THE EU TAXONOMY'S IMPACT ON THE BUILT ENVIRONMENT & REAL ESTATE INVESTMENTS

AALBORG UNIVERSITY IN CPH
MSc. SUSTAINABLE CITIES
THESIS PROJECT – JUNE 2023

AUTHOR: ERIK TRANG
SUPERVISOR: ARNE REMMEN

AALBORG
UNIVERSITY

AALBORG UNIVERSITY

STUDENT REPORT

Aalborg University Copenhagen
A. C. Meyers Vænge 15,
2450 Copenhagen SV, Denmark

Master thesis description

Education:
Sustainable Cities

Semester:
4. semester

Title of Project:
The EU Taxonomy's impact on the built environment and real estate investments

Project period:
01.02.2023 – 02.06.2023

Supervisor:
Arne Remmen

Student:
Erik Trang – 20183198

Number of pages:
67

Abstract:

This report is written as a thesis project on the Master, Sustainable Cities at Aalborg University in Copenhagen.

The thesis has been developed on the basis of a collaboration with Akademiker Pension, which along with the rest of the financial sector is facing a transformation by the EU Taxonomy. The EU Taxonomy regulation sets standards and guidelines for sustainable economic activities, including the building and real estate sectors. Therefore, the thesis has explored the following research question:

In what way does the EU Taxonomy affect the socio-technical regime of the built environment in a more sustainable development in relation to renovations? And what impact does it have on real estate investments?

To answer the research question, four analyses have been conducted. The first one gives an overview of the new attention points by the EU Taxonomy, while the second one examines the impact on the built environment and the challenges and needs for more sustainable development. The third analysis is a case study of how the EU Taxonomy affects real estate investments while the fourth and last analysis discusses the impact that the EU Taxonomy has for driving the built environment towards a more sustainable development.

Summary

The financial sector plays a key role in the sustainable development by redirecting investments to enable the transition from unsustainable systems and technologies to more sustainable alternatives. The EU Taxonomy, along with the SFDR (Sustainable Finance Disclosure Regulation), supports this transition by providing guidance, standardization, and transparency for sustainable investments. The EU Taxonomy Regulation is expected to push the financial sector to incorporate sustainability considerations into their decision-making. This thesis has explored the following research question:

In what way does the EU Taxonomy affect the socio-technical regime of the built environment in a more sustainable development in relation to renovations? And what impact does it have on real estate investments?

To answer the research question, four analyses have been conducted. The first analysis explored the new attention points created by the EU Taxonomy for the built environment in relation to renovations. The second analysis examined how the EU Taxonomy affects the socio-technical regime of the built environment and the challenges and needs for a more sustainable development. The third analysis highlighted the EU Taxonomy's impact on real estate investments and considerations for real estate investments through a case study of Akademiker Pension. Lastly, the thesis discussed the gaps and limitations of the EU Taxonomy in moving the built environment towards sustainable development.

The key finding for this thesis are:

1. New and more attention points for renovations. The EU Taxonomy requires renovations to integrate more, and more stringent, sustainability considerations related to energy consumption, climate resilience, water consumption, circular economy, and substances in building materials compared to the Danish Building Regulation.

These new attention points will affect the status quo of the built environment.

2. Impact on the socio-technical regime of the built environment. The EU Taxonomy sets a more sustainable direction and initiates changes in various elements of the socio-technical regime of the built environment. This requires development of new data, knowledge, competences, and technologies. Criteria related to circular economy and pollution in the Taxonomy are in particular challenging for the existing regime.

3. Impact on real estate investments. The EU Taxonomy serves as a tool to evaluate real estate investments, with a focus on sustainability considerations regarding climate mitigation and adaptation. The Taxonomy pressures real estate investors to renovate assets:

- Buildings where permit was applied before the 31st of December 2020 with an Energy Performance Certificate below B.
- Buildings where permit was applied after the 31st of December 2020 with an Energy Performance Certificate below A2015.

Thereby, the Taxonomy can help lift the baseline of the existing building stock if investors adopt the Taxonomy.

4. Gaps and Limitations. While the EU Taxonomy is a significant step towards sustainable development by setting standards and a direction for investments in the built environment, it has its gaps and limitations. The Taxonomy's criteria are minimum performance standards, which may reduce incentives for further actions according to the sustainability agenda. Additionally, it does not (directly) address embodied carbon or ensure a positive climate effect from a life cycle perspective.

All in all, the EU Taxonomy has a significant impact on the socio-technical regime of the built environment and real estate investments. The Taxonomy affects real estate investments by pressuring investors to renovate their assets. Through the criteria for renovation, the Taxonomy sets new attention points, initiates changes, and drives the built environment towards a more sustainable development. However, it is crucial to acknowledge that the Taxonomy's minimum criteria are not the endpoint for sustainable development. Further efforts are necessary to address its gaps and limitations in order to reach the climate goals.

Preface

This thesis has been written by Erik Trang as the final project on the Master, Sustainable Cities at Aalborg University in Copenhagen. The theme of the thesis is the sustainable transition of the built environment with a focus on investments as a driver. The research of the thesis spans from the period 1st of February 2023 until the 2nd of June 2023, and explores how the EU Taxonomy Regulation affects the built environment. During the period, the thesis had Akademiker Pension as a cooperation partner, providing data, sparring, introducing the thesis to relevant experts, and more. The thesis would therefore like to give a special thanks to:

- Søren Møller-Larsson & Kenneth Larsen for their time and willingness to cooperate. It has been a pleasure to collaborate and gain insight into their work on real estate investment and sustainability, including the Taxonomy.

Furthermore, the thesis would like to thank:

- Jonas Meier Uldall & Emil Veileborg Kocsis Aali at Rambøll for sharing their knowledge about the EU Taxonomy and their time for giving an interview and sparring.
- Amal El-Kaswani at Green Building Council Denmark (Rådet for Bæredygtigt Byggeri) for taking the time to do an interview and sparring in regard to the EU Taxonomy.
- Jesper Breinholt at PensionDanmark for giving an interview and sharing insights on PensionsDanmark's work with sustainability in the built environment.
- Morten Penthin Svendsen at Nykredit for giving an interview and giving viewpoints on the Taxonomy's influence on the built environment from a financial standpoint.
- Morten Lundby Pedersen at Bruun & Hjejle for sharing his knowledge on the EU Taxonomy and sparring.

Last, but not least, the thesis would like to thank Arne Remmen for good and constructive supervising and professional sparring throughout the period.

Table of contents

1. Introduction

Buildings are an indispensable part of our society. However, they also represent one of the largest sources of GHG-emissions and waste generation. As the world continues to combat climate change and try to achieve the climate goals, the green transition of the built environment becomes crucial.

The green transition of the built environment involves, among others, transformation of existing buildings into sustainable, energy efficient, and climate friendly systems. According to the Building Performance Institute Europe (BPIE), 97 % of the building stock in Europe needs to be renovated to help achieve the EU's goal of becoming climate neutral in 2050 (BPIE, 2017). Renovations will thereby play a key role. Not only can renovations reduce GHG-emissions through energy savings, but they can also contribute to resource conservation through a circular economy and thereby support a more sustainable development. To achieve this transition, it is necessary to redirect capital flows and channel investments into sustainable activities, systems, and technologies.

Recognizing the importance of guiding investments in this direction, the EU launched its action plan on sustainable finance, a comprehensive strategy designed to align investment flows with the climate goals (European Commission, 2018). A key component of this plan is the EU Taxonomy, a classification system for sustainable economic activities. The Taxonomy covers, among others, activities in the built environment, including renovations, but also acquisition and ownership of buildings. This sets criteria for when acquiring, owning, or renovating buildings can be considered sustainable.

This thesis seeks to explore how the EU Taxonomy affects the built environment and real estate investments towards a sustainable development through regulation of the financial sector.

2. Problem analysis

Climate change is one of the biggest challenges facing the world today. The increasing levels of GHG-emissions caused by human activities are leading to rising global temperatures and more extreme weather patterns which threatens the stability of the planet. The following problem analysis will highlight some of the challenges and needs for a more sustainable development. Furthermore, it will be highlighted why the financial sector and the built environment will play a key role in the green transition.

Already today, several of the planetary boundaries are being strained (cf. Figure 1). If these boundaries are breached, it could lead to catastrophic consequences that cannot be reversed, such as biodiversity loss, resource depletion etc. Protecting the planetary boundaries is therefore essential for the long-term survival and well-being of both humanity and the planet (Stockholm Resilience Centre, n.d.).

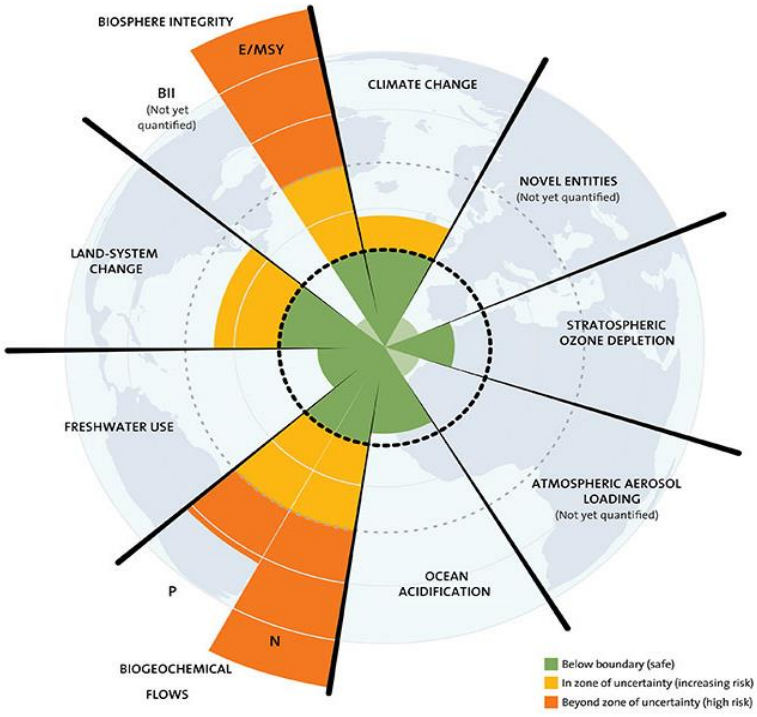

Figure 1 - Planetary Boundaries. Source: (Stockholm Resilience Centre, n.d.)

To stay within the planetary boundaries and maintain a safe and stable environment that can support life on earth, the global temperature rise must be limited to 2°C - preferably 1.5°C as stated in the Paris Agreement (UNFCCC, n.d.).

However, the world is not on track to meet the Paris Agreement. According to UNEP (United Nations Environmental Programme) the existing policies will lead to a temperature rise of 2.8°C by the end of the century, and the implementation of current commitments will only reduce this to a temperature rise of 2.5-2.6 °C (UNEP, 2022).

As the chances of limiting the temperature rise to 1.5°C by the end of the century are decreasing each year, there is a need to accelerate the green transition and create a system-wide transformation. Societal development has so far been closely linked with climate change due to the dependence of fossil fuels and overconsumption of resources. This trend is unsustainable and needs to be turned around. The next decade is crucial to ensure a sustainable development and curb the negative consequences of climate change (IPCC, 2022).

2.1 A sustainable development

A sustainable development is defined as: "*meeting the needs of the present without compromising the ability of future generations to meet their own needs"* (UN, n.d.).

As it is expected that the population will grow from 8 billion people today to 9,7 billion in 2050 (UN, 2019), the demand for energy and resources can be expected to increase. To meet the growing demand while reducing GHG-emissions, the world needs to accelerate the implementation of energy efficiency and renewable technologies and systems to phase out fossil fuels. Currently, this transition happens too slow.

Despite progress in increasing renewable energy production, global emissions continue to rise as energy demand exceeds renewable energy production (IEA, 2021). The latest numbers from IEA (International energy Agency) shows that renewable energy production accounted for under one third (28 %) of the global energy mix (IEA, 2022).

Renewable energy is a big driver for the green transition as it reduces dependence on fossil fuels and thereby also GHG-emission. However, a report from the Ellen MacArthur Foundation states that renewable energy can only address 55 % of global GHG-emissions. The remaining 45 % is linked to resource consumption (Ellen MacArthur foundation, 2021).

Today, the world consumes resources at a pace that will require 1,75 Earths, and based on Denmark's consumption, it would be 4 Earths. Over the last decades, earth overshoot day has continuously occurred earlier. This day marks the day when the Earth's resources that can be renewed within a year, have been depleted (Earth Overshoot Day, 2022). This trend indicates that the world exceeds the Earth's natural limits and consumes resources in a way that doesn't live up to the definition for sustainable development (UN, n.d.).

There is thereby a need to rethink how resources are being consumed to decouple GHG-emissions from societal development. Circular economy is a strategy for material efficiency and to tackle overconsumption by reducing the need for new raw materials. The circular economy aims to minimize resource consumption by preventing waste, extending the lifetime of products, and promoting reuse, recycling, and regeneration of materials (Ellen MacArthur foundation, 2021). Through the circular economy, GHG-emissions from the extraction, production, and transportation of new materials can be saved.

The thesis will focus on the built environment as the sector accounts for 50 % of raw material extraction, 35 % of waste generation, and 40 % of energy related CO2-emissions globally (World Green Building Council, n.d.). Despite the built environment being part of the cause for the climate crisis, it is also part of the solution for a sustainable development as resources and energy demand can be reduced to support the green transition. Transitioning the built environment will require major changes and the transition faces many challenges. One of them being carbon lock-ins.

2.2 The challenge of carbon lock-ins in the built environment

Carbon lock-in refers to the situation where society becomes dependent on systems and technologies that emit greenhouse gasses, which makes it challenging to implement more sustainable alternatives (Unruh, 2000). The built environment holds multiple carbon lock-ins that are linked to socio-technical aspects, such as culture, economy, politics etc. These lock-ins have led the built environment to a linear system of resource flow, which is characterized by the high waste generation and environmental impact. Status quo of the built environment thereby needs to be changed to reach the climate goals.

An example of how these lock-ins are expressed in the built environment can be seen in the use of concrete. Concrete is the most widely used building material in the world, and the climate impact linked to the production of concrete is carbon-intense and un-sustainable. The production of concrete requires cement which is made of scarce and non-renewable resources such as sand and gravel, which are becoming increasingly depleted. In addition, the cement production alone accounts for approximately 7 % of global CO2-emissions. (Bygninger og Grøn Omstilling et al., 2021). Concrete has been used for centuries and has become a technology that the built environment relies on. Furthermore, investments in concrete and infrastructure for concrete production, like cement plants, equipment for production, documentation of its properties etc. has been well established. This is a challenge for the green transition as the industry resists change due to economic aspects. Many jobs are linked to the production of concrete and cement plants have long lifespans, which makes profit a factor of resistance. In addition, other socio-technical aspects such as culture or politics have enhanced the carbon lock-in by favoring the use of concrete in the built environment. For example, the building regulations require documentation of materials' technical properties in constructions, and as there has been a long cultural history of using concrete, the material has an advantage in relation to documentation compared to other materials, like biobased building materials such as wood. This is especially the case in the Danish context compared to other countries like Norway or Sweden that have a more established culture and infrastructure for using biobased building materials like wood (BusinessInsights, 2020).

Thereby, investments play an important role in which systems and technologies that will be deployed in society. Past investments in systems and technologies, such as concrete, have created lock-ins which have been enhanced by other socio-technical elements. Furthermore, continuous investments in these unsustainable systems enhance the carbon lock-ins. In 2022, the 60 largest banks in the world provided 673 billion dollars in finance to companies using carbon-emitting systems and technologies (Makower, 2023). This is challenging for the achievement of the climate goals. There is therefore a need to redirect investments into more sustainable alternatives and evolve these to replace the past's unsustainable systems and technologies.

2.3 Redirecting the capital flow towards sustainability

The financial sector will play a key role in achieving the climate goals as investments are needed to transition away from the carbon-intensive systems and technologies towards more sustainable alternatives.

The EU estimates that there is a need for around 180 billion euros of investments per year towards 2030 to achieve the EU's targets agreed in the Paris Agreement (European Commission, 2018). To achieve this, the European commission announced an action plan on sustainable finance in 2018, that includes 10 initiatives, which aim to redirect capital flows to a more sustainable economy, mainstream sustainability into risk management, and foster transparency and long-termism (cf. Figure 2).

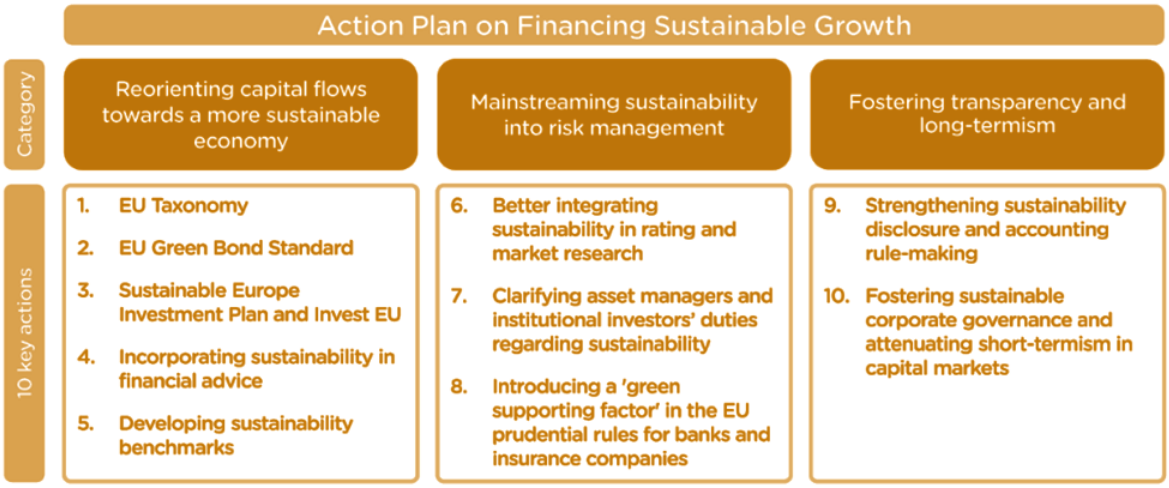

Figure 2 - The EU's sustainable action plan. Source: (Rambøll et al., 2021).

Overall, these initiatives aim to support the transition to a climate-neutral, climate-resilient, and resource-efficient economy by providing guidance, standardization, and transparency for sustainable investments (European Commission, 2018). Following the action plan, two of the key actions (Number 1 and 9 - cf. Figure 2) have been converted into regulations; The EU Taxonomy Regulation (EU) 2020/852 and the Sustainable Finance Disclosure Regulation (SFDR) (EU) 2019/2088.

2.4 Sustainable investments - The SFDR and The EU Taxonomy

The SFDR sets out rules on the disclosure obligations of financial market participants in relation to the integration of environmental, social, and governance (ESG) considerations.

There are disclosure requirements at both company and product level, as well as in relation to investment processes. The aim of the SFDR is to enhance the reliability of information, comparability, and transparency in relation to an investment's level of sustainability. There is a close link between the SFDR and the EU's Taxonomy Regulation, which specifies and expands a number of disclosure obligations in the SFDR (Finanstilsynet, 2023).

