

How can carbon pricing spur a transition towards a low carbon society for incumbent oil and gas companies?

Master thesis in Energy, Environment and Society

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Abstract

Many countries propose that a rapid transition towards a low-carbon society is crucial to avoid catastrophic climate change effects. Carbon pricing has resurfaced as a viable policy option that can facilitate this transition towards a low-carbon society. Many societal actors including actors within the Norwegian oil and gas are placing stronger emphasis and commitment to conduct their business activities and practices in a way that reduces greenhouse gas emissions from their operations as well as displaying increased support for carbon pricing. ***The aim of this thesis is, therefore, to analyze how carbon pricing can spur a transition towards a low-carbon society for incumbent oil and gas companies.*** This question is approached by conducting a systematic literature review and interviewing key informants.

The research undertaken in this thesis has revealed that carbon pricing does have the potential to spur a transition towards a low carbon society. However, due to low level of prices and that only 20 per cent of global emissions are covered by carbon pricing, the status quo is that these emissions reductions fall short of achieving the climate goals of limiting a temperature increase below 2°C, as enshrined in the Paris agreement. To attain these ambitions, it necessitates a strengthening of carbon pricing policies by implementing higher carbon prices as well as increasing the scope of carbon pricing globally. Another factor, which is also vital for the low carbon transition, is to increase public acceptability of carbon pricing by providing information provision and revenue recycling to the public or green spending. Additionally, it is also essential to spur the development of renewable energy and other low carbon technologies such as CCS. This thesis also looked at the feasibility of implementing global price commitment on carbon pricing; nonetheless, this was found to be unattainable, due to difficulties of achieving an agreement of this sort.

A compelling factor also discovered in this study is that it is equally important to address some of the challenges that are present in this low carbon transition, which includes: Time and pace of transition, political and behavioural challenges and technological development and cost. Similarly, societal actors also need to consider some of the challenging aspects associated with the vision of a net-zero society.

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1. Chapter 1: Introduction

1.0 Introduction

In recent debates, carbon pricing has resurfaced as a viable policy option due to its potential to induce economic and social transformation towards a low carbon and decarbonized world (Kojima & Asakawa, p.5, 2016). Furthermore, carbon pricing is viewed as an efficient policy option that can facilitate this low carbon transition as well as to spur investment and innovation of low-carbon technologies (Bulgurlu, 2020). Terms such as sustainable development, sustainability transitions and triple bottom lines are increasingly gaining importance. A way in which this is evident is through stronger emphasis and commitment placed by governing institutions as well as the business communities to conduct their core business activities and practices in a sustainable manner. These changes also apparent within the Norwegian oil and gas industry whereby many companies are engaging in activities to reduce greenhouse gas emissions from their operations as well as displaying increased support for carbon pricing. According to Equinor (2020), carbon pricing is viewed as the most proven and cost-effective means to tackle climate change. Shell (2020) has also shared similar views and has stated that carbon pricing is a useful tool that can stimulate investment of the development in low-carbon technologies and create new energy choices.

Against this backdrop, some contend that the practical reality is that although many countries have implemented some form of carbon pricing within their jurisdictions, these are currently not viewed as being significant enough to reach the required emissions reductions as stipulated by the Paris accord. The shortcomings of the current carbon pricing system have therefore set in motion debates calling for a reform of the currently operated carbon pricing systems. One of these reforms calls for the establishment of a global carbon price commitment on carbon pricing. This reform proposal has been proposed by many actors, including economists, scholars, governments, policymakers, and corporations such as Equinor and Shell. They all have urged international organization such as the United Nations

Framework Convention on Climate Change (UNFCCC), to feature global carbon pricing as a vital element of any global climate change agreement (Equinor, 2020; Van der Bergh et al., 2018). However, due to the lack of studies that address the progress of such proposals, this thesis will aim to examine the different narratives that exist amongst scholars and practitioners as to how effective global carbon pricing can be achieved. Additionally, this thesis will also assess the likelihood of implementing a global or uniform carbon price by evaluating existing barriers that have stalled a wide-spread implementation of such a carbon pricing mechanism. Furthermore, this paper will also review the literature concerning the effectiveness of carbon pricing as a policy tool to decelerate carbon emissions and will moreover also look at other reform proposals that can strengthen the viability of carbon pricing.

An extensive effort has been made to review the literature through the utilization of systematic literature review and by conducting semi-structured interviews with practitioners from various backgrounds including the academia, the oil and gas industry and climate research institutes, to answer this research question. By performing this endeavour will guide my interpretive process and will enable me to reveal the answer to this question by analyzing both practical and theoretical perspectives.

1.1.1 Background of study: Sustainable development and the transition towards a low-carbon society

Many countries propone that a rapid transition towards a low-carbon society is crucial to avoid catastrophic climate change effects (Chu et al., 2007). A low carbon society envisages that a society one way or another does not emit large quantities of carbon dioxide and other anthropogenic greenhouse gasses into the atmosphere (Peake, 2012).

According to the consensus reached by the Japan-UK Low Carbon Society project, a low-carbon society should strive to (Skea & Nishioka, 2008):

- Take actions that are compatible with the sustainable development principles, while ensuring that the development needs of all groups within society are met.

- Make an equitable contribution towards a global effort to combat climate change by limiting or avoiding anthropogenic greenhouse gases from entering the atmosphere, through deep cuts in global emissions.
- Demonstrate a high level of energy efficiency and use low-carbon energy sources and production technologies.
- Adopt patterns of consumption and behaviour that are in line with low levels of greenhouse gas emissions.

It is further argued that although this definition intends to cover all state of affairs nationally, the implications are different for countries that are at various stages of development. To achieve a low-carbon society for developed countries, would entail making deep cuts in CO₂ emissions by the middle of the 21st century, including the development and deployment of low-carbon technologies and changes to lifestyles and institutions (Skea & Nishioka, 2008). Whereas for developing countries, the achievement of a low-carbon society must go hand in hand with the achievement of broader development goals (Skea & Nishioka, 2008). There is a growing consensus that synergies can be drawn between the progress made in the low carbon transition with the Sustainable Development Goals (SDGs), in that combating climate change would significantly ease the path to achieving many of the UN SDGs (UN, 2019).

As transitions are a recurring theme in this thesis, it is therefore also essential to define what transitions are and how transitions take place. Transitions are seen as a co-evolutionary process that requires multiple changes in socio-technical systems. This term encompasses the development of technical innovations as well as how these innovations are applied in societies. Transitions are also characterized as radical shifts from one socio-technical system to another. Furthermore, this process involves an interaction between different social groups such as businesses or firms, policymakers, scientific communities, different types of user groups, social movements, and special interest groups (Grin & Schot, pg. 11,2011).

1.1.2 Norway's roadmap for sustainability and a low carbon society

Norway has often been praised for its active role in its mitigation efforts to combat climate change and is often pointed as a frontrunner in the net-zero carbon debate (Hermansen & Lahn, 2019). According to a Talanoa dialogue “Norway has an extensive history of pricing emissions” (p.2, UNFCCC, 2018). As early as in the 1990s, Norway introduced specific policies targeted to control greenhouse gas emissions, whereby the first measure was the introduction of taxes on CO₂ emissions that were implemented already in 1991 (Dovland, 2005; UNFCCC, 2018). Today around 80% of carbon emissions are subjected to a CO₂ tax and are also covered by the Emissions Trading System (ETS), which also includes the petroleum industry (UNFCCC, 2018). The Norwegian government has additionally in a policy briefing on February 2020, announced that its ambitions to strengthen its climate goal by 50% towards 55% emission reductions by 2030 compared to 1990 levels (Ministry of Climate and Environment, 2020). According to Climate Action Tracker (2020), Norway still has a way to go and has thus rated Norway's Nationally Determined Commitments (NDCs) as “insufficient”. There are several factors for reaching such a conclusion by the Climate Action Tracker, one of these are related to Norway's long-term goal of becoming a “low carbon society” which was engrained in the 2017 Climate Change Act. The goal here was to reach an 80-95% reductions below 1990 levels, and in the January 2019 declaration, the government announced its plans to increase this goal to a 90-95% emission reduction. However, as of June 2020, this target has not yet officially been reached (Climate Action Tracker, 2020). The government has also failed to specify what share of reductions were to be achieved domestically and what share through international offset credits (Climate Action Tracker, 2020). Similar views have also been shared by Hermansen & Lahn (2019). They have stated that due to lack of governmental assessment or strategy underlying the 2030 climate neutrality target “it is unclear how the Norwegian target should be interpreted, and how it relates to other aspects of Norway's climate policy. The only thing that seems clear is that it will require flexible mechanisms (carbon trading in different forms) and on a massive scale.” Another equally daunting factor is that due to COVID-19's impact on the economy and activity levels, the government has presented an economic recovery package of USD 2.8 billion (NOK 27

billion) which also includes tax relief for the oil and gas companies. The economists disapprove of this and warn that this could prolong Norway’s extraction of oil and gas activities, which could further damper the low carbon transition (Climate Action Tracker, 2020; Losnegård, Befring & Lydersen, 2020).

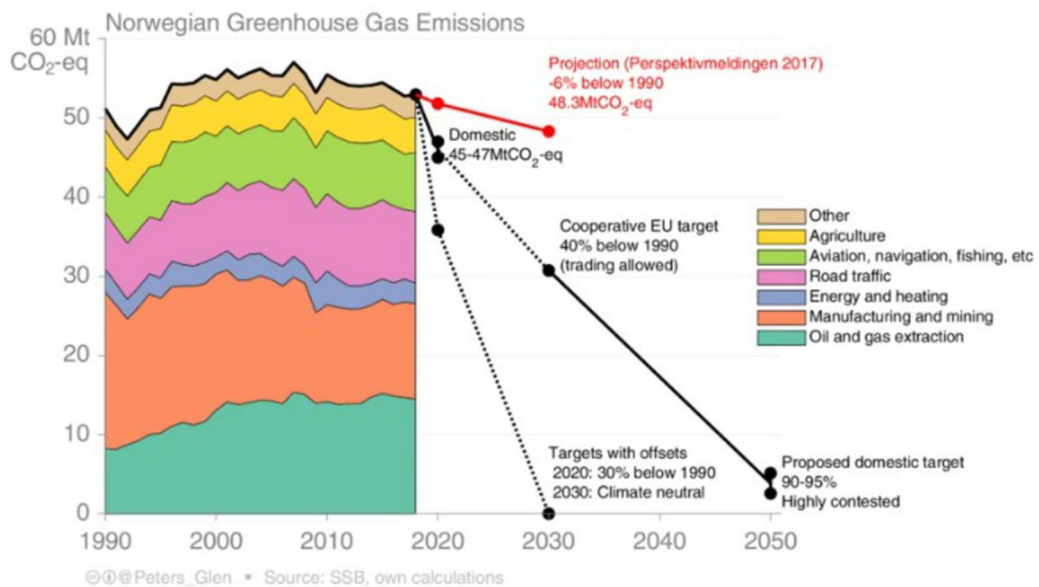


Figure 1: Norwegian greenhouse gas emissions and climate mitigation. Source: Cicero

1.1.3 Carbon pricing

Carbon pricing is, in this sense, increasingly gaining prominence in climate change debates and has resurfaced as a viable policy option that can facilitate the transition towards a low-carbon society (Ramstein et al., p.8, 19). The consensus amongst scholars and practitioners is that carbon pricing is perceived to be the most flexible and the most cost-efficient policy option that will facilitate in reaching the desired emission reductions, based on the “polluter pays” principle (Bowen, 2011; CDP, 2020; Zapf et al., 2019; Baranzini et al., 2017). The notion of this principle is based on the commonly accepted practice that those who engage in pollution generating activities should bear the social costs of pollution of managing it to prevent damage to human health and the environment (LSE, 2018).

Carbon pricing is a market-based instrument that internalizes the external costs of greenhouse gas emissions. “Externalities” in economic analysis refers to circumstances where the effect of production or consumption of goods and services imposes costs on others that are not reflected in the price of those goods and services (Bowen, p.3, 2011). By putting a price on

carbon can help to shift the burden of damages from GHGs to those who are engaged in emission generating activities (The World Bank, 2020). Furthermore, a carbon price provides an economic signal to emitters which allows them to decide either to transform their activities and lower their emissions or to continue emitting and paying for their emissions (The World Bank, 2020). A carbon price also provides an economic signal to consumers which thereby discourages demand for these products and services due to increases in the relative costs of these goods and services (Bowen, p.4, 2011). “By internalizing the externalities associated with CO2 emissions, carbon pricing can promote cost-effective abatement, deliver powerful innovation incentives, and ameliorate rather than exacerbate government fiscal problems” as stated by Aldy & Stavins (p.2, 2011)

Many countries have implemented and are scheduled to implement carbon pricing mechanisms within their jurisdictions. “In total, these carbon pricing initiatives cover 11 gigatons of carbon dioxide equivalent or approximately 20 per cent of global GHGs, which consists of 28 emissions trading systems (ETs) in regional, national and subnational jurisdictions, and 29 nationally applied carbon taxes” (Ramstein et al., p.9, 2019). A detailed overview of this is presented in figure 2.

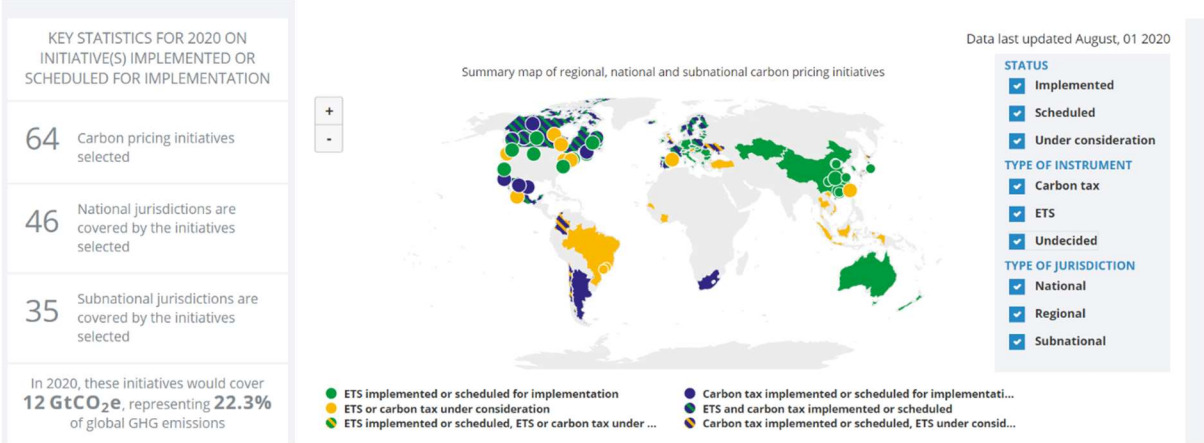


Figure 2: Carbon Pricing initiatives globally. Source: Carbon Pricing Dashboard

Carbon pricing can be classified as explicit carbon pricing, implicit carbon pricing and internal carbon pricing. Explicit carbon pricing puts a direct price on GHG emissions in a monetary unit per tCO₂e and includes carbon taxes, emissions trading systems (ETs), offset mechanisms and result-based climate finance (RBCF) (Ramstein et al., p.19, 2019). Implicit carbon pricing refers to other policies or instruments that effectively price carbon, such as fuel

taxation or the removal of fossil fuel subsidies (Ramstein et al., p.19, 2019; Price on carbon, 2020). Whereas internal carbon pricing refers to the practices applied by organizations to assign monetary value on GHG emissions (Ramstein et al., p.19, 2019; C2ES, 2020). By using an internal carbon pricing companies can manage climate related risks and prepare them for a transition towards a low-carbon economy (C2ES, 2020). Carbon pricing can be classified as explicit carbon pricing, implicit carbon pricing and internal carbon pricing. Explicit carbon pricing puts a direct price on GHG emissions in a monetary unit per tCO₂e and includes carbon taxes, emissions trading systems (ETs), offset mechanisms and result-based climate finance (RBCF) (Ramstein et al., p.19, 2019). Implicit carbon pricing refers to other policies or instruments that effectively price carbon, such as fuel taxation or the removal of fossil fuel subsidies (Ramstein et al., p.19, 2019; Price on carbon, 2020). In contrast, internal carbon pricing refers to the practices applied by organizations to assign a monetary value on GHG emissions (Ramstein et al., p.19, 2019; C2ES, 2020). By using internal carbon pricing companies can manage climate-related risks and prepare them for a transition towards a low-carbon economy (C2ES, 2020).

