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School of Business and Management

(MSIS) Strategy, Innovation and Sustainability

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Corporations on the Road to Low-Carbon Economy: Institutional Diffusion of Carbon Management

Master's Thesis

Supervisors: Professor Kaisu Puumalainen and Managing Director Petteri Laaksonen

ABSTRACT

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The purpose of this research is to define the institutional diffusion of carbon management, and what are facilitating and hindering factors in this institutional level change required to achieve such. The research originates from the 2050 targets of low-carbon economy. The focus of the study is within the forerunners, the innovative adopters of carbon management. Through these innovative adopters the institutional change process to carbon management is studied, by similarly identifying the drivers and barriers within this development. The institutional change processes efficiency and outcome is reflected directly towards the institutional diffusion of carbon management, ultimately defining the width and depth, and the result of the diffusion.

The data for this study was acquired through the CDP Investor program, and focuses only to the associated CDP Climate change programs data from the years 2010 to 2015. The studied companies represent the top 100 highest emitters each year, and in total data from 252 companies were analyzed.

The results indicate that at present the regulations are not the strongest influencers within institutional change towards carbon management, instead reluctance against such was discovered. Also the market conditions do not create pressure towards change. Instead the physical changes experienced as a result of climate change drive companies towards carbon management. The forerunner companies demonstrate isomorphic level in carbon management, which indicates wide and deep institutional diffusion. However, any concrete results in decreasing emissions are not achieved, and the forerunner companies decouple the carbon management actions from structure. Carbon management is not connected to companies' maximization objectives, hence the increasing returns which is the main reason for such results. At present the forerunner companies carbon management actions are made to comply with the societies changed preferences to mitigating climate change.

TIIVISTELMÄ

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Tämän tutkimuksen tarkoitus on määrittää hiilen hallinnan institutionaalisen diffuusion taso ja mitkä tekijät edesauttavat ja vaikeuttavat tätä institutionaalista muutosta diffuusion saavuttamiseksi. Tutkimus on saanut alkunsa matalahiilisen talouden tavoitteista vuoteen 2050 mennessä. Tutkimus keskittyy hiilen hallinnan edelläkävijäyrityksiin eli innovatiivisiin omaksujiin. Institutionaalista muutosta hiilen hallintaan voidaan tutkia näiden edelläkävijäyritysten kautta, samalla tunnistaen mitkä tekijät edesauttavat ja vaikeuttavat tätä muutosta tapahtumasta. Institutionaalisen muutoksen prosessin tehokkuus ja lopputulos heijastuvat suoraan hiilen hallinnan institutionaaliseen diffuusioon ja määrittävät lopulta kuinka laajasti ja syvälle tämä on levinnyt, sekä diffuusion tuottaman lopputuloksen hiilen hallinnassa.

Tutkimuksessa käytetty data on hankittu CDP Investor-ohjelman kautta ja keskittyy pelkästään CDP:n Climate change-ohjelman dataan vuosilta 2010 aina 2015 saakka. Tutkitut yritykset edustavat näiden vuosien satoja korkeimpia päästäjiä vuosittain ja kokonaisuudessaan 252 yritystä valittiin mukaan analyysiin.

Tulokset osoittavat, että tällä hetkellä vallitsevat lainsäädännöt eivät ole vahvimpia vaikuttajia institutionaalisessa muutoksessa hiilen hallintaan, sen sijaan haluttomuutta hiilen hallinnan lainsäädäntöä vastaan kohdattiin. Markkinavoimat eivät myöskään kehittäneet paineita tätä muutosta kohtaan. Näiden asemasta ilmastonmuutoksen aiheuttamat fyysiset muutokset ajavat yrityksiä ryhtymään hiilen hallintaan. Tutkitut edelläkävijäyritykset osoittivat hiilen hallinnassa isomorfista tasoa, joka indikoi laajaa ja syvää institutionaalista diffuusiota. Konkreettisia tuloksia laskevien päästöjen muodossa ei kuitenkaan saavutettu. Samalla edelläkävijäyritykset ovat erottaneet nämä hiilen hallinnan toimenpiteet yritysten rakenteesta. Nämä tulokset johtuvat siitä, että hiilen hallinta ei ole yhteydessä yritysten tavoiteltujen päämäärien kanssa eikä kasvavissa tuotoissa. Tällä hetkellä näiden edelläkävijäyritysten hiilen hallinnan toimenpiteet on tehty vain mukautuakseen yhteiskunnan muuttuneisiin arvoihin taistella ilmastonmuutosta vastaan.

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1. INTRODUCTION

1.1. Background and theoretical framework

This research originates from the 2050 targets of low-carbon economy and concentrates to studying companies' endeavors for mitigating climate change, more precisely their carbon management actions. The prevailing issues of climate change and related global warming are significant subjects to address, their importance is high considering preserving our planets future. Why study companies and their carbon management actions is best explained through a brief history of earth's climate change and associated greenhouse gas effect. As we know the earth has undergone several naturally occurred global scale state shifts known as the "climate changes" throughout its history, good examples are the ice ages experienced. However, this is the first time such planetary-scale climate change is driven directly by human activities. Ever since the industrial revolution we have been continuously pushing the limits by reaching earths thresholds, which have already caused global-scale changes within the earths biosphere. The previous stable state known as the Holocene has transformed to a new era called Anthropocene where we experience unnatural events in the biosphere due to human actions. While the changes we have caused are largely not yet permanent, and we have not reached what the scientist call the "tipping point" in earths biosphere, it is evident that we eventually will. This human driven climate change has a lot of unknowns; we do not know what are the consequences from reaching this tipping point causing the global state shift to take place, what these thresholds are, and is the change eventually irreversible. What we know for certain is that if we want to preserve the stable Holocene state and keep our planet habitable, we have to take actions against mitigating the human driven climate change. (Barnosky et al. 2012, 52 – 53, 57. Rockström et al. 2009, 472 - 473)

Why us humans are the main cause for climate change transpiring derives from the fundamental elements that make life possible on earth; the greenhouse effect and the greenhouse gasses causing the effect, such as Carbon dioxide (CO_2), Water vapor (H_2O), Methane (CH_4), Nitrous oxide (N_2O) and Chlorofluorocarbons (CFCs). While our lives depend on the greenhouse effect, human actions have increased this significantly causing the ongoing climate change and consequential global warming. Especially the carbon dioxide emissions, which ascend from e.g. burning fossil fuels or changes in land use, are one of the main drivers of this human triggered climate change. The outcomes of climate change include global warming, droughts and heat waves, wildfires, stronger and frequent storms, artic ice melting, sea level rise, heavy precipitations and floods, just to name a few. Based on research one important goal is to limit the average global temperature rise to 2 °C above pre-industrial levels by decreasing significantly our released carbon emissions. We have already experienced the effects of climate change, and even though we would succeed in limiting the global temperature average rise some areas would still experience the increased risks of forest fires, sea level rises and droughts in example. Decreasing our carbon emissions is necessary for preserving earth's biosphere in order to leave something behind for our future generations. The 2050 targets of low-carbon economy play therefore a major role within the mitigation of climate change. Why studying companies is particularly important derives from the fact that the companies are the greatest driving forces of climate change. Based on a study conducted by Heede (2013, 238) two-thirds of the historic carbon dioxide and methane missions, which are the main drivers of climate change, since the beginning of industrial revolution to the year 2010 can be traced back to 90 corporations. Therefore, companies and their carbon management actions play a key part in mitigating this human caused climate change. While we are able to point out where the major emissions have originated from we cannot point our fingers only to the corporations, because we humans, our development, needs, and prosperity thus our norms and culture are the ultimate reasons of this climate change. Mitigating climate change through engaging in carbon management should be on everyone's agenda, not just the companies. What we need is change in our policies, norms and values, and our culture of prosperity with the cost of our planet. As a result, we need to study carbon management from the "larger picture" thus the institutional perspective that consists from these political, normative and cultural aspects. As we need to change such aspects, we need to achieve institutional level change of mitigating climate change and therefore institutional change and diffusion of carbon management. (Barnosky et al. 2012, 57. NASA 2016. Rockström et al. 2009, 472 - 473. World Resources Institute a 2016)

For studying this larger picture and change as a whole, thus the institutional level change and diffusion of carbon management, we need to attain climate change related data that is therefore able to cover the whole world. This is where CDP steps in, it is a London based non-profit organization that has the world's largest database of climate change related data. CDP has been gathering this climate change associated data through questionnaires from the world's largest companies ever since 2002 when it launched its climate change program, and sent its first climate change related questionnaire to Fortune500 companies. Companies are not obliged in participating to the CDPs climate change program, instead they are invited to take part through the financial market pushes. These economic incentives ascend as CDP offers its climate change related data for the institutional investors whom apply the data within their investment decisions. These companies disclose climate change mitigation associated carbon management data from governance, strategy, targets and initiatives, risks and opportunities, and emissions. Since these companies participate independently by disclosing data related to mitigating the climate change, which is intended for institutional investors making “green” investment decisions, we can assume that these companies are the forerunners in climate change mitigation; the innovative adopters of carbon management. The disclosing companies have taken a leap within climate change mitigation by presenting how they are tackling the related issues, and similarly attracting the institutional investors within their compliance in terms of carbon management. (Baumast 2012, 302 - 303, 308. CDP a 2016. CDP d 2016)

From this CDP climate change data, the focus will be in the 100 highest emitting companies. These corporations created over 12% of the global carbon emissions in 2013, and are therefore significant influencers of climate change. Studying the highest emitting companies which are at the same time forerunners in climate change mitigation hence carbon management activities is a fascinating opportunity as they are the innovative adopters, the drivers of this global change towards carbon management. Their approaches, and what drivers and hinders them towards the 2050 targets of low-carbon economy can offer important findings considering our planets future. As the focus of this research is the global scale “larger picture”, the foundation of this theoretical background is built upon the theories of institutions. The core focus is to study the drivers and barriers in the institutional change to carbon management, and therefore determine the institutional diffusion of carbon management. The Figure 1 presents the theoretical framework applied. To achieve these 2050 targets of low-carbon economy we need institutional level change from “business as usual” indicating that we can release emissions quite freely towards managing carbon emissions. This institutional change is influenced by several factors, which at the same time hinder and facilitate the institutional diffusion of carbon management, that is necessary for achieving the low-carbon economy targets. The focus is on institutional scale because as stated, everyone’s contribution is necessary if we want to mitigate climate change. In this research, carbon management is perceived to include all of the companies’ climate change mitigation activities. (Palthe 2014, 59 – 61)

This research is part of a larger setting of Neo-Carbon Energy project, and it contributes to project stage Work Package 3 (WP3). The importance of this study is significant and highly relevant due to accelerating climate change and closing targets of low-carbon economy. Such a study that would identify through the innovative adopters of carbon management what is facilitating and hindering the institutional change to carbon management, and resulting institutional diffusion has not yet been conducted. As a result, this study can provide guidelines of what is driving and hindering the larger change in climate change mitigation actions towards the low-carbon economy. (Neo-Carbon Energy 2017)

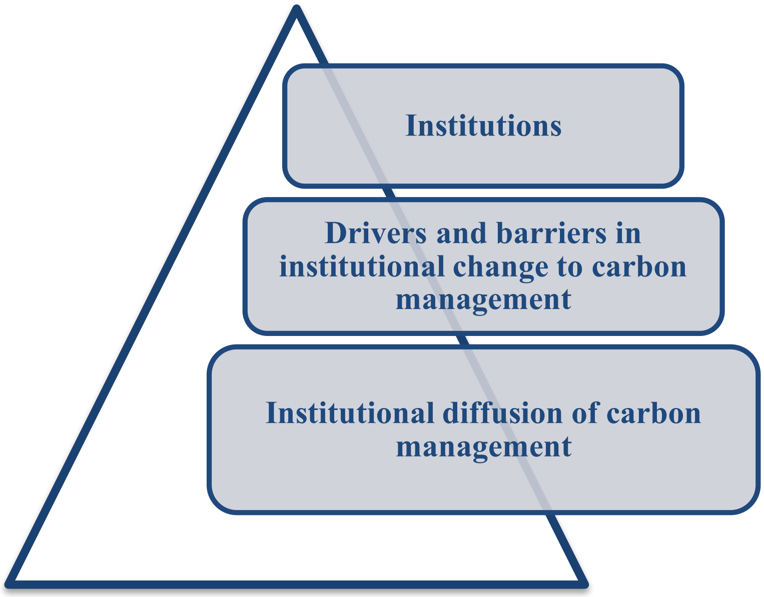

Figure 1. Theoretical framework

1.2. The research problem and research questions

As presented above, the research objective is to study the institutional change and therefore the institutional diffusion of carbon management. These two processes are strongly connected to each other; hence the institutional diffusion cannot transpire without the institutional change. The main research question is to define the achieved level in institutional diffusion of carbon management. In order to conclude such, we have to first study the institutional change to carbon management, which determines the direction, efficiency, and the outcome of this institutional diffusion. The above presented Figure 1 theoretical framework emphasizes the objectives of this research thoroughly. By using the forerunner companies in carbon management, this research will first study the drivers and barriers in institutional change to carbon management, and in consequence determine the level of the institutional diffusion of carbon management. Therefore, two research questions and related sub-questions are presented.

1. Drivers and barriers in institutional change to carbon management
   - What facilitates and hinders this process; the risks and opportunities in institutional change to carbon management?
   - What is the direction and the trends of the institutional change to carbon management?

For studying the drivers and barriers in institutional change to carbon management, emission data and climate change related risks and opportunities will be used from the CDP climate change database. These risks and opportunities are identical and consist from the political, physical climate change, and other climate-change related (e.g. the market conditions) aspects. As the companies determine whether a specific topic is considered as a risk or as an opportunity, it provides the perfect opportunity for studying the drivers and barriers of institutional change to carbon management. Through the carbon emission data, we are able to determine concrete carbon management results, which can be reflected towards the risks and opportunities in order to see more specifically what drives and hinders the carbon managements institutional change.

2. Institutional diffusion of carbon management.
   - What results have the companies' carbon management activities created?
   - How widely and deeply carbon management has diffused to the institutional level?

In order to define the width and depth of carbon managements institutional diffusion we have to identify the concrete results these forerunner companies have achieved in carbon management, for which we can use the carbon emission data. The width and depth of carbon managements institutional diffusion can be studied through the disclosed several different climate change mitigation related activities by companies. Because the diffusion is studied in the institutional level, we are looking for a similar structure of carbon management amongst companies and are there differences between sectors or countries. If the structure to carbon management is similar in the institutional level between companies and no differences are identified between sectors and countries, the results would indicate that carbon managements institutional diffusion has reached significant width and depth. For studying the similarities in the carbon management structure, a carbon management index was created; the CM Index. For building this CM Index, data which identifies the actions the companies are taking against mitigating climate change were used. These carbon management related data were acquired from climate change mitigation associated; governance, strategy, targets, initiatives, risks and opportunities, and emission related data which the companies have disclosed to CDP. Therefore, the CM Index is a good measure besides of companies' carbon management actions, also determining the width and depth of carbon managements institutional diffusion. In addition, the CM Index can be reflected to concrete emission results in order to see that are the stated actions mirrored to the emission performance.

1.3. Literature review

By studying the previously conducted researches linked to the theoretical backgrounds subjects, several directly and indirectly related studies could be discovered corresponding with this master's thesis objectives. For instance, topics related to institutional change, institutional diffusion institutionalization, diffusion of green innovations and cleantech, cleaner technology adoption, corporate sustainability and CSR, carbon management, and the 2050 targets of low-carbon economy, offered valuable perspectives towards conducting this research. Several of these studies were also conducted by applying CDP data. With the help of a previous research conducted in Lappeenranta University of Technology, all of the earlier conducted CDP related studies could be mapped, and the most beneficial amongst them selected under more thorough analysis. The used studies are presented in the Appendix 13 and Table 38.

1.3.1 Drivers and barriers in institutional change to carbon management

Several studies have been conducted that directly and indirectly reveal drivers and barriers in the process of institutional change to carbon management, and a number of these used CDP data as well. Researches with the direct institutional scope have been conducted in example by Ortiz-de-Mandojana et al. (2014), whom merge corporate governance and institutional elements for clarifying companies' environmental sustainability. By studying the regulative, normative and cognitive pressures, the authors discover that while regulative pressures hinder independent managers and distinct board chairs to endorse environmental sustainability, the normative processes have the reverse effect. Cognitive pressures where discovered in having a positive effect to the independent managers. Other studies revealing the institutional factors have been conducted in example by Okereke (2007), whom studied the motivations, and the drivers and barriers for companies to engage in carbon management for mitigating climate change. The author identified at the same time several institutional factors such as the regulative, normative and culturally-cognitive aspects in influencing the adoption of carbon management, and also company specific internal resource dependent factors. Babiak and Trendafilova (2011) identify institutional pressures influencing the adoption of sustainable practices, but in a lesser degree than the discovered strategic and legitimacy motives in their study of professional sports organizations operating in North America. Nevertheless, it has to be mentioned that such strategic and legitimacy motives may originated as a result of the institutional pressures, which the study did not take into account. (Babiak and Trendafilova 2011, 11. Okereke 2007, 475, 481. Ortiz-de-Mandojona et al. 2014, 150)

Studies that apply directly the CDP data and are related to the drivers and barriers in institutional change to carbon management, were conducted in example by Luo and Tang (2016), that identify institutional mechanisms, e.g. the strong regulative pressures, in being an explanatory factor for defining and influencing the quality of the companies' carbon management actions. The authors

Reid and Toffel (2009) also identify institutional factors for pushing companies towards carbon management actions, within their study of the corporate disclosures of climate change strategies, and what are the circumstances that drive companies to disclose climate change related information from resulting risks and opportunities, emissions, and climate change strategies. The authors discover that the institutional pushes from NGOs and political actors can influence the organizational norms, beliefs and practices. Institutional pushes are also identified by Weinhofer and Hoffmann (2010) ascending from the 2050 targets of low-carbon economy and associated institutional pressures for mitigating climate change. The authors focus their research towards the strategies applied by the electricity producers for mitigating climate change. Their results indicate that the size, location, and released carbon emissions are influencing factors within the different strategies for climate change mitigation applied by these producers. Although not with a direct institutional scope or findings, Agrawala et al. (2011) studied the climate change related risks and opportunities, and risk management for defining how the private sector has adapted to climate change. The authors focus and discover several motivations, capacities, and needs for adapting to climate change for influencing such. However, which evidently are influenced by the institutional elements of policies, norms, values and the culture although the study did not directly highlight such larger aspect. (Agrawala et al. 2014, 3. Luo and Tang 2016, 275. Reid and Toffel 2009, 1157. Weinhofer and Hoffman 2010, 77)

1.3.2 Institutional diffusion of carbon management

Also several studies that focus towards the institutional diffusion of carbon management have been conducted. In example, the author Gonzaléz (2005) identified institutional (regulative, normative, and culturally-cognitive), internal resource based, and technology specific factors that hinder and facilitate the diffusion and adoption of carbon management technologies within the Spanish pulp and paper industry. Somewhat similar factors, but related only towards institutional aspect, were identified by Campbell (2007) in influencing the institutional diffusion of CSR, and explaining why companies would behave in a socially responsible way. Doblinger and Soppe (2013) studied the NGOs influence to the diffusion and adoption of wind power by industrial incumbents. They identified that the NGOs can influence the normative aspect of the wind powers institutional diffusion, and make these incumbents favor such technologies within their selection of energy generation methods. Their findings indicate that the environmental groups can have positive influence within the institutional diffusion of novel carbon management technologies. Another institutional diffusion of carbon management study is conducted by Kolk et al (2008) directly from CDP data, and studying the CDPs influence for mitigating climate change through financial market pushes. By applying the institutional factors of global governance and market mechanisms, the authors discover that CDP has indeed diffused to the institutional level, but no evidence can be discovered that would support the statement that institutional investors are applying the provided data within their investment decisions. Nevertheless, the authors confirm that CDP offers valuable opportunities for researchers studying companies' actions against climate change. (Campbell, J 2007, 946. Doblinger and Soppe 2013, 274. Gonzaléz 2005, 20 – 21. Kolk et al. 2008, 719, 741 - 742)

Other related studies towards this research have been conducted by Gouldson and Sullivan (2012), whom study the companies voluntarily set long-term targets for decreasing emissions as a result for mitigating climate change. The discoveries indicate that such targets are realistic, probable, and are in line with national policies while may even exceed these. However, the authors also recognize that depending only to these voluntary commitments for decreasing emissions might not be sufficient, because they might focus only to direct emissions and disregard the indirect emissions which may even exceed the direct emissions. The same authors Gouldson and Sullivan (2013), conducted also a study focusing to the diffusion of climate change mitigation actions. The authors study how climate change mitigation activities and related emission performance have developed within a ten-year period. The findings indicate that while there has been development within the energy efficiency, the economic growth surpasses this progress. Authors also discover that along with the majority of the companies, the emissions will rise overtime without radical changes made to the business operations, and that they are lacking indirect emission management initiatives that are the major causes of such. (Gouldson and Sullivan 2012, 1. Sullivan and Gouldson 2013, 733)

1.3.3 The gap

Previous studies conducted related to this researches objectives are numerous. These earlier studies confirm that there are several drivers and barriers that influence the institutional change to carbon management. Such drivers and barriers can ascend from the institutional aspects; the regulative, normative and culturally-cognitive factors as noticed, but also from the company's internal resources. Also the market mechanisms and the societies acceptance, which are ultimately the outcomes and influenced by the institutional factors, play a significant role in such greater change. Also the institutional diffusion of carbon management and related "initiatives" (e.g. CSR) could be identified as being influenced by the similar factors ascending from the internal factors of companies, carbon management technology specific elements, and the institutional perspectives regulative, normative, and culturally-cognitive elements. Also related studies had been conducted against the diffusion of CDP itself and how it fulfills its mission for mitigating climate change through taking advantage of the economic pushes, the outcomes of emission reduction targets, and the climate-change diffusion and related emission performance throughout a ten-year period.

The research gap can be identified since none of these previously conducted studies focus at the same time to the drivers and barriers in institutional change, and the institutional diffusion of carbon management, involving also the elements of traditional diffusion within the research. While the earlier studies indeed study these processes, in example Okereke (2007) and Gonzalés (2005), they do not focus towards understanding the phenomenon more profoundly, and for example where the drivers and barriers ultimately originate from. Why this research is unique is because it examines the institutional change and institutional diffusion processes step-by-step, and studies the interrelationships of both larger mechanisms. As a result, this study is able to pinpoint precisely where in example the issues of carbon managements institutional change ascend from, and how their influence can be experienced further in the process of institutional diffusion. This is done by forming models for institutional change and the institutional diffusion, and identifying how these “distinct” but linked stages are interconnected between each other.

The research gap is also fulfilled by studying precisely the forerunners of carbon management hence the innovative adopters, and not concentrating to a specific sector or cities where the previous research largely focused. Although this research does not directly answer whether we are going to reach the 2050 targets of low-carbon economy, which the previous researches have, this research creates a unique approach towards the subject, and is able to offer concrete findings of the prevailing direction, the related issues and facilitators within such targets, and where all of these stem from. What is also distinctive from other studies, is the formation of carbon management index for measuring the different companies’ climate change mitigation activities, and do these correspond with the emission performance. With the help of this CM Index, we are able to determine whether the isomorphic structure within carbon management has been achieved amongst these forerunner companies, which none of the previous studies have been able to achieve.

1.4. Limitations and Scope

1.4.1 Theoretical

The focused subjects of institutional change and institutional diffusion of carbon management generate the theoretical limitations and scope of this research, portrayed in the Figure 1 above. The studied theories are limited to: institutions, institutional change, traditional diffusion model, and institutional diffusion with the related isomorphism and decoupling. The subjects will be studied from the carbon managements perspective by combining and applying associated studies. In order to answer the main research question of achieved level in institutional diffusion of carbon management, we have to first understand what institutions exactly are, where institutions consist from, how they change, and what facilitates and hinders this change to carbon management from transpiring. Also for comprehending the institutional level diffusion, the traditional diffusion processes have to be studied. The traditional diffusion processes are related to the institutional diffusion, and can be the initiators of institutional change. Lastly the institutional diffusion will be studied; how this diffusion transpires, and what factors facilitate or hinder this process in terms of carbon management. For figuring out the achieved level of institutional diffusion, hence the similarity in carbon management structure, the institutional isomorphism and related decoupling effect are included in the theoretical background. The isomorphism of carbon management defines the structural similarity and is the final level in institutional diffusion, indicating wide and deep institutional diffusion of carbon management. Decoupling is related to the isomorphism, since we can assume that the carbon managements institutional diffusion is not straightforward, as we have not achieved low-carbon economy yet, issues might be faced. Therefore, studying also the decoupling is important, decoupling the carbon management actions from structure can be the outcome of prevailing issues experienced by the companies within this whole institutional level process. All of these theoretical approaches are interrelated, thus their influences between each other are studied as well.

1.4.2 Empirical

This research concentrates studying the CDPs Climate change program's data. As stated, it is the world's largest database of its kind providing self-reported emission and climate change mitigation actions related data from the globally largest companies complying to climate change mitigation. The climate change program is the largest of the CDP programs, and in the 2016 report it received answers' from over 1900 companies and had more than 800 institutional investors controlling over $100 trillion in assets requesting data through the program. Therefore, the data is appropriate for studying the subjects of institutional change and institutional diffusion of carbon management. CDP has received criticism about the climate change questionnaires development throughout the years also noticed by the researcher, making the results difficult to compare between years. Therefore, the focus will be within the most recent years' Climate change programs data from the CDP 2011 to CDP 2016 reports, which represent the actual years' data from 2010 to 2015. It was noticed that the questionnaire has evolved largely to its latest form in 2010, hence the CDP 2011 report. The time window of this research will therefore be six years, that represents nearly half of the whole Climate change programs age. Taking into account the comparability of the different years' questionnaires, it can be determined that focusing only to the most recent years is valid and increases the reliability of this research. (CDP a 2016. CDB b 2016. CDP d 2016. Baumast 2012, 302)

From the Climate change programs participated companies, only the top 100 highest emitting companies each year will be studied. As we have discovered, the top 100 companies generated 12% of the global carbon emissions in 2013 (when calculating Scope 1 and Scope 2 emissions together), and for increasing the reliability, the sampling of the top 100 highest companies will be conducted each year. The Figure 2 displays the absolute direct Scope 1 and indirect Scope 2 emissions released by the top 100 highest emitting companies between years 2010 to 2014 (CDP 2011 to CDP 2015 reports). As we can see, the emission curve decreases and stabilizes significantly towards the end, indicating that the sampling of only top 100 highest emitters is valid and reliable.

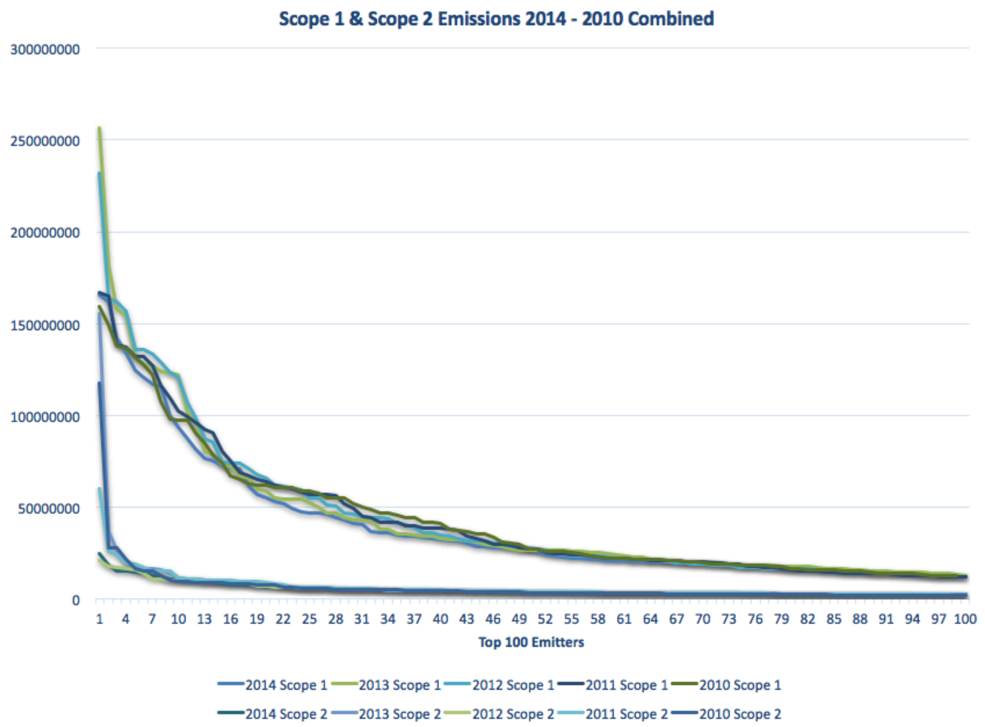

Figure 2. Top 100 highest emitters Scope 1 & Scope 2 years 2010 – 2014

From the CDP climate change program data, the focus will be in direct and indirect absolute emissions (Scope 1 and Scope 2), and the carbon management related activities for mitigating climate change; governance, strategy, targets, initiatives, risks and opportunities, and emission related data. These correspond the best with the studied subject and associated research objectives and questions, and the theoretical framework. Due to scope of this master's thesis and time limitations no further data from CDP is studied.

Financial indicators were also used within the research, and these were limited to the prevailing major indicators consisting from; size, profitability, liquidity and solvency (debt ratios). These indicators corresponded the best with the theoretical findings related to carbon management. For ensuring the reliability, several different financial indicators from these categories were tested. To ensure reliability these were acquired all from one source; Thomson Reuters.

1.5. Definitions

Institutions

Institutions are the controlling and guiding forces of our lives, which we have created to maintain balance and order in the interaction between each other. Institutions guide our everyday behavior, they define the rules of the "large picture"; general laws, standards, and principles under which we function. Therefore, institutions do not have to be only formally established rules, but they can be "the right thing to act" types of moral codes likewise. Institutions can differ to a great extent between each other, generally depending on what scale the institution is considered. An organization can form an institution, but similarly a country or the whole world could be considered as an institution. Different ways to act in organizations or countries are clear examples of how institutions differ by varying habits; we might perceive a certain behavior normal and wonder or even be terrified of another custom that is distinct from our idea of the "correct" behavior. As a result, institutions define and limit at the same time our collection of options, but correspondingly determine also if a certain person, e.g. the police, can break these formal or informal guidelines under specific circumstances. Institutions may be created or be a result of development occurring over time. Institutions consist from three pillars; regulative, normative, and cultural-cognitive, which correspondingly guide and limit our behavior. Institutions decrease uncertainty by bringing constancy, sense and motivation to human interaction in the political, social and economic context. (North 1990, 3 – 5. Scott 2014, 56, 59 – 60)

Institutional change and deinstitutionalization

Institutional change or deinstitutionalization indicate the weakening and growing abandonment of regulative system, reduced strength of mandatory anticipations and eroding norms, and once taken for granted topics experiencing growing doubts. Institutional change and deinstitutionalization indicate the same thing; they are the processes through which institutions develop, decline and vanish. Vanishing does not mean that institution is lost, but instead a new institution has replaced it, which is the institutional change. Institutional change is the cause within our societies development and therefore offers explanations to comprehending historical changes. (North 1990, 3 – 4. Scott 2014, 166 – 168)

Diffusion, institutional diffusion and institutionalization

Diffusion, institutionalization and institutional diffusion all indicate the same thing; institutionalization is the synonym for institutional diffusion. What differentiates diffusion and institutional diffusion is the extent of the "diffusion arena", which is larger in the institutional diffusion. Institutional change instigates institutional diffusion, but similarly diffusion of an idea or technology can instigate institutional change (but is not inevitable) and therefore institutional diffusion. Nevertheless, without institutional change there cannot be institutional diffusion, although traditional diffusion of an innovation is still possible. Institutional diffusion is also based on the three pillars of institutions. This institutional framework influences significantly to the diffusion and institutional diffusion; if the framework is altered as a result of the diffusion the diffusion transpires in the institutional level. Altering the framework indicates institutional change, therefore the processes in the institutional change, institutional diffusion and diffusion are very comparable. Institutional diffusion is the next step from institutional change, sort of "tip of the iceberg".

