11/Transformational-Plan.pdf>.
- [12] European Commission, 2020. https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en.
- [13] European Buildings Observatory, "EU Buildings Database," 2016. https://ec.europa.eu/energy/eu-buildings-database_en.
- [14] European Construction Sector Observatory, 2019. https://www.buildup.eu/sites/default/files/content/ecso_ar_housing_affordability_2019.pdf.
- [15] A. Pittini, "Social Housing in the European Union," 2012. https://www.researchgate.net/publication/308964157_Social_Housing_in_the_European_Union.
- [16] Hofstede Insights, <https://www.hofstede-insights.com/country-comparison/denmark.the-netherlands.sweden/>.
- [17] Byggföretagen (Swedish Construction Federation), "Nordisk byggkonjunktur 2019-2020," 2020. https://byggforetagen.se/app/uploads/2020/01/Nordisk_BK_19_20.pdf.
- [18] Dansk Industri (Confederation of Danish Industry), "Optimisme i bygge- og anlægsbranchen på trods af coronakrisen," 2020. <https://www.danskindustri.dk/arkiv/analyser/2020/10/optimisme-i-bygge-og-anlgsbranchen-pa-trods-af-coronakrisen/>.
- [19] Danish Energy Agency, *Presentation at Digital Trade Mission*, 2020.
- [20] Danish EPA, 16 12 2020. <https://eng.mst.dk/sustainability/sustainable-development-in-denmark/>.
- [21] Danish Government, 2018. https://mfvm.dk/fileadmin/user_upload/MFVM/Miljoe/Cirkulaer_oekonomi/Strategi_for_cirkulaer_oekonomi.pdf.
- [22] Trafik, bygge og boligstyrelsen, 2020. <https://baeredygtighedsklasse.dk/-/media/TBST-DA/Byggeri/Lister/Publikationer/Vejledning-om-den-frivillige-baeredygtighedsklasse-maj-2020.pdf>.
- [23] European Construction Sector Observatory, 2020. <https://ec.europa.eu/docsroom/documents/44005>.
- [24] Trade Mission, "Presentations at the Digital Trade Mission, Dutch-Danish Event on Sustainable Building & Energy Systems," 2020.
- [25] DanskeArk, "DanskeArk," 21 12 2020. <https://www.danskeark.com/>.
- [26] Finans DK, "Brancheanalyse: Byggeentreprenørbranchen 2019," 2019. <https://finans.dk/analyse/ECE11650535/brancheanalyse-byggeentreprenoerbranchen-2019?ctxref=ext>.
- [27] World Bank, "Doing Business 2020 - Economy Profile Denmark," 2020. <https://openknowledge.worldbank.org/bitstream/handle/10986/32853/Doing-Business-2020-Comparing-Business-Regulation-in-190-Economies-Economy-Profile-of-Denmark.pdf?sequence=1&isAllowed=y>.
- [28] Ramboll, "Større fokus på renovering kan bringe Danmark i mål i 2030," 29 10 2020. <https://dk.ramboll.com/medier/rdk/storre-fokus-paa-renovering-kan-bringe-danmark-i-maal-i-2030>.
- [29] Danish Government, "Strategy for energy renovation of buildings The route to energy-efficient buildings in tomorrow's Denmark," 2014. https://ec.europa.eu/energy/sites/ener/files/documents/2014_article4_en_denmark.pdf.
- [30] BIM+, "Which countries have the highest levels of BIM adoption in Europe?," 2018. <https://www.bimplus.co.uk/people/which-country-most-bim-mature-europe/>.
- [31] Navet Analytics, *Presentation Dutch/Swedish digital event Sustainable Building and Energy Systems*, 2020.
- [32] Swedish EPA, 16 12 2020. <http://www.swedishepa.se/Environmental-objectives-and-cooperation/Swedish-environmental-work/Work-areas/Climate/Climate-Act-and-Climate-policy-framework>.
- [33] Swedish EPA, 16 12 2020. <https://www.naturvardsverket.se/Miljoarbete-i-samhallet/Sveriges-miljomal/>.
- [34] Swedish Government, "National strategy for a circular economy," 2020. <https://www.regeringen.se/pressmeddelanden/2020/07/sverige-staller-om-till-en-cirkular-ekonomi/>.
- [35] Fossil Free Sweden, 2018. https://byggforetagen.se/app/uploads/2020/01/Fardplan_for_fossilfri_bygg_och_anlaggningssektor_20181228-1.pdf.
- [36] Nordic Council of Ministers, 2018. <https://norden.diva-portal.org/smash/get/diva2:1188884/FULLTEXT01.pdf>.