1.2 Research question

Although many countries have implemented some form of carbon pricing either through a carbon tax, cap-and-trade or a combination of the two within their jurisdictions, these are currently not viewed as being sufficient enough to reach the required emissions reductions. The shortcomings of the current carbon pricing system have therefore set in motion debates calling for a reform of the currently operated carbon pricing systems.

Economists, scholars, governments, policymakers, and corporations including Equinor and Shell are urging international organization such as the United Nations Framework Convention on Climate Change (UNFCCC), to feature global carbon pricing as a vital element of any global climate change agreement (Equinor, 2020; Van der Bergh et al., 2018). According to Baranzini et al., (2017) by implementing a global carbon price will ensure that there are no emission leakages or spillover effect which occur when carbon dioxide emissions increase as a result of emission reductions in other countries. The purpose of this thesis is, therefore, to examine the different narratives that exist amongst scholars and practitioners as to how effective global carbon pricing can be achieved. Also, the likelihood of implementing a global price commitment will be assessed. Furthermore, this paper will also review the literature

concerning the effectiveness of carbon pricing as a policy tool to decelerate carbon emissions, as well as to explore recent literature concerning carbon pricing reform proposals.

Therefore, this thesis will aim to answer the following research question:

How can carbon pricing spur transition towards a low carbon society for incumbent oil and gas companies??

This question will be approached by conducting a systematic literature review of 29 academic papers to identify and analyze emerging themes that exist concerning reform proposals of the current carbon pricing system. Furthermore, the likelihood of implementing a global or uniform carbon pricing will be assessed by examining existing barriers that have stalled a wide-spread implementation of such a carbon pricing mechanism. The results accumulated from this review will then be analyzed against practitioner's viewpoint on carbon pricing through the conducting of semi-structured interviews of practitioners from backgrounds such as academics, oil and gas industry and climate research institutes. However, it is needed to point out that at this stage, it is unknown what the relationship between conceptual literature and empirical data will be; nevertheless, it is assumed that these are somehow interlinked. What follows next is an illustration/model of how this study will be approached.

1.3 Mind map of carbon pricing and the transition towards a low carbon society

A low-carbon society is viewed as an ideal society that the different stakeholders are moving towards; the concept itself will be more or less held constant and will not be problematized in this paper. The locus of this study will be centred around how a low-carbon society can be achieved through the mechanisms of carbon pricing. Accordingly, this will be approached by viewing the different narratives that exist in the literature in parallel with how practitioners perceive this. It is ultimately, businesses and politicians that play a vital role in the effort to decarbonize and who face the practical reality of the task in hand. At the same time, the theoretical perspective tends towards being too normative and descriptive and has perhaps not embraced the existence of complex situations that these actors face. It is, therefore, interesting to see how the different narratives in literature intercede with the viewpoints of practitioners.

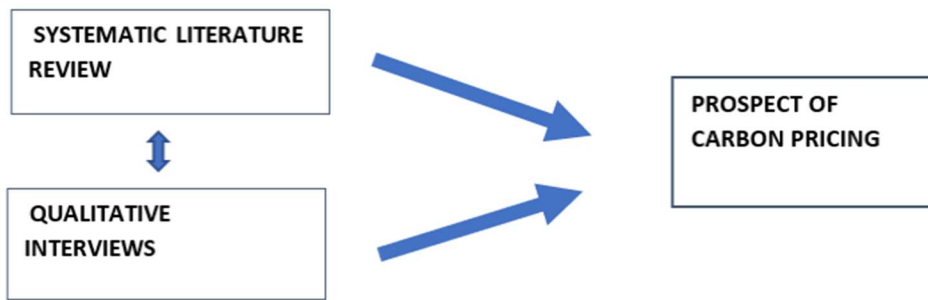


Figure 3: Mind map of the Prospects of Carbon Pricing

1.4 Overview and thesis outline

The structure of this thesis consists of the following five chapters:

Chapter one: This chapter is the introduction and will introduce and bring out the background of the study. This introduction will also include why the stated research topic was chosen for this thesis and will also present the research question.

Chapter two: This thesis chapter will present the theoretical framework the Multi-Level Perspective, which has been applied to examine how carbon pricing can spur a transition towards a low carbon society for incumbent oil and gas companies. An essential factor needed to be emphasized is that this theory will be utilized mainly to analyze the context of where we are in this transition and further to illustrate how energy transitions occur. Furthermore, this chapter will also explore the concepts of sustainable development, sustainability transitions and the triple bottom lines. The point of departure for this chapter will be the systematic literature review on carbon pricing and the key findings based on the selected domains: performance, reform and barriers.

Chapter three: The third chapter of this thesis will look into the methodological and research design approach taken to answer the research question, including the philosophical assumptions made, which is primarily based on the interpretivism paradigm with the basis of a qualitative research methodology. Additionally, this chapter will also present the chosen research strategy, research process, data collection as well as issues related to validity and reliability by undertaking verification strategy by Morse et al. (2002), to ensure that the

quality of research is credible. On a final note, this chapter will also discuss some limitations found within the study conducted and ethical considerations that are also essential to consider in any research.

Chapter four: This chapter aims to reveal the findings gathered from the interviews with selected practitioners. Furthermore, an attempt has also been made to answer the stated research question. The first part of this chapter will provide a holistic overview of the interviewees' background. Subsequently, a presentation of the findings will be introduced according to the predefined indicators: Carbon pricing effectiveness, oil and gas sector's role in the low carbon transition, carbon pricing reform and barriers and challenges. Additionally, a discussion of the results achieved from both systematic literature and the findings from the interviews will be carried out. The point of departure for this thesis will be an attempt to answer my research question by considering both the theoretical framework chosen as well as the findings contained through systematic literature review and the semi-structured interviews.

Chapter 5: This chapter will be the concluding part of this thesis.

2. Chapter 2: Theoretical framework and review of literature

2.1 Introduction

This chapter presents the theoretical framework which has been applied to examine how carbon pricing can spur a transition towards a low carbon society, for incumbent oil and gas companies. The framework that will be utilized for this purpose is the Multi-Level Perspective (MLP). An essential factor needed to be emphasized is that this theory will be utilized mainly to analyze the context of where we are in this transition and further to illustrate how energy transitions come about. This chapter will also explore the concepts of sustainable development and significantly paying attention to sustainability transitions and the triple bottom lines, as many companies are incorporating sustainability into their value system, business model, strategies and governance. The point of departure for this chapter will be the systematic literature review on carbon pricing and the key findings based on the selected domains: performance, reform and barriers. By looking into the literature stream, will illustrate the scenario and context of where we are in this low carbon transition through the lens of the theoretical framework MLP and will provide guidance and relate these findings to status quo.

2.2 Sustainability transitions and related key concepts

In recent times fundamental changes are occurring as societies progress towards a low carbon society. Transformational changes are also occurring in terms of behavioural changes towards climate concerns. Perez has stated that the environmental constraints that were the concern of some groups in society have now become the mainstream (Grin et al., 2010). Concepts such as sustainable development, sustainability transition and triple bottom lines are increasingly gaining importance in all aspects of society, businesses and industries. According to the website Youmatter (2020), Sustainable development is based on the “idea that human societies must live and meet their needs without compromising the ability of future generations to meet their own needs.” Whereas sustainability transitions are defined by Markard et al. (p. 956, 2012) as “long-term, multi-dimensional and fundamental transformation process, through which established socio-technical systems shifts to more sustainable modes of production and consumption.”

The term “triple bottom line” (TBL) was first introduced by John Elkington in 1994 (Elkington, 2018) and is an accounting framework based on the principles of sustainability, where the ultimate goal is to examine a company’s social, environment and economic impact. As of the late 1990s, this term has significantly taken off whereby corporate social responsibility (CSR) and sustainable development built on TBL, are now the cornerstone to value creation for many firms (Elkington, 2004). Aczel (2018) has pointed out that according to a compilation of over 50 studies from financial organizations such as Goldman Sachs, indicate that “companies that are the leaders in environmental, social and good governance policies are financially outperforming their less sustainable peers.” This profound change is also apparent within the major oil and gas companies, which has set in motion transformational changes occurring within these actor’s business activities and practices. Many oil and gas companies such as Equinor and Shell are investing in renewable energy. They have further also acknowledged that carbon pricing is essential in the low carbon energy transition, as they view carbon pricing as one of the most effective ways to combat climate change (Equinor, 2020). Furthermore, carbon pricing can also enhance the investment of the development in low-carbon technologies and to create new energy choices (Shell,2020).

2.3 The Multi-Level Perspective as the theoretical Framework

According to the context above, the most suitable choice of theory is the Multi-Level Perspective to address how the respective oil companies are transitioning towards a low carbon society, where the focus will be more centred on how carbon pricing can further spur this development. An essential factor needed to be emphasized is that this theory will be utilized mainly to analyze the context of where we are in this transition and further to illustrate how energy transitions occur. The purpose of this theory is to explain how transformations come about from one socio-technical system to another, produced by the interaction between three levels including the socio-technical regimes, the socio-technical landscape and niche innovations (Geels,2011).

Furthermore, this theory emphasizes how the alignment of trajectories within levels, and between levels, will produce transitions (Grin et al., p.18, 2010).The focal point in this paper will be to assess how landscape pressures such as the call for transforming the current carbon pricing system can take place and how these changes can impact on the socio-technical regime and niche innovations. By utilizing this theory will provide direction as to whether

these landscape pressures will be adequate to destabilize the socio-technical regime and further escalate their transition pathway towards a low carbon future.

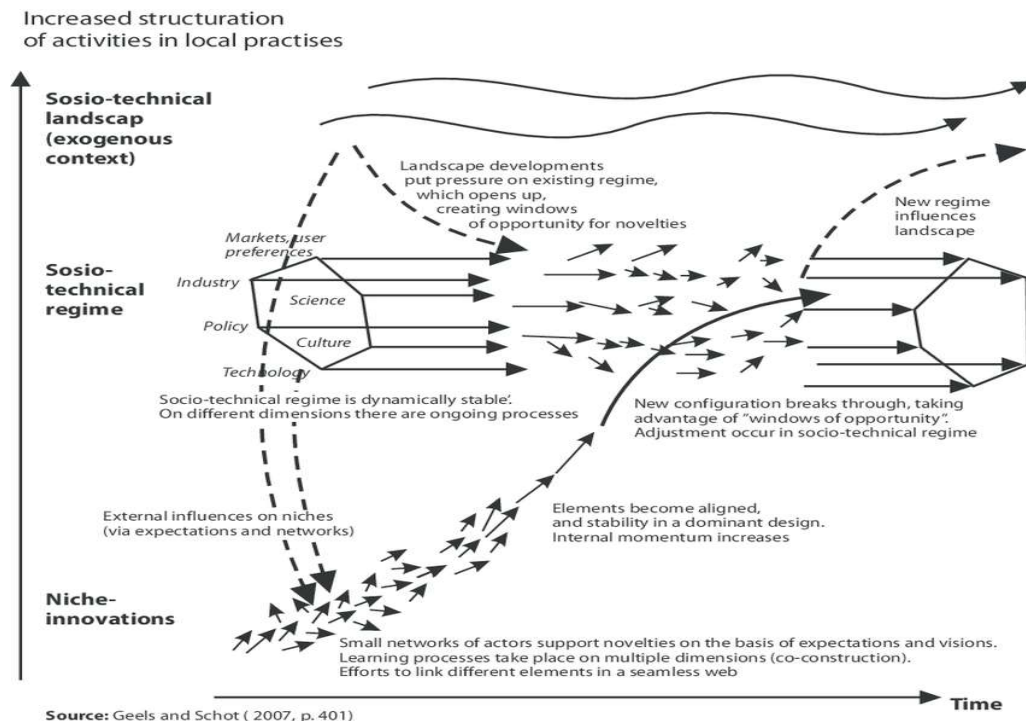


Figure 4: Multi-Level Perspectives on transitions.

2.3.1 The Socio-Technical Landscape

The socio-technical landscape is described as the broader context, which influences the niche and regime dynamics (Geels, 2011). The developments within landscape comprise both of slow-changing trends (e.g. demographical trends, political ideologies, societal values, and macro-economic patterns) and exogenous shocks (e.g. wars, economic crisis, major accidents, political upheavals) (Geels et al., 2017). The determining factors which may cause a disruption or destabilization of existing regimes are landscape pressures such as changes in the current carbon pricing policies, that ultimately leads to higher and effective carbon prices. Also, factors such as changes in demand for oil and gas or expectation of higher oil prices, other political and demographic conditions, increase in climate change concerns and pressure from financial investors or shareholders to decarbonize, can influence the existing regime. Moreover, these landscape pressures can set in motion destabilizing the existing regime, which can lead to creating a window of opportunity for the diffusion of niche-innovations (Geels, 2014). In the context of this paper, landscape factor such as changes in carbon pricing

policies will form the basis of analysis. Scholars and practitioners alike propone that a rapid transition towards a low carbon society is momentous to avoid catastrophic climate change effects. Carbon pricing is, in this sense gaining prominence in climate change debates and has resurfaced as a viable policy option that can facilitate this low-carbon transition (Ramstein et al., p.8, 19). The current carbon pricing schemes are considered to be insufficient to curb carbon emission significantly. The reasons are that these prices generally fall below the “social cost of carbon” (SCC) and is also too narrowly applied to meaningfully curb emissions (Boyce, 2018; Ball, 2018). Ramstein et al. (p.3, 2019) have reported that a carbon price covers only 20 per cent of global GHGs, and less than 5 per cent of those are currently priced at levels consistent with reaching the temperature goals of the Paris agreement. However, some encouraging developments are occurring in terms of the implementation process of carbon pricing schemes. As was noted by Ramstein et al. (p. 3, 2019), “a growing number of jurisdictions are implementing or planning to implement a carbon tax or an emissions trading system”, which constitutes of 57 carbon pricing initiatives around the globe. Additionally, many jurisdictions are also broadening and deepening their carbon pricing instruments to better align with their nationally determined climate goals. These strategies include increasing prices or stringency, as well as increasing emission coverage (Ramstein et al., p. 9, 2019). What these findings indicate is that landscape pressures are in motion, which in turn are influencing the niche and regime dynamics into making transformational changes accordingly. Nonetheless, it needs to be highlighted that changes in landscape dynamics are usually considered to be slow (Geels, 2011) and therefore to transition towards a low-carbon society swiftly requires an upscaling of these landscape pressures.