Isomorphism and sedimentation

Isomorphism and sedimentation describe the same thing. Fundamentally they indicate structural similarity, which is the possible and final outcome of institutional diffusion. Isomorphism is a sign of wide and deep diffusion of a given organizational form, resulting in similarity in the structure of these organizations.

Decoupling

Decoupling indicates that two elements that currently influence each other are separated as such that there no longer is an influencing connection between these two. In this research decoupling is discussed under carbon management, where economic performance has to be decoupled from the environmental influence it causes, and institutional isomorphism. From the institutional isomorphism perspective decoupling indicates that organizations decouple their stated action from the actual structure.

Organizations

Organizations can comprise from economic bodies (companies, trade unions, cooperatives), political bodies (political parties, regulatory agency, city council), social bodies (clubs, churches), and social bodies (universities, schools). They are driven by a particular reason to accomplish a specific target, in example a company that wants to deliver economic returns to its stakeholders. (North 1990, 5)

Carbon management

In this research carbon management is used to describe all the companies' actions for mitigating climate change. Therefore, carbon management does not indicate only management of the companies' carbon emissions, but it can be defined as a way of improving the effectiveness of input usage through companies' carbon strategy or policy, way to utilize opportunities of carbon management to gain competitive advantage, and decreasing emissions and risks for evading costs related to compliance. Therefore, carbon management can be measured through emission performance, but also activities in companies related to mitigating climate change. Originally carbon management was designed to comply with legislation, however at present it is considered to operate as a tool for risk management, and providing business opportunities through the experienced environmental and economic benefits. (Luo and Tang 2016, 275, 277 – 278)

Business as usual

"Business as usual" in this research indicates organizations conducting their operations without carbon management activities, therefore without consideration and compliance to the climate change mitigation. Companies that are conducting business as usual do not put pressure for decreasing emissions and do not pursue other related carbon management activities. Business as usual simply indicates that companies are conducting their operations with the cost of our planet; without considering their influence to the environment.

CM Index

CM Index is a collection of specific questions from CDP climate change questionnaire that represent companies' climate change mitigation activities, thus carbon management actions. These questions consist of climate change; governance, strategy, targets and initiatives, risks and opportunities, and emission related data. The higher the CM Index is, the more carbon management related activities the company engages in.

Scope 1 and Scope 2 emissions

Scope 1 emissions account for all of the direct GHG emissions from sources that are owned or managed by the reporting entity. Scope 2 emissions on the other hand are indirect GHG emissions, which originate from the actions of the reporting entity but transpire from sources owned or controlled by another entity, for instance indirect GHG emissions originating from consumption of purchased electricity, steam or heat. Scope 3 emissions are all the other indirect GHG emissions, but these are not analyzed within this study. (Greenhouse Gas Protocol 2012)

Emission intensity

Emission intensity defines the efficiency of direct (Scope 1) and indirect (Scope 2) emissions released per revenue (Net sales) generated. Generally, the lower the emission intensity is, the better.

1.6. Structure of the report

This research is constructed from five chapters. After this introduction chapter, the theoretical background will briefly introduce the used theories of institutions, institutional change, traditional diffusion, institutional diffusion, institutional isomorphism and carbon management. After familiarizing such, the theoretical approaches are applied directly in the context of carbon management. The theoretical approaches are combined to two larger settings of; drivers and barriers in institutional change to carbon management, and the institutional diffusion of carbon management. The research hypotheses are derived throughout these theoretical findings. Before analyzing the hypotheses, the third chapter will introduce the CDP more profoundly, what type of data was used and where such originates from, and present the applied quantitative research methods, models and tools. The more particular hypotheses which were not directly derivable from the theoretical background are presented within this research methods chapter.

The fourth chapter empirical findings will first present the related descriptive statistics, and then test the hypotheses along with the theoretical frameworks structure. Therefore, hypotheses are studied from the two larger theoretical perspectives of drivers and barriers to institutional change in carbon management, and the institutional diffusion of carbon management. The empirical discoveries are then summarized and presented with descriptive tables displaying the influence. The final chapter conclusions will discuss the empirical findings within the context of the theoretical findings, and propose reasons for the discovered results. The conclusions chapter will also summarize the findings, and offer through the combination of theoretical and empirical findings; the theoretical contributions, managerial and policy implications of such, ponder the reliability and validity of the research, and lastly make future research proposals.

2. THEORETICAL BACKGROUND

2.1. Introduction to theories

2.1.1 Institutions

As stated, institutions consist from three pillars, regulative, normative and cultural-cognitive, which can form, maintain and change the institutions. They influence what type of organizations are established and how they develop, but likewise the organizations influence to the institutional frameworks development. The three pillars influencing forces are very distinctive from each other, as we can see from the Table 1 representing the pillars features, dimensions, ideas and arguments. (Scott 2014, 59 – 60)

Table 1. Three pillars of institutions (Scott 2014, 60)

	Regulative	*Normative*	*Cultural-Cognitive*
Basis of compliance	Expedience	Social obligation	Taken-for-grantedness Shared understanding
Basis of order	Regulative rules	Binding expectations	Constitutive schema
Mechanisms	Coercive	Normative	Mimetic
Logic	Instrumentality	Appropriateness	Orthodoxy
Indicators	Rules Laws Sanctions	Certification Accreditation	Common beliefs Shared logics of action Isomorphism
Affect	Fear Guilt/ Innocence	Shame/Honor	Certainty/Confusion
Basis of legitimacy	Legally sanctioned	Morally governed	Comprehensible Recognizable Culturally supported

The regulative pillar consists of rules and regulations that control the behavior through sanctions if they are broken. Rules and regulations form the anticipated behavior, and therefore future behavior is predicted to transpire under these rules. Breaking the rules or regulations may result in the intervention of law enforcement and court, but also discrediting or shunning activities. The core elements of regulatory pillar are force, penalties and expedient responses. These are tempered through the prevailing rules that validate the use of force. Regulative pillar is also about supervising the system of regulation and the cost involved in the monitoring. Sometimes the agreements between parties can be overseen and put in force by themselves, but occasionally a neutral third party is required. Therefore, state is a significant party for monitoring and the basis for coercion, making it the rule maker, arbitrator and enforcer. The logic behind the regulative pillar is fairly simple; individuals create rules and laws that are believed to drive their interests, and individuals obey the rules and laws since they do not want to face the possible sanctions or look for the associated compensations of obeying rules. The development, spread and jurisdiction of regulatory institutions can be seen with the enlargement of laws, constitutions, codes, rules, regulations, directives and official structures of control. Emotions play a significant role within the regulative pillar since they are related to breaking the rules defined by the law. Emotions also operate as strong motivators towards change or defending of institutions, depending on are the emotions positive or negative towards the institutional rules. (Scott 2014, 59 – 64)

Values and norms are the fundamental element of normative pillar. Normative systems outline targets and aims, and define the correct means of contesting these goals. While regulations are deemed to be followed by everybody, norms and values can also be role specific; applying only to certain actors or titles, and the expected behavior from them. These roles can spawn from organizational hierarchy or these can be formed through time more or less unofficially with interaction to varying anticipations grown to direct behavior. Normative systems are recognized at the same time limiting and empowering social behavior. These systems generate simultaneously responsibilities and rights, duties and privileges, and mandates and licenses. The main rule guiding actors relates to the situation itself and the role of the actors leading to rationalization of what is the correct behavior for the actor to perform. Normative institutions consist e.g. from accreditations and certifications of standard setting bodies, such as International Organization of Standardization (ISO a 2016). Emotions are also linked to normative systems but differently than in regulative; normative standards raise feelings of shame for breaking “the norm” and on the contrary elicit the feeling of “honor” for complying with such. Emotions provide also a means to follow normative behavior hence disobeying or obeying the norms can lead to self-evaluation. Normative pillar is described to bring stability to institutions, it assures that norms and values are followed and guides in everyday “right or wrong”-questions. (Scott 2014, 64 - 66)

Cultural-cognitive features of institutions are the shared perceptions that establish the characteristics of social reality, and generate the borders through meaning is made. Cognitive frames can be applied to clarifying what type of information is noticed, how it is translated, how it is preserved, recovered and arranged in memory, and therefore how it will be understood. As a result, the frames influence the judgements, assessments, expectations and implications. External cultural frameworks outline the internal explanatory processes of us, cultural categories affect to our cognitive thinking, reaction and behaving of social interests in example. The cultural systems can vary from local situations, to organizations culture shaped from general structures and forms of belief, to organization fields constructed from organizing rationalities, and all the way to transnational and national levels that outline the favored political and economic structures. Institutionalization of cultural elements diverge within the degree of linkage to other elements and how strong is the influence to routines. While normative theorist stresses the conjointly emphasizing obligations with social roles, the cultural-cognitive theorist draw attention towards the force of patterns to specific actors and scripts for action. The social roles ascend with mutual comprehension of certain actions are related towards specific actors, these can be created within localized settings as standards of action, but it has to be taken into account that larger institutional frameworks also have an effect through delivering already shaped organizing models and scripts. Cultural-cognitive elements can bring in the understanding how organizational actors interpret and reply of the surrounding world. The emotional dimension of cultural-cognitive pillar is expressed with emotions of positive affect of confidence and certitude, contrasted with negative emotions of disorientation and confusion. Following and sharing the similar cultural beliefs leads to emotions of interconnection and competency whereas differing perspectives may be perceived as clueless or irrational. (Scott 2014, 66 – 70)

Commonly in institutional outlines we can detect a fluctuating mixture of these pillars. Integration of the three pillars can create an immense power through combining all of their strengths. Institutions can likewise experience a dominance of one pillar that supports the social order. In addition, disarranged pillars can occur within institutions if the different pillars support and encourage altering behaviors and choices. Misaligned pillars can create conflicts and confusion with differing motives and behaviors leading to change in the institutional framework. (Scott 2014, 70 – 71)

2.1.2 Institutional change

The three pillars of institutions, regulative, normative and culturally-cognitive, are central for institutional change. The change can compound from mixture of the three pillars or different sources, and the process can have several motives. In general, there are three common pressures to institutional change; political, social and functional that derive from these pillars. Political pressures stem from the regulative pillar, e.g. changing government that drives a diverse institutional structure. Social pressures arise from normative and culturally-cognitive pillars, and are a result of differences within groups and growing fragmentation of normative consent, producing conflicting or differing beliefs and habits. Functional pressures derive from the environment and the influences can be directed to all of these pillars, although most often the focus is to the regulative or normative pillar first. Functional pressures arise through observed issues in the performance level of the prevailing institutional structure, e.g. result of technological development or consumer demand. Mainly, institutional change comprises from marginal alterations within the institutional framework of rules, norms and enforcement. The instrument of change is the individual entrepreneur (an organization) acting towards the enticements represented within the institutional framework, and the mechanism for institutional change are shifting relative prices related to functional and political pressures, or preferences related to social pressures. These two mechanisms instigate the previously introduced pressures to institutional change. The more common source for institutional change are the changes in relative prices, and similarly functional and political pressures, because they alter the incentives in the interaction between organizations. Changes in relative prices indicate changes in the price of information, changes in technology, and changes in the share of factor costs. Changes in relative prices therefore link increasing returns and transaction costs, related to the efficiency of the markets, to the direction of the development path of the institution. Changes in preferences is a more complex process because it is about the rationalization and behavioral pattern of people of what they perceive as a typical behavior, however changes in relative prices influence this to some extent. In theory, the changes in preferences influences more significantly to the change in institutions, due to changes in the norms and culturally-cognitive elements. Changes in relative prices can ascend from external sources, but largely they are internal representing the constant maximization of e.g. profit or wealth objectives of organizations seeking increasing returns from the institutional arena. In example, organizations can be generating more efficient technologies, lobbying regulative bodies to take a preferable direction, and they can influence incrementally the norms with marketing with their immense resources. Cultural aspects of institutions do change over time, but the sources for these preference changes are commonly a result of learning, accidents and natural selection. (North 1990, 3 – 8, 83 – 84, 87, 95 - 97. Scott 2014, 166 – 171)

The long-run direction of the institutional change is influenced and driven principally by two elements that originate from the changes in relative prices and indirectly from changes in preferences as well: increasing returns, and imperfect markets with related transaction costs. In order for the institutional development path to emerge the increasing returns have to be linked to the institutional change, and for the path to become efficient the markets have to be competitive. Incomplete markets introduce shattered information feedback and therefore substantial transaction costs. This outlines the direction and may create divergent paths and persistently poor performance through the actors' subjective models that are shaped through both inadequate feedback and ideology. The institutional constraints mirror the payoffs and therefore the inducements of what types of skills, knowledge, and learning individual entrepreneurs in the organizations attain. This is fundamental for institutional change. The demand for skills and knowledge will result in demand for increases in the stock and allocation of knowledge. The characteristics of this demand will mirror preceding opinions regarding the payoffs to attaining various types of knowledge. The motivation to attain knowledge is connected to monetary returns and penalties, and it is also influenced by the societies acceptance towards it. The development of knowledge has an effect to how individuals observe the world around them and therefore how they rationalize, describe and justify that world. Information and likewise its price are significant for institutional change, especially for the efficiency of the development path. As a result, the institutional change model can at the same time hinder and facilitate the change process. The drivers and barriers to institutional change can originate from the mechanisms, pressures and the direction's related components. Reluctance to institutional change can also ascend directly from the organizations possessing different knowledge who want to innovate with the central elements of the "old" institutional structure to safeguard its existence. (North 1990, 74 – 76, 95 - 97. Scott 2014, 166 – 171)

Institutional change model

- 2 mechanisms initiate;
  - Changes in relative prices.
  - Changes in preferences (influences and can be influenced by changes in relative prices).
- These 2 mechanisms create 3 types of pressures;
  - Functional; originate generally from changes in relative prices.
  - Political; originate commonly from changes in preferences or relative prices.
  - Social; derive largely from changes in preferences.
- The direction of change is influenced by 2 components.
  - Increasing returns.
  - Imperfect markets with related transaction costs.

2.1.3 Traditional diffusion models

Diffusion indicates the process through an innovation (e.g. idea or technology) is communicated across specific channels, over time, and between the participants of a social system. Therefore, diffusion of innovations is constructed from four core elements; the innovation, communication channels, time, and a social system. Uncertainty is part of diffusion, it is related to the newness of the innovation, to the extent and likelihood of other choices available, and the information available. Information is correspondingly the method of decreasing this uncertainty. This process directs the possible technological development paths and possible lock-in effect to a structure or technology. Diffusion is similarly social change that can be described as a process of change transpiring in the construct and function of a social system, therefore transpiring under the influence and presence of the prevailing institutional system. (Rogers 2003, 5 – 6, 11) The social system can also provide pressures leading to institutional change of the current construct, and therefore institutional level of diffusion. This social or institutional change can transpire as a consequence of a novel ideas being invented, diffused, and adopted. This social change does not have to precede a new idea but also policy changes, political revolutions, changes in norms and values, and even natural events can cause a change to occur. (North 1990, 83 – 84, 87. Scott 2014, 156 – 159, 166 – 168)

As stated, there are four core elements in the traditional diffusion, these begin from the innovation, which can be a novel technology, practice, idea or an object. Five different characteristics of innovation define the pace and adoption rate. Relative advantage is the first one, defining how advantageous (economic, wealth, social convenience, satisfaction etc.) the innovation is perceived to the idea or technology it displaces. Compatibility of the innovation towards the social system, prevailing values, past experiences, and the needs of adopters. Third is the complexity of the innovation; the simpler the innovation, the faster the adoption. Fourthly can the innovation be tested as in trialability, and finally observability; are the results of the innovation observable. (Rogers 2003, 12 – 17)

Second element in diffusion are the communication channels. These are the methods of how the message related to the diffusion of an innovation is exchanged between the parties. The characteristics of the information exchange relationship between the parties and the consequence of the transfer defines whether the innovation is transferred or not to the recipient. Institutional framework, e.g. the societies acceptance towards the innovation, influences to a great extent the knowledge flows. Time is the third element and it consist from five timely arranged steps; 1 gaining knowledge about the innovation, 2 perception of the innovation, 3 deciding whether to adopt or not, 4 implementing the adoption decision and 5 confirming was the outcome of the innovation adoption positive or negative. Time dimension can also be described as the S-shaped curve of innovation adoption; this curve is related to the adopter categories that are also part of the time dimension. These previously described timely arranged steps are gone through by different adopters at specific stage of the S-shaped curve and therefore form the adopter categories. These adopter categories are also timely arranged depending in which part of the S-shaped curve they adopt the innovation; 1 innovators whom are the first adopters, 2 early adopters, 3 early majority, 4 late majority, and finally 5 laggards. Innovators commence the diffusion process and adopt the innovation when there are only few adopters, shortly after the curve starts to rise when early adopters and the majority join in. The steepness of the curve defines the adoption pace, and from early adopters to late majority it is most likely the sharpest. When the curve reaches it asymptote the diffusion process is complete. The social system or the institution can again influence significantly to the shape of the S-shaped curve thus the adoption rate's pace (Rogers 2003, 18 – 24). From the institutional level diffusions perspective, the adopter categories are merged only to innovative adopters and followers. In diffusion theories these early adopters are more important aspect of study, but from institutional viewpoint the followers are more significant. The innovative adopters are vital for commencing the diffusion, but without followers there would not be extensive social acceptance because the followers carry out the change function of diffusion. Therefore, institutional change and institutional diffusion are both reliant from the followers. (Redmond 2003, 669, 672 – 673)

The last element of diffusion is the social system, which consist of related members that are involved in common problem solving to achieve a mutual target. Social system can therefore be organizations, individuals, informal groups and so forth, and likewise the social system can form an institution. The diffusion transpires in the social system (e.g. the institution), and the construct of the social system (the institutional framework) influences the diffusion through creating a boundary (the institutional constraints) for the diffusion to transpire. The structure of the social system also influences and can instigate the diffusion, correspondingly it assists in explaining the behavior of its members in the diffusion process. The social systems influence to the adoption can be categorized to three different types; optional-, collective, and authority innovation adoption decision. Optional decisions center is the individual who makes the adoption decision, collective decisions are agreements between the members of the system to adopt, and authority decisions occur with the power of the government, and rules and regulations. (Rogers 2003, 23 – 31)

The traditional diffusion model

- Innovation initiates; novel idea, technology or practice.
  - 5 characteristics; relative advantage, compatibility, complexity, trialability and observability.
- Communication channels distribute; how the message and knowledge of the innovation is transferred in the social system.

- Time defines diffusion rate; the pace of the adoption generating the S-shaped curve.
  - 5 timely steps; knowledge, persuasion, decision, implementation, and confirmation.
  - 5 adopter categories; innovators, early adopters, early majority, late majority, and laggards.
- Social system, the arena where the diffusion transpires and which influences the diffusion.
  - 3 decision types: optional, collective and authority.

2.1.4 Institutional diffusion

The elements of institutional diffusion and therefore institutionalization are fundamentally no different from traditional diffusion model; the innovation (idea, behavior, technology) can instigate institutional change that leads to institutional diffusion of a new structure. The communication channels control, determine cost and ensure the flow of knowledge and information. This design extends over time related also to the adopter categories of innovative adopters and followers (only two in institutional diffusion compared to five in traditional diffusion models). Finally, the social system involving the regulations, norms, values and the culture influence and are influenced by this technologies, ideas or behaviors institutional diffusion. Diffusion and institutional diffusion transpire both under a social system, and what tells the difference is the scope of the diffusion; if regulations, norms and/or values are altered as a result of the diffusion, institutional change is occurring, and therefore also the diffusion transpires in the institutional level. However, it has to be kept in mind that the institutional framework influences significantly to the traditional as well as the institutional diffusion process, for instance what economic opportunities are utilized, and types of knowledge and skills pursued, but as discussed the settings can be vice versa. The path molded by institutional structure is crucial for the long-run progress of that social system. (North 1990, 76, 79, 83 – 84, 87. Rogers 2003, 5 – 6, 11. Scott 2014, 143 – 144, 156 – 159, 166)

For institutional diffusion there are three mechanisms; increasing returns, -commitments and -objectification. These mechanisms create three pressures to institutional diffusion; coercive (regulative), normative (norms and values) and mimetic (culturally-cognitive), discussed further. These mechanisms and pressures are fundamental for diffusing institutional structures. The most robust institutional diffusion is the result of these mechanisms, and subsequent pressures functioning together and supporting each other. They help to comprehend diverging motives and forces for adopting novel structures and behaviors. Institutional diffusion based on increasing returns introduces costs and benefits of positive feedback, thus incentives. The result of increasing returns can be a technological development path that may lead to lock-in effect to a certain technology and its dominance, although better solutions might be available. Additional progress to the same direction are rewarded, and the cost of swapping to another technology grows over time. This positive feedback is promoted by four elements; existence of a high setup cost, after an approach is obtainable the development of substitutes is associated with extra costs. Learning effects, due to time and effort invested to learning a specific approach lead to unwillingness to repeat the learning process necessary when swapping to another solution. Coordination effects, where several benefits accumulate to adopters of the same technology. Adaptive expectations, when latecomers observe the dominance of a specific approach and it increases their motivation to adopt it correspondingly. Increasing returns is generally the same process discussed under institutional change but taken further from the change to actual diffusion, it is also linked to changes in relative prices but can correspondingly influence the changes in preferences as well. Increasing returns usually arises from the environment, e.g. diffusion of a technological solution, and is linked to functional pressures for institutional change. The mechanism can result in all of the three institutional diffusion pressures, nevertheless coercive pressures are generally more common result of this mechanism due to organizations constant maximization effort of e.g. profits, and as a result lobbying the regulative directions. Increasing returns is the most common method explaining institutional change and therefore institutional diffusion, the mechanism is constantly ongoing in institutions and incrementally diffuses novel ideas and structures to the institutions. Therefore, if traditional diffusion leads to institutional level diffusion the mechanism is most frequently result of increasing returns. (North 1990, 95 – 97. Scott 2014, 143 – 144, 150 – 151, 156 - 159)

The institutional diffusion mechanism increasing commitments is based on the normative pillar of institutions, and therefore instigates normative pressures to institutional diffusion. Increasing commitments includes values and norms, constructions and procedures, and cooperative actors and individuals. It indicates that institutional diffusion is about infusing with value over the technical obligations, aligning the direction towards normative basis and therefore being reliant to its own history. Over time the diffusion accumulates denser, which increases commitment to similar objectives and entrenching the organization in a social environment. Collected capabilities determine the organizational arrangement rather than the transaction costs. The normative pressures for institutional diffusion therefore focus to commitments and network ties, the relational constructs as carriers. The diffusion processes of novel shapes and systems is a result of responsiveness to the spread of norms through professional networks, board members (part of several boards), and informal ties. While normative standards can arise gradually over time, they may be founded explicitly as a result of accreditation across trade- and professional associations or standardization organizations. Increasing commitments and therefore normative pressures are related to the changes in the preferences (norms and values). Institutional diffusion through increasing commitments is generally slower and not as frequent method as the increasing returns is, also it can be the result of increasing returns. The transfer of norms through e.g. professional networks does transpire constantly, but the possible diffusion of a novel structure it may cause is more gradual than with increasing returns. Nevertheless, if diffusion arises through normative basis it is more difficult to alter and thus strongly adopted. (Scott 2014, 145 – 147, 161 - 163)

Increasing objectification is the institutional diffusion mechanism that is based on the culturally-cognitive pillar of institutions, and therefore prompt the mimetic pressures for diffusion. Objectification is largely about transmitting collective beliefs to third parties indicating how things are done rather than how we do things, in this way the objectivity of the institutional world strengthens thus patters diffuse resulting in the intensifying levels of the institutional diffusion. Increasing objectification emphasize ideas, and the strongest are those that are taken for granted known as assumptions which are widely accepted and undisputed. Such beliefs are so deeply embedded that they remain undetected before someone from different culture with conflicting beliefs chases unfamiliar targets or applies uncommon or intolerable methods. The mimetic pressures increase a given organizational form, which again intensifies the likelihood of establishing additional similar organizations, therefore indicating that mimetic pressures are density dependent. The density is similarly a sign of cognitive status of this form, the cognitive legitimacy. As a result, the actors have to consider themselves as similar in some significant respect. The mimetic pressures reduce new formations and strengthen the prevailing organizational form. Correspondingly to increasing commitments, also the increasing objectification indicate the changes in preferences of institutional change. Increasing objectification and mimetic pressures lead to institutional diffusion that is at the same time most; deeply adopted, difficult to alter and slowest process. Diffusion through increasing objectification is the ultimate form of institutional diffusion and it is most likely the result of increasing returns and -commitments. (Scott 2014, 147 – 150)

The coercive or regulative pressures of institutional diffusion require clear requirements, efficient monitoring, and considerable sanctions. Whether the mechanism utilized are principally of power including charge of authority, or are dependent on the employment of threat or incentive, influences the outcome. The institutional effects can be anticipated to diverge by these mechanisms, authority being connected to the greater penetration. The argument against coercive pressures is that these are generally reliant on normative and cognitive elements. As a result, coercive pressures can be the result of all of the three institutional diffusion mechanisms; increasing returns, -commitments and -objectification. (Scott 2014, 159, 162) The three institutional diffusion pressures can also be translated to the traditional diffusions social systems innovation adoption decisions; authority innovation decisions as the coercive pressures, optional decisions as the normative processes, and collective decisions as the mimetic pressures. (Rogers 2003, 28 – 31)

Institutional diffusion model

- 3 mechanisms that create 3 pressures;
    - Increasing returns; can prompt all of the 3 pressures.
        - Comes from the environment and is the most common result of traditional diffusion.
        - Linked to changes in relative prices but can influence the preferences.
    - Increasing commitments; instigates normative and coercive pressures.
        - Comes from normative basis.
        - Linked to changes in preferences.
    - Increasing objectification; instigates mimetic and coercive pressures.
        - Comes from culturally-cognitive basis.
        - Linked to changes in preferences.

2.1.5 Institutional isomorphism

Institutional isomorphism and sedimentation indicates resemblance of organizations, and is the result of institutional diffusion pushing organizations to adopt parallel constructs and shapes. Throughout the three institutional diffusion mechanisms and pressures, the institutional effects are diffused across arena of organizations making them to adopt similar forms. These organizations highlight structural isomorphism as a significant result stemming from institutional and competitive processes. As a result, isomorphism is a reflection of organizations adapting the societies idea of what establishes a suitable organization, representation of the societies expectations of a proper organizations known as the societies “rationalized myths”. The more organizations adopt the idea the more deeply institutionalized it becomes, eventually reaching the isomorphism and thus sedimentation. Institutional isomorphism is facilitated through the processes that advance diffusion of ideas, customs and prescribed organizational structure between organizations. Through adapting the societies ideas, the organizations obtain legitimacy for their operations. (Boxenbaum and Jonsson 2008, 78 – 79, 81. Scott 2014, 51, 185)

The decoupling in isomorphism may occur when the organizations are pressured through the societies ideas of what is the proper structure and actions of an organization, and they are confronted by the issues where these ideas do not encompass an efficient solution from the organizational perspective. Also rivaling and internally conflicting societies ideas and therefore institutional pressures can occur concurrently. Decoupling is the organizations solution for these issues in the institutional pressures. Decoupling indicates that organizations declare of conforming to societies expectations, but actually do not within their actions thus continue in example the technical “business as usual”. The conflicting pressures can be solved through various methods e.g. conforming to different pressures in different means; encounter some demands through talk, some through decision and some by action. In this way they are able to satisfy all the interests and maintain their survival and efficiency. If organizations engage in decoupling they try to avoid close examination or at least try to control the process. In terms of adopter categories, the followers (later adopters) are more likely to engage in decoupling than the innovative early adopters. The late adopters try to conceal their actual intentions through apparent eagerness. Organizations that are the most enthusiastic in announcing their compliance, are the ones that most likely decouple their action from the stated intention. Decoupling is more likely to occur when the pressures are related to coercion thus faced with external regulatory obligations, the likelihood increases if there is disbelief towards the regulator. At the same time, more rigorous regulations are defined to decrease the likelihood of decoupling. Decoupling structure from action is also identified to occur more likely when there are high costs of implementation, but similarly high symbolic or financial rewards from adoption. Impression management can also result in decoupling, for instance building brand images through decoupling the internal actions from projected images, or organizations directing attention to legitimate socially desirable actions away from their illegitimate controversial actions. (Boxenbaum and Jonsson 2008, 79 – 81, 86 - 88, 91. Scott 2014, 187 – 188)

2.1.6 Carbon management

Effective carbon management necessitates decoupling economic development from the environmental affect it causes; in example the production rate remains the same or increases, while the environmental impact created decreases through requiring less energy and/or raw materials. While the environmental efficiency may increase, it does not necessarily lead to decreases in the environmental affect if the degree of production increase is greater compared to the degree at which environmental effectiveness develops due to technological change. Considering as an example manufacturing, technological change can improve the environmental efficiency by adopting technologies that generate fewer emissions and increasing the input-output efficiency, or replacing energy sources to low-carbon ones and as a result the technological change mitigates the environmental impact for each unit of input. Relative decoupling indicates that the environmental efficiency increases, but not at the same rate as the production as a result of the technological change. Absolute decoupling implies that the technological switch results in a major decrease of e.g. emissions per the unit of output resulting in overall emission cuts. Radical carbon management technological changes are required to achieve absolute decoupling. In order to achieve sustainable development broader diffusion of carbon management is obligatory though not adequate. Technological development is therefore necessary to achieve carbon management, and the change towards such technologies obliges institutional push. Studies highlight at the same time institutional elements, and the related environment hindering and facilitating the institutional change and therefore institutional diffusion to carbon management. (Babiak & Trendafilova 2011, 12 – 13. Boxenbaum and Jonsson 2008, 78 – 79, Gonzales 2005, 21 – 22. Horbach et al. 2012 113)

2.2. Drivers and barriers in institutional change to carbon management

2.2.1 Mechanisms

As stated, the two mechanisms leading to institutional change are changes in relative prices and changes in preferences, which are both significant for the institutional change to carbon management. Changes in preferences to carbon management would indicate that we perceive the idea of releasing zero emissions as typical behavior, and would therefore in theory offer a strong push to institutional change. Changes in relative prices could be the result of changes in price of information and the carbon management technology providing for instance competitive advantage, cost savings et cetera, related to the ongoing maximization objectives in organizations. This could eventually instigate the changes in preferences, but the process is generally more gradual. The problem with institutional change to carbon management is that there is a conflict between the two mechanisms; changes in preferences and changes in relative prices. Carbon management is indeed beneficial from social perspective, the preferences have changed towards the direction of protecting the environment and managing carbon emissions, however in the institutional arena this is not reflected in the changes of relative prices. The carbon management technology does exist but it does not correspond with the wealth maximization objectives in organizations. Although carbon management does decrease the external costs from social perspective, it is not linked by the changes in relative prices to the decreasing internal costs and therefore the increasing returns what the organizations are seeking from the institutional grounds. This creates a barrier for the institutional change to carbon management. (Gonzales 2005, 21 – 22. North 1990, 76 – 79, 83 – 84, 87. Scott 2014, 166 – 171)

The changes in preferences to carbon management are a result of 2050 targets of low-carbon economy, the climate change, global warming and pollution, which have likewise emerged risks and opportunities to organizations. Researchers have discovered that several organizations perceive mitigating the carbon emissions as one of the most important issues regarding their environmental responsibilities. As a result, organizations globally are applying carbon management to encounter the changing institutional environment due to result and response to the changing preferences. These above discussed profit or wealth maximization objectives of organization are connected to the development of the stock of knowledge. The institutional framework has a great influence to what economic opportunities are exploited, and types of knowledge, information and skills are reached in order to accomplish the specific wealth maximization objective of an organization. The institutional context therefore shapes the possible changes in relative prices and preferences, and this process is the crucial aspect towards the long-run progress of that society. (North 1990, 76 – 77) For employing carbon management, the knowledge is decisive since organizations have to acquire knowledge and information related to different topics of carbon management, such as; energy efficiency, cleaner technologies, innovation in the organizational processes and controlling emissions throughout the supply chain for example. Acquiring this type of knowledge is related to the price of information and therefore changes in relative prices, but can correspondingly be instigated by changes in preferences. Financial resources are needed to both; attaining the knowledge, and implementing carbon management which especially require large investments and therefore resources. Financial situation of the company may therefore hinder the institutional change; studies have discovered that organizations engage to carbon management more likely when their financial situation is healthier. This is also directly connected to the size of organizations; generally larger they are, the larger are their resources presenting issues for smaller organizations to engage in carbon management. Although the changes in relative prices would indicate e.g. higher profits, the organizations might not possess the required resources to change. Size brings in addition visibility to the general public and therefore making such organizations more responsive to changing preferences to mitigate the climate change. (Gonzales 2005, 21, 24 - 25. Luo and Tang 2016, 275, 277 – 279)

As a result of the findings in changes in relative prices, financial resources, and economic performances relation to carbon management, the first hypotheses is “H1 Emission performance is linked to financial performance”.

