Placing a Value on Internal Carbon Prices

Exploring Influencing Factors through a Mixed Methods Approach

Sarah Hay

Master Thesis in Culture, Environment and Sustainability

Centre for Development and Environment

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Abstract

The increasing use of internal carbon pricing among companies demonstrates the possibility of an interaction between business and environmental interests. An internal carbon price is a price that is voluntarily placed on a tonne of greenhouse gas emissions by a firm in order to inform its decision-making. It is a corporate reflection of inter-governmental discussions regarding placing a price on carbon. The internal carbon prices currently disclosed vary widely in value. This difference suggests that firms are using a variety of factors in order to calculate their internal prices. However, companies appear reluctant to reveal details of the calculation methods that they use.

This study sought to identify what influences the value given to an internal carbon price and, where such influencers were identified, to gain insight into how these factors impact the chosen value. A mixed methods approach was used which consisted of a literature review, a case study of Statoil and a multiple regression analysis across 121 companies. The integrated findings from this study suggest that companies adopt a rather pragmatic approach; and whilst many companies purport to base their pricing on carbon regulation, this may, in fact, not be the reality. The findings also reveal that a company's industry sector plays a role in the value that is used.

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1 Introduction

1.1 Setting the Scene

When discussing ways to tackle climate change, a frequent topic is whether both business and environmental interests can coincide. The increasing use of internal carbon pricing (ICP) suggests that this may be possible. ICP is a form of carbon pricing used by companies in order to inform their decision-making. Such company usage is set with the backdrop of inter-governmental discussions regarding setting a price on carbon. The lack of agreement on one global price is reflected in the ICP values used by companies: these values vary widely. This variance suggests that firms are taking into account a variety of factors in order to calculate their individual internal prices. However, companies appear reluctant to reveal details of the calculation methods that they use. The findings from this study suggest that companies adopt a pragmatic approach; and whilst many companies purport to base their pricing on carbon regulation, this may, in fact, not be the reality. This study also found that a company's industry sector plays a role in the ICP value that is used.

1.2 Carbon Pricing as Government Policy

A carbon price is a value that is placed on the emission of one unit (usually, a tonne) of carbon dioxide. It is a market-based instrument and is usually put into place either, "*directly*" through a carbon tax (for example, on the carbon content of fuel) or "*indirectly*" through the issuance and trading of a certain number of carbon emission permits (Galiana and Green 2010, 306). An example of the former is the carbon tax in Sweden that covers certain fossil fuel usage (World Bank 2015, 46). An example of the latter is the cap-and-trade system used in Europe: the European Union Emissions Trading Scheme ('EU ETS'). In 2015, carbon pricing policies could be "found in 39 countries and 23 regions" across the globe (CDP and We Mean Business Coalition 2015, preface). The number of new schemes is set to increase further.

Carbon pricing is often promoted as the most economically efficient governmental policy that can be used for mitigating carbon dioxide emissions. The economic reasoning behind this is based on "the incentives a carbon price creates to reduce the

consumption of energy" as well as the "positive stimulus to the development and deployment of carbon-neutral energy technologies" (Galiana and Green 2010, 306). On a broader level, it is argued that carbon pricing has the ability to "help guide future economic growth toward a lower carbon economy, and reduce the impacts of climate change over time" (Kennedy, Obeiter and Kaufman 2015, 7).

However, when discussing carbon pricing, it is important to remember that it is only one possible element of environmental policy and is not the single solution. Rather, "it must be complemented by measures to support the development of technologies, and to remove the barriers to behavioural change" (Stern 2007, 369).

1.3 Internal Carbon Pricing as Corporate Policy

Whilst carbon prices are usually "explicit market or regulatory price[s]", an internal carbon price "is used within a company to value the cost of a unit of CO_2 emissions" (CDP and We Mean Business Coalition 2015, 8).

ICP (sometimes referred to as a form of 'shadow pricing') is a corporate form of carbon pricing. It is a method that an increasing number of firms are voluntarily using in order to incorporate future environmental costs into their current investment decisions (CDP 2013a, 2). In 2015, over 1,000 companies reported that they use ICP or will do so within the next two years (CDP and We Mean Business Coalition 2015, preface). Furthermore, an effective ICP is a key criterion of the 'Business Leadership Criteria on Climate Change'. These 'Leadership' criteria have been formulated by the United Nations along with partners such as the Carbon Disclosure Project (CDP) and The Climate Group (Caring for Climate 2014, preface).

For the purposes of this thesis, an internal carbon price is defined as a financial value given, by a company, to a tonne of carbon dioxide emissions (United Nations 2014, 2). According to CDP (the first body to have collated comprehensive reports on the use of ICP), companies are using these prices for the following reasons: "as a planning tool to help identify revenue opportunities, risks, and as an incentive to drive maximum energy efficiencies to reduce costs and guide capital investment decisions" (CDP 2013a, 2). This tool is being implemented as a reaction to the "global corporate consensus that carbon will be priced" as companies wish to prepare for future regulatory environments

(CDP 2014, 4). In addition, ICP can assist companies in demonstrating "their support for effective carbon pricing policies" (World Bank 2015, 48).

1.4 The Range in Value of Internal Carbon Prices

The internal carbon prices currently disclosed vary widely in value: from 0.95 USD per tonne of carbon dioxide to up to 357 USD per tonne (CDP 2015a, 6-8). Moreover, "some of these [internal] carbon prices are substantially higher than current price levels in mandatory carbon pricing instruments" (World Bank 2015, 14). This suggests that firms use a variety of factors in order to calculate their internal prices. However, details of the calculation methods used are unclear. As a consequence, the central aim of this project was to gain insight into the logic used by companies to allocate a particular value for their ICP.

1.5 What is the Relevance of this Study?

This study contributes towards the discussion as to whether business and environmental interests can align. In particular, whether anticipated environmental consequences can be pragmatically included within business planning in such a way that better informs financial decision-making.

This study provides insight into a possible method that can be used by firms in order to anticipate climate risks across their operations and inform their decision-making. The method of ICP can be used whether or not companies are currently affected by carbon regulation. As such, self-initiated action by companies may be a short-cut to less carbon intensive business activities. This is in contrast to taking a reactive approach and simply waiting for governments to update, introduce and align emission reduction public policy.

The logic of how a particular ICP value is decided upon is interesting for the above discussions because it provides insight into factors that may inform and influence company environmental (and financial) policy. A key goal of this research was to gain insight into elements of the ICP calculation methods in order to provide clearer information on what really influences company climate strategy.

1.6 The Influence of Industry Sectors

This study found that a company's industry sector, affects its ICP value: companies, at least within some industry sectors, have similar ICP values to their competitors.

Whilst many companies purport to base their pricing on carbon regulation, this study suggests that this may, in fact, not be the reality. Company literature and statements suggest that regulation is key to influencing their ICP value. However, the regression analysis did not find carbon regulation to significantly influence ICP value. Further discussion as to why this may have been the case is contained in the later chapters of this project.

1.7 Research Question and Chosen Variables

The overarching research question for this project was ***what*** *influences the value of a company's ICP and* ***how*** *do these factors influence the value of a company's ICP?* Such a research question leant itself to a mixed methods approach and further, complementary, research questions were developed as the study progressed (see Chapter 2 for a more detailed outline).

Similarly, the choice of independent variables was developed throughout each stage of this project: potential independent variables were initially chosen after the literature review and these were then evaluated in the Statoil ASA ('Statoil') case study. The evaluation of these variables was conducted by including interview questions, in the case study, that focused on the initially suggested variables whilst, at the same time, also including open questions that encouraged insights into other potential factors. The document review section of the case study also considered any complementary or contradictory statements that related to the initially selected variables. Following the case study, a final selection of variables was decided upon for the econometric analysis. These final variables were: carbon regulation, shareholders and industry sector.

The carbon regulation variable represented the influence of carbon taxes or emissions trading systems on a company's ICP value (World Bank 2015, 22). The shareholder variable considered whether a company being listed on a stock exchange affected the ICP value. The industry sector variable was included in order to analyse whether the

area of the economy that a company operates within affects its ICP value. See Chapter 2 (Sections 2.5.2, 2.5.3 and 2.8.1) for a further description of the variables used in this project.

1.8 Methodological Overview

As mentioned above, this project was undertaken using a mixed methods approach. These methods were used to complement and inform each other in order to provide a more integrated picture of the topic at hand. A detailed outline of the research design model is contained in Chapter 2.

1.8.1 Literature Review

Firstly, a literature review was undertaken in order to identify potential variables that should be tested for their influence on ICP value. This literature review covered recent documentation (published from 2012 onwards) concerning company carbon pricing or ICP (if specifically mentioned). This review was not company specific and covered documents that summarized a variety of company and government opinions and actions on this subject. This literature was also used to inform which companies should be approached for the case study.

This review suggested that ICP value could be influenced by carbon regulation, industry sector, shareholders and the intended purpose behind the use of ICP. However, it was noted that when providing information regarding their ICP, companies were typically very vague as to how their values were calculated.

1.8.2 Company Case Study: Statoil

The company chosen for the case study section of this project was Statoil. This company was chosen on the basis that they have been using ICP for a while and have also changed the number and values of ICP used. This suggested a thought process behind applying a particular ICP value. Statoil is also a firm that is known to promote transparency and communication regarding their internal policies.

Building on the general literature review and prior to the interview, the first stage of the case study was to review publicly-available documentation relating to the ICP policy for Statoil. This document review suggested that carbon regulation was the main influencer of Statoil's ICP value and that collaboration within the energy sector (for example, in the form of industry associations and government lobbying) plays a key role in Statoil's sustainability policy.

The second part of the case study was an elite interview. This interview was conducted with an employee who has played a key role in implementing and updating Statoil's ICP policy. The interview was to be used in several ways. Firstly, the interview was to inform the development of the independent variables which would be used in the econometric analysis. This was to be done by evaluating the variables suggested in the literature review and also by helping to identify whether any other variables should be included in the regression analysis (see Section 1.7. above). Secondly, the interview findings were re-considered at the end of the project in order to assist in interpreting the regression results: for example, where differences between the regression findings and the literature review emerged, the interview findings were looked at again in order to see if they could explain this inconsistency. Lastly, the interview was used in order to provide insight into the reality of using ICP in a company and to help suggest any areas for further research.

The interview was a revealing source of information and found that there is a strong link between Statoil's ICP values and the carbon regulation under which they operate. The interviewee also suggested that the intended purpose behind the use of ICP could play a major role in the value applied by a company. One particularly interesting point was that a meeting between Statoil and two industry competitors (Shell and BP), which focused on discussing ICP strategy, has influenced Statoil's current ICP strategy. In addition, another insight gained from the interview is that Statoil uses a pragmatic approach to its ICP calculations. This simplicity was seen to be necessary in order to ensure that the policy is implemented within the firm.

1.8.3 Econometric Analysis: Multiple Regression

The final part of the mixed methods approach was the completion of a multiple regression analysis. The aim of this analysis was to assess the influence of the existence

of carbon regulation, listing on a stock exchange and industry sector on a company's ICP value.

The sample of companies used was the list of companies that disclosed their ICP value to CDP in 2015 (CDP 2015a). This was a total of 123 companies. 2 company cases were removed during the course of the analysis, in order to reduce any distortion in the results (as discussed in Chapter 2, Sections 2.8.6. and 2.8.7.). As such, the final number of companies included in the analysis was 121.

A key challenge that was presented at the data collection stage of the econometric analysis was that, when the project started, the sample of companies was originally drawn from a previous CDP report (CDP 2014). This is because the CDP 2015a report had not yet been published at this point in time. The list of companies contained in the 2014 report was much smaller than that in 2015a. As such, when the newer report was published, the data collection had to be restarted so that the project would benefit from a more recent and extensive data sample.

The findings from the regression analysis suggested that operating in certain industry sectors (consumer discretionary, energy, materials and utilities) leads to similar ICP values being used within these sectors.

1.9 Theory and Models

An interdisciplinary review of key theories and models was undertaken in order to provide a background to and also to inform this project. These theories and models concerned putting a price on carbon emissions. The aim of this theoretical overview was twofold: firstly, to inform the selection of the independent variables for the case study and regression analysis; secondly, to assist in interpreting the results throughout the mixed methods study.

The theories considered included some from classical welfare economics as well as broader (non-economic) theory that looks to explain variation in firm environmental behavior and policy. The particular models that were analysed were those that have been used by governments in order to place a social cost on carbon.

Useful insights were gained from the range of theories considered: the economic theories helped to explain what the ICP value *should* be, whereas the theories from other social sciences provided insight into the explanations as to why the ICP value is what it is *in reality*.

A particularly valuable insight gained from this review was through the discussion of the limitations regarding the modeling of a social cost of carbon. The complexity of these models is demonstrated by the required "assumptions that go well beyond the usual boundaries of science or economics" (Greenspan Bell and Callan 2011, 1). Accordingly, companies may, in reality, choose a simple calculation model in order to manage the (time consuming) complexity of putting a price on carbon.

1.10 Structural Overview

This thesis has been structured as follows: Chapter 2 outlines the methodological steps and challenges encountered in this project, Chapter 3 provides a theoretical overview and Chapter 4 covers the detailed literature review. Chapters 5 and 6 outline and discuss, individually, the results from the company case study and the regression analysis. Chapter 7 compares and integrates the findings from each part of the mixed methods. Lastly, Chapter 8 outlines the key conclusions from this project and discusses areas for further research.

2 Methodology

2.1 Introduction

This chapter will outline the mixed methods used in this project and reflect on the various challenges that were experienced. The project entailed three parts: a literature review, a case study and a multiple regression analysis. These qualitative and quantitative methods were analysed in a sequential manner, informing the next method as the study progressed. The individual results were then reflected upon and discussed, in combination, at the end of the project (see Chapter 7).

2.2 Why Mixed Methods?

For the purpose of this project, mixed methods were defined as follows: "integrating quantitative and qualitative data collection and analyses in a single study or program of inquiry'' (Creswell, Fetters and Ivankova, 2004, 7).

The central aim of this project was to gain insight into company ICP calculation methods in order to provide clearer information on what really influences company climate strategy. As such, the rationale behind using both qualitative and quantitative methods was to provide a more complete understanding of these ICP calculation methods. Furthermore, when specifically looking at ICP values, there is limited academic literature on this topic and so this area of research would greatly benefit from a multi-faceted analysis.

Accordingly, the qualitative data provided detailed information (on a micro-level) and the quantitative analysis provided a broader view (on a macro-level) on how companies may calculate the value for their ICP. Moreover, the qualitative data could be used to inform and improve the design of the econometric analysis. Depending on the results, the various types of analysis could either complement or differ from each other. A further discussion of the design of the mixed method model is provided later in this chapter.

2.3 Rationale for Each Individual Method

The role of the literature review was to identify, based on reports and company statements, any broad logic or context behind the value attributed to companies' ICP. Any rationale mentioned in this literature could then inform questions in the interview stage of the case study and also inform the selection of variables for the econometric analysis.

The role of the case study was to provide an in-depth example of the reality of company ICP. Potential logic identified in the general literature review and company document review could also then be posed as questions in the elite interview section of the case study.

The role of the econometric analysis was to identify any patterns, across companies, in how the identified variables affect the ICP value.

2.4 Research Design Model: Instrument and Triangulation

The model used for this project is a cross between a triangulation and an instrument model. The choice of this design was driven by the research objective of obtaining a fuller picture of the topic at hand.

The design uses an instrument model in the sense that it has been conducted in a sequential manner. In other words, the qualitative methods were undertaken, first, in order to inform the quantitative section of analysis (Creswell, Fetters and Ivankova, 2004, 11).

However, it is also similar to a triangulation model in the way that the results from each type of analysis were individually analysed, after each stage, and then discussed and compared, together, at the end of the project (Creswell, Fetters and Ivankova, 2004, 11).

This hybrid model was used in order to maximize the amount of information from each stage of analysis whilst also leaving flexibility to improve the planned quantitative stage based on the results obtained from the first, qualitative, stages of analysis.

Consequently, “stimulating a more thorough analysis” and capitalizing on the flexibility of a mixed method approach (Woolley 2009, 9-10).

Using a sequential approach was key in order to confirm or disregard variables identified for the research question. The qualitative elements of analysis helped to identify possible research questions as well as to inform the variable selection for the econometric analysis. Such an approach helped to improve the relevance and likelihood of significant results being achieved from the regression analysis. This was particularly applicable in relation to the case study as this provided an insight into how ICP is used by companies, in reality, rather than simply relying on intuition or company rhetoric.

2.5 Research Question and Variables

2.5.1 Developing a Research Question

One key challenge of performing a mixed method study is deciding how to phrase the research questions(s) so that it makes sense across the different methods. For this study, it was decided that the research question would evolve as each stage of the mixed method analysis was undertaken (Creswell and Tashakkori 2007, 208).

Firstly, the initial overarching research question for this project was: ***what*** *influences the value of a company’s ICP and* ***how*** *do these factors influence the value of a company’s ICP?* Such a research question leant itself to a mixed method approach as it asks both “what and how” (Creswell and Tashakkori 2007, 207).

Once a mixed method approach was decided upon, an additional overarching research question was added as a reminder to link and discuss the results found throughout the project: *how do the findings, from each individual method, complement or differ from each other?* This was a research question to be discussed at the end of the project, once all the stages of analysis were complete.

Following the literature review, the breadth of the study was narrowed down as potential influencing factors were identified (i.e. potential answers were found to the “what” question). Accordingly, the research question was updated as follows for the

purposes of the case study: *how is the value of a company's ICP influenced by carbon regulation, shareholders and industry sector?*

Following the case study, the same research question was used for the econometric analysis but a hypothesis was added for this method. The hypothesis was that all the independent variables (carbon regulation, shareholders and industry sector) would influence ICP value, with carbon regulation being the most influential. This hypothesis did not affect the way in which the econometric analysis was conducted but was considered when discussing and interpreting the regression results.

Carbon regulation was expected to be the most influential, on the basis that the literature review found this variable to often be directly mentioned by companies when they referred to the logic of the value they had placed on their ICP. This was also a factor that was brought up during the course of the Statoil case study.

In summary, the research questions for this project evolved as follows:

1. Overarching research question: what influences the value of a company's ICP and how do these factors influence the value of a company's ICP?

2. Linking research question: how do the findings, from each individual method, complement or differ from each other?

3. Research question for the case study and econometric analysis: how is the value of a company's ICP influenced by carbon regulation, shareholders and industry sector?

    a. Hypothesis for the econometric analysis: all the independent variables (carbon regulation, shareholders and industry sector) would influence ICP value, with carbon regulation being the most influential.

2.5.2 Choosing the Variables

As noted above, the variables (potential factors influencing ICP value) were initially chosen following the completion of the literature review: the existence of carbon regulation, shareholders and industry sector appeared to be potential influencers.

Whilst carbon regulation and industry sector were anticipated to be direct influencers, the shareholder variable was chosen as a proxy to stakeholder influence. A proxy variable is one that is "used instead of the variable of interest when that variable of interest cannot be measured directly" (Black, Hashimzade and Myles 2012, 329).[1] The existence of shareholders was chosen to represent stakeholder influence in order to narrow down the variable in a quantifiable and objective way. By doing so, this allowed the comparison of the same variable across both the qualitative and quantitative methods.

Following the completion of the case study analysis (both document review and interview), these variables were reviewed and kept for further analysis in the econometric section of the study (see Chapter 1, Section 1.7 for further comments on this).

2.5.3 Defining the Variables

For each method in this study, operational definitions were used for the variables being investigated. These are outlined in the table below.

Table 1: Operational Definitions

Dependent Variable	Operational Definition
ICP value	The financial value given, by a company, to a tonne of carbon dioxide emissions (United Nations 2014, 2).
Independent Variable	**Operational Definition**
Carbon regulation	An emissions trading system (ETS) and/or carbon tax that has been implemented or is scheduled to be implemented in a country, state or province (World Bank 2015, 22).
Shareholders	In existence for a company when that company is listed on a stock exchange.
Industry sector	The area of the economy that the company can be categorised within due to its business activities. The 10 industry sector categories used were taken from the company list provided in the CDP 2015a report on ICP that referred to the 'Global Industry Classification Standard' (GICS).

[1] As discussed in Section 2.9.2, this thesis is intended to be accessible to non-economists. Therefore, some terms are explained which may not be commonly used outside that discipline.

For the purposes of creating quantitative data for use in the econometric analysis, it was necessary, at that stage of the project, to define each of the variables further. Please refer to Section 2.8.1 for these definitions.

2.6 Method: Literature Review

2.6.1 Sources and Scope

The literature review was a general review of documents concerning corporate use of carbon pricing. Literature specific to the case study company was not included in this initial review (such company-specific literature was covered in the first part of the case study analysis).

A challenge of researching this topic is that there is limited academic literature specifically concerning the use of ICP or corporate shadow prices. As such, the literature reviewed were reports published by non-governmental organisations (NGOs) and non-profit organisations such as the World Bank and the United Nations.