2.3.2 The Socio-Technical Regimes

Within these levels, the socio-technical regimes are regarded to be more stable, as the social networks are more extensive, where the artefacts, regulations, markets, infrastructures, have merged into stable configurations. Here the rules are articulated, transparent and have a more structuring effect (Grin et al., p. 18, 2010). According to Grin et al. (p. 20, 2010), organizations are also resistant to significant changes due to the existing “web of interdependent relationships with buyers, suppliers, and financial backers as well as patterns of culture, norms, and ideologies”. Geels (2014) has stated that this alliance has empirically also been found to be true for fossil fuel industries which have been related to concepts such as mineral energy complex, carbon lock-in and fossil fuel historical block. As has been noted

by Geels (2014), the term “mineral energy complex” is referred to as capital accumulation by fossil fuel industries that are supported by policymakers. Whereas “carbon lock-in” refers to the infinite inertia related to technical, economic and institutional aspects of fossil fuel-based energy systems and lastly “fossil fuel historical block” which consist of fossil fuel corporations, industry representative organizations, and governments. The underlying rationalism for these alliances is related to the mutual dependencies that these actors share (Geels, 2014). Because of the stability of the existing socio-technical regimes, transitions do not occur that easily.

In the context of this paper, the actors within this level are the Norwegian oil and gas sector which by forming alliances with the ruling government, politicians and lobby groups have been able to resist change. The reason is that despite being one of the wealthiest countries in the world, Norway has relied heavily on the petroleum sector which accounts for 10 per cent of state revenues, 18 per cent of total investments, 12 per cent of GDP, and more than 36 per cent of Norwegian export, according to recent data from Norwegian Petroleum (Moe, 2015; Norwegian Petroleum, 2020). In this thesis, these actors will be referred to as the old socio-technical regime. However, due to more reliable and improved scientific data on climate change along with increased climate change concerns over the years, the Norwegian oil and gas sector has also been subjected to transformational changes. These factors have thereby pushed the industry towards a more sustainable transition pathway, where the ultimate goal is to reach towards a low carbon society, which is referred to as the new socio-technical regime. The status quo is thus a socio-technical regime that is in the midst of a transition, positioned between the old socio-technical regime and the new socio-technical regime. In this midway, niche innovations such as renewable energy are gaining prominence also within the oil and gas sector. This push towards the development and deployment of renewable energy has also been fueled by landscape factors such as increased climate change concerns, political factors including carbon pricing and other policies that have stimulated innovations of low-carbon technologies.

2.3.3 Niche Innovations

Niches are described as social networks that are small, unstable and precarious, consisting of entrepreneurs and innovators that are willing to take risks by developing radical innovations that deviate from existing regimes (Grin et al. p. 18, 2010). The niches here can be any new technological innovation or renewable energy sources such as solar, wind, and CCS where the main ambitions of niche actors are that their innovations may become a part of the regime or even replace it (Geels, 2011). However, as has been mentioned by Geels (2011), this is not an easy endeavour, due to existing regimes stability provided by lock-in mechanisms.

Nonetheless, changes are occurring, as niche innovations to an increasing degree are being incorporated within the current regimes. Renewable energy sources such as solar and offshore wind power are increasingly being included within the respective oil and gas companies' product portfolios.

Additionally, oil and gas companies comprising of Equinor, Shell and Total have by forming alliances, also engaged in the Northern lights project to invest and develop full-scale Carbon Capture and Storage (CCS) solutions (Equinor, 2020). However, for these niches to gain momentum, appropriate infrastructure, regulations, or consumer practices must be in place, which is considered essential to spur the development of low-carbon technologies (Geels, 2011). Therefore, it is required that for the development of these technologies to accelerate, these conditions must be fulfilled. As has been put forth by Geels (p.27, 2011) "Niches are crucial for transitions because they provide the seeds for systematic change."

2.4 The Systematic Literature review on Carbon pricing

Carbon pricing is seen as an essential policy mechanism that can curb and mitigate the dangerous impacts of greenhouse gas emissions and to drive investments towards more clean and efficient alternatives (CDP Worldwide, 2020). Moreover, carbon pricing is also viewed by scholars and practitioners to be the most flexible and the most cost-efficient policy option that can facilitate in reaching the desired emission reductions, based on the "polluter pays" principle (Bowen, 2011; CDP, 2020; Zapf et al., 2019; Baranzini et al., 2017). The notion of this principle is based on the commonly accepted practice that those who engage in pollution generating activities should bear the social costs of pollution of managing it to prevent damage to human health and the environment (LSE, 2018). The primary purpose of pricing

carbon is to internalize the external costs of greenhouse gas emissions. “Negative externalities” in economic analysis, refers to circumstances where the effect of production or consumption of goods and services imposes costs on others that are not reflected in the price of those goods and services (Bowen, p.3, 2011). These costs arise from pollution generating activities by corporations and industries, which causes harm to the environment, and thus imposes a cost to societies as a whole (Investopedia, 2019). By putting a price on carbon can help to shift the burden of damages from GHGs to those who are responsible for it, and who can reduce it (The World Bank Group, 2020). According to the projections made by the World Bank in their annual report “State and Trends of Carbon pricing”, there are a growing number of jurisdictions that have implemented or are planning to implement a carbon tax or an emission trading system. By which this constitutes a total number of 57 jurisdictions that have implemented and are scheduled for implementing carbon pricing initiatives (Ramstein et al., p.9, 2019). However, these efforts are considered insufficient, as “a carbon price covers only 20 per cent of global GHG emissions, and less than 5 per cent of those are currently priced at levels consistent with reaching the temperature goals of the Paris agreement” (Ramstein et al., p.3, 2020).

It is therefore interesting to analyze the literature stream, as this will allow me to examine the different narratives related to the effectiveness of carbon pricing as well as to explore the strand of research regarding reform proposals of carbon pricing and the related barriers. For this purpose, a systematic literature review has been utilized as a method in this thesis, which will further aid me to find factors and variables that will be compared against primary data obtained from expert opinions through interviews. This review will assess 29 academic papers written on carbon pricing. The systematic literature review aims to analyze emerging themes within the literature on carbon pricing, where the findings will be categorized and later be used in the formulation of interview questions. Furthermore, a systematic literature review allows for a deeper engagement of studies and provides better consistency in prioritizing empirical evidence over preconceived knowledge (Mallett et al., 2012).

2.4.1 The process of the Systematic literature review

When conducting the Systematic literature review (SLR), the guidelines of Siddaway (2014) were followed. A search in Google Scholar, Jstor, ScienceDirect, Scopus, the Web of Science, UIS Oria and the internet were conducted to uncover a large number of data across all dimensions concerning carbon pricing. The following search terms were used including the use of logical operators “AND” and “+”: “Carbon pricing”, “Global carbon pricing” and “Carbon pricing and effectiveness”, from the period 2000 - 2020, to extract papers within these databases. The primary purpose for selecting these search criteria was to find articles that feature global, uniform or harmonized carbon pricing as per Equinor and Shell’s call for a reform of the present carbon pricing system. Whereas the reason for choosing 2000 as the base year for searching, is related to resulting journal articles that assess the effectiveness of currently operating carbon pricing in countries. However, due to difficulties in finding relevant and suitable journal articles in Jstor, ScienceDirect, Scopus and the Web of Science, only papers retrieved from Google Scholar were assessed. The maximum number of documents accumulated were 112 000 when using the search term “carbon pricing” and 91 900 results when “global carbon pricing” was used as a search term. Additionally, the following search terms were also included “carbon pricing and effectiveness”, “uniform carbon pricing” and “uniform global carbon pricing”. By refining the search terms, the maximum number of papers found where 34 200. Due to the broad use of search terms, the resulting pieces uncovered also consisted of irrelevant topics. The procedure that followed next, therefore, consisted of manually selecting papers by their titles and by reading the abstracts, whereby only 94 academic papers were selected based on topics they covered according to the selection criteria’s set.

The selection criteria were based on the thematic areas needed for this thesis to address my research question, which was as followed:

1. Carbon pricing effectiveness
2. Carbon pricing reform proposals
3. Carbon pricing implementation barriers

The search results were after that exported into Endnote, which allowed for the removal of duplicates and subsequently, 46 available full-text papers were evaluated. For documents that only had abstracts available, UiS library was contacted as a means to get access to these

papers. These full-text papers were then categorized methodologically according to the topics they cover as stipulated below:

1. Current carbon pricing schemes applied (its effectiveness, drawbacks and shortcomings)
2. Carbon pricing reform proposals (global, uniform or harmonized)
3. Barriers to implementation

Additionally, these papers were also categorized according to the types of literature that were obtained, such as books, academic articles, reports, working papers and policy brief. Whereby only full-text peer-reviewed scholarly articles, books, reports, working paper and policy brief published in English during the period 2000 – 2020 were included. In this review, only a handful of 29 articles were selected based on the inclusion and exclusion criteria. A detailed overview of the process can be seen in figure 2. The inclusion criteria for the literature under review is primarily built on the topics or scope these studies cover, which was aimed at addressing my research question. The following inclusion criteria's were included: 1) key variables, based on how these studies were conducted based, emphasizing mainly on obtaining scientific and academic knowledge and that these papers are easy to grasp). 2) Research design (observational studies as well as qualitative studies) and 3) Time frame (historical assessment of carbon pricing and more recent studies on carbon pricing). The exclusion criteria set for this review were publication type (e.g. non-research articles), study design (unsuitable data or findings) and unvalidated or non-scientific measures). Upon reviewing these 29 papers, two cases were nearly at the prospect of becoming “near-miss” cases. The reason was that both of these articles were perceived to be too complicated and technically challenging to comprehend. However, due to the highly relevant topics (border-tax adjustments), both of these articles covered; it was decided to include these articles as well.



Figure 5. Flow chart of the SLR process

2.4.2 Descriptive analysis

When conducting the systematic literature review, a total of 31 papers were identified on the topic of carbon pricing, which includes empirical studies, editorials, reports, working papers and policy brief. These papers are published in 24 journals (including publishers of books and reports) illustrating that the topic of carbon pricing has mainly been published within the economic discipline. However, this topic has also spread across other domains and disciplines. The majority of carbon pricing research is concentrated within different economic fields such as environmental economics, ecological economics, political economy, to name a few. The 29 papers that are to be reviewed are spread across 22 journals (including publishers of books and reports).

As can be seen from figure 3, only a limited number of publications existed in the timeframe 2000-2011, however the topic of carbon pricing significantly gained importance within the academic field, as the number of publications increased dramatically in the later years.

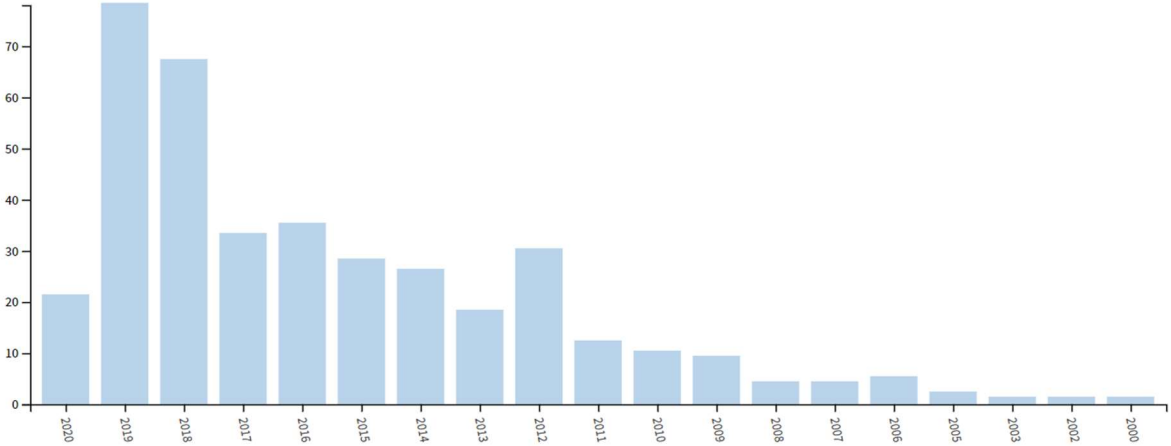


Figure 6: Number of publications on carbon pricing 2000-2020. Source: Web of Science

2.4.3 Findings and Thematic Analysis

This section will explore emerging themes within the carbon pricing literature and will address the research question: *How can carbon pricing spur transition towards a low carbon society for incumbent oil and gas companies?* Accordingly, the included papers in this study are categorized into three domains based on the themes uncovered: Performance, Reform and Barriers. Thematic areas and the ordered domains, along with their authors, will be presented in table 1. As some articles cover two or more domains, these articles have therefore been included in the domains accordingly.

On a general note, most of the articles that assess the effectiveness of carbon pricing as an instrument, view carbon pricing as an effective and cost-efficient tool in mitigating carbon emissions. However, due to shortcomings of currently applied carbon pricing (issues with design and low prices), these are not viewed as being sufficient enough and therefore requires some form of reform of the currently operating systems. According to table 1, the most debated domains of carbon pricing are reform. Below a more detailed discussion of all the domains will be included.

Performance

Most of the articles within the performance domain mainly include discussions of why carbon pricing should be a part of a climate policy solution. According to a policy brief by the New Climate Economy, there are four key benefits experienced with carbon prices: they are an efficient way to reduce GHG emissions; they are considered useful as it raises revenue to support public priorities; more comprehensive environmental and energy security benefits is achieved; and they provide a clear and credible price signal that can guide business expectations (Rydge, 2015). Carbon pricing is also said to strengthen incentives for cost-saving innovations (Boyce, 2018; Baranzini et al., 2017). Raymond (2019) has in his paper stated that despite some shortcomings, carbon pricing has contributed to two important things. Firstly, influential economic players, including governments, businesses and to a lesser extent consumer, have integrated decarbonization into their spending decisions. Secondly, carbon pricing has also motivated these actors to discover the most cost-effective means of cutting carbon emissions. They have managed to achieve this by utilizing low carbon technologies and exploring sustainable business models that incorporate green investments, policies that

consider climate change risk assessment and by lowering emissions in their business activities (Raymond, 2019).

Additionally, this domain also includes articles that assess the effectiveness of carbon pricing applied within the different jurisdictions. The efficacy of the carbon pricing tool was also viewed (Aldy & Stavins, 2012; Bruvoll & Larsen, 2004; Clò, 2009; OECD, 2016; Laing et al., 2017; Sterner & Köhlin, 2015; Tietenberg, 2013; Tvinnereim & Mehling, 2018; Harvey, Orvis & Rissman, 2018; Raymond, 2019; Ball, 2018), be it either a carbon tax or a cap and trade system. In terms of policy tool itself, the consensus amongst scholars is that carbon pricing is an efficient climate policy that has the potential to curb emissions significantly. In contrast, some authors differ to agree and contend that carbon pricing only causes emission reductions at the margin and that deep decarbonization requires a wholesale transformation of the economy (Tvinnereim & Mehling, 2019; Tietenberg, 2013; Rosenbloom et al., 2020). Ball (2018) has also shared similar views that pricing carbon emissions aren't contributing much to fight climate change. With regards to innovation, Tvinnereim & Mehling (2018) has stated that there is little evidence that carbon pricing has been able to spur investments in the innovation ecosystems and new infrastructures. Rosenbloom et al. (2020) have, in their paper, pointed out five weaknesses associated with carbon pricing, as mentioned below:

1. Problem framing and solution orientation (climate change is seen as a market failure rather than a fundamental system problem and does not confront carbon lock-in)
2. Policy priority (more focus on efficiency rather than effectiveness)
3. Innovation approach (tends to stimulate the existing system rather than transformation)
4. Contextual considerations
5. Politics (fails to reflect political realities)

In terms of currently applied carbon pricing, the effectiveness of these schemes was viewed as insufficient in terms of limiting a temperature increase of below two degrees (Klenert et al., 2017; Boyce, 2018; Van den Bergh et al., 2018; Tvinnereim & Mehling, 2018; Mehling & Tvinnereim, 2018; Ball, 2018). The reasons are that these prices generally fall below the “social cost of carbon” and is also too narrowly applied to meaningfully curb emissions (Boyce, 2018; Ball, 2018). It is therefore argued that a carbon pricing reform is in place.