- [37] Sweden Green Building Council, 16 12 2020. <https://www.sgbc.se/utveckling/utveckling-av-nollco2/vad-ar-nollco2/>.
- [38] Byggföretagen, "30 största byggföretagen efter omsättning i Sverige," 30 11 2020. <https://byggforetagen.se/app/uploads/2020/11/30-St%C3%B6rsta-2019-1.pdf>.
- [39] Sveriges Arkitekter, "Vågen framåt ("the way forward")," Sveriges Arkitekter, 2020.
- [40] World Bank, "Doing Business Sweden," 2020. <https://openknowledge.worldbank.org/bitstream/handle/10986/32898/Doing-Business-2020-Comparing-Business-Regulation-in-190-Economies-Economy-Profile-of-Sweden.pdf?sequence=1&isAllowed=yhttps://openknowledge.worldbank.org/bitstream/handle/10986/32898/Doing->
- [41] Skanska, 2016. <https://www.skanska.se/4932c6/siteassets/vart-erbjudande/projektutveckling/skolor/1000-skolor-pa-10-ar-skanska.pdf>.
- [42] National Board of Housing, Building and Planning (Boverket), "Miljonprogrammet," 2020. <https://www.boverket.se/sv/samhallsplanering/stadsutveckling/miljonprogrammet/>.
- [43] Delegation for Circular Economy Sweden, "Conference for circular economy, 3 december 2020," 2020.
- [44] Circle House, "Circle House Book," 2018. <http://grafisk.3xn.dk/files/permanent/CircleHouseBookENG.pdf>.
- [45] RE:Source, 19 10 2020. <https://formas.se/analys-och-resultat/seminarier/2020-08-25-mal-11-veckan.html>.
- [46] H Gerhardsson et al 2020 IOP Conf. Ser.: Earth Environ. Sci. 588 042036, "Transitioning the Swedish building sector toward reuse and circularity," 2020. <https://iopscience.iop.org/article/10.1088/1755-1315/588/4/042036/pdf>.
- [47] Re:Source, IVL Swedish Environmental Research Institute, EcoPlan in Medio, "Cirkulär upphandling i praktiken," 2020. <http://databas.resource-sip.se/storage/Cirkul%C3%A4r%20upphandling%20i%20praktiken%20-%20Projekt%20rapport%20.pdf>.
- [48] BAMB, "BAMB - Buildings As Material Banks," 2020. <https://www.bamb2020.eu/>.
- [49] T. Malmqvist, "LCA för byggnader Internationella erfarenheter," KTH & Smart Built Environment, 2019.
- [50] Centre for Industrialised Architecture (CINARK), "Materialepyramiden," 21 12 2020. <https://www.materialepyramiden.dk/>.
- [51] Fast Company, "In this new neighborhood, every building will be made entirely out of wood," 17 01 2020. <https://www.fastcompany.com/90451958/in-this-new-neighborhood-every-building-will-be-made-entirely-out-of-wood>.
- [52] Svenskt Trä, "Bygg med trä," <https://www.svensktra.se/bygg-med-tra/byggande/>.
- [53] TMF, 2019. <https://www.tmf.se/siteassets/statistik/statistiska-publikationer/trahusbranschen--uppd.-t-om-201904.pdf>.
- [54] S. Brege, T. Nord och S. Lars, "Industriellt byggande i trä – nuläge och prognos mot 2025," 2017.
- [55] Eurostat, "Share of energy from renewable sources 2018 infograph," 2018. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Share_of_energy_from_renewable_sources_2018_infograph.jpg.
- [56] Dansk Fjernvarme, "Fakta om fjernvarme," 20 08 2020. <https://www.danskfjernvarme.dk/nyheder/fakta-om-fjernvarme>.
- [57] RVO, "Stadsvervarming," 2020. https://www.rvo.nl/sites/default/files/bijlagen/Stadsvervarming_0.pdf.
- [58] Energimyndigheten Sweden, 2016. <https://www.energimyndigheten.se/globalassets/statistik/bostader/energistatistik-for-smahus-flerbostadshus-och-lokaler-2016.pdf>.
- [59] Energiföretagen, "Fjärrvärmestatistik Sverige," 2020. <https://www.energiforetagen.se/statistik/fjarrvarmestatistik/hillford-energi/>.
- [60] Energistyrelsen Danmark, 2019. https://ens.dk/sites/ens.dk/files/Statistik/energistatistik2019_dk.pdf.