Reports produced by the Carbon Disclosure Project (CDP) were of key focus as they were the only organization found to have collected data and to have produced extensive reports that purely focused on ICP. The data sample used for the econometric analysis was taken from the CDP 2015a report titled *'Putting a price on risk: carbon pricing in the corporate world'*.

The literature review began by considering the first document prepared by CDP on ICP (CDP 2013a). This was chosen as it was the earliest report that was found to collate primary data, on the subject of ICP, in an accessible manner. The literature review then progressed by working through more recent publications concerning ICP.

2.6.2 Method of Review

In order to improve the ability for the literature to be compared and discussed together, each piece of literature was analysed using the same, structured method. This method was as follows: firstly, a summary of the content was outlined; secondly, a criticism was

given of the literature source, and; lastly, the contribution of the piece of literature to the overarching research question was discussed.

Once each piece of literature had been analysed, an overall summary was given of the key contributions this review had provided to identifying the factors influencing ICP value. As a consequence, and as described above, the research question was updated to include the potential factors that were identified.

2.6.3 Challenges and Limitations of the Literature Review

One key challenge of the literature review was deciding which documents to include in the review and which to leave out. This decision-making could affect the reliability of the literature review as there is a risk that another researcher would focus on different publications. However, this reliability issue is managed by the limited amount of literature that specifically focuses on this recently emerging subject (documents directly referring to ICP were not found prior to 2013). As a consequence, it is likely that another researcher would have reviewed the same reports due to the limited number that were available when this review was conducted.

However, in terms of academic literature, another researcher may have decided to broaden the review to include all recent academic work on carbon pricing and climate policy, including governmental use. In contrast, the scope of the review in this project was limited to corporate usage.

Another potential limitation of this review was the risk of potential bias in the sources used. The organisations that prepared the reviewed reports may have a political agenda or certain values (or behaviour) that they wish to promote. As such, the information provided could be distorted. In the case of CDP, for example, they openly advocate on their website that they are working "to transform the way the world does business to prevent dangerous climate change and protect our natural resources" (CDP 2016). This vested interest may cause CDP to over-publish reports on ICP use based on their belief that this is a method in which business practices can be 'transformed' (see Chapter 4, Section 4.3.1 for further discussion). CDP also receives funding from a variety of corporate sponsors and governments (CDP 2016). This may cause the organisation to report current climate policy (either used by companies or governments) more

positively than if their operations were not reliant on such funding (see Chapter 4, Section 4.3.1 for further discussion). Despite these challenges, this fundamental source of data for this research project was taken to be suitably reliable.

2.7 Method: Statoil Case Study

2.7.1 Overview

A single, holistic case study of Statoil was conducted. A holistic case study is characterised by the use of one unit of analysis, typically completed using a qualitative approach (Yin 2012, 7). The study focused on one particular firm, which provided a sufficient amount of in-depth information within the time constraints of the project. As discussed below in Sections 2.7.2 and 2.7.6, whilst multiple case studies would have been preferable, a single case study was conducted due to Statoil being the only company that was willing to be interviewed.

The case study consisted of two parts: a document review and an elite interview. The document review focused on company-specific literature relating to the case study company and the elite interview was conducted with an employee that has a key strategic role in deciding the company's ICP.

2.7.2 Why Statoil?

Statoil was chosen to be the subject of the case study for several reasons. Firstly, it was one of the companies included in the sample that was to be used for the econometric analysis. Secondly, it is a company known for actively wishing to be transparent in relation to internal climate policy. Thirdly, and most importantly, Statoil was chosen for reasons of accessibility: it was the only company that had a senior employee (one with policy decision-making powers) that was willing to meet and discuss their ICP.

2.7.3 Document Review

The document review section of this case study entailed a review of publicly available information directly related to Statoil climate policy. In the planning of this project, it was hoped that it would be possible to obtain internal ICP documentation from Statoil.

However, this information was not available for reasons of competition. This issue if further discussed in the 'Challenges and Limitations' section (Section 2.7.6).

There were two key reasons for completing this document review. The first reason was to help inform and phrase the questions to be used in the elite interview section of the case study. The second reason was in order to be able to compare the pricing calculation information disclosed by the interviewee with any relevant policies outlined and demonstrated within the company documentation.

The review of each document was undertaken in the same structured manner as used for the general literature review (see Section 2.6.2).

2.7.4 Elite Interview

The interview was conducted with an employee that holds a key decision-making role in Statoil's sustainability policy, which includes ICP. It was agreed with the interviewee that they would be kept anonymous.

The interview was of an elite nature as it was conducted with an interviewee who was "given special, nonstandardized treatment" (Dexter 2006, 18). Such nonstandardized treatment of the interviewee included "letting the interviewee introduce…his notions of what he regards as relevant, instead of relying upon the investigator's notions of relevance" (Dexter 2006, 18).

The questions were open-ended and centred on encouraging the interviewee to explain how he understood the calculation process to be and the reasons behind the decisions within the internal price calculations. The interview was semi-structured in order to provide an outline for the interviewer but also to allow flexibility in the interviewee's responses. The interview was designed in such a way in order to create the possibility for new perspectives to be introduced that had not previously been considered within the research project. The interview guide is included in Appendix 1.

The interview was recorded following receipt of written consent from the interviewee that this could be done. It was also agreed that if any direct quotations were included in the project, these would be looked over by the interviewee prior to publishing. The interviewer wrote-up notes immediately following the interview. The interview lasted 1

hour. See Section 2.11 for further discussion of the ethical issues linked to the case study.

2.7.5 Analysis of Data

The narrative data collected from the case study was integrated and analysed through a word table (see Table 5 in Chapter 5, Section 5.5.1). This table was split into two columns (one for each sub-method: document review and elite interview) and the data was organised into rows of 'themes'. These themes were identified in order to allow a similar "pattern-matching logic" that could be applied both when analysing the case study findings and also when integrating the overall project findings in Chapter 7 (Yin 2012, 16). In other words, by structuring the table in such a way, this allowed for easier integration of the mixed methods findings as the project continued.

2.7.6 Challenges and Limitations of the Case Study

A central challenge to completing the case study was finding a company from the CDP 2015a list that had an employee, in a strategic role, who was willing to be interviewed. Many companies were contacted (around 30-40) but the only one that responded was Statoil. As such, after extensive efforts to find interviewees from more than one company, it was accepted that only a single case study could be completed within the time constraints of this project.

It is understandable that firms may not have wanted to discuss potentially confidential information with a person from outside of the company. This reason is particularly plausible as a key motivation for this research was that the publicly available information on the exact calculation of ICP is unclear: it could be that this lack of clarity was a conscious strategic decision made by firms. Many of the firms that are using ICP are well-known global entities that may wish to keep any form of detailed pricing or cost information hidden from competitors. As such, this may have led to potential interviewees being unwilling to participate as a case study for this research project.

Another limitation of the case study was that it was not possible to obtain internal company policy documentation relating to Statoil's ICP. It was hoped that this would be

possible to obtain after conducting the interview with the company employee. However, access to such information was not possible, under the discretion of the company, due to similar competition reasons as those outlined above. As such, this meant that external (publicly-available) and internal company publications could not be compared. However, it was still possible to cross-verify the information from the external documentation with the information provided in the interview.

Another potential limitation of the case study was that the interviewee and the company documents could have been "echoing the same institutional "mantra"" rather than the company's actual practices (Yin 2012, 13). Such repetition could have arisen purposefully, from the interviewee's anticipation of the pre-planned interview, or unconsciously, from the interviewee repeatedly speaking to representatives from outside the company. This validity issue was mitigated by reading as much of the company documentation as possible prior to conducting the interview. This enabled certain interviewee statements to be anticipated and also for questions to be incorporated within the interview guide that sought to reveal the calculation decisions that are made in practice (rather than just in theory).

2.8 Method: Econometric Analysis

2.8.1 Definition of Variables for Regression Purposes

Table 2 contains an outline of the variables used for the multiple regression analysis and how they were defined. It was necessary to further define some of the operational definitions outlined in Section 2.5.3 so that the data could be phrased in a numeric way.

2.8.2 Types of Variables

The dependent variable (ICP value) was a continuous, ratio variable. In other words, it could form any numerical value (in USD) apart from 0 or below. This is because ICP value is phrased as currency (USD). Companies without a particular ICP disclosed to CDP (2015a) were not included in the data sample.

Table 2: Definition of Variables

Dependent Variable	Operational Definition
ICP value	The financial value given (in USD), by a company, to a tonne of carbon dioxide emissions. Where a range or several ICP values are used, the mid-point was taken.
Independent (Dummy) Variable	**Operational Definition**
carbonreg	An emissions trading system (ETS) and/or carbon tax has been implemented or is scheduled to be implemented in the country, state or province where the company is headquartered.
listed	The company, itself, is listed on a stock exchange (in other words, not whether the parent company is listed on a stock exchange).
consumerdisc	Consumer discretionary industry sector as defined by GICS: "businesses that tend to be the most sensitive to economic cycles. Its manufacturing segment includes automotive, household durable goods, leisure equipment and textiles & apparel. The services segment includes hotels, restaurants and other leisure facilities, media production and services, and consumer retailing and services."*
consumerstap	Consumer staples industry sector as defined by GICS: "companies whose businesses are less sensitive to economic cycles. It includes manufacturers and distributors of food, beverages and tobacco and producers of non-durable household goods and personal products. It also includes food & drug retailing companies as well as hypermarkets and consumer super centers." *
energy	Energy industry sector industry sector as defined by GICS: "companies engaged in exploration & production, refining & marketing and storage & transportation of oil & gas and coal & consumable fuels. It also includes companies that offer oil & gas equipment and services" *
financials	Financials industry sector as defined by GICS:" companies involved in banking, thrifts & mortgage finance, specialized finance, consumer finance, asset management and custody banks, investment banking and brokerage and insurance. This Sector also includes real estate companies and REITs."*
healthcare	Health care industry sector as defined by GICS: "health care providers & services, companies that manufacture and distribute health care equipments & supplies and health care technology companies. It also includes companies involved in the research, development, production and marketing of pharmaceuticals and biotechnology products." *
industrials	Industrials industry sector as defined by GICS: "manufacturers and distributors of capital goods such as aerospace & defense, building products, electrical equipment and machinery and companies that offer construction & engineering services. It also includes providers of commercial & professional services including printing, environmental and facilities services, office services & supplies, security & alarm services, human resource & employment services, research & consulting services. It also includes companies that provide transportation services."*
infotech	Information technology industry sector as defined by GICS: "companies that offer software and information technology services, manufacturers and distributors of technology hardware & equipments such as communications equipment, cellular phones, computers & peripherals, electronic equipment and related instruments and semiconductors." *
materials	Materials industry sector as defined by GICS: "companies that manufacture chemicals, construction materials, glass, paper, forest products and related packaging products, and metals, minerals and mining companies, including producers of steel."*
telecomm	Telecommunications services industry sector as defined by GICS: "companies that provide communications services primarily through a fixed-line, cellular or wireless, high bandwidth and/or fiber optic cable network." *
utilities	Utiltities industry sector as defined by GICS: "companies such as electric, gas and water utilities. It also includes independent power producers & energy traders and companies that engage in generation and distribution of electricity using renewable sources."*
u	Error term

*Source: Global Industry Classification Standard (GICS) (MSCI 2016)

The independent variables (carbon regulation, listed and the 10 industry sectors) were dichotomous (two-part) dummy variables. Dummy variables are a method of turning categorical variables into data that can be put into regression analysis. A categorical variable is one that is made up of one or more distinct qualitative groups (Field 2013, 8); for example, the industry sector variable is categorised into 10 groups including energy, industrials and materials. The qualitative nature of these variables is the reason why they need to be transformed into dummy variables: a regression analysis requires variables to be expressed in quantitative terms.

The independent variables were 'transformed' into dummy variables by being put into the model as either 1 or 0 (i.e. yes or no): 1 where this variable applied to that particular company ('yes') and 0 when that variable did not ('no'). For example, a company headquartered in the UK, listed on the London Stock Exchange and based in the Energy sector would have the following data input in relation to the independent variables: carbonreg = 1, listed = 1, energy = 1 and all other industry sectors = 0.

2.8.3 Sources of Data and Sample

The sample of companies used for the econometric analysis was taken from the CDP 2015a report titled *'Putting a price on risk: carbon pricing in the corporate world'*. The 121 companies used were those that are currently using ICP and have also disclosed a particular ICP value to CDP (2015a, 50-66). There were 123 such companies listed in the CDP 2015a report, however, two were removed from the project sample as outliers (the removal of these two company cases is discussed further below). The ICP values included in the data set were those provided in this CDP report and are in USD.

Several of the companies within the data set reported a range of, or several different, ICPs. In these cases, a mid-point value was taken. This decision was made in order to keep the data consistent (in other words, just one ICP value per company) and also in order to minimise the distortion to the data that would have occurred if the lowest or highest values in the ranges had been used.

The industry sectors allocated to each of the companies were also taken from the CDP 2015a report. CDP used the, internationally accepted, GICS method of classifying industry sectors (MSCI 2016).

The question of whether the company was subject to carbon regulation or not was determined by whether carbon regulation existed in the relevant country (taken to be the location of company headquarters, which was found via the company websites). The existence of carbon regulation in those countries, states or provinces was based on the information collated in the 2015 World Bank report on carbon pricing (2015, 22).

The data in relation to the 'listed' variable was sourced from company websites and annual reports. These sites and reports clearly stated if the company was listed on a stock exchange.

2.8.4 The Econometric Model

Below is a formulaic description of the econometric model that was tested in the multiple regression analysis.

Equation 1: The Model

$$ICP\ value\ = (\beta_1 carbonreg + \beta_2 listed + \beta_3 consumerdisc + \beta_4 consumerstap + \beta_5 energy + \beta_6 financials + \beta_7 healthcare + \beta_8 industrials + \beta_9 infotech + \beta_{10} materials + \beta_{11} telecomm + \beta_{12} utilities) + u$$

β_k: regression coefficient

These variables were defined above in Table 2.

There is no intercept in this model in order to allow for the maximum number of dummy variables to be used (as there was no clear reference category for the dummy variables). See Section 2.8.2 for an explanation of what dummy variables are.

2.8.5 Method of Econometric Analysis

The method of econometric analysis used was Ordinary Least Squares (OLS) multiple regression.

Multiple regression was chosen due to the dependent variable being continuous along with the number of independent variables that were to be tested. The OLS method was

chosen as this is a straightforward way of helping to ensure that the best fitting econometric model is found. The process of 'finding a model of best fit' is outlined below.

The computer programme, SPSS, was used in order to conduct the regression analysis.

2.8.6 Finding a Model of Best Fit

Finding a 'model of best fit' means finding an econometric model that best explains the data being tested. The better the 'fit' of the model, the more accurate the results (variable coefficients) are likely to be and, as such, the better the model is at explaining any existing data patterns. This section outlines the process that was undertaken, for this analysis, in order to find the best fitting model.

The fit of the model can be measured by looking at the R^2 and the Adjusted R^2 statistics. The higher the values of these statistics (between the range of 0 and 1), the better the fit of the model.

Further to using the OLS method, which initially encourages a better fitting model, three stages were taken to find the best fit for the project data.

Stage One

A regression analysis was run on SPSS where all companies within the sample were included (in other words, n=123). The initial R^2 and the Adjusted R^2 statistics were noted.

Stage Two – Removing Outliers

Stage Two involved spotting and removing some outliers highlighted by the first run of the regression analysis in Step One. The cases (companies) removed were numbered 15 and 80 in the data sample. These were, respectively, NGK Spark Plug Co. Ltd. (headquartered in Japan) and Pennon Group (headquartered in the UK).

On re-running the regression analysis, the removal of these outliers was found to improve (increase) the values of the R^2 and the Adjusted R^2 statistics. As such, a better fitting model was created once cases 15 and 80 were removed from the data.

Whilst for non-economists, it may seem illogical to remove observations that stand out from the rest of the sample (and so, may actually be particularly interesting), this is an accepted practice in econometrics. Such practice is accepted because it mitigates the distortion (in other words, bias) of the econometric results (Dehon, Desbordes and Verardi 2015, 196).

This screening for outliers is an example of how conducting mixed methods forces the researcher to be aware of issues that econometricians otherwise take for granted. This is both a challenge and a merit of performing mixed method research (see Sections 2.8.7 and 2.10 for further comments on such issues).

Stage Three – Interaction Variable

In Stage Three, as well as having cases 15 and 80 removed from the data, an interaction variable was added to the model. This interaction variable was between the independent variables 'carbon regulation' and 'listed'.

An interaction variable, sometimes referred to as an interaction term, is an independent variable that is the product of two other independent variables. Such a variable, if found to be significant, can show whether the effect of one independent variable (for example, 'carbon regulation') on the dependent variable ('ICP value') is linked to the value of another independent variable ('listed').

The regression was then re-run. However, this time, the R^2 and the Adjusted R^2 statistics did not improve: the R^2 did increase very slightly (by 0.001) but the Adjusted R^2 decreased, although again only very slightly (by 0.005). Whilst this was not a dramatic change, these statistics suggested that the explanatory power of the model was not improved by including this interaction variable.

Accordingly, the interaction variable was removed from the final regression model. The model from Stage Two was, therefore, seen to be the one best fitting the project data. This is the final model outlined in Section 2.8.4. The coefficients and other explanatory statistics for the final model are outlined in Chapter 6.

2.8.7 Assumption Testing

Before the multiple regression analysis could be interpreted and taken to be reliable, certain standard regression 'assumptions' had to be tested. If any of these assumptions were unfulfilled, this would have meant that the model and accompanying results would not be reliable. Accordingly, conclusions or findings could not have been made from this analysis.

However, it is important to note that, due to the fact that this analysis was not looking to infer or predict precise values (rather, to suggest potential patterns), it was not necessary for these assumptions to be perfectly met.

The results from each assumption test related to the final chosen model (Stage Three described above) are outlined in Appendix 2. These were interpreted as follows:

Independence of Residuals

It is assumed that the errors of adjacent observations (those listed next to each other in the data set) are independent from each other i.e. are not correlated (Laerd Statistics 2016). Errors (or residuals) refer to the difference between the actual 'real-life' value of a variable (for example, ICP value) and the value suggested by the regression model. There will always be some errors (or residuals) in models as it is very unlikely that prediction or patterns can be calculated completely accurately.

If independence of residuals was not found, it would be concluded that the wrong econometric test was being used.

This assumption can be tested using the Durbin-Watson statistic. This statistic can range between 0 and 4. As the Durbin-Watson statistic for this model was close to 2 (1.963 – see Appendix 2), this demonstrated that there was independence of residuals.

Linearity

Due to the categorical (see Section 2.8.2) nature of the independent variables, it was not necessary to check whether there was a linear relationship between the dependent variable and the independent variables (collectively or on their own), as this would not have been applicable.

Homoscedasticity

It is assumed that there is homoscedasticity, in other words, that "the residuals are equal for all values of the…dependent variable" (Laerd Statistics 2016). If the assumption is not met, heteroscedasticity is said to be found. Heteroscedasticity and homoscedasticity are very technical terms that are difficult to communicate briefly. As such, a full explanation goes beyond the bounds of this thesis. Please refer to Wooldridge 2009 for an introductory overview.

Creating a scatterplot of studentized residuals and unstandardized predicted values tests this homoscedasticity assumption. This plot is Figure 1 in Appendix 2.

A studentized residual is the "unstandardized residual divided by an estimate of its standard deviation" (Field 2013, 306). A residual is unstandardized when it is "expressed in the units in which the original [dependent] variable was measured" (Field 2013, 885), which in this case is USD. Similarly, unstandardized predicted values are the values of the dependent variable (ICP value) calculated by the regression model, expressed in the units in which the original dependent variable was measured (USD).

The scatterplot was deemed to be satisfactory (with a naturally increasing spread up the y-axis as the data moves along the x-axis). Accordingly, this assumption was seen to be met.

No Multicollinearity

It is assumed that there is no multicollinearity, when there is more than one independent variable in the model. Multicollinearity "exists when there is a strong correlation between two or more" independent variables (Field 2013, 324). In reality, it is likely that some collinearity will be present in the data and as such, this assumption can be deemed to have been met if relatively low collinearity can be demonstrated.

Two ways in which collinearity can be measured are via the variance inflation factor (VIF) and the tolerance statistic. The VIF "indicates whether a predictor has a strong linear relationship with the other predictor(s)" and the tolerance statistic is equal to 1 divided by the VIF (Field 2013, 325).

A challenge to assessing whether this assumption has been met is that there is no strict agreement on what are 'worrisome' VIF or tolerance values. Under the rule that there is cause for concern if the largest VIF value is greater than 10 and/or there is a tolerance value less than 0.1, the 'listed' variable could be argued to be causing a problem (Field 2013, 325). However, on the basis that the average VIF value, across all the independent variables, is not substantially greater than 1 (3.6265 - see Table 8 in Appendix 2) and that this analysis is not aiming for precise prediction, it was deemed that this assumption was met.