The EU Taxonomy is a classification system for climate and environmentally sustainable economic activities, and applies to two groups (Rambøll et al., 2021):

1) Financial institutions that provide financial products in the EU and are under the SFDR.
2) Non-financial companies that are already required to submit a non-financial statement under the Non-Financial Reporting Disclosure (NFRD) regulation.

However, it is expected that the NFRD will be replaced by the CSRD (Corporate Sustainability Reporting Directive) in the near future. The first companies under the CSRD will have to report for the first time in the financial year 2024 and publish their results in 2025 (cf. Figure 3). This change will require approximately 50,000 companies (more than four times the current number under the NFRD - 11.700) to disclose information on potential risks arising from social and environmental issues, and on the impacts of their activities on people and the environment (European Commision, n.d.).

The timeframe of reporting requirements under the EU Taxonomy depend on the type of company and the timeline can be seen in the Figure below:

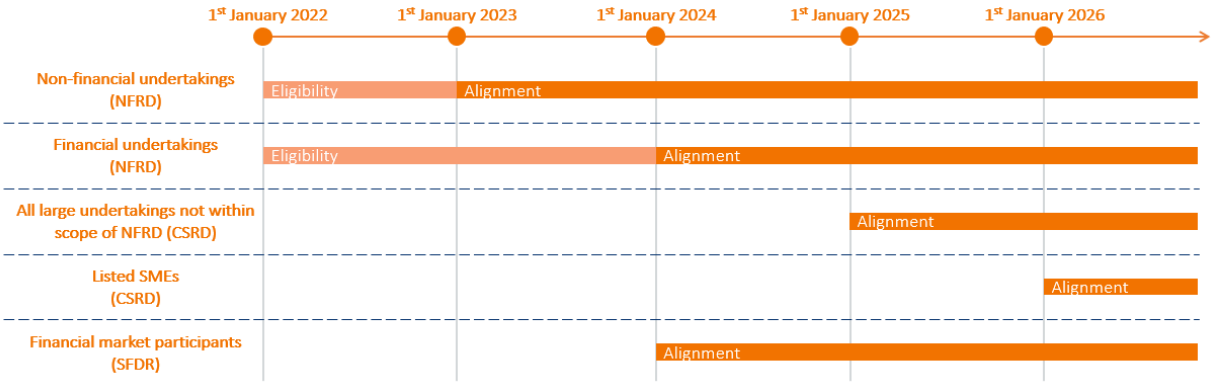

Figure 3 - Timeline of reporting requirements under the EU Taxonomy. Source: (Rambøll, n.d.). Note: Eligibility is when an economic can contribute substantially to one of the environmental objectives in the Taxonomy. Alignment is when the economic activity complies with all the criteria in the Taxonomy.

Figure 3 shows that more and more parts of the financial sector will have to report under the EU Taxonomy. Companies in Europe with financial products (article 8 and 9 products - cf. Appendix M) have to disclose how those align with the Taxonomy, while financial and nonfinancial undertakings covered by the NFRD (CSRD in the future) will have to report their eligibility and alignment with the Taxonomy (Rambøll, n.d.).

The EU has defined a number of eligible economic activities that can contribute substantially to the environmental objectives seen in Figure 4.

Figure 4 - The six environmental objectives of the EU Taxonomy. Source: (Nordic Sustainability et al., 2021).
Note: EO = Environmental Objective.

Under each of the six environmental objectives in Figure 4, technical screening criteria have been defined for when an economic activity can contribute substantially, or do no significant harm (DNSH), to the environmental objectives. However, only technical screening criteria for the first two environmental objectives (Climate change mitigation and climate change adaptation) have been translated into delegated acts. The technical screening criteria for the remaining four environmental objectives are yet to be published as delegated acts. However, the Technical Expert Group (TEG) on sustainable finance published their recommendations for the technical screening criteria for the remaining objectives in March 2022 and these are expected to be translated into delegated acts in 2023. (Rambøll & Moloney, 2022).

For an economic activity to be aligned with the EU Taxonomy, it is not enough to only contribute substantially to one or more of the six environmental objectives. The economic activity must also do no significant harm (DNSH) on the other objectives and meet the

minimum social safeguards standards (cf. Figure 5). The criteria in the EU Taxonomy are "knock-out criteria" which means that if one criterion is violated, the activity cannot become Taxonomy aligned.

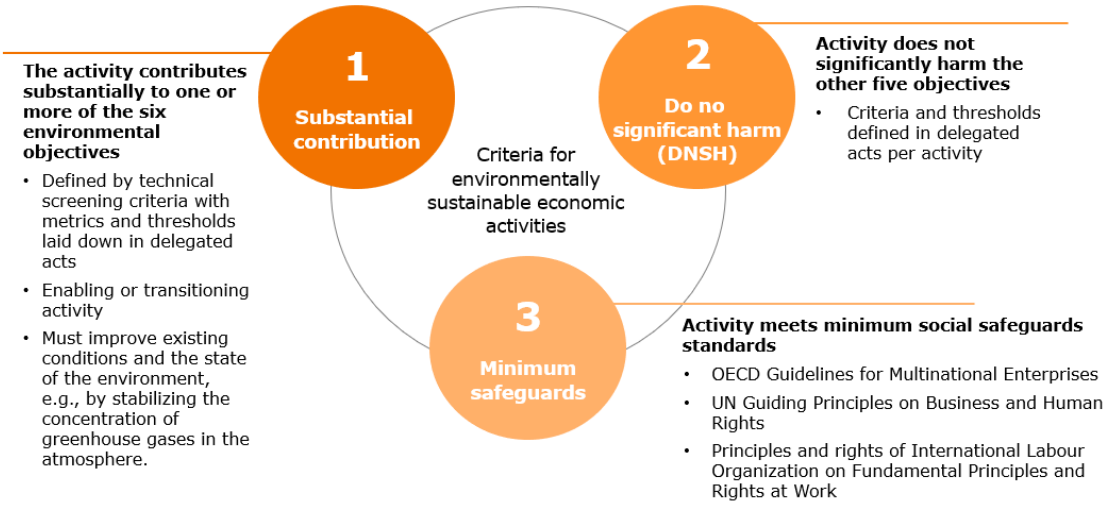

Figure 5 - Illustration of the steps an economic activity must follow to be classified as sustainable. Source: (Rambøll et al., 2021)

Financial market participants will have to disclose the proportion of their investments that are eligible and disclose the proportion of eligible investments that align with the Taxonomy (Finanstilsynet, 2023).

Under each environmental objective in the Taxonomy, different sectors have been defined to be eligible where economic activities in these sectors can contribute substantially to the environmental objectives. An example of the eligible sectors and economic activities for climate mitigation is illustrated in Figure 6.

Figure 6 - Eligible sectors and economic activities for climate mitigation. Source: (Rambøll, n.d)

Even though, that the financial sector is not a major emitter in itself, it has a large impact on a number of sectors (cf. Figure 6) through investments, loans, etc. Through the EU's action plan on sustainable finance, it is hoped that the financial sector will incorporate the Taxonomy and set requirements for economic activities in the different sectors to influence the whole value chain to adapt the Taxonomy's criteria and thereby create more sustainable activities.

There are good reasons for financial market participants to align with the Taxonomy. The SFDR and the EU Taxonomy are EU regulatory tools that reinforce the value of sustainability as a competitive parameter and drive the market into a green transition as the financial sector will have to create more transparency on how they integrate sustainability considerations and the sustainability impact of their investments (Finanstilsynet, 2023). As the EU moves towards a more sustainable economy, financial market participants that align with the Taxonomy may have better access to finance. Furthermore, aligning with the EU Taxonomy can give companies a competitive advantage and build a positive reputation (Rambøll et al., 2021).

To realize the potential impact of the EU Taxonomy and drive the market towards a green transition, it requires the financial sector to apply the framework.

Real estate has the highest reported proportion of eligibility in the Taxonomy compared to the other sectors due to the sector's highly polluting activities (Nordea, 2022). It is therefore interesting to explore how the Taxonomy's criteria will affect real estate investments to integrate sustainability considerations into their investments and push the built environment to be more sustainable.

2.5 The built environment and real estate investments

The built environment accounts for a large part of resource and energy demand, and is responsible for 36 % of the energy related CO_2-emissions in the EU (European Commission, 2020). The transition of the sector thereby plays a key role for a sustainable development.

Today, the majority of the building stock in the EU is energy inefficient. Energy efficiency in the EU is represented by Energy Performance Certificates (EPC) which is expressed by a letter ranging from A to G, with A being the most energy efficient and G being the least energy

efficient. According to the Buildings Performance Institute Europe (BPIE), 97 % of existing buildings have an EPC below A and needs to be upgraded to achieve EU's goal of becoming climate neutral in 2050 (BPIE, 2017).

As it is expected that around 80 % of the building stock will still be standing in 2050, it is important to bring those buildings' energy performance up to date. Renovation and increasing energy efficiency in these buildings will play a key role to combat climate change and support the green transition, as the most sustainable energy is the energy not consumed (World Economic Forum, 2022).

There are good reasons to focus on renovations as it can support the green transition by reducing consumption of both resources and energy. Furthermore, a report from Rambøll, shows that renovation is often both cheaper and has a lower climate impact than new construction (Rambøll et al., 2020). Moreover, the EU Taxonomy defines acquisition and ownership as an eligible activity, where one of the criteria is:

"For buildings where permit was applied before the 31st of December 2020, the building has at least an Energy Performance Certificate (EPC), A." (cf. Appendix K).

As 97 % of the building stock in the EU has an EPC below A, the majority of the building stock will have to be renovated in order to classify as sustainable under the Taxonomy. The Taxonomy also defines renovations as an eligible activity and sets criteria for what can be defined as a sustainable renovation.

Unlike the criteria for acquisition and ownership requirements, which only affect real estate investors, the criteria for renovations will indirectly affect the whole value chain of the built environment. The Taxonomy's criteria for renovation can thereby contribute to transitioning the built environment in a more sustainable development.

Renovations can contribute substantially to three of the environmental objectives: climate change mitigation, climate change adaptation, and circular economy. Under each environmental objective, renovations must meet different criteria in the Taxonomy. These criteria will be a driver for pushing the built environment in a more sustainable direction. For example, the criteria for substantial contribution to climate mitigation for renovations are (EU Taxonomy Compass, n.d.):

- *The building renovation complies with the applicable requirements for major renovations.*
    - *In Denmark: Renovation class 1 or 2 in the building regulation = EPC, A2010 or EPC, B* (Rådet for Bæredygtigt Byggeri.a, 2022).
- *Alternatively, it leads to a reduction of primary energy demand (PED) of at least 30 %.*

With the EU Taxonomy's criteria, the bar has been set for when renovations can classify as a sustainable activity which will guide the built environment towards a more sustainable development of the building stock. The Taxonomy's criteria will help raise the bottom of the building stock, given that the renovations comply with the criteria. If the existing building stock comply with the substantial contribution criteria to climate mitigation for renovation, it could enable major energy savings as the majority of the building stock is below EPC, B (cf. Figure 7)

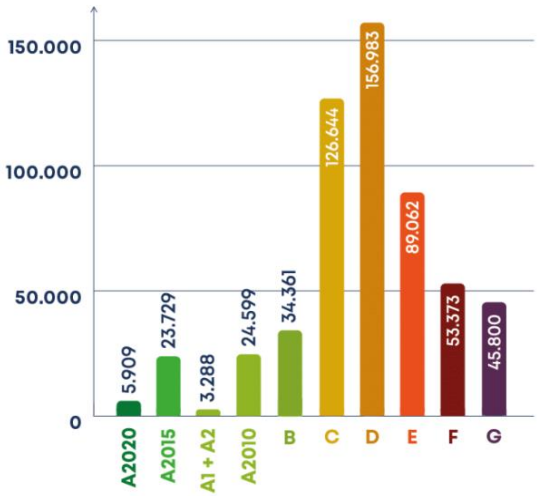

Figure 7 - Overview of the distribution of EPCs in the Danish building stock 2020. Source: (Energihjem, 2020). *Note:* In Denmark, new building classes have been introduced over time and three new A-classes have therefore been added to the scale: A2010, A2015 and A2020. The labels refer to the energy requirements in the building regulations. This means that a building labeled with A2010 meets the requirements of the 2010 Building Regulations (Energistyrelsen, n.d.).

Real estate investments in renovations play a major role in improving the existing building stock and at the same time reduce resource consumption (compared to demolition and new construction). The Taxonomy imposes a set of criteria for renovations to include and comply with a number of sustainability considerations. These criteria will influence the built environment to pay attention to these to classify as a sustainable economic activity.

With the criteria in the Taxonomy, the EU sets a clear distinction between sustainable and non-sustainable economic activities. The Taxonomy's criteria set a standard for investors to follow. This standard has the potential to drive the existing building stock towards a more sustainable development, as investors will need to disclose the level of sustainability of their investments, which will impact their business. The Taxonomy, along with the SFDR, will serve as a catalyst for pushing the existing building stock into a more sustainable development.

Summary:

The problem analysis shows that the world is not on track to meet the Paris Agreement. There is a need for a system-wide societal transformation. Here, the transition of the built environment will play a key role due to its high climate impact. However, the built environment faces multiple challenges in the transition - one of them being carbon lock-ins. To enable sustainable development, there is a need for redirecting the capital flow towards more sustainable systems and technologies.

The problem analysis highlights the following key points:

- The financial sector poses a significant role in accelerating the green transition in the form of investments, loans etc. Directing capital towards sustainable investments plays a crucial role in driving the transition.
    - The EU Taxonomy and the SFDR will support this by providing guidance, standardization, and transparency for sustainable investments.
- The EU Taxonomy Regulation and the SFDR will push the financial sector to incorporate sustainability considerations into their decision making and at the same time create more transparency in the financial sector regarding sustainability considerations.
    - This can influence the whole value chain to follow the Taxonomy's criteria for sustainable activities - causing a "trickle-down effect".
- The Taxonomy will push real estate investors to renovate their assets as the majority of the building stock do not align with the criteria under acquisition and ownership.
- The Taxonomy's criteria for renovations will play a key role in reducing emissions from the built environment by setting a standard.
    - The Taxonomy's criteria for renovation will affect the value chain of the built environment.

This thesis seeks to explore how the EU Taxonomy will affect the built environment and redirect real estate investments towards more sustainable activities. The thesis has found it interesting to see to what extent a financial regulation such as the EU Taxonomy will become a driver for a more sustainable built environment.

3. Research questions & delimitations

On the basis of the problem analysis, the thesis seeks to explore:

In what way does the EU Taxonomy affect the socio-technical regime of the built environment in a more sustainable development in relation to renovations? And what impact does it have on real estate investments?

To help answering the overall research question, the thesis will explore the following sub-questions:

1. What new points of attention does the EU Taxonomy create for the built environment in relation to renovations?
2. How does the EU Taxonomy affect the socio-technical regime of the built environment? And what changes does it require to create a more sustainable built environment and renovations?
3. What considerations does the EU Taxonomy pose for real estate investments?
   - A case study of Akademiker Pension.
4. To what extent does the EU Taxonomy create more sustainability in the built environment?

3.1 Delimitations

The following section will expound the delimitations made to create focus on the thesis' scope. Delimitations have been made on what this thesis will analyze, and the delimitations concern the following areas: Mechanisms for sustainable development in the built environment, Socio-technical regime of built environment, and the EU Taxonomy.

3.1.1 Mechanisms for sustainable development in the built environment

This thesis focuses on renovation as a driver for a more sustainable built environment. However, the thesis will also address other mechanisms such as circular economy and biobased building materials as they are included in the EU Taxonomy's criteria for renovations. The thesis defines sustainable renovations and buildings according to the Taxonomy's criteria for "renovations" and "acquisition and ownership", respectively (cf. Appendix I, J, and K).

3.1.2 Socio-technical regime of the built environment (in Denmark)

The thesis will, in the second analysis, be delimited to focus on the EU Taxonomy's impact on the socio-technical regime of the built environment. The Figure below illustrates the focus of analysis 2 "*Examining the impact of the EU Taxonomy on the socio-technical regime of the built environment".*

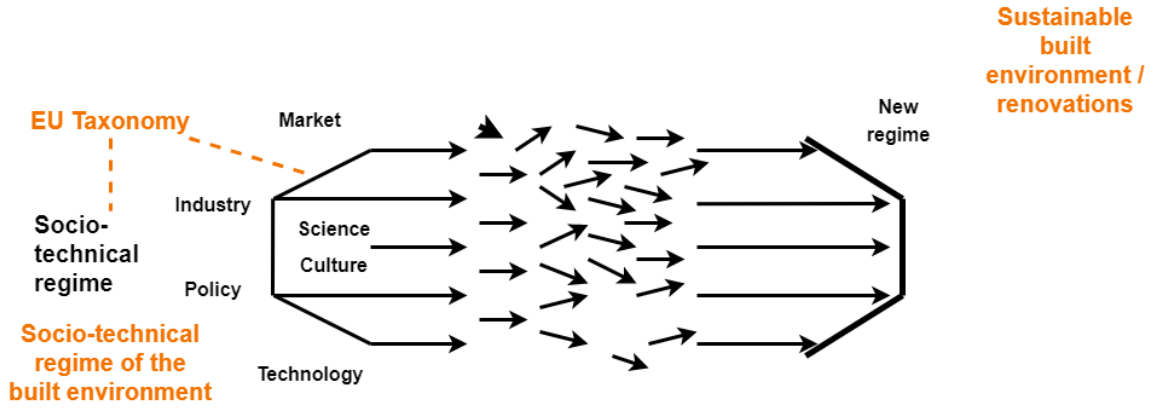

Figure 8 - Illustration of focus areas in analysis 2 of the Multi-Level Perspective (MLP). Own creation.

The thesis will focus on the required changes and challenges for reconfiguration of the existing socio-technical regime in order to transition to a new regime that creates a more sustainable built environment and renovations. However, the thesis will also address the mechanisms in the socio-technical landscape and niche landscape that can help drive the transition as well.

Denmark as reference

Conditions in the socio-technical regime vary from country to country. It has therefore been chosen to focus on one country, Denmark, to have clear references for the analysis.

3.1.3 The EU Taxonomy

The main focus of the thesis is to explore the impact of the EU Taxonomy on the built environment and real estate investments in relation to renovations. The first two analyses in the thesis will be delimited to focus on the technical screening criteria for renovations to examine the impact on the socio-technical regime of the built environment. In the third analysis, the thesis will address the Taxonomy's criteria for "acquisition and ownership" as these criteria influence investors to evaluate their portfolio and acquisitions which may lead to renovations if their assets do not comply. The thesis' study of the Taxonomy is illustrated in the Figure below:

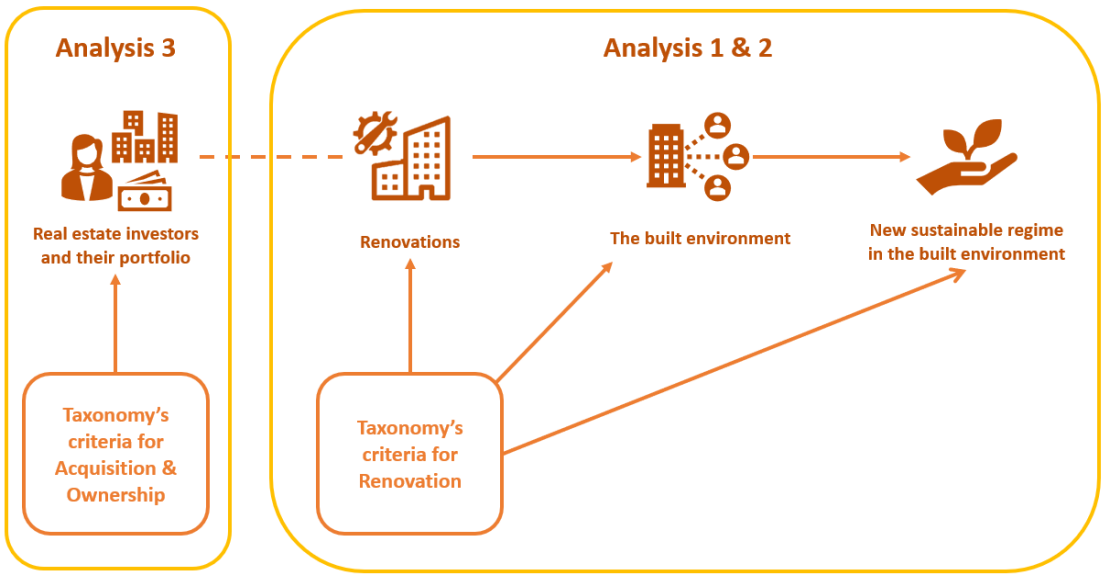

Figure 9 - Illustration of the thesis study of the Taxonomy. Own creation.