Reform

The Reform domain is the most widely discussed aspect that can be found in most of the articles and includes different proposals as to how carbon pricing possibly can become more effective in reaching the desired emission reductions. A common theme that can be found here is that carbon pricing has to become global in reach, with higher prices that reflect the true social cost of carbon. Additionally, these prices also have to be applied uniformly across different sectors and nations (Bowen, 2011; Cramton et al., 2017, Van den Bergh et al., 2018, Nordhaus, 2015; Ball, 2018). Some authors have proposed that this can be realized through the formation of a carbon pricing club also referred to as a climate club or by pursuing UNFCCC negotiations on a carbon pricing policy (Van den Bergh et al., 2019; Nordhaus, 2015; Cramton et al., 2017). Cramton et al. (p. 52, 2017) have stated that a global carbon price commitment governed by a climate club is needed as this would entail countries to commit to price their domestic carbon emissions on average, at least as high as the agreed-upon global carbon price. The authors have also emphasized that burden-sharing is crucial for any effective global climate agreement to avoid free-riding and hence have proposed the following global carbon pricing path (Cramton et al., p. 42, 2017):

1. First, to negotiate green climate fund payments as the results of these negotiations will determine what common price countries will accept. Therefore, to achieve the goal of maximizing the global carbon price on fairgrounds, it is suggested that the generosity of the climate fund be decided by a group of countries that are midway between donors and recipients. This is expressed as $G_i = \text{some formula}$, for each country i .
2. The next step is to negotiate a global price floor, $P(t)$, which is to be flexibly met by each country.

Nonetheless, for a club of this sort to be deemed successful, the following four conditions must be fulfilled: (1) that there is a public-type-good resource that can be shared; (2) that the cooperative arrangement including dues, is beneficial for each club member; (3) that non-members are excluded or penalized at relatively low cost to members; and (4) that the membership is a stable coalition (Nordhaus, p.1340, 2015).

Cramton et al. (p. 38, 2017) have in their book expressed that solving the free-rider problem is the heart of the solution to increase reciprocity and trust between countries. Similarly, Nordhaus has stated that establishing a climate club based on agreements on internationally harmonized minimum carbon price will be the most fruitful approach. Nordhaus (p.1341, 2015) has said that countries could meet the required international targeted price by using their preferred mechanism of choice, be it either a carbon tax, cap-and-trade or a hybrid system. However, Nordhaus has acknowledged that the use of prices in the form of universal and internationally harmonized carbon tax, levied on the carbon content of fossil fuels, is the most efficient strategy for slowing or preventing climate change (Cramton et al., p. 119, 2017; Nordhaus, p.1351, 2015).

A distinguishing feature of this club mechanism which has also been mentioned above is that non-participants are penalized under uniform percentage tariffs on imports of non-participants into the club region (Cramton et al., p.114, 2017). Nordhaus states that imposing external sanctions on non-members will be necessary to induce effective agreements (Cramton et al., p. 117, 2017). Also, Keen & Kotsogiannis (2014) have in their study concluded that Pareto-efficiency does require some form of border tax adjustment when carbon taxes in some countries are constrained. This argument is also supported by Cramton et al. (p. 39, 2017), who has stated that a climate policy agreement must cover three separate areas – abatement, burden-sharing and enforcement. According to the calculations by Nordhaus, the targeted carbon price has to be up in the range of \$50 per ton to assure that a relatively low penalty tariff induces widespread participation among countries (Cramton et al., p.115, 2017). If the targeted carbon price is as low as \$12.5 and \$25 per ton of CO₂, full participation and efficient abatement are achieved with relatively low tariffs (2% or more). However, as the targeted carbon price rises to \$ 50 per ton, full participation would be difficult to achieve. But would nonetheless assure that the Club attains 90%+ efficiency where the tariff rate would be 5% or more (Cramton et al., p. 121, 2017). Nordhaus has also pointed out that both theory and history supports that some form of sanctions on non-participants is required to induce countries to participate in agreements with a higher level of abatement (Cramton et al., p.118,

2017); Nordhaus, p. 1347, 2015). A paradoxical result also indicates that all regions would prefer a Climate Club regime with penalties and modest carbon prices to a regime with no penalties (Cramton et al., p.121, 2017).

Other reform proposals within the reform domain also include discussions of the appropriate carbon pricing design including a carbon tax, cap and trade or whether to apply a hybrid system (Zapf et al., 2019; Harvey, Orvis & Rissman, p.257, 2018; Cramton et al., 2017; Nordhaus, 2015; Raymond, 2019). Cramton et al. (p.7, 2017) have stated that “a global carbon price – so far excluded from considerations in international negotiations – would be the ideal basis for a common commitment in our view”. The reasons for this is because a price is easy to agree and handle, is relatively fair, is less vulnerable to gaming as compared to the global cap-and-trade systems. Furthermore, it is consistent with climate policies already in place, such as fossil fuel taxes and emissions cap-and-trade (Cramton et al., p.7, 217). Raymond (2019) has in his paper highlighted the importance to recognize cap-and-trade programs as a politically durable form of pricing carbon. He contends this is because emissions cap creates greater environmental certainty in terms of emissions reductions while at the same time safeguarding incentives to reduce emissions where the marginal costs of abatement are lowest. Other scholars also support this view due to difficulties of precisely determining the SCC upon which a Pigouvian tax is based. Because of these uncertainties in estimating the marginal damage over time and the cost of abatement, a quantity control (emissions trading) is preferable to price control (Pigouvian tax) when the increase in marginal damage costs is higher than the increase in abatement costs (Zapf et al., 2019). Raymond (2019) has pointed out that the criticism that the current GHG cap-and-trade programs are subjected to in limiting impacts on emissions is due to the lack of ambition of the emissions cap and duplication by other policies to reduce emissions, rather than the policy design itself.

Other themes which also forms a central part within the reform domain are issues related to distributional equity and burden sharing (Burtraw & Sekar, 2013; Klenert et al., 2017; Baranzini et al., 2017; Boyce, 2018). Klenert et al. (2017) and Boyce (2018) have in their paper emphasized the importance of public acceptability of carbon pricing through the effective use of the substantial revenues raised. They contend that this can be achieved by providing revenue recycling to the public as equal per-person dividends, which will turn the net impact of carbon pricing policy progressive (Klenert et al., 2017; Boyce, 2018; Baranzini

et al., 2017). According to Klenert et al. (2017) study, carbon dividends is also favoured among political and behavioural studies that emphasize the importance of distributional fairness, revenue salience, political trust, and policy stability amid partisan changes in government (Klenert et al., 2017). Raymond (2019) has also emphasized the importance of spending carbon revenue to address the climate change problem as well as offering short-term tangible benefits to citizens. Raymond (2019) further states that it is also politically feasible under a cap- and- trade instrument based on the option termed as “auction and invest”. According to recent developments within the EU ETS program, indicate that the EU will auction 57 per cent of all allowances. These revenues, in turn, will be collected to protect lower-income households from higher electricity prices as well as making potential investments to reduce emissions (Raymond, 2019). The EU has also set ambitions to fund research and development and to develop new renewable energy and carbon capture technology (Raymond, 2019).

Additionally, in the amid of reform proposal discussions, are the suggestions to eliminate or phasing out fossil fuel subsidies (Rydge, 2015; Aldy & Stavins, 2012; Haibera, 2020; Ball, 2018). Aldy & Stavins (p. 8, 2012) have in their paper stated that “phasing out fossil fuel subsidies can represent a significant progress towards “getting prices right” for fossil fuel consumption, especially in some developing countries, where subsidies are particularly large”. Similarly, Haibera (2020) has also proclaimed that the removal of energy subsidies can have big payoffs in terms of lower emissions and higher government revenues. By which global revenue gains from getting energy prices right are estimated at \$ 3.0 trillion or 4 per cent of global GDP. The removal of energy subsidies would also contribute to reducing global carbon emissions by 21 per cent (Haibera, 2020). According to the study by Rydge (2015), there has been a mixed success on the reform of fossil fuel subsidies. Reasons for this has primarily been due to lower oil prices, which has led to support from some governments to increase production subsidies, in part due to royalties they receive from these industries. Despite the predicaments faced by such reforms, several countries have also made significant progress by which 12 countries have successfully managed permanent and sustained reduction of subsidies (Rydge, 2015). Furthermore, 11 countries have partially succeeded whereby reforms achieved reduction for at least a year, but unfortunately, subsidies have been reintroduced or remain a political issue (Rydge, 2015). Rydge (2015) concludes that more needs to be done to phase out fossil fuel subsidies and that both developed and emerging economies should strive to eliminate such subsidies.

On a final note, the consensus amongst scholars within the reform domain is that complementary climate policies are also needed alongside carbon pricing (Baranzini et al., 2017; Sterner & Köhlin, 2015; Cramton et al., 2018; Rosenbloom et al., 2020; Tvinnereim & Mehling, 2018; Mehling & Tvinnereim, 2018). Baranzini et al. (2017) have in their paper emphasized that innovation policies, technology policy, information provision and other instruments should also form a part of a climate policy package. Ball (2018) has urged that target moves are required which includes phasing out coal as a fuel for electricity, speeding the development of CCS, maintaining nuclear energy, slashing renewable energy costs, combating deforestation and rising fuel prices. Mehling and Tvinnereim (2018) have argued that deep decarbonization in line with the 1.5° C target can only be ensured by drawing on a portfolio approach, where carbon pricing operates adjacent to other instruments, including regulation and legal mandates. In contrast, Sterner & Köhlin (p. 260, 2015) and Wagner et al. (2015) have asserted that progress needs to be made to promote renewable energy by subsidizing renewables in combination with carbon pricing. Cramton et al. (2018) also share similar views and state that investment in green research is needed and that some form of command and control style regulation is required, such as building standards. In the following section, the barrier domain will be discussed.

Barriers

To date, many barriers are preventing the proposed reforms from taking place, the main one being difficulties in reaching a shared commitment as proposed by Cramton et al. (2018) and Nordhaus (2015). These include how to determine the price and issues related to which carbon pricing mechanism to apply a price, including taxes, quotas system or a hybrid system. Also, which international body will govern compliance, how to make members comply with terms of the agreement by the use sanctions and how to distribute or use revenues generated with regards to fairness and distributional equity concerns. Nordhaus has stated that international negotiations are also hampered by the Westphalian dilemma, which is based on the treaty of Westphalia or system of sovereign states. This treaty grants each state political sovereignty with power to govern its territory, which has led to the current system of international law under which international obligations may only be imposed with the consent of the sovereign state (Cramton et al., p.112, 2017). Nordhaus further contends that because nations are deeply attached to their sovereignty, reaching universal, binding and, effective international agreements is extremely difficult (Cramton et al., p.112, 2017). Gollier & Tirole

have claimed that “addressing the global externality problem is complex because there is no supranational authority that could implement the standard internalization approach suggested by economic theory” (Cramton et al., p.167, 2017).

In addition to this, the reality is that political resistance towards carbon pricing prospers which hampers any efforts of widespread and effective implementation of carbon pricing. As has been mentioned by Baranzini et al. (2017), much of the resistance against carbon pricing is dominated by distributional equity concerns. The main issues related to this are that carbon pricing will have regressive distributional effects on income or consumers’ purchasing power. Political opponents and powerful lobby groups have been quick to exploit on these carbon pricing concerns, which has resulted in critical electoral victories and even in some cases led to climate policy reversals in Canada, Australia, France and many other jurisdictions (Rosenbloom et al., 2020; Baranzini et al., 2017). Furthermore, energy-intensive industries in many countries have also through lobbying managed to receive favourable treatment which in turn weakens the stringency of carbon pricing measures (Rosenbloom et al., 2020, Baranzini et al., 2017). Similarly, with regards to the proposals of redistributing revenues or the lump-sum transfer to developing countries via the green fund, the design of compensation poses a complex problem. Each country will want to contribute a small fraction to the green fund or receive the maximum number of permits if the carbon pricing design is based on cap-and-trade (Cramton et al., p.184, 2017).

Table 1. Thematic areas and domain categorization of selected papers

Domains	Thematic area	Authors
Performance	Why carbon pricing	Boyce, 2018, Baranzini et al., 2017, Zapf et al., 2019, Van den Bergh et al., 2018, Rydge, 2015
	What carbon pricing	Bowen, 2011, Ramstein et al., 2019, Harvey, Orvis & Rissman, 2018, Cramton et al., 2017
	Assessing effectiveness of carbon pricing	Bowen, 2011, Ramstein et al., 2019
	Carbon pricing and deep decarbonization	Aldy & Stavins, 2012, Bruvoll & Larsen, 2004, Laing et al., 2017 Stern & Köhlin, 2015, Arhlinghaus et al., 2016, Harvey, Orvis & Rissman, 2018, Tietenberg, 2013 Tvinnereim & Mehling, 2018, Mehling & Tvinnereim, 2018, Ball, 2018, Raymond, 2019 Tvinnereim & Mehling, 2018, Rosenbloom et al., 2020, Mehling & Tvinnereim, 2018
Reform	How to price carbon/carbon pricing design	Ball, 2018
	global, harmonised or uniform carbon pricing	Zapf et al., 2019, Cramton et al., 2017, Nordhaus, 2015, Harvey, Orvis & Rissman, 2018, Raymond, 2019
	climate clubs and border tax adjustments carbon revenue recycling and public acceptability	Van den Bergh et al., 2018, Cramton et al., 2017, Nordhaus, 2015 Van den Bergh et al., 2018, Habeira, 2020, Nordhaus, 2015, Keen & Kotsogiannis, 2014 Klenert et al., 2018, Boyce, 2018, Baranzini et al., 2017, Baranzini et al., 2000, Nature Climate Change, 2018, Raymond, 2019
	More than carbon pricing	Baranzini et al., 2017, Stern & Köhlin, 2015, I Wagner et al., Cramton et al., 2017 Rosenbloom et al., 2020, Tvinnereim & Mehling, 2018, Mehling and Tvinnereim, 2018 Ball, 2018
Barriers	global commitment on carbon pricing	Cramton et al., 2017, Rydge, 2015, Van den Bergh et al., 2018, Zapf et al., 2019
	Removal of fossil fuel subsidies	Haibera, 2020, Rydge, 2015, Aldy & Stavins, 2012
	Political sustainability /political economy constraints	Stern & Köhlin, 2015, Tvinnereim & Mehling, 2018, Rosenbloom et al., 2020, Baranzini et al., 2017
	Distributional equity and burden sharing Reaching a global common commitment and the Westphalian dilemma	Baranzini et al., 2017, Boyce, 2018, Stern & Köhlin, 2015, Burtraw & Sekar, 2013 Nordhaus, 2015, Cramton et al., 2017

3. Chapter 3: Methodology and Research strategy

3.1 Introduction

The methodological approach of scientific reasoning has long been contested amongst the scientific community especially during the scientific revolution (Kaluiji, p. 46, 2019), which has primarily been driven by the idea that in order to attain some purpose, one should think carefully about the way we acquire, process and organize information (Bortolotti, p.31, 2008). By systematically designing my research, will ensure that valid and reliable results are achieved while at the same time, address the research aims and objectives (Jansen & Warren, 2020). In this chapter, the methodological and research design approach used to answer the research question will be presented, including the philosophical assumptions made, which is based mainly on the interpretivism paradigm with the basis of a qualitative research methodology. Additionally, this chapter will also present the chosen research strategy, research process, data collection, as well as issues related to validity and reliability to ensure that the quality of research is credible. On a final note, this chapter will also discuss some limitations found within the study and ethical considerations that are also essential for all research.