Outliers and Influential Points

It is assumed that there are no substantial outliers or influential points (extreme anomalies that create bias) within the data set. If present, these anomalies could distort the regression results, leading to incorrect conclusions.

Table 9 in Appendix 2 shows a list of cases (companies) with standardized residuals ±3. This is an accepted method for identifying potential outliers. Standardized residuals are residuals "expressed in standard deviation units" (Field 2013, 884). It is possible to see from this table that the difference between the actual ICP value for these companies and the predicted value, based on the regression model, is quite wide (see 'Residual' column).

Prior to cases 15 and 80 being removed from the data set, they had also appeared in this table (for the Stage One model) as they had the highest standardized residuals.

It was decided that none of these outliers (cases 36, 63 and 91) would be removed from the data set and that this assumption was sufficiently met. This was on the basis that none of the Cook's Distance values (a statistic for measuring any leverage points that could distort the data) were high (none were greater than or close to 1). Additionally, as the reason behind this research project is the great range in company ICP values, it was decided that removing these additional three outliers would limit the ICP range too much. This was a decision that was influenced by the use of qualitative methods within this project. As noted in Section 2.8.6, the screening and removal of anomalous data points is a standard econometric technique. However, from completing the case study, the benefit of considering and including individual cases was emphasised: this allowed

insight into potential inconsistencies or quirks in ICP within and across companies. As such, removing these further three outliers would have risked adversely reducing the diversity of the data set which is what made the subject of ICP so interesting in the first place. This was a decision that, perhaps, would not have been made if this project had only consisted of an econometric analysis (see Section 2.10 for further discussion on the merits of a mixed method approach).

It is interesting to note that all five of the total outliers (apart from cases 15 and 36) were in different industries. Furthermore, these outliers had the highest (or second highest) ICP values in their respective industries and belonged to the industries that were later found to significantly influence ICP value:

- Case 15: NGK Spark Plug Co. Ltd. (highest ICP value in the consumer discretionary industry) *(removed);*
- Case 80: Pennon Group (highest ICP value in the utilities industry) (*removed);*
- Case 36: Coop Genossenschaft (second highest ICP value in the consumer discretionary industry);
- Case 63: AkzoNobel (highest ICP value in the materials industry);
- Case 91: Enbridge Inc. (highest ICP value in the energy industry).

The fact that these high ICP values exist in the industries that were later found to be significant in the regression analysis (see Chapter 6), further underlines the finding that these sectors are particularly interesting to look at in terms of ICP. As such, further analysing ICP within these industries would be an area that would benefit from further research (see Chapter 8).

Normal Distribution of Residuals

It is assumed that the residuals are *approximately* normally distributed. Please refer to Appendix 2 for the relevant plots linked to this model and data set.

Figure 2 (in Appendix 2) shows a histogram of the residuals with a superimposed normal distribution curve. The curve demonstrates a normal distribution that is slightly skewed: it has shifted slightly to the left of the chart. The reason why the curve is not at the centre is likely to be due to the fact that it is not possible for an ICP value to be less than 0, but the value can be as high as a company chooses (this can be seen in other econometric analysis when the dependent variable shares this characteristic; for example, employee salary or number of people). The mean and standard deviation, shown next to the histogram chart, are of statistically acceptable values (the mean is close to 0 and the standard deviation is close to 1).

It is useful to also look at the P-P Plot (Figure 3 in Appendix 2). A P-P Plot compares two probability distributions (in this case, expected cumulative probability compared to observed cumulative probability). In order to demonstrate normal distribution, the points on this plot should lie close to the straight line. This is not quite the case as the divergence from the straight line towards the right hand-side of the plot reflects the slight shift demonstrated on the histogram.

Whilst there was not a perfectly normal distribution of residuals, the distribution was deemed to be sufficient for the assumption to be met. This was decided on the basis that: firstly, linear regression is relatively robust to deviations from normality; secondly, categorical independent variables are being used and so the plots are likely to be made up of distributions for various groups, and; the aim of this analysis is not to look for precise predictions and so a certain level of deviation from normality can be accepted.

2.8.8 Challenges and Limitations of Multiple Regression

In terms of the validity of the regression analysis, there are some limitations. These limitations were largely linked to the necessity of narrowing the definitions of the independent variables so that they could be entered into the regression analysis.

In relation to the carbon regulation variable, in order to fully represent the existence of such regulation in the jurisdictions in which the various companies operate, it would have been necessary to track cross-border company transactions. This is due to the large majority of these companies having cross-border operations. It would have entailed analyzing international movements of goods or provisions of services (whether to, from

or within each company). Such an exercise would have been, not only, impractical (due to limited time and resources) but also unlikely to be possible due to companies wishing to keep such transaction information private. As such, this variable may not truly reflect the extent to which the sample companies operate within carbon regulation.

Also, by choosing a mid-point value for companies that use a range or selection of ICP values, this may mean that the full variety of ICP values was not explored in the regression analysis.

In terms of the shareholder ('listed') variable, this was defined in such a way that data was only collected in relation to companies that are listed on a public stock exchange. However, it is possible for companies to have shareholders but not to be listed on a stock exchange. As such, this potential influence may have been missed in relation to some of the companies that are not listed. On the other hand, this is unlikely to have greatly limited the analysis as the vast majority of the companies in the sample were, nevertheless, listed (111 out of 121 of the final sample).

Accordingly, it could be argued that this variable should have been removed at the point at which it became clear that nearly all of the companies within the sample were listed (after data collection was complete). Instead, a replacement proxy variable for stakeholder influence could have been used. For example, the company ownership structure could have been analysed (How many shareholders make up majority voting power? Is the company government owned?).

Another challenge relating to the regression analysis was linked to the reliance on rapidly updating secondary data. When this project started, the sample was drawn from a previous CDP report (CDP 2014). This was a much smaller and different list of companies to that included in the 2015a CDP report. Accordingly, the process of data collection had to be restarted as a more recent and extensive data sample was now available. This meant that the time consuming process of data collection (including checking place of headquarters and stock exchange listings for each company) had to be restarted. This was also an issue in relation to a very small number companies that were listed at the time the 2015a report was published but are now not (for example, due to liquidation of the company). In such situations, the listing data was taken at the time at which the CDP 2015a report was published (September 2015).

2.9 Challenges of the Middle Ground

This section will discuss the challenges and limitations specifically related to the use of a mixed methods approach. These challenges and limitations mainly relate to the issue of integrating the methods into one study, as opposed to simply conducting several methods parallel to each other. Where applicable, this section will outline how these limitations have been overcome or mitigated.

2.9.1 Mixed rather than Multiple Methods

As previously outlined, a typical key intention and reason for using mixed methods is to maximize the findings obtained from a research project. As noted by Bryman, "bringing quantitative and qualitative findings together has the potential to offer insights that would not otherwise be gleaned" (2007, 9). In order to ensure this is done, a central challenge of a mixed methods approach is to integrate the methods used, rather than simply conducting multiple methods parallel to each other. This is not necessarily an easy task.

This project followed the framework outlined by Yin (2006) in order to encourage integration. Yin's framework includes five key procedures to ensure integration throughout each stage of the project: research question, units of analysis, samples for study, instrumentation and data collection methods and analytic strategies (2006, 42). It is emphasised that "the more that a single study integrates mixed methods across these five procedures, the more that mixed methods research, as opposed to multiple studies, is taking place" (Yin 2006, 42). In contrast, if each individual method "uses its own isolated procedures, the result will be separate studies using different methods" (Yin 2006, 46).

In terms of the first procedure, research question(s), Yin advocates that the question or questions should be linked to each method rather than sharply "split" across methods (2006, 43). This project has actively sought to phrase and evolve the research questions so that the question(s) asked for each method, overlap and complement each other. The use of two overarching research questions and how a further question was developed as the study progressed, is outlined above in Section 2.5.

The ‘units of analysis’, fall under the second procedure within Yin’s framework. So that “each method [could] reach into the realm of the other”, it was planned that the same questions and variables were analysed within both the case study and the econometric analysis (Yin 2006, 44).

In terms of samples (the third procedure), it is advised that “the samples of each method may be nested within that of the other” (Yin 2006, 44). This was done, in this project, to the extent that the case study company came from the sample of companies that was to be used for the econometric analysis.

The fourth procedure concerns instrumentation and data collection methods. This is a particularly challenging area as each method is different and provides its own particular insights, for a reason. However, where possible, the data collection methods should be “cross-walked” or “complement” each other, whilst still allowing for “many non-overlapping items” (Yin 2006, 44-45). This was done through using the literature review to identify the potentially influencing factors (variables) to be investigated in the case study and econometric analysis. As a consequence, “directly comparable items” were created so that there were “common scope of data collection and variables” (Yin 2006, 45).

The final procedure in Yin’s framework covers ‘analytic strategies’. Accordingly, the “analyses should be formulated in directly analogous fashion, although they may use entirely different methodological techniques” (Yin 2006, 45). For example, as done in this study (in the case study and econometrics), the methods were able to “examine the relationships between the same dependent variable and associated independent variables” (Yin 2006, 45). Furthermore, it was ensured that the mixed methods told “the same story in describing the…variables” by using the same overarching variable definitions throughout the study (Yin 2006, 45). However, it was necessary for the purposes of creating quantitative data that the variables were further specified for completing the econometric analysis.

2.9.2 Language and Different Audiences

Linked to the above challenge of integrating the various methods, is the challenge of trying to use consistent language that can be understood by a range of audiences, despite

qualitative and quantitative methods encouraging the use of different method-specific vocabulary.

This challenge was particularly visible when writing up the results from the econometric analysis. Certain terms may be more familiar to econometricians and, as such, more quickly understood than for those who do not have an economics background; 'regression', 'behaviour of residuals', 'proxy variable' and 'assumption testing' are just some examples. This meant that extra care was taken in order to explain points relating to the econometric findings in every-day terms. However, this was especially challenging when writing up the 'finding a model of best fit' and 'assumption testing' stages of the regression analysis as these whole concepts may not be familiar to non-econometricians. Thus, extra time was spent explaining certain relevant concepts. These extra explanations would not have been necessary or required if a single, econometrics study had been undertaken.

Similarly, Bryman discusses the challenge of writing up mixed methods research for different audiences in the context of uneven emphasis of data sets (2007, 12). There is a likelihood that the audience reading a mixed method project may be more interested in one particular method, rather than all of the methods in equal measure. As such, there is a risk that, in anticipation of the audience's interest, the project may be written in such a way that particularly emphasizes one of the data sets, to the detriment of the others (Bryman 2007, 12). For instance, the audience for this project may be more interested and engaged by the qualitative results and uninterested by the econometric analysis, or the other way round. Similarly, there is a risk that one type of methodological language is used that attracts expected audiences but alienates others.

2.9.3 Bias in Methodological and Theoretical Preference

As the researcher's background for this project is in economics, there was a risk of bias towards economic theory and quantitative methods. As such, there was a risk that the results or theories linked to economics would be given more focus and seen to be of higher importance.

As Bryman outlines, "lingering affiliations" to one type of research method can discourage the most effective integration of findings as a researcher may feel more

confident in their skills relating to one of the methods (2007, 13). In terms of theories, for example, having an economics background means relevant economic theory is more likely to be already known and, hence, less time consuming to research and discuss due to this pre-existing familiarity. Thus, leading to a bias in the theory discussed.

This project has sought to counteract this potential bias by incorporating a research question that expressly requires the comparison and integration of findings across the methods. This project also sought to consider the relevance of a variety of theories as climate change policy (whether company specific or not) is an area that is covered by a wide variety of research disciplines (and not just economics).

2.9.4 Epistemology versus Ontology in the Project Design

There is also a potential limitation in relation to the project design where there is a combination of a sequential design with an integration of findings at the end of the study.

This design was used in order to maximize the findings in two ways: firstly, as the project progressed and, secondly, at the end of the study, once all the methods were complete and all data could be reflected upon. However, there is a risk that because some of the findings from an earlier method are integrated into the later methods, these cross-method findings could be more likely to agree than if another project design had been used. In other words, the final integrated findings of how company ICP is calculated (the ontological element) may been greatly influenced and constructed by the sequential project design (the epistemological element).

As discussed by Bryman, such issues can be challenging to address and researchers often take a pragmatic approach to resolving this problem (2007, 19). Accordingly, due to the time constraints for this project as well as the benefit seen in maximising the use of findings at each stage of the project, this issue is simply accepted as a limitation of the design.

2.10 Merits of the Middle Ground

As outlined above, there are a variety of challenges that are presented by completing a mixed methods study. However, there were also significant merits that were gained from tackling these methodological challenges: a mixed methods approach enabled an awareness of some implicit assumptions and simplifications used by econometricians that may narrow their vision.

The discussions in Sections 2.8.6 and 2.8.7 in relation to the removal of outliers from the regression data set are examples of this: the mixed methods approach encouraged the questioning of standard econometric practices that may limit research findings.

Similarly, the completion of the econometric analysis heightened the awareness of the researcher to the external validity issues related to the Statoil case study. In econometrics, the bigger the data sample, the more externally valid findings are seen to be. This created a reminder that the findings from the case study should not be too broadly applied.

2.11 Ethical Considerations

The key ethical considerations relating to this project relate to the case study method. This is because the data used in the literature review and econometric analysis was publicly available information.

2.11.1 Case Study: Notification to Norwegian Centre for Research Data (NSD)

In advance of the commencement of this project, the proposal was submitted to and approved by NSD. A copy of the draft informed consent letter and interview guide were submitted at the same time.

This notification of the project to NSD was required due to the potential that personal data could be obtained or stored during the course of completing the case study (for example, the name and email address of the interviewee and the interviewee's voice via the audio recording of the interview).

If applicable, it was agreed that any personal information regarding third persons mentioned in the interview, would be anonymised. This was not necessary as no personal data regarding third persons (for example, name) was included in the questions or the interviewee's responses.

As mentioned above, prior to the start of the interview, the interviewee was fully informed of the project purpose and their role within the project. This information was provided via the signing of an informed consent letter. As part of this letter, permission to make an audio recording of the interview was requested and given by the interviewee. This audio recording will be deleted on submission of this project thesis.

The interviewee was kept anonymous throughout the writing up of the project. However, it was highlighted to the interviewee that there was a risk that their identity could be guessed due to their senior role at the company. This was accepted and acknowledged by the interviewee. It was also agreed that if any direct quotations from the interview were to be used then these would be checked with the interviewee in advance of this thesis being submitted.

It was agreed with the interviewee that the company's name could be used in the writing up of this project.

2.12 Moving Forward

This chapter has provided an outline of the methodology used in this project. The next chapter will move on to provide a theoretical basis for the topic at hand.

3 Theory and Models

3.1 Introduction

This chapter will provide an overview of the theories and models that have helped to provide a background to, and also to inform, this project. It is important to note that there is limited academic discussion specifically focusing on a theoretical basis for calculating ICP. However, there is a variety of theories that support the idea of carbon pricing and putting a price on carbon emissions. This chapter will outline how economic theories can help to explain what value *should* be used for ICP and how theories from other social sciences can contribute by helping to explain *the reality* of ICP values.

Similarly, this chapter will also outline the models typically used by governments and academics to put a price on the social cost of carbon and how these can provide insight into potential methods that companies could use for their own calculations.

As such, this chapter will, firstly, provide an overview of key concepts relevant to this topic. Next, a discussion will be outlined of how classic welfare economics informs this issue. This will be followed by the introduction of relevant theories relating to variation in firm environmental behavior and policy. This introduction will include some economic theory but, in order to provide a broader insight, will not be limited to this subject discipline. Lastly, models behind the social cost of carbon will be discussed.. The various ways in which these theories and models can provide insight into ICP calculation methods, will be considered throughout this chapter.

3.2 Key Concepts

As mentioned in the first chapter of this project, a carbon price is a value that is placed on the emission of one unit (usually, one tonne) of carbon dioxide.

Carbon regulation, in the previous chapter, was defined as an emissions trading system (ETS) and/or carbon tax that has been implemented or is scheduled to be implemented in a country, state or province (World Bank 2015, 22). Such forms of regulations are ways in which a monetary value can be put on carbon dioxide emissions.

An ETS is a form of cap-and-trade system. Such a system involves "setting a maximum level of carbon emissions, with emissions allowances issued by regulators up to this cap that can be bought or sold" (Kennedy, Obeiter and Kaufman 2015, 3). Under this type of programme, the carbon price is seen to be the market price for the emissions allowances. (Kennedy, Obeiter and Kaufman 2015, 3).

In contrast, a carbon tax is "a fee added to the price of goods in proportion to their carbon content" (Kennedy, Obeiter and Kaufman 2015, 2).

3.3 Welfare Economics

There are several concepts and theories, central to classic welfare economics, which form the logic of putting a price on carbon. These help to explain, not only, why ICP should be used but also the value that should (or could) be applied.

3.3.1 Externalities

The first of these concepts is that of an 'externality'. "An externality…occurs when someone is seriously affected for good or ill as a result of a decision to which he or she is not a party" (Meade 1973, 45). Carbon dioxide emissions are an often-cited example of a negative externality. Negative externalities occur "when an activity… causes harm that is not reflected in the prices of goods or services" (Kennedy, Obeiter and Kaufman 2015, 4).

The concept of externalities was first explored by Marshall (1890) and then expanded upon by economists such as Pigou (1920), Kapp (1950) and Bator (1958) to become what modern economists are now familiar with.

3.3.2 Market Failure and Correction

Under classic economic theory, negative externalities lead to market failure, as the prices within the market do not reflect the full cost of the goods or services that are creating these emissions. Accordingly, such incomplete pricing information leads to inefficient decision-making by economic agents.

According to free market theory, this failure can be corrected (or "internalised") if the cost of the negative externality is reflected within market prices (for example, via a tax); thus, in theory, providing compensation to the recipients of the externality (Kula 1998, 69). However, in reality, even though the polluter may pay a tax, there is no guarantee that the money will be passed on to those bearing the cost of the externality (i.e. 'the pollutees'). Despite this challenge, such price information should, according to free market theory, still help to inform the decision making of economic agents in terms of the broader cost of production and consumption.

The creation of ICP is an example of such an attempt at market-correction through updated price information: a financial value for carbon dioxide emissions could inform corporate decision makers of the true cost of their business investments. As such, these prices, if sufficiently high, may lead to reduced investment in carbon-intensive activities. According to Rezai, Foley and Taylor, "Creating the correct price signal for GHG emissions… is sufficient to internalize the negative externality of global warming" (2012, 332).

The key way in which these concepts inform this research project is the emphasis on an accurate calculation of the cost of a negative externality. By exploring the logic behind the calculation of ICP values, this project could help to inform discussions as to whether these prices correctly reflect the total cost of a tonne of emitted carbon dioxide.

Additionally, Coase theorem is an economic concept that is central to understanding the logic behind carbon pricing through emission trading systems. Coase theorem considers how externalities can be internalized; essentially, it argues that "it is possible to achieve an optimal level of pollution reduction by an arbitrary *assignment* of property rights to either the polluters or the pollutees" (Hussen 2013, 60). Property rights, in this context, refer to 'ownership rights'; in other words, a person or company pays for the right to pollute. Accordingly, under this theorem, the problem of negative externalities can be solved by governments simply assigning ownership rights that allow for trading between the relevant parties. This is seen through the issuance and trading of emission permits throughout the EU ETS (European Union Emissions Trading System): carbon emissions are transformed into property that can be owned. The EU ETS allows companies that reduce their pollution (and so do not need all their emission permits) to sell these permits to companies that over-pollute (and so do not have enough permits).

This provides a financial advantage to companies that reduce their emissions and creates a financial cost for those that do not. In terms of the EU ETS, the idea is that, over many years, the EU will gradually reduce the total number of permits in the market. By doing so, companies would be forced to reduce their carbon emissions.

However, it is important to remember that the Coase theorem is based on the assumption of no transaction costs, which does not apply in reality. For instance, staff or outside consultants may need to be hired in order to facilitate the buying or selling of emission permits, including the provision of independent verification procedures. Accordingly, further costs (other than those suggested through Coase theorem) should be taken into account when assessing the full cost of carbon emissions.

3.3.3 Putting a Value on Environmental Costs

There are a variety of approaches within welfare economics that aim to place a value on environmental costs or benefits. These approaches suggest ways in which an ICP value could be calculated.

The replacement cost approach, for instance, is used to value an environmental effect by measuring, in monetary terms, the "gain from avoided environmental damage" (Hussen 2013, 123). An example of this would be an estimate of the monetary savings that would be gained by a firm not having to buy additional emission permits, due to reduced carbon dioxide emissions in its activities.

Another method is the hedonic pricing approach. This approach is based on the idea that the value of an environmental amenity can be measured by looking at the difference in market prices between assets that either do or do not benefit from that amenity (Hussen 2013, 125-126). For example, the cost of air pollution could be valued by comparing the market value for houses that suffer from air pollution with the market value of (very) similar houses that are situated in an area with no air pollution. However, a limitation to this approach is that it assumes that the negative externality has been internalised and, as a consequence, that the environmental cost or benefit is reflected in market prices. As discussed in Section 3.3.2, this is often not the reality and so differing prices of goods or services are unlikely to fully reflect the associated environmental cost or benefit that is being measured.