Furthermore, the thesis delimits its study of the Taxonomy to be based on the criteria published as delegated acts and the recommendations given by the Technical Working Group on sustainable finance in March 2022 (Platform on Sustainable Finance, 2022). The criteria which the thesis will be based on can be found in Appendix I, J, and K. Moreover, the thesis delimits from the minimum safeguards in the Taxonomy screening as it has been assessed that it could not be covered by the size of the thesis.

4. Research Design

In the following section, the research design for the thesis will be elaborated to explain the structure of the thesis and the link between the content and the research questions. This is illustrated in Figure 10.

4.1 New attentions points by the EU Taxonomy

The first analysis, "*New attention points by the Taxonomy"*, highlights how the Taxonomy's criteria affect renovations. Furthermore, the analysis will also highlight which criteria in the EU Taxonomy that require more than usual compared to the Danish Building Regulation in relation to renovations. The analysis has been made through desk research to collect the information needed to answer the first sub-question; *What new points of attention does the EU Taxonomy create for the built environment in relation to renovations?*

4.2 Examining the impact of EU Taxonomy on the socio-technical regime of the built environment

The second analysis, "*Examining the impact of the EU Taxonomy on the socio-technical regime of the built environment"*, explores the second sub-question; *How does the EU Taxonomy affect the socio-technical regime of the built environment? And what changes does it require to create a more sustainable built environment and renovations?*

The analysis highlights how the EU Taxonomy affects the different elements in the existing socio-technical regime of the built environment and outlines challenges as well as needs for a transition. The analysis has been conducted through the use of MLP as a theoretical framework together with desk research, and interviews.

4.3 Akademiker Pension's real estate investments

The third analysis, "*Akademiker Pension's real estate investments"*, answers sub-question number three; *What considerations does the EU Taxonomy pose for real estate investments? A case study of Akademiker Pension.*

Through a case study of Akademiker Pension's real estate portfolio, the analysis will highlight how the EU Taxonomy affects their real estate investments as well as the considerations it gives. Based on the case study, general conclusions will be drawn in relation to the Taxonomy's effect on real estate investments. The analysis is based on a case study, desk research, interviews, and the results drawn from the other analyses in the thesis.

4.4 The EU Taxonomy - Towards a sustainable development in the built environment?

The fourth analysis, *"The EU Taxonomy - Towards a sustainable development in the built environment?",* will discuss the sustainability level of the EU Taxonomy and will answer the fourth sub-question; *To what extent does the EU Taxonomy create more sustainability in the built environment?* The discussion will highlight aspects of the Taxonomy in terms of what it does well and what it may miss in relation to transitioning the built environment into a sustainable development that can contribute to the achievement of the climate goals. The discussion is based on the conclusions drawn from the previous analyses, interviews, and desk research.

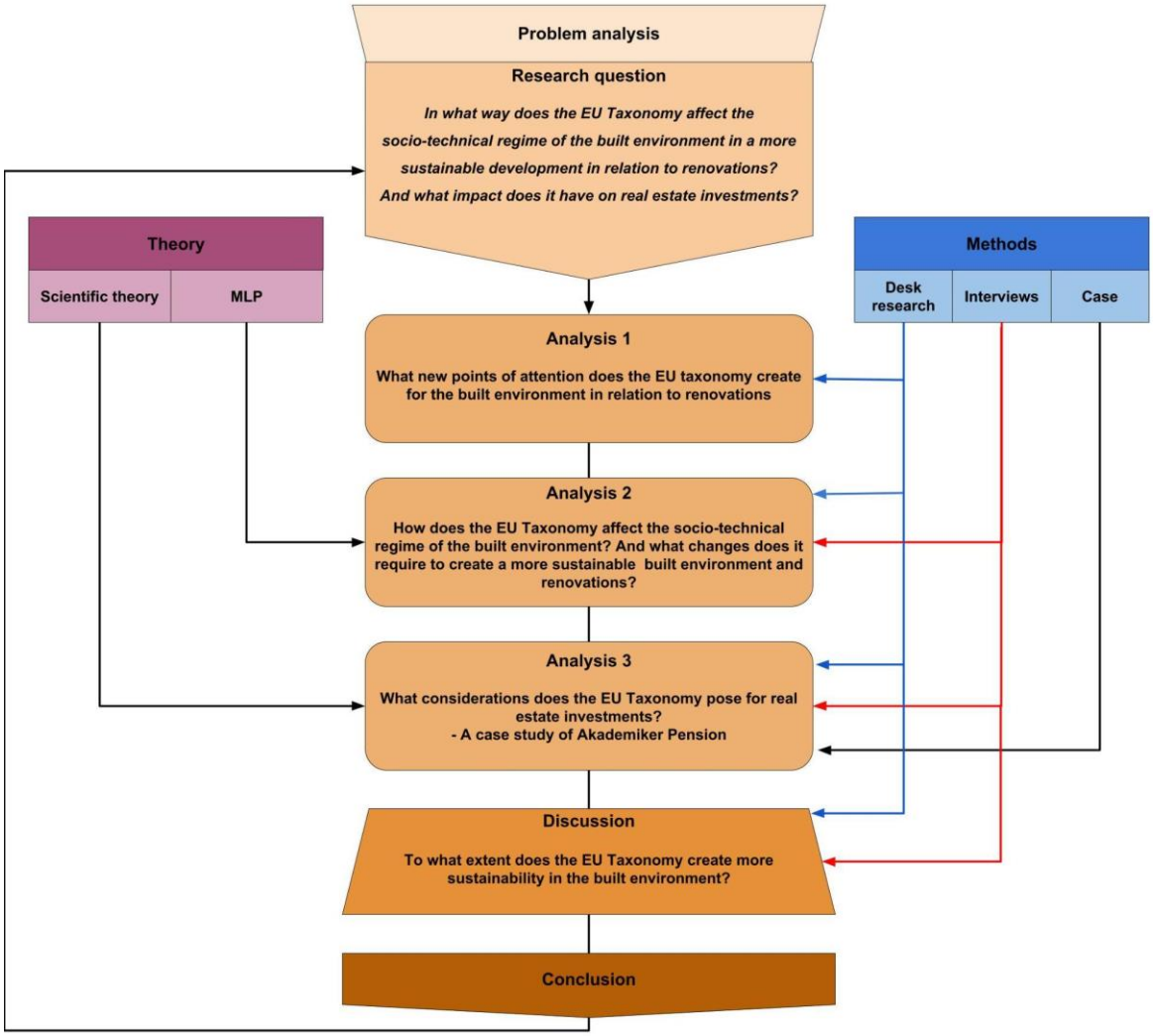

Figure 10 - Illustration of the thesis' research design

5. Theories

The following section will present the theory used in the thesis and how it has been used in the research. Furthermore, considerations will be highlighted in relation to the theory and the application of its influence on the thesis' research.

5.1 Multi-Level Perspective

The Multi-Level Perspective (MLP) is a theoretical framework designed by Frank Geels and others to analyze socio-technical transitions to sustainability. Socio-technical transitions involve changes of multiple elements such as: technologies, policies, markets, infrastructures, cultures etc. These elements are constantly reproduced, maintained, and transformed by multiple actors such as policy makers, industries, and others. Therefore, transitions are complex and long-term processes involving multiple actors. In the MLP, transitions are defined as a shift from one regime to another and occurs due to friction in, and between three different levels: Socio-technical landscape, Socio-technical regime, and niche innovations. Transitions are a non-linear process that results from the interplay of developments at the three different levels (Geels, 2010).

1. Socio-technical landscape (Exogenous context)

The socio-technical landscape refers to demographic trends which is an exogenous context that the niche and regime levels cannot influence in the short term. The socio-technical landscape is a broader context in society that influences regime and niche dynamics. For example, the climate crisis pressures regimes to adapt which might create a window of opportunity for niches to evolve (cf. Figure 11).

2. Socio-technical regime

Socio technical regimes consist of different elements in the form of systems, rules, and norms in different areas of policies, markets, cultures etc. (cf. Figure 11). These elements shape the regime and "business as usual" through regulations, cultures etc. Existing socio-technical regimes make strong interlinkage between these elements to preserve themselves through "lock-in mechanisms" (cf. Section 2.2). However, no regime is "locked-in" forever as the different elements in the regime change over time due to friction in and between the different

levels. Transitions (often) occur gradually in small adjustments of the different socio-technical elements which pressures the other elements to change. This might create a window of opportunity for niches to evolve.

3. Niche innovations

The niche landscape covers actors that work on (radical) innovations that pressures existing socio-technical regimes. These innovations seek to evolve into the regime (cf. Figure 11).

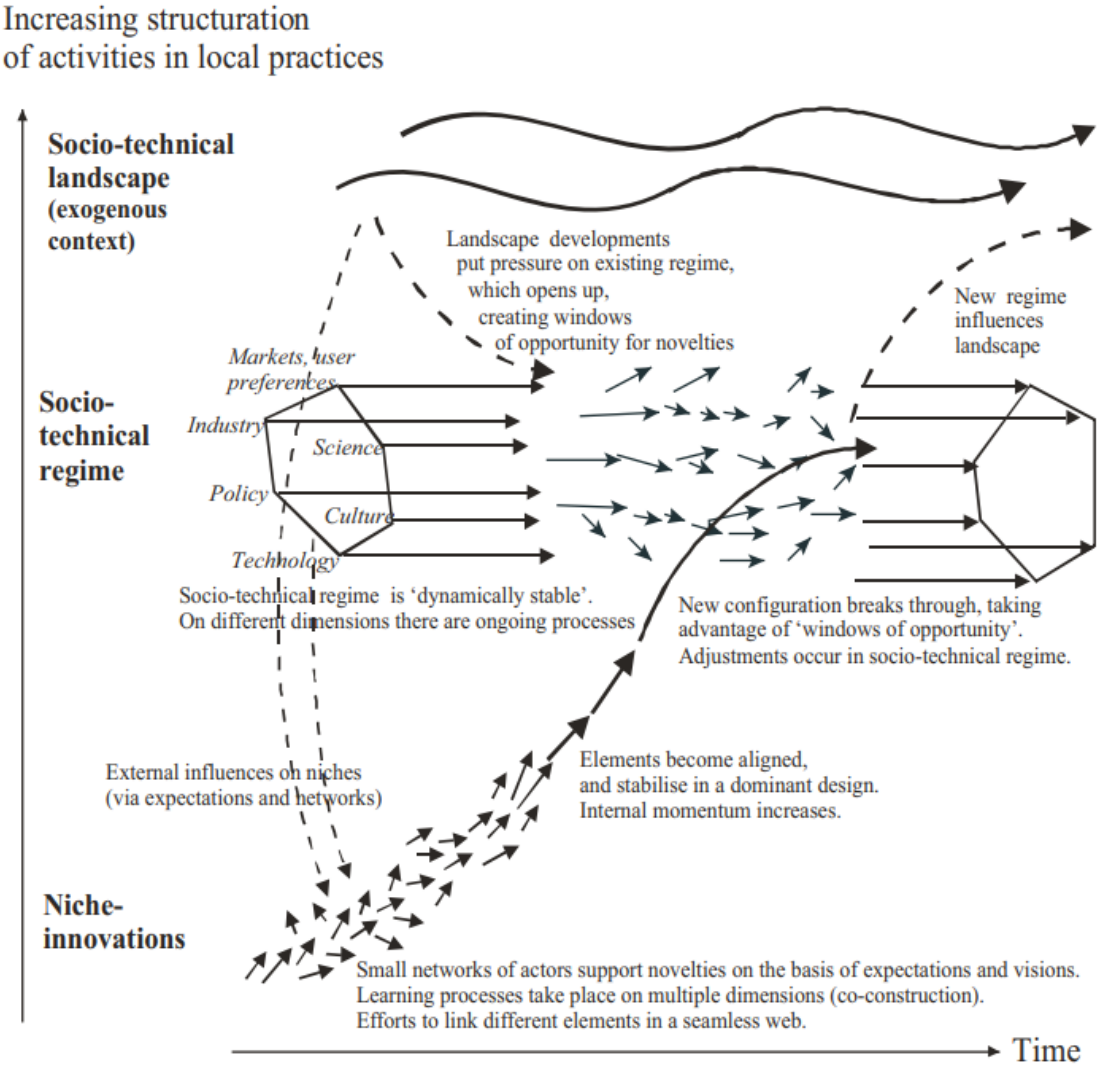

Figure 11 – MLP. Source: (Geels, 2010)

Figure 11 shows an illustration of the complex process of socio-technical transitions and that transitions require multiple changes to reconfigure to create a new regime. The three levels are interconnected and influence each other. The socio-technical landscape represents slowly changing external factors, while the socio-technical regime represents status quo, and niche

innovation represents actors who seek to foster (radical) innovation. Each level is dynamic in their own way which gives an opportunity to foster transitions towards new regimes. However, in the MLP, transitions highly depend on how the different levels interact as well as the interactions between the socio-technical elements like technologies, science, policies, markets, industries, and cultures. According to the MLP, transitions occur in three steps: emergence, diffusion, and reconfiguration (EEA, 2019).

The emergence phase involves the exploration of new niche innovations, but not all of them transition into the socio-technical regime successfully, as illustrated in Figure 11. The emergence phase covers experimentation and demonstration projects to gain experience and knowledge about the niche innovation. However, it (often) takes time before an innovation can progress to the next stage, diffusion.

The diffusion phase covers the expansion and increased acceptance of niche innovations. However, niche innovations may struggle to replace the existing regime as long as it remains stable. This is due to numerous lock-in mechanisms that stabilize the existing regime, making it challenging for niche innovations to gain traction across various socio-technical elements that require different circumstances.

The diffusion of niche innovations can be hindered by a mismatch between their application and the structure of the existing regime, such as consumer practices or market structures. As a result, other factors/elements may need to support the transition and enable their diffusion. For instance, pressure from the socio-technical landscape can cause tensions in the existing regime, leading to changes in markets, user preferences, policies, etc. If the technologies and practices in the existing regime cannot adapt to these changes, a window of opportunity for niche innovations may emerge.

The reconfiguration phase marks when new systems, rules, and norms have been established in the socio-technical regime. This phase involves adjustments in various socio-technical elements including cultures, markets, policies etc., which shapes the regime. (EEA, 2019).

5.1.1 Use of MLP

The MLP has been used to answer sub-question 2: *How does the EU Taxonomy affect the socio-technical regime of the built environment? And what changes does it require to create a more sustainable built environment and renovations?*

The MLP gives the analysis a theoretical framework and a structural approach to analyze the socio-technical regime of the built environment. The theory has been used to break down the complexity of transitions and understand the impact of the EU Taxonomy on the different socio-technical elements in the regime as well as the interlinkage between them for creating a transition. Furthermore, the use of MLP has given the thesis an understanding and overview of the challenges in the existing regime as well as the needs to enable a transition.

Through the MLP analysis of the different socio-technical elements: *policy, market, industry, culture, science & technology*, the thesis will highlight the impact of the Taxonomy on the built environment. Moreover, some of the challenges and needs for reconfiguration of the regime to a new and more sustainable regime will be highlighted.

5.1.2 Considerations of using MLP

The MLP does not prescribe the scope of the empirical topic, which means that the outcome of the theory depends on the delimitations of the thesis, as outlined in section 3.1.2. Due to the thesis' scope and use of MLP, considerations in relations to social aspects are missed.

Transitions are complex as they involve numerous variables. The thesis has simplified the MLP-analysis according to the delimitations and may have excluded variables that would have impacted the results. Furthermore, the application of the theory may have caused the thesis to cover too large an area, resulting in some places the thesis may have compromised and not gone in depth of the analysis.

Another consideration is that transitions are a dynamic and long-term process. Conditions in the regime may have changed during the time of the thesis which may make some of the points made in the thesis outdated. Moreover, the different levels in the MLP are more nuanced than indicated in the analysis. For example, when analyzing the culture in the built environment, not everyone in the regime has the same cultural practices.

Due to the complexity of the MLP, the thesis had to narrow its focus and simplify the analysis, which may not account for all the variables at play. Therefore, it is important to consider in the analysis' conclusions that there could be other variables that have not been accounted for. However, the scope of the thesis was determined based on what was assessed to be most appropriate in relation to the thesis' research question.

6. Methods

The following methodological chapter will describe the thesis' approach to its research on ***the*** EU Taxonomy's effect on the socio-technical regime of the built environment and real estate investments. The section will explain the different methods that have been used to conduct the research, how they have been used, and the considerations of their application.

The section will introduce case as a methodology to the thesis' research, followed by the case of Akademiker Pension. Afterwards the methods; *interview* and *desk research* will be introduced as part of collecting data for the thesis, and lastly, the chapter will explain the scientific approach through scientific theory.

6.1 Case

Case study is a qualitative method that allows for an in-depth analysis of a given case, rather than the breadth of analysis that characterizes the quantitative method. The purpose of a case study is not only to examine the circumstances of the given case, but to be able to explain something general on the basis of the context-dependent situation. Bent Flyvbjerg argues that case studies are useful for understanding complex social phenomena in his report *"Five misconceptions about the case study".* (Flyvbjerg, 2010).

The five misconceptions about the case study according to Flyvbjerg are:

1. Context-dependent knowledge is less valuable than context-independent knowledge.
2. Generalizations cannot be made from a single case.
3. A case can only be used to generate hypotheses, not to test them.
4. The case study is influenced by the researcher's preconceptions and expectations about the results of the study.
5. It is difficult to conduct a case study with valid validity to establish general theses and theories.

Flybjerg argues that these misconceptions can be mitigated through careful research design and data analysis.

6.1.1 Akademiker Pension as the case

The thesis has chosen to use Akademiker Pension as a case study to get an in-depth qualitative analysis of the EU Taxonomy impact on real estate investments. Through the case of Akademiker Pension, the thesis can get an understanding how the EU Taxonomy affects acquisitions and ownership of real estate and how this may affect the built environment.

The thesis uses the case in analysis 3, and keeps the address, value, etc. of all the assets confidential to protect Akademiker Pension's information. Only necessary data (EPC) for conducting a simplified Taxonomy screening of their real estate portfolio in relation to the criteria for acquisition and ownership has been used in the analysis (cf. Section 9).

