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Commit or Emit:

The Sustainability Characteristics of Danish Companies with Net-Zero Pledges

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This thesis explores the characteristics and sustainability strategies of Danish companies with certified climate targets and the distinction with *net-zero* targets. The probability of having a net-zero target is modelled with three explanatory variables – *life cycle assessments* (LCAs)*, disruptive innovation,* and *carbon offsetting*. The study is based on survey data gathered from thirty-four sustainability directors and managers in one hundred and thirty Danish companies with certified pledges.

The most innovative and disruptive companies are significantly correlated with having net-zero pledges, showing how sustainable practices as still perceived as disruptive and not as a mature market trend in itself. Having performed full product and building LCAs also has a significant association with net-zero pledges as they quantify environmental impacts. Due to carbon offsetting's controversial nature, there is no significant association between net-zero targets and the Danish companies in any category. This thesis argues that collaboration and climate public-private partnerships (PPPs) across the Danish sustainability system are needed. Moreover, this thesis outlines strands for future research centred on Nordics and the perceived value of environmental PPPs.

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Table of Contents

1. Introduction........ 6
1.1 Definitions 7
2. Aim and Research Question 10
3. Literature Review........ 11
3.1 Net-Zero Principles and Voluntary Climate Pledges 11
3.2 Global Carbon Offsetting Market........ 13
3.2.1 Carbon Capture and Storage 14
3.2.2 Agriculture, forestry, and other land use 15
3.2.3 Renewable Energy Projects 16
3.3 Survey Question Literature 17
3.3.1 Innovation and Disruptiveness........ 17
3.3.2 Supply Chain and Sustainability........ 18
3.3.3 Emission Scoping........ 18
3.3.4 Life Cycle Assessments 19
3.3.5 Public-Private Climate Partnerships........ 20
3.4 Corporate Sustainability Strategy Determinants 21
3.5 Global Firms Strategies and Net-Zero Pledges 22
3.6 Danish Emission Sources........ 23
3.7 CSR in Denmark and Danish Political Status 25
3.7.1 Governmental approach to GHG emission reduction........ 25
3.7.2 Private Businesses and their CSR Initiatives in Denmark 26
3.7.3 Danish businesses and Kyoto Carbon Credits........ 28
3.8 Research Gap........ 29
3.9 Theoretical Framework........ 30
4. Methodology........ 31
4.1 Models 32
4.2 Model and Study Limitations........ 34
4.3 Assumptions 35
5. Data........ 35
5.1 Inclusion of Variables 37
5.2 Descriptive Statistics........ 39
6. Results 39
6.1 Model 1 (Disruption)........ 40
6.2 Model 2 (LCA) 42
6.3 Model 3 (Carbon Offsets) 42
7. Analysis and Discussion 43
8. Robustness Check 47

9. Conclusion 48
10. References 51
Appendix A 63
Appendix B 64
Appendix C 67

List of Abbreviations

Table 1: List of Abbreviations

Corporate Social Responsibility	CSR
Greenhouse Gas	GHG
Intergovernmental Panel on Climate Change	IPCC
Multi-Level Perspective	MLP
Carbon Dioxide	CO2
Triple Bottom Line	TBL
Climate Ambitions	CAs
European Union	EU
Public Relations	PR
Carbon Capture and Storage	CCS
Research & Development	R&D
Agriculture, Forestry, and other Land Use	AFOLU
Foreign Direct Investment	FDI
Business-to-Customer	B2C
Life Cycle Assessments	LCAs
Public-Private Partnerships	PPPs
Danish Krone (Crowns)	DKK
United Nations Framework Convention on Climate Change	UNFCCC
Odds Ratios	ORs
United Nations	UN
Direct Air Carbon Capture	DAC
Sustainable Supply Chain Management	SSCM
Small and Medium Enterprises	SMEs
Hosmer-Lemeshow Goodness-of-Fit	GOF
Organisation for Economic Co-operation and Development	OECD
International Standard Industrial Classification for All Economic Activities	ISIC

List of Tables:

Table 1: List of Abbreviations ... 4
Table 2: Survey Questions ... 35
Table 3: Descriptive statistics for Models ... 39
Table 4: Model 1 Results ... 40
Table 5: Model 2 Results ... 42
Table 6: Model 3 Results ... 42
Table 7: Full data for Danish C02 emissions between 2010 and 2020 in 1000s of tonnes ... 63
Table 8: Model 1 Full Results ... 64
Table 9: Model 2 Full Results ... 65
Table 10: Model 3 Full Results ... 65
Table 11: Model 1 Classification ... 66
Table 12: Model 2 Classification ... 66
Table 13: Model 3 Classification ... 66
Table 14: Alternate Model 1 ... 67
Table 15: Alternate Model 2 ... 67
Table 16: Goodness-of-fit for Model 1 ... 68
Table 17: Goodness-of-fit for Model 2 ... 68
Table 18: Goodness-of-fit for Model 3 ... 68

List of Equations

(1): $logit(PYi = 1) = \exp(\beta 0 + \beta iXi)(1 + exp(\beta 0 + \beta iXi))$ ... 33
(2): $LogOR = logit(P\ Yi = 1) = lnP(1 - P)$ ... 33
(3): $ORs = a/cb/d = adbc$ ... 33

List of Figures

Figure 1: Danish CO_2 Emissions Sources between 2010 and 2020 (in 1000s of tonnes) (Danmark's Statistik, 2022) 24

1. Introduction

Danish companies are increasingly adapting to various pressures and adopting voluntary climate pledges and Net-Zero targets. Climate ambitions are now a segment of everyday life in countries such as Denmark, which self-identifies as a sustainability front-runner (Bäckstrand & Kronsell, 2015; Johansen & Werner, 2022). Notwithstanding any controversy about Denmark's front-runner status, it is clear that there are ambitions amongst the Danish public and private sector segments in mitigating their respective climate impacts, evidenced by Denmark's reputation as a corporate social responsibility (CSR) first-mover and front-runner (Boxenbaum, 2006; Brown & Knudsen, 2015; Lehmann et al., 2010; Metaxas & Tsavdaridou, 2010; Vallentin, 2015). This thesis will look at the companies that have pledged to reduce their greenhouse gas (GHG) emissions by making voluntary climate or net-zero pledges and seek to understand their characteristics and strategies to fulfil their goals.

This thesis uses a survey distributed to all the firms with either a climate or net-zero pledge as the data source for the quantitative study.[1] The survey's goal was to gather company and sustainability strategy answers, thereby seeking to understand inter-firm differences and how these manifested themselves in the companies' sustainability strategies. Fifteen of the thirty-four responding companies have net-zero pledges and nineteen have climate pledges. The sample covers many different sectors, including manufacturing firms, as well as a range of sizes (measured by the number of employees) within the Danish business environment.

The study is based on three models, centred around disruptive innovation, LCAs, and carbon offsetting, and, thus, the probability of the company having a net-zero pledge is determined according to the respondents' survey answers.[2] These three factors have their own relationships with sustainability at the firm level. Innovation is needed to develop technologies and practices to target and overcome sustainability issues, LCAs quantify a company's environmental impact through their products and buildings, and carbon offsetting, according to the IPCC (2022) is a necessary means to achieving international climate goals.

The research's implications are multi-faceted and centred around the benefit of understanding and exploring net-zero pledges and the companies that make them. Moreover, the Danish context is unique through the strong associations across the CSR spectrum. Thus, the Danish firms' responses and pressures may be unique and can be the basis for a framework for other firms to follow within a public-private context. Whilst evaluating firms' net-zero pledges is

[1] The distinction will be outlined in the definitions section.
[2] All four terms – disruption, LCAs, carbon offsetting, and net-zero pledges are defined in the definitions section.

not unique, it is not an established field of research, particularly in Denmark – highlighting this thesis's contribution.

As the study focuses on the interactions within the Danish system for sustainability and the multiple stakeholders within that process, a categorical framework is employed. The Multi-level perspective (MLP) is suitable through its diversified and dynamic approach, focusing on a technological and socio-technical network and actor mapping. The MLP categorises and charts pressures on the various system components within a transformation depending on the force's nature and characteristics. Structurally, firstly, this thesis will define key terms. Then, the aim and research question are explored. Thirdly, the literature review is outlined, followed by the methodological framework. Subsequently, the data, analysis and discussion, and robustness check sections are outlined, culminating in a conclusion.

1.1 Definitions

Net-Zero is a scientific term, but global attention towards the green transition has widened its usage. It is now a 'frame of reference through which global action against climate change can be [and is increasingly] understood' (Fankhauser et al., 2022, p.16). This results in net-zero becoming the chief framework and medium in climate change discourse. As such, it also has political, social, and economic spheres – extrapolated by technology transitions, economic and budgetary considerations, political interest and will, social concerns, and ethical judgements (Fankhauser et al., 2022; Scherer & Palazzo, 2011; Vallentin, 2015). These spheres combined with the political, legal, economic, and behavioural pitfalls constitute the current national sustainability systems, including Denmark.

Previously, climate ambitions were defined according to a percentage of emissions or a stabilised concentration of atmospheric Carbon Dioxide (CO_2) (Fankhauser et al., 2022). Conversely, 'climate ambition is increasingly expressed as a specific target date for reaching net-zero emissions' in line with the peak temperature outlined in the 2015 Paris Agreement (Fankhauser et al., 2022, p.15; United Nations, 2015). It is a budget for CO_2 and other GHG, which is balanced between the different spheres – the lithosphere[3], the atmosphere, and the biosphere (the land and ocean) (Artemieva, 2011). This net-zero budget is a sustainable balance

[3] The earth's upper crust, representing emissions from fossil fuels and industrial processes (Artemieva, 2011).

factoring in the GHG removed or stored on a multi-decadal level in carbon sinks (Fankhauser et al., 2022; Pan et al., 2011; Scurlock & Hall, 1998).[4]

Net-zero is also built upon the notion that planetary warming will stop when the net anthropogenic CO_2 emissions plateau – with the cumulative emissions as the determinants for present and future planetary warming (Fankhauser et al., 2022; Lewis & Maslin, 2015; Ruddiman, 2013; Steffen et al., 2011). Therefore, reaching and sustaining net-zero global anthropogenic CO_2 emissions and, in turn, declining non–CO_2 radiative forcing would halt anthropogenic warming globally on multi-decadal timescales (IPCC, 2022a, 2022b).

This thesis will not define net-zero with the short-hand, 1.5 Degrees Celsius as it detracts and distracts from the need to phase out emissions completely (Fankhauser et al., 2022; SBTI, 2022). Moreover, net-zero models the requirements for reaching a temperature goal, whilst 1.5 Degrees is a simplified temperature goal based on current scientific knowledge, which may be the subject of revision (Fankhauser et al., 2022; Matthews et al., 2009). Another issue with 1.5 Degrees Celsius is that company and country pledges are based on the Paris Agreement's two Degrees Celsius limit (United Nations, 2015). However, it is not certain that achieving net-zero by 2050, which is the timeline for many companies and countries, is enough to stay below the 2015 Paris Agreement's two Degrees Celsius ceiling (Deutch, 2020; United Nations, 2015).

Durable net-zero, not net-zero should be the end goal (Fankhauser et al., 2022). Durable net-zero constitutes a balance between the system levels – the lithosphere, atmosphere, and biosphere – and their internal relationships, and not just in the system. Durable net-zero is a sustainable, long-term solution with an outlook beyond the multi-decadal that the IPCC's referral to net-zero.

According to the Intergovernmental Panel on Climate Change (IPCC), it is necessary to offset emissions until companies and economies can be decarbonised (IPCC, 2022a, 2022b; United Nations, 2022). It is controversial, but this carbon offsetting market is imperative in humanity's quest to maintain livelihoods, mitigate previous and ongoing damage, and protect the planet itself. Carbon offsetting's controversy is manifested in an undeterminable path fraught with difficulties. Carbon offsetting represents companies paying for a carbon-negative project segment and thereby balancing their own emissions (McLennan et al., 2014). In a global market with donation sites situated mainly in developing countries – regulation and enforcement are difficult.

[4] Carbon sinks are natural and biological processes and locations where carbon is absorbed and stored, and which are therefore carbon-negative (Cailleau, Braissant & Verrecchia, 2004; Schulze, 2006). These include rainforests, wetlands, and the ocean.

Life cycle assessments (LCAs) are a means of holistically quantifying a building or product's environmental impact. Every process and component from the raw materials to production to the waste management is environmentally managed and assessed (Curran, 2013; Finnveden et al., 2009; Klöpffer, 1997). It is a widely applicable and strong tool, which forms the basis for sustainable policy-making (Finnveden et al., 2009; Fullana i Palmer et al., 2011; Sala et al., 2016). However, there are significant methodological gaps within data collection especially. LCAs require accurate data to paint a complete process picture (Curran, 2013). As such, when that is unavailable, then the results suffer.

In the words of Gobble (2012): 'true sustainability requires innovation – fundamental, disruptive, system-wide innovation' (Gobble, 2012, p.65). As such, there is an intrinsic relationship between innovation and sustainability – in a theoretical and market-based context. Indeed, sustainability is redefining innovation literature and creating new company-specific frameworks for innovation management (Seebode, Jeanrenaud & Bessant, 2012). This thesis will define disruptiveness as an innovative practice or product that has a profound effect on the market based on its capacity to change the market and the system quickly and irreversibly (Kivimaa et al., 2021). Disruptive practices impact all stakeholders in the company's ecosystem beyond the market, business model, actors, and networks to include behaviours, practices, and cultural models as well as the regulations and policy initiatives (Kivimaa et al., 2021).

Different terms exist with their unique relations to sustainable development. A second term is the Triple Bottom Line (TBL), which suggests that companies' bottom lines should be diversified to include social and environmental issues (Elkington, 2004). As such, there is a significant overlap between CSR and the TBL. This thesis will employ both terms, except when it comes to interactions with stakeholders including the Danish government, which is within the CSR framework through the Danish CSR regulations.