The contingent valuation method is another, similar, approach which entails identifying the monetary value that a person or firm would willingly pay for an environmental resource or service (Hussen 2013, 132). For example, this method could put a value on how much more a customer would be willing to pay for a good if the supplying company could ensure that the supply chain was carbon neutral.

3.4 Across the Social Sciences: Variation in Firm Environmental Behaviour

The above section outlined key economic theories that provide insights into why carbon pricing may be used and what methods should be considered when calculating an ICP value.

However, this climate-related topic can benefit from theories from a range of social sciences, as well as, economics: other disciplines can help to explain discrepancies between the value predicted by economic theory and the reality of ICP values. This section outlines a number of alternative theories that provide potential explanations for the reasoning behind the apparent variation in firm environmental behavior and policy. In turn, these may suggest reasons as to why such variation can be seen in ICP values.

3.4.1 Sources of Pressure: Stakeholders and Regulation

Firstly, it can be argued that particular pressure sources have a central influence on firm environmental policy; for example, stakeholder or regulatory pressure (Pulver 2007, 46).

In terms of pressure from stakeholders, this could include such wide-ranging influencers as governments, non-governmental organization (NGOs), consumers or shareholders. Kassinis and Vafeas argue that varying characteristics of such "stakeholder pressures" are what lead to variance in firm environmental policy (2006, 156). For instance, industries with a higher carbon footprint may experience pressure to mitigate and manage their environmental impact from climate-focused NGOs (leading to the use of an ICP). On the other hand, industries that rely heavily on end consumer purchasing patterns may use higher ICP values as a way to manage their public relations and to fit with consumer opinion.

Similarly, it could be argued that the regulatory environment in which a firm operates shapes its internal policy (Pulver 2007, 47). For example, it could be that where a carbon tax exists in a country, a company operating in this jurisdiction may design their ICP so that the value is equal to this tax. This would be a relatively straightforward and pragmatic way for a company to place a value on the direct cost that they incur in relation to carbon emissions. Accordingly, variance in country regulation could be reflected in the variance present in the ICP values seen within internationally operating companies.

3.4.2 Shared Networks

Alternatively, from a sociological perspective, other theories argue that inter-manager networks have a central influence on firm environmental policy.

The institutional model and environmental contestation approach both focus on this area of influence: networks and shared knowledge creation between key company actors, such as, managers are seen to have an significant influence on environmental policy (Pulver 2007, 47). Such networks could be within particular industries or across a variety of industries. For example, they could be formed through common educational or country backgrounds.

In particular, the environmental contestation approach argues that "co-created, shared understandings of market opportunities, likely regulatory outcomes and consumer behavior are key drivers in firm environmental behavior" (Pulver 2007, 50). Similarly, new institutionalist models state that decisions and actions made by companies are driven via the "process of shared knowledge creation by the firm (itself) and other actors in its organizational field" (Pulver 2007, 47).

As such, these theories could help to explain the variation in ICP value seen between companies that appear to have very similar activities (for example, between oil giants such as Royal Dutch Shell and Exxon Mobil). If particular networks or areas of shared knowledge can be identified, these groups may demonstrate homogeneity in company environmental policy (and, thus, ICP value).

3.4.3 Typologies of Firm Greenness

Rather than looking at inter-company relationships, it could be argued that the nature and extent of a firm's own "greenness" is what has the most influence on its environmental policy (Pulver 2007, 47).

For instance, Petulla categorises a company's approach to environmental management into three types: "crisis-oriented, cost-oriented and enlightened" (1987, 72). Each category refers to a different level of compliance and interest in environmental issues. For instance, 'enlightened' companies have the most "sophisticated" and long-term environmental policy based on an (apparently genuine) interest in tackling current and future climate challenges (Petulla 1987, 79 and 88). In contrast, 'cost-oriented' companies simply accept that compliance with environmental regulation is a legitimate business cost and so implement the minimal necessary compliance (Petulla 1987, 76). Alternatively, 'crisis-oriented' companies delay implementation of environmental policy until as late as possible and only put it into use when it is seen to be absolutely necessary (Petulla 1987, 73).

This classification of firms helps to identify the motivation for their environmental policy. As such, a company's motivation could influence the value they place on their ICP. For example, a company wishing to truly implement ICP into their daily and future decision-making may base their ICP value on expected carbon regulation. In contrast, a company simply wishing to appear concerned with the environment (but will actually not implement ICP as strictly as they profess) may have a very high ICP. Such a high ICP value would have no practical significance to the company itself but would send a public relations message that they are concerned with the high environmental costs related to carbon emissions. This usage would be classified as "green marketing" by Weinberg (1998, 247).

3.4.4 Systemic Influences

Other theories suggest that it is the broader, systemic background in which a company operates that affects their environmental policy. There are two key approaches that focus on this systemic-influence: the 'treadmill of production' model and ecological modernization theory (Pulver 2007, 48).

The ‘treadmill of production’ model, assumes an economic system with “ever-increasing production” coupled with “ever-increasing environmental impacts” on the basis of unlimited wants combined with competition between firms (Pulver 2007, 48). As such, this ever-expanding system means that environmental challenges will continue to be unresolved (Gould, Pellow and Schnaiberg 2008, xii). Under this model, it could be argued that ICP would not be introduced or used at all or, if it were, then it would have no influence on business operations.

Ecological modernization, on the other hand, views society as one that will increasingly adapt to ecological needs so that capitalism and environmental protection can coexist (Knutsen and Ou, 68). Accordingly, this approach would have a more optimistic view of ICP, with such pricing being an example of how business practices can adapt to coexist with the environment. As such, it could follow that the value placed on ICP would be the value that would allow the environment to be protected, whilst not damaging the capitalist system.

3.5 Integrated Models of the Social Cost of Carbon

The models used to calculate the social cost of carbon can help to provide suggestions as to how companies may choose to calculate their ICP. This is particularly useful when there is limited theoretical literature directly focusing on ICP. The fundamental logic behind these models is based on economic reasoning but these models do also seek to incorporate knowledge from other disciplines such as physics and sociology. Accordingly, each of the models discussed below is referred to as an “integrated assessment model” (Greenspan Bell and Callan 2011, 2).

The social cost of carbon can be defined as the marginal social damage (in monetary terms) that “an extra tonne of carbon released now would impose on the current and future society” (Hope and Newbery 2006, 32). It is a form of carbon pricing that measures “the scale of the externality which needs to be incorporated into decisions on policy and investment options in government” (Price, Thornton and Nelson 2007, 2). This measure is typically used by governments in order to calculate a cost to society (on

a global scale) of carbon emissions. This is in contrast to ICP, which looks at the cost of carbon emissions from the perspective of an individual company.

However, one key similarity between the social cost of carbon and ICP is that both have widely varying values: in the same way that different companies apply different ICP values, different governments have suggested different values for the social cost of carbon. This likeness implies that governments and companies may have similar reasons for this variance in calculated values.

This section will focus on three key models that have been used to calculate the social cost of carbon: the PAGE, DICE and FUND models. The discussion will be structured by considering two influential studies that have used one or more of these models. The features of these models will be outlined and the insight that they may provide to ICP calculations will be discussed. Firstly, the Stern Review (2006) will be considered. This review was commissioned by the UK government and estimated the social cost of carbon to be 86 USD per tonne of emissions. Secondly, the study undertaken by the US government will be considered. In contrast to the Stern review, the US government applied the value of 37 USD per tonne to the social cost of carbon (Bloomberg 2014).

3.5.1 The Stern Review: the PAGE Model

The Stern Review is a report that was published in 2006 and outlined the economic consequences of climate change. As mentioned above, it was commissioned by the UK government and it was written by a former chief economist at the World Bank (Nicholas Stern).

This report used the PAGE2002 Integration Assessment Model in order to calculate a social cost of carbon. PAGE stands for 'Policy Analysis of the Greenhouse Effect' (Hope, Anderson and Wenman 1993, 327). This model is complex and aims to "incorporate knowledge from more than one field of study" in order to reflect the interdisciplinary nature of climate change (Hope and Newbery 2006, 33). Moreover, it aims to calculate the impacts of climate change over region and time. The model includes equations that outline such phenomena as "adaptation to climate change", "the greenhouse effect", "regional economic growth" over time and "cooling from sulphate aerosols" (Hope and Newbery 2006, 34).

This model provides insight into the potentially wide-ranging factors that companies may use to calculate their ICP value. For example, firms may take into account future changes and regional differences in the variables they choose to base their calculation on. Furthermore, by including the principle that the social cost of carbon may change over time, the PAGE model suggests that companies may also update their ICPs as time progresses (rather than calculating one price and keeping this price constant for the next 50 years).

Another potentially key insight relates to the reasoning behind the variation in ICP values: this overall variation could be due to uncertainty as to the *particular values of the influencing factors*. This is something that the PAGE model demonstrates in terms of the social cost of carbon (Hope and Newbery 2006, 60). Accordingly, companies could all be using the same variables to calculate their ICP values but the numerical value of those variables could still vary widely due to different assessments of uncertainty (for example, in terms of the cost of future carbon regulation). This would lead to a variety of ICP values despite calculations being based on the same fundamental principles.

3.5.2 US Government: the DICE and FUND Models

In November 2013, the US government estimated the social cost of carbon to be 37 USD per tonne for the year 2015 (Bloomberg 2014). This is quite different from the value concluded by the Stern Review (86 USD per tonne). The US government considered a range of models when calculating this cost and this central value has been used by the Obama administration to inform policy decisions on climate regulation (Greenspan Bell and Callan 2011, 1).

The main models used by the US government's working group, in order to calculate the social costs of carbon, were PAGE (outlined above), DICE and FUND (Greenspan Bell and Callan 2011, 5). The DICE model will, first, be considered.

DICE stands for 'Dynamic Integrated Climate-Economy' (Nordhaus 1993, 27). The DICE model bases its logic on economic growth theory and the idea that society is willing to make climate investments now (hence, reducing current carbon emissions) in order to benefit from a less-changed environment in the future (Nordhaus 2014, 276).

The key distinguishing feature of this model is that it "tries to account for unpredictable but possible abrupt climate changes" (Greenspan Bell and Callan 2011, 6)

Cooke (2011) outlines a method that combines the Shapley cost allocation method with DICE. The Shapley cost allocation method is based on principles of game theory and calculates the shared benefit (or cost) of an individual cooperating with others in order to "secure" a shared outcome (Roth and Verrecchia 1979, 295). It can be used when discussing financial accounting theory.

Cooke's combination of the Shapley method with the DICE approach looked to calculate the cost of carbon in the same way as an insurance risk premium (2011, 1). It essentially sought to "illustrate an accounting method that prices [climate] risk" (Cooke 2011, 16). It is based on the assumption that "individuals are generally risk averse" and the accompanying assertion that "society should be willing to pay a "risk premium" to reduce these catastrophic risks" (Cooke 2011, 1). However, in this particular method, society's willingness to pay rather than what society *should be* willing to pay, is what was actually measured (Cooke 2011, 1). Society's implicit willingness to pay in order to counter the risk of climate damage was measured through interpreting "various international agreements" on climate change (Cooke 2011, 1).

The DICE model helps to provide insight into ICP since it suggests that companies may be taking future risks into account in their calculation methods. This may lead to a company using a higher current value as they try to take into account a variety of future risks.

The FUND model, on the other hand, stands for 'Climate Framework for Uncertainty, Negotiation and Distribution' (Tol 1997, 151). Similar to the PAGE model, FUND takes into account regional differences in a variety of factors such as population growth, energy use and concentrations of greenhouse gases (Tol 1997, 152). However, it does not take into account potential "abrupt, catastrophic changes" such as those incorporated into the DICE model (Greenspan Bell and Callan 2011, 6).

Through its consideration of differences between "nine major world-regions", the FUND model reinforces one of the insights from the PAGE model: that companies may

take into account regional differences (for example, in carbon regulation) when calculating their overall ICP value (Tol 1997, 152).

3.5.3 Assumptions Behind the PAGE, DICE and FUND Models

Whilst the above-described models can provide insights into the calculation methods that may be used by companies in their ICP, it is important to be aware of their limitations. The fundamental limitation is that, as true for all economic models, PAGE, DICE and FUND incorporate a variety of assumptions. These assumptions may not accurately reflect the reality of climate change, causing readers to question whether these models can be used to inform real-life decision-making.

Greenspan Bell and Callan argue that "developing the [social cost of carbon] requires assumptions that go well beyond the usual boundaries of science or economics" (2011, 1). In order to fit climate phenomena and related factors into an economic model, it is necessary that a "series of choices and value judgments" are made in order to quantify, exclude and narrowly define the variables (Greenspan Bell and Callan 2011, 11). This is further exacerbated by the "exceptional levels of uncertainty" related to the various factors being measured (Greenspan Bell and Callan 2011, 8). For example, the FUND model "assumes that agriculture can tolerate huge temperature changes", which is simply not realistic for the majority of crops (Greenspan Bell and Callan 2011, 7).

Similarly, the Stern report (based on the PAGE model) assumes a "near-zero time discount rate" (Nordhaus 2007, 701). The discount rate is an economic term that "specifies the extent to which the well-being of future generations shall be taken into account in decisions taken by the present generation" (McNeill 2010, 110). By assuming a discount rate that is "near zero", the social cost of carbon calculated in the Stern review is based on the idea that current generations are neutral towards how future generations are affected by climate change (Nordhaus 2007, 701). Whilst debates on climate ethics may include arguments that present society cares more or cares less about future generations, it seems unlikely that society would be neutral on this contentious subject.

Fundamentally, the most significant issue regarding the social cost of carbon relates to complexity: the majority of the above value judgments are hidden in the complexity of

the models. As such, policymakers and stakeholders may make decisions based on the values suggested by these models without being fully aware of any bias or simplification that may be being perpetuated.

These key limitations, whilst worrying for government policy that is based on the social cost of carbon, may provide a realistic insight into the methods used by companies in their ICP calculations: faced with such a wide array of methods companies may, in reality, adopt rather simple calculation methods for the purpose of ease and pragmatism. As such, the methods may not be as complex as anticipated.

3.6 Theory and Models: Chapter Summary

This chapter has considered the theoretical basis for carbon pricing. This range of theories, from a variety of disciplines, can provide insight into what influences firm behaviour and how this, in turn, affects the valuation approach that they choose in relation to their ICP.

However, the picture is rather confusing. Economic theories, alone, suggest alternative approaches which each provide different answers on how to calculate ICP: the final value appears to depend a lot on the assumptions made. Other disciplines confuse the picture even more by suggesting further ways in which an ICP value may be determined. This complex mix of alternative theoretical bases may help to explain why, in reality, companies have concluded upon such a variety of ICP values.

The models outlined in Section 3.5, that have been used to calculate the social cost of carbon, may also provide some practical insights into ICP calculation methods. These models have sought to integrate different fields of knowledge when looking to put a social cost on carbon emissions. However, evaluating the limitations of these models may provide the most valuable conclusion from this chapter: that companies may, in reality, choose as simple a calculation model as possible in order to manage the (time consuming) complexity of putting a price on carbon. This is a point that is also emphasised in the case study, where the Statoil interviewee explains that simple ICP is essential in ensuring that the policy is actually implemented (see Chapter 5, Section 5.5.2).

The next chapter will move on from this theoretical basis and outline the first stage of this project's mixed methods: the literature review.

4 Literature Review

4.1 Introduction

This chapter outlines the literature review undertaken for this project. The documents reviewed in this section are those that concern the corporate use of carbon pricing. However, government carbon pricing is also referenced. Literature specific to the case study company (Statoil) is not included in this review.

As the first step in the mixed methods process, the aim of this review was to identify any potential factors that influence ICP values. This would then inform the choice of variables to be considered in the Statoil case study and, then later, in the econometric analysis.

The literature review found that government regulation was most often mentioned as being an influencer on the ICP calculation process. Industry sector and stakeholders were also mentioned. However, it was also notable that, in general, when companies provided comments regarding their ICP, concrete answers were not provided as to how their values have been calculated.

The review began by considering the first document prepared by CDP on ICP (CDP 2013a) (see Chapter 2, Section 2.6.1). More recent publications concerning ICP were then considered. For the purpose of this chapter, the literature has been grouped into two sections in order to facilitate the ease of reading. The first section focuses on the current usage of carbon pricing (non-CDP reports) and the second section looks purely at CDP-issued documentation. CDP reflects half of this literature review as it the source that has published the most amount of information relating to ICP.

Each document has been reviewed in the same structured manner (see Chapter 2, Section 2.6.2).

4.2 Carbon Pricing: Current Usage

4.2.1 World Bank 2015: "*Status and Trends of Carbon Pricing*"

Summary of Content

This report, published in 2015, provides an overview of trends in the use of carbon pricing across the globe. This includes the use of carbon pricing instruments by both governments and businesses. The report also analyses the current risk of carbon leakage (this is where companies move to countries where emission costs are lower) as well as the benefits of international cooperation in the field of carbon pricing.

Trends seen in 2015 include the increasing implementation of carbon regulation (in the form of an ETS system or a carbon tax): "the number of carbon pricing instruments has expanded by 90 percent since 2012" (World Bank 2015, 20). Also included in the report is a very useful diagram illustrating the type and extent of carbon regulation used in countries, provinces and states across the globe (World Bank 2015, 22). In terms of carbon leakage, it was found that this is only an issue in certain emission and trade intensive sectors (World Bank 2015, 14).

Emerging trends include the "growing engagement of the private sector": both in terms of advocating a price being put on carbon for regulatory purposes but also by using their own internal carbon prices (World Bank 2015, 26). The World Bank also notes that "Some of these [internal] carbon prices are substantially higher than current price levels in mandatory carbon pricing instruments" (2015, 14). There are various comments as to the intended purpose behind the use of ICP. Potential purposes include, being "part of a risk management strategy to evaluate current or potential impact of a carbon price obligation on their operations", "as a means to identify and value cost savings and revenue opportunities in low-carbon investments", to "help companies to demonstrate their support for effective carbon pricing policies" (World Bank 2015, 48).

Criticism of Source

The World Bank is a US-based organization made up of 189 member countries (World Bank 2016a). The overarching aim of the World Bank is to eradicate poverty through "sustainable globalization" (World Bank 2016b).

The World Bank has demonstrated that it is pro-carbon pricing through its partnership with The Carbon Fund. This Fund works to "develop viable, flexible market mechanisms" (World Bank 2016c). As such, it may be that the World Bank's report on

carbon pricing is positively biased towards reporting the success and prevalence of carbon pricing instruments. However, as the aim of reading this report is to find information as to the details of ICP calculation methods, this information is less likely to be biased as it does not question the use or benefit of carbon pricing, in the first place.

Contribution to the Research Question

The report includes a diagram illustrating the range, in 2014, of the ICP values used by companies (World Bank 2015, 48). This highlighting of the variance in these values supports the logic of asking the initial question which led to this project being undertaken: why is there such a variance in ICP values?

More specifically, the statement that some of the ICP values "are substantially higher than current price levels in mandatory carbon pricing instruments", suggests that whilst carbon regulation may influence these values, other factors are also at play (World Bank 2015, 14). Additionally, the reference to firms using ICP in order to "demonstrate their support" for similar government policy, suggests that stakeholders may perhaps influence the formulation of the ICP (World Bank 2015, 48).

4.2.2 Kennedy, Obeiter and Kaufman 2015: "*Putting a Price on Carbon: A Handbook for U.S. Policymakers*"

Summary of Content

This 'handbook' provides an overview of government carbon pricing in terms of practical usage and programme design. This includes "whether, how, and when to implement a national carbon price" and the use of government revenue earned from such a regulatory instrument (Kennedy, Obeiter and Kaufman 2015, 1).

The handbook provides key definitions related to the topic of carbon pricing (such as, carbon tax and a cap-and-trade system) as well as an outline of the history of carbon pricing. An extensive comparison is also given as to the features of carbon tax in comparison to a cap-and-trade system.

When discussing how a carbon pricing system should be designed, it is considered which sectors should be included. For instance, it is highlighted that certain sectors have a higher emissions burden than others, with the "electric sector" being "responsible for about one third of total GHG emissions" in the U.S. (Kennedy, Obeiter and Kaufman 2015, 19). It is also argued that a carbon price should be adjusted over time to reflect that the relevant costs will not stay constant (Kennedy, Obeiter and Kaufman 2015, 22).

ICP is briefly mentioned but only as an example of the growing number of carbon pricing instruments being implemented across the world. This handbook focuses on state usage of carbon prices.