Akademiker-Pension

Akademiker Pension is a Danish pension fund with 150.000 members. The pension fund manages 130 billion DKK (AkademikerPension, 2022) of which around 3 billion DKK are in Real Estate (cf. Appendix G). However, Akademiker Pension has an ambition to increase their real estate investments to 7 billion DKK in 2026. Currently, Akademiker Pension manages 12 assets in Denmark which makes them a relatively small market participant compared to other pension funds in terms of real estate investments (Børsen, 2022). However, despite their relatively small real estate portfolio, it is believed that the Taxonomy's effect on Akademiker Pension's investments can be applied to larger investors.

6.1.2 Considerations of case

The use of case study will provide a comprehensive understanding of the field that the thesis explores and provide conclusions that can be conceptualized to explain the impact of the EU Taxonomy on real estate investments and the built environment. However, the case is based on the real estate portfolio of Akademiker Pension and considerations regarding renovations and Taxonomy alignment may therefore vary depending on the investor's portfolio, their strategy, the proportion of assets that cannot be Taxonomy aligned etc.

6.2 Interview

The following section will present the methodology used for conducting semi-structured interviews as part of the data collection for the thesis.

Interview is a qualitative method to get a detailed understanding of the perspectives, experiences, opinions etc. of one or more individuals. The structure of an interview is a conversation between an interviewer and a respondent where the interviewer asks questions to gather information. These questions can be both closed and open questions. However, the questions will often be open to get a more detailed answer from the respondent. (Aarhus University, n.d.).

There are various types of interviews such as the unstructured, semi-structured, structured, focus group interviews etc. This report has chosen to use the semi-structured interview because semi-structured interviews allow for a guided but flexible conversation with the respondent, which can produce valuable insights that might not have been identified using other methods.

6.2.1 The use of interviews

The thesis has had a qualitative approach through semi-structured interviews to explore complex issues in depth and gather data from the respondents' experiences, opinions, and perspectives. Respondents were selected by who were considered to be experts on the topic of this thesis. The interviews were conducted in person or through Microsoft teams meetings depending on the preference of the respondent. Each interview lasted between 15 to 45 minutes, and the interview questions were sent to the respondent beforehand. The thesis interviewed multiple relevant respondents representing different parts of the socio-technical regime of the built environment. The respondents that have been interviewed in this thesis are:

Søren Møller-Larsson, Head of Real Estate & Kenneth Larsen, Asset Manager at Akademiker Pension

Søren Møller-Larsson and Kenneth Larsen both work with the management of Akademiker Pension's real estate portfolio. Akademiker Pension is a cooperation partner of the thesis and is also used as the case. Møller-Larsson and Larsen have therefore been relevant to interview

to get their views on the Taxonomy both in relation to how they view the Taxonomy's impact on the built environment and its impact on their real estate investments.

The interview guide and the transcription of the interview can be found in Appendix B and G, respectively. The interview is referred to in the thesis as: Appendix G.

Amal El-Kaswani, Technical Consultant at Green Building Council Denmark (Rådet for Bæredygtigt Byggeri)

Amal El-Kaswani is a technical consultant at Green Building Council Denmark and works with the EU Taxonomy's criteria in a Danish context by creating guides for the built environment to handle the Taxonomy. The purpose of the interview was to gain an expert's view on the EU Taxonomy's impact and possible challenges it creates for the built environment.

The interview guide and the transcription of the interview can be found in Appendix A and D, respectively. The interview is referred to in the thesis as: Appendix D.

Emil Veileborg Kocsis Aali, Sustainability Consultant at Rambøll

Emil Veileborg Kocsis Aali is a sustainability consultant at Rambøll and works with advising clients in relation to the Taxonomy's criteria. The purpose of the interview was to get a consultant's view on the Taxonomy impact and the challenges it brings for the built environment.

The interview guide and the transcription of the interview can be found in Appendix A and E, respectively. The interview is referred to in the thesis as: Appendix E.

Jens Breinholt, Head of Sustainability at PensionDanmark

Jens Breinholt is head of sustainability at PensionDanmark's real estate department and works with implementation of sustainability considerations in their real estate projects. The purpose of the interview was to get an insight of what considerations and views another pension fund other than Akademiker Pension has on the EU Taxonomy and how they view the development of the market.

The interview guide and the transcription of the interview can be found in Appendix B and F, respectively. The interview is referred to in the thesis as: Appendix F.

Morten Penthin Svendsen, Analyst, Nykredit

Morten Penthin Svendsen works with the green transition from a financial standpoint at Nykredit and holds a PhD in impact investing. The purpose of the interview was to get a view on the Taxonomy's influence on the built environment from a financial standpoint to gain insights on the mechanisms affecting the built environment.

The interview guide and the transcription of the interview can be found in Appendix C and H, respectively. The interview is referred to in the thesis as: Appendix H.

Morten Lund Pedersen, Legal assistant, Bruun & Hjejle and Linda Nielsen, professor at University of Copenhagen's Center for Market and Economic Law.

Morten Lund Pedersen is a legal assistant at Bruun & Hjejle and Linda Nielsen is a professor at University of Copenhagen's Center for Market and Economic Law.

Bruun & Hjejle is a law firm that works with advising on all areas of real estate and specializes in real estate transactions, property development and asset management. The author of the thesis came in contact with Morten Lund Pedersen during a meeting with Akademiker Pension. An interview was intended but due to a lack of time, the interview never took place. However, Pedersen provided valuable insights and sources to the thesis that is unfortunately classified but he referred to Linda Nielsen who researches sustainability from a legal point of view. Due to the already available articles published by Nielsen, the thesis decided not to interview Nielsen, as the answers to the questions could be found in the available literature.

6.2.2 Considerations of interviews

Semi-structured interviews provide a valuable method for gathering data from respondents' experiences and perspectives. However, the thesis has only interviewed a few respondents relevant within the scope. Due to delimitations and the scope, the thesis might have overlooked relevant respondents and insights. Furthermore, the thesis has mainly interviewed the large market participants. Minor market participants might have different experiences and perspectives which could have provided valuable insights for the thesis. Therefore, the respondents' subjectivity needs to be taken into account as actors in the same field might have different views.

6.3 Desk research

Desk research is a methodology to analyze existing available data and information from a variety of sources, including reports, academic journals, books, online resources etc. (ResearchMethods.Net, 2022) The method has been used in this thesis as part of gathering data and information for the analyses.

6.3.1 The use of desk research

Desk research has been used to gather data sources such as official documents, reports, and publications from relevant authorities, organizations, and academic literature that provide information about the EU Taxonomy and the built environment. Together with other methods, the thesis analyzes in what way the EU Taxonomy affects the socio-technical regime of the built environment in a more sustainable development in relation to renovations and real estate investments.

6.3.2 Considerations of desk research

The thesis has only examined data and information that has been assessed to be within the scope of the thesis. There may therefore be data and information that has not been included in the thesis that could otherwise highlight other insights.

6.4 Scientific theory

The thesis has explored how EU Taxonomy affects the socio-technical regime of the built environment in a more sustainable development in relation to renovations, and its impact on real estate investments. Throughout the research, the thesis has applied a pragmatic approach to focus on practical consequences and the usefulness of the EU Taxonomy in creating a sustainable built environment through renovations and real estate investments.

Pragmatism in this thesis means that the thesis has emphasized the practical value of the EU Taxonomy in guiding sustainable investments in the built environment and promoting sustainability considerations to create a more sustainable development.

The thesis has taken a practical approach to analyze the impact of the EU Taxonomy on Akademiker Pension's real estate investments. The thesis has used a case study approach to

analyze how the EU Taxonomy affects real estate investments in relation to renovation and what considerations it may pose for financial market participants, like Akademiker Pension. This approach allows the thesis to evaluate the impact of the EU Taxonomy on real estate investments and its effectiveness in promoting sustainability in the built environment.

However, the pragmatic approach in the thesis acknowledges the complexity of the EU Taxonomy's impact on the built environment and real estate investments as it has not been fully implemented. In addition, the research has been a non-linear process where new knowledge has continuously been added throughout the period of the thesis. New knowledge in the field is continuously generated, which may have contributed with other views and considerations for the thesis.

7. New attentions points by the EU Taxonomy

The following section will go through the EU Taxonomy's criteria for renovations and highlight the new attention points which the Taxonomy brings compared to the Danish Building Regulation.

A large part of the Danish Building Regulation regulates the built environment in relation to provisions on accessibility, indoor climate, durability, safety, and energy requirements of buildings. The Building Regulation only sets overall minimum requirements for buildings in Denmark and are in most areas function-based (Den Frivillige Bæredygtighedsklasse, n.d.). This means that the focus is on the performance of the building, e.g., that moisture damage must be avoided, but it does not specify how the requirement must be met. There is thereby freedom in terms of methodology and technologies to meet the requirements. With the EU Taxonomy, the built environment meets more stringent requirements which will be highlighted in the following analysis.

7.1 The EU Taxonomy's criteria for renovations

Renovation has been defined as an eligible economic activity in the EU Taxonomy, and can align with the Taxonomy by following one of the three routes illustrated in Figure 12 below (EU Taxonomy Compass, n.d.):

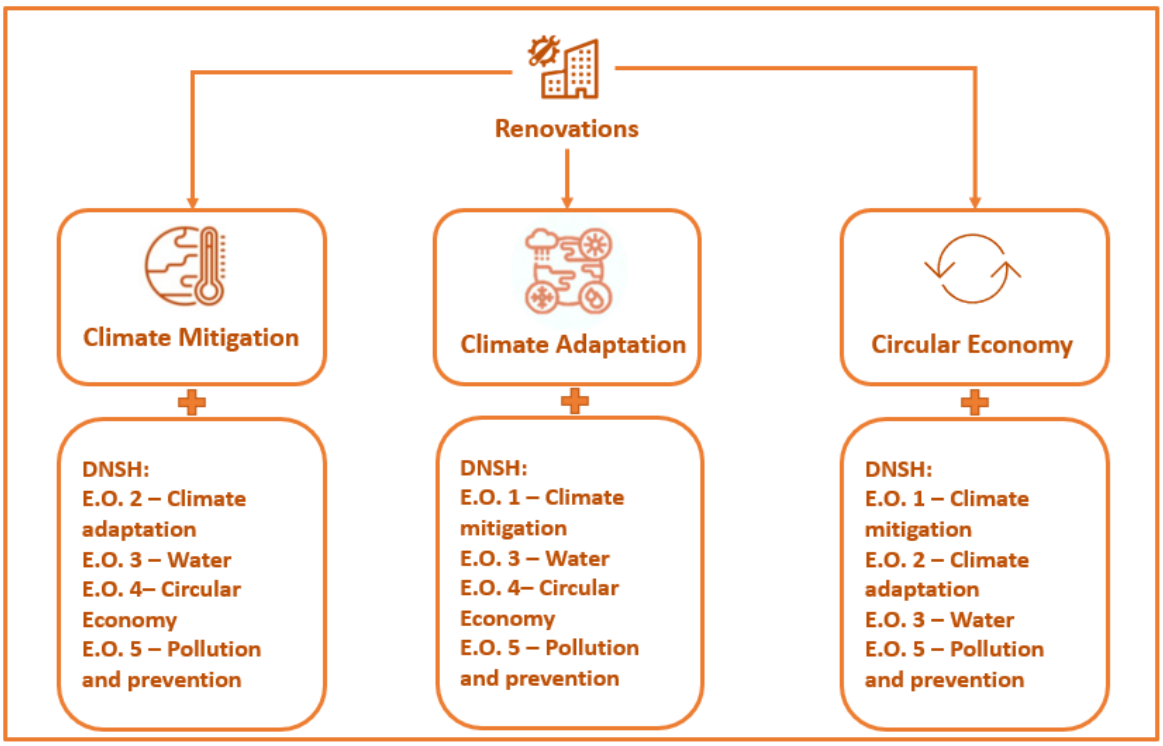

Figure 12 - The three routes that renovations can follow to align with the EU Taxonomy. Note: Environmental Objective (E.O.) nr. 6, biodiversity is not included as it has been assessed by the EU to be not applicable. Own creation.

For a renovation to align with the EU Taxonomy and classify as a sustainable economic activity, it must follow one of the routes illustrated above. The Taxonomy's criteria are knock-out criteria which means that all the criteria must be met to align with the Taxonomy (Rambøll et al., 2021). The Taxonomy requires renovations to integrate the environmental objectives and meet a number of sustainability considerations that are defined through the different criteria. However, environmental objective number six, biodiversity, is not included under renovation as The Technical Working Group on sustainable finance has assessed it not to be applicable for renovations. The reason why is unclear.

7.1.1 Climate mitigation

As mentioned in the problem analysis (cf. Section 2.5), the substantial contribution criteria for climate mitigation for renovation are:

- *The building renovation complies with the applicable requirements for major renovations.*
    - *In Denmark: Renovation class 1 or 2 in the building regulation = EPC, A2010 or EPC, B.*

- *Alternatively, it leads to a reduction of primary energy demand (PED) of at least 30 %*

In the first criteria above, the EU Taxonomy refers to the national regulation for energy requirements for renovations. In the Danish Building Regulation, the energy requirements for renovation are given in chapter 11, §280 - §282 *"Renovation class for existing buildings"*. To comply with the requirements, the energy demand of the building after the renovation shall be less than the energy frameworks set out in Table 1.

Energy framework for existing buildings, cf. BR18, chapter 11, § 281	Energy framwork (kWh/m2/year)	EPC
Housing, dormitories, hotels and similar		
Renovation class 1	52,5 + 1650 / Area	A2010
Renovation class 2	70 + 2200 / Area	B
Offices, schools, institutions and similar		
Renovation class 1	71,3 + 1650 / Area	A2010
Renovation class 2	95 + 2200 / Area	B

Table 1 - Energy framework for existing buildings. Source: (Bygningsreglementet §250 - §298, n.d.). Note: 1650 and 2200 denote kWh per year while the other numbers are kWh/m2/year.

Furthermore, the renovation shall reduce the building's energy demand by at least 30 kWh/m² and there must be a share of renewable energy in the total energy supply for the building (Bygningsreglementet §250 - §298, n.d.). The first criterion refers to the national legislation and therefore does not require any particular new points of attention in the Danish context.

However, the renovation can also contribute substantially to climate mitigation by reducing the primary energy demand by at least 30 %. In Denmark, it is already a requirement for renovations to document the energy framework. Therefore, the only new attention point to this criterion is to ensure to meet the target.

7.1.2 Climate adaptation

The substantial contribution criteria for climate adaptation can be found in Appendix I. To meet the criteria, renovations must screen for the climate risks in table 2 and implement measures to reduce physical climate risks that are material to the activity.

APPENDIX A: CLASSIFICATION OF CLIMATE-RELATED HAZARDS[669]

	Temperature-related	Wind-related	Water-related	Solid mass-related
Chronic	Changing temperature (air, freshwater, marine water)	Changing wind patterns	Changing precipitation patterns and types (rain, hail, snow/ice)	Coastal erosion
	Heat stress		Precipitation or hydrological variability	Soil degradation
	Temperature variability		Ocean acidification	Soil erosion
	Permafrost thawing		Saline intrusion	Solifluction
			Sea level rise	
			Water stress	
Acute	Heat wave	Cyclone, hurricane, typhoon	Drought	Avalanche
	Cold wave/frost	Storm (including blizzards, dust and sandstorms)	Heavy precipitation (rain, hail, snow/ice)	Landslide
	Wildfire	Tornado	Flood (coastal, fluvial, pluvial, ground water)	Subsidence
			Glacial lake outburst	

Table 2 - Overview of climate risks that must be assessed in the screening. Source: (EU Taxonomy Compass, n.d.)

As the table shows, the climate risk screening is comprehensive as many factors need to be taken into account. Risks should be categorized into low, medium or high levels and should be assessed on the basis of the methodological framework that emerges as best practice and available guidance. Compensatory measures, such as green infrastructure (for example trees), must be implemented to reduce the identified risks. Furthermore, the compensatory measures must be monitored and managed so that limit values for the different climate risks are not exceeded (cf. Appendix I).

The Danish Building Regulation does not set requirements for climate change adaptation. However, a number of different provisions are important for how developers should act when planning, designing and constructing buildings in coastal areas where climate change adaptation has particular importance, e.g., in relation to storm surges and rising sea levels

(Bygningsreglementet, n.d.). However, these provisions are mainly aimed for new construction. The Taxonomy sets requirements for climate adaptation and climate risk screening regardless of where the building is located and whether it is new construction or renovation.

Overall, the substantial contribution criteria to climate adaptation, creates a focus for renovations to improve the resilience of the buildings to climate change impacts.

7.1.3 Circular economy

The substantial contribution criteria for circular economy sets focus on preventing waste through reuse, recycling, and design principles. There is a requirement for a minimum of 90 % of construction and demolition waste (excluding waste with hazardous substances) generated on the construction site is prepared for reuse or recycling.

In addition, there are requirements for the composition of the building. A minimum of 50% of the original building must be retained in the renovation and at least 50% of the overall building must consist of a combination of reused components, recycled content, or renewable materials from responsible sources. Here, the minimum of reused and recycled materials must represent at least 15% each, while the remaining 20% must be either reused, recycled or renewable materials (such as biobased materials) or a combination of these three.

Furthermore, there are requirements for design and construction techniques that support circularity. For example, the EU Taxonomy refers to Level(s) indicators 2.3 (design for adaptability) and 2.5 (design for deconstruction) which is a framework to assess and report the sustainability performance of buildings (European Commision - Levels, n.d.).
Moreover, a life cycle assessment is required to be calculated for the entire renovation and made publicly available. (cf. Appendix I).

The Danish building regulation does not include requirements for circularity in relation to reuse and recycling of materials or in terms of design and construction techniques. Furthermore, there are no requirements for life cycle assessments for renovations at this point. However, guides and national strategies have been made to promote the circular economy and measure the climate impact of renovations in the built environment in Denmark (Værdibyg, 2021).

The substantial contribution criteria for circular economy in the Taxonomy, creates attention points for the built environment in terms of design and construction techniques, but also in terms of the use of materials. The Taxonomy sets specific targets for reused and recycled materials in the building and also promotes renewable building materials, like biobased, to be used in the renovation.

However, reuse and recycling as well as the use of renewable materials, are still niche technologies in the built environment and present a number of challenges/points of attention that need to be taken into account (Værdibyg, 2023). This will be highlighted in Analysis 2.

7.1.4 DNSH-criteria

The difference between the DNSH-criteria and the substantial contribution criteria is the aim of the criteria - as the names indicate. The substantial contribution criteria have more strict and additional requirements compared to their corresponding DNSH-criteria.

Climate mitigation

The DNSH-criterieon for climate mitigation for renovations is:

- *The building is not dedicated to extraction, storage, transport or manufacture of fossil fuels.* (cf. Appendix J)

The Danish Building Regulation does not set requirements for the use of the building. Thereby, the DNSH-criterion for climate mitigation creates a focus for developers and owners not to use the building for unsustainable activities as described in the criterion.

Climate adaptation

The DNSH-criteria for climate adaptation are similar to the substantial contribution criteria and aims to make buildings more resilient to climate change (cf. Section 7.1.2). The difference between the DNSH and substantial contribution criteria for climate adaptation, is that substantial contribution criteria require monitoring and follow-up of the climate change adaptation solutions (Rådet for Bæredygtigt Byggeri.a, 2022).