This thesis will not use the terms climate and net-zero pledges interchangeably.[5] Climate pledges are predominantly emission reduction pledges. Crucially, these companies often stop short of a net-zero goal – usually by defining their emission reduction in percentage and not absolute terms (UNFCCC, 2022). The pledges are diversified with some companies pledging to halve their emissions by 2030 and others significantly later (UNFCCC, 2022). The target net-zero dates vary too with 2028 as the earliest target whilst the vast majority are aiming for 2040 and 2050.

[5] Due to the overlap between net-zero and climate pledges, and to talk about the general system, the two different pledges will be grouped throughout the thesis, when appropriate, under the term climate ambitions (CAs).

2. Aim and Research Question

Studying climate ambitious companies in Denmark is vital in understanding the private and corporate sectors' attitudes towards sustainable development and their strategies to achieve their certified goals. In this thesis, the companies' characteristics, including their innovation focus, and whether they intend to use carbon offsets will function as proxy identifiers, according to the IPCC's latest international guidelines for successful climate mitigation (IPCC, 2022a, 2022b). Studying climate awareness transformations, and their impacts on individual companies, complements contemporary societal movements, and challenges established societal models and assumptions.

Denmark's sustainability image is consistently self-enforced, and its external, international diffusion leads to further passive enforcement (Ministry of Finance, 2021). Therefore, Denmark should be at the socio-technological frontier when it comes to researching and implementing sustainability initiatives, led by the innovative private sector acting as socially conscious citizens. However, how meaningful is the system-change progress and how is this reflected and manifested in Danish companies' CSR and climate ambitions? Whilst this thesis will not be able to answer these questions, it can contribute to them meaningfully.

This thesis will explore selected Danish companies with clear CAs, in the hope to explore the current state, progress, and outlook for environmental goals amongst the CSR frontrunners in the Danish private sphere. Exploring whether there are common characteristics of CA companies would allow for a greater understanding of the Danish CSR sphere and the private sphere's integration into the greater Paris Agreement's societal sustainability goals (United Nations, 2015). Many studies have focused on the TBL's benefit over the traditional bottom line, economically, thereby keeping the corporate in CSR; this approach is different (Ekwueme, Egbunike & Onyali, 2013; Gillan, Koch & Starks, 2021; Willard, 2012) Meaningful sustainability progress must be holistic, going beyond integrating sustainability into companies' established stakeholder interactions and economic outlook. This leads to the following research question:

- To what extent do sustainability strategy characteristics predict which Danish companies have net-zero pledges?

With the following sub-research questions:

- How do companies with emission reduction pledges differ from companies with net-zero pledges?

- How prominently do high-quality carbon offsets feature in the companies' sustainability strategies?

The following null hypotheses have been constructed to aid in testing the associations or lack thereof.

$$H_0 = There\ is\ no\ signficant\ probability\ that\ respondents\ with\ high\ disruptiveness\ scores\ have\ a\ net - zero\ pledge$$

$$H_0 = There\ is\ no\ signficant\ probability\ that\ respondents\ with\ complete\ LCAs\ have\ a\ net - zero\ pledge$$

$$H_0 = There\ is\ no\ signficant\ probability\ that\ respondents\ that\ carbon\ offset\ have\ a\ net - zero\ pledge$$

3. Literature Review

3.1 Net-Zero Principles and Voluntary Climate Pledges

Whilst this thesis has already defined net-zero, its origins, and its widespread use – a framework operationalisation is necessary. Several interpretations exist, as scholarly attention has turned towards the term. This thesis employs Fankhauser et al. (2022)'s framework which explores three overall principles that are necessary for understanding, using, and progressing net-zero based climate mitigation. This thesis will outline the ones with the greatest relevance to the thesis's aims.

Firstly, they emphasise the urgency of zero – the most cost-efficient emission reduction method is with short-term horizons and actions coupled with long-term planning. This brings down the technology costs through learning and scaling. Moreover, whilst decarbonising the energy sector has been a primary focus, zero refers to all emissions. This includes aviation, cement, steel industries, and more – sectors whose decarbonisation is currently technologically and economically constrained.

The second principle is the net's integrity – that continuing "business-as-usual" through a substantial increase in CO_2 removal through emission offsetting is unviable.[6] Instead, countries and companies must commit to reducing GHG emissions to the greatest extent possible, with carbon offsetting and CO_2 removal there to offset the unpreventable emissions. There cannot be

[6] See section 3.2.

a substantial push to increase removal to justify continued reliance on present fossil fuel path dependencies.

The final principle is that the transition must be consistent with sustainable development objectives. It should be globally equitable, not equal, based on the historic and present emissions. Countries that have low historic emissions have, on average, lower emissions than industrialised nations and, therefore, they should not be expected to contribute as much to mitigating past and present emissions. The developed and industrialised nations, who were the culprits and now have the technological knowledge and the financial power to accelerate their transitions should do so. Indeed, Deutch (2020) estimates that the United States and other developed countries could withstand most of the transition weight through their economic might. As such, the European Union (EU) suggests that investing 2.8 per cent of Gross Domestic Product (GDP) is needed for a 2050 global net-zero, which is above current spending and international pledges, but within the realm of possibility (Deutch, 2020). The transition must be seen as a long-term positive, economic opportunity, as structural rigidities and inertia in the respective economies are hindering meaningful progress (Fankhauser et al., 2022).

The transition must be equitable because the effects' distribution is not equal. From a socio-ecological perspective, CO_2 is a threat multiplier – increasing the hazard associated with other issues (Fankhauser et al., 2022). As such, the climate change effects cannot be dissociated from other globally adverse developments. These are various short- and long-term global effects, which are causing irreparable damage. For instance, the all-important rainfall frequency in the Maasai is dropping, causing wide-ranging droughts – impacting wildebeest migration patterns, which are a vital ecosystem pillar (Leal Filho et al., 2017). In the oceans, rising acidity levels and temperatures are fundamentally impacting natural processes to an unseen and unknowable degree (Pope & Selna, 2013).

Various issues have direct consequences for countries such as Denmark. Copenhagen is a city under direct and imminent threat from rising sea levels as a result of the polar ice caps melting (Hallegatte et al., 2011). Glacier levels in Greenland, a Danish territory, are dropping quickly (An et al., 2021). The effects are therefore local to Denmark too, and indeed other developments within the Danish territory will impact Denmark's capital. Melting ice caps are exposing another potential issue, natural methane (a worse GHG) deposits will be opened as the ice barriers melt – exacerbating the global GHG effect significantly (Hopcroft, 2017; Nisbet et al., 2019).

Socially, countries' and communities' livelihoods are under severe strain in a manner unseen or unheard of amongst the developed nations. Lethal and extreme weather events are rising in line with the GHG emissions, disproportionally affecting developing countries (Stott, 2016). As such, the global responsibility for climate action and mitigation should be a significant component in companies' or countries' strategies and general decision-making processes.

3.2 Global Carbon Offsetting Market

The Paris Agreement of 2015 awakened climate activism by demanding meaningful actions from national governments and the private sector (United Nations, 2015). This reignited the carbon offsetting market as a potential avenue for enhanced private sector contributions. However, it is also a market with weak transnational regulatory frameworks.[7] As such, it is a greenwashing friction point and one of its leading causes with corporations investing in questionable carbon offsetting sites and companies for Public Relations (PR), sustainability reports, and carbon balance purposes. This was a major issue in Denmark.[8] The market's voluntary nature increases the difficulty in site and emission accounting – transnational agreements between private sector companies prevent governments and international organisations from intervening effectively.

Indeed, there is academic scepticism toward the voluntary carbon offset market, which sees it as a "false solution" (Blum, 2020). After all, carbon offsetting is, according to Bumpus and Liverman (2008) effectively 'capital-accumulation strategies that devolve governmental control over the atmosphere to supranational and nonstate actors and the market' (Bumpus & Liverman, 2008, p.127). In effect, the market through its corporate actors wrestles control away from governments, ironically in stark contrast to Paris Agreement's emphasis on governmental progress (United Nations, 2015).

Some companies specialise in facilitating regulated access to the carbon offsetting market for interested companies, according to several criteria. The chief criteria naturally centre around the tonnes of CO_2 removed, the cost per metric tonne, and the carbon sink's lifecycle. These companies are found across the European continent with the co-operative organisation, the Gold Standard, being a recognised carbon site validation flagbearer with 2300 projects in ninety-eight countries at the time of writing (Blum & Lövbrand, 2019; Gold Standard, 2022). In Denmark, companies such as Klimate.co facilitate the carbon offsetting process – simplifying the process for companies which intend to employ high-quality external carbon offsetting. Site verification

[7] Some argue that existing national regulatory frameworks for wind and solar energy, particularly in Organisation for Economic Co-operation and Development (OECD) countries, can be adapted for emerging technologies such as CCS and hydrogen (See (Herbert Smith Freehills, 2021)).
[8] See section 3.7.3.

constitutes a start in securing legitimacy for the concept, which is key to the IPCC climate goals and national net-zero targets.

However, the interest spike in private sector voluntary offsets with the market value tripling since 2018 may lead to meaningful mitigative action; developing countries must ensure that they are not exploited in the industrialised countries' PR and CSR race (Streck, 2021). Corbera, Estrada & Brown's (2009) prediction that carbon investors would be altruistic as voluntary markets were to be driven by investors' willingness 'to support projects which are in line with poor countries' demands and priorities' has thus far failed to materialise, partly by clashing with the capitalist economy (Corbera, Estrada & Brown, 2009, p.25). Mitigation against this requires harnessing the strong public-private partnerships' complementarities that are arguably more well-developed in welfare states such as Denmark than elsewhere (Streck, 2021).

The carbon offsetting market can be moulded into corporate climate activism (Hisas et al., 2019). Carbon offsetting is vital for large corporations to meet their climate commitments until full decarbonisation can be achieved (Kreibich & Hermwille, 2021). Indeed, Donofrio, Maguire, Zwick & Merry (2020) argue offsetting companies tend to have a more aggressive emission reduction policy constituting a certifiable net-zero push; a theoretical foundation for others to follow (Donofrio et al., 2020). The sections below will introduce the various carbon offsetting forms and functions.

3.2.1 Carbon Capture and Storage

Carbon Capture and Storage (CCS) refers to different manufactured CO_2 removal processes whereby CO_2 is re-used in other industrial processes or stored deep underground in geological formations. Several types exist and new capture and storage processes are emerging from government and private-funded Research & Development (R&D). CCS has the potential to deliver low carbon heat and power, decarbonise industry, and facilitate the net removal of CO_2 through Direct Air Carbon Capture (DAC), all whilst playing a key role in meeting climate change targets (Bui et al., 2018; IPCC, 2022a, 2022b).[9] However, CCS and competition at the market and regime level remain elusive for the most disruptive applications – CCS's feasibility, credibility, and scalability remain unproven (Bui et al., 2018; Rackley, 2017; Roussanaly et al., 2021; Viebahn, Scholz & Zelt, 2019).

[9] DAC refers to the CO2 capture directly from the air via small modular installations. It can be used in other industrial and green applications such as green hydrogen, or pumped deep underground into rock formations as is the case with Climework's plant in Iceland (Viebahn, Scholz & Zelt, 2019).

CCS is the most controversial carbon offsetting solution, accusations centre on its unproven record and potential for societal backwardness. The American Physical Society (2011) made a pessimistic assessment, which underpins various works today including Chen & Tavoni (2013) – suggesting that CCS and particularly DAC would only be viable at the turn of the next century.

However, there is a growing recognition that carbon removal is necessary and the natural CO_2 removal processes including agriculture, forestry, and other land use (AFOLU) are insufficient. Indeed, as GHG emission reductions accelerate, there will be industrial processes that cannot be fully decarbonised. The possibility remains natural processes will be sufficient in maintaining a durable net-zero. However, until then, processes that go beyond the biological and natural must be implemented to ensure negative CO_2 emissions and levels (Amer et al., 2019; Pinson et al., 2017).

As such, the necessity persists in maintaining a continued but shorter technological development trajectory coupled with a diffusion of the process's potential merits, akin to solar and wind technology to create the commercially viable conditions for CCS and DAC (Bui et al., 2018; Grafström & Poudineh, 2021; Terlouw et al., 2021; Xu, Li & Zheng, 2016). Denmark has the wind technology and energy capacity to power a DAC facility with green energy, to remove CO_2 from the atmosphere continuously and sustainably. Indeed, the new Danish tax and carbon tax reform of April 2022 set aside three billion DKK for CCS (Danish Government, 2022). As such, this features as a survey question to understand if the companies have considered it as a strategy for their offsets and climate mitigation strategy. [10]

3.2.2 Agriculture, forestry, and other land use

Nature-based solutions were carbon offsetting site pioneers, safeguarding nature parks, forests, areas, and more in developing countries. AFOLU represents a proven carbon offsetting method, however, there are several issues. AFOLU encompasses a range from carbon-intensive traditional agriculture to restoring natural forests, which Lewis, Wheeler, Mitchard & Koch (2019) label as the best carbon capture solution. Moreover, AFOLU project verification is difficult in developing countries, leading to greenwashing issues for the greater carbon offsetting market (de Freitas Netto et al., 2020; Delmas & Burbano, 2011; Guix, Ollé & Font, 2022; Polonsky, Grau & Garma, 2010; Roulet & Touboul, 2015).

[10] See section 4.

However, there is progress when it comes to restoring natural forests through carbon offsetting donations (Donofrio et al., 2020). Similarly, natural forest management's complementarities fit into Fankhauser et al., (2022)'s call for a socio-ecological and equitable transition. Protecting and expanding natural forests protects biodiversity, manages water, and creates jobs – thereby securing local areas and ensuring their long-term sustainability.

AFOLU projects remain consistently popular with companies despite the elevated cost. Indeed, the price increased by thirty per cent, globally, from 2018 to 2019 due to a supply shortage (Donofrio et al., 2020). The hope is that demand will continue to increase, and drive further price increases – making more AFOLU projects economically viable and distributing the carbon offsetting donations more equally and equitably amongst the recipient developing countries (Donofrio et al., 2020). However, an unintended consequence may be a rise in unverified sites as the academic segment's scepticism and opportunistic land-grabbing manifest themselves (Bredsdorff, 2021; Fairhead, Leach & Scoones, 2012).