While the institutional framework determines the organizations maximizing possibilities, North (1990, 78) states that “even in the most productive economies in the modern world the signals generated by the institutional framework are mixed." Companies or economic organizations may invest to skills and knowledge that will pay off within the prevailing institutional constraints, but they may also allocate resources to changing these institutional constraints. Investing resources to changing the constraints occurs when the changes in relative prices in that direction show a greater maximization effect than investing to prevailing constraints. (North 1990, 76 – 79) These institutional constraints can be altered through for instance dedicating resources to changing policies that directly affect to the profitability or another wealth maximization objective of the organization. The more complex change in preferences can also be altered indirectly through persuading the society for investing in such skills and knowledge that eventually affect positively to the organizations maximization goal. Nevertheless, the changes in preferences generally alter the institutional constraints more absolutely because they are related to the normative and culturally-cognitive aspects, from which regulative perspective is reliant. Carbon management has indeed been associated by research to enhanced ecological performance and economic performance through for example improved efficiency, increased market value, and decreased costs of operations. Therefore, the needed changes of relative prices to carbon management should also be in place, although theories argue that these might be at present hindering the institutional change. Changes in relative prices and preferences are both needed to transpire the institutional change to carbon management. If these are in conflict, so will be the pressures these instigate as well, discussed next. Such a situation may create an inefficient development paths of the institution, discussed further. (Gonzales 2005, 21 – 22. Luo and Tang 2016, 275, 277 – 279)

- Drivers to carbon management:
  - Changed preferences to mitigate climate change; tool carbon management.
  - Changes in relative prices, maximization effect; knowledge and technology of carbon management creating economic and ecological benefits.
  - Healthy financial situation and larger size.

- Barriers to carbon management:
  - Changes in relative prices; decreasing external social costs are not reflected to decreasing internal costs related to wealth maximization objective in organizations.
  - Unhealthy financial situation, and small size.

2.2.2 Pressures

As introduced previously, the changes in relative prices and changes in preferences are the mechanisms for institutional change. The mechanisms lead to three types of pressures that define what type of institutional pressures facilitate, but can similarly hinder the institutional change to carbon management.

Functional

Functional pressures ascend from current institutionalized forms that face observed issues in the performance levels. Considering the ecology of institutions, organizations and actions; if a significant community, e.g. cluster of organizations, agrees that the prevailing institutional structure is incompetent or inefficient within the processes it delivers, this structure may experience restructuring or substitution, at the latest when issues accumulate. This does not indicate only problems, but the pressures to change the structure may stem from experiencing that the performance maybe enhanced through an alternative solution that improves maximization outcome in the organizations, e.g. higher profits through increased efficiency. These pressures can ascend from the environment; in example the energy prices can operate as a strong driver towards the institutional change in carbon management. Oil and gas are highly important sources of energy in the global economy, and likewise a significant cost for organizations in their operations. Shifts in the prices similarly influence the change towards carbon management, cost savings and reduced dependency to unrenewable energy sources are strong pressures to alter the institutional energy generation structure for example. However, the setting can be the opposite as well, declining prices of traditional fossil fuel energy sources, which can be a possible result of carbon management technologies, can operate as a barrier to carbon management for organizations to continue the business as usual. If the energy generation pool is “complete” and these renewable energy sources operate as extra sources, they will decline the traditional energy sources prices which can hinder the change to carbon management. Carbon managements technological change can therefore operate at the same time as a driver and a barrier to the institutional change. (Gonzales 2005, 25 – 26. North 1990, 76 – 79. Scott 2014, 164 – 167. Okereke 2007, 479 - 481, 483)

Market pressures can also be the source for the functional pressures to institutional change of carbon management. Even robustly institutionalized values and related structures of continuing business as usual can be subject to change as a result of consumer, investors, and competitors’ pressures. Environment often functions as the source for functional demands, consequently endangering the existence of the organization in contradiction to those internal elements dedicated in protecting the targets and values that originally were the foundation for the organizations establishment. Market pressures can create shifts in interests of the stakeholders that drive organizations to carbon management. These functional pressures can arise in example through consumers boycotting companies that do not manage carbon emissions, investors directing their investment to companies that engage in carbon management, competitors achieving competitive advantage through early entry in carbon management and similarly creating a channel of information decreasing uncertainty et cetera. Such shifts in the markets create functional pressures since they influence directly to the organizations maximization objective. While markets can drive companies to carbon management they can also hinder the change process. Uncertainty in the markets creates a barrier for change due to organizations not being able to predict whether their efforts in carbon management are rewarded or not by the market. The investments in carbon management are sizable and oblige permanent changes within the organizational processes, therefore such information about the markets has to be acquired before dedicating resources. (Boxenbaum and Jonsson 2008, 78 – 79. Gonzales 2005, 25 – 26. Okereke 2007, 481 – 484. Scott 2014, 167 – 168)

Political

Political pressures to carbon management compound from changes within fundamental power allocations or interests that are backing prevailing institutional structure of business as usual. Changing voter preferences and changing majorities in in legislative groups may initiate adjustments in regulatory legislation or enforcement customs that drive the institutional change to carbon management. Studies reveal that current and upcoming regulations are one of the most influential sources to transpire the institutional change to carbon management, the political environment drives organizations to a great extent in engaging to carbon management. Similarly, the political environment can create a barrier for institutional change to carbon management. Organizations that are eager to invest in carbon management technologies can be lacking a strong and long-term policy framework that is necessary for adopting carbon management technologies. The large initial investments of resources and long returns of investments times related to carbon management necessitate robust policy framework to safeguard that these resource investments are not wasted. This barrier to institutional change ascend from the uncertainty in the political environments perception to climate change, what technologies are supported, changing governments with differing views to carbon management and so forth. Organizations integrating carbon management to their strategies are faced with difficulties if uncertainty is present. Therefore, the uncertainties related to political environment concerning carbon management should be diminished in order to ensure the institutional change. Due to globalization the uncertainty can ascend from the international- as well as the local political environment. The uncertainty of the political environment is also one of the most common reasons for decoupling carbon management action from structure due to conflicting pressures and/or disbelief towards the regulator. (Babiak & Trendafilova 2011, 12 – 13. Boxenbaum and Jonsson 2008, 78 – 79. Gonzales 2005, 25 – 26. Horbach et al. 2012, 113. North 1990, 92 – 94, 99 – 101. Okereke 2007, 479 – 480, 482 - 483. Scott 2014, 159, 161 – 165, 168 – 169)

Correspondingly legislative authorities can be lobbied by business interests to alter corporate governance frameworks. Changes in the positions of political groups can decrease the support for prevailing institutional arrangements and offer differing motives and new opportunities for entrants. This competition for credibility may stem from the fact that climate change is shifting the ways to conduct business, and although policies and regulations create uncertainties regarding their direction, the overall path is becoming more clear due to the 2050 targets of low carbon economy. Organizations understand that it is better to be proactive than reactive by opposing regulations since the institutional change is undoubtedly occurring. The advantages can be achieved by investing resources to gain credibility and leverage for influencing the direction of change in the environmental policies regarding carbon management. However, this can likewise be a barrier to institutional change of carbon management if organizations are lobbying against the change, and innovate or continue with the business as usual method avoiding carbon management. (Okereke 2007, 479 – 480. Rogers 2003, 15. Scott 2014, 157 – 158, 166 – 169)

Social

Social pressures of institutional change to carbon management result from difference and differing opinions amongst organizations, and growing fragmentation of normative consent that produces conflicting or diverse beliefs and habits towards the business as usual. Also several overlapping and contending institutional frameworks weakens the stability of these. The recognition and push of society can operate as a strong driver to the institutional change to carbon management in organizations. This may be enhanced by NGOs like CDP observing, announcing and promoting carbon management. Correspondingly organizations are driven to carbon management by fiduciary obligations that rise the feelings of responsibility towards climate change. This is also related to trust between parties to act on behalf and in the best interest of the party, which affects could be experienced in supply chains or board member decisions for example. The social pressures also ascend through ethical considerations, the changing cognition that carbon management is the right and necessary thing to do. The ethical considerations reflect to the companies' environmental strategy, making the profit maximization objective more compatible with morals and ethics related to climate change. Image benefits are also experienced due to ethical behavior, the compliance with the societies expectations and altered preferences to mitigate climate change make the organizations operations and maximization objectives seen more positively; result in gaining the trust of consumers, investors and general public et cetera. Whether or not the organization engages in carbon management can be a decisive matter for investment decisions, considering in example "initiatives" of green investing and investing only to zero carbon companies. The social pressures of institutional change to carbon management may also rise indirectly through companies managing risks and losses of business operations due to inactivity of in climate change and thus carbon management, related also to the ethical considerations. The physically experienced damages that climate change causes (sea level rise, higher temperatures, extreme weathers and increase in storms) motivate the change to carbon management. The social thus normative and culturally-cognitive pressures decrease the likelihood of decoupling. However, if these social pressures to carbon management are conflicting, the influence is the opposite since organizations may face diverse and/or overlapping social pressures that might not additionally be efficient solutions in terms of the maximization objective in organizations. (Babiak & Trendafilova 2011, 12 – 13. Boxenbaum and Jonsson 2008, 78 – 79. Gonzales 2005, 21 – 22. Horbach et al. 2012, 113. North 1990, 76. Scott 2014, 145 – 147, 159, 161 – 163, 166 - 169, 187 – 188. Okereke 2007, 479 – 481)

- Drivers to carbon management
  - Functional; profits, increased efficiency, energy prices and market pressures.
  - Political; political support and direction, and organizations lobbying carbon management.
  - Social; recognition and pressure of the society, fiduciary obligations, ethical considerations (image benefits and trust of stakeholders) and managing risks and losses.

- Barriers to carbon management
  - Functional: energy prices, uncertainty in the markets.
  - Political; uncertainty in political environment and organizations lobbying business as usual.
  - Social; conflicting and overlapping social pressures, and institutional frameworks.

As we have noticed, these functional, political and social pressures provide both institutional drivers and barriers influencing the carbon managements institutional change. These institutional drivers and barriers in institutional change to carbon management can be studied through organizations perception of risks and opportunities from the institutional arena. Risks being the barriers and opportunities the drivers towards the institutional change to carbon management. This ascends from the idea that the analyzed risks and opportunities are identical; companies choose whether they perceive in example a certain regulative element as a driver (opportunity) or as a barrier (risk). Correspondingly, climate change and therefore carbon management should be considered as an opportunity rather than a risk. If organizations perceive these pressures (drivers and barriers) as risks, they are considered to possess reluctance towards carbon managements institutional change and have likewise higher emissions. Hypotheses "H2 Emissions are higher when more risks are distinguished" is consequently presented. On the contrary if organizations considered these pressures to create opportunities for them, they are engaging in carbon management and have lower emissions. As a result, hypotheses "H2a Emissions are lower when more opportunities are distinguished" is presented.

2.2.3 The direction

In theory, the institutional framework progressively develops the institution to more efficient direction. The economic, political and social organizations constantly develop to more efficient forms, however still inefficient institutions exist. The reasons for efficient and inefficient directions ascend through increasing returns and imperfect markets with the related transaction costs. These two drivers are significant determinants towards the carbon managements institutional changes direction. Both the carbon management technological development and institutional change to carbon management are path dependent processes, they likewise influence each other. Path-dependent factors are part of incremental changes in institutions, after a development path is set on a specific direction the organizations, network externalities, and the subjective shaping originating from history will strengthen this direction. The direction which are taken in both of these depend where the organizations (the instruments of change) perceive the "highest" increasing returns thus improved maximization objectives, which is also reliant on the information available and its cost in the markets. The institutional frameworks present in every economy both productive and unproductive opportunities for organizations. The inefficiency may rise already in the carbon management technologies development, hence are the existing technologies and their development the most efficient technological solutions? There is uncertainty around carbon management technologies and breakthroughs or minor events may favor and demonstrate increasing returns, although eventually another technological development path and therefore its institutional change direction would have been more efficient and involved higher returns downstream in example. The short-run attempts to maximize profits can outcome in chasing of inefficient activities within the institutional constraints and similarly pursuing productive activities can outcome in unforeseen results. In general, the more competitive the markets are the more efficient the paths of carbon management technological development and the institutional change to carbon management are. The competitiveness decreases the price of information and therefore the uncertainties related to the carbon management developments direction. (North 1990, 92 – 94, 99 - 101. Scott 2014, 144 – 145)

The increasing returns and competitiveness of the markets together with the institutional framework influences what types of internal capabilities, learning, knowledge, information and skills, organizations acquire. These internal capabilities are likewise vital for the efficiency of the institutional changes direction to carbon management. The environmental strategy defines whether the environmental and carbon management related topics are embedded to the organizations strategy, culture, and code of conduct. Lacking this internal capability will hinder and influence direction of the change towards carbon management. Studies reveal that organizations are shifting their perspectives of only managing the environmental threats towards perceiving them as opportunities and thus embedding them to strategies, which is important for the carbon managements institutional change. Related to the environmental strategy, what is the technological competency of the organizations indicating that do they possess the required proficiency and knowledge concerning carbon management. For instance, which technology suits best for the organization, what does it offer for them, and basic technological understanding of how to apply such. These internal capabilities of organizations are related to their absorptive capacity, which is necessary for the institutional changes of carbon management direction. Organizations are required to absorb technological knowledge of carbon management but correspondingly have the ability to forecast trends within the markets (economic, political and the cultural arena) related to the carbon management. (Babiak & Trendafilova 2011, 12 - 13. Gonzales 2005, 20 – 21, 24 – 25. North 1990, 73 – 79, 83 – 84, 87, 92 – 94. Rogers 2003, 16 – 17. Scott 2014, 166 – 168, 204 – 205)

As discussed, both institutional change and technological change display path dependence and are the fundamental bases for societal and economic development of carbon management. Increasing returns can be distinguished to play a major role within both of these changes. However, actors have more significant influence within institutional change to carbon management than its technological change, due to ideological beliefs affecting the subjective structure of the models that define choices. The choices are more complex within the institutional framework due to interrelationships between formal and informal constraints of institutions. This can outcome as in lock-in to a certain institutional structure, where prevailing business as usual to generate energy in example hinders the institutional change towards carbon management. The lock-in to a such institutional structure and related path dependence is more complicated to alter than it is regarding actual technological change needed for carbon management. The complexity compounds from interaction of the economy, policy, and the cultural affects; several actors demonstrating bargaining power towards institutional change of carbon management. Economic change in the long-run is the accumulative result of countless short-run choices of economic and political entrepreneurs, which directly and indirectly form performance. Subjective forming regarding the environment mirrors these entrepreneurs' choices. The level of outcomes being in line with intentions defines the level of entrepreneurs' models being "true models". These models indicate ideas, ideologies and beliefs, which are in best case only partly improved through the information feedback regarding the eventual results of the ratified policies. As a result, certain policies outcomes are unclear but also unpredictable. Throughout history of political and economic choices there is a large gap amongst purposes and eventual results. (North 1990, 103 – 104) Nevertheless, while the short-run courses are unpredictable, the overall path in the long-run is more foreseeable but similarly more complicated to alter. Take in example the 2050 targets and climate change, we know that carbon management is the necessary tool for preserve our planet. However, there are several carbon management technologies, which are supported differently by the institutional environment (markets, policies, society). Then there are fossil fuels, which are still necessary part of our economy and its development. We are still locked-in to these unrenewable energy sources and the renewable carbon management technologies have not yet been able to replace them. As a result, the institutional arena presents diverse opportunities to maximization objectives, uncertainty and confusion although the long-run path of low-carbon economy is clear. This is also related to the technological development path of carbon management technologies not being complete and ready to fulfill in example the energy needs of global economy.

- Drivers to carbon management:
  - Increasing returns linked to carbon management.
  - Competitive markets.
  - Internal capabilities; environmental strategy, technological competency, and therefore the absorptive capacity.
  - Long-run direction of low-carbon economy.

- Barriers to carbon management:
  - Imperfect markets, shattered information feedback.
  - Internal capabilities, if organizations lack these.
  - Lock-in to fossil fuels.
  - Short-run attempts to maximize profits.

Lastly related to the institutional changes direction, the trends in institutional drivers and barriers are studied from the risks and opportunities further descriptions. The direction of the institutional change is the result of the institutional change mechanisms and related pressures to carbon management, which were discussed previously. Therefore, the same risks and opportunities identified by companies can be used to study the direction as well. Due to the findings of directions in institutional change to carbon management, it is expected that companies distinguish both more drivers as well as barriers to carbon management. Therefore, the hypotheses H3 Risks and opportunities have increased throughout the years" is presented. In order to understand in which direction the institutional change to carbon management is going, the trends in drivers and barriers from the institutional environment are studied. These trends are acquired through organizations more detailed identification of risks and opportunities, which as discussed influence the institutional changes direction. Therefore, the hypotheses "H3a Trends in risks and opportunities" is presented.

2.3. Institutional diffusion of carbon management

The previously discussed institutional change process to carbon management is the preceding and necessary course to initiate the institutional diffusion of carbon management. Although the institutional change process is the foundation for institutional diffusion of carbon management, this change cannot transpire without the institutional diffusion, these two processes go hand in hand. The traditional smaller scale diffusions of carbon management innovations are progressively used as real-time case studies for innovation and diffusion theory. Nevertheless, only the traditional diffusion does not establish institutional change and –diffusion, instead there are further mechanisms that have to actualize. The process of diffusion of carbon management innovations involves stages that can be linear or diverse, and can involve fluctuation between disruptive changes to stable incremental developments. The common goal is to fuse economic growth and environmental sustainability. In general, the instant of the early innovation of carbon management technologies experience a process involving optimization and learning, gradually achieving market acceptance and as a result market share leading to the larger diffusion, thus spreading within the markets to the institutional grounds. (Babiak & Trendafilova 2011, 12 – 13. Hoff 2012, 14 – 15)

The structure for the institutional diffusion of carbon management remains fundamentally the same as the traditional diffusion models presents; carbon management innovations spread through communication channels over time in a social system scaled as the institutional arena. However, the diffusion transpires in the institutional level and is as a result more complex. Here to the social system included institutional changes mechanisms, pressures, directions efficiency and lock-in to paths related matters are significant determinants in the carbon management institutional diffusions development. The figure 3 presents a multistage framework for the institutional diffusion of carbon management. In this model the institutional diffusion mechanisms increasing returns, -commitments and -objectification operate together to reach the sedimentation of carbon management indicating coercive, normative and culturally-cognitive perception to carbon management, known also as the isomorphic level. The process starts from the mechanisms of institutional change, changes in relative prices and -preferences, that create functional pressures (the increasing returns) through technological change, political (coercive) pressures through legislation and/or social (normative and mimetic) pressures through market forces that cause organizations to advance novel ideas and solutions to carbon management. This process is linked to the maximization objective in organizations and therefore necessitates that increasing returns are associated in carbon management. Consumer demand in example, can be a powerful market mechanism and sufficient in some cases, but commonly there is a need for further incentives within the development or adoption process of carbon management to instigate increasing returns between organizations; e.g. political, social, economic and technological efficiencies push. (Figueiredo and Guillén 2012, 167 – 169. Rogers 2003, 5 – 6, 11. North 1990, 76, 79, 83 – 84, 87. Scott 2014, 147 – 149, 156 – 169)

For the initiating stages of institutional diffusion to carbon management there is a need for a systemic approach that takes into account that carbon managements institutional diffusion and adoption in organizations involve several moving parts emerging from the institutional arena e.g. what information is available and promoted, how this knowledge flows, where the increasing returns appear and how they direct the diffusion et cetera. Also the carbon managements technological innovations bring uncertainty due to its newness, is it compatible with the societies and organizational norms, values and processes, are the benefits observable, and can the carbon management solution be tested before adopting. Taking into account these elements and linkages amongst various components is necessary. Systemic approach is also relevant considering the sequencing of the phases of the institutional diffusion and adoption of carbon management; for instance, changes in relative prices to instigate knowledge of increasing returns from carbon management, altered preferences to persuade positive views towards carbon management, support adoption through functional and political pressures, ensure organizations implementing carbon management and safeguard the confirmation stage leading to social pressures of changes in the normative and cultural-cognitive basis. Carbon management compels changes, large and small, depending commonly about the radicalness of the innovation in hand. Especially radical carbon management innovations involve entirely novel designs of organizational processes, products and patterns of application, and consequently more uncertainty. The innovativeness of the organization has an impact when such radical carbon management solutions are adopted, thus in what stage of the S-shaped curve they adopt the carbon management technology. From the institutional perspective the innovativeness indicates capability and willingness to overturn conventional habits. Innovators are those whom are the first ones to disrupt customs and routines. These innovative adopters are vital for commencing the diffusion, but without followers there would not be extensive social acceptance because the followers carry out the change function of diffusion. Therefore, it is also key for this phases success to align the incentives of all of the stakeholders (governments, organizations, society) to ensure the followers continuing the diffusion. Without incentive alignment the extensive institutional diffusion of carbon management cannot transpire. How efficient and in what directions the organizations innovate in terms of carbon management is defined by the competitiveness of the market (e.g. cost of information, what similar organizations are doing) and increasing returns that these institutional change mechanisms have originated. These are also related to the internal capabilities of the organizations; do they distinguish such information and apply the knowledge for obtaining the increasing returns from carbon management from the institutional arena. (Figueiredo and Guillén 2012, 167 – 169. Redmond 2003, 669, 672 – 673, 676. Rogers, 2003 12 – 19, 20 – 21. Scott 2014, 147 – 149)

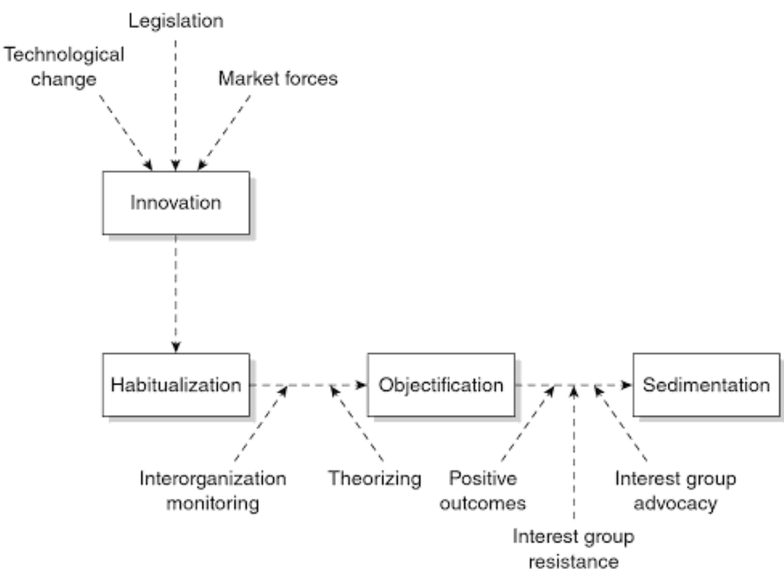

Figure 3. Component processes of institutionalization (Scott 2014, 149)

Social pressures are equally essential, which we are experiencing at the moment in the form of changing preferences to mitigate climate change. These changes in preferences instigate social thus the normative pressures to institutional diffusion where the increasing commitments habitualize carbon management, and bring it towards increasing objectification that shifts the carbon managements institutional diffusion to the culturally-cognitive basis, where it spreads to the habits, norms and values, hence the culture. To ensure such diffusions development the triple bottom line; people, planet and profit, has to be involved. For the effective institutional diffusion of carbon management, the social, environmental, and economic responsibilities have to all be considered in the process. This is also related to the incentive alignment and systemic approach, but considers the stakeholders' and their objectives from a greater and more fundamental perspective. Sedimentation or isomorphism is the final stage, which indicates substantially wide and deep diffusion of carbon management, reaching nearly all the potential adopters. The increasing commitments and -objectification generate normative and mimetic pressures for organizations to act alike, they embed carbon management deeply to the institutional structure and establish carbon management as the new "business as usual" where low-carbon economy is the "way to do things". As a result, carbon management is no longer considered as an "external" element of organizations operations, rather it is the normal internal element embedded in every organization. The final part is also related to the idea that we have to lead globally and act locally, therefore carbon management has to be adopted not just by organizations and governments, but likewise it obliges change in consumer behavior. Everyone has to be involved in carbon management in order to ensure that its institutional diffusion makes a difference, and we reach the 2050 targets of low-carbon economy. The greatest adoption of carbon management is only achieved if it possesses simultaneously unambiguous top-down direction and comprehensive bottom-up action. (Babiak & Trendafilova 2011, 12 – 13. Figueiredo and Guillén 2012, 169 – 170. Gonzales 2005, 21 – 22. Hoff 2012, 14 – 15. North 1990, 76, 79, 83 – 84, 87. Scott 2014, 147 – 149, 156 – 159)

2.3.1 Increasing returns

The theoretical findings point-out that the issues for carbon managements slow institutional diffusion might lay within the increasing returns not corresponding with the sought wealth maximization objectives in the organizations, although the decreased external social costs are experienced. Increasing returns are an important aspect of the institutional diffusion of carbon management because through the mechanism most of the diffusion processes are set off. Increasing returns assists to great extent in validating and therefore directing the carbon management to a greater institutional diffusion level of increasing commitments and objectification, needed to reach the isomorphic level of carbon management. These discovered relative advantages linked to increasing returns, studied under the institutional change through functional and coercive pressures, play a major part for the institutional diffusion and adoption. Indeed, increasing returns were discovered to be connected to carbon management. In example, studies demonstrated that carbon management is associated to increasing financial performance through improved efficiency; e.g. decreasing energy and material needs, and production costs. The market pressures were also distinguished from consumers and investors needs in example, these establish a green image for the organization that provides economic results through increasing revenues and investments. Improved image of the organizations can bring in competitive advantage, more motivated employees, improved quality of goods/services, and most importantly stakeholder approval. The coercive pressures and support was also distinguished in transpiring towards carbon management, and the related uncertainties prevailing carbon managements policies direction were noticed decreasing. Studies revealed that organizations are driven by a great extent by the development of the regulative environment, and correspondingly they want to attain leverage for influencing this regulative development. The altered preferences to mitigate climate change also drive the increasing returns. The greater this increasing returns through the relative advantages of the carbon management solution, and the more compatible it is with the organizations and societies values, norms, needs et cetera, the wider and deeper its institutional diffusion. (Babiak & Trendafilova 2011, 12 - 14. Boxenbaum and Jonsson 2008, 78 – 79. Gonzales 2005, 20 – 21, 26 – 27. Horbach et al. 2012, 113. Okereke 2007, 479 – 480. Rogers 2003, 15)

What hinders the institutional diffusion process of carbon management from increasing returns perspective is the mechanisms core element of positive feedback, which has caused the lock-in effect to the prevailing unrenewable energy sources and the business as usual. There is an existing high setup costs of carbon management technologies, and the already made investments to e.g. fossil fuels as the sources for energy. Investment cycles to alter organizational wide processes are not conducted easily, and not without clear confirmation of higher returns. The uncertainty and especially newness of carbon management necessitates learning effects, which correspondingly hinder the diffusion process since these have already been devoted to prevailing methods to conduct business. Also coordination effects of traditional business as usual exist, and adaptive expectation have not been prompted since the organizations have not yet adopted carbon management solutions that would make their operations low-carbon. Altering this inefficient technological and institutional development path is not an easy task to perform, because the costs of swapping to carbon management have grown since the industrial revolution, and the idea of requiring change is quite recent. The global economy is reliant on fossil fuels and as stated, prevailing carbon management solutions have only been able to decrease this reliability to some extent, but not enough to create such increasing returns that would transpire the carbon managements institutional diffusion in a very fast pace. The prevailing low energy prices in example hamper the institutional diffusion of these cleaner carbon management technologies. The 2050 targets confirm this suggestion, since there is still uncertainty that will we reach the targets, and going along with these plans the released emissions will still increase for several years until we are able to start decreasing them in a global scale. (Babiak & Trendafilova 2011, 13. Gonzales 2005, 25 – 26. Horbach et al. 2012, 114, 119. North 1990, 76 – 79, 83 – 84, 87, 99 – 101. Scott 2014, 70 – 71, 144 – 145)

The institutional diffusion of carbon management from the increasing returns perspective was also noticed to be hindered by the uncertainty in the coercive- and market pressures. The political directions were altering, which is also related to the competitiveness in the markets that at present creates also uncertainty towards the diffusion. The environmental regulations are constantly evolving and moving to somewhat unknown directions, and markets do not necessarily reward carbon management endeavors and if they do, what types are unpredictable. This makes it difficult for companies to predict the directions, and therefore achieve these increasing returns from carbon management that are necessary to ensure its institutional diffusion. Internal resources are significant for this, which are also related to transient gap hampering the achievement of increasing returns from the institutional diffusion of carbon management. Carbon management technologies involve large initial direct investment costs, while the benefits of cost savings in example are experienced in the medium or long-term, if transpire at all considering the uncertainty in the political and market environments. These internal capabilities explain why larger organizations are more likely to adopt carbon management technologies. The short-run maximization objectives can also explain the why especially the increasing returns might be hindering the institutional diffusion of carbon management. The alternative inefficient technological development paths, end of pipe technologies (EOP), that do create some benefits in terms of carbon management might be tempting to take. The institutional environment certainly promotes such because they bring in the increasing returns with minimal costs compared to more radical carbon management technologies. EOP technologies do not require the complete change of organizational processes, and similarly do not require significant resources. Why they are not as beneficial is because they do not focus directly to the efficiency and the source of how the emissions are generated in the first place, but to controlling the released emissions; what comes out of the pipe. (Gonzales 2004, 24 – 28. Rogers 2003, 5 – 6, 11, 15 – 17, 409 – 411. North 1990, 92 – 94, 99 - 101. Scott 2014, 144 – 145, 150 – 151, 156 - 159)

Increasing returns might also deter the institutional diffusion of carbon management due to diffusion cycle problem, where the later adopters attain higher increasing returns as a result of the technological development path. The development path of carbon management technologies has been noticed to decrease the prices significantly and increase the quality; familiar examples are the prices of solar panels and electric car batteries. The diffusion of the carbon management technology makes these costs come down, but without the diffusion the costs cannot come down, which are related to the learning and scale effects. These expectations of higher increasing returns and decreased uncertainty later in the carbon managements technological development lifespan may hinder the institutional diffusion process, especially in the case of smaller organizations related to their limited internal resources. (Boxenbaum and Jonsson 2008, 86 – 87. Gonzales 2005, 26 – 28. Kaufman 2009. Redmond 2003, 669, 672 – 673, 676. Redmond 2003, 669, 672 – 673, 676. Rogers 2003, 22 – 23)