Criticism of Source

This report was a working paper put together and published via the World Resources Institute (WRI). The WRI is a global research organisation that is funded by a variety of private and public donors: Bloomberg Philanthropies, the UK Department for International Development and the Norwegian Agency for Development Cooperation were the largest donors in 2015 (WRI 2016a). Such funding reliance could lead to bias in researching areas that are of most interest (and benefit) to these donors. However, WRI openly advocates transparency and independence in its research (WRI 2016b). This suggests that any potential biases, towards research areas of donor interest, are consciously mitigated by WRI.

At the start of the report, it is stated that "We believe that pricing carbon should be a core element in the United States' long-term strategy" for reducing greenhouse gas emissions (Kennedy, Obeiter and Kaufman 2015, 1). This clearly demonstrates the author's positive bias towards the use of carbon pricing in US policy. The title of the report ('a Handbook for U.S. Policymakers'), again, highlights that this document is aimed to have influence on the political debate in terms of US environmental policy. As such, similar to the World Bank, it could be that the benefits of carbon pricing are exaggerated.

Contribution to the Research Question

This handbook provides a useful background to carbon pricing and the reasons behind such a market-based instrument.

In terms of potential factors influencing ICP values, the discussion as to the varying emissions burden across sectors suggests that certain industries may have substantially higher carbon-associated costs. As such, it could be that industry sector influences the value of a firm's ICP.

4.2.3 Caring for Climate 2015: *"Executive Guide to Carbon Pricing Leadership: A Caring for Climate Report*"

Summary of Content

This report looks to outline the current status of corporate carbon pricing as well as to encourage companies to act as local and global 'leaders' in corporate environmental action through their use of carbon pricing.

It argues that by following the outlined 'Business Leadership Criteria' businesses can influence policy and be "market-ready" for future carbon regulation (Caring for Climate 2015, 3). The Business Leadership Criteria has three parts, the first of which specifically relates to ICP: "set an internal carbon price *high enough* to materially affect investment decisions to drive down greenhouse gas emissions" (Caring for Climate 2015, 3) (emphasis added). The second criteria relates to publicly advocating "the importance of carbon pricing" and the third refers to being transparent on the progress towards achieving the other two criteria (Caring for Climate 2015, 3).

The report also includes an overview of the background to corporate carbon pricing as well as examples as to how companies are using carbon pricing in practice (Caring for Climate 2015, 4). Various statistics are quoted in order to demonstrate the growing prevalence of carbon pricing on both a state and private level.

Three methods of ICP are outlined: a shadow price, an internal tax, fee or trading system and an implicit price (Caring for Climate 2015, 7). A shadow price is a type of ICP that informs decision-making but is not necessarily a real cost. An internal tax, on the other hand, is a form of internal financial incentive where a fee is applied to certain

activities or expenses. An implicit price, in contrast, is less direct and is the amount a company spends on reducing its greenhouse gas emissions (Caring for Climate 2015, 7).

When discussing the use of ICP in practice, two key challenges are cited: the "lack of common method or guidance to set a carbon price" and the "difficulty [of] arriving at the "right price" this is not too high to be reasonably implemented…or too low and ineffective in shifting investment decisions" (Caring for Climate 2015, 9).

The report contains a comment from a company explaining their process of finding a method for calculating their ICP value: after coming across difficulties trying to apply complex models in order to calculate an accurate market price, the company changed to a more pragmatic pricing approach that creates a general estimate based on carbon regulation (Caring for Climate 2015, 10). Furthermore, it is argued that the purpose of using ICP should have a significant effect on calculating an appropriate value: when shadow prices were used (for investment decision making purposes), ICP values where higher than when an internal tax or fee was used (to fund greenhouse gas emission reductions) (Caring for Climate 2015, 10).

Criticism of Source

Caring for Climate is a United Nations initiative set up by the UN Global Compact, UNFCCC and UNEP. Strategic partners include CDP, The Climate Group and Principles for Responsible Investment (Caring for Climate 2016a).

This initiative is openly pro-business and pro-carbon pricing. Caring for Climate argues that "business has the solutions to turn the climate challenge into market opportunity" and by focusing on carbon pricing (particularly, ICP), it is clear that this instrument is seen to be one of "the solutions" (Caring for Climate 2016b). As such, it is likely that the evaluation of the benefits of carbon pricing is not argued from a neutral or objective perspective.

It is important to be aware that the governance of this initiative may be biased towards presenting corporate climate action in a positive light. This is on the basis that the Caring for Climate "steering committee" includes representatives from companies such as The Coca-Cola Company, Tata and Siemens (Caring for Climate 2016c).

Contribution to the Research Question

This report provides a very useful overview of the current use of corporate carbon pricing along with the related challenges and benefits.

In particular, the discussion as to the challenge of putting the 'right price' on ICP is very relevant for this research project. The comment from a company saying that they opted for a simpler pricing approach after attempting to use a variety of complex models, suggests that companies are pragmatic in their valuation approach.

Furthermore, this report suggests that the intended purpose behind a company's ICP affects the value used. ICP that is aimed at affecting long term, strategic decision-making is likely to have a high value.

4.3 Internal Carbon Pricing: Carbon Disclosure Project (CDP)

4.3.1 Criticism of CDP as a Source

As the below documents are all published by CDP, it follows that this part of the literature review should begin with a criticism of this key source. CDP is an organisation that annually sends out questionnaires to companies across the globe, asking for disclosure of information regarding climate-related activities. This disclosed data is then analysed and summarised into various reports.

As discussed in Chapter 2, CDP may not be a completely unbiased source as their goal is "to transform the way the world does business" in order to mitigate climate damage (CDP 2016). This vested interest may cause CDP to promote the use of ICP in a positive light based on their belief that this is a method in which business practices can be 'transformed'. As such, the commentary within their reports (accompanying and interpreting the facts collected from companies) may be positively biased.

Most importantly, CDP receives funding from a variety of corporate sponsors and governments (CDP 2016). This may cause the organization to report the effectiveness of current climate policy more positively than if their operations were not reliant on such

funding. However, this potential risk and limitation is managed by the fact that CDP advocates independent and transparent operations. Therefore, it could be argued that they would be unlikely to go against such principles, themselves. As such, it CDP was concluded to be suitably reliable for the purposes of this project.

4.3.2 CDP 2013a: *"Use of Internal Carbon Price by Companies as Incentive and Strategic Planning Tool: A Review of Findings from CDP 2013 Disclosure"*

Summary of Content

This document provides a review of ICP-related information that was disclosed to CDP in 2013. This was the first report by CDP that focused purely on ICP. This report looks at "publicly traded companies operating or based in the United States" (CDP 2013a, 2).

This review states that ICP has "become standard operating practice in business planning" by such US companies: climate change is seen "as a key relevant business factor for which they wish to be prepared" (CDP 2013a, 2).

The disclosed reasoning behind the use of ICP is discussed; this includes "a response to regulatory environments", "to help identify revenue opportunities, risks" and "to guide capital investment decisions" (CDP 2013a, 2).

The range of ICP values disclosed in 2013 is mentioned (6USD-60 USD). It is argued that the ICP values are consistent with carbon prices seen in government initiatives: "The range in pricing used by companies reflects consistency with those governmental initiatives. Throughout the world, various policies involve carbon pricing, with significant range in price" (CDP 2013a, 7). However, it is not clear how this overall conclusion is made as this 2013a report only includes 11 disclosed ICP values: a very small sample.

The sector make-up of the companies using ICP is also discussed with the utility and energy sectors being "the most likely to employ internal carbon prices for strategic operation decision-making" (CDP 2013a, 2).

Various excerpts from companies' 2013 disclosures are included in the report. The excerpt from BP, for example, states that their ICP value is "based on our estimate of the carbon price that might realistically be expected in particular parts of the world" (CDP 2013a, 4). General Electric, on the other hand, simply refer to a 'model' that their Financial Services business uses but does not explain how this model is structured (CDP 2013a, 5). Wal-Mart also refers to the use of a model but goes one step further by mentioning that their ICP is "flexible, to allow it to change with time as external factors evolve" (CDP 2013a, 6).

Contribution to the Research Question

References to the calculation process of ICP values are vague but provide some hints as to potential influencing factors. BP's comments, for example, suggest that regulation in operating regions greatly influence the ICP value used.

Also, the statement from CDP that ICP values are consistent with government regulation, very much suggests that regulation plays a key role in the calculation process. However, this statement was made in relation to a small sample of companies and may not necessarily be broadly applied. Moreover, it does not appear (from the sample provided in this report) that company ICP values were precisely consistent with carbon regulation that existed in 2013. This suggests that other influencing factors are also at play.

4.3.3 CDP 2014a: *"Corporate Use of Carbon Prices: Commentary from Corporations, Investors and Thought Leaders"*

Summary of Content

The majority of this report contains statements from companies regarding their use of ICP. These statements were requested further to the CDP 2013 report and responded to further questions from CDP on ICP. One of these further questions was, "How are these prices calculated"? (CDP 2014a, 5).

However, despite this being one of the key questions, concrete answers were not provided in the company responses. Rather, vague references were made. For example,

Exelon Corporation states that "potential regulation of carbon is one of many considerations in our planning models" (CDP 2014a, 9). Xcel Energy advises that their ICP values are based on information from "third-party market forecasting consultants" (CDP 2014a, 18).

American Electric Power are a little more direct by stating that their ICP value is based on "legislation or regulatory action requiring carbon emissions reductions" (CDP 2014a, 6). They also mention that ICP is linked to their goal of ensuring that their "investors receive a fair return" (CDP 2014a, 6).

Contribution to the Research Question

Whilst the company statements are not particularly clear on the exact calculation methods they use for their ICP, it appears that current and expected carbon regulation plays a key role in determining the ICP value.

However, the various vague references to the existence of other influencing factors suggest that it is not just regulation that provides the ICP value. Other influencing factors could include shareholders, as suggested by American Electric Power.

4.3.4 CDP 2014b: *"Global Corporate Use of Carbon Pricing: Disclosures to Investors"*

Summary of Content

This extensive report is based on company responses to the CDP 2014 questionnaire. CDP state that this is "the first global analysis of corporate use of carbon pricing drawn from information provided directly by companies themselves" (CDP 2014b, 4).

The report is split into three sections: first, a full list of companies using ICP is given (including ICP values where these have been disclosed); the second section lists excerpts of company statements from the 2014 disclosure; the final section also provides company statements from the 2014 disclosure but, here, these statements purely focus on the implications of carbon pricing regulation on company activities. The report argues that the 2014 company disclosures "serve as powerful evidence of a global corporate consensus that carbon will be priced" (CDP 2014b, 4).

In 2014, 150 companies disclosed to CDP that they use ICP. However, only 25 of these provided the value (or range of values) that they use.

An excerpt from the Pennon Group's disclosure states that their ICP value is based on the UK government's "non-traded price of carbon" (CDP 2014b, 38). TD Bank Group also advises that their ICP value is linked to current carbon policy: the ICP is the cost of purchasing "renewable energy credits (RECs) and carbon offsets" (CDP 2014b, 41).

In terms of the impact of carbon pricing policies on business activities, there are many comments citing the challenge of uncertainty linked to the lack of international commitment on a price for carbon. The importance of a 'realistic' carbon price is also often mentioned.

Contribution to the Research Question

Once again, this report suggests that carbon regulation is a key influencer on ICP values: Pennon Group's reference to the government shadow price suggests that government policy and research may affect the ICP value, even if the use of this shadow price is not mandatory.

4.3.5 CDP 2015a: *"Putting a Price on Risk: Carbon Pricing in the Corporate World"*

Summary of Content

This extensive report is based on company responses to the CDP 2015 questionnaire. It is similarly structured to the CDP 2014b report and contains many excerpts from company responses to the 2015 questionnaire.

The most striking difference from the CDP 2014b report is that the "number of corporations disclosing they use an internal price on carbon has tripled" (CDP 2015a, 4). In 2015, a total of 435 said that they use ICP and 123 companies disclosed the particular ICP value(s) implemented. Furthermore, this report gives an estimate of the future usage of ICP: 583 further companies said that, whilst they are not currently using ICP, they "anticipate doing so in the next two years" (CDP 2015a, 4). CDP argue that

climate change now "represents a bona-fide line item in the standard budget assumptions of successful companies" (CDP 2015a, 4).

Again, references to calculation methods are typically vague: Danone, for example, refers to a ""Green Capex" procedure" for creating their "theoretical" ICP value (CDP 2015a, 18). As noted previously, where companies are more specific on what influences their ICP value, it is government regulation that is mentioned: Balfour Beatty, for example, mention that their ICP value is based on the "CRC tax rate" (this a mandatory carbon reduction scheme brought in by the UK government) (CDP 2015a, 23).

Contribution to the Research Question

This report provides the sample of companies to be used in the econometrics section of this project.

In terms of helping to suggest potential factors influencing ICP values, once again, regulation is repeatedly mentioned. However, as seen in the 2014 reports, the majority of company references to calculation methods are vague.

Also, the grouping of companies into industry sectors, throughout the report, suggests that this may affect the ICP process.

4.3.6 CDP and We Mean Business Coalition 2015: *"Carbon Pricing Pathways: Navigating the Path to 2°C"*

Summary of Content

This report outlines a 'Carbon Pricing Pathways Toolkit' which looks to provide a "set of conceptual tools" to decide upon and implement an effective carbon price (CDP and We Mean Business 2015, ii). Both governments and companies can use this framework. This report looks to contribute to the discussion as to how carbon pricing policies can be used in reality.

Two central 'dilemmas' are outlined in this toolkit: "global actions versus sovereign and sub-sovereign actions" which refers to the challenge of ensuring carbon pricing policies, at all levels, interact positively, and; "explicit carbon pricing versus policies that

implicitly price carbon" which refers to the need for policies that complement explicit pricing such as carbon taxes or cap-and-trade schemes (CDP and We Mean Business 2015, 3).

Additionally, a range of possible future trajectories of climate change are outlined in order to provide a framework for adjusting the carbon pricing discussion depending on the situation at hand. A trajectory is determined by the type and extent of environmental policies in place at a particular point in time (CDP and We Mean Business 2015, 20). One trajectory, for example, assumes ineffective and delayed climate policies leading to global temperatures rising "by more than 3°C above pre-industrial levels" (CDP and We Mean Business 2015, 28).

The toolkit also classifies different "pricing levels" (from subsidies as the lowest category to "targeted" as the highest) (CDP and We Mean Business 2015, 3). This classification is to provide "a common language" when discussing the merits of differing types and levels of carbon prices (CDP and We Mean Business 2015, 3).

Criticism of Source

This report was put together by the Carbon Pricing Pathways Project. This consists of CDP and the We Mean Business Coalition. This Project aims to "accelerate the adoption of effective carbon pricing mechanisms around the world" (CDP and We Mean Business 2015, ii).

The We Mean Business Coalition is made up of a range of non-profit organisations that work with "thousands of the world's most influential businesses and investors" to promote the transition to a low carbon economy (We Mean Business 2016). It has a corporate advisory board made up of representatives from multi-national corporations such as Unilever, Starbucks, Merril Lynch and Nike (We Mean Business 2016).

This close and strong influence of powerful companies may mean that reports produced by the We Mean Business Coalition will seek to promote environmental action that does not harm economic growth or 'business as usual' operations. Consequently, the carbon pricing framework may provide a toolkit that can help companies to *appear* concerned with climate change but may, in reality, not require a change in current business activities.

Contribution to the Research Question

References to ICP, in this report, are brief and general. However, this report is still valuable in terms of providing a useful framework for discussing and valuing carbon prices. The concepts discussed in the toolkit may be similar to those used by companies in their calculation methods. For example, companies may assume a certain 'future trajectory', linked to government environmental policy, when calculating their ICP value.

4.4 Overall Summary of Contributions

A variety of documents have been considered in this literature review. Overall, the key insights have been as follows: companies are typically vague when referencing their ICP calculation methods; however, when being more specific, government regulation is often cited as a factor influencing ICP values (this suggests that this is the strongest influencer).

There are also a couple of occasions where industry sector seems to be a potential influencer of ICP values. Pleasing shareholders and influencing policy appear to be a theme in the aim of ICP. As such, it could be that company stakeholders (such as, shareholders) may influence the level of ICP value implemented.

Similarly, the intended purpose for using ICP is also mentioned as a potential influencer. However, a challenge of including this as a variable is that it is highly subjective and companies may not state their true intentions. Furthermore, possible climate trajectories (for example, expected global temperature increases) are mentioned: an assumed trajectory could form the basis of companies' ICP calculations. However, as there are many different classifications and interpretations of potential trajectories, this would be a very difficult variable to define and collect data for.

Another interesting finding from this review is that companies appear to use pragmatic calculation methods, rather than overly complex models.

On this basis, carbon regulation, industry sector and shareholders were considered as potential variables for the case study section of this project. These variables were chosen as they were highlighted as potential influencing factors in this literature review.

Moreover, they could be measured objectively (and so could be consistently used, compared and integrated through the next two stages of this project). The regression analysis, in particular, requires variables that can be measured in an objective way.

It is important to note that a clear limitation exists for this literature review: all the sources considered advocate the use of carbon pricing. However, as this project is looking at a particular detail of the ICP process (valuation), rather than evaluating the effectiveness of such a policy, this bias should not effect the conclusions made from this review. As such, the sources are concluded to be suitably reliable.

The next chapter will move on to the second stage of this mixed methods project: the company case study.

5 Case Study: Statoil

5.1 Introduction

This chapter focuses on the case study section of this project and the insight that this has brought as to what influences ICP values. The subject of the case study was the Norwegian energy firm, Statoil ASA ('Statoil'). The aim of this method was to provide an in-depth example of the reality of company ICP. The first part of the case study entailed a document review of company-issued publications (including sections from the Statoil website). This review, along with the general literature review outlined in the previous chapter, was used to inform the questions posed in the second part of the case study: the elite interview. The interview was an insightful source of information that highlighted the importance of competitor ICP strategy as well as the need for a pragmatic approach to ICP. The combined findings of both sections of the case study are discussed in the final part of this chapter.

5.2 Who are Statoil?

5.2.1 Background

Statoil is an oil and gas company headquartered in Stavanger, Norway. Its operations focus on the exploration, production and processing of energy. Whilst the majority of these activities occur in the Norwegian continental shelf, Statoil has operations in 37 countries including China, Mozambique, Nicaragua and the UK (Statoil 2016a). Statoil has 22,000 employees across the world and is listed on both the New York and Oslo stock exchanges (Statoil 2016b).

Statoil stands out from other firms in its industry through its focus on transparency and advocacy on sustainability. The company "aims to be recognised as the most carbon-efficient oil and gas producer, committed to creating lasting value for communities " (Statoil 2016c). Most notably, it was ranked "No.1 on the 2014 Global 100 Index of the world's most sustainable energy companies, and number four of all corporations" (Statoil 2016c).

5.2.2 Ownership Structure

As mentioned above, Statoil is a publicly traded company. However, it was originally fully owned by the Norwegian government. This legacy is clear today with the Norwegian government still holding majority ownership: it is the largest shareholder with 67% ownership (Statoil 2016d). The other 33% is owned by shareholders who are based across the world, with a large proportion coming from the rest of Europe and the US (22.6%) (Statoil 2016e).

5.2.3 ICP at Statoil

In terms of ICP, Statoil applies two values: approximately 60 USD/tonne for projects in Norway and 50 USD/tonne for projects outside of Norway (Statoil 2016f). For the purposes of this chapter, the 60 USD value will be referred to as the 'Norwegian ICP' and the 50 USD value will be referred to as the 'Rest-of-the-World ICP'.

5.3 Document Review

5.3.1 Criticism of Source

This review looks at publicly available information issued or disclosed by Statoil in relation to ICP and/or the company's wider sustainability policy. As such, the information has not been written by a neutral source: Statoil has a strong vested interest in how it is portrayed. As such, it is important to be aware that this information may be biased towards promoting the company in a positive light.

5.3.2 CDP 2015b. *"Climate Change 2015 Information Request: Statoil ASA"*

Summary of Content

This report outlines the responses given by Statoil to CDP's 2015 questionnaire. It contains an outline of background information as well as more detail regarding the company's climate change policy. The questions answered by Statoil are those contained in CDP's oil and gas-specific questionnaire.

ICP is mentioned, briefly, several times. Firstly, it is mentioned when outlining how climate change is integrated into Statoil's long term business strategy: "to ensure that our portfolio is resilient in a low carbon world, we apply an internal carbon price of 50 USD/tonne CO2 for all new projects [outside of Norway] after 2020 in our investment decisions" (CDP 2015b, 6).

Secondly, the following statement is given in response to the question "Please provide details and examples of how your company uses an internal price of carbon":

> "Since last year we apply an internal carbon price of USD 50/tonne of CO2-equivalent (2014 real terms) for expected GHG emissions to all project investment decisions and which we use for portfolio management and strategic considerations. Note that Statoil's projects and operations in regimes already practicing higher carbon costs are evaluated using specific local prices/costs. Thus, for our activities on the Norwegian Continental Shelf the expected sum of the Norwegian CO_2 tax and the ETS price, 500 NOK/tonne (~$60 per tonne) should be used. To our knowledge, no other companies are applying a higher internal carbon price than we do" (CDP 2015b, 7).