Indeed, the potential rise in unverified sites is not the only hypothetical issue. AFOLU projects also encompass plantations and other commercial land uses. In the short-term, they are economically viable due to the product produced, however, they degrade natural forest biodiversity and the tree exploitation necessitates replacement every fifteen to twenty years (Lewis et al., 2019)[11]. As such, the carbon is released back into the atmosphere disregarding the IPCC's multi-decadal timeline. The complexity in ensuring the CO_2's long-term storage is partially mitigated by the capture process' relative ease, contrasting with CCS and particularly DAC (Cowlin et al., 2012; Rahman et al., 2017). Due to AFOLU projects' price per tonne of CO_2 removed, the market value was double that of renewable energy projects in 2019 (Donofrio et al., 2020).

3.2.3 Renewable Energy Projects

Renewable energy projects were, alongside AFOLU, the two primary and initial means of offsetting emissions (Bellassen & Leguet, 2007). As solar and wind energy prices have decreased, the investors' interest has grown (Fadly, 2019). Renewable energy projects are now markedly cheaper than AFOLU projects, which means that the demand is rising. Demand grew by seventy-eight per cent between 2018 and 2019, as prices fell by sixteen per cent (Donofrio et al., 2020). Renewable energy projects' economic viability is therefore still growing. This trend is likely to continue with the Covid-19 pandemic, Russian gas's lack of socio-political appeal, and the need for energy freedom (McWilliams et al., 2022; Padgett, 2011).

[11] New processes for crops including coffee are appearing in Costa Rica and South-east Asia that maintain a healthy balance.

In comparison with CCS and AFOLU, renewable energy projects are the most balanced solution weighing capture ease and storage longevity. However, issues with the IPCC's multi-decadal timeline persist. For instance, a current solar panel's lifetime is approximately twenty-five years, after which its toxic non-recyclable components are thrown out unless proper end-of-life management is implemented (Gul, Kotak & Muneer, 2016; Malandrino et al., 2017; Wang et al., 2019). The wind industry is similarly plagued, only recently have companies discovered cost-competitive ways to recycle the wind turbines and blades constructed with carbon-intensive materials including carbon fibre (Aso & Cheung, 2015; Morini, Ribeiro & Hotza, 2021). Moreover, offshore wind farms require metals with long global supply chains and mined metals including lead and copper – increasing their environmental impact (Topham et al., 2019; Wagner et al., 2011). Renewable energy projects are therefore undoubtedly better for the environment than fossil fuels, but the projects have a limited lifecycle and, currently, a detrimental environmental impact themselves.

3.3 Survey Question Literature

This section of the literature review serves as a contextualisation for the methodology chapter in exploring the questions asked and why they are relevant for the study and its outcomes.

3.3.1 Innovation and Disruptiveness

A socio-equitable transition depends on companies' innovative and disruptive capacity encompassing multiple stakeholders, especially consumers, and multi-level policy initiatives (Leach et al., 2012). Companies can no longer rely on monopolies within the innovative practice and product creation/optimisation and must engage in meaningful interactions with their ecosystems (Zubizarreta et al., 2021). Adopting disruptive technologies requires sturdy foundations – equally disruptive practices and organisational management as well as some low-technology solutions (Kivimaa et al., 2021). Moreover, there is a defined relationship between disruption and implementation through the eventual necessity to compete at market and regime levels (Khan & Bohnsack, 2020; Thaller et al., 2021). [12]

Disruption and its relationship with sustainability must be managed to remain positive and constructive by engaging TBL and CSR. However, developing sustainability knowledge is a continuous process in itself, where much is yet unknown and some of it may even be "unknowable" (Wals & Lenglet, 2016). What is unknown can be positive or negative, with the authors defining negative unknowable sustainability as: 'actions that are unsustainable but one has no ways of knowing this (at least not in the foreseeable future) or which one does not have the

[12] See 3.9.

resources or chooses not to allocate resources to find out' (Wals & Lenglet, 2016, p.54). Some innovative and disruptive practices will inevitably be categorised accordingly whilst others may indirectly aid sustainability efforts, including the Internet of Things that may aid in optimising the allocation of resources (Nasiri, Tura & Ojanen, 2017).

3.3.2 Supply Chain and Sustainability

This thesis will define supply chain management as the contact points in a company's production and logistics through which materials and information flow (Seuring et al., 2008). There is a new and strong focus on integrating sustainability into supply chain management, optimising it according to various CSR and TBL criteria (Govindan et al., 2014). Sustainable and supply chain management are aligned with the scholarly term: sustainable supply chain management (SSCM) (Ashby, Leat & Hudson-Smith, 2012; Martínez-Jurado & Moyano-Fuentes, 2014). The field is centred around highly qualitative methods – through case studies – and thus contextualised theory development (Ashby, Leat & Hudson-Smith, 2012). De Brito & Van Der Laan (2010) suggests that firms procrastinated integrating sustainability into their operations due to an operational focus, as opposed to a lack of environmental and social awareness. Firms were incapable of aligning the task and the greater societal context (De Brito & Van der Laan, 2010). However, evidence suggests that this is changing – particularly in Denmark – with the focus on mitigating first– and second-tier upstream and downstream social issues scope 3 emissions (Kannan, 2021).[13]

Nevertheless, there is a gap between legislation and enforcement in SSCM. Lerberg Jorgensen & Steen Knudsen (2006) argue that small and medium enterprises (SMEs) are facing greater pressures from their buyers than they demand from their suppliers. SSCM must be equally integrated on both sides of the supply chain to increase effectiveness and ensure that practices are, indeed, sustainable (Lerberg Jorgensen & Steen Knudsen, 2006). Otherwise, it becomes a case of greenwashing.

3.3.3 Emission Scoping

The GHG Protocol outlines three emission types (Diniz et al., 2021; Sotos, 2015). Scope 1 emissions occur directly within the company or factory as a process by-product (Hertwich & Wood, 2018). Scope 2 emissions are linked to energy usage and sourcing according to the national energy mix (Huang, Weber & Matthews, 2009). Scope 3 emissions are indirect emissions associated with other inputs – upstream and downstream in the supply chain as well as employee commuting,

[13] See 3.3.3.

air travel, and more (Downie & Stubbs, 2013; Mytton, 2020). There is a growing demand for GHG accounting to understand company emissions and for focusing on carbon mitigation strategies. Action is needed as global scope 1, 2, and 3 emissions grew forty-seven, seventy-eight, and eighty-four per cent respectively in the period between 1995 and 2015 (Hertwich & Wood, 2018). In the IPCC's five primary sectors – industry, transport, buildings, energy supply, and agriculture and forestry – the industrial sector's rise is most significant (Hertwich & Wood, 2018).

Scoping a company's emissions depends on the sector, and, in turn, on the company and its characteristics. Moreover, there is a lack of consensus and regulation on what activities to include in scope 3 reporting, exacerbating transparency issues (Downie & Stubbs, 2013). In industry, scope 3 can account for up to seventy-five per cent of emissions due to a complex supply chain (Huang, Weber & Matthews, 2009). Therefore, the company is forced to map and work within its supply chain to enact effective climate mitigation strategies. Integrating and enacting SSCM measures are a necessary means for progress – particularly for companies with cross-continental first and second-tier suppliers and downstream customers – otherwise, scope 3 emissions are ungovernable.

Coincidentally, in countries including the United States, scope 3 emission reporting is voluntary – meaning that many companies can hide their impact (Mytton, 2020). Companies, including Google and Microsoft, moving all their Internet Technology (IT) workload to the cloud allow the emissions to be voluntary scope 3 as opposed to scope 1 (Mytton, 2020). For service firms, activities such as commuting and air travel feature heavily in scope 3 reporting, which requires detailed data and reporting on each employee (Huang, Weber & Matthews, 2009).

Conversely, sectors such as energy supply and transport emissions in scope 1 can constitute nearly seventy per cent of their total through their internal processes (Hertwich & Wood, 2018). As such, their climate mitigation strategies should be internally focused. Identifying scope 1 emissions may be easier than the network-based scope 3, but the mitigation strategies may still be expensive, unfeasible and, thus, difficult to implement successfully. Scope 2 emissions are comparatively low in developed countries due to the increased green energy availability. However, for large and energy-intensive industrial processes, natural and biological gas is used, both of which affect a company's scope 2 emissions (O'Shea et al., 2020). Examples include the cement production in Denmark and more, which are difficult to decarbonise (Smil, 2016).

3.3.4 Life Cycle Assessments

While LCAs for products are becoming increasingly common, a key emission source in developed countries is buildings. Creating LCAs for buildings is difficult, particularly in historical capitals such as Copenhagen, across Europe, and the United States (Khasreen, Banfill & Menzies, 2009). However, purpose-built buildings facilitate mapping. Indeed, aggregating differences in the GHG emissions and energy use in buildings across the world paints a picture of buildings' construction and usage efficiency (Adalberth, Almgren & Petersen, 2001; Sharma et al., 2011). On average, fifty per cent of GHG emissions and eighty to eighty-five per cent of the energy usage occur during the usage or operational phase (Sharma et al., 2011). In other words, when the building has been constructed and while it is in use, residentially or non-residentially.

Adalberth, Almgren & Petersen (2001) found that for some Swedish buildings constructed in 1996, between seventy and ninety per cent of GHG emissions occurred in the usage phase. While this research is from 2001, many buildings are much older and, thus, the likelihood increases that this is a low estimate for a historical capital such as Stockholm or Copenhagen. As such, LCAs for buildings are an important company tool in understanding their emissions and how to reduce them, especially in new facilities' construction. Indeed, new Danish sustainable construction guidelines highlight LCAs as vital tools to brand construction as sustainable (Ministry of the Interior and Housing, 2021). Sustainable construction is becoming the new market trend in Denmark.

Moreover, new guidelines were issued by the Danish Consumer Ombudsman[14] highlighting the steps that businesses must take before they market their products as sustainable, green, environmentally-friendly, and more (Consumer Ombudsman, 2021). The data must be confirmed by independent experts 'normally using an LCA' and any potential disagreements among the experts must be publicised in the marketing material (Consumer Ombudsman, 2021, p.4). Moreover, the other products on the market cannot be equally sustainable, the company must document that the product's environmental performance is exceptional. As such, there are governmental pressures on companies to employ LCAs in their sustainability and business operations.

3.3.5 Public-Private Climate Partnerships

There is scholarly attention centred around public-private partnerships as a means of collectivising global governance in pursuit of climate goals (Bäckstrand & Kronsell, 2015). Indeed, Bäckstrand & Kronsell (2015) argue that these partnerships do not erode governmental or public authority; Instead, they function as a symbol of a natural authority transformation in modern societies by hybridising the relationship between states and nonstate actors. Pattberg (2010) argues

[14] An authority that keeps the consumers' interests at heart and combats unlawful and misleading market practices and companies.

that there is a great scope for synergistic relations if expectations, processes, and outcomes are properly managed in the two spheres. Indeed, PPPs can function as a catalyst for other positive socio-environmental developments, including increased societal inclusiveness and participation in environmental debates – thereby activating and engaging more stakeholders (Pattberg, 2010).

Buso & Stenger (2018) argue that by themselves public and private initiatives often fall short – corporate firms fail to reduce energy costs and emissions whilst the public programmes are not cost-effective. As such, the perception is that PPPs are an optimal solution, which leads to higher outcomes when the bargaining power is equal between the parties. However, unequal power balancing creates an additional institutional sphere with separate pathways and complex cultures, thereby defeating the collaborative nature that should be the PPP's cornerstone (Buso & Stenger, 2018; Pattberg, 2010). This is particularly the case when environmental regimes are fragmented and where nonstate actors' rise is outpacing the public ascent (Andonova, 2010; Koppenjan, 2015). With Denmark's scattered CSR approach, there is a risk of this happening (Vallentin, 2015). [15]

As such, the inherent system tensions – on an economic and environmental level – must be addressed, including but not limited to affordability, sustainability, benefits and risk of partnerships, and more (Taylor & Harman, 2016). PPPs for sustainability require new ways of thinking and pathways – building a holistic and multi-stakeholder process with frameworks centred on the environmental and not the economic regulation of the PPPs (Koppenjan, 2015). Thus, governments are required to establish a general set of success conditions for PPPs – and, thus, engage meaningfully with the private sector for implementation and the individual project or initiative's requirements. However, to understand the Danish firm's context, it is first necessary to explore how global firms have approached net-zero and climate pledges and the strategies to achieve them.

3.4 Corporate Sustainability Strategy Determinants

Before exploring studies on how companies deal with the net-zero pledge and their strategies to achieve the pledges, it is necessary to shed light on the companies' internal determinants in integrating climate ambitions. Indeed, Hsueh (2017) argues that among the five hundred biggest companies in the world, firm-level factors are the most significant indicators of participating in a climate governance initiative – synonymous with this thesis's use of the term CAs. Whilst having a "policy supporter" in the form of a state or a nonstate actor is positively correlated with participation, the research clearly shows that companies themselves, across

[15] See 3.7.1

different sectors, are the most influential determinants for firm-level participation in sustainability and CSR initiatives (Hsueh, 2017).

According to Setthasakko (2007), the primary factors for sustainability integration are both internal and external. Internally, top management leadership and their long-term company visions instigate meaningful progress towards sustainability integration. These visions are also affected by external factors such as new legislation (Miras-Rodríguez, Escobar- Peréz & Domínguez Machuca, 2015). Externally, the government and local communities pressure the companies. Interestingly, the author argues that international customers are more focused on quality and prices as opposed to sustainability (Setthasakko, 2007). However, this study is from 2007, and, thus, it is likely that opinions on this matter have changed (Verma & Chandra, 2018). Indeed, Verma and Chandra (2018) argue that sustainability is the most important attribute in hyper-competitive industries, such as the hotel industry.