3.2 Phenomenology as a philosophical assumption

Carbon pricing will be analyzed through phenomenology as a discipline which is defined as the study of structures of experience or consciousness (Smith, 2006). According to Smith (2006) phenomenology “is the study of “phenomena”: appearances of things, or things as they appear in our experience, or the ways we experience things, thus the meanings things have in our experience”. This study will be interpreted through a qualitative meta-analysis where the purpose will be to provide a more comprehensive description of the phenomenon. Ontological and epistemological assumptions will also be analyzed. According to Blaikie and Priest (p. 102, 2019) “ontological assumptions make claims about what kinds of social phenomena do or can exist, the conditions of their existence, and the way in which they are related.” Whereas, epistemological assumptions are concerned with types of knowledge that can be extracted including how this knowledge can be gained and with criteria for deciding when knowledge is both adequate and legitimate (Blaikie & Priest, p.102, 2019).

3.3 Research Strategy

The aim and purpose of this thesis is to assess how effective global carbon pricing can be achieved as well as the likelihood of its implementation. Therefore, it is imperative to identify with and choose a research design that is suitable for my research objective. There are four main strands of research designs available, deductive research design, inductive research design, retroductive research design and abductive research design. Additionally, all four provide distinctively different ways of answering questions, alternative starting and concluding points as well as various sets of steps between these points (Blaikie & Priest, p.21, 2019). After rigorously considering all of these designs, it was apparent that for my research, a combination of inductive research design and abductive research design seemed to be the most appropriate strategy. The reason is that my study comprised of a two-step process with regards to research methods/strategy used. The first step, which was conducted at the very starting point of my research, involved the collection of data through the process of a systematic literature review, the data that was gathered was afterwards coded into categories to generate descriptions. This method of inquiry fits well with inductive logic of inquiry, as inductive reasoning according to Blaikie and Priest (p.93, 2019) aims “to establish descriptions of characteristics and regularities” where the starting point of the research involves the collecting of data on characteristics and regularities. The second step involved in my study was to conduct semi-structured interviews with practitioners. The primary purpose was to discover how a social phenomenon, such as the implementation of a global or uniform carbon pricing, can take place. Abductive research strategy has, therefore, been applied for this purpose as this strategy assists in uncovering the largely tacit, mutual knowledge, the symbolic meanings, intentions and rules which provides the basis for the orientations of these actors (Blaikie & Priest, p.99, 2017). Furthermore, Blaikie & Priest (p.99, 2017) have noted that the social scientist’s task is to discover and describe this “insider” view. However, it is also imperative to point out that Abductive research is interpreted differently among some scholars. According to Blaikie & Priest (p. 99, 2017), Abductive logic is described as incorporating meanings and interpretations, the motives and intentions which are used by people in their everyday lives, which in turn directs their behaviour. Within the abductive strategy, the theory is considered to be the end product of the research (p. 93, Blaike & Priest, 2017). On the other hand, scholars such as Danermark, Ekstrom & Jakobsen (2002, p. 82) has described Abductive inference as the process to interpret and contextualize individual

phenomena within a conceptual or set of ideas. Whereas, Dey's (2004, p. 91) definition is described as the matter of interpreting a phenomenon in the light of some theoretical framework. The Abductive reasoning is based on logical inference which starts with observations and seeks to find the simplest and the most likely explanation for the observations through a new conceptual framework or idea (Danermark, Ekstrom & Jakobsen, 2002, pg. 80). As my research is based on observing and identifying changing behaviours towards carbon pricing, an abductive research strategy fits well with my logic of inquiry. According to Blaikie & Priest (2017, p. 99), Abductive logic is different than Inductive and Deductive reasoning as it contains meaning and interpretations, motives and intentions which are used by people in their everyday lives which thereby directs their behaviour. In contrast, Inductive and Deductive logic ignores this. Another factor which distinguishes Abductive reasoning from Inductive logic is that the theory in the case of Abduction is used together with observations to produce interpretations rather than to infer a generalization (Dey, 2004, p.91). Whereas in the case of Deduction, Abduction offers a plausible interpretation of the results, rather than producing a logical conclusion (Dey, 2004, p. 91). One of the strengths of using an Abductive research strategy in my thesis is that it provides guidance for the interpretative process, which can aid connecting the meanings to events with the broader context (Danermark et al., 2002, pg. 80). The way in which this is to be conducted is through the use of a theoretical framework, the Multi-Level Perspective (MLP). According to Dey (2004, pg. 91) "Abduction relates an observation to a theory and results in interpretations". One limitation, according to Danermark et al. (2002, pg. 81) is that there are, however, no fixed criteria from which a verifiable abductive conclusion can be drawn. Nonetheless, by utilizing the Abductive research strategy, the MLP theory, in my case, will help to explain some aspects of the phenomenon under investigation (Dey, p.91, 2004).

3.4 Qualitative research as a methodology

There are three types of research methodologies that are commonly used by a researcher to pursue the process of collecting, analyzing and interpreting data to understand a phenomenon (Williams, 2007). These three approaches are quantitative, qualitative and a mixed-method approach. The researcher typically selects a quantitative method if the research question requires some form of numerical and or statistical data. A qualitative approach is chosen when the research question necessitates textual data. Whereas, the mixed methods approach is utilized when the research question requires both numerical and textual information (Williams, 2007). According to Williams (2007), there are several methods for conducting qualitative research. These include recommended following five: Case studies, grounded theory, ethnography, content analysis and phenomenological. In this thesis, two qualitative methods have been applied, which includes content analysis and phenomenology. Leedy and Ormrod have defined content analysis as “a detailed and systematic examination of the content of a particular body of materials to identify patterns, themes, or biases” (Williams, 2007). This method corresponds/matches well with my utilization of the systematic literature review, where the purpose of the data gathering is the same as prescribed within the content analysis study, however excluding the statistical analysis as described by the two-step process by Williams (2007). A qualitative phenomenological research approach has also been applied through the data collection process from the semi-structured interviews. Creswell (p.13, 2009) has in his book described phenomenological research as a strategy of inquiry in which the researcher can identify the essence of human experiences concerning a phenomenon as described by participants.

For analysis purposes, this thesis will utilize a qualitative research approach with a Social constructivist worldview. According to Creswell (p.8, 2009), social constructivists hold the assumptions that individuals seek to understand the world in which they live and work, whereby the goal of the research is to establish the meaning of a phenomenon from the views of participants. In regards to this, qualitative research is a holistic approach, as it aims to form an understanding of how social actors derive meanings from their surroundings of a social or human problem (Creswell, p.4, 2009; Williams, 2007). Furthermore, Morse and Field (1996) have stated that “qualitative research enables us to make sense of reality, to describe and explain the social world and to develop explanatory models and theories. It is the primary means by which the theoretical foundations of social sciences may be constructed or re-examined.” Qualitative research is a process that involves purposeful use of describing,

explaining and interpreting collected data (Williams, 2007). Numerous qualitative methods will be applied in my research process, such as performing a comprehensive systematic literature review and interviewing key informants. According to Blaikie & Priest (2017, pg. 201) “qualitative methods are more concerned with producing discursive descriptions and exploring social actors’ meanings and interpretations”. In the qualitative methods, the data will be gathered through various kinds of documents, whereby the collection of these will be through primary data sources. The primary data will consist of sources such as academic journal articles, books and reports. The analysis of these documents along with interviewing key informants will assist in broadening the knowledge base surrounding the viability of carbon pricing as a climate policy as well as assessing how carbon pricing can spur a transition towards a low carbon society.

3.5 Research process

The process for planning and executing my paper involved a five-step process. The first step was to identify the theme and to establish a clear purpose of the research. The second step in my study contained a systematic literature review by searching for keywords to find the most relevant articles on carbon pricing. This process comprised of categorizing the selected papers into the selected domains: performance, reform and barriers. Thirdly, after thoroughly viewing my findings from the systematic literature review, an interview guide was prepared. The fourth step was the collection of empirical data obtained through the selection of appropriate interviewees that had expert knowledge regarding carbon pricing as well as geopolitical considerations related to climate policies. The process involved to generate these findings consisted of recording these interviews and taking notes after each interview. The final step was to analyze findings by comparing this data with the findings obtained from the systematic literature review, as well as to reflect the results against my overall research question.

3.6 Data collection

Primary and secondary data sets are often the two types of data that can be found within a research paper. According to Hox and Boeiji (2005), primary data is described as the collection of original or new data for a specific research problem. Despite the costly and time-consuming aspects of obtaining such data, the essential advantages of primary data are that the operationalization of the theoretical constructs, the research design and the strategy for data collection can be tailormade in accordance with the research question at hand (Hox & Boeiji, 2005). Also, this enhances the credibility of the findings. The secondary data, on the other hand, refers to data initially collected for a different purpose and reused by other researchers for a different research problem (Hox & Boeiji, 2005). One of the advantages of using secondary data is that it is often considered more economical and less time-consuming. However, a significant drawback of secondary data is that it may not contain the specific information that the researcher requires (Crossman, 2019).

This thesis uses both methods for collecting data. First, a systematic literature review was conveyed to find emerging themes related to the effectiveness of carbon pricing, carbon pricing reform proposals and possible barriers that are preventing a widespread deployment of carbon pricing. This part of the research is considered secondary data as the findings here provides understanding from pre conveyed knowledge. Furthermore, this thesis has also used a qualitative approach to obtain primary data to verify and enhance the results from the literature stream. In total, seven semi-structured interviews were conducted in fall 2020 with respondents from different professional backgrounds that hold expert knowledge related to carbon pricing.

3.6.1 Secondary data – systematic literature review

An extensive effort has been put forth to investigate the literature stream, from the selection of relevant articles, reports and books to the analysis and interpretation process, to reveal and unfold my research problem. Therefore, the findings contained within the systematic literature review have been a beneficial method as these findings have increased my knowledge and understanding of carbon pricing and have also aided me in formulating my interview guide. A more detailed overview of the systematic literature review process can be found in section 2.3.1.

3.6.2 Primary data – interviews

Another method which will also be applied is interviewing key informants. Payne & Payne (2004) have stated that “key informants are those whose social positions in research settings give them specialist knowledge about other people, processes or happenings that is more extensive, detailed or privileged than ordinary people, and who are therefore particularly valuable sources of information to a researcher”.

According to Andersen (2006), interviewing informants is a useful approach for generating knowledge as the assumptions and framework for the research process, is linked to an overall research strategy. With this regards, semi-structured interviews are gaining importance as it is capable of disclosing important and hidden facets of human and organizational behaviours (Qu & Dumay, 2008). The structure of the interview has therefore followed a semi-structured way of interviewing, as this has allowed me to ask pressing questions by following my interview guide, while at the same time enabling me for some flexibility by the inclusion of open-ended questions (Qu & Dumay, 2008).

Conducting the interviews

For my research, the selection of candidates was also systematically chosen. A total number of seven candidates were selected for the interviews, whereby two candidates belonged from the academia branch: a political scientist and the other economist who has also worked within the oil and gas industry and has participated in a climate change-related project in Norway. The other two candidates came from the respective oil and gas companies Equinor and Shell. These respondents have been a valuable source of knowledge as they have shared their views on carbon pricing and shed light on how the oil and gas industry is progressing towards a low carbon society. The final three candidates belong from science and research-based institutes, Cicero, Zero and Norsk Klimastiftelse, which also provided me with useful insights and perspectives on carbon pricing and the low carbon transition. An important point to be made is that the names and positions of these individuals will remain anonymous in this thesis.

The selection of these candidates was partly planned and was however not finalized until after my interview guide was complete. The completion of my interview guide was of importance, as the questions contained in this guide would direct me towards the appropriate participants to choose based on the questionnaire and research aim. Two of the interviewees I was already familiar with as they were my lecturers at the university. Hence, the first two emails were sent, which included an introduction of myself, the purpose of my research, my research question and my motivation to collaborate with them. They soon after both agreed to

be interviewed. The second email was sent to schedule appropriate timeframe as well as the venue to conduct these interviews. I also wanted to interview someone from the respective oil and gas companies Equinor and Shell, since I knew that both of these companies were engaged in and aspire to transition towards a low carbon future. My supervisor helped me in this process by suggesting her contact in Equinor. After that, an email to this person, who assisted me in finding a suitable candidate with the relevant knowledgebase related to my research aim. This person agreed to be interviewed, and convenient timing for the interview was agreed upon. A phone call was made to find the remainder interviewees from companies including Shell, Cicero, Norsk klimastiftelse and Zero. Once names and contact details were given, emails were sent requesting them for an interview. Most of these interviews were conducted online, due to covid-19, and as most of the interviewees were located in Oslo. However, two interviews were also conducted face to face as the interviewees, where both at the University of Stavanger. Overall, these interviews lasted for about approximately 30 minutes. The process during the interviews consisted of recording these interviews, and after that notes were written. Consent forms for interviews were also sent to all respondents. The participants were informed about the aim of the research and the interview process. This form also included what information would be stored, and that their identities would be anonymized. The only information that will be disclosed in this thesis is the name of these seven companies that the respondents. Also, through the consent form, the respondents were informed that they could withdraw from the interviews, if they would, later on, decide to do so. Below an overview of the interview participants and the process can be found. As can be seen from the table below, these participants have also been classified as A, B, C, D, E, F and G chronologically, to make the presentation of findings in a clear and presentable way.

Table 2. Overview of the conducted interviews

CLASSIFICATION	INTERVIEW	COMPANY NAME	INTERVIEW LOCATION	METHOD	INTERVIEW DURATION
A	1 st interview	University of Stavanger	Stavanger	Face to Face	19 minutes
B	2 nd interview	University of Stavanger	Stavanger	Face to Face	26 minutes
C	3 rd interview	Equinor	Oslo	Online	50 minutes
D	4 th interview	Shell	Stavanger	Online	34 minutes
E	5 th interview	Cicero	Oslo	Online	20 minutes
F	6 th interview	Zero	Oslo	Online	17 minutes
G	7 th interview	Norsk Klimastiftelse	Oslo	Online	28 minutes

3.7 Validity and Reliability

In any research-based studies, including qualitative and quantitative studies, the concepts of reliability and validity are of great importance to ensure that the credibility of a study is maintained (Golafshani, 2003; Cypress, 2017). Cypress (2017) and Morse et al. (2002) have stated that reliability and validity should be taken into consideration and carried out throughout the whole research process including while designing a study, analyzing the results, and judging the quality of the research. Within the qualitative research strand, there are many different interpretations with regards to the concepts of validity and reliability in the qualitative study. Some qualitative researchers have claimed that validity cannot single handily be defined as a fixed or universal term, but rather that it is affected by the researcher's perception of validity and by paradigm assumptions these researchers chose. These researchers have, therefore developed their concepts of validity testing (Golafshani, 2003). Cypress (2017) has defined validity as "the state of being well-grounded or justifiable, relevant, meaningful, logical, confirming to accepted principles or the quality of being sound, just and well-founded" or to simplify this "validity is concerned with the accuracy and truthfulness of scientific findings". Whereas reliability is referred to as the "replicability, repeatability and stability of processes and results" (Cypress, 2017; Golafshani, 2003; Leung,

2015). Golafshani (2003) has noted that an examination of trustworthiness is crucial to ensure reliability in qualitative research.