Water

The DNSH-criteria for water set specific technical requirements for water installations in the building such as (cf. Appendix J):

- *Wash hand basin taps, and kitchen taps have a maximum water flow of 6 liters/min.*
- *Showers have a maximum water flow of 8 liters/min.*
- *WCs, including suites, bowls and flushing cisterns, have a full flush volume of a maximum of 6 liters and a maximum average flush volume of 3,5 liters.*
- *Urinals use a maximum of 2 liters/bowl/hour. Flushing urinals have a maximum full flush volume of 1 liter.*

The criteria set focus for the renovation to use water saving installations. In some cases, the criteria will be met by using the most common technologies. For example, a modern WC uses three and six liters for a small and a large flush, respectively (Bolius, 2020) which meet the DNSH-criteria above. But the average shower uses 10-20 liters of water per minute (Bolius, 2022) which does not comply with the criteria above. The criteria create a focus for renovations to promote sustainable use of water and protect water resources through installations.

The DNSH-criteria for water thereby set focus on the technical properties of the installations in order to comply with the Taxonomy.

Circular economy

As mentioned in section 7.1.3, the Danish Building Regulation does not set requirements for circularity in relation to reuse and recycling of materials or in terms of design and construction techniques. The DNSH-criteria for circular economy are similar to the substantial contribution criteria but have less specific targets. The DNSH-criteria for circular economy focus on three focus areas:

- At least 70 % (by weight) of the non-hazardous construction and demolition waste generated on the construction site is prepared for reuse.
- Operators limit waste generation.
- Building designs and construction techniques support circularity.

Compared to the substantial contribution criteria for circular economy, the DNSH-criteria requires 70% of the waste to be prepared for reuse, while the substantial contribution criteria

require 90% of the waste to be prepared for reuse or recycling. There is thereby a stronger focus on preparation for reuse in the DNSH-criteria. However, the percentage for the DNSH-criteria is lower compared to the substantial contribution criteria.

To meet the other DNSH-criteria for circular economy in relation to limiting waste generation and promoting building designs that support circularity, the renovation must use best available techniques and standards that enables reuse and recycling (cf. Appendix J).

Thereby, the DNSH-criteria for circular economy sets focus for renovations to reduce resource consumption through preparation of reuse and reducing waste through circular design and construction principles.

Pollution

The DNSH-criteria for pollution set requirements for renovations to minimize the use of hazardous materials and reduce pollution that harm the environment and human health.

The Danish Building Regulation sets requirements that focus on the pollutants that occur in building materials or are formed during the use of the materials so that they do not cause harm to people's health or comfort. The requirements in Denmark concerning the content of hazardous substances in building materials are subject to the EU Regulations; *Construction Products Regulation* and the *REACH Regulation*, which is the EU's chemical legislation (Den Frivillige Bæredygtighedsklasse, n.d.). The Building Regulation refers to EU's Lowest Concentrations of Interest (LCI) values. These values indicate the upper levels of concentrations of substances that are considered to pose no risk to health and recommends the use of building materials with the lowest possible emission of pollutants to the indoor climate (Bygningsreglementet §329 - §333, n.d.).

Compared to the Taxonomy, the Taxonomy sets more strict requirements in the DNSH-criteria. For example, one of the requirements for DNSH for pollution is: *Building components and materials used in the building renovation that may come into contact with occupiers emit less than 0,06 mg of formaldehyde per m³ of material or component.*

In relation to formaldehyde, the Danish Building Regulations recommend following the World Health Organizations limit value of 0,1 mg of formaldehyde per m³.

The DNSH-criteria for pollution thereby create a greater focus on the content of harmful substances in building materials. The substances and limit values set in the DNSH-criteria thereby become attention points for the renovation to comply with the Taxonomy.

7.1.5 Sub-conclusion

On the basis of the analysis above, the following key points are:

- The EU Taxonomy requires renovations to integrate sustainability considerations in relation to energy consumption, climate resilience, water consumption, circular economy and substances in building materials.
- The EU Taxonomy's criteria will require renovations to follow more, and more stringent, requirements in relation to the Danish Build Regulation - if the renovation wants to align with the Taxonomy and classify as a sustainable activity.

The areas where the EU Taxonomy brings new attention points to renovations and what new attention points, can be seen in table 3 below.

	New attention points	Attention point
Substantial contribution		
Climate mitigation	(X)	Partially new attention point. Reduction of the primary energy demand of at least 30 % must be achieved if the renovation does not comply with the renovation requirements for major renovations in Denmark
Climate adaptation	X	Carrying out climate risk screening and implementation of measures to reduce physical climate risks that are material to the activity. Improvement of the building's resilience to climate change impacts and maintenance and measurement/control plans
Circular Economy	X	Focus on preventing waste through reuse, recycling, and design and construction techniques. The criteria includes specific targets which must be met to comply with the Taxonomy. Furhermore, a life cycle assessment must be carried out.
DNSH-criteria		
Climate mitigation	X	The use of the building does not go to unsustainable activities such as: extraction, storage, transport or manufacture of fossil fuels.
Climate adaptation	X	Similar to the substantial contribution, but with out requirement for maintenance and measurement/control plans
Water	X	Focus on water installations to meet the targets set in the criteria.
Circular Economy	X	Focus on limiting waste generation. At least 70 % (by weight) of the non-hazardous waste on the construction site is prepared for reuse. Furthermore, design and construction techniques support circularity
Pollution	X	Focus on the content and documentation of harmful substances in building materials.
Biodiversity		Not applicable

Table 3 - Overview of the areas which the EU Taxonomy creates new attention points for renovations and what new attention points. Source: Own creation.

As shown in the table, all the criteria in the EU Taxonomy gives new attention points for renovation. The EU Taxonomy influences renovations to include a number of sustainability considerations that the Danish Building Regulations do not take into account. The Taxonomy's criteria are minimum requirements for being classified as a sustainable economic activity and will thereby influence the built environment in a more sustainable direction if the financial market participants adopt the Taxonomy.

The following analysis will explore how the EU Taxonomy's criteria for renovation affects the socio-technical regime of the built environment and highlight the changes the Taxonomy requires and potential challenges for transitioning towards a more sustainable development.

8. Examining the impact of EU Taxonomy on the socio-technical regime of the built environment

The existing socio-technical regime of the built environment is receiving pressure to change as the status quo does not align with a sustainable development. The transformation of the built environment plays a key role for a sustainable development due to its high climate impact on the environment, but relies on investments to transition away from the non-sustainable systems and technologies (cf. Section 2). The EU has with its action plan on sustainable finance set the financial sector as a catalyst for this transition, and this analysis will explore how the Taxonomy drives the built environment in a more sustainable direction. The analysis will highlight the challenges and needs the existing socio-technical regime has for reconfiguring to a sustainable regime in relation to renovations (cf. Figure 13).

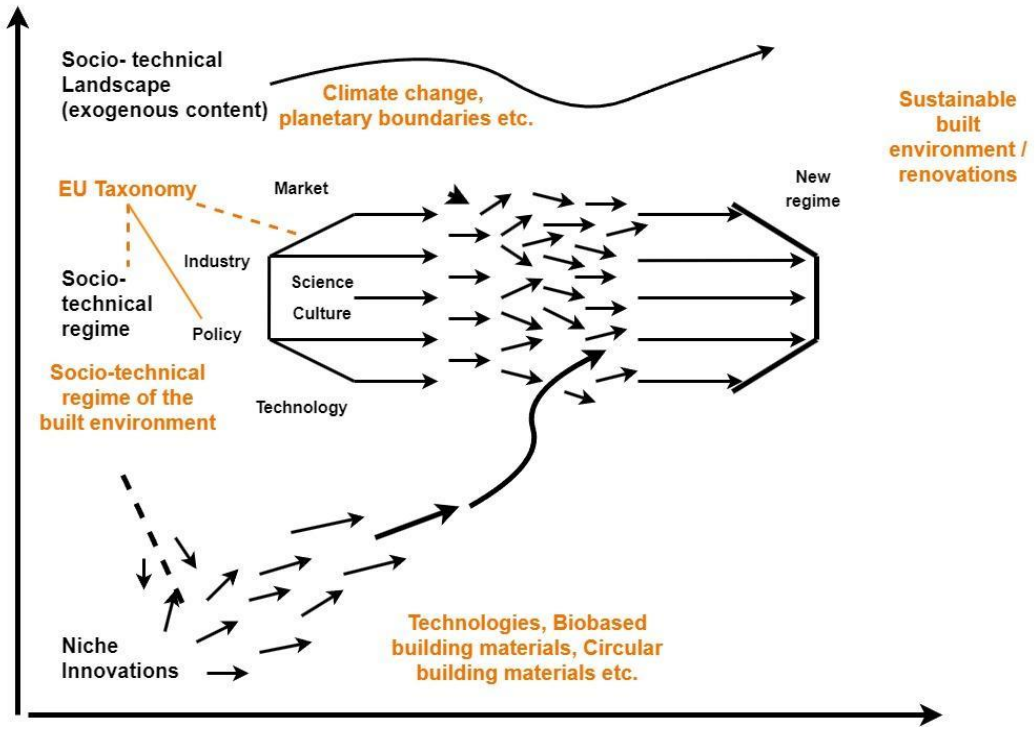

Figure 13 - Illustration of the analysis "Examining the impact of EU Taxonomy on the socio-technical regime of the built environment". Own creation.

8.1 Reconfiguration of the socio-technical regime of the built environment for Taxonomy alignment.

The EU Taxonomy is a regulatory instrument that creates a change within the policy element and indirectly influences the other elements in the socio-technical regime as illustrated in Figure 13. As the different elements in a regime are interconnected, the change of one element (such as policy change in the form of the EU taxonomy) can lead to changes in the rest of the regime as well as the niche landscape (cf. Section 5.1). For example, the Taxonomy sets criteria for circular economy which affect the culture in the built environment to design and construct renovations to comply with the criteria. This will also affect the development of technologies, industries etc. as the Taxonomy promotes circularity in the built environment.

The EU Taxonomy (along with and the SFDR) aim to support the transition towards a sustainable development by providing a classification system that defines what activities can be considered environmentally sustainable.

The analysis will go through how the different elements in the socio-technical regime of the built environment are affected by the Taxonomy in relation to renovations and what lock-in mechanisms there may be for transitioning the regime in a more sustainable direction.

8.1.1 Policies

Policies are a key element in the MLP in this case as it shapes the framework for the other elements in the socio-technical regime through regulation. With the introduction of the Taxonomy, sustainability considerations have been put higher on the agenda in the built environment compared to national regulation (cf. Section 7.1.4).

The Taxonomy thereby sets a direction for the built environment in relation to pointing the existing building stock in a more sustainable development when renovating. Even though the Taxonomy is a regulatory instrument that applies to financial market participants, it will also impact non-financial participants in the built environment as well through a "trickle-down effect" (if financial market participants apply the Taxonomy's criteria). Linda Nielsen, professor at University of Copenhagen's Center for Market and Economic Law states in an article (Nielsen & Riisberg, 2022):

"The EU has paved the way and it is now up to investors and companies to put the ball in the court of the targets that represent sustainable economic activities, as defined in the Taxonomy regulation."

The Taxonomy's criteria set performance standards in relation to energy efficiency, climate adaptation, water efficiency, circular economy, and pollution, which pushes the other socio-technical elements to adapt to these standards. Thereby, the EU Taxonomy's criteria will initiate multiple changes in the built environment that will point the regime towards a more sustainable development, if applied by investors.

However, the transition towards Taxonomy aligned renovations and a more sustainable built environment faces different challenges. In relation to policy challenges in the existing socio-technical regime of the built environment, national policies may need to adapt to support the direction that Taxonomy points towards. In the table below, the thesis has assessed which areas in the policy element that may be in conflict with the Taxonomy's criteria:

Environmental objectives	Challenges with existing policies	Details
Climate mitigation		Assessed to no challenges as the Taxonomy refers to the existing national policies
Climate adaptation		Assessed to no challenges as existing national policies do not regulate this for renovations
Water		Assessed to no challenges as existing national policies support water saving installations
Circular Economy	X	Challenges assessed due to existing national policies for documentation of building materials technical properties
Pollution	(X)	Challenges assessed in relation to circular economy as current policies do not exclude all harmful substances to be incorporated in buildings which prevent circularity
Biodiversity	Not applicable	

Table 4 - Overview of The Taxonomy's challenges with existing national policies. Own creation.

The criteria for circular economy in the Taxonomy require design and construction techniques that support circularity, but they also require the use of reused and recycled building materials and promotes the use of renewable materials (such as biobased materials) (cf. Section 7.1.3). These three types of materials support circularity and it is the use of these "circular building materials" that faces challenges in relation to existing national policies (Værdibyg, 2023).

The Danish Building Regulation sets requirements for the documentation of the building materials' technical properties in relation to a wide range of topics, such as strength, fire safety, moisture etc. Especially, documentation of fire safety can be a challenge for niche technologies

like circular materials as the building regulation sets requirements for the documentation of the overall construction composition. This means that if one material gets replaced in the construction, documentation of the overall construction's performance must be provided (CONCITO, 2023). It should be emphasized that the safety level should not be lowered in the building regulations, but there should be a greater political focus on supporting and generating the necessary documentation. Circular building materials lack documentation in relation to the Building Regulations requirements and this is partly why these materials struggle to diffuse in the regime. For the circular economy in particular, already incorporated materials are difficult for the built environment to document in relation to the Building Regulation as information about the materials' quality is insufficient (CONCITO, 2022).

Greater political focus on promoting circular economy will play an important role in supporting the transition of the regime to meet the Taxonomy's criteria and reconfigure for a more sustainable regime. For example, policies can support circular economy by ensuring that materials do not contain harmful substances that can prevent reuse and recycling of building materials. Here, the existing policies do not fully ensure that harmful substances cannot be incorporated into buildings (Realdania, 2023). The Taxonomy only sets disclosure obligations and existing policies can thereby support the Taxonomy through hard law regulation.

To support the built environment's transition towards a more sustainable regime, the existing policies should adapt to support the Taxonomy's criteria. Here, existing policies in relation to pollution and the Building Regulation can be a challenge for circular economy in the regime.

8.1.2 Market

The EU Taxonomy reinforces the value of sustainability as a competitive parameter on the market as a common language has been established. Before the Taxonomy the definition of sustainable renovations and buildings was unclear. Different certification schemes, such as DGNB, LEED, BREEAM etc. were floating around and were more of an extra initiative for the front runners. It created action in the built environment but not on the same scale as the Taxonomy will do now. With the Taxonomy, a shift in the market is taking place. Morten Lundby Pedersen, Legal assistent at Bruun & Hjejle states:

"Whereas in the past companies have been tempted to ask themselves whether it is "worthwhile" to work with sustainability, the question now becomes "can we afford not to?"

With the EU Taxonomy, sustainability will become more important on the market, and not just for the front runners. In the future, it can be expected to become more expensive for investors to own non-sustainable buildings (= non Taxonomy aligned) (Rambøll et al., 2021). Søren Møller-Larsson, Head of Real Estate at Akademiker Pension sees the Taxonomy as parameter to be included in real estate investments as he states:

"The Taxonomy is both an opportunity and a risk. By approaching it in a sensible way, one can reduce risks, but also create some value because the market is pricing the asset differently." (cf. Appendix G).

Møller-Larsson sees the market evolving in a direction where Taxonomy aligned buildings will be more attractive, which creates incentives for the built environment to fulfill the Taxonomy's criteria. This point is supported by Jesper Breinholt, Head of sustainability at PensionDanmark:

"Commercially on the large scale, it will be the Taxonomy that will fill the market. So, if you are not compliant, there is a risk of ending up with stranded assets." (cf. Appendix F).

The impact of Taxonomy on the market in the socio-technical regime will be significant. Morten Penthin Svendsen, analyst at Nykredit, believes that the Taxonomy will affect the market in the following way:

"It can be expected that there will be an A and a B team in the future, where there are green assets that are Taxonomy aligned and then there are assets that are not Taxonomy aligned, where two different markets may arise" (cf. Appendix H)

The Taxonomy impacts the market by creating a clear distinction between sustainable and non-sustainable buildings, where previously there was a loose definition of the term "sustainable". It can be expected that buildings that meet the Taxonomy's criteria will be more attractive in the future. This will lead more investors to include the Taxonomy's criteria in their real estate investments and thereby create a "trickle-down effect" of the Taxonomy's sustainability considerations throughout the entire value chain of the built environment.

However, the Taxonomy's criteria do face challenges on the market in the built environment which can be seen in the table below:

Environmental objectives	Challenges with existing market	Details
Climate mitigation	X	Challenges assessed as much of the existing building stock was built before 1980 (CONCITO, 2021). It is therefore doubtful whether these buildings can meet the Taxonomy's criteria due to low energy performance
Climate adaptation		Assessed to no challenges in relation to market conditions
Water		Assessed to no challenges technologies are widespread and available
Circular Economy	X	Challenges assessed due to insufficient market for circular building materials
Pollution	X	Challenges assessed as a number of harmful substances were used in construction between 1950-1980, which may pose challenges for the reuse and recycling (VCØB et al., 2021)
Biodiversity	Not applicable	

Table 5 - Overview of The Taxonomy's challenges with the existing market. Own creation.

In Denmark, more than 65% of the existing building stock was built before 1980, before the energy requirements were introduced in the Building Regulations (CONCITO, 2021). Many of those buildings can be expected to go through renovations in the coming years. Here, the Taxonomy will help lift and push large parts of the building stock in a more energy efficient direction. However, many buildings may not be able to meet the Taxonomy's criteria for substantial contribution to climate mitigation due to their condition. This is not a challenge for the Taxonomy itself, but more a challenge for real estate investors. In some cases, the condition of the building can be so poor that the investment decision is between demolition and new construction or renovation (Rambøll et al., 2020).

A similar challenge applies to pollution and the circular economy. Due to the past's way of building, harmful substances have been used which may pose challenges in relation to reuse or recycling the materials from older buildings (VCØB et al., 2021). Furthermore, lack of data of the content in materials in existing buildings makes it difficult for the built environment to document that the Taxonomy's criteria for pollution are complied (CONCITO, 2022).

There can thereby be a market challenge in the existing building stock to fulfill the Taxonomy's criteria for renovation due to the condition of older buildings.

Another market challenge for the Taxonomy is related to circularity. Circular building materials are still a niche technology in the existing socio-technical regime of the built environment. The market is currently considered to be immature and limited to a few demonstration projects (Realdania, 2023). In addition, there are challenges in relation to obtaining the right quantity, documentation of circular materials. (CONCITO, 2022).

There are thereby challenges in relation to the conditions of the existing building stock and the market maturation of circular solutions. Despite problems with the existing building stock, the Taxonomy can help avoid the same challenges in the future. In relation to market maturation, it can be expected that the Taxonomy will drive the demand for circular materials due to its impact on real estate investors. However, there is still a need for the other elements in the socio-technical regime to follow.