Indeed, stakeholder, and specifically, customer pressure is a leading driver in integrating sustainability and creating sustainable business plans and strategies (Foerstl et al., 2015; Rauter, Jonker & Baumgartner, 2017). Companies invest in sustainability partly to manage their relationships with their customers, as they secure their place in the market and increase their capabilities. As such, this section shows how multiple stakeholders, both internal and external, influence the sustainability strategies of international firms. Understanding the sustainability context allows for an exploration of firms' relationships with net-zero pledges.

3.5 Global Firms Strategies and Net-Zero Pledges

Exploring global firms' strategies in terms of net-zero and climate pledges and the strategies to achieve the pledges is vital in informing and contextualising Danish firms' responses. Comello, Reichelsetein & Reichelstein (2021) discuss the net-zero pledge variations as companies strategically limit the specificity and scope of their pledges, especially in terms of their scope 3 emissions and their required reporting (Hsu et al., 2016).

Larrea et al (2022) employ a methodological framework to assess Spanish companies' sustainability strategies and their net-zero pledges. Many Spanish companies lack clear action plans for achieving their goals (Larrea et al., 2022). The companies lack the resources, knowledge, and willingness to implement actionable initiatives to achieve the goals. Whether this is intentional, or accidental is hard to ascertain, but intentionality equals a greenwashing ploy. Fisher-Vanden & Thorburn (2011) suggest that firms that commit to reducing GHG emissions experience negative and abnormal stock returns, thereby lowering the firm value. They argue that this dissuades companies with strong hierarchical and corporate structures from climate participation fearing economic repercussions (Fisher-Vanden & Thorburn, 2011). However, this is disputed in other studies as United States firms in the Dow Jones Index with corporate sustainability have greater free cash flows and higher levels of growth (Artiach et al., 2010).

According to Larrea et al (2022), selected sectors such as energy, finance, and other services score employ higher scoring sustainability strategies compared with the food & beverage, tobacco, industry, and entertainment sectors. These firms have devoted more resources and integrated net-zero into their operations on a deeper level. Moreover, carbon offsetting is a significant component for some, which negates Fankhauser et al (2022)'s emphasis on GHG emission reduction above offsetting and carbon removal (Comello, Reichelstein & Reichelstein, 2021).

Indeed, the uncertainty around carbon offsetting is manifested in differing strategies. On one hand, companies employ carbon offsetting to suggest that they are progressing towards net-zero. According to Dawson, Dargusch & Hill (2022), Allianz reported a thirty-one per cent decrease in emissions in 2019 compared to 2020 based on substantial carbon offsetting through renewable energy projects. As such, Allianz publicised a substantial reduction in emissions without reducing their sustained coal investments or breaking their established path dependencies (Dawson, Dargusch & Hill, 2022). On the other hand, other companies struggle to formulate clear strategies for carbon offsetting and integrating them into the core business and sustainability strategies (Larrea et al., 2022).

There is a lack of uniformity in the reporting practices, action plans, and visions for integrating CAs into company and business strategies. The pledges' voluntary natures and the legal inconsistencies and loopholes allow international companies to be strategic with their climate commitments and publicise favourable metrics. Exploring the Danish context is important in uncovering whether the firm responses are replicated.

3.6 Danish Emission Sources

To understand how companies strategize around offsetting and reducing their GHG emissions, it is necessary to explore the emission sources within Denmark and the private sector. Two distinct carbon accounting methods exist – one is production-based, the total emissions produced in a country, and the other is consumption-based, quantifying the consumed products' emission-intensiveness (Baumert et al., 2019). With the international focus on a production-based accounting system, the emissions are embedded in the developing countries' industries, which are producing goods for developed nations. Indeed, between 1995 and 2015, emissions rose most significantly in industrialising and developing nations, reliant on international trade deficits and industrialised nations outsourcing production for their economic growth (Altenburg, Schmitz & Stamm, 2008; Atlantic Council & Rhodium Group, 2021; Hertwich & Wood, 2018; Rodrik, 2006).

Denmark is not a production-based economy, but primarily a service economy (Hansen & Winther, 2012). As such, Denmark imports many CO_2 intensive products, with the emissions embedded in the international trading system (Baumert et al., 2019). Many Danish emissions are therefore embedded in consumption – and often – excessive consumption. Therefore, the emissions should mostly be scope 3, and indirect, with buildings during their operational phase as significant emitters (Nyborg & Røpke, 2015).

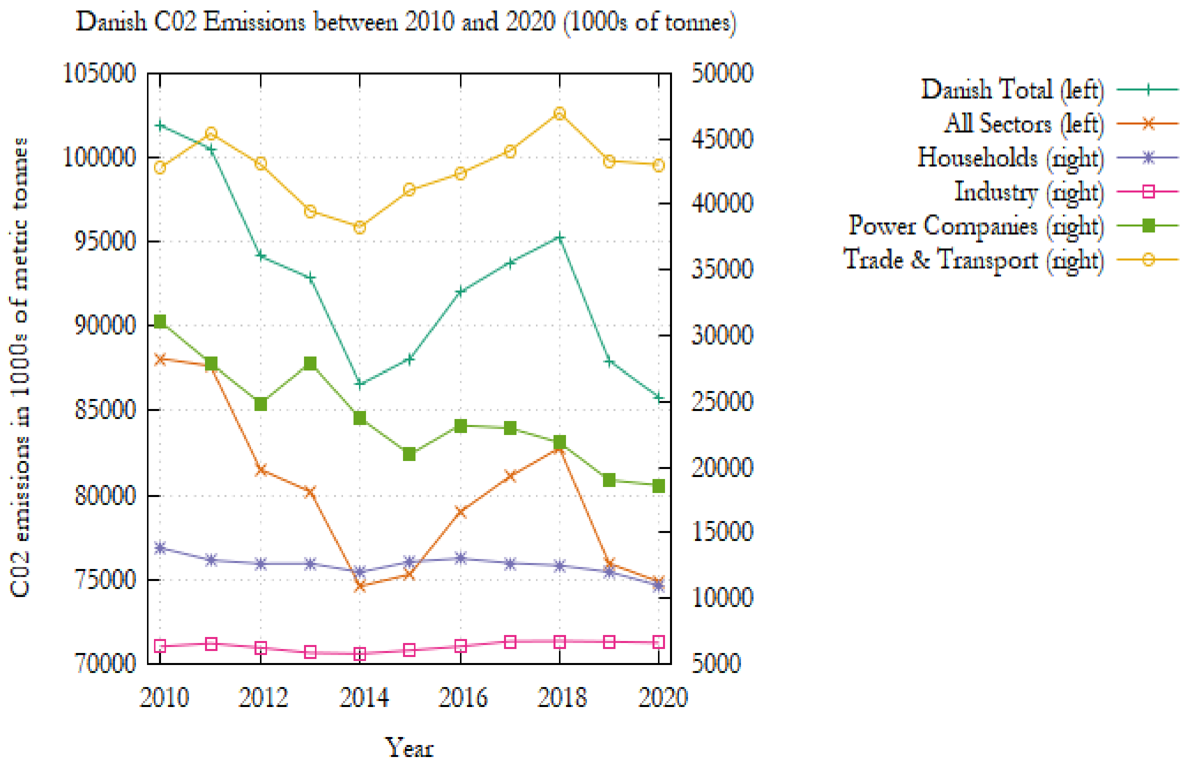

Figure 1: Danish CO_2 Emissions Sources between 2010 and 2020 (in 1000s of tonnes) (Danmark's Statistik, 2022)

Figure 1 above shows the Danish emissions sources between 2010 and 2020.[16] [17] Notably, Danish emissions have generally fallen in the period up to 2019.[18] The decline is particularly evident in the power companies as the switch to wind energy and away from coal manifests itself. The average sector-based emissions have fallen in line with the overall decline (partly due to being a large share of it), meaning that Danish businesses, on average, emit less than they did in 2010. As

[16] All sectors is the Danish total minus households.
[17] Table 6 in Appendix A has the full data, including more sectors. The data includes the biomass burning (these emissions are not always counted due to technical loopholes in the accounting) and the transport emissions imbedded in the international trading system. The production-based emissions imbedded in the international trading system are not included as the data is not publicly available.
[18] 2020 emission statistics can be anomalies due to the Covid-19 pandemic.

such, there has been a degree of success in mitigating emissions. However, the emissions in targeted sectors have risen, including industry and the trade and transport sectors. Therefore, there are still companies and sectors that must display more meaningful progress in mitigating their GHG impact.

3.7 CSR in Denmark and Danish Political Status

3.7.1 Governmental approach to GHG emission reduction

To understand CSR's role in Danish society, it is necessary to explore the Danish welfare state's role. There are passive and active governmental pressures on the private sector's CSR activities. The governmental aim is to create environments where the Danish social norms and the business' internal actions encourage positive and constructive behaviour – thereby self-regulating processes (Gond, Kang & Moon, 2011; Jackson et al., 2017). Gond, Kang & Moon (2011) challenge the scholarly deficiencies on the governmental role in CSR to misunderstanding the national governance system's role in shaping the national CSR. The Danish governance system is intrinsic to the Danish CSR, as the government's passive pressure is based on the Danish multi-stakeholder social and societal contract, which itself is centred around integrity, trust, and transparency (Rendtorff, 2019). However, little research has been conducted on the relationship between the welfare state and CSR's social component; the corporate element has been the main subject (Brejning, 2016).

The social contract's active component encompasses extensive minimum demands within national and international frameworks – through the state and EU regulation and enforcement (Nielsen & Frederiksen, 2015).[19] Regulation is centred around two approaches – rewards and positive reinforcement for desired behaviour, the carrot, and the negative reinforcement, the stick, for unconstructive behaviour (Brejning, 2016; Brown & Knudsen, 2015; Nielsen & Frederiksen, 2015). However, there is little evidence to suggest that voluntary approaches and the carrot are more effective than compulsory agreements within the private-public context (Bryden et al., 2013).

In April 2022, the Danish government announced a new measure for ensuring meaningful GHG progress: a carbon tax in the new "green tax reform"(Danish Government, 2022). A carbon tax is a policy measure where a business has to pay a fee for GHG emissions measured per metric tonne (Hoel, 1996). Climate scientists tout carbon taxes as necessary in the collective fight against climate change. As such, it follows the regulatory framework through a financial reward (or less

[19] New forms of Rousseau (1762)'s social contract are emerging within the environmental risk and climate change adaptation literature contextualised by modern issues (Adger et al., 2018; Carey, James & Fuller, 2014; Gibbons, 1999; Jackson, Dugmore & Riede, 2017; Lazar, 2013).

severe punishment) for CO_2 and GHG emission avoidance. The money is then invested in the green transition by the Danish government, which means that the money is invested regardless (Danish Government, 2022). In theory, the beneficiary should be the climate.

However, there is a focus on the TBL's finance aspect and the CSR's corporate side with this policy too. The government has announced that there is a discount rate for businesses involved in "mineral processes" bringing the cost down from seven hundred and fifty Danish Krone (DKK) to one hundred DKK per tonne.[20] This number lies below The Danish Economic Council's and the Climate Committee's two independent recommendations – which suggested a carbon price between one thousand-two hundred and one thousand – five hundred DKK distributed equally across all sectors (Sæhl, 2022). Bluhdorn and Deflorian (2019) argue that a new type of performative governance is prevailing, where liberal consumer societies maintain and manage their systematic unwillingness and inability to achieve socioecological transitions. Indeed, the Danish Government (2022) recognises that Denmark is currently falling short of its own goals – even accounting for the new tax reform. As such, strong and consistent bottoms-up pressure is needed to refocus the faltering Danish approach (Toft & Rüdiger, 2020; Vallentin, 2015).

The mixed reactions to the carbon tax and its ambition levels allude to the differing priorities. The political right argues that the tax is detrimental to Denmark's economic outlook whilst the political left and climate experts (beyond the Social Democrats) argue it is unambitious (Sæhl, 2022). As such, Danish businesses are attempting to create and enforce their targets in a political landscape where the roads are paved with good intentions, but where the end product is predicted to fall noticeably short. Understanding the public-private relationships' strength through a corporate lens contextualises Denmark's scattered CSR policy and provides insight into the possibilities and scopes for collaboration in pursuit of common goals across the entire ecosystem.

3.7.2 Private Businesses and their CSR Initiatives in Denmark

Danish companies are engaged in a wide range of CSR activities, bridging the public-private gap as stakeholders and corporate citizens in the green transition (Boxenbaum, 2006; Brown & Knudsen, 2015; Toft & Rüdiger, 2020). The external CSR-linked pressures on the companies stem from the market and not necessarily the strong Danish domestic institutions (Brown & Knudsen, 2015). As such, CSR and the TBL constitute an increasingly apparent economic opportunity relative to the socially constructed minimum threshold (Rendtorff, 2019).

[20] For companies within the EU's 2030 quote system, the cost would increase to 1,125 DKK. The EU's current price is around 600 DKK (Sæhl, 2022). However, these EU quotes can be transferred thereby decreasing the greatest Danish emitters' rate to around 520 DKK per tonne under the new deal (Kristensen, 2022).

Indeed, there is a strong positive correlation between CSR practices and stakeholder pressures on business outcomes (Berg et al., 2018). The opportunity exists for businesses to distinguish themselves and thereby reap holistic value chain benefits (Lehmann et al., 2010). Interestingly, according to Lehmann, Toh, Christensen & Ma (2010) crises such as the financial crisis of 2008 – 2009 and, therefore, hypothetically, the Covid-19 pandemic provided opportunities to reinforce CSR's core importance (Bae et al., 2021). Indeed, Bae, El Ghoul, Gong and Guedmani (2021) suggest that investors and consumers can distinguish between genuine CSR companies and the rest, especially during crises.