2.3.2 Increasing commitments

The institutional diffusion of carbon management through increasing commitments has emerged through the altered norms and values, that is guiding the institutional diffusion process towards the normative direction where the increasing commitments embrace the organizational identity of carbon management being a proper way to conduct e.g. business. The changed preferences have established norms and values regarding the mitigation of climate change. These have originated through social pressures coming from the experienced physical changes as a result of climate change with the related global warming, and at the same time coercive and normative pressures of 2050 targets in example. Carbon management is beneficial from the social perspective and has therefore arose as a norm that we have to engage in it. This can be noticed through climate change and sustainability strategies, thus carbon management strategies, being part of nearly every organization. Such organizations that do not have carbon management related matters implemented to their strategies and activities, visible in their websites for instance, represent the minority. This is also related to the size, since larger organizations are exposed to the society more, and consequently experience the influence of altered preferences and social pressures more likely. Therefore, the commitments are increasing between organizations towards the similar objectives in carbon management. The increasing commitments are also reliant on history, which does indicate that the carbon managements institutional diffusion is influenced by the norms of conducting business as usual through e.g. fossil fuels as we have for the past century and today. For that reason, the social pressures can be diverging and deterring the normative pressures and increasing commitments, explaining similarly why fossil fuels are still the foremost part of our economy. Have the norms altered enough in terms of carbon managements institutional diffusion, remains a question. The increasing returns does influence the commitments (and the opposite), which also make the signals somewhat mixed as a result of carbon management providing both facilitating and hindering elements in terms of the increasing returns and coercive pressures. What is certain is that both increasing returns, and –commitments are needed for the institutional diffusion of carbon management to take place. The increasing commitments, thus normative pressures have to be in line with the wealth maximization objective in organizations; the pressures have to offer an efficient solution from the organizational perspective as well to ensure the institutional diffusion of carbon management through increasing commitments. (Gonzales 2005, 21 - 22, 24 - 25. Luo and Tang 2016, 275, 277 – 279. North 1990, 76 – 79, 83 – 84, 87. Scott 2014, 145 – 147, 166 – 171)

For increasing commitments, the communication channels are an important element, since they enable the institutional diffusion of carbon management to gain the needed followers. The current technological solutions facilitate faster and easier methods of transferring information and maintaining social relationships, therefore they benefit the normative pressures and increasing commitments related to carbon management. Social media is a strong tool for our society and together with altered normative basis of mitigating climate change the organizations wrong doings are exposed swiftly and effortlessly, correspondingly pressuring organizations to compliance of carbon management. Although most fastest and efficient way to create awareness-knowledge is the internet, the traditional commitments and network ties are more important for the carbon managements institutional diffusion from the normative perspective. These interpersonal channels of face-to-face discussion amongst two or more individuals are a more effective channel in terms of the acceptance of carbon management, particularly if these individuals share a related socioeconomic status, education or other significant similarity e.g. norms, values and culture. The carbon managements institutional diffusion related increasing commitments and network ties can be identified through in example fiduciary obligations that organizations distinguish as driving them towards carbon management. These norms and values instigate fiduciary obligations of responsibility to engage in carbon management, related also to the trust between parties to act accordingly that influences the commitments in the network ties of board members, professional networks et cetera. The normative pressures and increasing commitments to carbon management also arise through NGOs and accreditation organizations, like CDP and ISO, driving “soft laws” towards the carbon management, such as reporting, monitoring, compliance and self-regulation. These types of normative “soft laws” have been powerful and important influencers to diffuse carbon management to the institutional level of commitments. The norms are also significant influencers to the coercive pressures of carbon managements institutional diffusion, since these regulative pushes are commonly the result of the prevailing or altered normative and culturally-cognitive perspectives. (Babiak & Trendafilova 2011, 12 – 13. Boxenbaum and Jonsson 2008, 78 – 79. Gonzales 2005, 21 – 22. Horbach et al. 2012, 113. North 1990, 76. Okereke 2007, 479 – 481. Rogers 2003, 18 – 19. Scott 2014, 145 – 147, 159, 161 – 163, 166 - 169, 187 – 188)

2.3.3 Increasing objectification

Increasing objectification is associated to the increasing commitments, it is the result of normative pressures extending and strengthening the carbon managements institutional diffusion to the culturally-cognitive basis. Without increasing commitments, the increasing objectification to carbon managements institutional diffusion cannot take place, hence increasing returns influences the objectification as well. Through the increasing commitments and related similar pressures to carbon management, the institutional diffusion advances further and embeds to the culture, creating mimetic pressures for organizations to adopt similar structure that encompasses carbon management. The altered preferences and related social pressures to carbon management are as a result the central elements of increasing objectification likewise. Increasing objectification to carbon management indicates transmitting collective beliefs that in example; decreasing and managing the carbon emissions is our and your responsibility, the only way to conduct business. Through transmitting to others the objectivity of carbon managements institutional diffusion strengthens and intensifies going further towards sedimentation, the isomorphism. For carbon managements institutional diffusion, the incentives of increasing returns and identity of increasing commitments are vital, but increasing objectification embraces the idea that for instance carbon emissions have to be controlled. It diffuses carbon management to the culturally-cognitive pillar of institutions making it the assumption, widely accepted and undisputed. It indicates that carbon management is so deeply embedded to the organizations operations that it remains undetected until someone with conflicting beliefs to carbon management conducts business by e.g. not controlling emissions. (Babiak & Trendafilova 2011, 12 – 13. Boxenbaum and Jonsson 2008, 78 – 79. Gonzales 2005, 21 – 22. Horbach et al. 2012, 113. North 1990, 76 – 79, 83 – 84, 87. Okereke 2007, 479 – 481. Scott 2014, 145 – 150, 159, 161 – 163, 166 - 171, 187 – 188)

Increasing objectification and mimetic pressures to institutional diffusion of carbon management can be distinguished as discussed above from the similar matters as the increasing commitments, but more distinctly throughout the altered preferences and social pressures generating ethical considerations. Such are reflected to the organizations strategy and push organizations to adopt carbon management and influence the organizational culture as well. These ethical considerations ascend from environments physical developments and resulting damages caused by the climate change. Organizations are starting to objectify carbon management as the right and necessary thing to do. It is not only about guiding against risk and losses from these physical changes, but responding to the social consensus that carbon management has to be conducted because the climate change will only get worse through the business as usual. Ethical considerations also benefit the organizations maximization objective and therefore the increasing returns are experienced. Such are image benefits from compliance with the societies expectations that help to gain the trust of investors, consumers, general public and governments in example. Similarly, as in the increasing commitments, we can notice the increasing objectification of carbon management through organizations adopting carbon management related objectives as part of their operations. Majority of the organizations want to announce that they carry their environmental responsibilities and ethical considerations, which also pinpoint the mimetic pressures to carbon management. Such high similarity in organizations correlates positively against establishing additional similar organizations, indicating density dependence. This organizational form of carbon management being part of every organization reduces the formation of organizations that do not employ carbon management, and similarly strengthens the prevailing structure where carbon management is implemented to the structure. This density is the sign of cognitive status of this form, the cognitive legitimacy of carbon management, significant for the mimetic pressures to the institutional diffusion of carbon management. (Babiak & Trendafilova 2011, 12 – 13. Boxenbaum and Jonsson 2008, 78 – 79. Gonzales 2005, 21 – 22. Horbach et al. 2012, 113. North 1990, 76 – 79, 83 – 84, 87. Okereke 2007, 479 – 481. Scott 2014, 145 – 150, 159, 161 – 165, 166 - 171, 187 – 188)

Has carbon management achieved the increasing objectification, thus the final level in its institutional diffusion is debatable, in some level of carbon management definitely, but releasing emissions is still taken for granted and the normal way to conduct business. The technological development path of carbon management has not yet been able to reach stages where we could make our economies as low-carbon. There are carbon management technologies that make this possible, but as we have discussed throughout the institutional change and -diffusion to carbon management chapters, their diffusion to institutional level of objectification is not yet possible. Clear examples are the 2050 targets being the goal to achieve the low-carbon economy. In order to achieve such goals, carbon management institutional change and -diffusion has to be currently happening, which it indeed is as the theoretical findings from both institutional change and institutional diffusion of carbon management revealed. Although there were barriers, there were also strong drivers to carbon managements institutional change which have transpired carbon managements diffusion in the institutional level. (Boxenbaum and Jonsson 2008, 78 – 79. Figueiredo and Guillén 2012, 169 – 170. Gonzales 2005, 25 – 26. North 1990, 99 – 101. Scott 2014, 70 – 71, 143 – 144, 150 – 151, 159, 166 – 171)

Institutional diffusion was distinguished spreading through the increasing returns, -commitments, and -objectification of carbon management, and the related coercive, normative and mimetic pressures were also present. The majority of the institutional diffusions difficulties did lie in the diffusion mechanism increasing returns and to some extent in the coercive pressures as well, as it was anticipated in the result of institutional change chapters' theoretical findings. The increasing returns linked to carbon management are particularly significant determinants of the organizations maximization objectives, and therefore needed to achieve the most robust diffusion of three mechanisms and pressures functioning together. The theoretical findings point out that the change and institutional diffusion is ongoing regardless of the few issues identified in the increasing returns. This institutional diffusion of carbon management is transpiring under normative (commitments), and culturally-cognitive (objectification) basis, making the development path more difficult to alter, but due to the observed problems in the increasing returns the process is slower. Nevertheless, the transpiring change to carbon management and its instigated institutional diffusion should be visible particularly amongst the forerunner organizations of carbon management; as a result, the hypotheses "H4 Companies are decreasing emissions", is presented. (Boxenbaum and Jonsson 2008, 78 – 79. Figueiredo and Guillén 2012, 169 – 170. Gonzales 2005, 25 – 26. North 1990, 99 – 101. Scott 2014, 70 – 71, 143 – 144, 150 – 151, 159, 166 – 171)

2.3.4 Isomorphism

Isomorphism and therefore sedimentation of carbon management amongst organizations is the final level achieved in the institutional diffusion, indicating wide and deep diffusion of carbon management. The theoretical findings reveal that organizations are subject to carbon management through the institutional diffusion mechanisms and related pressures to adopt similar structures where carbon management is part of the majority of the organizations operations. This structural isomorphism in carbon management is the reflection of organizations corresponding with the societies altered preferences to preserve the climate, and correspondingly the way for organizations to achieve legitimacy for their operations in the modern economy. The above theoretical findings revealed that increasing returns and coercive pressures, and increasing commitments and normative pressures to carbon management are present, which have shifted the diffusion to the increasing objectivity and mimetic basis. All of these mechanism and pressures are significant determinants whether the isomorphism in carbon management is existing, but increasing objectivity and mimetic pressures are the final decisive factors. Although the diffusion mechanism increasing returns did show some conflicts and possible deterring factors for carbon managements institutional diffusion, which influences the increasing objectification and mimetic pressures, the isomorphism can be expected to have been achieved amongst the forerunner organizations of carbon management. Therefore, the hypotheses "H5 Institutional isomorphism in carbon management is present;

companies have highly similar structure for carbon management", is presented. (Boxenbaum and Jonsson 2008, 78 – 81. Scott 2014, 51, 147 – 150, 185, 187 - 188)

As discussed, decoupling carbon management actions from organizational structure indicating that organizations state of engaging in carbon management while they actually do not, may appear if there are issues amongst the diffusion mechanisms, conflicting and mixed institutional pressures or signals, and/or adopting carbon management is not beneficial from the organizations maximization objectives perspective. In the theoretical findings several of such issues were identified that might lead to decoupling. To begin with, there is a conflict along with the changes in preferences and changes in relative prices, carbon management is beneficial from social perspective but this is not necessarily reflected in the decreased internal costs. This can be for instance the result of technological development paths lock-in to prevailing business as usual and fossil fuels. Carbon management might not be able to produce the required/similar efficiency, but there is a high reward from adopting carbon management, in example; stakeholder approval, trust of government, consumers, investors, image benefits et cetera. Therefore, the societies idea of what is a proper organizational structure does not create an efficient solution for the organization, which leads to decoupling in carbon management. The same issue can be experienced along with the political and the functional market pressures, that were identified of being one of the strongest influencers in carbon managements diffusion, but correspondingly were recognized of bringing uncertainty along with their signals to carbon management that can lead to decoupling. Especially if there is disbelief towards the regulator, organizations are bound to decouple their carbon management actions from structure. The experienced high symbolic and financial rewards that carbon managements adoption are tempting to organizations and therefore may lead to stating of engaging in carbon management in order to achieve such, while concrete actions are not carried out. Decoupling can also be smaller organizations solution to correspond to the pressures and achieve the benefits due to carbon managements high initial costs and long payback times necessitating resources that these smaller players might not possess or it is not financially wise. (Babiak & Trendafilova 2011, 12 – 13. Boxenbaum and Jonsson 2008, 78, 79 – 81, 91. Gonzales 2005, 21 – 22, 24 – 26, Horbach et al. 2012, 113. Luo and Tang 2016, 275, 277 – 279. North 1990, 76 – 79, 83 – 84, 87, 92 – 94, 99 – 101. Okereke 2007, 481 – 484. Scott 2014, 144 – 145. 166 – 171, 187 - 188)

While there were several reasons to engage in decoupling of carbon management, there are also motives not to. The institutional diffusion mechanisms and related pressures are correspondingly pushing organizations towards carbon management and providing the discussed benefits. In example carbon management was noticed to be linked to increased ecological and economic performance, with the related image benefits and achievable competitive advantage. The altered preferences have diffused carbon management to the normative and culturally-cognitive basis, which decrease considerably the likelihood of decoupling. Carbon managements institutional diffusion through the professional networks of increasing commitments and ethical considerations of increasing objectification therefore mitigate decoupling. The long-term path of 2050 targets connected to carbon management is bringing in stability towards the political environment and market forces. Customers, supplier, stakeholders increasingly compel mitigation of climate change and thus carbon management, and the more these have power to the organization, the less likely they engage to decoupling. Also the probability and associated risks and losses of getting caught from decoupling in carbon management as a result of social media has risen substantially, and brought in pressures for especially larger more visible organizations to act accordingly. The innovative early adopters of carbon management are distinguished of being eager to implement the adopted carbon management plans, compared to the followers (late adopters) which are more prone to abandon these actions earlier. As a result, it can be expected that decoupling action from structure amongst the studied forerunners (the early adopters) in carbon management does not occur, as a consequence the hypotheses "H6 Decoupling does not occur" is introduced. (Boxenbaum and Jonsson 2008, 86 - 88, 91. Gonzales 2005, 21-22. Luo and tang 2016, 275, 277 - 279. North 1990, 76 – 79, 103 – 104. Scott 2014, 187 – 188)

2.4. Hypotheses

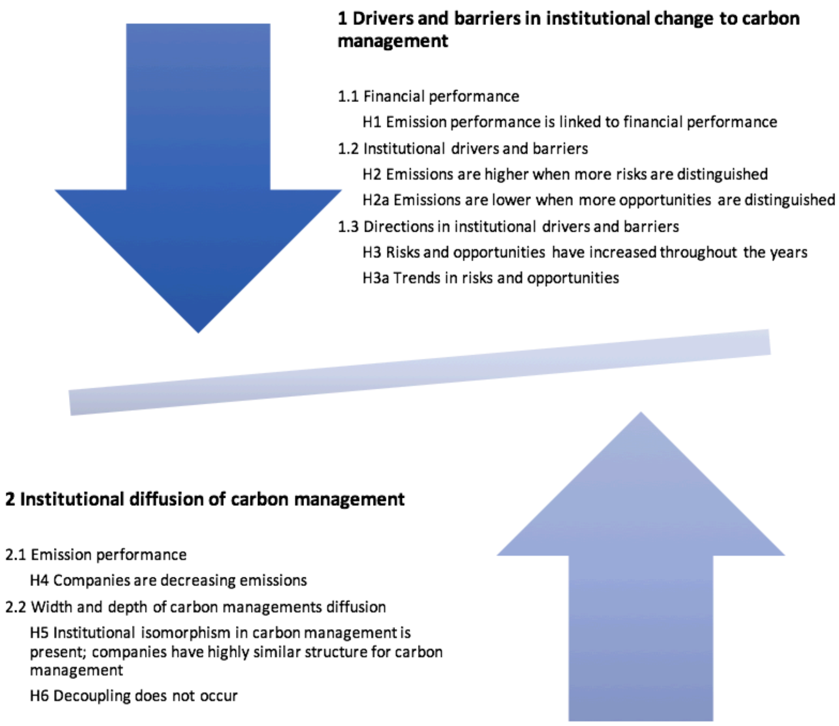

Figure 4. Hypotheses

Additions to the hypotheses (rest of the hypotheses presented in chapter 3.3 Data collection):

1 Drivers and barriers in institutional change to carbon management

1.1 Financial performance and the related hypotheses "H1 Emission performance is linked to financial performance" is studied through:

- "H1a Higher absolute emissions", connection to financial performance.
- "H1b Higher emission intensity", connection to financial performance.

1.2 Institutional drivers and barriers

- "H2b Companies distinguish more risks and opportunities when risk and opportunity management is applied", is based on the idea that companies risk and opportunity management is efficient and therefore, distinguishes more of the risks and opportunities as in the drivers and barriers to institutional change in carbon management.

2 Institutional diffusion of carbon management

2.1 Emission performance and related hypotheses "H4 Companies are decreasing emissions" is studied through:

- "H4a Absolute emissions are decreasing", in comparison to calendar year.
- "H4b Emission intensities are decreasing", in comparison to calendar year.
- "H4c Investments to carbon management", the connection of financial performance to the investments made for carbon management in order to decrease e.g. emissions.

2.2 Width and depth of carbon managements diffusion "H5 Institutional isomorphism in carbon management is present; companies have highly similar structure for carbon management" and "H6 Decoupling does not occur" are studied through:

- "H5a CM Index results are similar across sectors and countries" the more similar the CM Index scores are, the higher is that structures density which indicates isomorphism.
- "H6a Emissions are lower when CM Index is higher", as the CM Index represents companies' carbon management activities it can be expected that higher CM Index scores result in lower emissions.

3. RESEARCH METHODS

3.1. CDP

The CDP, previously known as the Carbon Disclosure Project, is an independent nonprofit organization that gathers and delivers comprehensive information related to the environment about climate change, water scarcity and deforestation. The purpose is to encourage and promote transparency by surveying and announcing climate change associated data from companies, cities, states and regions, and therefore move in the direction of becoming a more sustainable economy by taking advantage of financial market pushes through the investors, purchasers and policy makers using the data to make better-informed decisions on behalf of climate change mitigation. CDP collects the data from companies and cities by requesting information through questionnaires that focus to climate change and related mitigation activities. CDP started in 2000 in London with the purpose of driving the disclosure of carbon emissions and decrease initiatives regarding the biggest global and public firms. The first questionnaires, called CDP Instrument of choice, were sent out in 2002 to the Fortune500 companies. Its purpose was to drive disclosure of carbon emissions and climate change mitigation activities amongst the globally largest companies. During that time more than 30 institutional investors were giving this initiative weight in order to enhance the risk management of their investment decisions through the disclosure of companies' climate associated data. The first questionnaire managed to attract over 200 disclosing firms, and this first report was published in 2003. Nowadays CDP has enlarged its scope by generating five programs for disclosure of data in order to focus more towards specific climate change issues, with the common goal of mitigating climate change through economic pressures. These five programs are; Climate change, Water, Forest, Supply Chain and Cities, and they attracted in total more than 5600 companies and over 500 cities to disclose climate change related data in 2016. CPD also has a separate Investor program, which offers these five programs data to over 800 institutional investors globally controlling $100 trillion in assets. As a result, CDP has grown to become the world's largest database of its kind, holding unique data from primary carbon, water and deforestation. (Baumast 2012, 302 - 303, 308. CDP a 2016. CDP c 2016. CDP d 2016. CDP e 2016)

This investor program is especially significant because it delivers the five programs collected data besides to the investors, also to policy makers and other customers such as research organizations. The participating institutional investors and the assets they control, drive the compliance amongst the organizations within the climate change mitigation actions, and similarly motivate more businesses and cities to take part to the surveys. The basis for the investor program is the growing climate uncertainty creating physical, reputational and regulatory risks that generate pressures to investors assets. By the programs provided data, the investors are better informed to understand the risks in their portfolios, protect their investments and capture opportunities, therefore make enhanced financial decisions and similarly intensify corporate engagement towards climate change mitigation. The purpose of the investor program is to offer climate change-associated information to investors globally with the aim of promoting transparency regarding the matter of greenhouse gas (GHG) emissions, and drive measures to decrease these emissions. The fundamental idea of CDP is that the organizations are encouraged to develop programs and measures for reducing their CO_2 emission and water usage through measuring, studying, contrasting and reporting of data and information on corresponding risks, opportunities and strategies. Such endeavors are made public through CDP with the main target of applying the disclosed information that would be exploited by investors to develop actual financial motivations in the shape of share price performance. Therefore, with the help of CDP data investors can accomplish fiduciary duties and safeguard the investments, investors are able to quantify the affect and further involve and assist within climate issues, and drive policy changes. The data provided through the investor CDP adds value to financial returns and assists in thriving for sustainable future of low-carbon economy. (Baumast 2012, 302 – 303, 308. CDP a 2016. CDP b 2016. CDP c 2016. CDP d 2016. CDP e 2016. CDP k 2016. CDP l 2016)

This research data has been acquired through the Investor program, and the more specific focus is on the climate change program which purpose is to increase knowledge of businesses regarding their environmental performance, and at the same time capitalize the transition to low-carbon economy. More specifically, it is intended for mitigating the carbon and climate change risk through measuring and disclosing data of businesses about climate risk and low-carbon opportunities on behalf of the institutional investors (the Investor program). The climate change data is collected through questionnaire that is constructed from four major areas: governance, strategy and measures related to carbon emissions, risks and opportunities of carbon emissions, and carbon accounting and carbon emissions. The program originates from the risks related to climate change, in example: the global warming threshold of 2 degrees Celsius and related biosphere changes, and climate change setting assets worth of $4 trillion by the year 2030 at risk. But also the opportunities stemming from companies driving the climate change mitigation through innovations faster than the governments can, and the $53 billion generated in savings by the companies participating in the climate change program. CDP has also identified through studies that transparency regarding the carbon risks has driven a positive effect to businesses valuation, and best companies in terms of reducing carbon intensity outperform the market. (CDP a 2016. CDP c 2016. CDP e 2016. CDP f 2016. CDP g 2016. CDP h 2016. CDP i 2016. CDP j 2016)

3.1.1 Commentary on CDP

Since CDP has achieved the status of being the world's largest database of climate change related data, and the cause it drives through mitigating climate change with the institutional investor push, it has been evidently noticed by the public and as a result has received criticism, but also positive feedback. The criticism pointed against CDP focus in example to the data itself; as the CDP questionnaires have evolved throughout the years, it makes the yearly comparison difficult. The voluntarily disclosed CDP data is missing consistency since the information is not verified or audited by an external party, or the companies do not necessarily meet the required verification criteria and might leave questions unanswered. Also sector specific questions and descriptive approaches make these qualitative data analyses between companies and sectors problematic. As a result, it might be difficult to comprehend what the companies have actually achieved. (Baumast 2012, 308. Kaufman 2009. Kolk et al. 2008, 721, 741. Knox-Hayes and Levy 2011, 5 - 6)

These data-related issues are also partly the reasons for the other criticism pointed out, for instance that CDP data is not applied by asset managers in a large basis because the data is not adequately comprehensive to actually value the assets and measure carbon risks. CDP does not offer any tangible climate risk-related information, which makes comparison of financial risk schemes between companies difficult for investors. Criticism is also aimed at CDP not being able to control or measure where the investors eventually direct their investments, and that participation can only be a tick in the box for the investors of contribution towards climate change mitigation. Also the fact that organizations partaking to CDP receive a positive image from such even though they would have to cut emissions anyhow, and those who do not participate and create large emissions cannot be influenced. As a result, CDP is deemed of not being useful for financial investors, and the cause it drives by mitigating climate change through financial pushes is overvalued, due to the relationship between institutional investors and disclosing companies not being achieved. (Baumast 2012, 308. Depoers et al. 2014, 448. Kaufman 2009. Knox-Hayes and Levy 2011, 5 – 6. Kolk et al. 2008, 721, 719, 741)

Likewise, CDP has received recognition, in example it is driving a valuable cause, and has achieved positive publicity with the large institutional investor support and request of data. While the data's value to investors has been questioned, it evidently offers several other valuable functions such as developing policy measures regarding carbon emissions, CO_2 trading, for research purposes and thus complying to the mitigation of climate change eventually. The CDP data verification has been improved throughout the years as a direct response to feedback, and similarly improving its usability to investors. Also not participating to CDP is frequently translated as an indication of possible weakness within the businesses governance and risk management contexts. Despite the critiques to the data consistency, CDP offers such data that any other organization in the world is not able to deliver. It is a highly unique and a large database consisting of climate change related information from the companies, cities, and states that provides vast opportunities in terms of the low-carbon economy targets in example. While its applicability to the investors has been questioned, the questionnaires have developed significantly throughout the years in order to achieve the CDPs cause of harnessing the investor pressures for mitigating climate change through disclosure and transparency. (Baumast 2012, 308. Depoers et al. 2014, 448. Kaufman 2009. Knox-Hayes and Levy 2011, 5 – 6. Kolk et al. 2008, 721, 719, 741)

3.1.2 Comparison of similar initiatives

There are also other similar projects to CDP such as the Asset Owners Disclosure Project (AODP) and Carbon Tracker. These two are also both non-profit organizations, AODP founded in 2008 and Carbon Tracker in 2009. The AODP defends asset owners against the climate change risk, and their objective is to provide the members, stakeholders and the general public the possibility to distinguish asset owners that take into considerations the climate change risks in their portfolios and those who do not. As a result, AODP operates together with insurance corporations, pension funds, sovereign wealth funds, universities and foundations. In practice Asset Owners Disclosure Project advises and persuades investors to alter the vast inequity within their investments between high- and low-carbon assets, thus concentrate to enhancing the mitigation of climate change. These investors are triggered to rearranging the investment chains to focus and implementing more long-term investment customs. AODP publishes ranking list of 1000 biggest asset owners and which of these funds cope the best with climate change risk, for the stakeholders, industry and members to observe. As a result of the ranking lists, they also offer different ratings such as Global Climate 500 Index, Insurance Index, Country Index and country specific index. (Asset Owner Disclosure Project a 2016. Asset Owners Disclosure Project b 2016. Asset Owners Disclosure Project c 2016. The Climate Institute 2016)

Carbon tracker on the other hand is a financial advisory board with the intention of securing the global energy markets from climate risk by raising the awareness of the capital markets regarding climate related threats, and harnessing them to mitigating climate change. They deliver financial and regulatory research about the risk premium related to fossil fuels and ensuring that the risk premium is priced properly. This brings larger scrutiny amongst financial regulators, asset owners, analysts and investors, also it enables to improve the financial regulatory system for increased transparency regarding the climate risk involved in fossil fuels. The key for how Carbon tracker operates is through mapping the shift of the fossil fuel industry to reach the goal of staying within the carbon budget that enables us to stay below the two degrees' temperature rise limit of global warming. Informing the policy-makers and mainstream financial markets regarding the disordered transition is likewise a key part of the advisory boards objectives. Therefore, carbon tracker co-operates with financial officials for increasing transparency with climate and stranded asset risk, and the risk premium involved with fossil fuel. (Carbon Tracker a 2016, Carbon Tracker b 2016, Carbon Tracker d 2016)

As a result, all of these initiatives are eventually similar by taking advantage of the economic aspect of climate change for mitigating climate change, although by different methods. While AODP focuses towards asset owners and Carbon Tracker largely to the global energy market, CDP focuses to the companies directly. As discussed in the introduction, two-thirds of the historic carbon and methane emissions all the way from the beginning of industrial revolution until 2010, can be traced back to 90 companies (Heede 2013, 238) Therefore, considering this researches objectives, the data provided by CDP suits the research needs better. The other initiatives data could not be applied in understanding the institutional change to carbon management, and the institutional diffusion of such.

3.2. Data collection and measurement

3.2.1 Financial figures

The financial indicators used within this research were acquire through Thomson Reuters. All of the financial figures were converted to USD (except the % margins) and collected from the fiscal years 2010 to 2015, since the companies used the same fiscal years for disclose data to CDP. In addition, the financial figures were acquired with the scale 1000, except the % margins. The applied financial figures were collected by using four main categories that corresponded the best to the theoretical finding, and the hypotheses following from such discoveries.

The financial indicators

- Size indicators:
    - Net sales, Market capitalization and Employees.
- Profitability indicators:
    - Gross profit, Gross profit margin %, ROA % (return on asset), ROE % (return on equity), EBIT (earnings before interests and taxes), EBIT margin %, Cash flow margin %, and Free cash flow.
- Liquidity ratios:
    - Current ratio, Quick ratio, and Excess cash margin %.
- Solvency (debt ratios):
    - Total debt/total assets %, and Total debt/total equity %.

3.2.2 CDP Climate change program

The data was collected from CDP Climate change programs questionnaire response excels, between CDP 2011 to CDP 2016 reports, representing the fiscal years' data from 2010 to 2015 years'. The specific questions were selected on the basis that they serve the purpose of this study objectives the best, and similarly questions that had remained the same throughout the years, in order to retain the reliability of this research. These questions construct from general information, and climate change related actions and data; sector and countries, emission data, risk and opportunities, and carbon management related data from climate change governance, strategy, targets and initiatives, risks and opportunities and emission related data.

Sector and countries

The sectors are defined using the GICS Standard, and these were: Industrials, Materials, Consumer Staples, Utilities, Energy, Consumer Discretionary, and Services sector consisting from IT, Tele, Health and Financial sectors. The Services sector was generated due to only few observations from these separate sectors, and them fitting under one larger "services" sector group.

The country differences were tested by using "reported data from countries" indicating that the companies' responses to the questionnaire includes data from all of these countries. Because there were so many countries where data was disclosed from, these were divided to larger areas; North Europe and UK, West Europe, East Europe, South Europe, North America, South America, Middle

America, Russia and CIS (Commonwealth of Independent States), Africa, North Africa and Middle East, South-East Asia, Oceania and Rest of word (including reported data from Air space and Seas).

Emission data

The direct Scope 1 and indirect Scope 2 absolute emissions collected from the climate change questionnaires excels results are in metric tonnes CO2e. The emission intensities were calculated by dividing Scope 1 or Scope 2 emissions results with the Net sales figure. Emission performance was also measured in the investments to carbon management through emission reduction initiatives question "CC33b C7 Initiatives implemented in the reporting year, Investment required (unit currency – as specified in CC0.4)". The currencies were all converted to USD on the basis of the companies specified reporting dates exchange rates.

Risk and opportunities

Risks and opportunities were collected from the three categories; changes in regulations, changes in physical climate parameters, and changes in other climate-related developments. These risk and opportunity drivers are identical; excluding the underlined drivers which were only part of risk categories. All of the different risk and opportunities are listed in Table 2 below. The hypotheses H3a trends are further descriptions of these same risks and opportunities.

The analyzed functional pressures stem from the H1 findings of emission performance and financial performances connections, and the other climate-related development category. Political pressures derive from the regulation category, and the social pressures originated from the physical and other climate-related development categories.

Table 2. Risks and opportunities

Risks and opportunities driven by changes in regulation:	Risks and opportunities driven by changes in physical climate parameters:
International agreements	Change in mean (average) temperature
Air pollution limits	Change in temperature extremes
Carbon taxes	Change in mean (average) precipitation
Cap and trade schemes	Change in precipitation pattern
Emission reporting obligations	Change in precipitation extremes and droughts
Fuel/energy taxes and regulations	Snow and ice
Product efficiency regulations and standards	Sea level rise
Product labelling regulations and standards	Tropical cyclones (hurricanes and typhoons)
Voluntary agreements	Induced changes in natural resources
General environmental regulations, including planning	Uncertainty of physical risks
Renewable energy regulation	Other physical climate drivers
Uncertainty surrounding new regulation	
Lack of regulation	
Other regulatory drivers	
Risks and opportunities driven by changes in other climate-related developments:	
Reputation	
Other drivers	
Fluctuating socio-economic conditions	
Changing consumer behaviour	
Increasing humanitarian demands	
Uncertainty in market signals	
Induced changes in human and cultural environment	
Uncertainty in social drivers	

Carbon management practices

The carbon management index, CM Index, was collected through specific questions that were defined of representing companies’ carbon management actions the best, these consisted from climate change mitigation actions such as governance, strategy, targets and initiatives, risks and opportunities, and emission related data. Also the criteria necessitated that these have remained consistent throughout the selected time-series and thus questionnaires development, these questions are presented in Table 3 and 4. All of the question responses were coded to 0 or 1 form, and as a result have equal weight in the CM Index, the question specific guidelines are visible in Table 3. Also the multicollinearity of these variables were tested, and these variables correlated between each other making the CM Index a reliable index.