8.1.3 Industry

The Taxonomy affects the industry by requesting solutions to fulfill the Taxonomy's criteria. In some cases, the solutions are already there. For example, for water, the water saving technologies are already there (cf. Section 7.1.4) but for circular economy there can be challenges for scale due to challenges on the market. The previous section showed that conditions of older buildings can be a challenge for circularity due to missing data of both quality and content of substances (cf. Section 8.1.2). The challenges for the industry element are listed in the table below (cf. table 6):

Environmental objectives	Challenges with existing industry	Details
Climate mitigation		Assessed to no challenges. Industry can deliver solutions
Climate adaptation		Assessed to no challenges. Industry can deliver solutions
Water		Assessed to no challenges. Industry can deliver solutions
Circular Economy	X	Challenges assessed in relation to solutions and scale
Pollution	X	Challenges assessed as data is missing
Biodiversity	Not applicable	

Table 6 - Overview of The Taxonomy's challenges with the existing industry. Own creation.

The Taxonomy sets criteria for the use of circular building materials, which can help drive demand and to promote innovation of the niche technology. However, niche technologies, like circular building materials, faces multiple challenges to diffuse in the existing regime due to incompatibility with the different socio-technical elements (cf. Section 5.1).

To scale up circularity in the industry, supply and demand need to keep up. The Taxonomy helps drive the demand for circularity up, which can help develop the industry. However, there will be a transition phase where the industry needs time to adapt and develop solutions and standards before the circularity can scale from a niche technology into the regime.

In relation to pollution, the Taxonomy puts greater focus on the content of building materials (cf. Section 7.1.4). This will require manufacturers to deliver the needed documentation. Emil Veileborg Kocsis Aali, Sustainability Consultant at Rambøll points out a challenge in the industry:

"The Taxonomy sets a number of requirements in relation to substances in building materials that developers and contractors cannot find in the manufacturers' product specifications. This puts developers in a very complicated situation because it is the developers who ultimately have to document that their buildings or renovations do not contain these substances. But data is not yet provided by the manufacturers. So, the EU Taxonomy puts pressure on the top of the value chain, i.e. on the developers, and forces them to get the manufacturers to get a grip on the content of their materials." (cf. Appendix E)

In addition, Amal El-Kaswani, Technical Consultant, Green Building Council Denmark recognizes the challenge that Aali points out:

"The methodology for this is not defined, it is unclear what the potentially harmful substances are and the de minimis threshold is not defined by the European Commission. The positive side of the complex contamination criterion is that innovation in this area is expected and that it will lead to the restriction of chemicals in building materials." (cf. Appendix D)

The Taxonomy thereby requires the industry to build up new data in relation to materials' content. However, the methodology is not yet defined. Furthermore, the Taxonomy also requires scaling of circular solutions before the regime can reconfigure to a more sustainable built environment.

8.1.4 Culture

The culture in the built environment is known for being rather conservative (cf. Appendix F and G), which will be a challenge as the Taxonomy impacts the culture in new ways. The challenges are again related to circular economy and pollution as seen in the table below:

Environmental objectives	Challenges with existing culture	Details
Climate mitigation		Assessed to no challenges. The culture has the competences to fulfill the criteria
Climate adaptation		Assessed to no challenges. The culture has the competences to fulfill the criteria
Water		Assessed to no challenges. The culture has the competences to fulfill the criteria
Circular Economy	X	Challenges assessed in relation lack of competences across the value
Pollution	(X)	Challenges assessed in relation to past culture's way of building
Biodiversity	Not applicable	

Table 7 - Overview of The Taxonomy's challenges with the existing culture. Own creation.

The built environment has a long history for building with conventional building materials like concrete. Knowledge and experience with these materials have been built up over time, creating standard solutions that have gained a status as "Common Technical Ownership" (CTO). CTO is used as a term for the knowledge and practice that exists in the built environment as correct practice within a professional community or is an expression of the best knowledge in a given area. In other words, CTO is a professional and technical knowledge base that provides guidance for the built environment. This knowledge is highly based on the use of conventional

building materials (BUILD, 2020), which does not align with a sustainable development (cf. Section 2).

Therefore, the same knowledge and experience need to be built up around circular building materials as well. Kenneth Larsen, Asset manager at Akademiker Pension states:

"There is a need to build competences across the value chain to work with different materials than we have been used to." (cf. Appendix G)

The Taxonomy's criteria for circular economy requires new methods in the built environment in terms of design, construction, and demolition techniques etc. and thereby new competences (CONCITO, 2023). Today, the right competences to build circular are limited to a small part of the built environment (cf. Appendix G).

The Taxonomy thereby initiates a shift in the regime where new competences will be built up to enable a larger part of the built environment to work with circularity in the future. A cultural shift will play a big part in transition of the built environment and getting rid of the past's carbon lock-in effects. The past culture of the built environment turns out to be a problem for circularity today. A challenge is the design and construction techniques that have been used in the past, making it difficult to reuse materials (CONCITO, 2022). This is partly also responsible for the high waste generation from the sector (cf. section 2.1).

Another challenge is related to the past's use of harmful substances in building materials, such as asbestos, which has made it difficult to reuse and recycle materials, resulting in a linear economy in the sector (VCØB et al., 2021).

The Taxonomy will thereby require new competences and set requirements that will enable more circularity in the built environment in the future as the criteria address the challenges of the past. This will support the transition towards a more sustainable built environment.

8.1.5 Science and technology

The Taxonomy focuses on increasing the use of more sustainable technologies, such as water saving technologies, building materials with no/or less harmful substances, and circular building materials through its criteria. As highlighted in the previous sections, most of the challenges relate to circular economy and pollution.

In relation to the science and technology element, the challenge is that the Taxonomy requests data that currently does not exist by the manufactures (cf. section 8.1.3) and that it requests the use of technologies that do not currently meet or fit with the requirements of the existing regime (niche technologies).

The existing regime bases its knowledge and technologies on the CTO (cf. section 8.1.4). CTO highly consists of documentation, knowledge, and experience, and as the circular materials lack knowledge and documentation of their technical properties in relation to the Building Regulations' technical criteria, it is challenging for them to diffuse. A simplification of the knowledge challenge is illustrated in Figure 14:

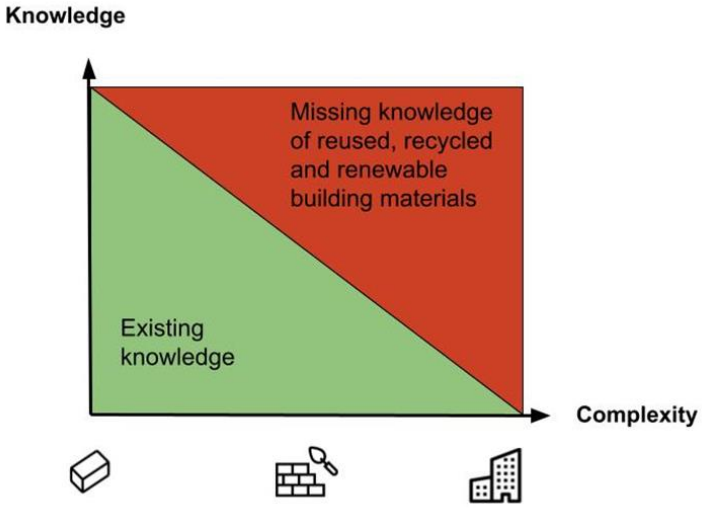

Figure 14 - Simple illustration of the knowledge gap of reused, recycled, and renewable (biobased) materials

Figure 14 illustrates a knowledge gap of circular building materials. As complexity of the construction increases, the less knowledge there is of these materials technical performance in the overall construction in relation to fulfilling the Building Regulations requirements (cf. Section 8.1.1). This gap needs to be documented to reduce risks, and thereby support diffusion of their application (CONCITO, 2023).

The lack of knowledge and documentation can influence some stakeholder in the built environment to opt for safer choices, such as conventional materials that are recognized as CTO to reduce risks (Værdibyg, 2023). Building materials with a lack of documentation puts the actors in the built environment at greater risk, which also increases the cost. This may ultimately discourage some from using them. This partly also affects the market and the industry, as demand may be limited due to greater risks (Værdibyg, 2023).

The development that the Taxonomy attempts to create in the built environment thereby faces challenges in the science and technology element. But at the same time, the Taxonomy tries to break down the challenges by putting pressure on the built environment to use circular materials which can drive innovation in the regime.

However, overall, the EU Taxonomy faces multiple challenges in the existing regime and needs support from the other elements to transition the built environment into a more sustainable development.

8.1.6 Sub-conclusion

To answer the second sub-question; *How does the EU Taxonomy affect the socio-technical regime of the built environment? And what changes does it require to create a more sustainable built environment and renovations?*

The analysis summarizes the following key-points:

- The Taxonomy sets a more sustainable direction and initiates changes in the different elements in the socio-technical regime of the built environment through its criteria.
- The Taxonomy requests new data, knowledge, competences, and technologies to be built up in the regime.
- The Taxonomy's criteria for circular economy and pollution are in particular a challenge for the existing regime.
- The transition of the built environment towards a more sustainable regime depends on a wide range of changes of the different elements in the regime.

The transition is a nonlinear process and depends on how the different elements develop. The different elements influence each other and the changes in one element can support the development of another element - or work against it. There will thereby be a transition phase of the built environment as new competences, knowledge etc. needs to be built up, and the different elements need to reconfigure.

Table 8 below lists some of the impact, challenges, and required changes that the Taxonomy has in the different elements for transitioning the built environment.

	Policies	Market	Industry	Culture	Science & Technology
Impact	• Puts sustainability considerations higher up on the agenda • Sets a direction for the regime	• Reinforces the value of sustainability as a competetive paramter • Clear distinction between sustainable and non-sustainable properties,	• Push on the industry to transition • Window of opportunity for innovation	• Push on the culture to build up new competences to enable more circularity	• Increased focus on the use of sustainable technologies
Challenges	• Existing regulation in relation to circular building materials and harmful substances	• Conditions in relation existing building stock • Market maturity for circular building materials	• Lack of scale , solutions and data to fulfill the Taxonomy's criteria for circular economy and pollution	• Conservatism • The past's building culture gives challenges in relation to circularity • Lack of competences to build circular	• Lack of knowledge and documentation of niche technologies like circular building materials • Greater risk for niche technologies
Requirements for Recon-figuration	• Adaptation of regulation to support the Taxonomy	• Development of the market in relation to circularity and scale	• Build up data in relation to pollution and circular economy • Scale solutions for circular economy	• Education across the value chain to work circular	• Development of knowledge and documentation • Development of technologies to support circularity

Table 8 - Overview of the impact, challenges, and requirements the EU Taxonomy has for the existing socio-technical regime of the built environment. Own creation.

On the basis of the analysis, it can be expected that the Taxonomy's criteria for renovation will have a great impact on the existing regime by becoming a driver for a more sustainable development. However, the development depends to a large extent on whether The Taxonomy helps to trigger renovations of the existing building stock.

9. Akademiker Pension's real estate investments

The following analysis will explore how the EU Taxonomy's criteria for acquisition and ownership affects real estate investments through a case study of Akademiker Pension's real estate portfolio. The analysis consists of three parts. The first two parts will screen Akademiker Pension's real estate portfolio according to Green Building Council Denmark's Taxonomy guide for acquisition and ownership (Rådet for Bæredygtigt Byggeri.a, 2022) while the last part will highlight considerations for real estate investments. Through the case study, the analysis will draw general conclusions and considerations in relation to the Taxonomy's effect on real estate investments.

As the Taxonomy is a classification system for sustainable economic activities (cf. Section 2.3), it can be used by investors to evaluate their assets and potential acquisition. To align with the Taxonomy under acquisition and ownership, the asset must follow one of the two routes illustrated in the figure below (Rådet for Bæredygtigt Byggeri.a, 2022).

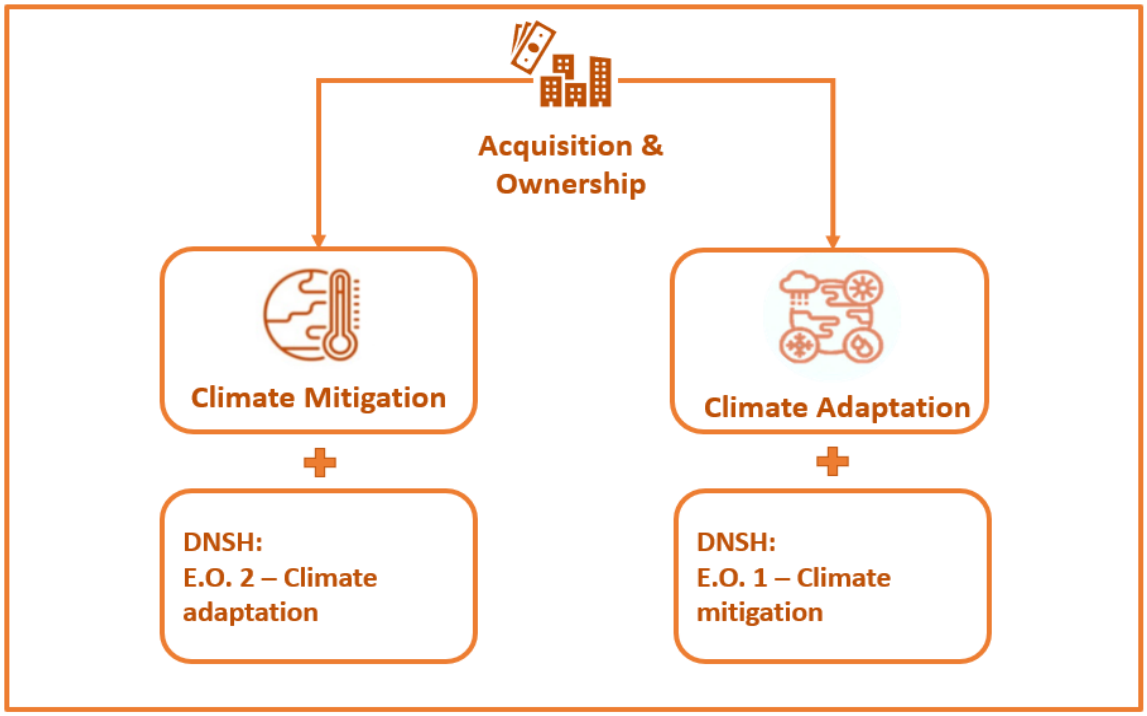

Figure 15 - The two environmental objectives that acquisition and ownership can make a substantial contribution to. Note: There are no DNSH-criteria for the environmental objectives 3-6 as these have been assessed to be not applicable. (EU Taxonomy Compass, n.d.). Own creation.

The two routes contain different criteria, which will be presented in the following sections. The screenings have been performed by checking each asset in Akademiker Pension's real estate portfolio against the criteria for the two routes (cf. Figure 15). The screenings have been simplified to keep Akademiker Pension's data confidential. Only data of EPC is included in the screenings (cf. section 6.1.1).

9.1 Taxonomy screening for substantial contribution to climate mitigation + DNSH for climate adaptation.

For a building to contribute substantially to climate mitigation under acquisition and ownership, the building must follow the criteria (Rådet for Bæredygtigt Byggeri, 2022):

1. *For buildings where permit was applied before the 31st of December 2020, the building has at least an Energy Performance Certificate (EPC), A.*
    a. *As an alternative, the building is within the top 15% of the national or regional building stock expressed as operational Primary Energy Demand (PED).*
        i. *In Denmark = Minimum EPC, B, is required to meet the criterion (cf. Appendix L).*
2. *For buildings where permit was applied after the 31st of December 2020, the building meets the criteria specified in Section 7.1 (New construction) that are relevant at the time of the acquisition:*
    a. *The Primary Energy Demand (PED) is at least 10 % lower than the threshold set for the nearly zero-energy building (NZEB) requirements in national measures.*
        i. *In Denmark = EPC, A2020 or energy performance that is at least 10% less than EPC, A2015.*
    b. *For buildings larger than 5000 m2, upon completion, the building resulting from the construction undergoes testing for air-tightness and thermal integrity, and any deviation in the levels of performance set at the design stage or defects in the building envelope are disclosed to investors and clients.*
    c. *For buildings larger than 5000 m2, the life-cycle Global Warming Potential (GWP) of the building resulting from the construction has been calculated for each stage in the life cycle and is disclosed to investors and clients on demand.*

3. *Where the building is a large non-residential building (with an effective rated output for heating systems, systems for combined space heating and ventilation, air-conditioning systems or systems for combined air-conditioning and ventilation of over 290 kW) it is efficiently operated through energy performance monitoring and assessment.*

Furthermore, the building must meet the DNSH-criteria for climate adaptation to align with the Taxonomy. The DNSH-criteria for climate adaptation under acquisition and ownership are the same as for renovation (cf. Section 7.1.4).

Akademiker Pension's real estate portfolio (currently) consists of 12 assets, where 11 of them applied for building permits before the 31st of December 2020, and one after. Assets 1-11 therefore must follow criteria number 1 above, while asset 12 must follow criteria number 2. Furthermore, asset 1-11 are commercial real estate and will therefore have to meet criteria number 3 above as well.

The portfolio's alignment with the criteria for substantial contribution to climate mitigation and DNSH to climate adaptation is listed in table 9 and 10 below:

Akademiker Pension's real estate portfolio - Building permit was applied before 31st of December 2020	Substantial contribution to climate mitigation: Minimum EPC class A or within the top 15 % of the national stock expressed operational Primary Energy Demand (PED)	Substantial contribution to climate mitigation: Non-residential buildings with a heating or cooling demand greater than 290 kW, building automation is installed to control the technical installations	DNSH - Climate adaptation
Asset 1	B		
Asset 2	C		
Asset 3	B		
Asset 4	C		
Asset 5	C		
Asset 6	C		
Asset 7	D		
Asset 8	C		
Asset 9	C		
Asset 10	B		
Asset 11	C		

Tabe 9 - Overview of Akademiker Pension's real estate portfolio (Buildings before 31st of December 2020) in relation to the Taxonomy's criteria for acquisition and ownership: substantial contribution to climate mitigation + DNSH for climate adaptation. Note: "Green" marks compliance. "Red" marks non-compliance.

Akademiker Pension's real estate portfolio - Buildings permit was applied after 31st of December 2020	Substantial contribution to climate mitigation: Energy label A2020 or energy performance that is at least 10% less than A2015	Substantial contribution to climate mitigation: For buildings larger than 5000 m2, upon completion, the building resulting from the construction undergoes testing for air-tightness and thermal integrity	Substantial contribution to climate mitigation: Life Cycle Assessment (LCA) If the gross floor area of the building is greater than 5000 m2	DNSH - Climate adaptation
Asset 12	A2015			

Table 10 - Overview of Akademiker Pension's real estate portfolio (Buildings after 31st of December 2020) in relation to the Taxonomy's criteria for acquisition and ownership: substantial contribution to climate mitigation + DNSH for climate adaptation. Note: "Green" marks compliance. "Red" marks non-compliance.

None of the assets in the portfolio reaches full alignment with the criteria at this point (cf. Table 9 and 10). Some of the assets partially meet the criteria in the Taxonomy, and the amount of adjustments will therefore vary from asset to asset. For example, for asset 1 and 3, climate risk screening and implementation of climate adaptation solutions (for identified risks) would create Taxonomy alignment. While an asset like 11 would need more comprehensive adjustments in the form of energy renovation, installation of building automation, and climate risk screening plus implementation of climate adaptation solutions.