Lastly, further insight is given into the calculation method behind the ICP values through the following statement: "Our internal price of carbon assumes major increase of CO_2 price both in Europe and in the rest of the world towards 2040" (CDP 2015b, 19).

Contribution to the Research Question

The above statements from Statoil provide several key insights into their ICP calculation process.

The first insight is that, where a country's carbon costs are seen to be higher than Statoil's Rest-of-the-World ICP value, this country difference is taken into account and a higher cost is estimated. On this basis, it is clear that the Norwegian ICP value is calculated based on carbon regulation applicable in Norway: "the Norwegian CO_2 tax and the ETS price" (CDP 2015b, 7).

Similarly, it seems that anticipated future carbon regulations are taken into account when calculating the Rest-of-the-World ICP value. It is interesting to note that Statoil assumes that the cost of carbon regulation will continue to increase over time. It is not clear how these future estimates are calculated.

This disclosure to CDP provides context to Statoil's ICP policy by referring to the aim of this instrument at the company: to help Statoil face and meet future challenges and opportunities related to climate risk. It is also mentioned that ICP is used when making all investment future decisions (rather than just some).

When it is clear from the full CDP disclosure discussed in the literature review (CDP 2015a) that there are several companies using higher ICP values, it is interesting to note that Statoil has the impression that they have the highest. Perhaps this understanding is due to differing implementation: companies with ICP values higher than Statoil's may not use ICP to help make every investment decision across a variety of countries.

5.3.3 Statoil 2015. *"2015 Sustainability Report"*

Summary of Content

This report is aimed at company stakeholders and outlines the ways in which safety and sustainability are taken into account within current Statoil operations.

The introduction to the report provides useful background information such as, "In 2015, 37% of our oil and gas equity production took place outside of Norway" (Statoil 2015a, 2). This gives an idea of how much of Statoil's operations are spread across the globe. The following statement provides insight into the long-term nature of Statoil's strategy: "We aim to provide energy for a low carbon future and to create lasting value for communities" (Statoil 2015a, 2).

Statoil's key stakeholders are said to include "shareholders (including our majority owner the Norwegian government), host governments, civil society and employees" (Statoil 2015a, 4). The importance that Statoil places on its relationship with its stakeholders is emphasized: the company actively tries "to nurture lasting and constructive relationships with the various actors in our operating environment— for

their benefit and for our own commercial success" (Statoil 2015a, 8). Climate change is listed as the first "material topic" that stakeholders are concerned with; more specifically, in relation to issues such as "Climate risk and portfolio resilience", "How we manage our emissions" and "low carbon technologies" (Statoil 2015a, 4).

ICP is referred to as a means to identify "climate related business risks and opportunities" as well as to measure "Asset portfolio resilience" (Statoil 2015a, 14). Risks are seen to include "higher carbon costs and stricter climate regulations" (Statoil 2015a, 14). ICP is listed as one of the "tools" applied to take "relevant risk factors into account" (Statoil 2015a, 14). Other tools include "scenario planning and stress testing of projects against various oil and gas price assumptions" (Statoil 2015a, 14). These tests are applied in order to calculate a net present value (NPV) of a project. In this context, ICP is used to test a project's "sensitivity towards carbon prices" (Statoil 2015a, 14).

Statoil also states that their analysis has "demonstrated that the main contributor to changes in NPV for our asset portfolio is variations in oil and gas prices" (Statoil 2015a, 15). As such, it is not ICP that appears to have the largest affect on future projects' NPVs.

Contribution to the Research Question

This report emphasises the role of stakeholders in influencing Statoil sustainability policy. The Norwegian government (as the majority owner) is specifically referenced. This suggests that stakeholders (including shareholders) could have influence over Statoil's ICP policy.

This report also reinforces Statoil's view that a possible future could involve stricter and more costly carbon regulation.

It is interesting to be provided with further detail regarding the implementation of ICP at Statoil: it is used as part of the calculation towards a financial value (NPV) of a potential project. It is also interesting to note, although unsurprising, that ICP is not the largest influencer of a project's NPV.

5.3.4 Statoil 2015. *"Energy Perspectives: Long-Term Macro and Market Outlook"*

Summary of Content

This report looks to contribute to "a fact based discussion on future developments in global energy markets" (Statoil 2015b, 3). Geopolitical relations are greatly discussed in this report as well as the resulting effects these are likely to have on both economic growth and energy demand.

Statoil deem the future outlook of the energy market to be uncertain. Accordingly, three potential development scenarios (over a 25-year period) are considered and their impacts discussed. Each potential trajectory assumes differing levels of political, economic and climate relations. The estimated outcomes of each of these scenarios differ in terms of projected demand for respective sources of energy. Most notably, "New renewable energy is expected to grow significantly in all scenarios" (Statoil 2015b, 3). "Pressure" on "energy efficiency measures" and "substitutes to gasoline and diesel" is also estimated to increase in two out of the three scenarios (Statoil 2015b, 16).

Contribution to the Research Question

This report is useful in that it provides an overview of (energy) sector-specific risks, from Statoil's perspective; these include various pressures on areas such as energy efficiency and favouring of fuel types. As companies within the energy sector work with sourcing energy (that is often carbon intensive), they may be more likely to be directly affected by a change in carbon regulation. As such, industry sector could be a potential factor in the calculation of ICP values.

This report also emphasises the role that politics and regulation play in the energy sector.

5.3.5 Statoil Website[2]

The below sub-section summarises the review of the various pages from Statoil's website that relate to environmental and climate change policy.

Content: Statoil 2016. *"Climate Change"*

This webpage outlines Statoil's position on climate change as well as their climate advocacy work.

Statoil "acknowledges the scientific consensus on human-induced climate change and supports the efforts… to prevent dangerous manmade interference with the climate system" (Statoil 2016g).

A key element of Statoil's climate advocacy is promoting a cost for carbon and positioning themselves as a business pioneer in this area: "In Norway, Statoil already operates successfully with the highest carbon tax in the world – around USD 65 per tonne of CO_2. We have shown that it's possible for oil and gas production to prosper in a world of carbon pricing" (Statoil 2016g). This fits into their wider view that "A price on greenhouse gas emissions based on the emitter pays principle should be the preferred climate policy framework" (Statoil 2016g).

It was noted that, when this webpage was looked at the time of preparing the proposal for this project (late 2014/early 2015), this webpage referenced Statoil's ICP and a change that occurred in 2014: a lower value ICP was introduced for non-Norway projects. This change is no longer referenced.

Content: Statoil 2016. *"Environmental Impact"*

This webpage states Statoil's approach to managing the environmental impact of their operations: "Statoil's aim is to avoid causing significant harm to the local and regional environment" (Statoil 2016h).

Details of the company's approach are broken down into four sections: air emissions, cleaning technologies, biodiversity and chemicals. Stakeholder concerns and efforts to

[2] Many of the references used in this section refer to 2016, despite the document review occurring in 2015 (prior to the case study interview). This is due to referencing being completed in 2016.

be transparent are outlined. It is also stated that Statoil's environmental policy includes "integrating environmental and social risk management into our planning and decision-making processes, at all levels in the organization" (Statoil 2016h). It is likely that ICP is an element of this policy.

Content: Statoil 2016. *"Engagement and Dialogue"*

This webpage outlines Statoil's external engagement with stakeholders on sustainability issues. The stakeholders are described as:

> "the many individuals and organisations that are affected, directly or indirectly, by Statoil's operations, whether these are related to our role as energy provider, employer, business partner, or company that generates revenue and supports local development" (Statoil 2016i).

Engagement and "cooperation" with stakeholders is stated to be "essential to our commercial success" and a "prerequisite to create lasting value for those we affect in society" (Statoil 2016i). A description of Statoil's engagement with stakeholders is split into four categories: governments, local communities, civil society and international organisations and industry associations.

The reference to Statoil's involvement with industry associations demonstrates the strong element of collaboration across the oil and gas industry: "Major associations are better at representing the views of the industry than single companies and are often a valuable partner for the regulator in developing new requirements, or frame conditions, for our industry" (Statoil 2016i).

Content: Statoil 2014. *"Statoil Steps Up Advocacy on Carbon Pricing and Methane Reduction Efforts"*

This webpage contains a Statoil press release from 2014 that outlines an increase in climate advocacy by the company, fronted by the CEO. The press release was issued in advance of the CEO speaking at the UN Secretary's Climate Change Summit in New York. Carbon pricing and methane emissions are the key topics mentioned.

Statoil's ICP is briefly referenced: "Statoil also applies an internal price on carbon of USD 50 per tonne of CO_2 equivalent in its investment decisions" (Statoil 2014). This reference is stated in context of arguing that the Norwegian carbon dioxide tax has "made the Norwegian continental shelf a world leader in carbon-efficient oil and gas production" (Statoil 2014).

It is also interesting to note that the CEO of Statoil, in 2014, is now the CEO of BG Group. BG Group is a key competitor of Statoil's, in the oil and gas industry, and is also now part of Royal Dutch Shell plc (BG Group 2014)

Overall Contribution to the Research Question

The Statoil website suggests that the use of ICP may support their wider climate advocacy view that a price on greenhouse gases is the "preferred climate policy framework" (2016g). For instance, ICP at Statoil may be a way of demonstrating how and why such an approach may benefit businesses. Also, the removal of the reference to the lowering of the Rest-of-the-World value in 2014 suggests that the reasoning behind this value change may not wish to be emphasised.

The references made on the website regarding stakeholder concerns in Statoil's environmental policy, suggest that stakeholders (including, perhaps, the majority shareholder - the Norwegian government) may affect the ICP calculation process (Statoil 2016h). This is further suggested on the Statoil (2016i) webpage where engagement, discussion and cooperation with stakeholders are outlined as being key to the company's policy on sustainability. This again, suggests that stakeholder interests may influence details of the company's sustainability policy (such as ICP calculation).

Furthermore, it could be that Statoil's climate advocacy may be a way of promoting the interests of its majority owner: the Norwegian government. The 2014 press release is clear in its praise of the Norwegian government's carbon dioxide tax: it has "made the Norwegian continental shelf a world leader in carbon-efficient oil and gas production" (Statoil 2014).

The reference on one of the webpages to the collaboration between companies across the oil and gas industry suggests that there may also be a certain level of homogeneity

in industry environmental policy (Statoil 2016i). Accordingly, this could be reflected in similarities in ICP calculations across companies within the same industry.

Moreover, the fact that the former CEO of Statoil is now the CEO of an industry competitor, suggests a certain level of integration of employees across the oil and gas industry (Statoil 2014). This integration could lead to similar policies being implemented within the same industry.

5.3.6 Summary of Findings from the Document Review

Table 3: Analysis of Document Review: Statoil and ICP

Themes	Document Review: Statoil and ICP	
	Key Points	Key Quotes
Carbon regulation	• Carbon regulation (Norwegian carbon tax and ETS) determines the Norwegian ICP value (CDP 2015b) • ICP value may vary between countries depending on jurisdiction-specific costs (CDP 2015b)	• "for our activities on the Norwegian Continental Shelf the expected sum of the Norwegian CO_2 tax and the ETS price, 500 NOK/tonne (~$60 per tonne) should be used." (CDP 2015b, 7) • "projects and operations in regimes already practicing higher carbon costs are evaluated using specific local prices/costs." (CDP 2015b, 7)
Industry sector	• Uncertainty in the future of the energy sector and associated sector-specific risks (Statoil 2015b) • Role of oil and gas industry associations and industry collaboration towards shared objectives (Statoil 2016i) • Former CEO of Statoil now CEO at industry competitor (Statoil 2014)	• "Statoil is a member of a number of industry associations and chambers of commerce" (Statoil 2016i)
Shareholders and other stakeholders	• Statoil's commitment to engaging with and nurturing their relationship with stakeholders (Statoil 2015a, 4) (Statoil 2016h) • Engagement with stakeholders key to sustainability policy (Statoil 2016i) • Climate advocacy to promote shareholder interests (e.g. Norwegian Government)? (Statoil 2015a) (Statoil 2014)	• "Our key stakeholders include investors and shareholders (including our majority owner the Norwegian government), host governments, civil society and employees" (Statoil 2015a, 4). • "essential to our commercial success" (Statoil 2016i)
Intended purpose	• Aim of ICP at Statoil is to help the company to face and meet future challenges and opportunities related to climate risk (CDP 2015b) • ICP as climate advocacy (Statoil 2016g) (Statoil 2014)	• "to ensure that our portfolio is resilient in a low carbon world" (CDP 2015b, 6) • "A price on greenhouse gas emissions based on the emitter pays principle should be the preferred climate policy framework" (Statoil 2016g)

Themes	Document Review: Statoil and ICP	
	Key Points	Key Quotes
		• CO_2 tax making "the Norwegian continental shelf a world leader in carbon-efficient oil and gas production" (Statoil 2014)
Implementation	• ICP is used when evaluating all future investment projects (CDP 2015b) • Part of net present value (NPV) calculations but not the biggest influencer (Statoil 2015a, 14-15)	
Other	• Reference to 2014 change in ICP values (lowering value for the Rest-of-the-World) has been removed. Reasoning unclear (Statoil 2016g)	

5.4 Interview

5.4.1 Background

For the second part of this case study, an interview was conducted with a Statoil employee who holds a strategic role in the company's environmental policy. As it was agreed that this employee would be kept anonymous, they will be referred to as 'Statoil Employee' or 'interviewee'. The interview took place at the Statoil London offices on 21st August 2015. The interview lasted 1 hour.

The aim of this interview was to obtain practical insights into the reality of ICP at Statoil. This could then be compared to company statements seen in the document review. The interview could provide details that may otherwise have been missed from only completing a document review. This could also help to better inform the choice of variables to be used in the next stage of the project: the econometric analysis.

Table 4, within the next section, collates the findings from this interview into key themes.

5.4.2 Overview of Interview Findings

Table 4: Overview of Elite Interview Findings

Themes	Elite Interview (Statoil Employee 21.08.15)
	Findings

Carbon regulation	• Strong link between ICP value and carbon regulation
	• Different types (a holistic view) of regulation taken into account for ICP valuation: carbon tax, emissions trading, performance regulation
	• Future regulation taken into account (ICP values estimated until 2040)
	• Specific link between Norwegian ICP and Norwegian regulation
	  • Norwegian offshore tax on carbon dioxide emissions = 429 NOK (Statoil ICP = 500 NOK). EU ETS covers the other 71 NOK.
	  • Value likely to be kept constant as Norwegian government have mentioned (but not committed) that if the EU ETS increases in value, the offshore carbon tax will be lowered.
	  • USD value of Norwegian ICP changes as exchange rate changes.
	• For Rest-of-the-World ICP:
	  • Specific differences in country-by-country regulation does not directly influence the ICP value, unless the country has a higher carbon price/cost than Statoil's ICP. In this case, the higher cost would then be used (this is why there is a separate Norwegian ICP value).
	  • Rather, country differences in regulation affects the investment decisions indirectly: any country difference in regulation is shown indirectly via the (wider) host country risk analysis, not the ICP (a host country adjusted NPV is then applied – this takes into account social unrest, war, country-specific regulation)
	  • i.e. two places where carbon regulation can influence a project's NPV
	  1. ICP (mainly here)
	  2. Host country risk (a small part of this is country-specific carbon regulation)
	  • Therefore, potential risk of double-counting of country regulation

Industry sector	• Unknown whether ICP values are influenced by industry sector
	• Other oil and gas companies may have different intended purposes for ICP (e.g. as a resilience test regarding worst case scenarios)
	• But clear collaboration (value in sharing and learning from each other) in the energy sector:
	  • A meeting was arranged between Statoil, Royal Dutch Shell (Shell) and BP where ICP strategy was discussed in context of the sector
	  • Comparison between Statoil and Shell ICP approaches: Shell strategy is more complex but still relatively simple (Shell advised Statoil to not make the calculation process too complicated)
	  • Comparison between Statoil and BP ICP approaches: influence of BP's ICP value on Statoil's ICP – BP inspired Statoil to include more gases than just carbon dioxide

Shareholders and other stakeholders	• No link between Statoil's ICP particular value(s) and its shareholders
	• Norwegian government as majority owner:
	  • Shareholder interest more linked to having ICP, in the first place (the Norwegian government would question Statoil if they did not use ICP)
	  • Government shareholder leads to more scrutiny regarding climate change agenda and advocacy, in general
	  • Statoil's stance on carbon pricing fits with that of the Norwegian government

Themes	Elite Interview (Statoil Employee 21.08.15)
	Findings

Intended purpose	• Possible link between ICP value and intended purpose of a company:
	  • If hedging risk is intended purpose (to test resilience and prepare for 'worst case' scenario), more likely to have a higher ICP value
	  • If estimating the 'most likely' scenario in order to predict real future costs, more likely to have a lower ICP value
	  • If for public relations purposes (doing the 'right' thing), could be more likely to have a higher ICP value.
	  • i.e. if ICP value will really impact future investments, likely to be lower. If ICP will not impact future investments, likely to have a higher ICP
	• Statoil's intended purpose:
	  • Somewhere in the middle (a quite possible future but not a worst case scenario – i.e. an extreme ICP value is not applied in order to test project resilience)
	  • ICP purpose is not to stop projects but in order to ensure that these future costs are taken into account
	  • To protect investments
	  • Benefit regarding climate advocacy: ICP helps to back up advocacy regarding the global pricing of emissions. Carbon pricing seen as a political space.

Time dynamic	• Statoil does not include a time dynamic in ICP value calculations: a consistent, flat price is applied for estimated emissions between 2020-2040 • Both ICP values are too high for 2020 regulation but might be too low in 2040 • Shell also uses a flat price
Introduction and changing ICP values	• ICP has been in place at Statoil for around 10 years • Previously had more ICP values. Had four at one point: OECD (non-EU) ICP (model based), non-OECD ICP (removed around 5 years ago), Norwegian ICP and EU ICP • In 2014, review of ICP strategy: changed so only two ICP values and also a more holistic overview of regulation is now taken into account when allocating an ICP value • Reason for two ICP values (Norwegian and Rest-of-the-World): Norway has a higher carbon tax than the internally calculated ICP • ICP strategy is reviewed every year (but not in depth)

Implementation	• Several departments involved in implementation: corporate sustainability, market analysis and finance
	  • Corporate sustainability and market analysis: ICP strategy
	  • Finance: ICP implementation and day-to-day use
	• ICP as a shadow greenhouse gas emissions cost (in practice, this is mainly carbon and a relatively small amount of methane)
	• ICP is not a real charge, but a shadow cost that drives investment decision making
	• ICP values are estimated for up to 2040 (i.e. in theory, should not change in value before 2040)
	• Rest-of-the-World ICP value applied to Non-Norway projects with emissions from/after 2020 (ICP calculated for 2020-onward emissions).
	• The finance department use ICP as part of net present value (NPV) calculations for future investment projects (a line on the calculation spreadsheet)
	  • ICP is a minor cost compared to others included in NPV calculations
	  • ICP calculated on estimated direct emissions (carbon and methane)
	  • Total NPV is considered on a case-by-case basis
	  • Potential projects that already have a higher cost (e.g. heavy oil) are more likely to have higher ICP costs (generally)
	  • Host country adjusted NPV calculations take into account social unrest and country-specific regulation (final row on calculation spreadsheet)
	• ICP does not affect the oil price through each stage of the supply chain (which, was

Themes	Elite Interview (Statoil Employee 21.08.15)
	Findings
	noted, would be the most effective way of reflecting the true cost of greenhouse gas emissions)
Practicality	• Key importance of using a simple approach to ICP, at Statoil • Complex models are not used at Statoil for ICP valuation • Time dimension not taken into account; rather, aim that ICP value evens out over 2020-2040 • The simplicity of the ICP logic is important in ensuring that it is actually approved by the business and implemented by Statoil's finance team • Therefore, this is a reason for not using complex models for calculating the value of the ICP (in reality, the ICP is an estimate that aims to still be valid in 2040)

5.5 Combined Findings

5.5.1 Analysis Across Sub-Methods

Table 5: Overall Analysis from Case Study: Key Findings

Themes	Case Study: Sub-Method	
	Document Review	Elite Interview
Carbon regulation	• Carbon regulation (Norwegian carbon tax and ETS) determines the Norwegian ICP value (CDP 2015b) • ICP value may vary between countries depending on jurisdiction-specific costs (CDP 2015b)	• Strong link between ICP value and carbon regulation • Different types (a holistic view) or regulation taken into account for ICP valuation: carbon tax, emissions trading, performance regulation • Future regulation taken into account (ICP values estimated until 2040) • Specific link between Norwegian ICP and Norwegian regulation • For Rest-of-the-World ICP: specific differences in country-by-country regulation does not directly influence the ICP value, unless the country has a higher carbon price/cost than Statoil's ICP. In this case, the higher cost would then be used (this is why there is a separate Norwegian ICP value).