CM Index was also used to study decoupling by measuring its connection to emission performance. In addition, the “H6 Decoupling does not occur” is also studied through hypotheses: H6b Scope 1 and Scope 2 absolute emission change compared to previous year is consistent with the question “CC12.1 How do your gross global emissions (Scope 1 and 2 combined) for the reporting year compared to previous year.” This examines are the companies disclosed absolute direct and indirect emission changes consisted with the responses to this question.

Table 3. CM Index questions

Questions used to construct CM Index - Any other option in each question will result in 0

Participated to CDP **(5 times or more = 1)**

CC1.1 - Where is the highest level of direct responsibility for climate change within your organization? **(Board level = 1)**

CC1.2 - Do you provide incentives for the management of climate change issues, including the attainment of targets? **(Yes = 1)**

CC1.2a C1 - Please provide further details on the incentives provided for the management of climate change issues - Who is entitled to benefit from these incentives? **(All employees = 1)**

CC2.1 - Please select the option that best describes your risk management procedures with regard to climate change risks and opportunities **(Integrated into multi-disciplinary company-wide risk management processes = 1)**

CC2.2 - Is climate change integrated into your business strategy? **(Yes = 1)**

CC2.3 - Do you engage in activities that could either directly or indirectly influence public policy on climate change through any of the following? (tick all that apply) **(Yes = 1)**

CC3.1 Absolute emission reduction target that was active in the reporting year? **(Yes = 1)**

CC3.1 Emission intensity reduction target that was active in the reporting year? **(Yes = 1)**

CC3.2 - Do you classify any of your existing goods and/or services as low carbon products or do they enable a third party to avoid GHG emissions? **(Yes = 1)**

CC3.3 - Did you have emissions reduction initiatives that were active within the reporting year (this can include those in the planning and/or implementation phases) **(Yes = 1)**

CC3.3b C1 - For those initiatives implemented in the reporting year, please provide details in the table below - Activity type **(One activity type = 1, If all activity types used possible to gain 13 points)**

CC3.3c C1 - What methods do you use to drive investment in emissions reduction activities? - Method **(One method = 1, If all methods used possible to gain 13 points)**

CC5.1 - Have you identified any inherent climate change risks that have the potential to generate a substantive change in your business operations, revenue or expenditure? Tick all that apply **(All three categories = 1)**

CC6.1 - Have you identified any inherent climate change opportunities that have the potential to generate a substantive change in your business operations, revenue or expenditure? Tick all that apply **(All three categories = 1)**

CC8.6 - Please indicate the verification/assurance status that applies to your reported Scope 1 emissions **(Complete = 1)**

CC8.7 - Please indicate the verification/assurance status that applies to at least one of your reported Scope 2 emissions figures

CC13.1 - Do you participate in any emissions trading schemes? **(Yes = 1)**

CC13.2 - Has your organization originated any project-based carbon credits or purchased any within the reporting period? **(Yes = 1)**

Table 4. CC3.3b Activity types and CC3.3 Methods

Activity type:	**Method:**
CC3.3b Energy efficiency: building fabric	CC3.3c Compliance with regulatory requirements/standards
CC3.3b Energy efficiency: building services	CC3.3c Dedicated budget for energy efficiency
CC3.3b Energy efficiency: processes	CC3.3c Dedicated budget for low carbon product R&D
CC3.3b Fugitive emissions reductions	CC3.3c Dedicated budget for other emissions reduction activities
CC3.3b Low carbon energy purchase	CC3.3c Employee engagement
CC3.3b Low carbon energy installation	CC3.3c Financial optimization calculations
CC3.3b Process emissions reductions	CC3.3c Internal price of carbon
CC3.3b Transportation: fleet	CC3.3c Internal incentives/recognition programs
CC3.3b Transportation: use	CC3.3c Internal finance mechanisms
CC3.3b Product design	CC3.3c Lower return on investment (ROI) specification
CC3.3b Behavioral change	CC3.3c Marginal abatement cost curve
CC3.3b Waste recovery	CC3.3c Partnering with governments on technology development
CC3.3b Other	CC3.3c Other

As the CM Index includes several different components it can be expected that some increase the emission performance, thus decrease the emissions, differently than others. This difference can ascend from the absolute emission or emission intensity types (direct / indirect), popularity, and whether the influence is experienced now, next year or after two years. Any assumptions for the differences are not made, instead these are studied in order to characterize the affect. To study such the hypotheses "H7 Different carbon management practices of the CM Index affect emissions in different manners" is presented. The related sub-hypotheses are presented below.

- "H7a Emissions decrease through similar initiatives implemented in the reporting year (activity types) by companies". The purpose in this hypotheses is to test the various emission reduction initiative activity types, visible in Table 4, affect to emission performance, and measure are such activity types popular amongst the analysis groups companies.

- "H7b Emissions decrease through similar methods used by companies to drive investment in emission reduction activities". Same idea as with above H7a, the methods are visible in Table 4.

- "H7c Emissions are lower when verification takes place"; external verification of emissions seen as keenness for carbon management, and therefore lower emissions as well.

- "H7d Emissions are lower when companies participate to emission trading schemes"; also keenness to carbon management, such companies want to decrease their emissions.

- "H7e Emissions are lower when companies purchase originated carbon credits"; purchasing originated carbon credits indicate eagerness to carbon management.

- "H7f Emissions are lower when companies have emission reduction targets and initiatives"; these targets are actual and their results can be experienced.

3.3. Quantitative research

This study uses quantitative research methods for analyzing the acquired secondary data from CDP Climate change program. Quantitative approach was selected because CDP has collected the data by a structured questionnaire, and the data was already largely in a quantifiable form. For testing the hypotheses and seeing the development throughout the years required a quantitative approach. Also due to the selected large sample size of 252 companies and total of 1512 observation through the six years' time-series, quantitative research methods suited best for the analyzing such data. The quantitative research methods are able to make generalization of the results of the selected forerunner companies in carbon management to a larger population of such, which is required in terms of the research objectives of studying the institutional diffusion of carbon management.

The quantitative research analysis method was selected to be panel regressions due to the nature of the data. As we have the sample of the same 252 companies throughout six years (generating total of 1512 observations) the panel regressions provide the opportunity to partition the individual companies to a six-year observation, and therefore be able to take into account that these are the same companies, but their observations show-up always six-years in a row generating a time-series. The panel regressions are therefore the best method for analysing such time-series data, and taking into account the six-year period. As a result, we are able to by statistically reliable means observe all of the company's progress across the time-series of six-years. These panel regressions were analysed by using Stata analysis tool. (Princeton University Library 2007)

For testing the hypotheses through panel regressions, there are generally two methods that could be applied for the analyzed data; the fixed effects model and the random effects model. Deciding which one to use can be statistically tested by Hausman test, which was conducted with every model analyzed. However, all of the models were tested with random effects model. The Hausman test was conducted in order to discover whether the analyzed random effects models have a possible issue within their reliability. All of the tested models in appendices are bolded if Hausman test issue occurred, indicating that the null hypothesis was rejected and fixed effects model should have been applied. The reasons for using only random effects model is because when generating the models and selecting the appropriate control variables we could observe that the sector influenced all of the dependent variables tested. In order to use the time invariant sector as a control variable, random effects models had to be applied. In addition, in every model the heteroscedasticity was controlled. Every analysed model used the same control variables; sector for controlling the differences between sectors, and employees for controlling the companies size influence. These control variables were tested and confirmed to have an effect for the dependent variables in each of the hypotheses. In addition, the multicollinearity of these control variables was tested, and statistically significant correlation was not discovered. (Torres-Reyna 2007)

In addition, QDA-miner was applied in testing the hypotheses H3a of trends in risks and opportunities. Within this specific hypothesis the data was acquired through companies' further risk and opportunity descriptions that could be even one-page long. These answers were collected from the three groups of risk and opportunity descriptions; regulative, physical climate parameters and other climate-related developments, and combined yearly between all of the companies within three groups of risks and opportunities. The text analysis tool QDA miner was applied for statistically analyzing how often a specific word occurs throughout the years; has it statistically significantly increased, decreased or remained the same.

4. EMPIRICAL FINDINGS

4.1. Descriptive statistics

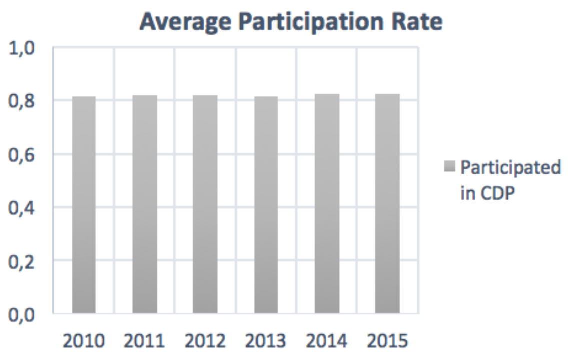

Figure 5. Participation rate to CDP development

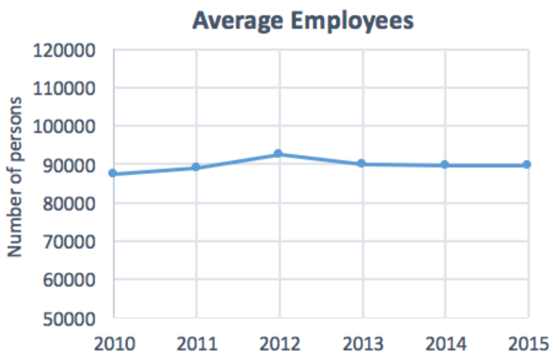

Figure 6. Employees development

The participation rate in the Figure 5 between the top 100 highest emitting companies each year has remained the same; from the total 252 companies that have participated to CDP between years 2010 to 2015, just over 80% participate each year. In the Figure 6 is the size indicator used in the analysis representing the number of employees. The average size of the companies has increased slightly compared to 2010 and 2015, also a spike in the size can be seen in 2012. However, as a whole the participating companies size has not significantly changed.

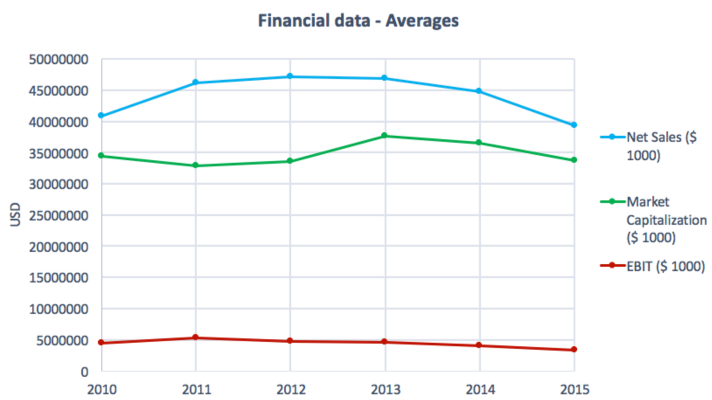

Figure 7. Financial data development

Net sales and Market capitalization were also used as size indicators, and in Figure 7 we can see some changes. The average Net sales has increased throughout the years, but eventually ended up lower in 2015 compared to 2010. Market capitalization first decreased, then increased, and eventually fall below 2010 numbers. Together with findings of employees change, we can conclude that the size of the companies has remained largely the same. The average EBIT has decreased slightly from 2010 to 2015.

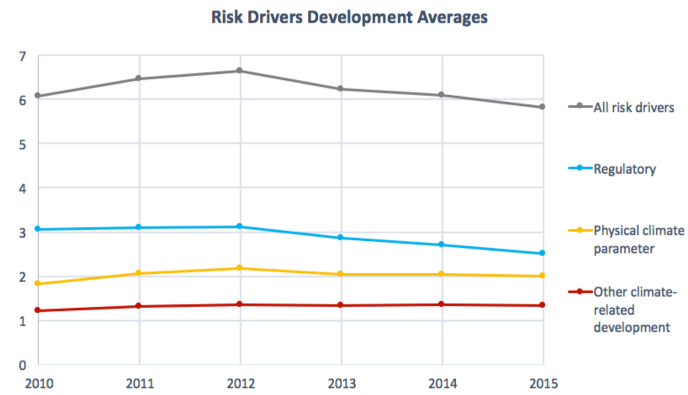

Figure 8. Risk drivers' development

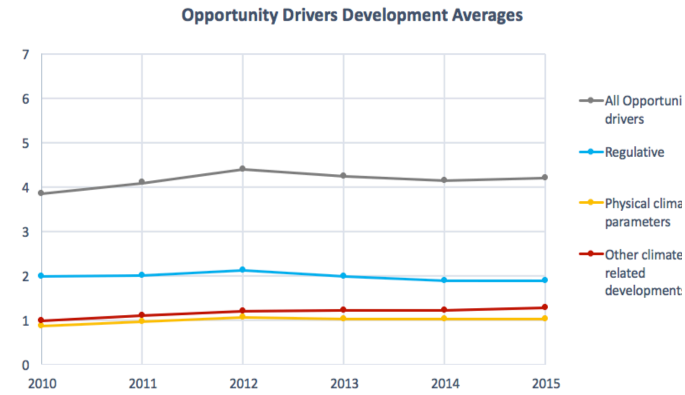

Figure 9. Opportunity drivers' development

The Figure 8 points out that all of the risk drivers have decreased, however this decrease comes directly from regulative risk drivers that have decreased significantly from 2010 to 2015. Otherwise physical climate parameter and other climate-related development risk drivers have increased slightly. The Figure 9 indicates that all of the opportunity drivers have increased from 2010 to 2015, and this increase comes from physical climate parameter and other climate-related developments opportunities that have increased, while regulative opportunity drivers have decreased to some extent. Also what can be seen from Figure 8 and 9, is that companies distinguish twice as more risks from physical climate parameter related developments than opportunities. Regulative risks are still higher than the opportunities, but the risks are decreasing significantly and so are the opportunities, but to a lesser extent. Other climate-related development opportunities and risks are in the same levels. Overall companies experience considerably more risks than opportunities, however the trend shows that this situation might change in the near future.

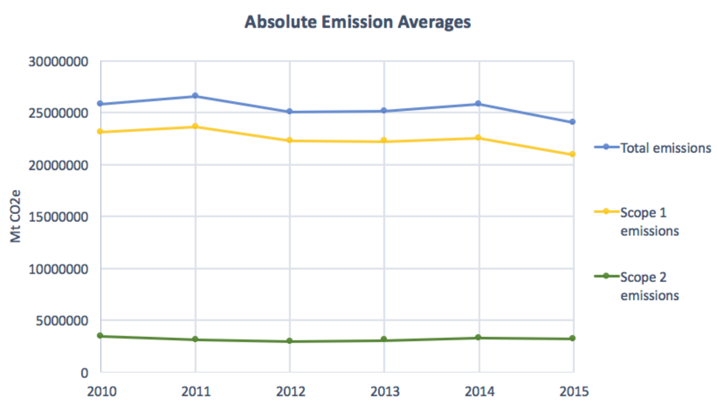

Figure 10. Absolute emissions development

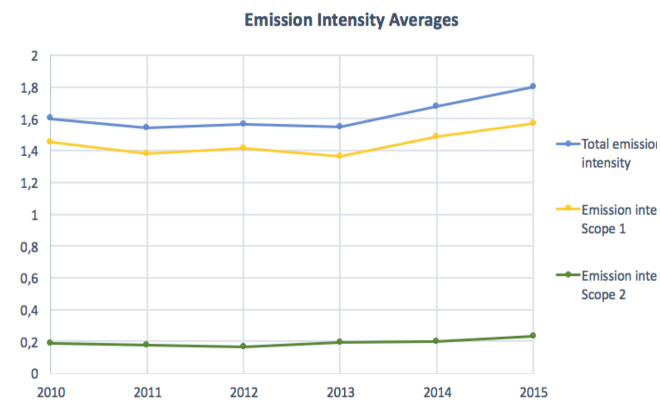

Figure 11. Emission intensities development

Figure 10 and 11 represent emission performance of absolute emissions and emission intensity from 2010 to 2015. The total absolute emissions, which consist largely from direct Scope 1 emissions, have decreased from the 2010 numbers, and the same development can be seen from the indirect Scope 2 emissions. Vice versa, all of the emission intensity lines are on a clear rise. However, it has to be kept in mind that the changes in the net sales influences the emission intensities correspondingly.

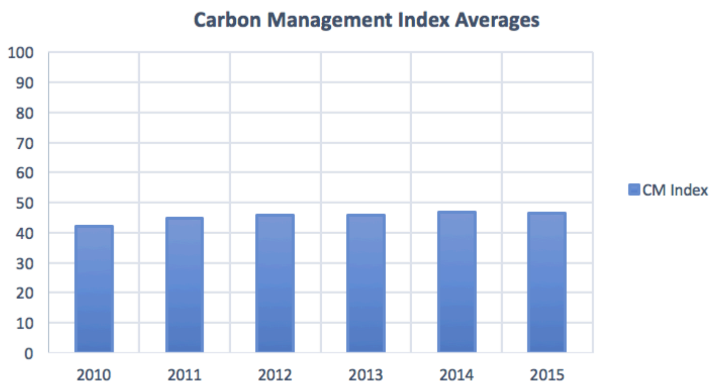

Figure 12. CM Index development

From the Figure 12 we can distinguish that the averages of the carbon management index, CM Index, are rising amongst the analysis groups companies. Nonetheless, the averages are low, and below 50 out of the maximum 100.

4.2. Drivers and barriers in institutional change to carbon management

The control variables; sector and employees, influence to the emission performance can be distinguished from Appendix 1 Table 11. The sector findings are all in comparison to the Consumer staples sector. Companies operating in the sectors; Utilities, Energy, Materials and Industrials have greater direct absolute emissions and emission intensities compared to Consumers staples. Companies operating in Materials, Energy and Services sector have higher indirect emissions compared to Consumer staples sector, which companies on the other hand has greater indirect emissions in comparison to Industrials. Lastly, Materials sector companies have higher indirect emission intensities than companies in Consumer staples. The companies size influences the emissions as well; the more employees the company has, the higher are its direct and indirect absolute emissions. Therefore, larger companies have higher absolute emissions, but not necessarily higher emission intensities, from which no statistically significant findings were made. Above models risk levels were below 1%.

4.2.1 Financial performance

H1 Emission performance is linked to financial performance.

H1a Higher absolute emissions

Higher profitability figures now result variably in greater direct Scope 1 and indirect Scope 2 absolute emissions now, next year, and after two years (see Appendix 1 Table 9). The higher the gross profits, EBIT and free cash flow now, the greater are the direct absolute emissions now as well. In addition, the higher free cash flow now results in greater direct emissions next year, and higher EBIT now appears in emission performance as greater direct emissions after two years. The results of indirect emission findings were more consistent. Larger market capitalization, gross profit and EBIT now increase the indirect emissions now, next year and after two years. All of these above tested models were statistically significant in less than 1% risk levels. Any statistically significant connections between rest of the tested profitability, liquidity or solvency figures and absolute emissions were not found. Hypotheses "H1a Higher absolute emissions" is partly supported, connections to certain financial performance indicators were observed.

H1b Higher emission intensity

More findings were discovered from the emission intensities and financial performances connections, however these were the opposite to absolute emission discoveries; the higher profitability figures now outcome variably in lower direct and indirect emission intensities now, next year, and after two years (see Appendix 1 Table 10). Higher market capitalization, gross profit, and EBIT now results in lower direct and indirect emission intensities now, next year and after two years. In addition, higher free cash flow now is connected to lower indirect emission intensity now. The relationships are very minor due to scope difference; financial figures are in tens of millions while emission intensities are on average less than two. Nevertheless, greater connections can be found from the percentage figures of EBIT margin, ROA and ROE discoveries, that support these findings. Higher these are now, the lower are the direct emission intensities now as a result. Additionally, greater ROA now is connected to lower direct emission intensity after two years, and higher EBIT margin now is linked to lower indirect emission intensity now. The risk levels in all of the above models were less than 1%. Likewise, with the absolute emissions, there were not any statistically significant relationships amongst liquidity or solvency figures and emission intensities. The hypotheses "H1b Higher emission intensity" is also partly supported due to linkages with the profitability figures. As a result, the hypotheses “H1 emission performance is linked to financial performance” is partly supported; profitability is connected to emission performance but in an inconsistent means.

4.2.2 Institutional drivers and barriers

H2 Emissions are higher when more risks are distinguished.

Any statistically significant findings from the total risk drivers summed up or examined separately as total regulative, physical, and other risk driver categories, and between direct and indirect emissions or emission intensities were not discovered. Findings from individual risk drivers were however identified. In general, recognizing specific regulative risk drivers increases the direct emissions and emission intensities, but results in lower indirect emissions and emission intensities. Companies that distinguish now risks that are driven by changes in regulative risk drivers’; air pollution limits, emission reporting obligations and voluntary agreements, have as a consequence higher direct emissions variably either now, next year or after two years. On the contrary, identifying regulative risk drivers’; product labelling regulations and standards and lack of regulation now, results in lower indirect emissions now, next year, and after two years. With lack of regulation the influence increases; indirect emissions are lower next year, and even lower after two years. The regulative risk drivers also influence the emission intensities. Identifying now the renewable energy regulation results in greater direct emission intensity after two years. Again the influence is the opposite with indirect emission intensity, hence companies recognizing lack of regulation now have lower indirect emission intensities now and next year in the similar growing affect as with indirect emissions. All of the above models were statistically significant in less than 1% risk levels (See Appendix 2 Table 12 and Table 14).

The findings from individual risks driven by changes in physical climate parameters influence are inconsistent, and impact more the indirect emissions and emission intensities (see Appendix 2 Table 13 and 14). Specifying change in temperature extremes now influence can be recognized after two years in higher direct emissions. Also companies detecting physical risk driver tropical cyclones is connected to greater direct emission intensity now, and greater indirect emissions now, next year and after two years. Finding the change in mean temperature as a risk driver now results in lower direct emissions after two years, but to higher indirect emissions now and next year. Uncertainty of physical risks is reflected to higher indirect emissions now and next year. Companies classifying induced changes in natural resources have lower indirect emissions now and after two years, and indirect emission intensity after two years. Physical risks snow and ice, is connected to lower indirect emission intensity now, and sea level rise to lower indirect emission intensity next year. These models had a similar below 1% risk levels as well.

The findings of other climate-related developments risk drivers are also contradictory, and do not influence the emission intensities (see Appendix 2 Table 13). Finding fluctuating socio-economic conditions as a risk driver now, shows as greater direct emissions now, but as lower indirect emissions after two years. Reputation risk is reflected to higher indirect emissions after two years, while increasing humanitarian needs risk lead to lower indirect emissions next year. Models risk levels were also below 1% with the statistically significant findings. Therefore, the hypotheses “H2 Emissions are higher when more risks are distinguished” is not supported; such relationships were not discovered, and specific risk drivers influence the emission performance inconsistently to make any coherent conclusions. Identification of risks cannot be defined as barriers to carbon managements institutional change, as deliberated in the hypotheses explanation.

H2a Emissions are lower when more opportunities are distinguished.

Similarly, any statistically significant findings from the total opportunity drivers counted together or examined separately category wise, and between direct and indirect emissions or emission intensities were not discovered. There are significantly less connections with the opportunity drivers than risks to emission performance, and the influence in emission intensity can only be recognized with one opportunity driver. In addition, also the individual opportunity drivers influence to emission performance display inconsistency. (see Appendix 2 Table 15 and Table 16). Companies that recognize now regulative risk opportunity emission reporting obligation, have higher direct emissions now and next year, while identifying it as a risk resulted in higher direct emissions. On the contrary, distinguishing regulative opportunity cap and trade schemes, results in lower direct emissions now. The opportunities from physical climate related developments result all in lower indirect emissions and emission intensity, while no connection to direct emissions are found. Identifying change in mean temperature as an opportunity results in lower indirect emissions and emission intensities next year, while identifying it as a risk lead to higher indirect emission intensities now and next year, and lower direct emissions after two years. Also the physical opportunity snow and ice, results in lower indirect emissions next year and twice as low after two years, whereas identifying it as risk resulted in lower indirect emission intensity. Distinguishing opportunities from other climate-related developments now influence is only statistically significant with indirect emissions. Fluctuating socio economic condition opportunities lead to lower indirect emissions after two years, whereas identifying it as a risk lead to higher direct emissions now and lower indirect emissions after two years. Lastly, distinguishing induced changes in human and cultural environments as an opportunity is reflected to higher indirect emissions now. All of the above tested models were statistically significant in less than 1% risk levels. The hypotheses "H2a Emissions are lower when more opportunities are distinguished" is also rejected, such connections were not discovered and identification of individual opportunities may lead to both higher and lower emission performance. Identification of opportunities cannot be defined as drivers to carbon managements institutional change, as deliberated in the hypotheses explanation.

H2b Companies distinguish more risks and opportunities when risk and opportunity management is applied

Risk management procedures in companies are efficient, and these processes have grown more or less linearly throughout the years (see Appendix 3 Table 18). Companies that have risk management procedure in place identify more risks and opportunities amongst all of the three categories; regulative, physical, and other, and therefore the total risks and opportunities as well (see Appendix 3 Table 17). Risks dominate the opportunities in each of the three categories quantities identified as a result of the companies' risk management procedure. Regulative risks and opportunities are identified the most. All of the models tested were statistically significant with less than 1% risk levels. As a result, the hypotheses "H2b Companies distinguish more risks and opportunities when risk and opportunity management is applied", is supported.

The control variables also had an influence to the risks and opportunities (see Appendix 3 Table 17). In general, the larger companies identify more opportunities in total and from each category as well, but the influence is the greatest in regulative opportunities. Also the larger the company is, the more it will identify all of the risk drivers in total, but only more risks from the other climate-related developments category. Companies operating in different sectors also experience more risks and opportunities, in comparison to Consumer staples sector. The total risks are greater amongst companies in Utilities and Energy sectors, which also recognize more regulative risks and opportunities. The Utilities sector companies faces also more physical risks, while Energy sector companies distinguishes more risks from the other category. Regulative risks and opportunities are experienced more amongst the Services sector companies, and also more opportunities in total. Companies operating in the Materials sector distinguish more other climate-related risks, and more regulative opportunities. In conclusion, larger organizations are subject to more risks and opportunities, and differences can be identified sector-wise. The risk levels were below 1% amongst all of the above models.

4.2.3 Directions in institutional drivers and barriers

H3 Risks and opportunities have increased throughout the years

In the all risks and opportunities categories there is no visibly growing trend, these are both greater only in 2012 compared to 2010, however when examining categories separately changes can be recognized. In general, the regulative risks have decreased (also one regulative opportunity) to a great extent throughout the years, except renewable energy regulation where both risks and opportunities have grown. The total regulative risks, international agreements, cap and trade schemes, emission reporting obligations, product labelling regulations and standards, and lack of regulation related risks have all decreased in 2014 and 2015 in a growing numbers compared to 2010. In most of the cases such regulative risks are identified twice as less in 2015 than in 2010. The general environmental regulations, including planning opportunity was the only identified regulative opportunity that had decreased between the companies. All of the other models are statistically significant in less than 1% risk levels, except renewable energy regulation models which are statistically significant in 5% risk levels. (See Appendix 4 Table 19 and 21)

There is a noticeable growth in both physical risks and opportunities, and the total numbers in both were higher until 2013 compared to 2010 although no statistically significant findings in the later years were recognized. The physical risk induced changes in natural resources is only risk that has declined throughout the years, with twice as less risks experienced in 2015 than in 2010. The change in temperature extremes has increased the same amounts both as a risk and as an opportunity. The clearest and nearly a linear growth is with the physical risk change in precipitation extremes and droughts that is identified almost twice as much in 2015 than in 2010. The risks of tropical cyclones have also grown. All of the above models were statistically significant in risk levels in less than 1% (see Appendix 4 Table 20 and 21).

Other climate-related development risks and opportunities have also increased throughout the years, especially the opportunities (see Appendix 4 Table 20 and 21). While all of the other risks are only higher in 2013, the all of the other opportunities are distinguished by companies in a linearly growing pace all the way to 2015. Both distinguishing reputation as a risk and as an opportunity have grown each year. Nevertheless, the highest growth is with the other climate-related development opportunity changing consumer behavior, where companies find twice as many opportunities in 2015, in comparison to 2010. The risk levels in all of these models were also below 1%. In conclusion, the hypotheses “H3 Risks and opportunities have increased throughout the years” is partly supported. Only partially due to the clear declining trends with regulative risks and to some extent opportunities as well. Nevertheless, a clear growth with physical and other risks and opportunities is distinguished, particularly with physical risks.

H3a Trends in risks and opportunities

Although the regulative risks and opportunities were identified of decreasing in quantities, generally the certain trends amongst the individual risks and opportunities were growing in both categories. (see Appendix 5 Table 22). Companies within their further regulative risk descriptions in the recent years’ bring out increasingly more the following words; Intended Nationally Determined Contributions (INDC, related to United Nations Framework Convention on Climate Change UNFCCC, and decreasing greenhouse gas emissions), stability, decarbonisation, lawsuits, Specified Gas Emitters Regulation (SGER) and imports. Declining trends in the regulative risk descriptions where identified with CE (mandatory product marking for products sold in European Economic Area), and overseas, which have both decreased when describing the regulative risks more profoundly in the recent years. In terms of the trends in regulative opportunities further descriptions, coming closer to 2015 companies bring out words in increasing pace within their responses about landfill, decarbonisation, compressed natural gas (CNG), biogas, Combined Cycle Gas Turbines (CCGT) and Hydro. Decreasing trend is only identified in the word CSR (Corporate Social Responsibility) from the regulative opportunities further portrayal. The above findings were all statistically significant variably between risk levels less than 10%, 5% or 1%.

The growing trends along with the physical risks and opportunities in quantities is consequently visible with the risk and opportunities further descriptions, especially the discussion with physical opportunities shows an increasing trend along with specific words. (see Appendix 5 Table 23). The trends with risks that are driven by changes in physical climate parameters indicate that companies have been highlighting in the recent years’ words such as; windy, biofuels, flows, earthquake and groundwater. The declining trends in the discussions are seen in the words; greenhouse, rainstorm, ecosystem and biomass. In the physical opportunities further descriptions companies bring out increasingly more the words GHG, wood, microbial, sustainability, pesticides, pests, food, forest, harvesting, trees, fibre, and mosquitoes. Likewise, as with regulative opportunities, also the word

CSR experiences a declining trend with physical opportunities detailed descriptions. These above findings were all statistically significant variably between risk levels less than 10%, 5% or 1%. Consistent with H3 findings, also within the other climate-related developments further risk and opportunity descriptions increasing trends can be identified with the majority of the findings of certain words (see Appendix 5 Table 24). The increasing trends in specific words that companies brought out in their risk descriptions are boycotts, fertilizers, ESG (The Environmental, Social and Governance criteria for socially conscious investors screening investments), advertising, campaigns, drought, and renewables. Decreasing trends within risks are seen with words Kyoto and ETS (EU Emission trading system). The trends with words from other climate-related opportunities further descriptions are only increasing. Companies highlight increasingly in opportunities the words CDP, certification, ESG (also brought out as a risks), chlorine, oxide, hydro (as with regulative opportunities), and mill. These above findings were all statistically significant variably between risk levels less than 10%, 5% or 1%. The hypotheses “H3a Trends in risks and opportunities” is therefore supported, observable trends with risks and opportunities could be identified.

4.3. Institutional diffusion of carbon management

4.3.1 Emission performance

H4 companies are decreasing emissions

H4a Absolute emissions are decreasing

The hypotheses “H4a Absolute emissions are decreasing” is not supported. There were no statistically significant findings between the direct and indirect emissions relationship to calendar year. Also reported data from countries or the sector did not reveal any differences.

H4b Emission intensities are decreasing

The hypotheses “H4b Emission intensities are decreasing” is not supported. Only findings were from indirect emission intensities being slightly lower in the year 2012 compared to 2010 (see Appendix 6 Table 25). Sectoral differences were identified; with companies in the Utilities sector the direct emission intensity is three times higher each year in comparison to all other sectors, and the difference has grown over time. Companies operating in the Materials sector have higher indirect emission intensity, and the difference is the highest in 2015. All of the above models were statistically significant in risk below 1% risk levels.

H4c Investments to carbon management

More investments to carbon management are made when the Net sales and EBIT are higher, also companies in the Utilities sector investments more to carbon management in comparison to companies from the Consumer staples sector (see Appendix 6 Table 26). These models were significant with 5% risk levels. Calendar year, liquidity, solvency, and rest of the profitability indicators did not influence the investments to carbon management. Therefore, hypotheses "H4c Investments to carbon management" is partly supported, since some findings were made.