Authors including Morsing, Schultz and Ulf Nielsen (2008) argue that businesses may suffer from a CSR "Catch-22" where CSR engagement is encouraged, and yet actively communicating the engagement is discouraged (Morsing, Schultz & Nielsen, 2008). However, the act of publicising a climate pledge or net-zero target is in stark contrast to Morsing, Schultz and Nielsen (2008)'s claims. This suggests that publicising relevant goals and progress is becoming a key company strategy to safeguard against greenwashing claims (Bae et al., 2021). Most companies have easily accessible sustainability or CSR sections on their websites, use social media to highlight CSR activities often, and they have their employees advocate their impact (Andrikopoulos & Kriklani, 2013). Moreover, 1100 of Denmark's largest corporations must report their CSR policies and actions to the government (Lehmann et al., 2010).

Companies use their value and mission statements as the guide for their CSR activities (Lehmann et al., 2010). Chapple and Moon (2005) identify three CSR "waves" – three stages of CSR development, based on business value integration and alignment.[21] The first wave centres around community-based activities and projects, such as building schools and improving welfare (Chapple & Moon, 2005). The second wave targets product development and processes through optimising energy use, and LCAs. The third wave concerns employee involvement, through their participation in the other waves, but also addressing employee-related issues (Lehmann et al., 2010; Nielsen & Frederiksen, 2015). According to Chapple and Moon (2005), participation and donations to community-led projects merely constitute a superficial CSR integration. As such, companies must invest time and resources in ensuring that environmental CSR is not limited to the first wave, but that it permeates all three waves as appropriate.

[21] There is not a strict timeline to the waves, according to Chapple and Moon (2005), but the waves refer to a set sequence that build on previous foundations.

3.7.3 Danish businesses and Kyoto Carbon Credits

CSR's integration into the Danish social economy constitutes a bond based on trust and transparency between corporate citizens and society; this has been broken in the past. The pledges' voluntary nature and the carbon offsetting markets' inherent faults were exploited by Danish businesses. The Danish investigative newspaper, Politiken, uncovered ninety-two Danish companies, which intentionally or otherwise effectively falsified carbon credits through Chinese and Indian fluoroform (HFC-23) GHG projects (Skjoldager, Arnfred & Kjeldtoft, 2020).[22] The EU had decommissioned the projects and attempted to dissuade investments, and yet, the Danish investments continued unabated. The Danish companies continued with these climate credits until 2013, despite a Danish ban on HFC-23 credits in 2008 due to uncertainty over the long-term effects, and the 2011 EU ban on the United Nation (UN)'s Kyoto Carbon credits (Skjoldager, Arnfred & Kjeldtoft, 2020; United Nations, 1997).

The EU and several international experts suspect that only a fraction of the money prevented GHG emissions as intended. The rest was funnelled into the factory owners, their consultants, and the respective governments' coffers. The Danish companies invested 3.2 million credits within the UN's Kyoto Protocol to prevent HFC-23 emissions (Stanley et al., 2020). In turn, as per the EU's allegations, the factory owners needlessly increased production to emit more gasses, so that they could claim more climate credits in recapturing and breaking down the gasses. Breaking down the gasses was unbelievably cheap whilst the revenue was disproportionally large, between thirty and eighty times larger than the overheads. Assuming that calculation is right, then only between 1.25 and 3.3 per cent went to climate action with the rest officially unaccounted for (Skjoldager, Arnfred & Kjeldtoft, 2020).

Undoubtedly, there are many cases like this – where various stakeholders have abused the credit system. Indeed, another article claims many former and flawed AFOLU UN credit sites still exist within the carbon offsetting system today, undermining the system's overall validity (Bredsdorff, 2021). This case specifically, beyond exposing the flaws and loopholes in credits, also confirms some authors' suspicions around CCS and how the technology can be intentionally misappropriated. As such, there is heightened importance in exploring companies' sustainability pledges and strategies in this thesis.

[22] HFC-23 is 12,000 times more potent GHG than CO_2 and atmospheric levels are increasing (Hillbrand & Doniger, 2020).

3.8 Research Gap

Sustainability research currently has many diversified branches, among them a corporate sector emphasis. However, common academic problems appear - it can be one-dimensional in their approach, not taking the market realities into account. net-zero pledges and publicising climate pledges are relatively new phenomena, which means that research is sparse. Moreover, studies including Larrea et al (2022) employ methodological frameworks to assess net-zero companies' sustainability strategies. As such, they do not explore the characteristics of the companies themselves.

Other studies have attempted to gauge companies' sustainability output via the companies' websites and their public communication strategies. Publishing and showcasing sustainability progress through websites is common, as such, they are an ideal means of judging CSR progress. These studies looked into the sustainability progress versus the company's size and profitability (Andrikopoulos & Kriklani, 2013; Chatterjee & Zaman Mir, 2008; Kolk, 2003). As such, they also looked at the market reality of sustainability and how firms interact with sustainability on a tangible level. Andrikopolus & Kriklani (2013) focused on Denmark specifically and found, on average, minimal climate reporting, particularly among the most profitable as well as the smallest companies. These studies, however, did not use surveys to investigate differentiating and holistic characteristics. Similarly, studies on carbon offsetting tend to either focus on the academic feasibility and credibility issues, situating themselves above the individual firm level (Denton, Chi & Gursoy, 2020; Herr et al., 2019; Kreibich & Hermwille, 2021).

This piece is trying to shed light on the pledging companies in what is commonly regarded as a national frontrunner, Denmark. Understanding pledging firms' characteristics through their innovativeness, their LCA use, and their carbon offsetting strategies could be a foundation for a framework and matrix to identify and leverage other companies who may benefit from the market opportunity. Every firm must attempt decarbonisation at some stage as lagging behind may affect their market performance, customer loyalty, and their financial sustainability. As such, understanding how different firms react to these external pressures is invaluable. The characteristics are one segment, the other is the response and the strategy implementation to reach their internal and external targets. These firms have already reacted to the external and landscape pressure by adopting these voluntary pledges, but their decarbonisation strategy will range widely, depending on their characteristics.

Changing the perspective and exploring strategies for decarbonisation in Denmark is vital in grounding academic research and increasing corporate accessibility and common foundations.

As such, this thesis attempts to contribute in a few ways. Firstly, by exploring climate ambitious companies in Denmark and the determinants for net-zero targets – thereby taking a step back from the approach of Larrea et al. (2022). Secondly, this thesis sheds light on the Danish national situation and contextualises the firms' pledges and the interactions within the Danish socio-technical system for sustainability and CSR, which the MLP maps and positions.

3.9 Theoretical Framework

This thesis will employ the MLP as its theoretical framework, mapping the companies and their interactions and pressures. Whilst the MLP is traditionally seen as a technology-focused framework, it is becoming a normative framework within transition studies by charting flows across different societal levels as well (Geels, 2012). It is organised into three levels, the landscape, the regime, and the niche level. Each level has its characteristics, timelines, pressure points, and mutually inclusive interactions (Geels & Schot, 2007).

The top-level, the landscape, is characterised by large-scale international developments that can happen over decades. These include wars, and, in this thesis' case, the public outcry for climate change action and the measures adopted by international institutions including the IPCC (Smith, Voß & Grin, 2010). The landscape level is the most static and whilst some climate pressures are new, they will remain and intensify through near-universal awareness exemplified by ongoing legislative processes (IPCC, 2022a, 2022b).

The regime is the middle layer, which is represented by the status quo. The regime is the section that is under the most pressure through its interactions with the landscape and niche level. It is more dynamic than the landscape level but more static than the niche level. Usually, it is characterised by current technology, the market, social norms and practices, and more (Smith, Voß & Grin, 2010). A key component is the companies' reactions to pressure by creating certified net-zero or climate pledges, as well as the current technology and CSR initiatives designed to achieve the pledges. Traditionally, they are AFOLU and renewable energy offsets as well as GHG emission reduction among easily decarbonised sectors and industries (Fankhauser et al., 2022; McKinlay et al., 2021; Smil, 2016; Victoria et al., 2020). The Danish government also resides here.

Maintaining the status quo and avoiding and resisting change is instinctual to humans (Burnes, 2015; Jost, 2015). However, as these firms have already reacted to the building pressure with their pledges, they are arguably more receptive to positive pressures than other components residing here.[23] As such, this study attempts to chart the responsive firms' characteristics to the

[23] The companies have reacted to the pressure at various times, which is an issue that is beyond this thesis's scope.

initial pressures, but, crucially, the distinction in the response – in the form of a climate or net-zero pledge. The MLP framework has therefore already been initially applied to a certain extent, and this study employs it to chart the continued interactions and pressures as an ongoing transition amongst the greater socio-technical network.

The niche level is characterised by dynamism, where practices and technology susceptible to market conditions reside.[24] Generally, this is an innovative area, but some products, services, and technology fail to affect or shift the regime level and thereby fade into total or relative obscurity (Smith, Voß & Grin, 2010). In this thesis' context, the niche level is represented by the recognition that all sectors and industries must be decarbonised, the response to the Danish Government's (2022) Carbon / Green tax's ambition level from a climate science perspective, and the increasingly general and IPCC recognition that the climate targets cannot be reached through GHG emission reduction alone; a wider but regulated adoption of carbon removal is also needed (Fankhauser et al., 2022; IPCC, 2022a, 2022b; Smil, 2016).

This is reflected in new, costly, and complex technologies such as Direct Air Carbon Capture (DAC) – which disrupt the traditional carbon offsetting projects through their geographic flexibility, but which depend on government subsidies and cost-intensive R&D to prove their global scalability, feasibility, functionality, and credibility (Gambhir & Tavoni, 2019; Kumar et al., 2015; Lackner, 2013; Nemet, 2012; Roussanaly et al., 2021). Interestingly, the net-zero pledge was until recently a niche-level norm, but it has caused a regime transformation as awareness is spreading and firms are being affected by it. As such, the transition is ongoing as the market, or, potentially legislation, will require more firms to adopt net-zero pledges. Thus, the MLP in this thesis is mapping and tracking an ongoing system transformation. Transitions occur within the MLP framework, and their typologies depend on the disruptive force's frequency, source, and timing as well as the effect on the regime (Geels & Schot, 2007; Suarez & Oliva, 2005).

4. Methodology

This thesis employs a quantitative methodology based on primary survey data. The survey questions can be found in table 9 in Appendix A. Moreover, the data is cross-sectional as it gathers data about the current state of affairs, and it was created to generalise from a sample to a population (Creswell, 2009). As it is a quantitative study, a deductive literature approach was employed, which it frames the work and its findings (Creswell, 2009).

[24] This could be due to unfavourable market conditions, high cost in a price-competitive market, or technological immaturity.

The ordinal/ categorical survey is targeted at sustainability professionals – managers and directors – within Danish companies with a net-zero or certified climate pledge (Fink, 1995). According to United Nations Framework Convention for Climate Change (UNFCCC) (2022), there are one hundred and thirty eligible companies in Denmark. As such, the potential number of respondents was quite small, which makes generalisation harder.[25]

The survey was sent out in two separate ways – research was done to find sustainability managers' and directors' emails and contact information, so the survey was sent directly to them. The other approach was to contact general information emails and use company contact forms hoping the query would be forwarded to the relevant individual. Both approaches were occasionally used to establish contact and a successful outcome. The niche target group necessitated this approach; it was not viable to distribute it publicly. Ten respondents have requested the thesis in its final form.

The study uses logistic regression model theory, which uses predictor variables to predict an outcome's likelihood or lack thereof. Moreover, this study is composed of a binary classification.[26] Whilst ordinary least squares regressions are more common in economics, logistic models are more accurate and superior in their predictions of probabilities on the dependent variable (Harrell, 2015a, 2015b; Shi & Hua, 2021). This is vital in a study with few observations. Other advantages include that normal observations and error term distributions are not required. Finally, there is no assumption of linearity between the independent variables and the dependent variable.

After the models were created, results were charted and then analysed with the literature review's knowledge and within the MLP framework. The pressures on the regime from above and below were formalised. Moreover, the probability classification score and the goodness-of-fit were tested within the robustness check, to optimise the models and ensure their relevance to the hypotheses and their replicability (Fagerland & Hosmer, 2012; Hosmer, Lemeshow & Klar, 1988).[27]

4.1 Models

This study's models use logistic regression theory. Due to the number of observations, the explanatory variables are separated into different models according to best practice (Bursac et al.,

[25] See section 4.2.
[26] Logistic models can be adapted for multi-classic classification, where the dependent variable has more than two potential outcomes.
[27] See section 8.

2008; Heinze & Schemper, 2002; Hosmer, Lemeshow & Klar, 1988). The first model explores the relationship between disruptive practices and a net-zero pledge, with public connection and SSCM as control variables. The second model explores the association between LCAs, and the net-zero pledge, while the third model provides insight into carbon offsetting and the net-zero pledge. All three models have the same number of observations, thirty-four, however, the first and third models have fewer observations due to perfect associations with climate or net-zero pledges.[28] All three models have the same theoretical formula below, derived using logistic regression model theory (Cox, 1958; Harrell, 2015a, 2015b; Osborne, 2008):

(1): $$logit(P(Y_i = 1)) = \frac{\exp(\beta_0 + \beta_i X_i)}{(1 + exp(\beta_0 + \beta_i X_i))}$$

P = Event occurrence probability

Y = Dependent variable, Net-Zero pledges/company

β_0 = Population Y Intercept/ The Constant

β_i = Coefficient for the Population Slope.

X_i = Explanatory variables vector, as outlined in the data section.

Exp = Exponential function (Shi & Hua, 2021).

Furthermore, this thesis uses the probabilities odds ratios (ORs). They are a means of interpreting the likelihood of a desired outcome occurring (Nemes et al., 2009). In effect, they test the probability of an outcome occurring with a particular exposure [the independent variable vector] and the odds of the outcome occurring without said exposure (Szumilas, 2010). If the odds ratio is one, then the variable has been omitted due to a perfect success rate or due to a complete lack of association. As part of the methodology, the three models' probabilities are converted to ORs, due to ease of interpretation, by this equation:

(2): $$Log(OR) = logit(P\ (Y_i = 1)) = ln\frac{P}{(1-P)}$$

The alternative way to calculate ORs is through a two-way frequency table (Szumilas, 2010):

(3): $$ORs = \frac{a/c}{b/d} = \frac{ad}{bc}$$

Where:

[28] Including al the determinants in one model was attempted – see section 8.

a = Respondents with net-zero pledge and an explanatory variable.

b = Respondents with no net-zero pledge (only climate pledge) and an explanatory variable.

c = Respondents with a net-zero pledge and no explanatory variable.

d = Respondents with no net-zero pledge (only climate pledge) and an explanatory variable.