The actions that Akademiker Pension will have to do for alignment with the Taxonomy in relation to the route for substantial contribution to climate mitigation are:

- Renovation of asset: 2, 4, 5, 6, 7, 8 ,9, 10, and 11 to at least EPC, A, or be in top 15 % of the national building stock = EPC, B (cf. Appendix L).
- Installation of building automation to control technical installations for asset 4, 10 and 11.
- Renovation of asset 12 to A2020 or 10% less PED than A2015.
- Climate risk screening of all assets + implementation of climate adaptation solutions if significant climate risks have been spotted.

9.2 Taxonomy screening for substantial contribution to climate adaptation and DNSH for climate mitigation.

For a building to contribute substantially to climate adaptation under acquisition and ownership, the building must follow the same substantial contribution criteria to climate adaptation for renovation (cf. Section 7.1.2). Furthermore, the building must meet the DNSH-criteria for climate mitigation to align with the Taxonomy. The DNSH-criteria for climate mitigation under acquisition and ownership are:

1. *The building is not dedicated to extraction, storage, transport, or manufacture of fossil fuels.*
2. *For buildings where permit was applied before the 31st of December 2020, the building has at least an Energy Performance Certificate (EPC), C.*
    a. *As an alternative, the building is within the top 30 % of the national or regional building stock expressed as operational Primary Energy Demand (PED).*
3. *For buildings where permit was applied after the 31st of December 2020, the Primary Energy Demand (PED) defining the energy performance of the building resulting from the construction does not exceed the threshold set for the nearly zero-energy building (NZEB) requirements.*
    a. *In Denmark = A2020 or energy performance that is at least 10% less than A2015.*

All the assets in Akademiker Pension's real estate portfolio must meet the DNSH-criteria for climate mitigation number 1 above. At the same time, asset 1-11 must meet criteria number 2, while asset 12 must meet criteria number 3. The portfolio's alignment with the criteria for substantial contribution to climate adaptation and DNSH to climate mitigation is listed in table 11 and 12 below:

Akademiker Pension's real estate portfolio - Building permit was applied before 31st of December 2020	Substantial contribution to climate adaptation	DNSH - Climate mitigation: Minimum EPC class C or within the top 30 % of the national stock expressed operational Primary Energy Demand (PED)	DNSH - Climate mitigation: The building is not dedicated to extraction, storage, transport or manufacture of fossil fuels.
Asset 1		B	
Asset 2		C	
Asset 3		B	
Asset 4		C	
Asset 5		C	
Asset 6		C	
Asset 7		D	
Asset 8		C	
Asset 9		C	
Asset 10		B	
Asset 11		C	

Table 11 - Overview of Akademiker Pension's real estate portfolio (Buildings before 31st of December 2020) in relation to the Taxonomy's criteria for acquisition and ownership: substantial contribution to climate adaptation + DNSH for climate mitigation. Note: "Green" marks compliance. "Red" marks non-compliance.

Akademiker Pension's real estate portfolio - Buildings permit was applied after 31st of December 2020	Substantial contribution to climate adaptation	DNSH - Climate mitigation: Energy label A2020 or energy performance that is at least 10% less than A2015	DNSH - Climate mitigation: The building is not dedicated to extraction, storage, transport or manufacture of fossil fuels.
Asset 12		A2015	

Table 12 - Overview of Akademiker Pension's real estate portfolio (Buildings after 31st of December 2020) in relation to the Taxonomy's criteria for acquisition and ownership: substantial contribution to climate adaptation + DNSH for climate mitigation. Note: "Green marks" compliance. "Red" marks non-compliance.

None of the assets in the portfolio reaches full alignment with the criteria at this point (cf. Table 11+12). However, table 11 indicates great potential for Taxonomy alignment of asset 1-11 if climate risk screenings and implementation of climate adaptation solutions are carried out (except asset 7).

The actions that Akademiker Pension will have to do for alignment in relation to the route for substantial contribution to climate adaptation are:

- Climate risk screening of all assets + implementation of climate adaptation solutions if significant climate risks have been spotted.
- Renovation of asset 7 to at least EPC, C.
- Renovation of asset 12 to EPC, A2020 or 10% less PED than A2015.

9.3 Taxonomy and its influence on real estate investments

A significant difference between the two routes given in Green Building Council Denmark's Taxonomy guide in the two previous Sections 9.1 and 9.2. The route for substantial contribution to climate mitigation requires more comprehensive adjustments of the portfolio compared to the route for substantial contribution to climate adaptation. This indicates an easier way for Taxonomy alignment by following the route for climate adaptation as less renovations are needed for Akademiker Pension. This is mainly due to different criteria for the building's EPC for the two routes (cf. Section 9.1 and 9.2).

However, the route for substantial contribution to climate adaptation can raise issues of greenwashing. It can be questioned whether owning (or acquiring) a building can contribute significantly to the climate through climate adaptation? In the case of Akademiker Pension, 10 of their 12 assets could become Taxonomy aligned by contributing substantially to climate

adaptation as most of their assets already complied with the DNSH-criteria for climate mitigation (EPC = C). Thereby 10 of their assets could become Taxonomy aligned without actually reducing the climate footprint of the building. (cf. Table 11 and 12).

Ramboll argues that one cannot align their assets with the Taxonomy by following the route for substantial contribution to climate adaptation (cf. Appendix N). Here, Rambøll refers to the European Commission's Notice (2022/C 385/01) which states (European Commision, 2022):

"Climate adaptation activities can only count the CapEx and OpEx for Taxonomy-eligibility. It is important to note here that the turnover derived from products and services associated with an adapted activity cannot be recognized for Taxonomy-eligibility. This is because once the substantial contribution to climate change adaptation of an activity has taken place (i.e. once the activity has been made resilient to climate change), the turnover corresponding to that activity should not count as eligible"

So, for example, if one builds a flood protection wall, only the cost of building the flood protection is eligible for substantial contribution to climate adaptation, but the ownership of the asset (the building) is not. Thereby, the economic activity of ownership of the building itself does not follow the Taxonomy's criteria for alignment, where, among others, a substantial contribution to one or more environmental objectives must be made (cf. Section 2.3).

This essentially means that real estate investors will have to follow the route for climate mitigation to align the ownership of their assets with the Taxonomy. As shown in section 9.1 and 9.2, the route for climate mitigation has more stringent criteria in relation to EPCs. This means that more assets will have to be renovated in order to align under the route for climate mitigation. Around 85 % of the building stock in Denmark cannot comply with substantial contribution criteria for climate mitigation of EPC A or B (for buildings where permit was applied before 31st of December 2020) (cf. Appendix L).

The Taxonomy thereby puts pressure on real estate investors to renovate if they have the following assets:

- Buildings where permit was applied before the 31st of December 2020 with an EPC below B

- Buildings where permit was applied after the 31st of December 2020 with an EPC below A2015

As 85 % of the building stock do not comply with criteria above, the Taxonomy can eventually lead to a significant push of the existing building stock towards a more sustainable development if investors adapt the Taxonomy's criteria and decide to align their assets.

How Akademiker Pension and other financial market participants should approach the Taxonomy in relation to their assets depends to a large degree on their objectives and the situation of the individual asset. Some considerations for real estate investments in relation to the Taxonomy could be:

What are the objectives for the portfolio?

- Is the objective to have the assets Taxonomy aligned?
    - If yes, does it make sense to align the asset with the Taxonomy - both in terms of economic and environmental aspects?
        - For example, if an asset was recently renovated. Would it make sense to renovate the asset again just to become aligned?
    - If no, what are the risks and what is the impact on the investments?

The above are just some of the considerations to be made in relation to real estate investment and the Taxonomy. There are also other considerations that play a role in real estate investment that are not taken into account in the Taxonomy. The discussion in chapter 10 will, among other things, touch some of the areas that the Taxonomy "overlooks" in relation to directing real estate investments in a more sustainable development.

9.4 Sub-conclusion

Through the case study of Akademiker Pension's real estate portfolio, the following key points can be drawn in relation to the Taxonomy's influence on real estate investments:

- The criteria for acquisition and ownership serve as a tool to evaluate real estate investments.
- The criteria set focus on sustainability considerations in relation to climate mitigation and climate adaptation.

    - In particular climate mitigation through energy efficiency (EPCs), as ownership of assets (buildings) have to follow the route for substantial contribution to climate mitigation to align with the Taxonomy.
- The criteria put pressure on majority of the existing building stock to be renovated.

As renovations are an eligible activity under the Taxonomy, the criteria for renovation will then be triggered, including more sustainability considerations (cf. section 7) which will drive the built environment towards a more sustainable development. However, there are also aspects that the Taxonomy does not take into account in terms of creating a sustainable development in the built environment. This will be highlighted in the following discussion.

10. The EU Taxonomy - Towards a sustainable development in the built environment?

The following section discusses to what extent the EU Taxonomy creates more sustainability in the built environment. The analysis will first discuss the impact and effect of the Taxonomy based on the previous analyses. Then the gaps and limitations of the Taxonomy in terms of transitioning the built environment towards a sustainable development will be discussed.

10.1 The impact and effects of the Taxonomy in the built environment and real estate investments.

In the first analysis it was highlighted that the EU Taxonomy poses new attention points for the built environment in relation to renovations. New and more sustainability considerations are put higher on the agenda for the built environment compared to the existing regulation (cf. Section 7.1.5).

The second analysis showed that the EU Taxonomy initiates changes in the different socio-technical elements in the regime of the built environment. Here, the Taxonomy requires, among others, new competences, new and more data of building materials in terms of content, quality, and technical properties to transition the regime and reconfigure for a more sustainable development (cf. Section 8.1.6).

The third analysis showed that the Taxonomy drives change in the built environment by pressuring real estate investors to renovate their non-sustainable assets (=non-Taxonomy aligned) and thereby creating pressure from the top of the value chain in the built environment.

However, the Taxonomy is voluntary in the sense that, currently, only disclosure obligations in relation to the Taxonomy are required. Linda Nielsen, professor at Copenhagen University's Center for Market and Economic Law, describes the Taxonomy as a "soft hard-law" and states in an article (Nielsen & Riisberg, 2022):

"Overall, sustainable finance positions itself between legislation and societal expectations by leaving it up to the investor to determine the normative effect."

The EU Taxonomy (and the SFDR) is in essence a hard law, as it forces the financial sector to disclose and create transparency regarding their investments. However, it is not binding in terms of action to comply with and can therefore be described as a soft hard-law.

The effect of the Taxonomy on the built environment thereby highly depends on what degree the financial market participants adopt the Taxonomy in order to create the trickle-down effect in the built environment through the criteria. The financial sector plays a key role for a sustainable development, as there is a need to redirect investments towards sustainable activities, which is exactly what the EU is trying to do with its action plan on sustainable finance (cf. Section 2). The second analysis indicated that financial market participants will largely adopt the Taxonomy, creating a shift in the market towards sustainable activities (= Taxonomy alignment) (cf. Section 8.1.2). This will have a significant impact on real estate investors who will be influenced to keep up with the market development. As 85 % of the existing building stock do not meet the Taxonomy's criteria for EPC under acquisition and ownership, many investors will need to renovate their assets. Therethrough, the Taxonomy will help lift the baseline of the building stock.

With the EU Taxonomy creating a clear distinction between sustainable and non-sustainable activities, investors' credibility will be tested. With the disclosure obligations in relation to the Taxonomy, it will be clear to see how serious financial market participants are about the sustainability agenda based on their share of Taxonomy alignment. Thereby, the Taxonomy puts pressure on investors to focus on sustainable economic activities in order to gain/maintain

positive reputation, have better access to finance and more (cf. Section 2.4 and 8.1.2). And thereby the financial sector can serve as a catalyst for moving, among others, the built environment in a more sustainable direction.

However, as the Taxonomy redirects investments in a more sustainable direction over the coming years, the socio-technical regime of the built environment faces structural challenges to meet the Taxonomy's criteria for renovation. To enable the effect of the EU Taxonomy on the built environment, the regime needs to support the transition by setting focus on political, market, cultural, industrial, and scientific development to transition the regime (cf. Section 8.1.6). This development will require a transition phase.

Even though the Taxonomy helps drive innovation and the transition of the regime, there is a need for the whole regime to reconfigure to meet the Taxonomy. The criteria are knock-out criteria, the Taxonomy thereby does not reward assets that fulfill the many other criteria if one criterion is violated. It is debatable whether there is a need for a more nuanced picture of the Taxonomy and the green transition of the built environment. The following section will discuss the gaps and limitations of the Taxonomy.

10.2 Gaps and limitations of the Taxonomy

The EU Taxonomy was officially adopted in July 2020 (Erhvervsstyrelsen, n.d.), but is still under development. Linda Nielsen writes in an article (Nielsen, 2022):

"The rules set out a multitude of obligations and are extremely complex. The overall set of rules runs to many hundreds of pages and is far from complete. There are many outstanding issues, ambiguities, and doubts about interpretation."

As highlighted in chapter 9, there are different interpretations of the Taxonomy. Green Building Council Denmark has interpreted it in one way as stated in their guidance, while Ramboll interprets it in another way. The different interpretations give different answers - and the difference is significant in terms of the impact on real estate investments and the built environment (cf. section 9.1 and 9.2). However, the European Commission's Notice (2022/C 385/01) makes it clear that ownership of the asset cannot contribute substantially to climate adaptation - only the climate adaptation solution itself. The different interpretations is an

example of the complexity of the Taxonomy's rules, where the devil is in the details. It is problematic if the different consultants in the built environment interpret the Taxonomy so significantly different. Ramboll expresses that they see other consultants aligning clients' assets with the route for substantial contribution to climate adaptation, which is considered Greenwashing by Ramboll (cf. Appendix N).

The various interpretations of the Taxonomy can potentially downplay the full effect of the Taxonomy if the different consultants points investors in significantly different directions as seen in analysis 3 (cf. Section 9.1.3). Furthermore, it can lead to miscommunication and potentially greenwashing, which the Taxonomy has been set out to avoid. It is therefore important to create more clarity on the Taxonomy's rules in the built environment so that the sector moves in the same direction.

However, disclosure obligations under the Taxonomy will have to get a third-party verification to avoid mistakes and greenwashing. Yet, it remains to be determined who will be the watchdog on all the information reported under the Taxonomy in the future. The platform on sustainable finance recommends that verification is made by: *"a third party registered and supervised by ESMA or an official authority if non-EU"* (Platform on sustainable finance, 2022). This will ensure that the Taxonomy is respected and that its positive environmental impact on the built environment is realized. But as the Taxonomy is still not complete and it still has some gaps, it is unsure to estimate the Taxonomy's full effect on the built environment.

In addition, the Taxonomy also includes a number of inadequacies in relation to the sustainable development of the built environment. Among other things, the Taxonomy's criteria are minimum standards, which can reduce the incentive to take further actions than just Taxonomy alignment. On the other hand, it helps to improve the baseline of the built environment.

Although, the criteria in the Taxonomy will help to improve the built environment overall, the Taxonomy also overlooks a number of considerations in relation to sustainable development. For example, the embodied carbon of building materials is not addressed to a very high degree. The route for substantial contribution to the circular economy during renovation indirectly focuses on this area by requiring the use of circular building materials. However, the other routes do not address this. Furthermore, an asset can still become Taxonomy aligned under acquisition and ownership even though it fails the criteria for renovation. As the criteria for

acquisition and ownership only focuses on energy efficiency and climate adaptation, the importance of circular economy (and also the other environmental objectives) under renovation might be downplayed.

The Taxonomy's criteria focus heavily on energy efficiency (cf. Appendix I, J, and K), which is an important step for sustainable development. However, as the energy system gradually transitions to renewable energy sources, emissions from the operation of buildings will be reduced. Therefore, there is a need to focus more on the climate impact of building materials. This is important to include to ensure a real reduction of the climate impact. For example, the Taxonomy could require that renovations should be considered in a life cycle perspective, so the reduction of climate impact from energy savings is greater than the climate impact caused by the materials used. But as the Taxonomy mainly focuses on EPCs, a real climate reduction cannot always be ensured. For example, a renovation from EPC, A2015 to A2020, which creates Taxonomy alignment, will result in low energy savings and the climate effect may therefore be questionable from a climate perspective (cf. Section 9.1 - Table 10).

If real estate investors decide to renovate just to align with the Taxonomy even though the climate impact will be greater than the energy savings, the derived effect of the Taxonomy may arise. There may therefore be a need for a more nuanced picture of the Taxonomy's criteria, where the building's individual situation is taken into account.

In addition, Amal El-Kaswani believes that the Taxonomy alignment should also be more nuanced:

"(...) I also think it is valuable to document how large a proportion of the building meets the various criteria. For example, 60 percent of the building meets this criterion and so on to get a more nuanced picture of where we are performing well, and where we are performing poorly. You don't get that if you just look at a page, where it says that you are compliant or not. So, it's the underlying factors that are interesting."

As El-Kaswani states, having a more nuanced view of Taxonomy alignment can help stakeholders to identify strengths and weaknesses, and thereby make more informed decisions, and prioritize actions for improvement.

The way the Taxonomy is currently organized, there is a clear distinction between sustainable and non-sustainable activities. On one hand, this is good for lifting the bottom of the built environment, but on the other hand, it can become a challenge for pushing the top of the built environment to take further actions in the green transition.
If Taxonomy alignment becomes the most important factor for investors, how can the built environment be pushed to work beyond the Taxonomy's criteria There are gaps in the Taxonomy, like embodied carbon, and there are even more gaps in that have not been addressed in the thesis, such as the social aspects in and between buildings, CO2-requirements to reduce the climate impacts etc. These gaps are also important to include for a sustainable development in the built environment but are currently not considered in the EU Taxonomy.

11. Conclusion

The financial sector poses a significant role for the sustainable development in the form of investments to create a transition from the past's unsustainable systems and technologies towards sustainable alternatives. The EU Taxonomy (and the SFDR) supports this transition by providing guidance, standardization, and transparency for sustainable investments. The EU Taxonomy Regulation will push the financial sector to incorporate sustainability considerations into their decision making compared to existing regulation.

As the majority of the building stock does not meet the Taxonomy's criteria for acquisition and ownership, this will pressure real estate investors to renovate their assets in order to classify these as sustainable. Through the Taxonomy's criteria for renovation, investors can put pressure on the whole value chain in the built environment to comply - causing a "trickle-down effect".

This thesis has therefore explored the following research question:

In what way does the EU Taxonomy affect the socio-technical regime of the built environment in a more sustainable development in relation to renovations? And what impact does it have on real estate investments?

To answer the overall research question, the thesis explored four sub-questions, where the first sub-questions investigated what new attention points the EU Taxonomy created for the built environment in relation to renovations? Here, the following key points were drawn:

- The EU Taxonomy requires renovations to integrate sustainability considerations in relation to energy consumption, climate resilience, water consumption, circular economy and substances in building materials.
- The EU Taxonomy's criteria will require renovations to follow more, and more stringent, requirements in relation to the Danish Build Regulation - if the renovation wants to align with the Taxonomy and classify as a sustainable activity.

The new attention points for renovations affect the built environment, which leads to the second sub-question which explored how the EU Taxonomy affects the socio-technical regime of the built environment? And what changes does it require to create a more sustainable built environment and renovations? The analysis showed:

- The Taxonomy sets a more sustainable direction and initiates changes in the different elements in the socio-technical regime of the built environment through its criteria.
- The Taxonomy requests new data, knowledge, competences, and technologies to be built up in the regime.
- The Taxonomy's criteria for circular economy and pollution are in particular a challenge for the existing regime.
- The transition of the built environment towards a more sustainable regime depends on a wide range of changes of the different elements in the regime.