There are a variety of procedures and standards that can be applied in order to ensure that the trustworthiness and credibility of a study are maintained. A researcher can apply measures such as triangulation, testing of internal and external validity, prolonged engagement and persistent observations of the phenomena being studied. Also, the use of detailed and thick descriptions and accuracy in the researcher's transcripts can be applied to ensure that no obvious mistakes are made during transcription (Creswell, p.190, 2009; Cypress, 2017; Golafshani, 2003).

3.7.1 The reliability and validity of my research

In order to ensure that this research is consistent with the scientific criteria of validity and reliability, the verification strategies of Morse et al. (2002) were followed. Accordingly, there are five verification strategies which have been suggested: 1) methodological coherence, 2) sampling sufficiency, 3) developing a dynamic relationship between sampling, data collection and analysis, 4) thinking theoretically and 5) theory development.

The first strategy, which is the methodological coherence, aims to ensure that there is a link between the research questions, its methods, the data and analytic procedures. With regards to this strategy, it is believed that the research process in this thesis has followed a logical pattern, starting from a systematic literature review, where the data collected provided useful insight and further guided me to formulate the questionnaire for the interviews. The procedure thereafter was to compare the correlation between the data obtained through the academic stream and the informant's insight and finally to reflect my findings with overall research aim and question.

The second strategy is related to sampling sufficiency, which is based on the criteria that samples must be appropriate, necessitating the selection of participants who best represent or have expert knowledge of the topic. Henceforth concerning the explanation mentioned above, it is asserted that this thesis has also fulfilled this criterion. Moreover, this can be verified by the selection process of the interviewees, where it was made sure that the interview participants were relevant while at the same time came from different professional

backgrounds that hold expert knowledge related to carbon pricing. A total number of seven participants were interviewed, which included companies such as the University of Stavanger, Equinor, Shell, Cicero, Zero and Norsk Klimastiftelse. A more detailed overview of this process can be located in section 3.5.2. This selection process allowed me to get different perspectives on my research problem. It was also vital for my study, as this ensured that the information gathered could be considered trustworthy and meaningful by being able to attain consistency with the research topic. By fulfilling this criterion ensures that sufficient data to account for all aspects of the phenomenon have been obtained.

The third step in the verification strategy is collecting and analyzing data simultaneously. Accordingly, the research process involved in this thesis has continuously been based on analyzing the theoretical data obtained from literature stream, which has provided me with an overview of what is already known and further to guide what type of additional data is required for the research aim. An example of this is through the literature review undertaken in this thesis, which provided me with useful knowledge and additionally guided me to formulate interview questions and hence to the generation of a different knowledge base. Morse et al. (p.18, 2002) have stated that “this pacing and the iterative interaction between data and analysis is the essence of attaining reliability and validity.”

The fourth aspect of the verification strategy is theoretical thinking which encompasses that emerging ideas from data are reconfirmed by new data, thereby giving rise to new ideas that in turn must be verified in the already collected data. A considerable amount of effort has been put forth to reconfirm the theoretical data with the practical insights obtained through the conducting of interviews. This process also involved making comparisons between the interview findings, which were after that reconfirmed with data obtained from the literature stream. Additionally, new data that was found from the interviews were also rechecked to confirm the trustworthiness of the data. It is, therefore, asserted that this verification criterion is also considered fulfilled.

Fifth verification strategy is related to theory development. Morse () has suggested two mechanisms by which a theory is developed. 1) an outcome of the research process, rather than being adopted as a framework which upon analysis is drawn from; and 2) as a template for comparison and further development of theory. With regards to this verification criteria, it is believed that this criterion has not been fulfilled. Nonetheless, an effort was made to

understand the results obtained from the research process by analyzing these findings through the chosen theoretical framework.

3.8 Limitations of research

The research conducted in this thesis consisted of both a secondary data analysis through the systematic literature review and primary data that were gathered through interviews which have provided insights from both theoretical and practical perspectives. This process has further abled me to verify the data collected as well as to give a better contextual understanding of the phenomena under study. However, it needs to be pointed out that every research has some limitation no matter how well it is conducted or constructed, which was also the case for the research undertaken here. As the study conducted here is purely qualitative research, some limitations are present in terms of this that needs to be taken into account.

The main challenge presented within qualitative research is issues related to rigour, which thus requires that the study is carried out in a way that it is regarded as unbiased, in-depth, valid, reliable, credible and rigorous (Anderson, 2010). However, for a qualitative researcher to establish that the study conducted is accurate and reliable, is not always an easy task because rigour is more challenging to maintain, assess and demonstrate (Anderson, 2010). In this study, some limitations were found related to the verification strategy by Morse (2002), specifically concerning the fifth verification due to difficulties to establish reliability and validity related to theory development. Additionally, limitations were also present under some of the interviews, as questions had to be restructured and asked in a different order, which led to neglecting some questions. However, as there was a total of seven respondents, this did not pose a significant limitation in this thesis.

3.9 Ethical considerations

In any research conducted, ethical considerations are of paramount importance which requires researchers to be responsible in the way participants are treated both in terms of providing them autonomy as well as in the sense of trustworthiness. The core ethical principles according to Blaikie and Priest (p.53, 2019) are based on the voluntary consent to participate in research, that the study is of scientific value and to convey research in a way that does not harm anyone involved in the research. As this research involved conducting semi-structured interviews, NSD guidelines were followed. However, as this research did not involve any personal data related to the participants, it was decided not to register this project in NSD. Prior to commencing the semi-structured interviews, the first step was to send emails to the selected participants, which included an introduction of myself, the purpose of my research including my research question and my motivation to collaborate with them including the value that would be added to this thesis through their knowledge. Once the individuals agreed to participate, consent forms for the interviews were created by following NSD's suggested guidelines. Additionally, the participants were also informed that this project would not disclose any personal information, including their names and positions. These points were also specified in the consent form that was given to the interviewees. These participants were additionally informed that they could at any time decide to withdraw from participating in this research and that participation was voluntary. Furthermore, the consent form also included information related to how data would be stored from the interviews, and that the information obtained through the interviews would be deleted after the completion of this project.

4. Chapter 4: Data presentation and Results

4.1 Introduction of findings from the interviews

This chapter aims to reveal the findings gathered from the interviews with selected practitioners. Furthermore, an attempt has also been made to answer my research question. The first part of this chapter will provide a holistic overview of the interviewees' background. Subsequently, a presentation of the findings will be introduced according to the predefined indicators: Carbon pricing effectiveness, oil and gas sector's role in the low carbon transition, carbon pricing reform and barriers and challenges. Additionally, a discussion of the results achieved from both systematic literature and the findings from the interviews will be carried out. The point of departure for this thesis will be an attempt to answer my research question by considering both the theoretical framework chosen as well as the findings contained through systematic literature review and the semi-structured interviews.

4.2 Interviewees background

As has been mentioned earlier in this thesis, the identity of the participants will not be revealed due to a confidentiality clause contained within the interview consent form. However, the only thing that will be mentioned is the name of the companies these individuals are employed. In total, seven semi-structured interviews were conducted. The first two interviewees are located in Stavanger. Both of these respondents work at the University of Stavanger. One of these respondents has a professional background as a political scientist, whereas the other respondent is an economist. Both of these participants are considered to be very knowledgeable within their field as well as holding expert knowledge related to carbon pricing and low carbon energy transitions. The other two participants belong from the respective oil and gas companies, Equinor and Shell. These respondents have also been a valuable source of knowledge as the answers contained through these interviews, provided me with an industry-specific perspective on carbon pricing and shed light on how the oil and gas industry is progressing towards a low carbon society. The remaining three participants came from science and research-based institutes, Cicero, Zero and Norsk Klimastiftelse, which also provided me with useful insights related to my research aim. In order to make the presentation of findings in a clear and presentable way, the respondents will be classified as A, B, C, D, E, F and G chronologically, which means that the first interviewee will be referred to as A and

the last interviewee as G. An overview of this, can also be found in table 2 overview of the conducted interviews, under section 3.5.2 in this thesis.

4.3 Presentation of the findings

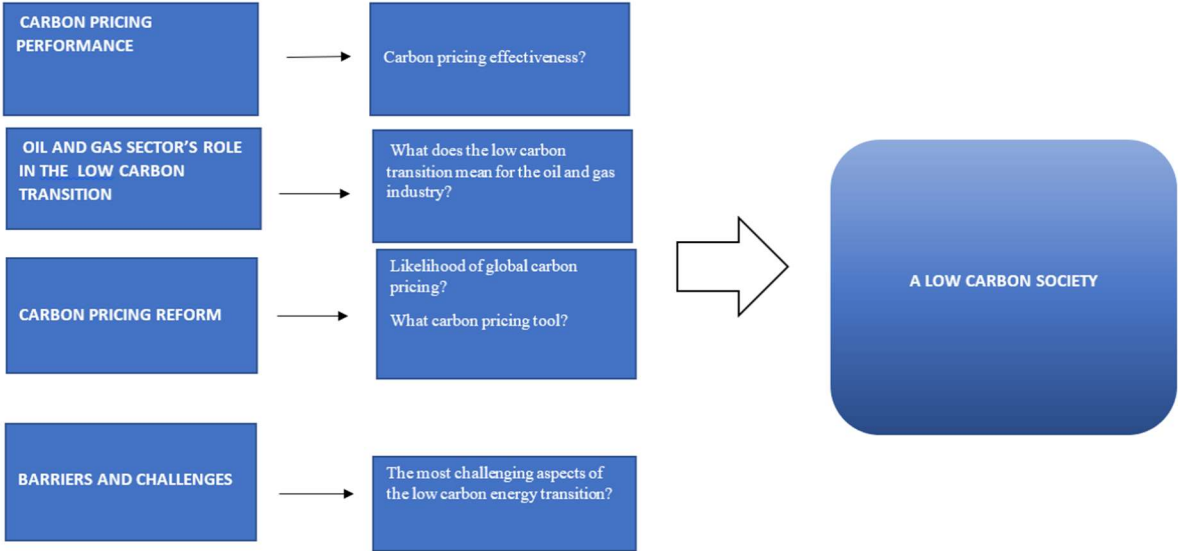


Figure 7: Mind map of interview findings

In this section a presentation of the findings will be thoroughly addressed according to the predefined findings indicators: Carbon pricing effectiveness, Oil and gas sector’s role in the low carbon transition, carbon pricing reform and barriers and challenges, which is also illustrated above in figure 7 mind map of interview findings.

4.3.1 Carbon pricing performance

The consensus amongst all of the practitioners is that carbon pricing is seen as the most effective and cost-efficient climate policy tool to curb carbon emissions. According to participant A, "carbon pricing is a critical tool to make the pollution generating industries accountable for the damage they cause to the environment through their activities. How this can be accomplished is by putting a price on carbon either through a carbon tax or via emissions quotas, which can incentivize these actors to take action and lowering their carbon emissions". However, it has also been pointed by participant B, D and E that other climate policy measures are also needed together with carbon pricing. Among these climate policies, subsidies for renewable energy were considered vital as this will generate significant emissions reductions and stimulate the growth in low carbon technologies. By taking these measures can further accelerate the transition towards a low carbon society. Upon the question of why carbon pricing has not been able to deliver adequate or required emission reductions in line with the Paris Agreement, six of the participants stated that the reasons are because prices have been too low. Participants E and F also said that there are very few countries that are covered or have implemented some form of carbon pricing within their jurisdictions. Other factors that have also been pointed out by participant B and D in the interviews are carbon leakage and difficulties in reaching global agreements on carbon pricing.

4.3.2 Oil and gas sector's role in the low carbon transition

As my research aim is to examine how carbon pricing can aid the oil and gas companies to transition towards a low carbon society, it is therefore also imperative to analyze the oil and gas sectors role in this low carbon energy transition. The respondents were therefore asked questions related to a speech made by Eldar Sætre from Equinor as well as some strategies that are applied within the oil and gas companies, which include internal carbon pricing and increased investments in renewable energy technologies.

The following question was asked: In the interview during the ONS 2020 opening speech, Eldar Sætre stated that "there is a need for a transformation of the energy transition. where the goal is to produce less oil and gas over time and significantly more renewable energy production". He has further stated that "production and the volume that goes into producing oil and gas must be reduced". What are your thoughts on that? As a response to this statement, all seven respondents agreed, and it was further added by respondent C that these ambitions should also be increased. His response was as followed: "the oil and gas companies have a

significant role to play in lowering carbon emissions within their production, which is also an ambition that Equinor aims to achieve. In my opinion, these ambitions can even be more forceful. The underlying question one needs to ask is how the oil and gas industry can aid in this transformation towards lowering the carbon footprint of societies. And this is something we need to reflect upon because it is very convenient to say that we are only covering a demand as the world needs more energy. We don't believe that it's our fault as we are merely covering a demand. That's very easy to say. The oil companies could probably have done much more to initiate this transformation in the direction of lower carbon emissions, for example through electrification and through technological know-how that people have, which includes not only the production but also how energy is used”.

As a follow-up question to this, it was also asked whether they thought that the oil and gas companies could achieve this. There were, however, differing views with regards to this. Some respondents, such as respondents A and B, were sceptical of the ambitions of oil and gas companies, and it was further added that these actors would not do this voluntarily. Therefore, policies and framework conditions must be in place to ensure that these ambitions are realized. According to respondent A, “the idea's behind the geopolitics is that there should be costs involved with pollution generating activities so that the demand for oil and gas is significantly reduced. By doing so, would also signal the oil and gas companies to produce less, where the overall result would be a dampening effect on both investments and recovery activities in the oil and gas industry”.

Whereas, respondent E stated that “much of the ambitions of the oil and gas companies have rested on the development and deployment of CCS technology, however, due to the technology being new, modern and relatively an expensive one, it is risky to rely on this technology alone. Therefore, it is critical to significantly reduce the production and use of coal, oil and gas to avoid catastrophic impacts of climate change”. Respondents C and D stated that for the oil and gas companies to achieve this, much is also dependent on the political will and willpower. Additionally, it was also pointed out by respondent D that it is uncertain how fast this transition will occur and what the scope of this transition will be. Respondent C and D both agreed that noticeable changes would transpire, as the European based companies such as Shell, Eni, Repsol and Equinor to name a few, share the same vision and are also part of the Oil and Gas Climate Initiative (OGCI). The OGCI (2020), aims “to lead the oil and gas industry response to climate change and scale up low carbon energy solutions”.

In contrast to these views, the respondents F and G had a more optimistic view. Respondent F contended that “the oil and gas companies, especially the major ones, can achieve this, as the energy sector is more capital intensive and is, therefore, better equipped to embrace this transition. The question is rather, either they will transition or be outcompeted. Suppose the big companies do not manage to transition. In that case, it may as well be that these companies may not exist in a few years”. Respondent G, on the other hand, believes that “the real transition for the oil and gas sector is much more about a shift in investments from fossil energy and into renewable energy”. He states that this transition is much more critical than a small-scale emission reduction from their oil and gas production. He further noted that even though these allocations of investments in renewables are for the time being incremental, changes are occurring.

An example of this was given in terms of increased investments in offshore wind power in the Northern Sea basin. His statement was as followed “In 2020 or 2021 there will be greater investments in Offshore wind power than in upstream oil and gas. Therefore, it is a matter of strategic choice to adjust and grow or to continue to produce oil and gas over 30 years and to close their businesses, as the demand for oil and gas will decline. Therefore, large-scale companies such as Equinor, Shell and BP have to transform, and carbon pricing is in this sense vital because carbon pricing incentivizes them to make changes in their technology and production”.