4.2 Model and Study Limitations

A key limitation with a significant impact is the number of survey respondents. More than twenty-six per cent of the population was captured, which is significant and allows for valid results that can point to trends.[29] However, it was assumed that more companies with CAs would be willing to discuss their sustainability and CSR strategies based on the literature review (UNFCCC, 2022).

Expanding the study to include the Nordics in their entirety was considered, however, that would dilute the national results. With a national focus, there is ample ground for future national comparison.[30] Another potential expansion would be the inclusion of all Danish companies – and allowing them to self-declare whether they had a climate pledge, net-zero target or neither. However, there was a possibility that these potential respondents would overstate their company's progress in an unverifiable manner compared to CA companies. As such, keeping the eligibility small was the best compromise. With the small number of respondents, thirty-four, achieving significant and generalisable results at the ninety-ninth and ninety-fifth percentile was impossible, but two out of three models achieved noteworthy results at the ninetieth percentile.

Another limitation concerns the sustainability professional's knowledge about their business as a holistic entity and their ability to answer the survey questions accordingly. Two of the questions target topics that fall in other departments, the supply chain complexity, and the market disruptiveness/innovation focus. The questions are necessary to establish the company characteristics, and whilst any senior-level professional has insider knowledge, there may be more qualified people within the organisation to answer these questions. For the technical sustainability questions the option: "I'm not sure" was included as an option to allow answers according to the best of their ability.

[29] Assuming generalisability is difficult due to the numerous differences between the firms – in sectors, size, actors, characteristics, and more and beyond this thesis' scope (Burchett et al., 2020).
[30] See section 9.

4.3 Assumptions

Several assumptions influenced the data management process due to the data's nature and the study's goals. One assumption is that the professionals answered truthfully. The implicit wish to give a good representation of one's and the company's impact is a bias. As such, the survey is set up to avoid questions concerning the goal ambition (especially relevant for climate pledge companies) or the progress towards set targets.

Despite the lack of questions on the company's CSR and TBL progress – it is assumed that the companies are indeed progressing and, more importantly, that they intend to fulfil their pledges. Whilst there may not be a complete strategy to fulfil them yet, it must be a work in progress. If a firm's intention to meet the pledges is wavering, then it is greenwashing of the highest degree, which would have a severe impact on this thesis's results. While exploiting technicalities and loopholes has occurred in Denmark, it is presumed that the companies do not currently, at least intentionally, engage in such behaviour. Moreover, the offsetting sites are assumed to be high-quality sites – regardless of whether they are CCS, AFOLU or renewable energy projects.[31]

5. Data

This thesis's data stems from various sources, with the survey targeting sustainability professionals at the centre. The survey questions are outlined in table 2 below with the questions rooted in the literature review.

Table 2: Survey Questions

Survey Questions	Answer Options	Number of Respondents	Obligatory to Answer
How disruptive is in terms of innovative capacity is your company in its market(s)?	1 – 5	34	Yes
What is the main focus of your business model?	1 – 5	34	Yes
How strong are the company's connections with public institutions in environmental sustainability matters?	1 – 5	34	Yes
The bulk of the company's emissions are scope:	1, 2, 3	34	Yes
Does the company have a long supply chain?	1 – 5	34	Yes

[31] Verifying the sites' validity is beyond this thesis' scope.

Has the company performed full Life Cycle Assessments on all products and buildings?	Yes or No	34	Yes
Is high-quality carbon offsets a company objective until the net-zero target is reached?	1 – 5	34	Yes
If some company emissions are being offset, is it done internally or through other dedicated businesses?	Internally or externally.	20	Dependent on the previous question, so no

There is a wide range of companies in the sample of thirty-four companies with different business characteristics in terms of their industries, products, services, and sizes.[32] For instance, some of the biggest companies and numerous Small and Medium-sized Enterprises (SMEs), in terms of employment are represented. While the Danish economy is primarily service-based, manufacturing and industrial companies are represented. Some of these companies produce infrastructure and products that accelerate the green transition whilst others are engaged in metal sectors, which are difficult to decarbonise (Smil, 2016). The respondent's range manifests the diverse company scopes – some are large multinational conglomerates whereas others are budding sustainability start-ups, currently focused on the Danish market.

The companies' websites were a source of information about the companies' respective industries ensuring their validity and relation to the respondents' answers. In that sense, all data the companies provided all the data via their public communications and their representatives. The thesis uses the common sector categories according to the UN International Standard Industrial Classification for All Economic Activities, known as ISIC, to ensure a common standard and codification for comparative purposes (ed. United Nations, 2008).

The companies with net-zero and climate pledges were obtained through the UNFCCC (2022) and their partner list. The database is a collection of various initiatives including the Getting to Zero Coalition, Business Ambition for 1.5 Degrees Celsius, Climate Ambition Alliance, the Science-Based Targets Initiative (SBTI), and more (UNFCCC, 2022). Using a certified database was essential in verifying, regulating, and certifying the companies' pledges (UNFCCC, 2022). There are undoubtedly more companies in Denmark with net-zero and climate pledges, but these

[32] This study will not outline the companies' headcount, size, industry, and products/services as it would be a means to ascertaining the study's companies, thereby undermining the promise to the companies.

are not certified by membership in certifying initiatives and organisations. As such, the absence of any external verification and validation of the goals, sustainability strategies, and progress made these companies unsuitable for participation in this study. Therefore, it is also not possible to ascertain the exact number of Danish net-zero companies beyond the UNFCCC (2022) database.

The rest of the population is an extension of the study's sample in their diversity across the metrics above. Although the proportion of companies with a net-zero goal, fifteen out thirty-four, is higher than the population at large, a degree of generalisation is still possible as these are the trend-setting companies. The net-zero transition is ongoing and, thus, the population of one hundred and thirty companies can be generalised based on the near future, if not the immediate present. More and more companies will announce certified net-zero pledges over the coming years and join the trend-setters.

The UNFCCC (2022) gathers different pieces of information from the pledge-holders. If it is a climate pledge centred around GHG emission reductions, then the percentage reduction, the target date, and the initial reference date are provided. Moreover, the companies can report their progress, especially if they are SBTI members, which feeds into the UNFCCC database. This reporting is voluntary and only counts towards announced emission reduction commitments, not net-zero commitments. Another potential source could have been the SBTI, but their list of companies is less comprehensive and their contribution-based model does not require companies to validate all their GHG scope 3 emissions (SBTI, 2022). Moreover, the companies in the two lists overlap; therefore, it was natural to use the more comprehensive list.

5.1 Inclusion of Variables

Dependent variable: Net-Zero Pledge

The dependent variable was not determined through the survey submissions, but through the UNFCCC database which logs the pledges that the companies have made. Any pledge that was not a net-zero pledge was coded as 0 and net-zero pledges were coded as 1 for the logistic models. As such, this is a dummy variable, allowing for binary classification.

Explanatory variable: Disruptiveness

The first explanatory variable, disruptiveness, is derived from the respondents' survey answers, assuming an association between disruptiveness and the net-zero target's disruptiveness. The answers, according to the survey, are coded as 1 – only follows market trends, the least disruptive to 5 – at the technological frontier and the most disruptive.

Explanatory variable: LCAs

The LCA variable is designed to explore whether full LCAs have been made on all products and the company buildings. The theory is that having a full LCA is vital to knowing all emissions and thereby key to setting accurate targets. It is based on survey responses and has two categories: 1 – No and 2 – Yes.

Explanatory variable: Carbon Offsetting

The carbon offsetting variable is designed to explore the companies' offsetting strategies on a scale of 1 to 5. 1 – no emissions are compensated to 5 – all are compensated. As such, it tests the companies' overall sustainability strategy and whether it encompasses carbon offsetting or just GHG emission reductions.

Control Variable: Public Connection

In the first disruption-based model, the public connection is a control variable due to the link between public connections and innovation. It is assumed that companies with greater public connections have better access to R&D funding, allowing for a greater innovation-based disruptiveness. It is coded as 1 – functions independently of public institutions to 5 – has many PPPs.

Control Variable: Supply Chain

Similar to public connection, the supply chain is a control variable in the disruption-based model. As supply chain disruption impacts global economies, innovation is taking centre stage in overcoming these difficulties. New products and specifications with shorter and closer supply chains are appearing. There is a dual assumption with this variable – that companies with short supply chains have net-zero targets, but also that some large, multinational corporations with long and complicated supply chains have net-zero targets too due to a wealth of resources. The variable is coded as 1 – Short and efficient to 5 – many cross-continental suppliers.

5.2 Descriptive Statistics

Table 3: Descriptive statistics for Models

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
Net-Zero	34	.441	.504	0	1	0	1	.237	1.056
Carbon offsets	34	2.47	1.237	0	5	0	5	-.176	2.37
Disruption	34	3.38	1.181	1	5	1	5	-.443	2.474
Public Connection	34	2.82	1.29	1	5	1	5	-.01	1.861
Supply Chain	34	3.47	1.27	1	5	1	5	-.557	2.216
LCA	34	1.18	.521	0	2	0	2	.235	3.204

The number of observations, thirty-four, is the same across all three models. The Net-Zero mean is .44, meaning nineteen companies have climate pledges and fifteen have net-zero pledges. Disruption's mean is 3.38, which suggests that there are slightly more companies that self-identify as disruptive than market-trend followers. As such, these companies can, on average, be classified as trendsetting, allowing for a near-future generalisation for the population.

Public connection's mean is 2.82 suggesting a near-even company distribution, with a slight majority functioning more independently of public institutions. LCA's mean of 1.18 means that the vast majority have not or do not know if they have completed full LCAs on their products and buildings, highlighting how this is a niche-level action. Similarly, the carbon offsets mean of 2.47 suggests that a slight majority of the emissions are not being offset. In the results section below, the models' results are outlined.

6. Results

The study's research question is: To what extent do sustainability strategy characteristics predict which Danish companies have net-zero pledges? As expected, the study's size has had a profound effect on the results' significance level and thus their magnitude. The three models' results will each be explored in turn below. As the determinants are categorical and not continuous variables, the categories' association with the dependent variable is adjudged in relation to the chosen base level. Hence, there are numerous ORs in the models below and not a single coefficient for each variable.

6.1 Model 1 (Disruption)

Table 4: Model 1 Results

Net-zero and Variables	Odds Ratio	St.Err.	t-value	Sig
1. Disruption	.324	.887	-0.41	
3. Disruption (Base level)	1	.	.	
4. Disruption	15.698	31.939	1.35	
5. Disruption	49.122	115.085	1.66	*
1. Public Connection	2.353	5.325	0.38	
2. Public Connection	14.645	27.466	1.43	
3. Public Connection (Base level)	1	.	.	
4. Public Connection	80.228	187.962	1.87	*
1. Supply Chain	.043	.145	-0.93	
2. Supply Chain	1.151	2.807	0.06	
3. Supply Chain (Base level)	1	.	.	
4. Supply Chain	.051	.138	-1.10	
5. Supply Chain	3.339	9.309	0.43	
Constant	.081	.201	-1.02	
Number of Observations: 28				
**** p<.01, ** p<.05, * p<.1*				
Classification score: 89.29%				

The model classification score is 89.29 per cent making this a good predictor for the data.[33] [34] The baseline odds if all predictors are set to zero, represented by the constant, is 0.08, highlighting the variables' effect on the data and the climate pledge companies' prevalence.

Two categories are omitted, firstly, the second disruption category: mainly responds to market trends, due to a perfect failure prediction. Effectively, all the companies who identified with this category had a climate rather than a net-zero pledge. Secondly, the fifth public connection category is omitted due to perfect success; all companies with numerous environmentally-themed PPPs have net-zero targets. As such, the observation number is twenty-eight as four and two observations were omitted in the respective categories.

[33] Full classification table is table 9 in Appendix B.
[34] The classification score is a test that tests the model's goodness of fit based on a 2 by 2 table and measures how the model classifies predicted versus actual outcomes. If the outcome probability is more than 0.5 then it is positive, otherwise it is negative (Kanninen & Khawaja, 1995).

For the models, the middle categories were chosen as the base level and the other categories' reference points in the models' significance. All three variables are spectrum-based meaning that the neutral, middle category forms the best basis for understanding the inter-firm differences. As such, these categories' omittance is automatic.

The null hypothesis can be rejected at the ninetieth significance level, for the fifth disruption category with an OR of 49.12, suggesting an association between high levels of disruption and net-zero pledges. Moreover, there is an elevated OR for the fourth disruption category, with an OR of 15.67. Conversely, there is a probability of 0.32 to have a net-zero target by following market trends alone. This suggests that highly innovative firms are at the forefront of the sustainability integration movement in Denmark. Conversely, firms that just follow market trends are less likely than the base level to have net-zero targets. Centring sustainability is, thus, not a market trend yet.

The model's other significant result is public connection's fourth category with an 80.29 OR and a significance at the ninetieth level. With the fifth category predicting success, it is evident that there is an association between PPS and net-zero pledges in Denmark. However, it does not necessarily mean that the Danish government is a driver. Instead, the potential for collaboration across the CSR spectrum creates opportunities for knowledge sharing to further sustainability operations.

