UNIVERSITY OF GOTHENBURG

SCHOOL OF BUSINESS, ECONOMICS AND LAW

Internal Carbon Pricing

AN EXPLORATORY CASE STUDY ON THE IMPLEMENTATION OF AN INTERNAL CARBON PRICE IN A MULTINATIONAL ENTERPRISE

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Abstract

Climate change is often considered a market failure in the field of economics as the risks and costs are not reflected in the market price. Many scientists and actors in the field therefore argue that the cost must be internalized to properly discount these risks and costs. Internal carbon pricing (ICP) bridges the gap, effectively allowing companies to take responsibility for their carbon emissions. Responding to calls for studies of ICP implementation, this thesis expands on the ICP literature through an in-depth case study of Volvo Cars. Data triangulation is applied, allowing for a nuanced evaluation of how the commercial- and procurement business units respond to the implementation. The results of this thesis shows that the most central prerequisite for a successful implementation is access to rigorous and structured data, regardless of the pricing mechanism applied. Furthermore, this thesis finds that the specific price have limited impact if the foundation of the ICP is not properly in place. Therefore, the ICP in itself is not as important as the behavior that it motivates. Moreover, the suitability of ICP differs between the business units studied as a result of the difference in how they operate, where this thesis advocates for a stronger effect on the procurement unit as it allows for a company to internalize emissions on a component level.

***Keywords**: Internal Carbon Pricing (ICP), Carbon Pricing, Implementation, Barriers, Carbon emissions (CO2),*

JEL Classifications: Q50, Q51, Q56

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Abbreviations

ICP	Internal Carbon Price
MNE	Multinational Enterprise
GHG	Greenhouse Gas
SCC	Social Cost of Carbon
ETS	Emission Trading System
ESG	Environmental, Social & Governance
BEV	Battery Electric Vehicle
HEV	Hybrid Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
ICE	Internal Combustion Engine
CO2	Carbon Dioxide
CDP	Carbon Disclosure Project
BP	British Petroleum
TTW	Tank To Wheel
BU	Business Unit
NFDR	Non-Financial Reporting Directive
LCA	Life Cycle Analysis

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1. Introduction

Climate change and the negative development of carbon emissions is one of the largest challenges of the 21st century and as of 2022, we are still breaking the wrong kind of records. IPCC (2022) states in their report - Climate Change 2022: Mitigation of Climate Change - that to reach the goals of the Paris Agreement, global carbon emissions must peak before 2025 and be cut in half by 2030.

Climate change is often considered a market failure in the field of economics as the risks and costs are not reflected in the market price. Many scientists and actors in the field therefore argue that the cost must be internalized to properly discount these risks and costs (Grantham Research Institute, 2018). The pricing of carbon is a solution that forces emitters to take responsibility for their emissions. Pricing carbon within an organization, referred to as internal carbon pricing (ICP) effectively creates a cost incentive, forcing companies to internalize costs of emission and take responsibility for their carbon footprint, making ICP one of the prominent tools in the decarbonisation race.

Carbon pricing in general is nothing new, but carbon pricing within an organization is a relatively unexplored field in the literature. Yet, it is gaining traction amongst governments and corporations in various sectors. This is emphasized in a recent statement from the World Bank's Carbon Pricing Dashboard: "*There is a growing consensus among both governments and businesses on the fundamental role of carbon pricing in the transition to a decarbonized world*" (World Bank, 2022, Section. What is Carbon Pricing). From a corporate standpoint, over 2000 companies (80% increase since 2017), 226 of which are among the world's 500 largest companies by market cap, have already implemented or are planning to implement an ICP[1] within the next two years. Notable examples include Microsoft, Société General and Samsung (CDP, 2021; World Bank, 2022).

McKinsey (2022) estimates that investments of $275 trillion[2] is required to reach the Net-zero 2050 goal, a corresponding average of $9.2 trillion annually or $3.5 trillion more than today. A large portion of these investments will be spent on low-emission assets and enabling infrastructure in combination with reallocation from high-to-low emission assets. One of the industries at the heart of this transition is the car industry, which accounts for approximately

[1] Internal carbon price in this context captures different types of recognized methodologies, including but not limited to, Cap&Trade, Carbon fee, and Shadow price. See Background.
[2] January 2022 (pre-war numbers)

16%[3] of global emissions (Statista, 2022; Statista, 2021). Within the car industry, Volvo Cars recently decided to become the first car manufacturer to implement an operation wide ICP and this thesis follows the early stages of their implementation process.

The automotive industry accounts for a predominant share of the total GHG emissions of the world. However, the electrification revolutionizing the industry demonstrates the increasing significance of sustainability. Simultaneously, stakeholders demand more from companies' sustainability initiatives (Eccles & Klimenko, 2019). With a recent listing on the Stockholm stock exchange, and as one of the larger car manufacturers in Europe, Volvo Cars is positioned to become a leading figure in the decarbonizing transition of the industry. As such, Volvo Cars offers an interesting arena to explore the implementation of ICP within large organizations, which is the key focus of this thesis.

Within the category of corporations "using or are planning to use an ICP within the next two years" Volvo Cars are just passing the "user" threshold. In November 2021, at the COP-26 summit in Glasgow, the company announced an introduction of an ICP of 100 Euro/Ton CO2 (Volvo Cars 2021) and is therefore the first car manufacturer to implement an operation wide internal carbon price (Volvo Cars, 2022). In anticipation of more stringent regulation, Volvo Cars states that the aim of the implementation is to future-proof the organization by staying ahead of the regulatory curve. The ICP will work as a steering mechanism to help support decisions that align the company with overarching company goals - "*putting sustainability on par with quality and cost*" (Volvo Cars, 2022, p. 161).