Nevertheless, the hypotheses "H4 Companies are decreasing emissions" is rejected, companies are not decreasing emissions.

4.3.2 Width and depth of carbon managements diffusion

H5 Institutional isomorphism in carbon management is present; companies have highly similar structure for carbon management

H5a CM Index results are similar across sectors and countries

The analysis of CM Index relationship to countries and sectors did not reveal any statistically significant differences, except CM Index is lower amongst companies that have reported data from Southern Europe (see Appendix 7 Table 27). Also the Figure 13 and 14 representing the CM Index averages support these findings; CM Index graphs show nearly identical and clustered strings amongst sectors and countries. The averages of the CM Index remain roughly below 50 out of maximum 100. CM Index has grown over three points from 2010 to 2015 amongst analysis group companies, visible also in Figure 12. The "participated to CDP" finding also supports this, indicating that the higher CM Index is the result of later participation (higher number). All of the above models are statistically significant in below 1% risk levels. In addition, the higher employees' amount had an influence to CM Index indicating that the larger companies have higher CM Index (model statistically significant in 5% risk level). In total the hypotheses "H5a CM Index results are similar across sectors and countries" and therefore the hypotheses "H5 Institutional isomorphism in carbon management is present; companies have highly similar structure for carbon management" are both supported. The institutional isomorphism in carbon management can be identified through highly similar structures.

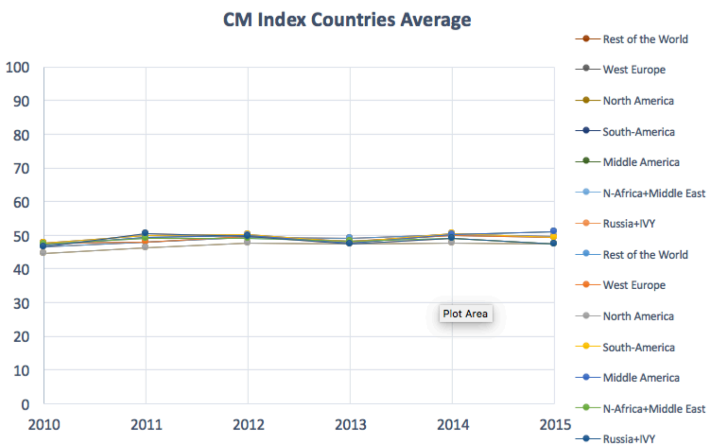

Figure 13. CM Index countries average

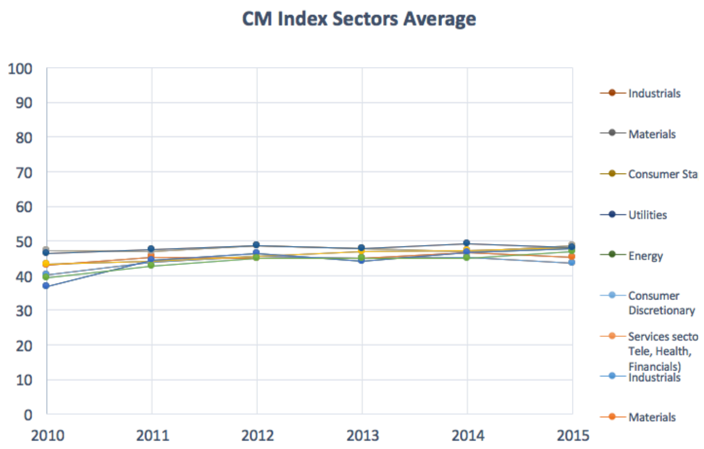

Figure 14. CM Index Sectors average

H6 Decoupling does not occur

H6a Emissions are lower when CM Index is higher

CM Index affect to emission performance was the opposite. The higher CM Index figures now result in greater indirect emissions now, next year, and after two years when the affect to indirect emissions has doubled in comparison to starting point "now" (see Appendix 8 Table 28). Any other relationships to emission performance was not discovered. The models were statistically significant in less than 1% risk levels. Therefore, the hypotheses "H6a Emissions are lower when CM Index is higher" is rejected, the influence is the opposite.

H6b Scope 1 and Scope 2 absolute emission change compared to previous year is consistent with "CC12.1 How do your gross global emissions (Scope 1 and 2 combined) for the reporting year compared to previous year."

The companies' responses to question CC12.1, and the calculated total disclosed emission change in comparison to previous year were consistent between each other. When companies replied to the question CC12.1 that their emissions have decreased in comparison to previous year, in 88% of the cases also the calculated disclosed emissions had decreased. Likewise, when companies replied that emissions had increased, in 85% cases the calculated emissions had also increased in comparison to previous year (see Appendix 8 Table 29 and Table 30). The option emissions have not changed had

too few responses to make any conclusions. Models were statistically significant in less than 1% risk levels. As a result, the hypotheses “H6b Scope 1 and Scope 2 absolute emission change compared to previous year is consistent with CC12.1 How do your gross global emissions (Scope 1 and 2 combined) for the reporting year compared to previous year”, is accepted.
In conclusion, the hypotheses “H6 Decoupling does not occur” is rejected. The H6a findings indicate that decoupling is occurring. The findings of H6b only indicate that disclosed emissions are consistent with the response to another question. CM Index defines the carbon management actions, and by measuring such towards emission performance a more reliable result to decoupling can be achieved.

H7 Different carbon management practices of the CM Index affect emissions in different manners

H7a Emissions decrease through similar initiatives implemented in the reporting year (activity types) by companies

Out of the 13 predefined emission reduction initiative activity types, six activities were discovered in influencing the direct emissions and emission intensities performance, and five of these did decrease the emissions, while one activity was connected to higher direct emissions (see Appendix 9 Table 31 and 32). These activities had a considerable influence to the emission performance. In addition, no connections to indirect emissions were discovered. The most popular activity type for decreasing emissions selected by companies was “Energy efficiency: in processes”, which resulted in lower direct emissions now. The second most popular activity “Low carbon energy installation” resulted in lower direct emission intensities next year. Third most popular activity “Energy efficiency: building services” lead to lower direct emission intensities after two years. The “Other” activity was also a popular option and resulted in lower direct emissions next year, however it cannot be characterized what the actual activity type is. The lower end in popularity was “Fugitive emissions reductions”, which was connected to lower direct emission intensities after two years. Lastly the activity, average in popularity, “Behavioral change” resulted in greater direct emissions next year and after two years. All of the above models were significant in risk levels below 1%. As a result, the findings support the hypotheses “H7a Emissions decrease through similar initiatives implemented in the reporting year (activity types) by companies”, and it is accepted.

H7b Emissions decrease through similar methods used by companies to drive investment in emission reduction activities

From the 13 prescribed methods driving investments in emission reduction activities, seven methods were identified in effecting the emission performance. The influences of these seven methods are inconsistent (see Appendix 10 Table 33 and 34). The most popular method for driving investments in emission reduction activities selected by companies was “Compliance with regulatory requirements and standards” and it did result in decreased indirect emission intensities after two years. The second most popular method was “Dedicated budget for energy efficiency” and it resulted in lower direct emission intensities after two years. Also a high ranking method “Dedicated budget for low carbon product R&D” leads to lower indirect emission intensities next year. Average in popularity the method “Internal incentives/recognition programs” resulted in lower direct emission intensities, but higher indirect emissions after two years. On the contrary, average in popularity method for driving investments in emission reduction activities “Financial optimization calculations” applied by companies caused higher direct emissions after two years. The unspecified “Other” method was also average amongst choices, and it lead to higher direct emission intensities next year and after two years. Lastly lower end in popularity, the method “Internal price for carbon” was linked to higher indirect emissions after two years. All of the models were below 1% risk levels in their statistically significance. The hypotheses “H7b Emissions decrease through similar methods used by companies to drive investment in emission reduction activities” is partly accepted since most popular methods are connected to decreased emissions.

H7c Emissions are lower when verification takes place

Any relationships between the emission verification and absolute emissions were not discovered. However, it was noticed that when direct emissions are verified the direct emission intensities are higher next year and after two years (see Appendix 11 Table 35). Likewise, when the indirect emissions are verified, both the direct and indirect emission intensities are higher after two years. These models significances were below 1% risk levels. Nevertheless, the hypotheses; “H7c Emissions are lower when verification takes place” is rejected.

H7d Emissions are lower when companies participate to emission trading schemes

Participation to emission trading schemes (ETS) did not influence the direct emissions, but the indirect emissions are higher now, next year and after two years as a result of participation (see

Appendix 11 Table 36). These models were statistically significant in less than 1% risk levels. Any relationships to emission intensities were not discovered. Therefore, the hypotheses “H7d Emissions are lower when companies participate to emission trading schemes” is rejected, the influence is the opposite.

H7e Emissions are lower when companies purchase originated carbon credits

Between purchasing originated carbon credits and the emission performance, any statistically significant correlations were not found. Therefore, the hypotheses “H7e Emissions are lower when companies purchase originated carbon credits” is rejected.

H7f Emissions are lower when companies have emission reduction targets and initiatives

Companies that have emission intensity reduction targets have at the same time lower direct emissions (see Appendix 12 Table 37), the finding is statistically significant in below 1% risk level. Absolute emission reduction targets or declaring of using emission reduction initiatives were not connected to emission performance. As a result, the hypotheses “H7f Emissions are lower when companies have emission reduction targets and initiatives” is partly accepted; emission intensity reduction targets do result in lower direct emissions.

In conclusion, the hypotheses “H7 Different carbon management practices of the CM Index affect emissions in different manners” is partly accepted, findings that support the diverging emission performance affects (decreasing emissions) were discovered.

4.4. Summary of results

4.4.1 Financial performance

The Table 5 summarizes the findings of financial performances influence to emission performance. The size influence to emissions was as expected, bigger companies have greater emissions. However, size was not connected to emission intensity. The higher profitability figures in companies’ is connected to releasing more absolute emissions, but releasing less emissions per revenue generated (emission intensity). This indicates that profitability has been decoupled from the emission performance per generated total revenue. Although the absolute emissions increase as the profitability increases, the companies’ total revenues increase more with respect to the amount of released emissions. Emission intensity results point out that the companies with high profitability figures today are likewise more efficient at controlling their released direct and indirect absolute emissions per revenue generated now and in the near future. However, this indicates that decreasing emissions is expensive and/or not cost-efficient at the moment because of the contradictory absolute emission findings. Liquidity and solvency signifying the companies' financial health, did not influence the emission performance.

Table 5. Summary of financial performance findings

Financial performances influence to emission performance

	Size	Profitability	Liquidity	Solvency
Direct emissions	↑	↑	-	-
Indirect emissions	↑	↑	-	-
Direct emission intensities	-	↓	-	-
Indirect emission intensities	-	↓	-	-

4.4.2 Institutional drivers and barriers

The hypothesized idea of risks being the barriers and opportunities the drivers in institutional change to carbon management did not actualize as expected. The institutional drivers and barriers to carbon management could not be directly identified through the relationship between emission performance and recognition of more risks or opportunities. The individual risks and opportunities did influence the emissions performance, but in a very inconsistent manner, as we can see from Table 6 which summarizes the main directions of influence drawn from the individual risks and opportunities affects. Some consistencies could be recognized, generally identifying regulative risks increase the direct emission and emission intensities, however at the same time specific regulative risks were connected to decreasing the indirect emission and emission intensities. Likewise, certain opportunities from the physical climate parameters development decreased the indirect emissions and emission intensities.

In numbers there were more findings within individual risks than opportunities connections to emission performance, and most of these relationships were from the physical risk category. The regulative risks and opportunities affected the direct emissions and emission intensities the most, while physical and other risks and opportunities influence focused almost only to indirect emissions, with few exceptions. Nevertheless, these regulative risks increasing the direct emissions are; air pollution limits, emission reporting obligations and voluntary agreement. Such risks are certainly not barriers to carbon management, but instead show that organizations with higher emissions distinguish these as their risks because they are reluctant in decreasing these emissions. The regulative risks that can be perceived as actual institutional barriers, were renewable energy regulation e.g. uncertainty in such, and lack of regulation. The institutional drivers from the regulative opportunities identified were cap and trade schemes, and emission reporting obligations. The physical categories findings from both risks and opportunities were all related to evident results of climate change and global warming, these are such that we cannot alter and will transpire if emissions are released in prevailing methods. As a result, the physical risks cannot be categorized as institutional barriers to carbon management, but neither can the opportunities; change in mean temperature or snow and ice, distinguished as clear institutional drivers although they were linked to improved emission performance. While the influences to emission performance of physical category are very inconsistent, the high number of relationships to emission performance (mostly indirect) suggest that the category as a whole is an institutional driver to carbon management. Companies have started to notice and experience the influences of climate change related matters creating risks (and opportunities) for them, demanding action and similarly driving them towards carbon management. The findings from the "other" category indicate that it does not offer neither institutional drivers or barriers to carbon management through the contradictory relationships to emission performance. Only the risks were related to emission performance, but findings of reputation, increasing humanitarian demands and fluctuating socio-economic conditions are not true barriers to carbon management. Instead they reflect reluctance to carbon management, especially reputation.

Companies risk management procedures were also distinguished functional and yielded results, and it had also increased throughout the years. Companies in operating in different sectors were also identified of experiencing risks and opportunities in different quantities. Also the larger companies identified especially more opportunities, and to some extent more risks as well.

Table 6. Risk and opportunities influence to emission performance, and change

Institutional drivers and barriers

	Regulative		**Physical**		**Other**	
	Risks	Opportunities	Risks	Opportunities	Risks	Opportunities
Direct emissions	↑	↓ & ↑	↓ & ↑	-	↑	-
Indirect emissions	↓	-	↓ & ↑	↓	↓ & ↑	↓ & ↑
Direct emission intensities	↑	-	↑	-	-	-
Indirect emission intensities	↓	-	↓ & ↑	↓	-	-
Risk and opp. direction 2010 -> 2015	↓	↓ & ↑	↑	↑	↑	↑

4.4.3 Directions in institutional drivers and barriers

The directions within institutional drivers and barriers are not straightforward either as a result of the previous hypotheses findings. In numbers the regulative risks and opportunities had experienced the most significant decrease (especially the risks), and the clearest growth was identified from the physical and other-climate related risks and opportunities. The table 6 summarizes such findings. Nevertheless, as the Figure 8 and 9 indicate regulative risks are still the highest separate category with twice as more risks and opportunities compared to physical and other categories although the trends are altering. In addition, interesting highlights are renewable energy regulation and reputation where both risks and opportunities have grown, and increasing opportunities distinguished from changing consumer behavior.

The findings from regulative, physical and other risks and opportunities further descriptions also revealed similar growing trends. The identified words were brought in increasing manners in the recent years, especially with physical and other risks and opportunities while few declining words were discovered. Also most of the findings were from the physical risk and opportunity category, in line with above results. The recent trends within regulative risks lie in themes of decreasing emissions and related regulations, lawsuits, and global operations. In terms of regulative opportunities, the trends focus also towards decreasing emissions, clean energy, and disposal of wastes. Overall, the physical risk and opportunity themes focus towards associated topics of climate change, global warming and ecosystems. In addition, physical risks concentrate to emissions and pollution causes, natural disasters, and biofuels (most likely due to the source of raw material extraction). While physical opportunities deliberate topics of sustainability, natural resources, biotas and greenhouse gasses. The trends of other climate-related development risks and opportunities are a mixture of varying subjects. The risks consist from topics of reputation, emission mitigation through regulations, physical climate changes, sustainable investing and renewables. The opportunity themes vary between sustainable investing, soft laws, mitigating emissions and clean energy.

4.4.4 Emission performance

The emission performance has not changed between the years 2010 and 2015, except in Utilities and Material sectors where the emission performance has decreased as a result of increasing emission intensities throughout the years, as we can see from the Table 7 summarizing the findings. Also the investments to carbon management have not altered in relation to the calendar year. While the emission intensity had increased in the Utilities sector, more investments to carbon management in this sector were also made. Companies that have higher revenues and profitability invest more to carbon management. This supports to some extent the discovery of emission intensities being lower amongst profitable companies, hence they likewise invest more to carbon management. Liquidity or solvency figures did not affect the investments in carbon management. As a result, the institutional diffusion of carbon management cannot be distinguished through the emission performance.

Table 7. Institutional diffusion of carbon management: Emission performance

Institutional diffusion of carbon management: Emission performance

		2010 -> 2015		
	2010 -> 2015	Utilities	Materials	
Direct emissions	-	-	-	
Indirect emissions	-	-	-	
Direct emission intensities	-	↑	-	
Indirect emission intensities	-	-	↑	
	2010 -> 2015	Utilities	Net sales	EBIT
Investments to carbon management	-	↑	↑	↑

4.4.5 Width and depth of carbon management diffusion

The width and depth of carbon management diffusion findings are controversial; these are summarized in Table 8. The isomorphism, hence similar structure for carbon management was identified amongst sectors and reported data from countries, through the CM Index findings. The only clear influencer to carbon managements structure was the company size, hence larger companies have to some extent greater CM Index. CM Index results were also rising throughout the years signifying improved carbon management actions, while the average scores remained quite low and below 50 out of maximum 100. The different components of CM Index also had a diverse influence to emission performance, but not the expected differing decreasing effect since these actions also increased the emissions. Majority and similarly the most popular different activity types for decreasing emissions did decrease the direct emissions and emission intensities principally next year or after two years. The methods for driving investments in decreasing emissions had more fluctuating influence to emission performance experienced mostly next year and after two years, although the most popular methods were connected to decreasing emissions. The discoveries from activity types and methods support the isomorphic structure for carbon management being present amongst the analysis groups companies. Regarding the targets for improving emission performance only the emission intensity target resulted in decreased emissions the same year, while absolute targets and emission reduction initiatives did not have an effect. However, purchasing originated carbon credits did not influence emissions at all, and the rest of the components emission verification and participation to emission trading decreased the emission performance. Such outcomes bring in uncertainty towards companies' carbon management actions, and lead to the verdict of decoupling carbon management actions from structure occurring.

The higher CM Index scores did not result in improved emission performance, instead they had the reverse influence, and higher CM Index scores resulted in greater indirect emissions now and in the future. Also the findings from emission performance indicate that the analysis group companies are not decreasing emissions, while at the same time these carbon management actions are increasing amongst them as a result of developing CM Index scores. The discovery of companies disclosed emission change being consistent with the announced emission is not enough to decline the decoupling from transpiring. As a whole, the carbon management actions companies take are decoupled from actual structure since they are not connected to increased emission performance. Although some carbon management actions are identified of improving the emission performance, in large picture these improvements do not create concrete outcomes. In conclusion, the width and depth of carbon managements institutional diffusion is debatable. The isomorphic structure in carbon management has been achieved in some level, thus carbon management has diffused between the analysis group companies. However, this diffused carbon management structure along with low average scores does not lead to improved emission performance and has resulted in decoupling, which points out that the institutional diffusion of carbon management is far from complete.

Table 8. Width and depth of carbon management diffusion

Institutional diffusion of carbon management: Width and depth of carbon managements diffusion

	Sectors	Countries	Employees	2010 -> 2015	Average		
CM Index	-	-	↑	↑	48/100		
	CM Index	Activity types	Methods	Emission verification	Participate to ETS	Originated carbon credits	Emission intensity reduction targets
Direct emissions	-	↓ & ↑	↑	-	-	-	↓
Indirect emissions	↑	-	↑	-	↑	-	-
Direct emission intensities	-	↓	↓ & ↑	↑	-	-	-
Indirect emission intensities	-	-	↓	↑	-	-	-

5. CONCLUSIONS

5.1. Discussion

5.1.1 Drivers and barriers in institutional change to carbon management

Mechanisms

The purpose of this chapter was to study the mechanisms, pressures and the direction of the institutional change to carbon management in order to reveal the processes related drivers and barriers. The first theoretical observation tested in the analysis was emission performances connection to financial performance. However, such findings that would support the theories of financial performance being linked to improved emission performance presented by Gonzales (2005) and Luo and Tang (2016), were not discovered in the empirical part. Companies financial health or the larger size of the company indicating greater resources, was not linked to engaging in carbon management and is not supported for being a driver or a barrier to carbon management. What was discovered is that carbon management with the prevailing methods applied by the forerunner companies is not cost-efficient, and does not generate the desirable results of lower emissions and greater financial performance what Gonzales (2005) and Luo and Tang (2016) suggested. Engaging in carbon management and controlling emissions seems to be expensive instead. These support the theoretical deliberations of Gonzales (2005) pointing out that there is a conflict between the changed preferences of mitigating climate change and the changes in relative prices; the internal costs do not decrease through carbon management and as a result it is not at present linked from the economic perspective to the wealth maximization objective of companies, which creates substantial barriers for the institutional change to carbon management. Profit is a significant incentive to adopt carbon management solutions, as Okereke (2007) and Figueiredo and Guillén (2012) pointed out. While the companies' maximization objectives of economic results are not related to carbon management, the mechanisms in institutional change to carbon management has to rely on changes in preferences which makes the process slower. The change is reliant on both mechanisms and generates inefficiencies to the institutional change process if these two are conflicting.

Functional pressures

The functional, political and social pressures that the institutional mechanisms generate were also analyzed in the empirical part. These pressures were translated to drivers and barriers which were then further analyzed through companies' perception of risks and opportunities from the institutional environment. The hypothesized idea of connecting carbon management direct outcomes of emission performance results to drivers and barriers did not realize as expected, but inferences could still be made since the fundamental idea of risks being the barriers and opportunities the drivers still remains. The functional pressures were already partly analyzed throughout the above findings from financial performance, which did not prove the theoretical deliberations of carbon management being connected directly to economic results and increased efficiency. From the other climate-related development category no connections to market conditions, suggested by Gonzales (2005) and Okereke (2007) to exist, were not discovered that could be distinguished as either institutional drivers or barriers to carbon management. Companies did highlight the market condition reputation as a risk with related higher emissions as well, but perceiving reputation as a risk signals that companies with higher emissions are unwilling to engage in carbon management. Reputation should instead be considered as an opportunity, which would at the same time indicate eagerness to carbon management. The functional pressures do not reveal any institutional drivers and barriers to carbon management, therefore there are no functional pressures in carbon management that would cause the companies to mold the prevailing institutional structure of business as usual to the direction of carbon management.

Institutional change to carbon management is therefore missing its central element of the change deriving from internal elements e.g. experienced improvements to maximization objective in terms of economic benefits, and relies largely only to external pressures since neither the markets do not pressure companies towards carbon management. As the internal pressures to institutional change are missing, the external pressures coming from political and social basis have to be highly robust in order for the change to transpire. The missing functional pressures hinder the change process significantly and make the development at least gradual, hence why would companies want to change if it hinders their maximization objectives, and is additionally not rewarded by the market? The economic aspect, incentive alignment and everyone's contribution essential for institutional diffusion of carbon management discussed by Figueiredo and Guillen (2012) do not actualize by the empirical findings.

Political pressures

Analysis of the political environment did reveal particular matters; in example there is a prevailing reluctance towards managing carbon emissions amongst the forerunner companies in carbon management. This was recognized through the companies perceiving regulations that support decreasing emissions and thus carbon management as their risks while having at the same time higher direct emissions, which certainly could not be translated as institutional barriers to carbon management from the political pressures. This might however create the distinguished institutional barrier that companies are lobbying the business as usual in the political environment. It was distinguished by Scott (2014) that companies use their resources to alter the institutional environment and -constraints in order to advance their wealth maximization objectives. As the companies are reluctant towards the political environments push to carbon management, they might be using their resources for preserving the business as usual if it is better from their wealth maximization objectives perspective at present. Also the findings from functional pressures support such, however any other concrete evidence supporting these speculations could not be retrieved from the empirical findings. Actual institutional barriers from the regulative perspective were identified from renewable energy regulations and similarly lack of regulation, which both might be as a result of the distinguished uncertainty in the political environment e.g. through changing governments, which carbon management technologies are supported and lacking a strong policy framework to support carbon management, also identified by Gonzales (2005) and Okereke (2007). Companies that are eager towards carbon management are therefore missing the push, consistency and support of the regulative environment to make in example the large investments to carbon management, therefore hindering the ongoing institutional change process.

Actual institutional drivers from the political environment could also be recognized, these were cap and trade schemes providing economic motivations to carbon management, and emission reporting obligations which was connected to companies with larger direct emissions, showing that they perceive disclosing their emissions positive matter perhaps through being able to show the progress in carbon management, and gain leverage and trust of the stakeholders. Distinguished regulative institutional drivers and barriers towards carbon management remained minor, at least when measuring such through emission performance. Therefore, the theoretical argument proposed by Gonzales (2005), Horbach et al. (2012), Okereke (2007) and Luo and Tang (2016) of regulative environment being one of the most influential factor in institutional change to carbon management is not supported by the findings from political pressures. These empirical findings indicate that the institutional change to carbon management is largely reliant on social pressures, and therefore the altered preferences. However, the largest in quantity of identified risks and opportunities (drivers and barriers) is still the regulative category indicating that its influence is significant amongst the analysis group companies, but this is deliberated further in the direction chapter.

Social pressures

The social pressures, thus institutional drivers and barriers in institutional change to carbon management, were discovered from the physical climate change and the other climate-related developments categories. The findings of risks and opportunities from the changes in physical climate parameters had most of the findings in relation to emission performance, and were related to the physical changes and damages what the climate change and global warming cause. As already deliberated in the summary of the analysis results, the findings from physical climate changes category are not institutional barriers to carbon management, instead both the risks and opportunities act as drivers towards the institutional change in such. This was also supported by the theoretical findings of Luo and Tang (2016); these physically experienced changes and related damages push companies to adopt carbon management. Despite the emission performances connections were unclear, the fact that most of the connections to emission performance (whether positive or negative) were from the physical category demonstrate that the outcomes of climate change and global warming are taken seriously and generate tangible risks and opportunities to companies. While carbon management is certainly the solution for managing these, it similarly shows that companies are influenced by the Okereke (2007) identified social pressures of ethical considerations and fiduciary obligations to mitigating climate change that correspondingly drive the institutional change to carbon management.

The findings of the other climate-related category offered controversial results showing both unwillingness to carbon management, but similarly supported the finding of ethical considerations towards social aspect of climate change in companies exist. This reluctance towards carbon management was discovered from the social pressures through companies perceiving ethical considerations related matters delivering risks to their operations. Such findings show that climate changes affects to the social environment have been noticed and companies consider that these ethical related matters create e.g. costs for their operations. This can be interpreted as pessimism towards climate change, and therefore to some degree also as unwillingness to carbon management. Nevertheless, noticing that such ethical considerations of the social aspect are tangible risks and influential towards the company’s operations is at the same time a positive discovery. Likewise, as the physical risks, identifications of these ethical considerations as risk can be interpreted as an indirect institutional driver to carbon management; because they are identified it proves that ethical considerations in companies are present, these risks in companies have to be managed and the solution for managing the risks is ultimately carbon management. Therefore, supporting to some extent the Gonzles (2005) and Okereke (2007) highlighted market pushes as well.

Any direct drivers from the other climate-related development category in relation to emission performance and thus carbon management were not distinguished. Also the voluntary participation to CDP and therefore disclosing climate change related data displays that the recognition of the society, ethical considerations and fiduciary obligations push companies towards carbon management. Altogether these also create image benefits which improve the maximization objectives in companies, however direct linkages to these functional pressures could not be made in the empirical findings. Nevertheless, in total the analysis results support the theoretical findings by Gonzales (2005), Okereke (2007) and Luo and Tang (2016) of social pressures creating institutional drivers to carbon management, while institutional barriers were not discovered. These findings of social pressures affect are important since the social pressures are strong influencers within the carbon managements institutional change to the normative and culturally-cognitive basis. Also the empirical findings of missing functional and vague political pressures indicate that if the social pressures would be absent as well, the institutional change to carbon management could not transpire. In addition, the social (people), environment (planet) aspects, and associated incentive alignments vital for the institutional diffusion identified by Figueiredo and Guillen (2012) are present. However, the institutional change process of carbon management as a whole and considering the systemic approach to institutional diffusion; both are missing significant elements making the changes development path and therefore diffusion outcome presumably inefficient.

Direction

The direction of the institutional change to carbon management was defined of being influenced by increasing returns and imperfect markets, these are formed as a result of the mechanisms and related pressures discussed above. Therefore, the above findings have to be connected the direction likewise, which bring the identified divergences towards the direction in institutional change to carbon management. The political pressures and related regulative opportunities and risks (drivers and barriers) category offers in quantity most of the findings and therefore could be considered as one of the most influential aspect to the institutional direction of carbon management, what also the theoretical findings of Gonzles (2005), Okereke (2007), and Luo and Tang (2016) argue. When looking more profoundly what these regulative risks and opportunities are in addition to emission performance connections, we can see that the theoretical findings are not completely supported. The regulative findings only showed reluctance of managing carbon emissions and therefore reluctance in the institutional change direction to carbon management. However, the analysis of the direction reveals that overall the regulative environments influence is decreasing considerably. The reluctance, actual barriers of uncertainty, but also the drivers of economic incentives (and therefore direct increasing returns), are all decreasing. The declining trend did not concern the renewable energy regulations created influence to the direction which offers both drivers to carbon management and barriers of uncertainty in slightly increasing manners. These declining discoveries indicate that companies have accepted the long-run directions of low-carbon economy, and adapted to the altering environment of conducting business with associated stabilizing of regulative environment. The trends of the regulative environment point out to the right direction of carbon management related matters of e.g. decreasing emissions and clean energy, but not in robust manners that would influence its direction significantly. The Gonzales (2005) and Okereke (2007) deliberated uncertainty prevailing carbon management technologies and regulations relationship can be distinguished from the rising renewable energy regulation risks, but similarly the increasing opportunities of such show that the political environment influences this positively too. The long-run direction of low-carbon economy through 2050 targets is an evident driver of the institutional changes direction of carbon managements, but it cannot be taken for granted as noticed through the prevailing uncertainty. Despite in declining trends the regulative environment still offers increasing returns through cap and trade schemes, and similarly the regulative environment facilitates but also hinders the market conditions prevailing carbon management technologies development as there are uncertainties of which development path to take and advance.

The findings from changes in physical climate conditions indicate that these are the most influential category of the institutional changes direction as well. The trends are identified only increasing, and the profounder analysis showed that climate change and global warming without doubt impact and raise discussion in companies. The increasing trends show that internal capabilities, and related environmental strategies exist in companies. Although technological competency nor the absorptive capacity cannot be distinguished, the findings of internal capabilities are significant stimulus in the institutional direction taken. Without Okerekes (2007) identified internal capabilities existing in companies, the long-run path of carbon management is certainly inefficient. The ethical consideration discoveries from the social pressures also indicate that increasing returns can be linked to carbon management, but these actualize indirectly while the direct increasing returns from emission performances missing connection to economic performance might be hindering the institutional changes direction. The impact of other climate-related developments categories is still minor in comparison to the regulative or physical, but its influence is increasing amongst the analysis groups companies. Findings reveal that the market conditions are altering towards rewarding carbon management actions and offering therefore possible direct increasing returns for companies engaging in such, supporting Gonzales (2005) and Okereke (2007) findings. Nevertheless, also the reluctance against these market condition changes to carbon management was noticed of increasing.

In total the increasing returns were vaguely and within the empirical findings only indirectly connected to the institutional changes direction in carbon management. The empirical findings identified that the prevailing market conditions through functional and political pressures of carbon managements institutional direction are missing or minor. While the social pressures were existing the overall findings indicate imperfect markets with high transaction costs thus shattered information feedback. These results suggest that the markets are not competitive enough in directing the carbon managements institutional change towards an efficient path creating concrete outcomes. Companies do possess the internal capabilities, but in example the technological competency cannot be confirmed. The long run direction of low-carbon economy is clear but does not come without obstacles, not even from the regulative directions perspective of how to reach such targets. The empirical findings point out that the institutional change mechanisms, required pressures, and increasing returns and market conditions are in total excessively disorganized and absent creating inefficiencies to the long-run path of the institutional change to carbon management. Also the lock-in as a result of the positive feedback of the institutional development path of business as usual and the associated technological development path both at present are compelling, which complicates and hinders the carbon managements institutional change. The change is evidently emerging and ongoing, but is it enough to reach the 2050 targets of preserving our planet remains unclear, this will be further pondered next under the institutional diffusion of carbon management.