- [61] Danske Energi, 15 12 2020. <https://www.danskeenergi.dk/nyheder/2018-satte-rekord-solenergi>.
- [62] Energimyndigheten Sweden, 2020. <https://energimyndigheten.a-w2m.se/Home.mvc?ResourceId=168344>.
- [63] Energinet, "Flexafregning og nettoafregning," 2020. https://energinet.dk/El/Private-ekunder/Flexafregning_Nettoafregningsgruppe6.
- [64] Energimyndigheten, "Frågor och svar om investeringsstödet," 2020. <http://www.energimyndigheten.se/formybart/soleportalen/vanliga-fragor-och-svar-om-investeringsstodet/>.
- [65] Skatteverket, 2020. <https://www.skatteverket.se/omoss/press/pressmeddelanden/2020/2020/nyskattereduktionforprivatpersonersominstallerargronteknik.5.67614884175c97df4192b91.html>.
- [66] Swedish Government, "Elektrifieringsstrategi (the electrification strategy)," 15 10 2020. <https://www.regeringen.se/regeringens-politik/transportsektorn-elektrifieras/el-4/>.
- [67] Dagens Nyheter, "Regeringen måste planera för fyrfaldig elanvändning," 14 01 2021. <https://www.dn.se/debatt/regeringen-maste-planera-for-fyrfaldigad-elanvandning/>.
- [68] Ea Energianalyse, "Roadmap for elektrificering i Danmark," 2020. https://www.ea-energianalyse.dk/wp-content/uploads/2020/08/Litteraturstudie_Roadmap_for_elektrificering.pdf.
- [69] Danish Transport, Construction and Housing Authority, "Elektrificeringsprogrammet," 16 11 2020. <https://www.trafikstyrelsen.dk/da/Jernbanesikkerhed/Megabaneprojekter-og-miljoevurderinger-VVM/Elektrificeringsprogrammet>.

- [70] Energimyndigheten Sweden, 15 12 2020. <https://www.energimyndigheten.se/nyhetsarkiv/2020/solcellsstatistik-2019--nu-finns-44-000-solcellsanlaggningar-i-sverige/>.
- [71] Energimyndigheten, "Renovera miljonprogrammet energismart," 2010. . <https://energimyndigheten.a-w2m.se/FolderContents.mvc/Download?ResourceId=104252> .
- [72] Public Housing Sweden, "Från noll till åtta procent," 2019. . <https://www.sverigesallmannnytta.se/sabo-slar-larm-byggriser-na-har-okat-48-procent-pa-tre-ar/> .
- [73] Fastighetsägarna, "Hometail Fastighetsägarens roll under en pandemi," 2020. <https://www.fastighetsagarna.se/globalassets/rapporter/stockholms-rapporter/hometail-fastighetsagarens-roll-under-en-pandemi?bustCache=1611298166812>
- [74] BBC, "This is what coronavirus will do to our offices and homes," 06 08 2020. <https://www.bbc.co.uk/news/resources/idt-dc2d6e2d-3ab4-42de-8d03-bb7eda5fff8e> .
- [75] European Construction Observatory, "BIM in the EU construction sector," 13 06 2016. . <https://ec.europa.eu/docsroom/documents/34518>
- [76] Transport och bolgministeriet, 2019. . <https://www.ttm.dk/publikationer/2019/strategi-for-digitalt-byggeri/> .
- [77] European Commission, 11 10 2020. . https://ec.europa.eu/growth/industry/sustainability_en .
- [78] European Commission, "Circular Economy - Principles for Building Design," 2020. . <https://ec.europa.eu/docsroom/documents/39984> .
- [79] Byggföretagen Sweden, "Statistics on the 30 biggest construction companies in Sweden 2018," 2018. . <https://byggforetagen.se/app/uploads/2020/01/30-St%C3%B6rsta-2018.pdf> .
- [80] London School of Economics and Political Science, "Social Housing in Europe," 2007. . <http://www.iut.nu/wp-content/uploads/2017/07/Social-Housing-in-Europe-I.pdf> .
- [81] Public Housing Sweden, "Making it easier for foreign construction companies in Sweden," 2016. . <https://www.sverigesallmannnytta.se/trycksaker/making-it-easier-for-foreign-construction-companies-in-sweden/>
- [82] European Construction Sector Observatory, "Improving energy and resource Efficiency," 2018. . https://buildup.eu/sites/default/files/content/ecso_ar_to3_november_2018.pdf .
- [83] National Geographic, 26 11 2020. . <https://www.nationalgeographic.org/encyclopedia/anthropocene/> .