Themes	Case Study: Sub-Method	
	Document Review	Elite Interview
Industry sector	• Uncertainty in the future of the energy sector and associated sector-specific risks (Statoil 2015b) • Role of oil and gas industry associations and industry collaboration towards shared objectives (Statoil 2016i) • Former CEO of Statoil now CEO of industry competitor (Statoil 2014)	• Unknown whether ICP values are influenced by industry sector • Clear collaboration (value seen in sharing and learning from each other) in the energy sector: • Statoil, Shell and BP meeting where ICP strategy was discussed in context of the sector

Shareholders and other stakeholders	• Statoil's commitment to engaging with and nurturing their relationship with stakeholders (Statoil 2015a, 4) (Statoil 2016h)
	• Engagement with stakeholders key to sustainability policy (Statoil 2016i)
	• Climate advocacy as a way of promoting shareholder interests (e.g. Norwegian Government)? (Statoil 2015a) (Statoil 2014)
		• No link between Statoil's ICP particular value(s) and its shareholders.
		• Norwegian government as majority owner:
		  • Shareholder interest more linked to having ICP, in the first place
		  • Statoil's stance on carbon pricing fits with that of the Norwegian government

Intended purpose	• Aim of ICP at Statoil is to help the company to face and meet future challenges and opportunities related to climate risk (CDP 2015b)
	• ICP as climate advocacy (Statoil 2016g) (Statoil 2014)
		• Possible link between ICP value and intended purpose by a company:
		  • I.e. if ICP value will really impact future investments, likely to be lower. If ICP will not impact future investments, likely to have a higher ICP
		  • E.g. If for public relations purposes (doing the 'right' thing), could be more likely to have a higher ICP value.
		• Statoil's intended purpose:
		  • A quite possible future– an extreme ICP value is not applied in order to test project resilience
		  • ICP purpose is not to stop projects but in order to ensure that these future costs are taken into account
		  • Benefit regarding climate advocacy: carbon pricing seen as a political space

Themes	Case Study: Sub-Method	
	Document Review	Elite Interview

Implementation	• ICP is used when evaluating all future investment projects (CDP 2015b)
	• Part of net present value (NPV) calculations but not the biggest influencer (Statoil 2015a, 14-15)
		• Previously had more ICP values. Had four at one point: OECD (non-EU) ICP (model based), non-OECD ICP (removed around 5 years ago), Norwegian ICP and EU ICP
		• Reason for two ICP values since 2014 (Norwegian and Rest-of-the-World): Norway has a higher carbon tax than the internally calculated ICP
		• Several departments involved in implementation: corporate sustainability, market analysis and finance
		• The finance department use ICP as part of net present value (NPV) calculations for future investment projects
		  • ICP is a minor cost compared to others included in NPV calculations
		  • Host country adjusted NPV calculations take into account social unrest and country-specific regulation (final row on calculation spreadsheet)

Practicality		• Key importance of using a simple approach to ICP, at Statoil • Complex models are not used at Statoil for ICP valuation • Important in ensuring that it is actually approved by the business and implemented by the Statoil's finance team
Time dynamic		• Statoil does not include a time dynamic in ICP value calculations: a consistent, flat price is applied for estimated emissions between 2020-2040 • Shell also uses a flat price

5.5.2 Overall Findings

This case study has provided an informative example of ICP usage. When comparing findings across the two sub-methods (document review and interview) there were various themes that were identified and have been categorised in the above table.

A key finding for both sub-methods was that carbon regulation has the greatest influence on Statoil's ICP value. This was indicated in Statoil's public documentation and confirmed in the interview. Specifically, Statoil's Norwegian ICP value is based on the carbon regulation that is present in Norway: the Norwegian CO_2 tax along with an

estimate of the costs linked to the EU ETS. However, in both sub-methods, the calculation logic behind the Rest-of-the-World ICP was less clear: whilst the interview went further by explaining that current and future global carbon regulation is taken into account, how a particular overall value is decided upon was not explained. Rather, the most significant insight gained into the methodology behind the Rest-of-the-World ICP value was that a different value would only be used in a country where local carbon regulation costs (for example, carbon tax) exceeded 50 USD/tonne. It was only in Norway that the carbon costs were seen to be higher (hence, the application of a higher Norwegian-specific ICP value).

Another finding was that, whilst industry sector was not overtly referred to as influencing the ICP values, collaboration within the energy industry was evident. The document review highlighted that, at an overall strategic level, collaboration with other companies within the same industry plays a central role in achieving Statoil's objectives. This was complemented in the interview by the statement that Statoil, Shell and BP held a meeting to discuss and compare their respective ICP strategies. It was also noted in the interview that the sharing of knowledge and strategy discussions between these oil and gas companies influenced Statoil's updated ICP strategy. Certain similarities between the firms' ICP methodology were also found.

In terms of the effect of shareholders on ICP values, the document review illustrated the importance of stakeholder engagement in Statoil's overall sustainability policy. However, when this topic was addressed in the interview, it was stated that shareholders did not directly influence the ICP values. Rather, if any influence could be identified it would be linked to the implementing of ICP, in the first place.

When the interviewee was asked to suggest his thoughts as to any further influences on ICP values (in general), he argued that intended purpose behind using ICP could be a key factor; Statoil does not have the highest ICP values on the basis that they wish to apply a realistic value in order to inform investment decision making on the costs that, in reality, may occur. This is opposed to using an extremely high value in order to test investment project resilience against 'worst-case' scenarios (which would involve very high carbon emissions costs). Such 'resilience testing' is typically performed in the oil and gas industry in relation to how investments would be affected by extreme fluctuations in oil prices. Similarly, it was suggested that if public relations was the

main reason for a company introducing an ICP, then the value used may be higher in order to attract attention. This is particularly interesting as in both the interview and document review, it was evident that ICP is part of Statoil's strategy on climate advocacy. However, the idea that Statoil's ICP is intended to be used in order to influence real investment projects is supported by both sub-methods which identified that ICP forms an element of project net present value (NPV) calculations.

The key practical insight provided by the interview was that a simple approach to ICP was central in ensuring that ICP was used and implemented in Statoil's decision making. It was explained that Statoil did not use complex models to calculate an ICP value, on the basis that the finance department (the business area applying ICP) would not implement a policy that was overly complex and hindered their every day tasks. An example of simplicity in Statoil's ICP calculation is the way in which a time dynamic is not included; in other words, one flat price is estimated and then applied consistently across a number of years (until 2040).

5.5.3 Case Study: Conclusion

In conclusion, the case study found that carbon regulation was the strongest factor influencing Statoil's ICP values. As such, this factor was kept as an independent variable for the econometric analysis. However, the fact that both values (Norwegian and Rest-of-the-World) were not precisely equal to specific values presented by carbon regulation instruments, suggests that there may also be other influencing factors: for example, the Rest-of-the-World value does not appear to be not equal to a particular country carbon tax or ETS permit price.

It was evident from the case study that there has been collaboration within (at least some of) the energy sector in terms of ICP methodology. Accordingly, industry sector was identified as a potential influencing factor and was kept as a variable to be further examined in the econometrics analysis.

Whilst shareholders were not seen to influence ICP values, stakeholders were, nevertheless, identified as key engagers and influencers in Statoil's sustainability policy. As such, this variable was kept to be further assessed in the econometric analysis in order to see if any broad patterns could be identified across a sample of companies.

Also, as noted in the literature review, whilst intended purpose was identified as a potential influencer, this is an element that is highly subjective and confidential. For instance, it is unlikely that companies would admit to only using ICP for public relations purposes, even if that were the case. Due to this limitation of identifying true (not just stated) intended purpose, across a wide number of companies, this factor was not included as a variable in the econometric analysis.

The next chapter will discuss the findings from the econometric analysis.

6 Regression Analysis

6.1 Introduction

The aim of this econometric analysis was to identify any patterns in how the independent variables affect the value of a company's ICP. The regression suggested that operating in certain industry sectors (consumer discretionary, energy, materials and utilities) leads to higher and, more similar, ICP values.

Firstly, a brief description of the results will be outlined, followed by a table summary of the numerical results. Lastly, these results will be discussed and interpreted.

6.2 The Econometric Model

Below is a formulaic description of the econometric model that was tested in the multiple regression analysis. Please refer to Chapter 2 (Methodology) for a further description of this model.

Equation 2: The Model

$$ICP\ value = (\beta_1 carbonreg + \beta_2 listed + \beta_3 consumerdisc + \beta_4 consumerstap + \beta_5 energy + \beta_6 financials + \beta_7 healthcare + \beta_8 industrials + \beta_9 infotech + \beta_{10} materials + \beta_{11} telecomm + \beta_{12} utilities) + u$$

β_k: regression coefficient

6.3 Description of Results

A multiple regression was run in order to assess the influence of the existence of carbon regulation, listing on a stock exchange and industry sector on a company's ICP value. The industry sectors used were as follows: energy, materials, industrials, consumer discretionary, consumer staples, health care, financials, information technology, telecommunication services and utilities. Please refer to Chapter 2 (Methodology) for a further discussion of why this classification of industries was used.

Checks were made on certain standard regression assumptions (see Appendix 2 and Chapter 2) that, if unfulfilled, would have meant that the model (and accompanying results) would be unreliable. These assumptions were tested and no issues were found. The aim of this analysis was to identify any patterns, rather than to find inference (in econometric terms). As such, it was not essential that the standard regression assumptions were perfectly met. On this basis, it was concluded that the assumptions of independence of errors, homoscedasticity, unusual points and normality of residuals were sufficiently met. Linearity was not applicable here due to the nature of the independent variables (categorical). Accordingly, the model was concluded to be reliable.

These variables, in combination, were found to statistically significantly influence ICP value ($F(12, 109)= 9.934$, $\rho < 0.001$, Adjusted $R^2 = .47$). However, when looking at the variables individually, only some of the independent variables added statistically significantly to the influence on ICP value, $\rho < 0.05$. All of the significant variables were industry sectors: the consumer discretionary industry, the energy industry, the materials industry and the utilities industry. The mean ICP value was found to be 25.7571 USD.

A full outline of regression coefficients (and standard errors) can be found in Table 6, on the next page.

6.4 Discussion and Interpretation of Results

This section discusses how the results in Table 6 could be interpreted. This discussion considers these results on their own, without taking into account the findings from the case study or literature review. The outcome of the full mixed method study is considered together, in Chapter 7.

6.4.1 Overall Model Significance

Firstly, it is interesting to consider the significance of the model as a whole: that the overall model (all the independent variables together) is better at identifying patterns in the ICP value than chance alone would have suggested.

However, it is by looking at the variables that were found, individually, to be significant that any specific patterns can be identified.

Table 6: Linear Regression Model of Variables affecting ICP Value (95% confidence intervals reported in parentheses and variables found to be significant (at 0.05 level) highlighted in bold)

Independent Variable	Unstandardised Coefficients		Standardised Coefficients	ρ (Significance)
	B	Standard Error	β	
Carbon Regulation	6.526 *(-5.869, 18.921)*	6.254	.153	.299
Listed	-6.709 *(-25.312, 11.895)*	9.386	-.171	.476
Consumer Discretionary (Industry)	**33.132** ***(9.087, 57.178)***	**12.132**	**.288**	**.007**
Consumer Staples (Industry)	13.216 *(-16.858, 43.290)*	15.174	.071	.386
Energy (Industry)	**39.899** ***(15.492, 64.307)***	**12.315**	**.409**	**.002**
Financials (Industry)	17.778 *(-8.136, 43.691)*	13.075	.149	.177
Health Care (Industry)	17.193 *(-27.158, 61.543)*	22.377	.059	.444
Industrials (Industry)	19.326 *(-3.691, 42.342)*	11.613	.187	.099
Information Technology (Industry)	13.602 *(-19.439, 46.643)*	16.671	.066	.416
Materials (Industry)	**27.634** ***(5.567, 49.702)***	**11.134**	**.353**	**.015**
Telecommunications Services (Industry)	35.753 *(-0.102, 71.609)*	18.091	.150	.051
Utilities (Industry)	**27.025** ***(4.025, 50.024)***	**11.604**	**.292**	**.022**

Note: R^2 = .522, Adjusted R^2 = .47 (ρ < .05), F (12, 109)= 9.934 (ρ < .001)

6.4.2 Importance of the Consumer Discretionary, Energy, Materials and Utilities Industries

Four individual variables were found to significantly influence the ICP value: the consumer discretionary, energy, materials and utilities industries. The coefficients for each of these variables are positive. This implies that a company operating within these industry sectors is more likely to have a larger ICP value. For instance, the industry with the highest unstandardized coefficient is the energy industry (B = 39.899). This value indicates that a company that is in the energy sector would have an ICP value of 39.899 USD (providing that all other variables are held constant). However, this discussion will not go further into detail regarding the exact value of the coefficients, as the aim of this analysis was to identify any patterns of influence of carbon regulation, listing and industry on ICP value. What is key here is that the coefficients for these industries are positive and are higher than the mean ICP value (25.7571 USD). Thus, suggesting that these industry sectors may be linked to higher ICP values.

When considering why this is the case, it appears reasonably intuitive that the energy, materials and utilities sectors would have higher ICP values as these are sectors that have the most carbon intensive activities. In 2013, for example, these industries were "responsible for well over three quarters (87%) of scope 1 and 2 [greenhouse gas] emissions" (CDP 2013b, 8). As such, carbon emissions could be seen to have a more substantial cost to their business activities (whether in terms of public relations or complying with environmental regulations).

This leads to the discussion that ICP value may, in fact, be a proxy for another variable: it could be argued that ICP value is a reflection of a company's commitment to public relations. Public relations, here, is meant in terms of the image portrayed to stakeholders. Those industries with higher carbon emissions may see greater benefit in creating a positive public image and, as an element of this, may be motivated to state higher ICP values in order to promote an environmentally conscious image. Kassinis and Vafeas argue that varying characteristics of "stakeholder pressures" lead to variance in firm environmental policy (2006, 156). The energy, materials and utilities sectors face strong pressure from stakeholders, such as, end consumers and non-governmental organisations and, as a consequence, may implement higher than average ICPs in order to manage this pressure.

Whilst having much lower emissions than the energy, materials and utilities sectors, the significance of the consumer discretionary industry could also be explained via the 'proxy' argument (CDP 2013b, 12). This sector includes sub-industries such as "automotive, household durable goods, leisure equipment", "textiles and apparel", "hotels, restaurants" and "consumer retailing and services" (MSCI 2016, 1). Essentially, it "encompasses those businesses that tend to be the most sensitive to economic cycles" (MSCI 2016, 1). As a consequence, it could be argued that such businesses may be more sensitive to stakeholder opinion and, as such, demonstrating the use of environmentally conscious internal policies may benefit their consumer ratings and popularity. Similarly, feedback from stakeholders in this industry is likely to be relatively immediate. This is because goods and services in the consumer discretionary industry are typically bought on a regular basis and so any fluctuations in demand preferences will quickly translate to revenue figures. As such, companies in this sector may be more likely to rapidly implement and update policy (in this case, a higher ICP) as a reaction to changing consumer opinion.

However, this potential explanation is based on two assumptions: firstly, that consumers are concerned with the environmental policy of the companies that they buy their products from, and; secondly, that based on these concerns, consumers exhibit environmentally conscious purchasing behaviour. This is not necessarily the case (see Schetzer, Stackman and Moore 1991 and Roberts and Bacon 1997 for detailed discussions on these issues).

As such, a stronger overall argument as to why these four industry sectors influence ICP value could be taken from the institutionalist and environmental contestation theories (discussed in Chapter 3). These theories emphasise the importance of networks and shared knowledge creation (Pulver 2007, 47). Furthermore, they argue that cross-company manager networks are key to influencing a firm's environmental policy. When applying these theories to the issue at hand, it could be argued that each of the four industries has its own array of networks and knowledge creation. Thus, leading to a certain level of homogeneity in industry policy.

The environmental contestation approach argues that "co-created, shared understandings of market opportunities, likely regulatory outcomes and consumer behavior are key drivers in firm environmental behavior" (Pulver 2007, 50). Similarly,

new institutionalist models state that decisions and actions made by companies are driven by the "process of shared knowledge creation by the firm (itself) and other actors in its organizational field" (Pulver 2007, 47). An organisational field is a company's "key suppliers, resources and product customers, regulatory agencies" and competitors (DiMaggio and Powell 1983, 148); in other words, their industry. The key decision makers in each industry are the managers. Therefore, "the particular economic, political and socioideological networks in which individual firm managers are embedded" highly influence firm environmental decision-making (Pulver 2007, 47). The characteristics of these networks are dependent on the industry in which a company operates and, as such, the behaviour of firms within the same industry is likely to be more homogenous than when looking at companies operating within different industries.

However, on the basis that manager networks play a key role in affecting environmental policy, all of the industry variables, rather than just a few, should have been found to be significant in the regression analysis. This is because each industry sector has its own network with certain homogeneous characteristics. However, this was not the case. A possible explanation for this could be that the industries found to be significant, are those that have the strongest internal industry networks which demonstrate similar economic and political ideologies. This is an area that would benefit from further research.

6.4.3 Non-Significance of Carbon Regulation and Stock Exchange Listing

It was not only the other industry variables that were not found to be significant within the regression model; neither the existence of carbon regulation or being listed on a stock exchange were found to significantly influence ICP value.

This is particularly interesting in relation to carbon regulation as this is an element that was often mentioned in company literature as being the main influencer of ICP value (this is discussed in more detail in Chapter 7). As such, it was expected that carbon regulation would not only be significant, but also the strongest influencer on ICP. The reason for this variable's non-significance could be due to certain methodological decisions that were made when collecting the data for this method. The carbon regulation variable (either 'yes' or 'no') was determined by whether carbon regulation

currently exists in the country, state or province where the company's *headquarters* are located. The variable was defined in such a way in order to reduce the complexity of the data gathering as this was performed within a limited timescale. As the vast majority of the companies within the sample are multinational, a more accurate way of measuring whether a company operates within jurisdictions with carbon regulation could have been to look at every country where a company operates. Such an exercise would be very difficult to complete, as cross-border transactions (both internally and externally) would need to be tracked in order to accurately reflect where a company operates its business. Such tracking would require access to confidential accounting information such as cross-border payments, movements of goods as well as the provision and purchase of international services. As this transaction information was not collected (due to time and confidentiality issues), this methodological limitation could be the reason why carbon regulation was not found to significantly influence ICP value. Research in this area could, therefore, benefit from a repeated study but with a more complex definition of the carbon regulation variable. It may then be found that carbon regulation does significantly affect a company's ICP value.

In terms of the shareholder ('listed') variable, a possible reason that this was not found to significantly influence a company's ICP value, could be that this is not a proxy for stakeholder influence. This was the key reason why this variable was included in the model. As discussed in the previous sub-section, stakeholder pressure can take a variety of forms. As such, stakeholder pressure may vary, irrespective of whether or not a company is on a stock exchange. The fact that the vast majority of the companies within the data sample were listed on a stock exchange (111 out of 121) did initially suggest that this variable would not be significant.

In contrast, it could be that being listed affects the likelihood that a company has an ICP, in the first place, as opposed to affecting the particular price used. This could be because companies on stock exchanges are required to disclose extensive financial information and an ICP value may be a by-product of this. On the London Stock Exchange, for example, reporting annual greenhouse gas emissions has been a part of the regular reporting requirements since 2013 (Carbon Trust 2013). Again, this is a potential pattern that would benefit from further research.

6.5 Regression Analysis: Chapter Summary

The aim of this multiple regression analysis was to identify any patterns influencing a company's ICP value. The overall model was found to demonstrate influence on ICP value, better than, chance alone would have done. In particular, it was found that four industry sectors significantly influence ICP value: consumer discretionary, energy, materials and utilities. The results imply that, firstly, companies within these industries are more likely to have similar ICP values to other companies within the same sector, than companies operating in other sectors do; secondly, firms within these industries are more likely to have higher than average ICP values. The rest of the industry sectors and the other two independent variables were not found to be significant.

The significance of the consumer discretionary, energy, materials and utilities industries could be explained through the importance of shared industry networks as well as ICP value being a proxy for investment in public relations.

The reason why the other variables were not found to be significant could be due to methodological limitations, in terms of carbon regulation and stock exchange listing. With regards to the other industry sectors, this could be explained through the potential weakness or lack of industry networks between managers within these sectors.

In the next chapter, these regression results will be integrated with the findings from the other elements of the mixed method analysis (literature review and Statoil case study).

7 Integration of Findings

7.1 Introduction

Integration of the mixed method findings is a central step to obtaining a more comprehensive picture of the issue at hand. In order to fulfill this step, the findings across each method have been summarised in a table format (see Table 7); these findings have been split into key themes in order to facilitate a common scope of analysis. The results were then compared, contrasted and discussed in order to identify integrated conclusions. This discussion seeks to provide equal emphasis on each method used: the literature review, the case study and the econometric analysis.

7.2 Revisiting the Research Questions

Before considering the cross-method findings, it is necessary to revisit the research questions:

1. Overarching research question: what influences the value of a company's ICP and how do these factors influence the value of a company's ICP?