For the supply chain variable, there are no omitted categories but, conversely, there are no statistically significant results. Moreover, the results differ and the ORs do not increase linearly. For the first category, the short and efficient supply chain, the OR is 0.04, but the second category has an OR of 1.15, making a net-zero pledge more likely than the base level. With the longer supply chains, the fourth category's OR of 0.05 contrasts markedly with the cross-continental fifth category's OR of 3.34. The differing ORs across the categories and the absence of patterns suggest that other variables and determinants are more influential in the associations with net-zero pledges. Thus, there is potential for substantial SSCM improvement in Danish companies' upstream and downstream supply chains. However, it can be argued that the fifth category's OR suggests that the companies with cross-continental supply systems, and presumably a wealth of resources, are aware of their operations' environmental impact and have created strategies – in the form of net-zero pledges – to mitigate against it.

6.2 Model 2 (LCA)

Table 5: Model 2 Results

Net-zero & Variable	**Odds Ratio**	**St.Err.**	**t-value**	**Sig**
1. LCA (Base level)	1	.	.	
2. LCA	5.667	5.183	1.90	*
Constant	.529	.218	-1.54	
Number of Observations: 34				
**** p<.01, ** p<.05, * p<.1*				
Classification Score: 67.65%				

This model explores the correlation between having full LCAs and net-zero pledges. The classification score is 67.65 per cent[35], which means fewer observations have been correctly classified than in Model 1. The number of observations is thirty-four and no categories have been omitted due to perfect associations with climate or net-zero pledges. As LCA is a dummy variable, the base level is 1: No, which was the majority's response.

The constant of 0.53 shows the likelihood of having a net-zero pledge if the LCA variable was held constant. The null hypothesis is rejected at the ninetieth significance level suggesting that there is a correlation between having full LCAs and net-zero pledges. Indeed, the OR of 5.67 highlights the increased probability that performing LCAs constitutes a valuable tool for measuring emissions and thereby planning the mitigation strategies. As LCAs are a crucial tool for quantifying a company's environmental impact, which has been adopted by regime members, it can be argued that it is very difficult to create net-zero pledges without full LCAs. If net-zero targets are created without LCAs then they do not account for all of the company's comprehensive emissions – which would be misleading to consumers.

6.3 Model 3 (Carbon Offsets)

Table 6: Model 3 Results

Net-Zero & Variable	**Odds Ratio**	**St.Err.**	**t-value**	**Sig**
1. Carbon Offsets (Base level)	1	.	.	
2. Carbon Offsets	.333	.36	-1.02	
3. Carbon Offsets	.571	.54	-0.59	

[35] Table 10 in Appendix B is the full classification table.

4. Carbon Offsets	2	2.236	0.62	
Constant	1	.707	0.00	
Number of Observations: 33				
**** p<.01, ** p<.05, * p<.1*				
Classification Score: 63.64%				

The third model centres on the association between carbon offsetting and net-zero pledges as part of a company's greater and concrete mitigative sustainability strategy. The classification score is 63.64 per cent, the lowest of the three models.[36] The base level is the first category with no emissions offsetting either internally or externally; it is the basis for the other categories and their association with the dependent variable, net-zero pledges. The fifth category, full emission compensation, is omitted due to a perfect success association, meaning all the companies had a net-zero pledge. Only one company had compensated all their emissions and, as such, the observation number is thirty-three. The constant is 1, showing the net-zero pledge probability if the carbon offsetting variable is excluded.

None of the categories is significant at any percentile and therefore the null hypothesis is accepted within the given dataset. However, the ORs differ across the various categories. Interestingly, companies that compensate some or half of their emissions are less likely to have a net-zero pledge than the companies that offset none of their emissions. The base level companies with net-zero pledges may have aggressive GHG emission reduction strategies that render offsetting futile. Conversely, the companies that offset many of their emissions are twice as likely to have net-zero targets than the companies without offsets. Thus, the companies at both ends of the spectrum are more likely to have net-zero targets than the second and third categories, suggesting that they have created clear action plans for reaching their goals. The first companies are focusing on GHG emission reduction and the fourth and fifth categories are incorporating offsetting to a greater degree.

7. Analysis and Discussion

The study revolves around the following research question: To what extent do sustainability strategy characteristics predict which Danish companies have net-zero pledges? There is pressure on the private sector to display meaningful CSR progress as there are notable differences between the companies with net-zero pledges and climate pledges. The null hypothesis' rejection at the ninetieth percentile in two out of three models demonstrates this finding.

[36] Table 11 in Appendix B is the full classification table.

Therefore, there is a significant association between company characteristics, sustainability strategies, and the differences between Danish companies' climate and net-zero pledges. Thus, this study suggests that specific company profiles are more likely to have a net-zero pledge. This profile is, according to this study's scope and results, based on a strong internal innovation/disruptiveness effort, PPPs, and having full LCAs to quantify the company's environmental impact. However, there is a general guardedness in including carbon offsets, despite the landscape level pressure.

Disruptive, system-change focused sustainability innovation, and to a certain extent sustainability innovation, is still not a Danish market trend, even among the progressive companies surveyed. The disruption variable's mean of 3.38 and the ORs heavily favouring the active disruption categories suggest that most companies, and therefore, most sectors and the market have not recognised innovation R&D's long-term investment opportunity. Organic innovation for sustainability is insufficient through its maintenance of contemporary path dependencies and the current regime inertia.

Indeed, innovation for sustainability is arguably a response to external forces, which temporarily disrupt the system, but it is not a forceful driver in itself. As such, the R&D must transcend innovation path dependencies and be disruptive across the entire CSR regime – from social practices to relevant actors to the market itself. The disruptiveness should lay in the methods and strategies to reach net-zero targets; setting the net-zero goal should not be a disruptive practice. However, it is and will inevitably remain a vital regime level component to continuously develop and optimise patterns, practices, and products, cementing disruptiveness as a good net-zero predictor.

A worry is the Danish sector emissions, which may continuously increase as companies are adapting and shortening their supply chains (Lopes de Sousa Jabbour et al., 2020; Pujawan & Bah, 2022; Sarkis, 2020). As such, SSCM is an important topic for Denmark considering the elevated industry, transport, and trade emissions between 2010 and 2020, matching global trends. Per the survey, seventy-eight per cent of companies highlighted scope 3 emissions as their main emittance, which is in line with the literature review. If sector-specific emission rises are an issue in Denmark, then SSCM is urgently needed in industrialising nations and production-based economies. Implementing SSCM is a network-based approach, tying into the holistic and multi-stakeholder approaches needed to achieve Fankhauser et al (2022)'s net-zero principles as well as the PPPs' collaborative nature. Indeed, it constitutes a forensic investigation of a company's impact on other businesses and individuals.

LCAs are also an exploration of a company's impact, going beyond other businesses and individuals to include the planet itself. However, full LCAs' adoption is scarce, according to the survey, despite the inter-regime Danish governmental pressure to do so. The inter-regime pressures taking the form of the Danish Consumer Ombudsman and the new Government guidelines for sustainable construction, among others, highlight LCAs as founding elements in understanding embedded GHG emissions. Indeed, it would be exceedingly difficult for companies to set net-zero goals without performing full independent LCAs and thereby understanding their environmental impact to the fullest degree. The rejection of the null hypothesis exemplifies this correlation between net-zero targets and full LCAs. The companies who have not performed full LCAs should react to the inter-regime pressure and construct climate mitigation strategies accordingly – as it must be cored in sustainability and business strategies.

The government's approach to LCAs is clear and transparent – this does not extend to the general sustainability strategy; however, according to the survey responses, it is evident that Danish companies with numerous consolidated PPPs are more likely to have net-zero targets. The fourth PPP category rejecting the null hypothesis at the ninetieth level establishes this understanding. Indeed, PPPs may constitute a constructive approach by eliminating inter-regime pressures and encouraging knowledge sharing and collaboration. Instead, the PPP's collaborative nature likely drives the ambition and results, but this requires forensic investigation in a different setting.[37]

Carbon offsetting remains controversial for Danish companies, partly through the loose regulative landscape but also the potential CSR communication pitfalls. The categories' lack of significance and the low ORs compared to the other models reflects this phenomenon. [38] The divided academic landscape is manifesting itself in the private sector, wary of costly missteps. As such, twenty-nine per cent of the companies in the survey that offset emissions do so internally, more than expected, to ensure full control over the process and the effects on the company's external image. On one hand, CCS represents business-as-usual and an association with mineralogical and fossil fuel-based societal tendencies and processes, which DAC companies must combat alongside developing the technological development trajectories. On the other hand, AFOLU and renewable energy projects' immersion in Global North and Global South power structures perpetuate continued global inequalities.

[37] See section 9.
[38] The perfect association between the only company in the fifth category and net-zero pledges is not a basis for statistical significance.

Indeed, CSR initiatives are based on perceived reward, and the potential for unintended consequences was highlighted through the Danish companies' Indian and Chinese Carbon Credit investments.[39] These trends do not match a socio-equitable transition, and yet, the common climate science consensus is that CO_2 and other GHG must be removed from the atmosphere due to the historical emissions. As such, companies and academia should collaborate to establish frameworks to regulate the carbon offsetting market. Upon completion, then carbon offsetting may become a widely accepted and integral sustainability component – and, thus, associated with net-zero pledges and companies.

Applying the MLP and this thesis' conceptual foundation shows the intra-regime pressure points alongside the pressures from above and below. Indeed, this net-zero transition is a contemporary phenomenon, and, thus, the MLP aids in mapping interactions as they arise. The three determinants belong to distinct levels of the MLP framework. LCAs are an inter-regime phenomenon, through the Danish government and the Consumer Ombudsman's recommendations and decrees. Conversely, innovation for sustainability provides pressure from two levels. Innovation for sustainability is also a regime level component in its evolution of the system from within, maintaining current path dependencies and pathways.

However, disruptive innovation will always be synonymous with the niche level due to its focus on rapid systematic regime change. As a disruptive practice or product transforms the regime, a new one emerges at the niche level, challenging the new status quo. As such, as the net-zero pledge is becoming a regime level component, some companies aim to compensate for all their historic emissions, in line with durable net-zero, and other companies are climate-positive thereby actively aiding the environment.

Carbon offsetting permeates all three MLP levels. The landscape-level pressure, mainly through the IPCC, centres on carbon offsetting's vital role in reaching climate goals. However, it is also a regime level component through the Danish government's Green Tax Reform's CCS funding. Finally, on the niche level, there is an emphasis on new AFOLU methods that promote Indigenous lands, biodiversity, and crop output, which challenge traditional carbon offsetting norms and sites. As such, carbon offsetting is a multi-faceted MLP component.[40] The companies' carbon offsetting caution may be linked to the diverse carbon offsetting perspectives, which signify the absence of a unified system attitude. The scepticism is exemplified by the low ORs and the varied survey responses.

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[39] See 3.7.3.
[40] Exploring the carbon offsetting MLP interactions in more detail is beyond this thesis's scope.

The insights provided by IPCC reports and the increasingly bleak climate and landscape-level modelling are not enough to disrupt and force system change. The now constant pressure exerted by climate activists and scientists, from below, is not enough either. Evidently, the change must therefore come from within the regime and the market. The study's trend-setting companies must pave the way for other actors and components. The companies eligible for this study have all acted to various extents and must passively and actively engage others to follow suit and adopt the study's sustainability characteristics, centred around disruptiveness and LCAs.

The net-zero pledge must cease to be a transformative action, and instead be a vital regime-level component across Danish society tying in all stakeholders. Indeed, the friction that underpins the current Danish sustainability system is a leading cause of economic and market inertia. The recognition that everyone across Danish society is a common stakeholder in building and maintaining progress is arguably lacking. The interactions between the three MLP levels should be complementary and based on seizing TBL opportunities within the Danish social contract and its unique market setting. As such, PPPs may embody the traits that underpin successful net-zero pledges. Indeed, climate PPPs are an innovative venture as a manifestation of an environment that favours experimentation and trendsetting. PPPs are also the subject of extensive risk assessments, which quantify the venture's potential impact. As such, LCAs and quantifying impact is not an alien concept. Thus, net-zero targets' strong association with PPPs may be associated with the interactions with the study's two significant determinants.[41]

The Paris Agreement, United Nations (2015) is founded on the notion that the private sphere can become climate and not just corporate citizens, pressuring their respective national governments to action. To realise that vision, there must be a meaningful corporate push, aided by governmental incentives and guided by climate-friendly legislation. Neither side should wait for the other to act, meaningful and ambitious partnerships involving all stakeholders in Danish society are necessary. A significant step would be a greater implementation of disruptive innovation, PPPs, and LCAs at the company level, the study's characteristics which are significantly correlated with net-zero pledges in Denmark.

8. Robustness Check

The low observation number for this study impacted the model specifications. As such, this section will, firstly, explore alternate model specifications that were abandoned during the methodological process. Secondly, it will perform more tests, specifically the Hosmer-Lemeshow

[41] This requires more research, see section 8.

test, to explore the models' goodness-of-fit (GOF) as a measure of appropriateness (Hosmer, Lemeshow & Klar, 1988; Hosmer Jr, Lemeshow & Sturdivant, 2013).

Two alternate model specifications were evaluated. The first included all the variables, including the control variables (public connection and supply chain).[42] In this model, the high number of variables prevented any meaningful results – numerous categories have omitted or failed associations with the dependent variable. Thus, the confidence intervals are not usable, which effectively makes the model disadvantageous. The second alternate model did not include the control variables. Per the literature review, it was hard to create the theoretical basis for including these three variables in one cohesive model. Moreover, the tenuous relationships between the variables are reflected in the ORs, which differ greatly from the study's three main models. As such, exploring the three explanatory variables in separate models allowed for a holistic and specific investigation of their relationships with net-zero pledges.

The Hosmer-Lemeshow GOF test was performed on all three models.[43] The models were divided into groups to assess the GOF at different probabilities within the distinct groups, depending on the models and their capabilities. Therefore, there are four groups in the first model (due to including more variables), two in the second model, and three in the third model. For the first model, the classification is poor at low probabilities due to a higher number of observations than expected but improves significantly in the third and fourth groups. With the second model, the expected observation count nearly matches the observed number, making it a usable predictor for the data. Finally, the third model is also a good predictor for the data measured in each group's expected versus observed observations. In summary, the three models are, within the possibilities tested, the most accurate predictors for the data.