5.1.2 Institutional diffusion of carbon management

As discussed, the inefficiencies in the carbon managements institutional change development path are reflected to the width and depth of the institutional diffusion of carbon management. The discoveries revealed that the institutional isomorphism in carbon management is present amongst the forerunner companies. This points out that institutional diffusion mechanisms increasing returns, -commitments and -objectification, and the associated pressures of coercive, normative and mimetic, have to all be present. Otherwise the isomorphism in carbon management could not have been achieved. However, the empirical findings discovered that the institutionally diffused isomorphic structure in carbon management amongst the forerunner companies is not efficient. The analysis revealed that the emission performance is not improving, the carbon management index average scores are low although on an increasing trend, and carbon management actions are decoupled from the actual structure. The identified inefficiencies and issues in the institutional change development path of carbon management materialize to the absent concrete outcomes, which raise substantial concerns towards low-carbon economy targets. The observed issues have resulted in institutional diffusion of ineffective carbon management, which is the companies' response to the altered preferences. At present the carbon management is made to comply with the societies expectations, the rationalized myths of what is a proper structure for an organization.

What was already pondered through the theoretical findings from Gonzales (2005), Okereke (2007) and Luo and Tang (2016), and confirmed by the empirical findings, is that most of the issues with carbon managements institutional diffusion lay in the mechanism increasing returns explaining why the diffused structure is inefficient and carbon management is subject to decoupling. Hindering this institutional diffusion mechanism are the missing; relationship of economic performance and carbon management, the market pressures although vaguely increasing, and strong coercive pressures with associated uncertainty. Also lacking the internal resources may be hindering the diffusion, as pointed out the larger size increases the carbon management index, and greater revenues (size) and profitability increase the disclosed investments to carbon management which however does not create concrete results in the larger picture. Such empirical findings are contradictory to the size and profitability's influence to absolute emissions which were noticed to increase such, but at the same time decrease emissions when measuring through emissions per generated revenue. What this means is that carbon management is eventually too expensive for decoupling the economic performance from the environmental affect created. There is a trade-off between these two from which companies are bound to choose. Either you increase the economic performance, or you increase the environmental performance with the cost of economic performance. At present carbon management is not connected directly to increasing returns, which considerably hampers its institutional diffusion from the companies' wealth maximization objectives perspective, creating misaligned incentives and missing profit from the triple bottom line discussed by Figueiredo and Guillen (2012). However, there were also positive observations that facilitate the increasing returns diffusion mechanism through the fiduciary obligations and ethical considerations that can indirectly create economic benefits as discussed. These together with the altered preferences most likely have driven the institutional isomorphism in carbon management from the increasing returns perspective. While the profit aspect is missing, the people and planet aspects also deliberated by Figueiredo and Guillen (2012) important for carbon managements institutional diffusion exist through ethical considerations and fiduciary obligations (social and environmental).

The increasing commitments and –objectification with related normative and mimetic pressures are more challenging to distinctly reveal through the analysis. These are influenced by the normative and culturally-cognitive aspects of institutions, from which the changed preferences to climate change mitigation influence to a great extent. Clear signs of these mechanisms and pressures are evidently the attained institutional isomorphism of carbon management although inefficient, where these mechanisms and pressures play a central role. The altered norms and values through social pressure findings were identified from the participation to CDP, fiduciary obligations and ethical considerations. In addition, noticed by Scott (2014) the density of the isomorphic carbon management structure is the sign of its cognitive status, and therefore the mimetic pressures have carried carbon managements diffusion to the cultural-cognitive basis. Although the increasing returns related to the maximization objective are necessary, the increasing returns are partly the result of the norms and culture which ultimately define what the objective is and the means to achieve it. Likewise, the regulations and thus coercive pressures are the reflection of prevailing norms, values and thus cultural-cognitions. If carbon management has diffused completely to the norms and culture, the empirical findings should show results since these are the strongest diffusion mechanisms though the diffusion with these two mechanisms only is more gradual. While the empirical discoveries did show some reluctance towards these social pressures but not actual institutional barriers, these solely cannot explain why the institutional diffusion of carbon management does not create concrete results and related actions are ultimately decoupled from companies' structure.

Why the resulted isomorphic structure in carbon managements institutional diffusion is at present inefficient is largely due the empirical and theoretical findings identified issues of the inefficient institutional change development path, which have reflected principally to the diffusion mechanism increasing returns. In the end the reasons for these issues lies within the theoretically deliberated issues originating from the prevailing unsustainable business as usual, lock-in to unrenewable energy sources, and diffusion cycle problem of carbon management technologies. We can indirectly notice through the empirical findings that the business as usual offers better increasing returns in terms of companies' maximization objective. Also in example the fossil fuels are strong and obligatory part of our economies. Therefore, the norms and culture have not completely altered, because at present we could not survive and prosper without conducting "business as usual" and associated unrenewable energy sources. The prevailing carbon management solutions are not efficient enough that they would be able to correspond with the whole global economy's needs. Neither does the institutional environment except such, which the 2050 targets demonstrate; we can still increase our emissions globally before we have to start declining them. As a result, companies can engage in decoupling in order to correspond with conflicting institutional pressures; we still accept such behavior because we have to.

Due to the altered preferences towards carbon management, there are evidently high rewards for adopting such, as brought up in the theoretical findings e.g. gaining leverage to influence the institutional direction, image benefits, stakeholder approval just to mention few. This most likely explains why carbon management related activities are visible in almost every companies' website; the institutional environment requires this while it does not largely necessitate actual results and proofs of such, the established image of conducting carbon management seems to be enough. Nevertheless, progress in carbon management should already be visible especially amongst the forerunner companies considering reaching the low-carbon economy targets. If these innovative adopters' contributions of carbon management do not create tangible outcomes and lead to decoupling, what is the current state of the more important followers raises significant concerns. Reaching the 2050 targets of low-carbon economy is dependent of these followers, at present the results of this study do not show promising signs. However, as noticed and brought up by Figueiredo and Guillen (2012) achieving the highest adoption of carbon management is not possible without everyone's contribution. The foundation cannot only be top-down, but it similarly has to be bottom-up, indicating that organizations and countries contribution to carbon management is at the same time as important as it is ours, the peoples, contribution. At present the greatest drivers of the institutional diffusion of carbon management are ultimately the experienced physical changes due to climate change and global warming.

5.1.3 Summary

Drivers and barriers in institutional change to carbon management

- Mechanism
  - Changes in relative prices.
    - Financial performance not related to improved emission performance.
    - Carbon management not linked to wealth maximization objectives; expensive and not cost-efficient, the internal costs do not decrease.
  - The preferences have changed to mitigating climate change and thus carbon management.
    - Contradict with the changes in relative prices.

- Pressures
  - Direct functional pressures, and related institutional drivers and barriers not discovered.
    - Reluctance against carbon management discovered from the market conditions.
    - Functional pressures for changing the prevailing institutional structure of business as usual to carbon management missing.
  - Political pressures minor, reveal considerable reluctance towards carbon management related regulations.
    - Institutional drivers; economic and image benefits through regulations.
    - Institutional barriers; uncertainty in the regulative environment, and support of carbon management technologies. Companies possibly lobbying against carbon management due to discovered reluctance.
  - Social pressures displayed the strongest influence, driven by altered preferences.
    - Institutional drivers from the physical outcomes of climate change and global warming. Participation to CDP, and ethical considerations and fiduciary obligations related to environmental and social aspect of climate change, create slight market pushes. Recognition of the society and the associated image benefits may create economic outcomes; result indirectly as functional pressures.
    - Institutional barriers not discovered. Discovered reluctance within the social aspect of ethical considerations; possible pessimism towards carbon management.

- Direction
  - Political pressures decreasing significantly. The most influential category, but mostly due to the reluctance towards carbon management regulation.
    - Institutional drivers, barriers and the reluctance decreasing.
    - Uncertainty and possibilities of carbon management regulations increasing.
    - Targets of low-carbon economy and stabilizing political environment.
  - The changes in physical climate conditions very influential, also increasing.
    - The greatest (and almost only) driver in the institutional change to carbon management.
    - Reveal that internal capabilities and environmental strategies in companies exist.
    - Market conditions influence increasing but still minor, also the reluctance against market pressures increased.
  - Increasing returns only vaguely connected. Markets not competitive enough; high transaction costs and associated shattered information feedback prevail.
  - Long run direction of low-carbon economy clear, but carbon managements institutional change development path inefficient.

Width and depth of carbon managements institutional diffusion

- Increasing returns and coercive pressures.
  - Most of the institutional change development paths identified issues reflected here.
  - Increasing returns not connected to carbon management, missing: the relationship of economic performance and carbon management, market pressures and strong coercive pressures (uncertainty prevails).
  - Trade-off between economic performance and environmental influence; companies have to select one while the other suffers.
  - Ethical considerations and fiduciary obligations may indirectly facilitate.

- Increasing commitments and objectification, related normative and mimetic pressures.
  - Isomorphic structure in carbon management a clear sign of these existing.
    - Without the mechanisms and related pressures not possible.
  - Driven by changed preferences to mitigate climate change.
    - Ethical considerations, fiduciary obligations and participation to CDP.

- Isomorphic structure in institutional diffusion of carbon management achieved.
  - Does not create concrete outcomes; emissions do not decrease.
    - Forerunners in carbon management decouple action from structure.
    - No differences between sectors or countries.
  - Carbon management made to comply with societies expectations due to altered preferences.
  - Physical climate change and global warming, and the resulted changed preferences are the main causes of achieved isomorphic structure in carbon management.

5.2. Theoretical contribution

This research offers theoretical contributions towards carbon management related studies of traditional diffusion, institutional change and institutional diffusion. The contribution comes from combination of all of these theoretical aspects and various approaches by researchers to interrelated models of institutional change and diffusion of carbon management, and also showing how connected these all are. For the traditional diffusion studies of carbon management, it is vital to understand how it is connected to the larger picture of the institutional level since these technological solutions of carbon management are compulsory part of our future, and achieving the wider institutional diffusion of such is obligatory. Through detaching the influencing parts of the strongly linked models of institutional change and diffusion of carbon management, and studying these separately the possible institutional drivers and barriers could be identified, and their interrelationships between the parts and the whole process could be recognized. Therefore, this researches theoretical contribution is important because further studies within the subject can be focused directly to where the prevailing issues existed and how we are able to overcome these problems, and broaden the positive influence of the facilitating matters. As a whole this is very significant, because it focuses to the low-carbon economy and associated 2050 targets, which are essential for preserving our planet.

The theoretical contribution is also targeted to addressing the Gonzales (2005), Okereke (2007) and Luo and Tang (2016) proposed idea of regulative pressures being the greatest influencer within the institutional change and diffusion of carbon management. Through studying the forerunner companies within carbon management we could identify that at present the regulative pressures are not the strongest actual incentives, but instead generate largely only reluctance towards such. Instead the changes in the physical environment, due to climate change and global warming, are the prevailing drivers within the institutional change and diffusion of carbon management. The altered preferences ascending from the norms and values are what instigated actual institutional drivers.

Also the empirical findings were able to demonstrate that at present carbon management is not cost-efficient, and where the possible institutional level problems lie related also to the regulative pressures. These discoveries are important because the further researches can be aimed at studying further why the regulative pressures large influence did not actualize, and how we can achieve such.

5.3. Managerial and policy implications

Managerial implications

Carbon management is the obligatory part of preserving our planet, and it is evident that every company has to eventually engage in such. The theoretical findings from authors Gonzales (2005), Okereke (2007), and Luo and Tang (2016) indicate that carbon management is related to in example; economic benefits, image benefits, increased efficiency, gaining leverage to influence the regulative environments development, trust of stakeholders, more motivated employees, attract investors and so forth. While this study did not discover directly such relationships to carbon management, other studies have indicating that these are possible to attain. The preferences have changed to mitigate climate change, and engaging in carbon management will eventually be rewarded by the market mechanisms likewise. The empirical findings of this study identified that such change is already transpiring. It was also discovered that higher profitability is connected to decreased emissions per revenue generated, while it points out the cost-efficiency issue in carbon management it is only matter of time when this will change to actual economic benefits being directly connected to improved emission performance. Being the early entrant may provide robust competitive advantages with the possibility to set the technological development paths course. The society does at present reward compliance in mitigating climate change because it expects such behavior, and the importance will only increase in the future considering the 2050 targets of low-carbon economy.

The empirical findings recognized several proven approaches to engage in carbon management that have created concrete outcomes of decreased emissions. Because these were applied by the forerunner companies in carbon management and at the same time were the most popular amongst them, it gives strong references of their functionality. First of all, setting up targets to decrease emission intensities was noticed to be efficient and resulted in emission reductions. Tangible targets are recommended to be set. Considering investments in carbon management related activities, it was noticed that using following methods to drive the investments resulted at the same time reduced emissions; compliance with regulatory requirements and standards, dedicated budget for energy efficiency and low carbon product R&D, and internal incentives and recognition programs. Such methods were efficient in terms of increasing the companies' emission performance, and are therefore recommended to be applied. The empirical findings also discovered direct carbon management activities that decreased emissions. These activities were; energy efficiency in processes and building services, low carbon energy installations, and fugitive emission reductions. Utilizing these carbon management activities are also recommended for companies.

Policy implications

The theoretical findings from Gonzales (2005), Okereke (2007), and Luo and Tang (2016) all highlight regulations being the most important incentive and facilitator in the institutional diffusion and adoption of carbon management. Nevertheless, these strong regulative pressures to carbon management were not discovered within the empirical findings. What is even more alarming is that forerunner companies in carbon management display prevailing reluctance towards carbon management related regulations. The empirical findings also highlighted the prevailing uncertainty amongst the regulative environment, while this was noticed decreasing together with the reluctance, so were the identified institutional drivers. The associated carbon management technologies specific regulations uncertainty and the possibilities were both increasing. As a result, there is clearly room for a stronger policy framework that is necessary to ensure that we achieve the low-carbon economy targets of 2050. While such targets have clearly influenced and directed the carbon managements institutional change and diffusion, the current development path is not efficient. The strong policy framework is necessary in example for companies being able to justify the large investments for engaging in carbon management. The most radical technologies, at the same time most beneficial, require the greatest investments which cannot be made if there is uncertainty from the regulative environment supporting such in the long-run.

Setting up the policy framework for carbon management requires that the prevailing uncertainty is diminished, also there has to be greater incentives in order to defeat the reluctance towards carbon management regulations. This policy framework has to consider incentive alignment of all the stakeholders as Figueiredo and Guillen (2012) suggest. Organizations are largely driven by their maximization objectives, and at present carbon management was not linked to such where the majority of the issues originated, the profit aspect of the carbon managements institutional diffusion is missing. Radical changes are therefore needed to address these issues, in example putting a price for carbon would change the situation rapidly. The policy framework could offer economic incentives and penalties for engaging in carbon management through setting significant prices e.g.

high taxes for releasing emissions, while providing tax reliefs to companies that progress in carbon management. As a result, the missing increasing returns would be directly linked to carbon management. Cap and trade schemes, and emission reporting obligations are at present the only actual institutional drivers to carbon management derived from the political pressures, related directly to economic benefits. The policy framework should take advantage of these, and the social aspect originating from climate change and global warming. At present these experienced physical changes are the strongest institutional drivers of carbon management. Also the policy framework can also influence the high transaction costs and shattered information feedback reflected directly to the carbon managements institutional diffusion, tackling such issues can be positively influenced by decreasing the uncertainty of the political environment and putting the price for carbon. These may also address the discussed diffusion cycle issue of carbon management technologies and these hindering positive feedback and lock-in to prevailing business as usual. In total, the strong policy framework may facilitate the institutional change development path of carbon management in becoming efficient.

5.4. Reliability and validity of the research

There are few matters what might hinder the reliability and validity of this research. First of all, the financial indicators used are very sector specific and thus influenced by the sector. In this study the sectors influence to financial indicators was not controlled. Also when calculating the emission intensities and investments to carbon management US dollar was used as a currency, and converting foreign currencies might weaken the reliability to some extent, although the most used currency was the USD. The separate elements of carbon management index were given equal weight, which does not fully correspond with the reality. Nevertheless, this was obligatory for constructing the index. Also the variables did positively correlate between each other, indicating that the carbon management index is functional. The research focuses only to years between 2010 and 2015 (from CDP 2011 to CDP 2016), and lengthening the research distance might offer more visible results and actual progress. This could also show better the results of the methods used to driving investments in carbon management, and carbon management activities applied by companies, since these influence most likely is visible after several years while now these could only be tested two years backwards in order to have enough observations to do such. Anyhow, the six years studied are a long period considering the continuously developing carbon management, which is already in itself a novel subject. Also the CPD climate change questionnaire has evolved significantly throughout the years, and expanding the time period could therefore decrease the reliability due to altered questions. Also few Hausman test issues could be observed within the random effects models which might influence the reliability and validity of the empirical results, as the test issue indicates that fixed effects model should applied. However, the time inconsistent control variables that instead increase the reliability of the empirical findings, demand that random effects models were used.

All in all, the quantitative approach was the correct choice for the data analyzed and the related quantitative methods were applied correctly. The applied panel regressions were specifically suitable and ideal for the data set that was collected between the six years' time-series, and studying these yearly developments. The observations of 252 companies throughout six years generate in total 1512 observations which are enough for applying quantitative methods, increasing the reliability of the research. The focus was within the top 100 largest emitters from CDP, and as shown in the introduction through the Figure 2 and 3, studying further was not necessary since the emission curves start to stabilize already after the top 20 emitters. As these top 100 emitters created over 12% of the global emissions in 2013, it establishes a reliable sampling regarding the institutional level carbon management activities. Also the reliability increases due to selecting the top 100 highest emitters each year by generating in total 252 companies, which were the top 100 highest emitters during the years 2010 to 2015. Also the data base is the world's largest and one of its kind concentrating to climate change related data, there is no other data set that would be able to provide such possibilities. As a result, the analyzed data is valid for studying the carbon managements institutional change and diffusion.

5.5. Future research proposals

Further research could focus to enlarging the timespan of this research, and focus further towards studying the carbon management index. It would be interesting to study the carbon management index influences and development from the beginning of CDP climate change program in 2002. Also the carbon management index could be developed more by adding different weights to variables, and possibly customizing the index to be sector specific by emphasizing factors that are important in terms of carbon management in this specific sector. As a result, the carbon management index could be developed as a global standard that would be able to generate a reliable and independent meter for measuring the company's progress within the carbon management actions. The CDP climate change program offers valuable and unique data that would be able to develop such.

The further research could be taken to understand more specifically why the increasing returns mechanism experiences the most issues and why the increasing returns do not actualize within carbon management, and how we are concretely able to achieve such in institutional level. Related also to the previous, the research should be taken to study how we can create a strong policy framework that supports carbon managements institutional change and development better in order to achieve the theorized strongest influence of regulations, e.g. put price to carbon, by Gonzales (2005), Okereke (2007), and Luo and Tang (2016). A suitable starting points for such would be to study why the leading companies in carbon management display reluctance towards associated regulations.

What would also be attracting to study are the methods used to drive investments in carbon management, and the applied carbon management activities. The empirical findings displayed how these are able to generate already concrete results of decreased emissions, but through expanding the time-series of the study it would be possible to see better how in example the methods for driving investments actualize. The same study methods could be applied to the emission reduction targets and initiatives. Also the risks and opportunities influence could be researched by similar methods of enlarging the time-series. Likewise, studying more specifically the further risk and opportunity descriptions, timeframes and impacts of such could bring in additional data about the institutional drivers and barriers to carbon management.

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APPENDICES

Appendix 1

Table 9. H1a Higher absolute emissions

H1a Higher absolute emissions

	Market cap	Gross profit	EBIT	Free cash flow
Absolute emissions SC1 +0	-	**0.163725****	**0.2460486****	0.1481757*
Prob > chi2	-	0.0000	0.0000	0.0000
Number of Obs / groups	-	939 / 189	1119 / 229	1120 / 229
Absolute emissions SC1 +1	-	-	-	0.1691405*
Prob > chi2	-	-	-	0.0000
Number of Obs / groups	-	-	-	937 / 221
Absolute emissions SC1 +2	-	-	**0.2076259***	-
Prob > chi2	-	-	0.0000	-
Number of Obs / groups	-	-	753 / 214	-
Absolute emissions SC2 +0	0.023477**	**0.054744****	**0.0735936***	-
Prob > chi2	0.0000	0.0000	0.0000	-
Number of Obs / groups	1061 / 215	930 / 188	1067 / 217	
Absolute emissions SC2 +1	**0.0209759****	0.0749062**	**0.1286522****	-
Prob > chi2	0.0000	0.0000	0.0000	-
Number of Obs / groups	897 / 211	790 / 185	903 / 212	
Absolute emissions SC2 +2	0.020326**	0.0722284**	**0.1356296****	-
Prob > chi2	0.0000	0.0000	0.0000	-
Number of Obs / groups	726 / 206	640 / 182	734 / 207	-

Significance 5% = *
Significance 1% = **
Hausman test reliability issue = **bold**
Financial figures: +0 year and scale 1000

Table 10. H1b Higher emission intensity

H1b Higher emission intensity

	Market cap	Gross profit	EBIT	EBIT margin %	Free cash flow	ROA %	ROE %
Emission intensity SC1 +0	(2.63e-09)**	**(6.94e-09)****	**(1.06e-08)****	(0.7768849)**	-	(0.8259936)*	**(0.065274)***
Prob > chi2	0.0000	0.0000	0.0000	0.0000	-	0.0000	0.0000
Number of Obs / groups	1111 / 226	939 / 189	1119 / 229	1119 / 229	-	1113 / 229	1097 / 228
Emission intensity SC1 +1	(2.55e-09)**	(4.12e-09)**	(1.13e-08)**	-	-	-	-
Prob > chi2	0.0000	0.0000	0.0000	-	-	-	-
Number of Obs / groups	926 / 218	792 / 185	934 / 220	-	-	-	-
Emission intensity SC1 +2	(2.55e-09)**	(2.98e-09)*	**(1.25e-08)****	-	-	(0.8196991)**	-
Prob > chi2	0.0000	0.0000	0.0000	-	-	0.0000	-
Number of Obs / groups	741 / 211	639 / 182	751 / 213	-	-	747 / 213	-
Emission intensity SC2 +0	-	**(1.69e-09)****	**(1.76e-09)****	(0.1533546)**	(9.11e-10)**	-	-
Prob > chi2	-	-	0.0000	0.0000	-	-	-
Number of Obs / groups	-	930 / 188	1067 / 217	1067 / 217	1068 / 217	-	-
Emission intensity SC2 +1	**(3.54e-10)***	(1.38e-09)*	**(2.22e-09)****	-	-	-	-
Prob > chi2	-	0.0000	0.0000	-	-	-	-
Number of Obs / groups	894 / 209	789 / 184	902 / 211	-	-	-	-
Emission intensity SC2 +2	(4.60e-10)*	(1.72e-09)**	**(2.90e-09)****	-	-	-	-
Prob > chi2	-	0.0000	0.0000	-	-	-	-
Number of Obs / groups	722 / 204	638 / 181	732 / 206	-	-	-	-

Significance 5% = *
Significance 1% = **
Hausman test reliability issue = **bold**
Financial figures: +0 year, scale 1000 (except %)

Appendix 1

Table 11. Control variables

Control variables

	Industrials	Materials	Utilities	Energy	Consumer Disc.	Servicessector	EmployeesFY
Absolute emissions SC1 +0	2.03e+07**	**2.63e+07****	**5.63e+07****	3.93e+07**	-	-	**30.41084****
Prob > chi2	0.0000	0.0000	0.0000	0.0000	-	-	0.0000
Number of Obs / groups	1124 / 230	1124 / 230	1124 / 230	1124 / 230	-	-	1124 / 230
Absolute emissions SC2 +0	(860635.7)*	3345814**	-	1838530**	-	1799870*	7.504608**
Prob > chi2	0.0000	0.0000	-	0.0000	-	0.0000	0.0000
Number of Obs / groups	1072 / 218	1072 / 218	-	1072 / 218	-	1072 / 218	1072 / 218
Emission intensity SC1 +0	0.5606204**	1.359452**	**3.819876****	0.4933903**	-	-	-
Prob > chi2	0.0000	0.0000	0.0000	0.0000	-	-	-
Number of Obs / groups	1122 / 229	1122 / 229	1122 / 229	1122 / 229	-	-	-
Emission intensity SC2 +0	-	**0.4034625**	-	-	-	-	-
Prob > chi2	-	0.0000	-	-	-	-	-
Number of Obs / groups	-	1070 / 217	-	-	-	-	-

Significance 5% = *
Significance 1% = **
Hausman test issue = bold

Appendix 2

Table 12. H2 Absolute emissions are higher when more risks are distinguished, regulative risks

H2 Absolute emissions are higher when more risks are distinguished
Regulative risks

	DY	EB	EF	EE	EJ
Absolute emissions SC1 +0	2258640*	2106593**	-	-	-
Prob > chi2	0.0000	0.0000	-	-	-
Number of Obs / groups	1124 / 230	1124 / 230	-	-	-
Absolute emissions SC1 +1	1966911*	-	3335124*	-	-
Prob > chi2	0.0000	-	0.0000	-	-
Number of Obs / groups	941 / 222	-	941 / 222	-	-
Absolute emissions SC1 +2	-	-	2686541*	-	-
Prob > chi2	-	-	0.0000	-	-
Number of Obs / groups	-	-	756 / 215	-	-
Absolute emissions SC2 +0	-	-	-	(702975.8)**	(791485.7)*
Prob > chi2	-	-	-	0.0000	0.0000
Number of Obs / groups	-	-	-	1072 / 218	1072 / 218
Absolute emissions SC2 +1	-	-	-	(453646.6)*	(901602.8)**
Prob > chi2	-	-	-	0.0000	0.0000
Number of Obs / groups	-	-	-	908 / 213	908 / 213
Absolute emissions SC2 +2	-	-	-	(629651)*	(1221413)**
Prob > chi2	-	-	-	0.0000	0.0000
Number of Obs / groups	-	-	-	737 / 208	737 / 208

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
DY = Regulative Risk driver: Air pollution limits
EB = Regulative Risk driver: Emission reporting obligations
EF = Regulative Risk driver: Voluntary agreements
EE = Regulative Risk driver: Product labelling regulations and standards
EJ = Regulative Risk driver: Lack of regulation

Table 13. H2 Absolute emissions are higher when more risks are distinguished, physical and other risks

H2 Absolute emissions are higher when more risks are distinguished
Physical- and other risks

	EQ	ER	EX	EY	EZ	FI	FK	FG
Absolute emissions SC1 +0	-	-	-	-	-	2934033*	-	-
Prob > chi2	-	-	-	-	-	0.0000	-	-
Number of Obs / groups	-	-	-	-	-	1124 / 230	-	-
Absolute emissions SC1 +1	-	-	-	-	-	-	-	-
Prob > chi2	-	-	-	-	-	-	-	-
Number of Obs / groups	-	-	-	-	-	-	-	-
Absolute emissions SC1 +2	(1510502)*	2116729*	-	-	-	-	-	-
Prob > chi2	0.0000	0.0000	-	-	-	-	-	-
Number of Obs / groups	756 / 215	756 / 215	-	-	-	-	-	-
Absolute emissions SC2 +0	-	-	**667906.5****	**(603624.3)***	**875554.2***	-	-	-
Prob > chi2	-	-	**0.0000**	**0.0000**	**0.0000**	-	-	-
Number of Obs / groups	-	-	**1072 / 218**	**1072 / 218**	**1072 / 218**	-	-	-
Absolute emissions SC2 +1	-	-	**668205.7****	-	**960934.5***	-	(484368.8)*	-
Prob > chi2	-	-	**0.0000**	-	**0.0000**	-	0.0000	-
Number of Obs / groups	-	-	**908 / 213**	-	**908 / 213**	-	908 / 213	-
Absolute emissions SC2 +2	-	-	889503.2**	(865615.2)*	-	(660558.4)*	-	946187.7
Prob > chi2	-	-	0.0000	0.0000	-	0.0000	-	0.0000
Number of Obs / groups	-	-	737 / 208	737 / 208	-	737 / 208	-	737 / 208

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
EQ = Physical climate parameters Risk driver: Change in mean (average) temperature
ER = Physical climate parameters Risk driver: Change in temperature extremes
EX = Physical climate parameters Risk driver: Tropical cyclones (hurricanes and typhoons)
EY = Physical climate parameters Risk driver: Induced changes in natural resources
EZ = Physical climate parameters Risk driver: Uncertainty of physical risks
FI = Other climate-related developments Risk driver: Fluctuating socio-economic conditions
FG = Other climate-related developments Risk driver: Reputation
FK = Other climate-related developments Risk driver: Increasing humanitarian demands

Appendix 2

Table 14. H2 Emission intensities are higher when more risks are distinguished, regulative- and physical risks

H2 Emission intensities are higher when more risks are distinguished
Regulative- and physical risks

	EH	EJ	EX	EQ	EV	EW	EY
Emission intensity SC1 +0	-	-	0.1048252*	-	-	-	-
Prob > chi2	-	-	0.0000	-	-	-	-
Number of Obs / groups	-	-	1122 / 229	-	-	-	-
Emission intensity SC1 +1	-	-	-	-	-	-	-
Prob > chi2	-	-	-	-	-	-	-
Number of Obs / groups	-	-	-	-	-	-	-
Emission intensity SC1 +2	0.2037304	-	-	-	-	-	-
Prob > chi2	0.0000	-	-	-	-	-	-
Number of Obs / groups	752 / 213	-	-	-	-	-	-
Emission intensity SC2 +0	-	(0.0353763)*	-	0.0429949*	(0.0183476)*	-	-
Prob > chi2	-	0.0001	-	0.0002	0.0002	-	-
Number of Obs / groups	-	1070 / 217	-	1070 / 217	1070 / 217	-	-
Emission intensity SC2 +1	-	(0.0706588)*	-	0.0264203*	-	(0.0351976)*	-
Prob > chi2	-	0.0000	-	0.0000	-	0.0000	-
Number of Obs / groups	-	905 / 211	-	905 / 211	-	905 / 211	-
Emission intensity SC2 +2	-	-	-	-	-	-	(0.0325757)*
Prob > chi2	-	-	-	-	-	-	0.0000
Number of Obs / groups	-	-	-	-	-	-	733 / 206

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
EH = Regulative Risk driver: Renewable energy regulation
EJ = Regulative Risk driver: Lack of regulation
EX = Physical climate parameters Risk driver: Tropical cyclones (hurricanes and typhoons)
EQ = Physical climate parameters Risk driver: Change in mean (average) temperature
EV = Physical climate parameters Risk driver: Snow and ice
EW = Physical climate parameters Risk driver: Sea level rise
EY = Physical climate parameters Risk driver: Induced changes in natural resources

Appendix 2

Table 15. H2a Absolute emissions are lower when more opportunities are distinguished, regulative-, physical-, and other opportunities

H2a Absolute emissions are lower when more opportunities are distinguished
Regulative-, physical- and other opportunities

	FY	FZ	GM	GR	HB	HC
Absolute emissions SC1 +0	(2008791)*	3586963**	-	-	-	-
Prob > chi2	0.0000	0.0000	-	-	-	-
Number of Obs / groups	1124 / 230	1124 / 230	-	-	-	-
Absolute emissions SC1 +1	-	3736705**	-	-	-	-
Prob > chi2	-	0.0000	-	-	-	-
Number of Obs / groups	-	941 / 222	-	-	-	-
Absolute emissions SC1 +2	-	-	-	-	-	-
Prob > chi2	-	-	-	-	-	-
Number of Obs / groups	-	-	-	-	-	-
Absolute emissions SC2 +0	-	-	-	-	**418735.7***	-
Prob > chi2	-	-	-	-	**0.0000**	-
Number of Obs / groups	-	-	-	-	**1072 / 218**	-
Absolute emissions SC2 +1	-	-	(325116.2)*	(437228)*	-	-
Prob > chi2	-	-	0.0000	0.0000	-	-
Number of Obs / groups	-	-	908 / 213	908 / 213	-	-
Absolute emissions SC2 +2	-	-	-	(764234.4)*	-	(393170.4)*
Prob > chi2	-	-	-	0.0000	-	0.0000
Number of Obs / groups	-	-	-	737 / 208	-	737 / 208