The first two analyses showed a great impact of the Taxonomy on the built environment. But as the EU Taxonomy is a financial regulation, the effect on the built environment highly depends on how well the financial market participants adapt the criteria. Through a case study of Akademiker Pension, the third analysis investigated what considerations the EU Taxonomy poses for real estate investments? The analysis showed the following key points:

- The criteria for acquisition and ownership serve as a tool to evaluate real estate investments.
- The criteria set focus on sustainability considerations in relation to climate mitigation and climate adaptation.

    - In particular climate mitigation through energy efficiency (EPCs), as ownership of assets (buildings) have to follow the route for substantial contribution to climate mitigation to align with the Taxonomy.
- The criteria put pressure on majority of the existing building stock to be renovated.

The EU Taxonomy will pressure real estate investors to renovate their assets if they have the following assets:

- Buildings where permit was applied before the 31st of December 2020 with an EPC below B
- Buildings where permit was applied after the 31st of December 2020 with an EPC below A2015

Thereby, the EU Taxonomy is a tool for moving the baseline of the built environment towards a more sustainable development by affecting real estate investments. However, the normative effect is up to the investors. Furthermore, the EU Taxonomy has its gaps and limitations in relation to moving the built environment towards sustainable development. The EU Taxonomy's criteria are minimum performance standards which can reduce incentives for pushing the built environment even further on the sustainability agenda. In addition, the Taxonomy does not address embodied carbon (in a high degree) or ensures a positive climate effect in a life cycle perspective, and it therefore requires a focus on these considerations - either politically or among the stakeholders - to drive the built environment even further to reach the climate goals.

Overall, the Taxonomy is a great step towards sustainable development as it sets a standard and direction for investments, including the built environment. However, the sustainable development does not end at the Taxonomy's minimum criteria.

12. References

AkademikerPension. (2022). *ANSVARLIGE INVESTERINGER.* Retrieved May 17, 2023, from AkademikerPension: https://akademikerpension.dk/media/orofknyx/ansvarlighedsmagasin_2022.pdf#page=2

Beyersdorff, S., Staal, B., & Fellingham, A. (2021, April 19). *How the Future-Fit Business Benchmark can help you prepare for the coming EU Taxonomy disclosures — Nordic Sustainability.* Retrieved March 13, 2023, from Nordic Sustainability: https://nordicsustainability.com/how-the-future-fit-business-benchmark-can-help-you-prepare-for-the-coming-eu-taxonomy-disclosures/

Bolius. (2020, November 3). *5 gode råd: Spar penge på at nedsætte toiletskyllet.* Retrieved April 21, 2023, from Videncentret Bolius: https://www.bolius.dk/5-gode-raad-spar-penge-paa-at-nedsaette-toiletskyllet-42426

Bolius. (2022, August 15). *Hvor meget kan du spare med en sparebruser?* Retrieved April 21, 2023, from Videncentret Bolius: https://www.bolius.dk/hvor-meget-kan-du-spare-med-en-sparebruser-7056

BPIE. (2017, October 26). *97% of buildings in the EU need to be upgraded > BPIE.* Retrieved March 13, 2023, from Buildings Performance Institute Europe: https://www.bpie.eu/publication/97-of-buildings-in-the-eu-need-to-be-upgraded/

BUILD. (2020, December). *Alment teknisk fælleseje En institutionel analyse af fællesejets rolle i byggebranchen.* Retrieved May 8, 2023, from build.dk: https://build.dk/Assets/Alment-teknisk-faelleseje/BUILD-Rapport-2020-27.pdf

BusinessInsights. (2020, October 26). *Nu er træ for alvor på vej ind i byggeriet.* Retrieved May 16, 2023, from Business Insights: https://www.businessinsights.dk/klima/nu-er-trae-for-alvor-paa-vej-ind-i-byggeriet/

Bygninger og Grøn Omstilling. (2021, November). *Anvendelse af beton i byggeriet.* Retrieved April 7, 2023, from Bygninger og Grøn Omstilling: https://concito.dk/files/media/document/2021.11.26%20Fremsynsnotat%20beton%20i%20byggeriet.pdf

Bygningsreglementet §250 - §298. (n.d.). *BR18.* Retrieved April 15, 2023, from BR18: https://bygningsreglementet.dk/Tekniske-bestemmelser/11/Krav

Bygningsreglementet §329 - §333. (n.d.). *BR18 - §329 - §333 - 1.1. Forureninger af byggematerialer.* Retrieved May 1, 2023, from BR18: https://bygningsreglementet.dk/Tekniske-bestemmelser/13/Vejledninger/Generel_vejledning/Kap-1_1

Bygningsreglementet §40 - §46. (n.d.). *Administrative bestemmelser (§ 1 - § 47).* Retrieved May 4, 2023, from Administrative bestemmelser (§ 1 - § 47) | BR18: https://bygningsreglementet.dk/Historisk/BR18_Version1/Administrative-bestemmelser/Krav

Bygningsreglementet. (n.d.). *BR18.* Retrieved May 23, 2023, from BR18: https://bygningsreglementet.dk/Vejledninger/Klimasikring/Vejledning_Klimasikring/Byygeri_i_kystnaere_omraader?Layout=ShowAll

Børsen. (2022, Septemper 27). *Solgte massivt ud i 00'erne: Pensionskasse gør klar til stort comeback på ejendomsmarkedet.* Retrieved April 11, 2023, from Børsen: https://borsen.dk/nyheder/ejendomme/pensionskasse-vil-udvide-portefoljen-med-7-mia-kr-inden-for-fire-aar?b_source=soren&b_medium=row_1&b_campaign=list_3

CONCITO. (2021, June 28). *Renovering af bygninger er en vigtig del af klimaløsningen.* Retrieved May 6, 2023, from CONCITO: https://concito.dk/nyheder/renovering-bygninger-er-vigtig-del-klimaloesningen

CONCITO. (2022, December). *Cirkulær økonomi i byggeriet Med fokus på genbrug og genanvendelse af byggematerialer.* Retrieved May 4, 2023, from concito.dk: https://concito.dk/files/media/document/2023-03-08%20Fremsyn%20Cirkul%C3%A6r%20%C3%98konomi%20genbrug%20og%20genanvendelse.pdf

CONCITO. (2023, Maj 08). *Anvendelse af biobaserede byggematerialer.* Retrieved May 8, 2023, from concito.dk: https://concito.dk/udgivelser/anvendelse-biobaserede-byggematerialer

Den Frivillige Bæredygtighedsklasse. (n.d.). *Bæredygtighedsklassen set i forhold til bygningsreglementet - Bæredygtighedsklasse.* Retrieved April 21, 2023, from Den frivillige bæredygtighedsklasse: https://xn--bredygtighedsklasse-lxb.dk/2-introduktion-til-kravene/baeredygtighedsklassen-set-i-forhold-til-br-

Earth Overshoot Day. (2022). *Past Earth Overshoot Days - #MoveTheDate of Earth Overshoot Day.* Retrieved February 12, 2023, from Earth Overshoot Day: https://www.overshootday.org/newsroom/past-earth-overshoot-days/

EEA. (2019). Sustainability transitions: policy and practice. EEA. Retrieved from www.eea.europa.eu: https://www.eea.europa.eu/publications/sustainability-transitions-policy-and-practice

Ellen MacArthur foundation. (2021). *Completing the picture: How the circular economy tackles climate change.* Retrieved February 13, 2023, from Ellen MacArthur Foundation: https://ellenmacarthurfoundation.org/completing-the-picture

Energihjem. (2020, October 30). *Energimærkning: Alt du skal vide om energimærket.* Retrieved April 13, 2023, from Energihjem.dk: https://energihjem.dk/energimaerkning/

Energistyrelsen. (n.d.). *Det viser energimærket | Energistyrelsen.* Retrieved April 29, 2023, from Energistyrelsen |: https://ens.dk/ansvarsomraader/energimaerkning-af-bygninger/det-viser-energimaerket

EPSI. (2022, June 22). *EPSI: Lægernes Pension vinder igen på kundetilfredshed.* Retrieved April 11, 2023, from AkademikerPension: https://akademikerpension.dk/media/nhlhq2fq/2022-06-22-epsi-pension-branchestudie-2022-pressemeddelelse-publiceret-22-06-2022.pdf

Erhvervsstyrelsen. (n.d.). *Rapportering efter taksonomiforordningens artikel 8 (Guide) | erhvervsstyrelsen.dk.* Retrieved May 19, 2023, from Erhvervsstyrelsen: https://erhvervsstyrelsen.dk/rapportering-efter-taksonomiforordningens-artikel-8-guide

EU. (2020, June 22). *EUR-Lex - 32020R0852 - EN - EUR-Lex.* Retrieved February 26, 2023, from EUR-Lex: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32020R0852

EU Taxonomy Compass. (n.d.). *Taxonomy compass.* Retrieved March 21, 2023, from ec.europa.eu: https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/224/view

European Commision - Levels. (n.d.). *Topics - Circular economy - Level(s).* Retrieved May 1, 2023, from Language selection | Environment: https://environment.ec.europa.eu/topics/circular-economy/levels_en

European Commision. (2022, October 06). *Publications Office.* Retrieved May 19, 2023, from Publications Office: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022XC1006(01)&from=EN

European Commision. (n.d.). *Corporate sustainability reporting.* Retrieved March 11, 2023, from Finance: https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

European Commission. (2018, March 8). *Sustainable finance: Commission's Action Plan for a greener and cleaner economy.* Retrieved February 28, 2023, from europa.eu: https://ec.europa.eu/commission/presscorner/detail/en/IP_18_1404

European Commission. (2020, February 17). *In focus: Energy efficiency in buildings.* Retrieved March 13, 2023, from European Commission: https://commission.europa.eu/news/focus-energy-efficiency-buildings-2020-02-17_en

European Commission.A. (n.d.). *Buildings and construction.* Retrieved March 13, 2023, from Language selection | Internal Market, Industry, Entrepreneurship and SMEs: https://single-market-economy.ec.europa.eu/industry/sustainability/buildings-and-construction_en

Finanstilsynet. (2023, February 21). *Disclosureforordningen - Bæredygtig finansiering.* Retrieved March 3, 2023, from Finanstilsynet: https://www.finanstilsynet.dk/Tilsyn/Information-om-udvalgte-tilsynsomraader/Baeredygtig_finansiering/Disclosureforordningen

Flyvbjerg, B. (2010, February). *Fem misforståelser om casestudiet.* Retrieved April 16, 2023, from ResearchGate: https://www.researchgate.net/publication/244485915_Fem_misforstaelser_om_casestudiet

Geels, F. W. (2010, November 24.). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Elsevier*. Retrieved from https://reader.elsevier.com/reader/sd/pii/S2210422411000050?token=34D52816E261441C47429619A9CCA1B9551017B9CF44D45403E9310B1C39105272F4E7341F43A17E0BC8FFD149AB81CD&originRegion=eu-west-1&originCreation=20230324131641

IEA. (2021, July 15). *Global electricity demand is growing faster than renewables, driving strong increase in generation from fossil fuels - News.* Retrieved February 9, 2023, from IEA: https://www.iea.org/news/global-electricity-demand-is-growing-faster-than-renewables-driving-strong-increase-in-generation-from-fossil-fuels

IEA. (2022, September). *Renewable Electricity – Analysis.* Retrieved February 13, 2023, from IEA: https://www.iea.org/reports/renewable-electricity

IPCC. (2022, April 4). *The evidence is clear: the time for action is now. We can halve emissions by 2030. — IPCC.* Retrieved February 22, 2023, from IPCC: https://www.ipcc.ch/2022/04/04/ipcc-ar6-wgiii-pressrelease/

Makower, J. (2023, May 1). *Inside the art and science of banks' 'financed emissions' | GreenBiz.* Retrieved May 16, 2023, from Greenbiz: https://www.greenbiz.com/article/inside-art-and-science-banks-financed-emissions

Moloney, P. (2022, April 7). *The Circular Economy Taxonomy. What is it and what sectors are included?* Retrieved March 11, 2023, from Ramboll: https://ramboll.com/ingenuity/the-circular-economy-taxonomy

Moloney, P., & Verhey, M. (2021, January 19). *The EU Taxonomy Regulation: 5 reasons to start aligning today.* Retrieved March 11, 2023, from Ramboll: https://ramboll.com/ingenuity/the-eu-taxonomy

Nielsen, L. (2022, September 1). *2022 Advokaten 3 Min forskning: Bæredygtighed i juraens verden.* Retrieved April 24, 2023, from Advokatsamfundet: https://www.advokatsamfundet.dk/nyheder-medier/tidligere-artikler/2022/advokaten-3/2022-advokaten-3-min-forskning-baeredygtighed-i-juraens-verden/

Nielsen, L., & Riisberg, E. M. (2022). *REGULERING AF EN BÆREDYGTIG FREMTID - Alle ansatte tilknyttet forskningsområdet.* Retrieved May 16, 2023, from Det Juridiske Fakultet: https://jura.ku.dk/ansatte/forskningsomraadet/?pure=da%2Fpublications%2Fregulering-af-en-baeredygtig-fremtid(96603f3f-7a5e-4add-84c6-0c4cdfbd5777).html

Nordea. (2022, May 3). *A first look at companies' EU Taxonomy reporting.* Retrieved April 11, 2023, from Nordea: https://www.nordea.com/en/news/a-first-look-at-companies-eu-taxonomy-reporting

Platform on Sustainable Finance. (2022, March). *Annex to the platform on Sustainable Finance's report with recommendations on technical screening criteria for the four remain.* Retrieved April 18, 2023, from Finance: https://finance.ec.europa.eu/system/files/2022-03/220330-sustainable-finance-platform-finance-report-remaining-environmental-objectives-taxonomy-annex_en.pdf

Platform on sustainable finance. (2022, October 12). *Platform on Sustainable Finance's recommendations on data and usability of the EU taxonomy.* Retrieved May 20, 2023, from Finance: https://finance.ec.europa.eu/system/files/2022-10/221011-sustainable-finance-platform-finance-report-usability_en_1.pdf

Rambøll. (n.d.). EU Taxonomy Regulation Quickguide to the New Standard for Green Transition. Rambøll. Retrieved March 12, 2023, from https://ramboll.com/-/media/files/rm/eu-taxonomy-quick-guide.pdf?la=en

Realdania. (2023, April). *Roadmap for cirkulær økonomi i byggeriet.* Retrieved May 6, 2023, from realdania.dk: https://webuilddenmark.dk/wp-content/uploads/2023/04/Roadmap_for_cirkulaer_oekonomi_i_byggeriet_17_04_23.pdf

ResearchMethods.Net. (2022, August 3). *Documentary Research - Types, Methods and Examples.* Retrieved May 23, 2023, from Research Method: https://researchmethod.net/documentary-research/

Rådet for Bæredygtigt Byggeri.a. (2022, February 23). *Vejledning - Taksonomiforordning 2020/852 7.2 Renovering af eksisterende bygninger.* Retrieved May 14, 2023, from rfbb.dk: https://ee005d883a369b5a623ec663eecf93eb.cdn.bubble.io/f1680694797881x157401381301751420/Taksonomivejledning%20v.%202.0%20for%207.2%20Renovering%20af%20eksisterende%20bygninger.pdf?AWSAccessKeyId=AKIATBBF73RNGVJNFEZN&Expires=1684099347&Signature=MddDOLj7U0

Rådet for Bæredygtigt Byggeri.a. (2022, February 23). *Vejledning - Taksonomiforordning 2020/852 7.7 Erhvervelse og ejerskab af bygninger.* Retrieved May 13, 2023, from rfbb.dk: https://ee005d883a369b5a623ec663eecf93eb.cdn.bubble.io/f1680694777439x501141415616289000/Taksonomivejledning%20v.%202.0%20for%207.7%20Erhvervelse%20og%20ejerskab%20af%20eksist

erende%20ejendom.pdf?AWSAccessKeyId=AKIATBBF73RNGVJNFEZN&Expires=1683804939&Signa

Stockholm Resilience Centre. (n.d.). *The nine planetary boundaries.* Retrieved February 12, 2023, from Stockholm Resilience Centre: https://www.stockholmresilience.org/research/planetary-boundaries/the-nine-planetary-boundaries.html

Sørensen, L. H., & Mattson, M. (2020, October 30). *Rambøll-rapport: Renovering er bedst for økonomi og klima.* Retrieved March 20, 2023, from Bygherreforeningen: https://bygherreforeningen.dk/renovering-giver-miljoemaessige-og-totaloekonomiske-fordele/

UN. (2019, June 17). *Growing at a slower pace, world population is expected to reach 9.7 billion in 2050 and could peak at nearly 11 billion around 2100 | UN DESA | United Nations Department of Economic and Social Affairs.* Retrieved February 12, 2023, from the United Nations: https://www.un.org/development/desa/en/news/population/world-population-prospects-2019.html

UN. (n.d.). *Sustainability | United Nations.* Retrieved February 13, 2023, from the United Nations: https://www.un.org/en/academic-impact/sustainability

UNEP. (2022, October 27). *Emissions Gap Report 2022.* Retrieved February 11, 2023, from UN Environment Programme: https://www.unep.org/resources/emissions-gap-report-2022

UNFCCC. (n.d.). *The Paris Agreement.* Retrieved March 10, 2023, from UNFCCC: https://unfccc.int/process-and-meetings/the-paris-agreement

Unruh, G. (2000, October 1.). Understanding carbon lock-in. Elsevier. Retrieved from sciencedirect.com: https://www.sciencedirect.com/science/article/pii/S0301421500000707

VCØB. (2021, Juni). *CIRKULÆR ØKONOMI I BYGGERIET.* Retrieved May 8, 2023, from Videncenter for Cirkulær Økonomi i Byggeriet: https://vcob.dk/media/2087/temaark-samlet-inkl-lsevejledningfinal.pdf

Verhey, M., Kielhorn, D., & Moloney, P. (2021, March 17). *Making sense of the EU Sustainable Finance Regulations.* Retrieved February 28, 2023, from Ramboll: https://ramboll.com/ingenuity/making-sense-of-the-eu-sustainable-finance-regulations

Værdibyg. (2021, January 28). *Renovering tilbage på dagsordenen.* Retrieved May 9, 2023, from Værdibyg: https://vaerdibyg.dk/renovering-tilbage-paa-dagsordenen/

Værdibyg. (2023). *En vejledning om risikobarrierer for bæredygtige byggematerialer.* Retrieved May 18, 2023, from Værdibyg: https://vaerdibyg.dk/vejledning/risiko-som-barriere-for-baeredygtige-byggematerialer/

World Economic Forum. (2022, November 8). *For net-zero cities, we need to retrofit our older buildings. Here's what's needed.* Retrieved March 13, 2023, from The World Economic Forum: https://www.weforum.org/agenda/2022/11/net-zero-cities-retrofit-older-buildings-cop27/

World Green Building Council. (n.d.). *What is a Sustainable Built Environment?* Retrieved April 7, 2023, from World Green Building Council: https://worldgbc.org/what-is-a-sustainable-built-environment/

Aarhus University. (n.d.). *Interviews.* Retrieved April 3, 2023, from Metodeguiden: https://metodeguiden.au.dk/interviews