9. Conclusion

There are clear associations between certain sustainability characteristics and having net-zero targets in the Danish private sector, underlined by the rejection of the null hypothesis in two out of three models. As such, there is a sustainability strategy blueprint for Danish companies based on PPPs, disruption, LCAs, and possibly more with a more comprehensive research scope. Understanding the full GHG protocol emissions from products and buildings, using LCAs, allows for more precise mitigation strategy formulation and implementation. LCAs feed into the same

[42] Table 13 and 14 in Appendix C.
[43] Tables 15, 16, and 17 in Appendix C.

network-based and multi-stakeholder processes required for eliminating the system-wide tension in favour of collaboration and PPPs.

Adopting net-zero pledges remains an innovative practice, exemplified by their rarity and the significant correlation between disruption and net-zero targets. Whilst disruptive practices deliver shock waves to the system, sustainable processes must become a market trend for Danish companies to meet their climate targets. Net-zero targets, through the study's determinants, must become the norm for companies and the internal and international legislation must improve in scope and rigidity. As such, the socio-technical regime must continuously evolve and be engaged in an ongoing transition. This transition must be based on collaboration and partnerships across the regime's various actors and components. Indeed, the high ORs and the perfect success association for categories four and five in climate PPPs showcase the solution's potential.

The Danish socio-technical regime for sustainability is undergoing noteworthy changes; however, the magnitude and pace of change are not significant enough. The Danish system demands solutions, which eliminate the systemic pressure and lay the foundations for the favourable characteristics of net-zero pledges. Regardless of the CSR waves in companies, the private sector cannot singlehandedly perform the green transition. It must be a process that transcends traditional market and societal boundaries. Denmark, and thus, by extension, its private sector see itself as a sustainability pacesetter; now is the time to become a frontrunner in absolute terms and adhere to the Fankhauser et al (2022)'s net-zero principles in a local and global context. Building this process on this thesis' business and sustainability characteristics, including disruptive innovation, PPPs, and LCAs allows the companies to future-proof their operations.

A practical implication of this work is a greater understanding of the company characteristics associated with net-zero targets and how that affects companies' sustainability strategies going forward. Companies with climate reduction pledges will be able to see the differences between themselves and net-zero companies, and, potentially, see the merits of setting their own net-zero target. Moreover, exploring the Danish socio-technical regime for sustainability may highlight avenues for private collaborations and PPPs. On a simpler level, the ten companies who have requested a copy of this thesis will hopefully gain a greater appreciation of their change-making capabilities and their company's role as a Danish system stakeholder.

The paths for future research are numerable and varied. Firstly, the feasibility of sustainability joint-ventures and PPPs must be explored. Secondly, as mentioned previously, the Danish focus' expansion is possible. It could include more variables, such as size and profitability, thereby embodying more TBL aspects; the Nordics where similar social contracts and semi-unified public systems exist; or it could become the basis for national comparisons. Finally, scholarly research must address the government's role in driving corporate sustainability progress in systems with social contracts but also in divided countries, where CSR's penetrative power and importance are diminished.

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Appendix A

Table 7: Full data for Danish C02 emissions between 2010 and 2020 in 1000s of tonnes

Source	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
In Total	101882	100519	94131	92845	86572	88064	91998	93764	95281	87937	85814
Households	13816	12890	12620	12641	11984	12765	13020	12672	12487	11996	10951
Sectors in total	88066	87628	81511	80203	74588	75299	78979	81092	82794	75941	74862
AFOLU	2528	2493	2309	2317	2169	2184	2241	2177	2212	2083	2098
Fossil Fuel Exploitation	2117	1941	1886	1822	1784	2011	1789	1829	1646	1538	1409
Industry	6304	6542	6209	5818	5749	6008	6302	6697	6716	6673	6591
Power Companies	31019	27883	24860	27918	23722	20963	23173	22967	21862	18998	18606

Construction	1520	1654	1490	1222	1355	1450	1489	1578	1625	1592	1546
Trade and transport, with more	42830	45401	43053	39494	38283	41080	42349	44068	46992	43324	43024
Information and Communication Technology	111	103	98	78	72	77	88	89	86	83	74
Finance and Insurance	65	62	59	56	50	51	58	55	56	52	47
Real Estate	100	92	107	85	77	86	77	81	81	78	74
Houses	31	27	40	33	35	37	37	42	38	41	40
Service Firms	430	422	408	359	366	394	407	426	451	456	434
Public Administration including healthcare and education	841	867	845	864	806	827	820	929	874	871	782
Culture and other services	170	141	148	137	118	130	148	151	155	152	137

Appendix B

Table 8: Model 1 Full Results

Net-zero and Variables	**Odds Ratio**	**St.Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
1. Disruption	.324	.887	-0.41	.681	.002	69.712	.324
2. Disruption (Omitted)	1	.	.	.	.	.	1
3. Disruption (Base level)	1	.	.	.	.	.	1
4. Disruption	15.698	31.939	1.35	.176	.291	846.56	15.698
5. Disruption	49.122	115.085	1.66	.096	.498	4847.225	49.122
1. Public Connection	2.353	5.325	0.38	.705	.028	198.406	2.353
2. Public Connection	14.645	27.466	1.43	.152	.371	578.205	14.645
3. Public Connection (Base level)	1	.	.	.	.	.	1
4. Public Connection	80.228	187.962	1.87	.061	.813	7916.912	80.228
5. Public Connection (Omitted)	1	.	.	.	.	.	1
1. Supply Chain	.043	.145	-0.93	.351	0	32.234	.043
2. Supply Chain (Omitted)	1.151	2.807	0.06	.954	.01	137.118	1.151
3. Supply Chain (Base level)	1	.	.	.	.	.	1
4. Supply Chain	.051	.138	-1.10	.27	0	10.072	.051

5. Supply Chain	3.339	9.309	0.43	.665	.014	787.716	3.339
Constant	.081	.201	-1.02	.31	.001	10.325	.081
Mean dependent var		0.464		SD dependent var		0.508	
Pseudo r-squared		0.438		Number of Observations		28	
Chi-square		16.927		Prob > chi2		0.076	
Akaike crit. (AIC)		43.746		Bayesian crit. (BIC)		58.400	
**** p<.01, ** p<.05, * p<.1*							

Table 9: Model 2 Full Results

Net-zero & Variable	**Odds Ratio**	**St. Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
1. LCA (Base level)	1	.	.	.	.	.	
2. LCA	5.667	5.183	1.90	.058	.944	34.032	*
Constant	.529	.218	-1.54	.123	.236	1.188	
Mean dependent var		0.441		SD dependent var		0.504	
Pseudo r-squared		0.088		Number of Observations		34	
Chi-square		4.123		Prob > chi2		0.042	
Akaike crit. (AIC)		46.539		Bayesian crit. (BIC)		49.592	
**** p<.01, ** p<.05, * p<.1*							

Table 10: Model 3 Full Results

Net-Zero & Variable	**Odds Ratio**	**St. Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
1. Carbon Offsets (Base level)	1	.	.	.	.	.	
2. Carbon Offsets	.333	.36	-1.02	.309	.04	2.769	
3. Carbon Offsets	.571	.54	-0.59	.554	.09	3.641	
4. Carbon Offsets	2	2.236	0.62	.535	.224	17.894	
5. Carbon Offsets (Omitted)	1	.	.	.	.	.	
Constant	1	.707	0.00	1	.25	3.998	
Mean dependent var		0.424		SD dependent var		0.502	
Pseudo r-squared		0.063		Number of Observations		33	
Chi-square		2.841		Prob > chi2		0.417	
Akaike crit. (AIC)		50.146		Bayesian crit. (BIC)		56.133	
**** p<.01, ** p<.05, * p<.1*							

Table 11: Model 1 Classification

Model 1 Classification			
Classified	**D**	**~D**	**Total**
+	11	1	12
-	2	14	16
Total	13	15	28
Classified + if predicted Pr (D) >=.05			
True D if defined as zero!=0			
Sensitivity		Pr (+|D)	84.62%
Specificity		Pr(-|~D)	93.33%
Positive predictive value		Pr(D| +)	91.67%
Negative predictive value		Pr(~D| -)	87.50%
False + rate for true ~D		Pr(+|~D)	6.67%
False - rate for true D		Pr(-|D)	15.38%
False + rate for classified +		Pr(~D|+)	8.33%
False - rate for classified =		Pr(D| -)	12.50%
Correctly classified			**89.29%**

Table 12: Model 2 Classification

Model 2 Classification			
Classified	**D**	**~D**	**Total**
+	6	2	8
-	9	17	26
Total	15	19	34
Classified + if predicted Pr (D) >=.05			
True D if defined as zero !=0			
Sensitivity		Pr (+|D)	40.00%
Specificity		Pr (-|~D)	89.47%
Positive predictive value		Pr (D| +)	75.00%
Negative predictive value		Pr(~D|-)	65.38%
False + rate for true ~D		Pr(+|~D)	10.53%
False - rate for true D		Pr (-|D)	60.00%
False + rate for classified +		Pr(~D|+)	25.00%
False - rate for classified =		Pr (D| -)	34.62%
Correctly classified			**67.65%**

Table 13: Model 3 Classification

Model 3 Classification			
Classified	**D**	**~D**	**Total**
+	8	6	14

-	6	13	19
Total	14	19	33
Classified + if predicted Pr (D) >=.05			
True D if defined as zero !=0			
Sensitivity		Pr (+|D)	57.14%
Specificity		Pr(-|~D)	68.42%
Positive predictive value		Pr(D| +)	57.14%
Negative predictive value		Pr(~D| -)	68.42%
False + rate for true ~D		Pr(+|~D)	31.58%
False - rate for true D		Pr(-|D)	42.86%
False + rate for classified +		Pr(~D|+)	42.86%
False - rate for classified =		Pr(D| -)	31.58%
Correctly classified			**63.64%**

Appendix C

Table 14: Alternate Model 1

Net-Zero & Variables	**Odds Ratio.**	**St.Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
1.disruption	3.313e+33	.	.	.	.	.	
2o.disruption	1	.	.	.	.	.	
3b.disruption	1	.	.	.	.	.	
4.disruption	6.634e+29	2.258e+37	0.00	1	0	.	
5.disruption	3.182e+15	1.083e+23	0.00	1	0	.	
1.public_con	0	0	-0.01	.995	0	.	
2.public_con	1	2	-0.00	1	.02	50.396	
3b.public_con	1	.	.	.	.	.	
4.public_con	6.633e+29	2.258e+37	0.00	1	0	.	
5o.public_con	1	.	.	.	.	.	
1b.lca	1	.	.	.	.	.	
2.lca	1.007e+22	6.774e+25	0.01	.994	0	.	
1b.carbonoffsets	1	.	.	.	.	.	
2.carbonoffsets	0	.412	-0.00	1	0	.	
3.carbonoffsets	1	2	-0.00	1	.02	50.389	
4.carbonoffsets	1	2.828	-0.00	1	.004	255.572	
5o.carbonoffsets	1	.	.	.	.	.	
Constant	0	0	-0.00	1	0	.	

Mean dependent var	0.444	SD dependent var	0.506
Pseudo r-squared	0.701	Number of obs	27.000
Chi-square	26.006	Prob > chi2	0.001
Akaike crit. (AIC)	27.090	Bayesian crit. (BIC)	37.457
**** p<.01, ** p<.05, * p<.1*			

Table 15: Alternate Model 2

Net-Zero & Variables	**Odds Ratio**	**St.Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**

1.disruption	1.002	1.514	0.00	.999	.052	19.379	
2o.disruption	1	.	.	.	.	.	
3b.disruption	1	.	.	.	.	.	
4.disruption	1.238	1.265	0.21	.835	.167	9.177	
5.disruption	1.411	1.851	0.26	.793	.108	18.445	
1b.carbonoffsets	1	.	.	.	.	.	
2.carbonoffsets	.352	.413	-0.89	.374	.035	3.516	
3.carbonoffsets	.701	.793	-0.31	.754	.076	6.443	
4.carbonoffsets	1.616	2.143	0.36	.717	.12	21.719	
5o.carbonoffsets	1	.	.	.	.	.	
lca	2.086	1.84	0.83	.405	.37	11.756	
Constant	.421	.617	-0.59	.555	.024	7.441	

Mean dependent var	0.483	SD dependent var	0.509
Pseudo r-squared	0.085	Number of obs	29.000
Chi-square	3.415	Prob > chi2	0.844
Akaike crit. (AIC)	52.753	Bayesian crit. (BIC)	63.692

**** p<.01, ** p<.05, * p<.1*

Table 16: Goodness-of-fit for Model 1

Group	**Prob**	**Obs_1**	**Exp_1**	**Obs_0**	**Exp_0**	**Total**
1	0.1039	0	0.4	7	6.6	7
2	0.4058	2	1.6	5	5.4	7
3	0.8711	5	4.5	2	2.5	7
4	0.9973	6	6.5	1	0.5	7
Number of observations = 28						
Number of groups: 4						
Hosmer-Lemeshow chi2(2) = 1.43						
Prob > chi2 = 0.4892						

Table 17: Goodness-of-fit for Model 2

Group	**Prob**	**Obs_1**	**Exp_1**	**Obs_0**	**Exp_0**	**Total**
1	0.3887	9	9.7	17	16.3	26
2	0.6670	6	5.3	1	2.7	8
Number of observations = 34						
Number of groups: 2						
Hosmer-Lemeshow chi2(1) = 2.14						
Prob > chi2 = 0.1439						

Table 18: Goodness-of-fit for Model 3

Group	**Prob**	**Obs_1**	**Exp_1**	**Obs_0**	**Exp_0**	**Total**
1	0.3636	6	4	13	13.0	19
2	0.5000	4	4	4.0	4.0	8
3	0.6667	4	4.0	2	2.0	6
Number of observations = 33						
Number of groups: 4						
Hosmer-Lemeshow chi2(1) = 1.20						
Prob > chi2 = 0.1648						