The participants were also asked questions regarding internal carbon pricing and whether they thought that this strategy is efficient to reduce emissions. The answers given by the participants were that they considered internal carbon pricing as a good strategy for the decision-making process within these companies. However, their view was that this tool is aimed more towards assessing climate risk rather than emission reductions. Participant A said that “on a societal level, internal carbon 'pricing might not be so reasonable as it will contribute to moving emissions to other locations or perhaps even to reduce the overall price on emissions, caused by the decline in demand for emission quotas when emissions are reduced”.

A final question asked within this finding's indicator, was related to viewpoints on renewables investments made by the oil and gas companies and whether they thought that these investments would cause a shift from fossil fuel-based investments and into more renewable energy investments. The consensus amongst the practitioners that were asked this question was that investments in renewables are considered to be necessary to spur the low carbon

energy transition. However, Participant B stated that “according to findings by the International Energy Agency (IEA) the number of investments into renewables made by the oil and gas companies were minimal. The conclusion here was that if the oil and gas companies do not change their portfolio investments into more renewables, we will not be able to reach the climate goals”.

Participant E also shared similar views and said that “these changes in investment decisions made by these actors are rather based on gaining a competitive advantage and can also be seen as a form of greenwashing”. He further stated that it is of vital importance to increase investments into renewables. However, both participant B and G acknowledge that even though the share of renewable energy investments are of small-scale, changes are occurring as these stakeholders have declared that more investments will be made into renewables.

4.3.3 Carbon pricing reform

The questions constructed under this finding's indicator were based on some reform proposals that also consisted of featuring global carbon pricing as a critical element of any global climate change agreement as this was also something that the oil and gas companies emphasized on. The participants were asked of their viewpoints on this proposal and also what they thought were some of the challenges with this initiative. All of the seven participants considered this proposal to be unrealistic due to difficulties in reaching a global agreement to implement a global carbon price that all countries would adhere to. Respondent D also mentioned that “efforts have been made to feature global carbon pricing as a part of climate change agreement, including in a forum such as the *conference of the parties*. However, they were unable to reach a consensus on this matter and, it is, therefore, necessary to consider other options”.

In addition to this, participant A also stated that “to attain a global agreement of this sort, CO₂ taxes globally must be adjusted in a way that makes the financial burden of taxation higher for well-developed countries than it is for the developing countries”. In contrary to this, Regional agreements or a climate club as suggested by Nordhaus, with a carbon tariff, were considered to be a more realistic approach according to respondents B, E and G.

Whereas, participant A stated that “although a climate club would be able to solve some of the coordination dilemmas, it would not solve the coordination challenges”. Other participants, including participant C and F, considered the linkage between regional systems such as EU ETS with other similar quota systems to be feasible as well.

Within the literature stream, some scholars also discussed the types of carbon pricing design to implement including a carbon tax, cap and trade or whether to apply a hybrid system. The participants were, therefore asked what carbon pricing tool they considered to be the most effective in terms of reducing carbon emissions. There were very different viewpoints amongst the participants on this question. Participant B preferred a hybrid system. Some participants, including participant A and C, favoured cap and trade system as it ensures environmental effectiveness while at the same time enabling emission reduction paths (Eden et al., 2016). As was put forth by participant A, “the advantages of a cap and trade system are first and foremost that this mechanism would assure that the resources are channelled to emission reduction measures that have the lowest cost. The second advantage with a cap and trade system, which is perhaps also the most important one, is that in an ideal world you have full control over the total emissions as the emissions emitted is given by the cap”. Participant E, on the other hand, favoured carbon taxes by which two reasons were given. “The first reason is that emissions quotas have been ineffective in the past, as the system has been vulnerable to political pressure, free allocation of quotas and manipulation of the quotas system when prices were high. The second reason is that you avoid dilemmas around increasing the measures over time or if a country decides to reduce emissions that go beyond what was agreed internationally, which would implicate some other European country to emit more because there is a ceiling on total emissions”.

The remainder participants D, F and G, considered all forms of carbon pricing as useful. Participant G further added that "the question of which carbon pricing to choose depends on which country, which sector and how the revenues from carbon pricing are intended to be used." Whereas participant F view was that he would personally prefer a carbon tax, however, as an emissions trading system is more politically feasible, then an emissions trading system was viewed as a better option.

A final question was asked related to the recent EU ETS reforms which focus on a more robust action-and-invest model by which the revenues obtained will be directed towards both public benefits as well as climate benefits. Here they will not only be using the revenue to protect lower-income households from higher electricity prices but also citing potential investments to reduce emissions, fund R&D, and to develop renewable energy and CCS technology. The respondents were asked whether they thought this reform would be able to spur a low-carbon transition as well as to increase public acceptability of carbon pricing. Three respondents A, F and G all agreed that this is an admirable policy reform and is

considered by respondent B to be essential to increase public acceptance of carbon pricing. Respondent A stated that “I have great faith in the changes and adjustments that are being made with the ETS system in recent years and especially that they have opened up for the total quota ceiling to be reduced year by year as technologies and companies adapt to reduce the carbon footprint. If the carbon footprint is reduced and the quota remains the same, low CO₂ prices become a reality, and that is not beneficial. Therefore, it is important to lower the ceiling on emissions in line with the development that is taking place”. Furthermore, he also stated that “public acceptance of climate policies would also increase as a result of the use of revenues for income equalization”. Respondent F also believed that these steps taken through this reform have proven to be very useful. He further informed that “many EU members actually use these revenues via “innovation fund” to support R & D activities, renewable energy and CCS projects. Also, through the “solidarity fund” money is transferred from the rich to the poor EU countries”. Other participants were not familiar with this reform. However, all agreed that reforms made to the ETS system by regulating the influx of quotas have proven to be very efficient, as the prices have stabilized at a much higher level. With regards to this, respondents B and C also pointed out that “in order ensure that the EU ETS system works optimally following the ambitions they have set, it is essential to continuously make adjustments by reducing the quota ceiling in accordance with efforts being made to lowering carbon footprint”.

4.3.4 Barriers and challenges

Many challenges need to be addressed as societies transition towards a low carbon future. The participants were, therefore asked what they considered the most challenging aspect of the low-carbon energy transition. The answers given were rather extensive and also included different elements to be considered in this low carbon energy transition. Furthermore, the findings contained here provided me with new insights that are considered to be both immensely valuable and unique as these issues were not addressed in the literature stream. The following challenges were voiced: Time and speed of transition, political and behavioural challenges, technological development and costs and the costs associated with a net-zero society.

Time and pace of transitions

Some participants such as participant B, G and F believe that one of the most significant challenges we have is that we are running short of time, which thus requires an urgent transformation of societies to avoid irreversible climate change effect. Respondent G stated that “the emissions curve must significantly be reduced and to reach that speed of emission reductions, the conversion in the form of more renewable energy must take place faster than has been the case. Along this pathway, some obstacles may appear, which also needs to be confronted, whether it is issues related to interference with nature or distributional effects.” Participant B said that “there are also challenges in terms of increasing political vigour and swiftness of action to implement effective policies. In the face of these challenges, it is essential to raise carbon prices and also utilize other policy measures such as support schemes, subsidies and to make changes to the framework conditions for the oil and gas industry”.

Political and behavioural challenges

Behavioural changes in population and businesses is also an element that came through in the interviews as a challenging aspect of the low carbon energy transition. According to respondent A, “the main challenges lies in to change the behaviour of companies and households in a way that changes the energy mix and reduces the carbon footprint. On a more superior level, the challenges are to implement policies that are directed to reduce carbon emissions and to change the energy mix. An underlying reason for this is because voters do not elect politicians who are dedicated to making these changes”.

Respondents C and D also had similar views where it was expressed that “one of the challenges is to make changes in people’s behaviours and lifestyles, which is considered as a vital element to aid the low carbon transition”. Similarly, respondent E also related the challenges of the low carbon transition to political issues, such as resistance from population and businesses. Here an example was given with regards to the recent wind power debates which has primarily been based on the general public opposing the deployment of wind farms, due to concerns related to interference with nature. In essence, participant E believes that “the real challenge lays in how to confront new conflict areas that arise concerning new climate control measures”.

Also, respondents A and D revealed that there are challenges related to political issues at a global level. Respondent D’s concerns were with regards to difficulties in reaching international agreements between countries that could also aid in reducing other challenges such as carbon leakage. Whereas Respondent A stated that “Internationally, the main challenge is to coordinate policy between countries in a way that is both politically acceptable and at the same time can achieve the climate goals under the Paris Agreement. Therefore, to achieve this, it is essential to balance efficiency concerns related to distribution and admit that other framework conditions apply for the less developed countries than it does for the developed countries and this is also something which should be embedded in an international agreement”.

Technological development and costs

Technological development and costs were seen as a core challenge by respondent D. He asserted that “low-carbon technologies are often costly and therefore requires that framework conditions are established through incentives to advance the technological breakthroughs and the availability of such products. By incentivizing these technologies will make it both appealing and attractive to offer low-carbon technologies”.

Other challenges emphasized were related to technological development by Respondent G. He stated that there are also hindrances in technological developments as “some technologies are more complex and take longer time to develop, due to legal matters which requires political involvement and adaptation that must also be taken into consideration by companies”.

Costs associated with a net-zero society

The European Union (2020) envisions a net-zero society as both an urgent challenge and an opportunity to build a better future for all. Respondent C expressed some concerns related to these goals. “The real challenge with realizing this goal is that it will require an extensive amount of technological investments, make transformational changes to existing distribution systems and infrastructures, and it has to happen in a relatively short period.”

It was further highlighted that the costs of making these technological investments and the transformational changes would be costly, and hence the question is who will bear these costs? Respondent C mentioned that “some of the dilemmas here could be solved if we can achieve technological breakthroughs. However, as the prices of already developed technologies are relatively high, it will be a challenging task to accomplish”.

4.4 Discussion of results and research question

As has been mentioned throughout this thesis, the sole purpose of my research is to analyze how carbon pricing can spur a transition towards a low carbon society for incumbent oil and gas companies. This thesis has examined the effectiveness of carbon pricing, carbon pricing reform proposals and barriers. An effort has also been made to address the viability of establishing a global price commitment on carbon pricing. The reason is due to the emphasis placed by some scholars and a group of oil and gas companies. It has, therefore been of great importance to gather and explore both the theoretical and practical perspectives on carbon pricing. By doing so, has enabled me to gain valuable knowledge on the feasibility of carbon pricing and additionally to analyze the prospects of achieving a global price commitment of carbon pricing. In this section, the chosen theoretical perspective, together with the findings contained through the literature stream, will form the basis to interpret and analyze the results accumulated from the semi-structured interviews to answer my research question. However, it needs to be established that the theoretical framework chosen for my research, has its limitation as it can only assess where we are in this transition and not how we can transition towards a low carbon society. Therefore, the foundations from which the answer to my research question will be drawn will be through the findings from systematic literature review and interviews.

How can carbon pricing spur a transition towards a low carbon society for incumbent oil and gas companies?

Practitioners and scholars alike agree that carbon pricing is seen as an essential part of the climate policy package to curb carbon emissions. The potential of carbon pricing has also proven to be effective in terms of lowering carbon emissions and stimulate innovation and development of low-carbon technologies, which is essential to attain the goal of a low carbon society. However, in terms of climate change and the purpose of limiting temperature increase to below 2° C, these emissions reductions fall short. The reasons are that the currently operating carbon prices are too low and that there are only a few countries that are covered by a carbon pricing scheme to cause meaningful emissions reductions. This perception was also found to be accurate according to findings contained from the literature stream and the interviews. A critical element to consider is then how should carbon prices be set to cause meaningful emissions reductions where the goals it to progress towards a low carbon society?

The complexity of this matter is that there are no single answers for this. Also, there are many different proposals and views as to how carbon pricing should be established. These reform proposals include the following: global price commitment on carbon prices, selection of carbon pricing instrument that effectively cause emission reductions and alternative climate policy options.

A common theme that was revealed in the literature stream was that carbon pricing has to become global in reach by being uniformly applied across different sectors and nations. It was further contended that this could be realized through the formation of a carbon pricing club also referred to as a climate club or by pursuing UNFCCC negotiations on a carbon pricing policy. Nonetheless, as was disclosed from the interview findings, it is highly unlikely to accomplish a global agreement of this sort, due to difficulties in reaching a shared commitment on implementing a uniform carbon price that would encompass all countries. According to respondent D, efforts have been made to pursue a global agreement regarding carbon pricing in different forums, including at the conference of the parties. However, these negotiations have come to a standstill and therefore necessitates considering other options. The underlying reasons are related to equity concerns and burden-sharing. By which entails that CO₂ taxes globally must be adjusted in a way that makes the financial burden of taxation higher for well-developed countries than it is for the developing countries, as was put forth by respondent A. Upon the question of the viability of climate club mechanism envisioned by Nordhaus with a CO₂ border tax, respondents B, E and G considered that a club mechanism similar to that of Nordhaus to be more realistic and attainable. Such a proposal is currently also under discussions within the EU, which implies that if an importing country is to sell a commodity or goods to EU countries and does not have a carbon price implemented, this country will be subjected to a carbon border tax by the EU. However, as was mentioned by respondent A, although a climate club would be able to solve some of the coordination dilemmas, it would not solve the coordination challenges.

In contrast to this, respondents C and F considered the possibility of linking carbon markets such as EU ETS with other similar quota systems to be feasible as well. With regards to the question of appropriate carbon pricing instrument to implement that effectively cause emission reductions, answers differed both in the context found within theoretical and practical perspectives. According to Boyce (p.53, 2018) “there is one, and only one instrument in the climate policy mix that can guarantee with certainty that emission targets are

met: a carbon price that is driven by mandated reductions in the use of fossil fuels.” Other scholars have also favoured cap-and-trade programs, as they regard cap-and-trade as a politically durable form of pricing carbon. The reasons given are that emissions cap creates greater environmental certainty in terms of emissions reductions while at the same time safeguarding incentives to reduce emissions where the marginal costs of abatement are lowest (Raymond, 2019; Zapf et al.,2019).

Additionally, this pricing mechanism is also preferred over carbon taxes due to difficulties of precisely determining the SCC upon which a Pigouvian tax is based on (Zapf et al., 2019). Similarly, two respondents have also favoured the cap-and-trade system as it ensures environmental effectiveness through having full control over the total emissions emitted, which is given by the cap. Whereas other viewpoints are inclined towards a price mechanism, as it is easy to agree and handle, is relatively fair and is less vulnerable to gaming as compared to the global cap-and-trade systems. Respondent E also had similar views due to mismanagement of the European quota system in the past, by which the system had been vulnerable to political pressure, free allocation of quotas and manipulation when prices were high. Whilst respondent B preferred a hybrid approach. The other respondents held more or less a neutral view whereby all forms of carbon pricing instruments were considered productive.

Another aspect which is also paramount for the low carbon transition is to increase public acceptability of carbon prices. Within the literature stream, some scholars have contended that this can be realized by providing revenue recycling to the public as equal per-person dividends or using revenues towards green spending. As by doing so will turn the net impact of carbon pricing policy progressive (Klenert et al., 2017; Boyce, 2018; Baranzini et al., 2017). Additionally, Klenert et al. (2017) has disclosed that carbon dividends are also favoured among political and behavioural studies that emphasize the importance of distributional fairness, revenue salience, political trust, and policy stability amid partisan changes in government. These studies indicate that by earmarking carbon revenues for a specific purpose such as green investments or transfers made to significantly affected groups, will achieve greater public support for carbon prices (Klenert et al., 2017).