2. Linking research question: how do the findings, from each individual method, complement or differ from each other?

3. Research question for quantitative (econometric) analysis (and case study): how is the value of a company's ICP influenced by carbon regulation, shareholders and industry sector?

This chapter looks, specifically, at answering the linking research question. The findings will be interpreted in the context of the overarching research question, as the goal of this project is to identify what influences a company's ICP value.

Table 7: Review of Findings Across Methods

Themes	Method		
	Literature Review	Case Study (Statoil)	Econometric Analysis (Regression)
Carbon regulation	• Government regulation often cited as influencing ICP value (although companies are typically vague)	• Carbon regulation as greatest influencer on Statoil's ICP value • Current and future carbon regulation taken into account	• Carbon regulation not found to significantly influence ICP value
Industry sector	• Industry sector identified as potential influencer • Varying emissions burden between sectors	• Collaboration evident within energy sector • Meeting between competitors to discuss ICP strategies • Influence of competitor strategy on Statoil's ICP strategy (similarities)	• Consumer discretionary, energy, materials and utilities sectors found to significantly influence ICP value • These industry sectors lead to higher ICP values • No other industry sectors were found to be significant
Shareholders	• Pleasing shareholders part of intended purpose	• Shareholders not seen to influence ICP value • Shareholders (and other stakeholders) linked to wider sustainability strategy • Perhaps linked to implementation of ICP	• Existence of shareholders (being listed on a stock exchange) not found to significantly influence ICP value • 111 out of 112 companies = listed

Intended purpose	• Differing intended purposes
	  • Risk management strategy
	  • Identifying low-carbon investments
	  • Demonstrating wider support for carbon pricing
	  • Pleasing shareholders
	  • Long term/short term uses
		• Identified as potential influencing factor
		  • Testing resilience = higher ICP value
		  • Public relations = higher ICP value
		  • Inform real investment decisions = more realistic (lower?) value (Statoil's intended purpose)
		• ICP as part of Statoil's wider climate advocacy	

Practicality	• Some companies used pragmatic calculation methods • Possibility for further complexity: climate trajectories considered for general carbon pricing (potential changes over time)	• Simplicity and ease of implementation essential to ICP approval/usage at Statoil • Complex models not used • Statoil use flat price (not adjusted over time) – a consistent estimate to be applied between 2020-2040	

7.3 Integration of Cross-Method Findings

Table 7 summarises the cross-method findings into five key themes: carbon regulation, industry sector, shareholders, intended purpose and practicality. Each of these themes have been considered or suggested as influencers of ICP values at some point during this project.

Carbon regulation was a factor that was shown to be the strongest influencer of ICP value in both the literature review and the Statoil case study. However, these findings contrast starkly with the conclusion of the regression analysis: carbon regulation was not found to significantly affect ICP value. This leads to two potential conclusions. Firstly, the difference in the regression results could be due to a methodological limitation (as discussed in Chapter 6). If this were the case and the limitation were corrected, it might be found that the regression analysis agreed with the findings from the other two methods and it could be concluded that carbon regulation is, in fact, the strongest influencer. Alternatively, the second conclusion could be that company rhetoric (as shown by the broader literature review as well as the Statoil case study) does not fit the reality of company policy. Accordingly, this would be an interesting area for further research in order to understand why this difference exists. For example, this inconsistency could be linked to the 'greenness' typologies discussed in Chapter 3: a company that is not motivated to truly analyse the effect of carbon emissions on their investment decision-making may simply refer to carbon regulation as this is a straightforward benchmark that is easy to cite. However, at least in terms of Statoil's Norwegian ICP value, it is clear that this is directly linked to carbon regulation in Norway (see Chapter 5).

In contrast, all three methods agree that a company's industry sector influences ICP value. The findings from the qualitative and quantitative methods build on each other: the literature review suggested that industry sector may be a factor through references to differing emissions burdens between sectors; the case study demonstrated how there is collaboration between companies within the energy sector in terms of their ICP strategy, and; the econometric analysis found that, within the sample, four sectors significantly influence ICP values (a similarity in ICP value is demonstrated within these sectors). These combined findings suggest that industry sector is an influencing factor but,

perhaps, only in relation to certain sectors (such as those found to be significant in the econometric analysis). In particular, the case study and regression complement each other, by the energy sector being found to be one of the significant industries and Statoil, which is part of this sector, clearly discussing ICP with competitors. Furthermore, as mentioned in Chapter 6, this importance of industry sector in creating homogenous values could be explained by each sector having its own particular array of networks and knowledge sharing. In the case study, such knowledge sharing was highlighted as an important part of Statoil's ICP methodology decision process. As suggested in Chapter 6, the reason for only some sectors being found to be significant in the regression analysis could be linked to stronger networks existing in these particular sectors.

When considering the cross-method findings in terms of shareholders, it can be concluded that the existence of shareholders does not influence company ICP value. This was a finding that was confirmed within each individual method. However, it could be that shareholders (and stakeholders, in general) do influence ICP but in terms of the implementation of an ICP policy, in the first place, rather than in terms of its value. This was suggested in both the literature review and case study and would help to explain why shareholders were not found to significantly influence ICP in the regression analysis.

The idea that the intended purpose of ICP could affect a company's ICP value was raised in the case study. This built on the differing intended purposes identified in the literature review. This was not included as a variable in the regression analysis due to methodological limitations (the challenge of identifying actual intended purpose across a large number of companies). However, this is an area that would benefit from further research in order to consider whether this is an influencing factor. A focus on intended purpose may also incorporate stakeholder influence as 'pleasing shareholders' was noted as a potential reason for using ICP.

The importance of practicality in ICP valuation was a key finding from the literature review that was then confirmed, from Statoil's perspective, in the case study. The literature review demonstrated that some companies preferred to use pragmatic calculation methods, despite the possibility of using much more complex methods (for example, taking into account expected changes in climate trajectory over time). Statoil,

in turn, advised that it uses a pragmatic approach with the aim of making it simple to implement. This again, is a factor that could be linked to intended purpose (as the use may affect the necessity for simplicity). Furthermore, the influence of practicality on ICP calculation methods fits with the insight gained from analysing the modeling of the social cost of carbon: due to the assumption bias and time consuming nature of complex calculation models, companies may choose to use a straightforward method purely for pragmatic reasons (see Chapter 3 for further discussion).

7.4 Conclusion of Findings

In conclusion, across the identified five key themes, the findings from the individual methods complement or build on each other in all but one case. The case where there is a contrast in findings is in terms of carbon regulation: the regression results are inconsistent with those found in the case study and literature review.

Most fundamentally, industry sector is found to be a factor that influences ICP value: it appears that companies, at least within the some industry sectors, have similar ICP values to their competitors. This was a finding that was demonstrated across all methods.

In terms of shareholders, this was concluded (across all methods) to not be an influencing factor on ICP value.

The influence of intended purpose and practicality on ICP calculation was highlighted in both the case study and literature review but, due to methodological limitations, was not tested in the regression analysis.

Accordingly, the application of mixed methods to this research question has provided a fuller picture of ICP valuation: if only one or two of these methods had been used, the apparent inconsistency regarding carbon regulation would not have been identified. Furthermore, the insight regarding the potential influence of intended purpose would not have been gained, if only an econometric analysis had been undertaken.

The next chapter will conclude this project and outline areas that would benefit from further research.

8 Overall Conclusion

8.1 The Influence of Industry Sectors

This project has found that a company's industry sector, affects their ICP value: companies, at least within the some industry sectors, have similar ICP values to their competitors. It has been discussed that this could be due to shared political, economic and socio ideological networks that exist within each sector. Managers, for example, are more likely to meet counterparts who work in the same sector due to industry conferences, trade organisations and shared company interests. Alternatively, similarity in ICP values within certain industry sectors could be due do these sectors facing more criticism than others in relation to their carbon emissions: this is a logical explanation in relation to the energy, materials and utilities sectors.

However, following the argument that ICP is a method for companies to reduce their climate risk through better decision-making, it could be that only cooperating within the same sector causes companies to miss out on innovative ideas. Perhaps, the implication of homogenous policy within industry sector is that the most effective ICP methods are not being shared cross-sector. Moreover, the most effective valuation methods may not be created, at all, as they may require cross-sector collaboration in order to build on ideas used and seen within different sectors.

8.2 Pragmatism and Rhetoric

This project also found that companies typically apply a pragmatic approach to placing a value on their ICP: complexity is avoided in favour of a calculation methodology that is easy to understand and implement. This was exemplified through the discussions with Statoil.

A surprising conclusion was that, whilst company rhetoric may state that they base their ICP value on carbon regulation, this might not be the reality. This finding is not fully certain due to the potential methodological limitation that could be the reason behind the conflicting findings seen within this study. The next section will outline how this, as well as other areas, could be explored through further research.

8.3 Further Research

In terms of further research, an initial step could be performing a repeat study of the econometric analysis, applying a more complex definition of the carbon regulation variable. As discussed in Chapter 6, the reason for carbon regulation not being found to significantly influence ICP value could be the limited way in which the variable was defined: as the large majority of the companies within the sample were multinational, a more accurate way of measuring whether a company operates within jurisdictions with carbon regulation could have been to collect such information for every country in which it has activities. Whilst, for reasons of confidentiality discussed in Chapter 6, it would be very difficult to obtain all cross-border transaction data, information as to where each company has branches or subsidiaries should be reasonably straightforward (although time consuming) to find out from their websites. By updating this definition, it could be tested whether this was the reason why the regression analysis did not complement the results from the literature review and case study. If the same results were still shown, despite the more complex variable definition, further research could be undertaken in identifying why this apparent inconsistency exists between company rhetoric and the reality of ICP methodology.

In terms of the main conclusion from this project, a further study could be completed that would test the theory that shared networks and knowledge are what causes companies within the same industry sector to have similar ICP methodologies. This could be done by conducting company case studies for the rest of the sectors that were found to significantly influence ICP values in the econometric analysis: consumer discretionary, materials and utilities. An alternative case study (instead of Statoil) could also be conducted for the energy industry. Through the case studies, the level of collaboration within these sectors could be analysed and would help to explore, further, exactly how industry sector affects ICP value as well as why such influence occurs.

Another key area for further research would be examining how intended purpose affects the ICP values chosen by companies. This was a potential influencer that was identified in two of the methods within this project but, due to methodological challenges, was not tested in the regression analysis. If sufficient time were available, interviews could be conducted with each company that disclosed its ICP value to CDP, in order to try to

ascertain their intended purpose for their ICP. The interview responses could then be compared with company literature (as well as the full disclosure responses to CDP) in order to check whether there is a discrepancy between company literature and the reality discussed by company employees. An updated econometric analysis (with intended purposes as dummy variables) could then be undertaken. By conducting such interviews, it could also be explored whether the importance of having a practical (and simple) ICP methodology is related to the intended purpose of using ICP.

Similarly, as mentioned in Chapter 6, a study could be conducted as to whether a company being publicly traded influences the likelihood of that company introducing ICP in the first place. This again, could be due to the intended purpose of the ICP policy (for example, ICP as stakeholder management).

8.4 Final Thoughts

The insights gained from this project would not have been found without using a mixed methodology. As noted previously, if only one or two of these methods had been used, certain insights would not have been identified. In addition, by considering theories from across the social sciences, a theoretical logic has been suggested behind the discrepancy between how ICP values could be calculated and how they are calculated in reality.

The benefit of using both a mixed methodology and interdisciplinary theories is clear: a fuller and more integrated picture of the research issue can be found. Perhaps, ICP methodology could also benefit from a mixing of cross-sector ideas.

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Appendix 1: Interview Guide

INTRODUCTION OF THE INTERVIEWER

Hi, so as I have previously explained, my name is Sarah Hay and I will be interviewing you for my Masters thesis at the University of Oslo. Thank you again for agreeing to meet with me.

During the interview, the main topic that I would like to discuss is your company's internal carbon pricing. But please mention anything else that you think may be useful in relation to understanding this area.

Before we get started, did you get a chance to look at the consent form that I sent to you?

[NOTE:

- *If read, signed and happy – continue to start of interview and begin recording*
- *If does not want to be recorded – continue to start of interview and make extensive notes*
- *If questions re exactly how info from interview will be used:*
  - *Nothing will be directly quoted without being checked with you beforehand*
  - *If still an issue, no direct quotes will be included – info paraphrased and just quoted indirectly*
  - *Your contribution will be anonymous but, unless a significant issue, Statoil's name will be used as it is likely the company will be identifiable by the info provided anyway*.]

START RECORDING [*if permission is given*]

GENERAL QUESTIONS

Main questions	**Additional questions**	**Clarifying questions**
1. What is your role at Statoil?	• What is your role in relation to internal carbon pricing?	
2. How does internal carbon pricing work at Statoil?	• [*Can you confirm the values of the internal carbon prices used by Statoil?* • Why was it first put into place? • How is it implemented? • Is internal carbon pricing applied to all types of future emissions? (Scope 1, 2, 3)? • E.g. does 500 NOK = one tonne of scope 1 emissions from a project in Norway? Or one tonne of all estimated emissions?	• Can you expand a little on this? • Can you give me some examples?

CALCULATION OF INTERNAL CARBON PRICE		
Main questions	**Additional questions**	**Clarifying questions**

3. What is/was the framework for calculating particular carbon prices?
• [As I understand it, Statoil applies 2 carbon prices (Norway 65 USD and Non-Norway 50 USD)]
• ((in Norway = Norwegian carbon tax + EU ETS))
 	
4. Are there any other factors that you think I should cover but that I have missed?
	• I mentioned in the project summary and the consent letter that I will also be conducting a statistical analysis as part of my study. There are several factors that I will be looking at to see if they influence the value of an ICP.
	• I'd like to know your opinion regarding whether you think, in general, these factors affect the value of ICPs?
	  • Does carbon regulation affect the ICP?
	  • Does the industry sector influence the ICP? E.g. if in materials, telecommunication or energy sector?
	  • Does the existence of shareholders influence the ICP?
	• What about specifically in relation to Statoil's ICP? Or rather, in relation to the two Statoil ICPs that I understand are used?
	• E.g. Company documentation suggests that the Norway ICP is largely based on Norway's carbon tax? What about EU ETS (unclear)?
	  • Other country regulation: Perhaps for the non-Norway ICP, the regulation of other countries in which Statoil operates? Or countries where Statoil has operating control of projects?
	  • [If applicable] How is future regulatory risk put into monetary terms?
	• E.g. being a part of the energy sector?
	• E.g. Do you think your ICP(s) would be different if you did not have shareholders?
		• Can you expand a little on this?
		• Can you give me some examples?

5. I understand that Statoil is introducing two different internal carbon prices: one for Norway (500 NOK = $64 – previously universal internal carbon price) and one for the rest of the world ($50). What is the logic behind this separation?	• [if not said in answer] Why will there be a lower price for projects outside of Norway? • [if not said in answer] Have these two different prices already been introduced? (projects starting from 2020? – unclear in co. docs) • Are there plans/possibilities to adjust these prices in the future? E.g. if regulation changes?	
Conclusion of interview		
6. Is there any relevant internal documentation, that you would be happy to give me, that provides further information on the company's internal carbon pricing process? 7. Are there any other points that you would like to cover or that you think I should include in my project? 8. Just as a last point, do you know of any contacts that you think would be useful to speak to on this subject within other energy companies? (e.g. ExxonMobil or BG group) Again, thank you very much for taking the time to meet with me!		

Appendix 2: Regression - Assumption Testing

Independence of Residuals

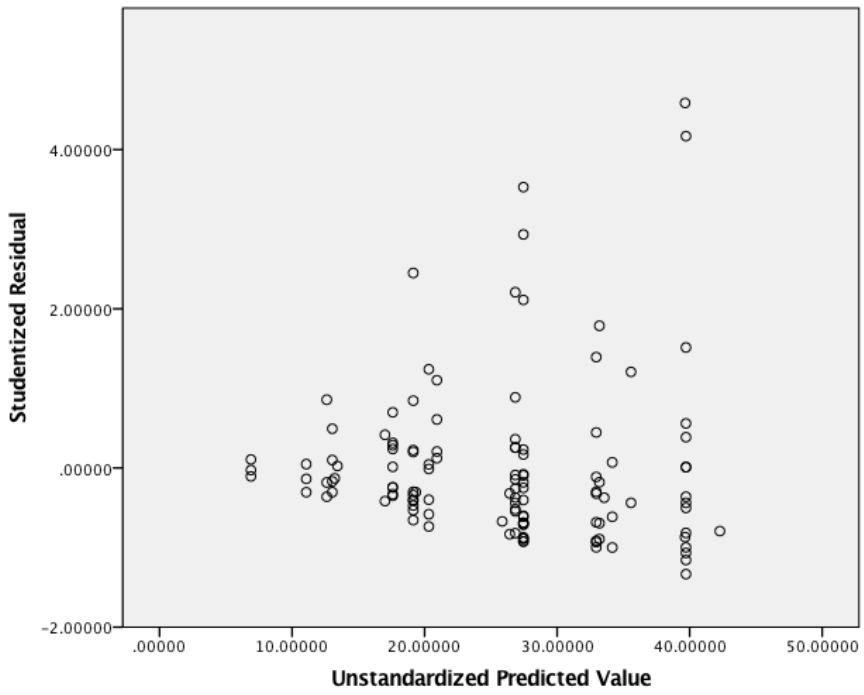
Durbin-Watson statistic = 1.963

Linearity

Not applicable (categorical independent variables).

Homoscedasticity

Figure 1: Homoscedasticity of Residuals



No Multicollinearity

Table 8: Collinearity Statistics (potential worrisome variable has been highlighted – see Chapter 2)

Variable	Collinearity Statistics	
	Tolerance	VIF (Variance Inflation Factor)
Carbon Regulation	.205	4.980
Listed	**.077**	**13.007**
Consumer Discretionary (Industry)	.393	2.545
Consumer Staples (Industry)	.653	1.531
Energy (Industry)	.275	3.631
Financials (Industry)	.376	2.728
Health Care (Industry)	.751	1.332
Industrials (Industry)	.348	2.870
Information Technology (Industry)	.676	1.479
Materials (Industry)	.217	4.617
Telecommunications Services (Industry)	.766	1.306
Utilities (Industry)	.279	3.582

Note: mean VIF value = 3.6265

Outliers and Influential Points

Table 9: Outliers (standardised residual greater than ± 3)

Case Number	Company Name	Standardised Residual	ICP Value (Actual) (*USD*)	Predicted Value (*USD*)	Residual (*USD*)
36	Coop Genossenschaft	4.197	154.74	39.66	115.08
63	AkzoNobel	3.461	122.35	27.45	94.90
91	Enbridge Inc.	4.4046	150.66	39.72	110.94

Cook's Distance: no values greater than 1 (largest is 0.33999)

Normal Distribution of Residuals

Figure 2: Normal Distribution – Histogram

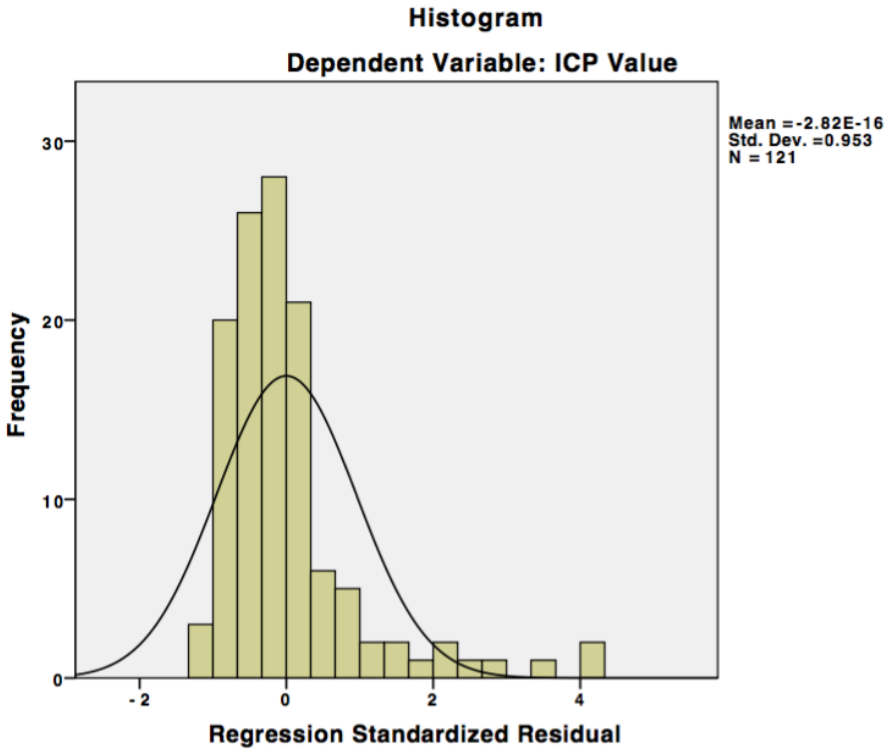


Figure 3: Normal P-P Plot