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
FY = Regulative Opportunity driver: Cap and trade schemes
FZ = Regulative Opportunity driver: Emission reporting obligations
GM = Physical climate parameters Opportunity driver: Change in mean (average) temperature
GR = Physical climate parameters Opportunity driver: Snow and ice
HB = Other climate-related developments Opportunity driver: Induced changes in human and cultural environments
HC = Other climate-related developments Opportunity driver: Fluctuating socio-economic conditions

Table 16. H2a Emission intensities are lower when more opportunities are distinguished, physical opportunities

H2a Emission intensities are lower when more opportunities are distinguished
Physical opportunities

	GM
Emission intensity SC1 +0	-
Prob > chi2	-
Number of Obs / groups	-
Emission intensity SC1 +1	-
Prob > chi2	-
Number of Obs / groups	-
Emission intensity SC1 +2	-
Prob > chi2	-
Number of Obs / groups	-
Emission intensity SC2 +0	-
Prob > chi2	-
Number of Obs / groups	-
Emission intensity SC2 +1	(0.0272368)*
Prob > chi2	0.0000
Number of Obs / groups	905 / 211
Emission intensity SC2 +2	-
Prob > chi2	-
Number of Obs / groups	-

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
GM = Physical climate parameters Opportunity driver: Change in mean (average) temperature

Appendix 3

Table 17. H2b Companies distinguish more risks and opportunities when risk and opportunity management is applied

	CC2.1	Industrials	Materials	Utilities	Energy	Consumer disc.	Services	Employees
All risk drivers total	**4.391439****	-	-	**2.741729***	**2.41192***	-	-	**2.39e-06***
Prob > chi2	**0.0000**	-	-	**0.0000**	**0.0000**	-	-	**0.0000**
Number of Obs / groups	**1327 / 234**	-	-	**1327 / 234**	**1327 / 234**	-	-	**1327 / 234**
Regulatory risk drivers total	**2.259491****	-	-	**1.168035***	**1.276235***	-	**1.307516***	-
Prob > chi2	**0.0000**	-	-	**0.0000**	**0.0000**	-	**0.0000**	-
Number of Obs / groups	**1327 / 234**	-	-	**1327 / 234**	**1327 / 234**	-	**1327 / 234**	-
Physical risk drivers total	**1.230453****	-	-	**1.126601***	-	-	-	-
Prob > chi2	**0.0000**	-	-	**0.0000**	-	-	-	-
Number of Obs / groups	**1327 / 234**	-	-	**1327 / 234**	-	-	-	-
Other risk drivers total	**0.9044583****	-	**0.5449188***	-	**0.658986***	-	-	**1.11e-06****
Prob > chi2	**0.0000**	-	**0.0000**	-	**0.0000**	-	-	**0.0000**
Number of Obs / groups	**1327 / 234**	-	**1327 / 234**	-	**1327 / 234**	-	-	**1327 / 234**
Opportunity drivers total	**2.963963****	-	-	-	-	-	**2.153526***	**2.54e-06****
Prob > chi2	**0.0000**	-	-	-	-	-	**0.0000**	**0.0000**
Number of Obs / groups	**1327 / 234**	-	-	-	-	-	**1327 / 234**	**1327 / 234**
Regulatory opp. drivers total	**1.325261****	-	**0.8751672***	**1.284292****	**1.256833****	-	**1.237271***	**1.50e-06****
Prob > chi2	**0.0000**	-	**0.0000**	**0.0000**	**0.0000**	-	**0.0000**	**0.0000**
Number of Obs / groups	**1327 / 234**	-	**1327 / 234**	**1327 / 234**	**1327 / 234**	-	**1327 / 234**	**1327 / 234**
Physical opp. drivers total	**0.7807068****	-	-	-	-	-	-	**6.58e-07***
Prob > chi2	**0.0000**	-	-	-	-	-	-	**0.0000**
Number of Obs / groups	**1327 / 234**	-	-	-	-	-	-	**1327 / 234**
Other opp. drivers total	**0.869238****	-	-	-	-	-	-	**4.22e-07***
Prob > chi2	**0.0000**	-	-	-	-	-	-	**0.0000**
Number of Obs / groups	**1327 / 234**	-	-	-	-	-	-	**1327 / 234**

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
CC2.1 Risk management procedures with regard to climate change risks and opportunities
Sector results are compared to Consumer staples sector

Table 18. H2b Risk and opportunity management has increased

H2b Risk and opportunity management has increased

	2010	2011	2012	2013	2014	2015
CC2.1	Comparison year	0.5665879*	0.6870606*	-	1.226226**	1.191608**
Prob > chi2	0.0004	0.0004	0.0004	-	0.0004	0.0004
Number of Obs / groups	1327 / 234	1327 / 234	1327 / 234	-	1327 / 234	1327 / 234

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
CC2.1 Risk management procedures with regard to climate change risks and opportunities
Yearly results compared to 2010

Appendix 4

Table 19. H3 Risks have increased throughout the years, regulative risks

H3 Risks have increased throughout the years
Regulative risks

	2010	2011	2012	2013	2014	2015
1	Comparison year	-	0.7346527*	-	-	-
Prob > chi2	0.0005	-	0.0005	-	-	-
Number of Obs / groups	1327 / 234	-	1327 / 234	-	-	-
2	Comparison year	-	-	-	(0.3914901)*	(0.6456919)*
Prob > chi2	0.0007	-	-	-	0.0007	0.0007
Number of Obs / groups	1327 / 234	-	-	-	1327 / 234	1327 / 234
2.1	Comparison year	-	-	(0.8984052)*	(1.377285)**	(1.228171)**
Prob > chi2	0.0000	-	-	0.0000	0.0000	0.0000
Number of Obs / groups	1327 / 234	-	-	1327 / 234	1327 / 234	1327 / 234
2.2	Comparison year	-	-	-	-	(0.817788)*
Prob > chi2	0.0017	-	-	-	-	0.0017
Number of Obs / groups	1327 / 234	-	-	-	-	1327 / 234
2.3	Comparison year	-	-	-	(0.9404484)*	(1.794347)**
Prob > chi2	0.0007	-	-	-	0.0007	0.0007
Number of Obs / groups	1327 / 234	-	-	-	1327 / 234	1327 / 234
2.4	Comparison year	-	-	-	(1.63536)*	(2.640148)**
Prob > chi2	0.0001	-	-	-	0.0001	0.0001
Number of Obs / groups	1168 / 206	-	-	-	1168 / 206	1168 / 206
2.5	-	Comparison year	26.78537**	27.70182**	27.43046**	27.32211**
Prob > chi2	-	0.0224	0.0224	0.0224	0.0224	0.0224
Number of Obs / groups	-	1101 / 234	1101 / 234	1101 / 234	1101 / 234	1101 / 234
2.6	Comparison year	-	-	-	(1.496331)*	(2.431425)*
Prob > chi2	0.0289	-	-	-	0.0289	0.0289
Number of Obs / groups	1327 / 234	-	-	-	1327 / 234	1327 / 234

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
Yearly results compared to 2010
1 = All risk drivers in total
2 = Regulatory risk drivers total
2.1 = Regulative risk driver: international agreements
2.2 Regulative risk driver: Cap and trade schemes
2.3 Regulative risk driver: emission reporting obligations
2.4 Regulative risk driver: Product labelling regulations and standards
2.5 Regulative risk driver: Renewable energy regulation
2.6 Regulative risk driver: lack of regulation

Appendix 4

Table 20. H3 Risks have increased throughout the years, physical- and other risks

H3 Risks have increased throughout the years
Physical- and other risks

	2010	2011	2012	2013	2014	2015
3	Comparison year	0.2160216*	0.4254181**	0.2909266*	-	-
Prob > chi2	0.0245	0.0245	0.0245	0.0245	-	-
Number of Obs / groups	1327 / 234	1327 / 234	1327 / 234	1327 / 234	-	-
3.1	Comparison year	-	1.499926**	1.490813**	-	-
Prob > chi2	0.0003	-	0.0003	0.0003	-	-
Number of Obs / groups	1327 / 234	-	1327 / 234	1327 / 234	-	-
3.2	Comparison year	0.7654319*	1.404672**	1.306777**	1.570136**	1.867769**
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Obs / groups	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234
3.3	Comparison year	-	0.8030024*	-	1.097637*	-
Prob > chi2	0.0461	-	0.0461	-	0.0461	-
Number of Obs / groups	1327 / 234	-	1327 / 234	-	1327 / 234	-
3.4	Comparison year	-	-	(1.98552)**	(2.126854)**	(2.087072)*
Prob > chi2	0.0042	-	-	0.0042	0.0042	0.0042
Number of Obs / groups	1327 / 234	-	-	1327 / 234	1327 / 234	1327 / 234
4	Comparison year	-	0.1993045*	-	-	-
Prob > chi2	0.0000	-	0.0000	-	-	-
Number of Obs / groups	1327 / 234	-	1327 / 234	-	-	-
4.1	Comparison year	0.8976789**	1.450245**	1.163881**	1.314387**	1.538976**
Prob > chi2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Number of Obs / groups	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
Yearly results compared to 2010
3 = Changes in physical climate parameter risk drivers total
3.1 = Physical climate parameters Risk driver: Change in temperature extremes
3.2 = Physical climate parameters Risk driver: Change in precipitation extremes and droughts
3.3 = Physical climate parameters Risk driver: Tropical cyclones (hurricanes and typhoons)
3.4 = Physical climate parameters Risk driver: Induced changes in natural resources
4 = Other climate-related development risk drivers total
4.1 = Other climate-related developments Risk driver: Reputation

Appendix 4

Table 21. H3 Opportunities have increased throughout the years

H3 Opportunities have increased throughout the years
Regulative-, physical- and other opportunities

	2010	2011	2012	2013	2014	2015
1	Comparison year	-	0.5835739**	-	-	-
Prob > chi2	0.0000	-	0.0000	-	-	-
Number of Obs / groups	1327 / 234	-	1327 / 234	-	-	-
2	Comparison year	-	-	-	-	-
Prob > chi2	0.0009	-	-	-	-	-
Number of Obs / groups	1327 / 234	-	-	-	-	-
2.1	Comparison year	(0.9442235)*	(1.009758)*	(1.24273)*	(1.645972)**	-
Prob > chi2	0.0009	0.0009	0.0009	0.0009	0.0009	-
Number of Obs / groups	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234	-
2.2	-	Comparison year	23.07514**	24.24259**	24.21592**	24.29368**
Prob > chi2	-	0.0260	0.0260	0.0260	0.0260	0.0260
Number of Obs / groups	-	1101 / 234	1101 / 234	1101 / 234	1101 / 234	1101 / 234
3	Comparison year	-	0.1937281**	0.1417919*	-	-
Prob > chi2	0.0000	-	0.0000	0.0000	-	-
Number of Obs / groups	1327 / 234	-	1327 / 234	1327 / 234	-	-
3.1	Comparison year	-	1.376888*	1.289515*	1.562894*	-
Prob > chi2	0.0058	-	0.0058	0.0058	0.0058	-
Number of Obs / groups	1327 / 234	-	1327 / 234	1327 / 234	1327 / 234	-
4	Comparison year	0.0955649*	0.221138**	0.2435882**	0.2505818**	0.2897487**
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Obs / groups	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234
4.1	Comparison year	0.6640816*	1.27328**	1.257014**	1.309694**	1.476339**
Prob > chi2	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
Number of Obs / groups	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234	1327 / 234
4.2	Comparison year	-	1.276524**	1.371509**	1.844363**	2.106463**
Prob > chi2	0.0000	-	0.0000	0.0000	0.0000	0.0000
Number of Obs / groups	1327 / 234	-	1327 / 234	1327 / 234	1327 / 234	1327 / 234

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
Yearly results compared to 2010
1 = All opportunity drivers in total
2 = Regulative opportunity drivers in total
2.1 = Regulative Opportunity driver: General environmental regulations, including planning
2.2 = Regulative Opportunity driver: Renewable energy regulation
3 = Physical climate parameters opportunity drivers total
3.1 = Physical climate parameters Opportunity driver: Change in temperature extremes

4 = Other climate-related developments opportunity drivers total
4.1 = Other climate-related developments Opportunity driver: Reputation
4.2 = Other climate-related developments Opportunity driver: Changing consumer behaviour

Appendix 5

Table 22. H3a Trends in regulative risks and opportunities

H3a Trends in regulative risks and opportunities

Regulative risks	2010	2011	2012	2013	2014	2015	Total count / %	chi2	P (2-tails)
INDC***					33,3 %	66,7 %	15 / 100%	35,000	0,000
Stability***			4,0 %	20,0 %	48,0 %	28,0 %	25 / 100%	27,560	0,000
Decarbonisation***	5,6 %	16,7 %			22,2 %	55,6 %	18 / 100%	24,000	0,000
Lawsuits***	15,8 %	15,8 %	21,1 %			47,4 %	19 / 100%	17,316	0,004
SGER***			5,6 %	38,9 %	33,3 %	22,2 %	18 / 100%	16,000	0,007
CE***	40,0 %	30,0 %	20,0 %	5,0 %	5,0 %		20 / 100%	15,400	0,009
Overseas***	60,0 %	20,0 %			10,0 %	10,0 %	10 / 100%	15,200	0,010
Imports**		10,3 %	10,3 %	17,2 %	31,0 %	31,0 %	29 / 100%	13,414	0,020
Regulative opportunities	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total count / %**	**chi2**	**P (2-tails)**
CSR***	78,3 %	8,7 %	8,7 %	4,3 %			23 / 100%	63,870	0,000
Gasification***	1,8 %	1,8 %		40,0 %	38,2 %	18,2 %	55 / 100%	57,036	0,000
Landfill***	5,3 %	5,3 %	2,6 %	44,7 %	42,1 %		38 / 100%	49,474	0,000
Decarbonisation***		5,3 %	5,3 %		42,1 %	47,4 %	19 / 100%	27,421	0,000
CNG***			5,6 %	5,6 %	44,4 %	44,4 %	18 / 100%	25,333	0,000
Biogas***	7,1 %			32,1 %	35,7 %	25,0 %	28 / 100%	22,143	0,000
CCGT**	5,6 %	11,1 %	22,2 %	16,7 %	44,4 %		18 / 100%	13,333	0,020
Hydro*			8,3 %	16,7 %	33,3 %	41,7 %	12 / 100%	11,000	0,051

Significance 1% = ***
Significance 5% = **
Significance 10% = *

Table 23. H3a Trends in physical risks and opportunities

H3a Trends in physical risks and opportunities

Physical risks	2010	2011	2012	2013	2014	2015	Total count / %	chi2	P (2-tails)
Greenhouse***	76,2 %	14,3 %	4,8 %			4,8 %	21 / 100%	55,286	0,000
Rainstrom***		46,7 %	40,0 %	6,7 %	6,7 %		30 / 100%	39,600	0,000
Windy***			14,3 %	19,0 %	47,6 %	19,0 %	21 / 100%	19,286	0,002
Biofuels***	7,1 %	21,4 %	21,4 %			50,0 %	14 / 100%	15,143	0,010
Ecosystem**	29,2 %	29,2 %	25,0 %	12,5 %	4,2 %		24 / 100%	12,000	0,035
Biomass**	36,4 %	36,4 %	27,3 %				11 / 100%	11,364	0,045
Flows**	4,8 %	12,7 %	23,8 %	19,0 %	25,4 %	14,3 %	63 / 100%	11,191	0,048
Earthquake*		7,1 %	28,6 %	35,7 %		28,6 %	14 / 100%	10,857	0,054
Groundwater*			8,3 %	25,0 %	25,0 %	41,7 %	12 / 100%	10,000	0,075
Physical opportunities	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total count / %**	**chi2**	**P (2-tails)**
GHG***	5,4 %	6,3 %	3,6 %	27,0 %	28,8 %	28,8 %	98 / 100%	53,811	0,000
Wood***			3,7 %	22,2 %	18,5 %	55,6 %	27 / 100%	36,778	0,000
CSR***	75,0 %	8,3 %	16,7 %				12 / 100%	31,000	0,000
Microbial***					50,0 %	50,0 %	10 / 100%	20,000	0,001
Sustainability***		9,1 %	21,8 %	25,5 %	14,5 %	29,1 %	55 / 100%	19,727	0,001
Pesticides***			10,0 %		50,0 %	40,0 %	10 / 100%	15,200	0,010
Pests***				10,0 %	50,0 %	40,0 %	10 / 100%	15,200	0,010
Food**	6,5 %	9,7 %	9,7 %	12,9 %	22,6 %	38,7 %	58 / 100%	13,710	0,018
Forest**	5,2 %	8,6 %	13,8 %	22,4 %	22,4 %	27,6 %	58 / 100%	13,586	0,018
Harvesting**	5,3 %		5,3 %	21,1 %	36,8 %	31,6 %	19 / 100%	13,526	0,019
Trees*			14,3 %	42,9 %	21,4 %	21,4 %	14 / 100%	10,857	0,054
Fibre*			10,0 %	20,0 %	50,0 %	20,0 %	10 / 100%	10,400	0,065
Mosquitoes*		5,0 %	20,0 %	15,0 %	30,0 %	30,0 %	20 / 100%	9,400	0,094

Significance 1% = ***
Significance 5% = **
Significance 10% = *

Appendix 5

Table 24. H3a Trends in other climate-related risks and opportunities

H3 Trends in other climate-related risks and opportunities

Other risks	2010	2011	2012	2013	2014	2015	Total count / %	chi2	P (2-tails)
Boycotts***				33,3 %	33,3 %	33,3 %	24 / 100%	24,000	0,000
Kyoto***	63,6 %	9,1 %	9,1 %	9,1 %	9,1 %		11 / 100%	17,909	0,003
Fertilizers***				37,5 %	31,3 %	31,3 %	16 / 100%	16,250	0,006
ESG***			7,7 %	7,7 %	46,2 %	38,5 %	13 / 100%	16,077	0,007
Advertising**			16,7 %	22,2 %	22,2 %	38,9 %	18 / 100%	12,000	0,035
Campaigns**		8,0 %	16,0 %	16,0 %	36,0 %	24,0 %	25 / 100%	11,720	0,039
Drought*				30,0 %	40,0 %	30,0 %	10 / 100%	10,400	0,065
ETS*		40,0 %	30,0 %	30,0 %			10 / 100%	10,400	0,065
Renewables*		7,1 %	7,1 %	21,4 %	21,4 %	42,9 %	14 / 100%	10,000	0,075

Other opportunities	2010	2011	2012	2013	2014	2015	Total count / %	chi2	P (2-tails)
CDP***		10,1 %	15,9 %	21,7 %	26,1 %	26,1 %	89 / 100%	21,696	0,001
Certification**		11,1 %	14,8 %	11,1 %	25,9 %	37,0 %	27 / 100%	13,667	0,018
ESG**			23,1 %	26,9 %	26,9 %	23,1 %	26 / 100%	13,231	0,021
Chlorine**			6,7 %	26,7 %	33,3 %	33,3 %	15 / 100%	11,800	0,038
Oxide*			23,1 %	7,7 %	38,5 %	30,8 %	13 / 100%	10,539	0,061
Hydro*		5,3 %	15,8 %	15,8 %	26,3 %	36,8 %	19 / 100%	10,368	0,065
Mill*		23,1 %	15,4 %	7,7 %	23,1 %	30,8 %	26 / 100%	10,000	0,075

Significance 1% = ***
Significance 5% = **
Significance 10% = *

Appendix 6

Table 25. H4b Emission intensities are decreasing

H4b Emission intensities are decreasing

	2010	2011	2012	2013	2014	2015
Emission intensity SC2 +0	**Comparison year**	-	**(0.0371085)***	-	-	-
	0.0000	-	**0.0000**	-	-	-
	1070 / 217	-	**1070 / 217**	-	-	-
	Utilities 2010	Utilities 2011	Utilities 2012	Utilities 2013	Utilities 2014	Utilities 2015
Emission intensity SC1 +0	3.067799**	3.013168**	3.163355**	2.854367**	3.15352**	3.494088**
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1122 / 229	1122 / 229	1122 / 229	1122 / 229	1122 / 229	1122 / 229
	Materials 2010	Materials 2011	Materials 2012	Materials 2013	Materials 2014	Materials 2015
Emission intensity SC2 +0	0.4055422**	0.375562**	0.3061748**	0.3558465**	0.3952577**	0.4796438**
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	1070 / 217	1070 / 217	1070 / 217	1070 / 217	1070 / 217	1070 / 217

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
Yearly results compared to 2010
Sector results compared to all other sectors

Table 26. H4c Investments to carbon management

H4c Investments to carbon management

	Net sales	EBIT	Utilities
CC3.3b	20.1978*	127.1683*	1.62e+09**
	0.0372	0.0267	0.0372
	838 / 198	836 / 198	838 / 198

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
CC3.3b Initiatives implemented in the reporting year Investment required
Yearly results compared to 2010

Appendix 7

Table 27. H5a CM Index results are similar across sectors and countries

H5a CM Index results are similar across sectors and countries

	Employees	South Europe	Participated CDP	2011	2012	2013	2014	2015
CM Index	0.0000142**	**(7.603662)****	0.5711915**	1.973306**	3.044837**	2.631544**	3.490383**	3.275007**
Prob > chi2	0.0450	**0.0080**	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001
Number of Obs / groups	1127 / 233	**1127 / 233**	1126 / 233	1127 /233	1127 /233	1127 /233	1127 /233	1127 /233

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
Sector results compared to Consumer staples sector (No statistically significant findings made)
Yearly results compared to 2010

Appendix 8

Table 28. H6a Emissions are lower when CM Index is higher

H6a Emissions (absolute and intensity) are lower when CM Index is higher

	CM Index
Absolute emissions SC2 +0	15738.92*
Prob > chi2	0.0000
Number of Obs / groups	1070 / 218
Absolute emissions SC2 +1	25372.77**
Prob > chi2	0.0000
Number of Obs / groups	861 / 205
Absolute emissions SC2 +2	32201.11**
Prob > chi2	0.0000
Number of Obs / groups	675 / 195

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**

Table 29. CC12.1 Decreased

CC12.1 Decreased	Decreased Combined gross global emissions (SC1 + SC2) change compared to previou 0	1	.	Total
0	396 86.46	51 10.10	174 31.69	621 41.07
1	57 12.45	446 88.32	96 17.49	599 39.62
.	5 1.09	8 1.58	279 50.82	292 19.31
Total	458 100.00	505 100.00	549 100.00	1,512 100.00

Pearson chi2(4) = 1.3e+03 Pr = 0.000

Table 30. CC12.1 Increased

CC12.1 Increased	Increased Combined gross global emissions (SC1 + SC2) change compared to previou 0	1	.	Total
0	454 87.98	59 13.20	108 19.67	621 41.07
1	54 10.47	383 85.68	162 29.51	599 39.62
.	8 1.55	5 1.12	279 50.82	292 19.31
Total	516 100.00	447 100.00	549 100.00	1,512 100.00

Pearson chi2(4) = 1.2e+03 Pr = 0.000

Appendix 9

Table 31. H7a Absolute emissions decrease through similar initiatives implemented in the reporting year by companies

H7a Absolute emissions decrease through similar initiatives implemented in the reporting year by companies

	CQ	CY	DA
Absolute emissions SC1 +0	(1278370)*	-	-
Prob > chi2	0.0000	-	-
Number of Obs / groups	1124 / 230	-	-
Absolute emissions SC1 +1	-	1658743*	(1179821)*
Prob > chi2	-	0.0000	0.0000
Number of Obs / groups	-	941 / 222	941 / 222
Absolute emissions SC1 +2	-	2114480*	-
Prob > chi2	-	0.0000	-
Number of Obs / groups	-	756 / 215	-

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
CQ = Initiatives implemented In reporting year, the Activity type: Energy efficiency: processes (763 / 1512)
CY = Initiatives implemented In reporting year, the Activity type: Behavioral change (243 / 1512)
DA = Initiatives implemented In reporting year, the Activity type: Other (272 / 1512)

Table 32. H7a Emission intensities decrease through similar initiatives implemented in the reporting year by companies

H7a Emission intensities decrease through similar initiatives implemented in the reporting year by companies

	CT	CP	CR
Emission intensity SC1 +0	-	-	-
Prob > chi2	-	-	-
Number of Obs / groups	-	-	-
Emission intensity SC1 +1	(0.08264)*	-	-
Prob > chi2	0.0000	-	-
Number of Obs / groups	937 / 220	-	-
Emission intensity SC1 +2	-	(0.0853342)*	(0.133781)**
Prob > chi2	-	0.0000	0.0000
Number of Obs / groups	-	752 / 213	752 / 213

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
CT = Initiatives implemented In reporting year, the Activity type: Low carbon energy installation (403 / 1512)
CP = Initiatives implemented In reporting year, the Activity type: Energy efficiency: building services (379 / 1512)
CR = Initiatives implemented In reporting year, the Activity type: Fugitive emissions reductions (145 / 1512)

Appendix 10

Table 33. H7b Absolute emissions decrease through similar methods used by companies to drive investment in emission reduction activities

H7b Absolute emissions decrease through similar methods used by companies to drive investment in emission reduction activities

	DN	DO	DP
Absolute emissions SC1 +0	-	-	-
Prob > chi2	-	-	-
Number of Obs / groups	-	-	-
Absolute emissions SC1 +1	-	-	-
Prob > chi2	-	-	-
Number of Obs / groups	-	-	-
Absolute emissions SC1 +2	**1709317***	-	-
Prob > chi2	**0.0000**	-	-
Number of Obs / groups	**756 / 215**	-	-
Absolute emissions SC2 +0	-	-	-
Prob > chi2	-	-	-
Number of Obs / groups	-	-	-
Absolute emissions SC2 +1	-	-	-
Prob > chi2	-	-	-
Number of Obs / groups	-	-	-
Absolute emissions SC2 +2	-	1225987*	773445.5*
Prob > chi2	-	0.0000	0.0000
Number of Obs / groups	-	737 / 208	737 / 208

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
DN = Method: Financial optimization calculations (366 / 1512)
DO = Method: Internal price of carbon (225 / 1512)
DP = Method: Internal incentives/recognition programs (298 / 1512)

Table 34. H7b Emission intensities decrease through similar methods used by companies to drive investment in emission reduction activities

H7b Emission intensities decrease through similar methods used by companies to drive investment in emission reduction activities

	DU	DJ	DP	DK	DI
Emission intensity SC1 +0	-	-	-	-	-
Prob > chi2	-	-	-	-	-
Number of Obs / groups	-	-	-	-	-
Emission intensity SC1 +1	0.1922897*	-	-	-	-
Prob > chi2	0.0000	-	-	-	-
Number of Obs / groups	937 / 220	-	-	-	-
Emission intensity SC1 +2	0.2247261*	(0.2005078)*	(0.146351)*	-	-
Prob > chi2	0.0000	0.0000	0.0000	-	-
Number of Obs / groups	752 / 213	752 / 213	752 / 213	-	-
Emission intensity SC2 +0	-	-	-	-	-
Prob > chi2	-	-	-	-	-
Number of Obs / groups	-	-	-	-	-
Emission intensity SC2 +1	-	-	-	(0.0391208)	-
Prob > chi2	-	-	-	0.0000	-
Number of Obs / groups	-	-	-	905 / 211	-
Emission intensity SC2 +2	-	-	-	-	(0.0422438)*
Prob > chi2	-	-	-	-	0.0000
Number of Obs / groups	-	-	-	-	733 /206

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
DU = Method: Other (312 / 1512)
DJ = Method: Dedicated budget for energy efficiency (614 / 1512)
DP = Method: Internal incentives/recognition programs (298 / 1512)
DK = Method: Dedicated budget for low carbon product R&D (413 / 1512)
DI = Compliance with regulatory requirements/standards (777 / 1512)

Appendix 11

Table 35. H7c Emissions are lower when they are verified

H7c Emissions are lower when they are verified

	1	2
Emission intensity SC1 +0	-	-
Prob > chi2	-	-
Number of Obs / groups	-	-
Emission intensity SC1 +1	**0.1808987***	-
Prob > chi2	**0.0000**	-
Number of Obs / groups	**937 / 220**	-
Emission intensity SC1 +2	0.1481331*	0.1045814*
Prob > chi2	0.0000	0.0000
Number of Obs / groups	752 / 213	752 / 213
Emission intensity SC2 +0	-	-
Prob > chi2	-	-
Number of Obs / groups	-	-
Emission intensity SC2 +1	-	-
Prob > chi2	-	-
Number of Obs / groups	-	-
Emission intensity SC2 +2	-	0.0378062**
Prob > chi2	-	0.0000
Number of Obs / groups	-	733 / 206

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
1 = Scope 1 emissions are verified
2 = Scope 2 emissions are verified

Table 36. H7d Emissions are lower when companies participate to emission trading schemes

H7d Emissions are lower when companies participate to emission trading schemes

	CC13.1
Absolute emissions SC2 +0	**461621.6****
Prob > chi2	**0.0000**
Number of Obs / groups	**1072 / 218**
Absolute emissions SC2 +1	**464337.6****
Prob > chi2	**0.0000**
Number of Obs / groups	**908 / 213**
Absolute emissions SC2 +2	**569968.7****
Prob > chi2	**0.0000**
Number of Obs / groups	**737 / 208**

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
CC13.1 Participates in emission trading schemes

Appendix 12

Table 37. H7f Emissions are lower when companies have emission reduction targets and initiatives

H7f Emissions are lower when companies have emission reduction targets and initiatives

	CC3.1
Absolute emissions SC1 +0	(3406971)**
Prob > chi2	0.0000
Number of Obs / groups	1124 / 230
Absolute emissions SC1 +1	-
Prob > chi2	-
Number of Obs / groups	-
Absolute emissions SC1 +2	-
Prob > chi2	-
Number of Obs / groups	-

Significance 5% = *
Significance 1% = **
Hausman test issue = **bold**
CC3.1 Emission intensity reduction target that was active in the reporting year

Appendix 13

Table 38. Literature review

Literature review, the studies

Drivers and barriers in institutional change to carbon management

Authors: Ortiz-de-Mandojana, N. Aguilera-Caracuel, J. Morales-Raya, M. 2014
Corporate Governance and Environmental Sustainability: The Moderating Role of the National Institutional Context

Author: Okereke, C. 2007
An Exploration of Motivations, Drivers and Barriers to Carbon Management: The UK FTSE 100

Authors: Babiak, K. Trendafilova, S. 2011
CSR and Environmental Responsibility: Motives and Pressures to Adopt Green Management Practices

Authors: Luo, L. Tang Q. 2016
Determinants of the Quality of Corporate Carbon Management Systems: An International Study

Authors: Reid, E. M. Toffel, M. W. 2009
Responding to Public and Private Politics: Corporate Disclosure of Climate Change Strategies

Authors: Weinhofer, G. Hoffmann, V. H. 2010
Mitigating Climate Change – How Do Corporate Strategies Differ?

Authors: Agrawala, S. Carraro, M. Kingsmill, N. Lanzi, E. Mullan, M. Prudent-Richard, G. 2014
Private Sector Engagement in Adaption to Climate Change: Approaches to Managing Climate Risks

Institutional diffusion of carbon management

Authors: González, P. R. 2005
Analysing the Factors Influencing Clean Technology Adoption: A Study of the Spanish Pulp and Paper Industry

Author: Campbell, J. L. 2007
Why Would Corporations Behave in a Socially Responsible Ways? An Institutional Theory of Corporate Social Responsibility

Authors: Doblinger, C. Soppe, B. 2013
Change-actors in the U.S. electric energy system: The role of environmental groups in utility adoption and diffusion of wind power

Authors: Kolk, A. Levy, D. Pinkse, J. 2008
Corporate Responses in an Emerging Climate Regime: The Institutionalization and Commensuration of Carbon Disclosure

Other related studies

Authors: Gouldson, A. Sullivan, R. 2012
Long-term corporate climate change targets: What could they deliver?

Authors: Gouldson, A. Sullivan, R. 2013
Ten years of corporate action on climate change: What do we have to show for it?