Similarly, respondent B also emphasized the importance of addressing distributional equity concerns and referred to the recent protest on higher gasoline and diesel prices in France by the Yellow Vest. He further mentioned that it is essential to put in place policies that ensure

equitable distribution of burdens. Furthermore, some studies also emphasize information provision to citizens and firms about the opportunities to reduce GHG emissions, which may further increase the acceptability of carbon prices as well as increase support for innovative climate policies (Baranzini et al., 2017).

Scholars and practitioners alike have pinpointed that in addition to carbon prices, it is also necessary to implement other climate policy measures aimed at accelerating the development and growth of low carbon technologies and innovation activities. As was stated by Bowen (p.29, 2011) “carbon pricing on its own is likely to under-deliver investment in research and development of new technologies, but innovation policies alone are likely to under-deliver on emissions reductions.” Baranzini et al. (2017) have also emphasized on other climate policies to avoid the risk of lock-in of currently cost-effective technologies. For the low carbon transition to transpire, it is essential to accelerate the deployment of renewable energy and energy efficiency measures, according to IRENA & IEA (p.8, 2017). With regards to this, many oil and gas companies are increasingly investing in renewable energy sources such as offshore wind power and solar power. However, as was mentioned by respondent G, the development process of offshore wind is a bit more complicated as the advancement of this technology requires political involvement and adaptation that must be taken into consideration by companies. An encouraging development is, however, that the costs of these technologies are falling year by year, according to IRENA (2020). Also, promising advancements are being made regarding offshore wind projects, as there are more players involved in these projects as well as the progression driven by the Norwegian government to open offshore areas for wind power development (The explorer, 2020; Ministry of Petroleum and Energy, 2020). Norwegian oil and gas companies such as Equinor, Shell and Total are also engaged in CCS project which has been named “Longship” (Gassanova, 2020). The planning phase of this project is finished. By which an investment decision by the Norwegian parliament is to occur in late 2020. However, some of the challenges with new or groundbreaking technologies are the associated costs, which can be quite expensive. CCS technology is also considerably expensive, which has been estimated to cost a minimum of 11 billion NOK, which includes construction and 5-year operational costs (Falnes, 2019). Similar concerns related to technological costs were also put forth by respondents D and E. As was mentioned by respondent D, it is, therefore, necessary to put in place incentives to promote low-carbon technologies to make it both appealing and attractive to offer these technologies. Other policy reforms have made a case for the removal of fossil fuel subsidies, which is considered as a

significant step towards “getting prices right” for fossil fuel consumption (Aldy & Stavins, 2012). Similarly, Haibera (2020) has mentioned the removal of energy subsidies would also contribute to reducing the global carbon emissions at 21 per cent.

4.4.1 Challenges and opportunities as societies progress towards a low carbon future

As societies move towards a low carbon society, they are faced with significant opportunities and vast challenges. An advantage that has presented itself is an emerging market that catalyzes on offering low carbon technology and solutions, which is seen as a vital step in the efforts to decarbonize economies. This profound change is also apparent within the oil and gas companies, as these companies are investing in renewable energy and are also engaged in technological innovation projects such as the CCS. Similarly, transformational changes are occurring within the political realms as well, as societies increasingly place importance to avert climate change effects. An example of this can be given in terms of recent EU ETS reforms, by which the EU is considering to reduce the total quota ceiling yearly in line with the development that is taking place as technologies and companies adapt to reduce their carbon footprint (European Union, 2018). The EU ETS has also implemented reforms that focus on a more robust action-and-invest model by which the revenues collected from the actioned allowances will be directed towards both public benefits as well as climate benefits (Raymond, 2019). Despite these encouraging developments, there are also a vast of challenges in the pathway towards a low carbon society. As was revealed through the findings from the interviews, the following difficulties were mentioned to be amongst the most significant challenges in the low carbon transition: Time and pace of transition, political and behavioural challenges, technological development and costs and the costs associated with a net-zero society. Some of these findings were considered to be an immensely valuable source of knowledge, as these issues were not addressed in the literature stream. These findings were, therefore considered as unique, which includes challenges related to time and pace of transition, political resistance towards low-carbon technologies such as onshore wind power, technological development and costs, as well as costs associated with a net zero-society. These issues will be thoroughly addressed below.

One of the significant challenges that humanity is faced with is the time and pace of transition that this transition needs to occur at, which thus requires a swift transformation of societies to avoid irreversible climate change effect. According to the Intergovernmental Panel on Climate Change (IPCC) assessment report, it was concluded that the adverse effects

associated with global warming of 1.5°C would be more manageable than the impacts of a 2°C warming (Saint-Geniès, 2018). The co-author of this special report Priyadarshi Shukla stated that “Limiting global warming to 1.5°C compared with 2°C would reduce challenging impacts on ecosystems, human health, and well-being” (Leahy, 2018). Accordingly, it was noted in this report that unprecedented efforts are required to cut fossil fuels in less than 15 years and further to eliminate the use of fossil fuels in 30 years (Leahy, 2018). Therefore, as was put forth by Respondent G, to reduce fossil fuel use significantly, it is also required that conversion in the form of more renewable energy must take place faster than has been the case. Furthermore, to spur the development and growth of low carbon technologies, it is equally important also to address some of the challenges related to costs, as these technologies are often costly. It is thus required that framework conditions are established through incentives to advance the technological breakthroughs and the availability of such products.

Other aspects which were also considered as challenging in this low carbon transition are political and behavioural factors. The challenge here is to cause changes in the behaviour of companies and households in a way that transforms the energy mix and reduces the carbon footprint. Whereas, on a more superior level, the challenges are to implement policies that are directed to reduce carbon emissions and to change the energy mix, which may not always be that easy as this requires political willpower and determination. An important question, therefore, remains to be asked. Where does this place us in this low carbon energy transition? As was highlighted in section 2.3 of this thesis, the current transition process can be analyzed through the MLP theory. The socio-technical regime is the Norwegian oil and gas sector, which has, for a long time, managed to resist change. However, due to more reliable and improved scientific data on climate change along with increased climate change concerns over the years, this sector has also been subjected to transformational changes. These landscape factors have pushed the industry towards a more sustainable transition pathway, where the ultimate goal is to reach a low carbon society. The status quo is thus a socio-technical regime that is in the midst of a transition. And to escalate this transitioning process, it is required that carbon pricing policies are strengthened in terms of higher prices and that other climate policies are implemented as well, according to findings from literature stream and interviews. In terms of the MLP, this represents an increase in landscape pressure and to increase the scope of niche-innovations.

5. Chapter 5: Conclusion

5.1 Conclusion

The aim and purpose of this thesis were to assess how carbon pricing can spur a transition towards a low carbon society for incumbent oil and gas companies. Therefore, to understand this phenomenon, the Multi-Level Perspective (MLP) was chosen as the theoretical framework to uncover where these respective oil and gas companies are in this low carbon transition. Additionally, to analyze how these actors can transition towards a low carbon society through the mechanisms of carbon pricing, a systematic literature review and semi-structured interviews with practitioners were conducted. An advantage with the utilization of systematic literature review is that it allows for a deeper engagement of studies and provides better consistency in prioritizing empirical evidence over preconceived knowledge (Mallett et al., 2012). Whereas, the insights gained through interviewing key informants is perceived as a considerably valuable source of information to a researcher (Payne & Payne, 2004).

Practitioners and scholars alike agree that carbon pricing is seen as an essential part of the climate policy package to curb carbon emissions. The potential of carbon pricing has also proven to be effective in terms of lowering carbon emissions and stimulate innovation and development of low-carbon technologies, which is essential to attain the goal of a low carbon society. However, due to low level of prices and that only 20 per cent of global emissions are covered by carbon pricing, the status quo is that these emissions reductions fall short of achieving the climate goals of limiting a temperature increase below 2°C, as enshrined in the Paris agreement. Therefore, to attain the ambitions of a low carbon society, higher carbon prices must be realized as well as to increase the scope of carbon pricing initiatives globally. This paper has also viewed carbon pricing reform proposals including a global price commitment on carbon prices, selection of carbon pricing instrument that effectively cause emission reductions and alternative climate policy options. The consensus amongst practitioners regarding the feasibility of achieving a global price commitment on carbon prices was considered to be unrealistic, due to difficulties in reaching a universal agreement on implementing a harmonized carbon price that would encompass all countries.

On the other hand, a club mechanism similar to that of Nordhaus was viewed as more realistic and attainable. Whereas, some practitioners also considered the possibility of linking carbon

markets such as EU ETS with other similar quota systems to be feasible as well. Different answers were revealed regarding to which carbon pricing instrument that was considered to reduce emissions effectively. However, the commonly held view according to both theoretical and practical perspectives was that cap-and-trade programs are regarded as a politically durable form of pricing carbon than carbon taxes. The reasoning presented for this argument is that emissions cap creates greater environmental certainty in terms of emissions reductions while at the same time also safeguards incentives to reduce emissions where the marginal costs of abatement are lowest. Furthermore, this pricing mechanism is also preferred over carbon taxes due to difficulties of precisely determining the SCC upon which a Pigouvian tax is based on (Zapf et al., 2019). In contrast, some respondents shed doubts on the effectiveness of this system due to mismanagement occurrences in the past.

This thesis revealed that it is also essential to include other climate policy tools targeted towards accelerating the development and growth of low carbon technologies to aid in this low carbon transition. Another factor which was also considered vital for the low carbon transition was to have in place strategies or policies that increase the acceptability of carbon prices and other climate reforms. Policy recommendations as to how this could be attained were through providing information provision and revenue recycling to the public or green spending. In sum, what this thesis has revealed is that carbon pricing does have the potential to spur a transition towards a low carbon society. However, to attain these ambitions, it necessitates a strengthening of carbon pricing policies by implementing higher carbon prices as well as increasing the scope of carbon pricing globally. Additionally, it is also essential to spur the development of renewable energy and other low carbon technologies such as CCS. A compelling factor also discovered in this study is that it is equally important to address some of the challenges that are present as societies move towards a low-carbon society. Similarly, societal actors also need to consider some of the challenging aspects associated with the vision of a net-zero society. As was stated by one of the interview respondents “the real challenge with realizing this goal is that it will require an extensive amount of technological investments, make transformational changes to existing distribution systems and infrastructures, and it has to happen in a relatively short period.” Furthermore, costs associated with these technological investments and transformational changes are considered to be tremendous.

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Annexure 1: Interview guide English

1. Do you consider carbon pricing as an effective climate policy instrument?
2. What are the main reasons for why carbon pricing has not been able to deliver adequate or required emission reductions in line with the PA goal?
3. Many companies including the ones within the Norwegian oil sector are factoring in internal carbon pricing into their investment decisions, do you consider this as an effective strategy to lowering carbon emissions?
4. Eldar Sætre has in his interview under ONS 2020 opening stated that “a transformation of the energy transition is needed” where the aim is to produce less oil and gas over time and significantly more renewable energy production. He has further stated that “the production and volume that goes into producing oil and gas has to shrink”. What are your thoughts on that, and can the oil and gas companies achieve this?
5. We are also witnessing big oil companies such as Equinor and Shell investing in renewable energy sources such as offshore wind, solar PV as well as engaging in CCS projects. What are your thoughts on that?
6. One common theme found in the literature on CP reform proposals is that carbon pricing has to become global in reach, with a global price commitment and a carbon price which is applied uniformly across sectors. What are your thoughts on that?
7. Within the literature it has also been proposed to establish a club mechanism by Nordhaus, named Climate club, are you familiar with this and what are your thoughts on this proposal?
8. Many oil companies amongst them Equinor and Shell have urged international organization such as the United Nations Framework Convention on Climate Change (UNFCCC), to feature global carbon pricing as a key element of any global climate change agreement, what do you think are some of the challenges with this initiative?
9. In the literature there are also authors that discuss the viability of carbon pricing instrument in terms of effectiveness and acceptability where the options discussed are carbon taxation, a cap and trade system or a combination of the two (namely a hybrid system). Which carbon policy instrument do you consider to be the most effective option to curb emissions and at the same time can become politically feasible?
10. The EU ETS is also undergoing reform with a stronger action-and-invest model by which the revenues obtained will be directed towards both public benefits as well as climate benefits (here they will not only be using revenue to protect lower income households from higher electricity prices but also citing potential investments to reduce emissions, fund R&D and to develop new RE and CCS technology. Do you think that this new approach taken by the EU ETS will be able to spur a low-carbon transition and increase public acceptability of carbon pricing?

11. What is the most challenging aspect of the low-carbon energy transition that we are witnessing today?
12. Are there any industry specific challenges that you consider to hindering the transitions towards a low carbon society?

Annexure 2: Interview guide Norwegian

1. Hva er dine tanker om karbonprising og mener du dette er et effektivt klima politisk verktøy?
2. Hva er hovedårsakene til at karbonprising har hatt utfordringer med levere tilstrekkelige eller nødvendige utslippsreduksjoner i tråd med Paris avtalen?
3. Eldar Sætre har i intervjuet under ONS 2020 åpningstalen uttalt at "det er behov for en transformasjon av energiovergangen" der målet er å produsere mindre olje og gass over tid og betydelig mer fornybar energiproduksjon. Han har videre uttalt at "produksjonen og volumet som går med til å produsere olje og gass må reduseres".
 - Hvordan stiller du deg til hans uttalelse?
 - Kan oljeselskapene oppnå dette?
4. Mange selskaper, inkludert selskaper innen den norske oljesektoren, tar i bruk intern karbonprising i sine investeringsbeslutninger. Ser du på dette som en effektiv strategi for å redusere karbonutslipp?
5. Vi ser også at store oljeselskaper blant annet investerer i fornybare energikilder som havvind, solcelleproduksjon samt involverer seg i CCS-prosjekter.
 - a. Hva er ditt synspunkt på dette?
 - b. Tror du at disse handlingene vil føre til mindre olje- og gassvirksomhet og mer fornybar energi virksomhet?
6. Innenfor karbonprising reform debatten er det foreslått at karbon prising må bli et sentralt element i en global klimaavtale med en global pris forpliktelse som er applikert jevnt på tvers av sektorene.
 - Hva er dine tanker rundt dette?
7. Det er også foreslått mulig etablering av en internasjonal organisasjon på lik linje med «Nordhaus climate club».
 - Kjenner du til det?
 - Har du noen tanker om dette?

8. Mange oljeselskaper, blant dem Equinor og Shell, har oppfordret internasjonal organisasjon slik som FNs rammekonvensjon om klimaendringer (UNFCCC), til å ha global karbonprising som et sentralt element i enhver global klimaendringsavtale,

Hva tror du er utfordringene til et slikt initiativ?

- a. I karbon pricing litteraturen er det også diskusjoner om hvilke karbon pricing instrument (carbon tax, cap and trade og hybrid) som bør tas i bruk med tanke på potensiale til å effektivt redusere utslipp og som samtidig kan bli politisk akseptert av både politikere og befolkningen
- b.
- c. Hvilket karbon pricing instrument anser du for å være det beste alternativet med tanke på dette?

9. EU ETS gjennomgår også en reform med en sterkere handlings- og investeringsmodell. Her er inntektene som oppnås rettet mot både a) offentlige fordeler til lavinntekts familier og b) klimagevinster i form av potensielle investeringer for å redusere utslipp.

Har du tro på en slik reform?

10. Hva anser du som den største utfordringen i det grønne skiftet hvor målet er å strekke seg mot et lavt karbon energiomstilling?

- a. Er det noen konkrete utfordringer dere ser i bransjen som forhindrer et lavt karbon energiomstilling?