The global consensus that; we must act now, and that pricing carbon is a piece of the puzzle is rather clear. However, practically implementing an ICP within an organization is a relatively unexplored field in the literature. Closing the gap between academia and practice creates a better understanding of the opportunities and struggles that companies face in implementing an ICP. As an increasing share of companies are contemplating implementing an ICP, this thesis sets out to answer the questions of the "*Why"* and "*How"* of ICP, together with how a multinational enterprise responds to an official implementation through an exploratory case study of Volvo Cars.

[3] Road transport(including passenger cars, trucks, buses and mini buses, and two/three wheels) accounts for 78% of transport emissions (20,5% of Global emissions)

The thesis is structured in the following way; the rest of Chapter 1 contains problematization, purpose, and delimitations, Chapter 2 introduces the reader to ICP by presenting definitions and applied methodologies, Chapter 3 looks into the literature surrounding ICP, its incentives, barriers, effects, ending with some context for organizational change, Chapter 4 describes the research methodology, Chapter 5 presents the results of the interviews and the case study, giving an overview of the implications for Volvo Cars, Chapter 6 discusses the findings and finally Chapter 7 presents the exploratory conclusion, limitations, and suggestion for future research.

1.1. Problematization and Purpose

The growing number of ICP adoptions in the corporate sector (CDP, 2021) has triggered an increase in research on the topic. Gorbach et al. (2022) summarize existing knowledge about ICP and develop a flow-chart (see figure 1) for implementation. Riedel et al. (2021) investigate barriers to implementation in German companies, and Bento & Gianfrate (2020) study determinants of ICP implementation. Chang (2017) study private firms' incentive to adopt an ICP and finds that in general, the motives are cost-reductions through energy efficiency. Galán-Valdivieso et al. (2019) finds that corporate carbon policies and the disclosure of an ICP has a positive effect on companies perceived legitimacy.

The contribution of this thesis lies in the investigation of why and how firms implement and use ICP through an applied case study on the implementation in a multinational enterprise. The reasons behind an ICP adoption can be multi-facetted, including using it as a hedging mechanism in anticipation of future regulation, as a risk mitigation tool in the transition to a low-carbon economy, and to externally display carbon reducing ambitiousness (Ahluwalia 2017). The literature usually investigates why from the perspective of institutional theory (Gorbach et al. 2022; Wang et al. 2022), arguing that investor awareness and social and legal pressure motivates companies to implement ICP. These motives are rooted in isomorphic pressures in organizations' pursuit of legitimacy (Dimaggio & Powell, 1983). However, even if these isomorphic pressures make companies more homogenous, we still see persistent innovation and change in the mechanisms that firms implement to support their strategy. Aldy et al. (2021) argues that ICP could just serve as a signaling mechanism to stakeholders and legislators that companies are delivering on their environmental promises while not engaging in any concrete actions, effectively making it a form of greenwashing. This is also emphasized by Green (2021), who argues that the absence of standardization let's companies roam free and

set their own rules. Using the concepts of institutional theory as a starting point, this thesis expands on previous work of why companies implement ICP.

The literature focusing on ICP implementation is scarce. The practical examples available lack generalizability as a result of the implementation in a controlled context (among Yale campus buildings, see Carattini, 2017) and as a result of the ETS mechanism being implemented under arbitrary conditions (unlimited emission credits; see Background) (Victor & House, 2006). The lack of studies of ICP practices could stem, both from the relative recency of ICP as broader phenomena within organizations, and from the sensitive nature of the implementation with regards to organizational response and stringency. The lack of situated research means that most ICP studies derive information from official statements (especially the CDP database) (Riedel et al., 2021; Chang, 2017; Bento & Gianfrate, 2020). It has also led several authors to argue for in-depth studies of ICP. Specifically, Bento & Gianfrate (2020) suggest more research on implementation and the effects of the adoption, Riedel et al (2021) propose more research on organizations in different sectors, and Chang (2017) suggests further research on how companies engage in carbon pricing, controlling for size and revenues. Due to the lack of in-depth case studies of ICP implementations, this thesis investigates how different BUs in a multinational enterprise respond to an ICP implementation.

An in-depth case study requires access to the inner workings of an organization, its people. The thesis's major strength is therefore the close examination of Volvo Cars, the enabler to shed light upon why a company decides to implement an ICP and how business units (BU) respond to the actual implementation. With a recent introduction of an ICP, Volvo Cars makes a compelling case and a good subject under the conditions of transparency.

1.1.1. Purpose

The purpose of this research is to understand why organizations choose to adopt an ICP, how they do it, and what organizational thresholds they face. The thesis fulfills this purpose through the means of a case study on Volvo Cars.

1.1.2. Delimitations

Within the scope of Volvo Cars, the thesis is limited to consider the commercial and procurement BUs. The BUs are chosen since they represent two opposite sides of the company, the former revenue oriented and the latter cost oriented. Other BUs that could be contributory to answering the research question are excluded due to a limitation of data access and the

timeframe of thesis. A large portion of previous work has studied the technical differences between ICPs. Therefore, this thesis analyzes the implementation of an ICP within a multinational enterprise and does not attempt to technically compare different methodologies.

2. Background

Before introducing the concept of pricing carbon within an organization, it is important to understand how emissions are measured. Throughout the value chain of a company's production, distribution, and recycling process, different stages have different amounts of direct and indirect emission, often referred to as scopes of emission. Developed by WRI & WBCSD[4] and outlined in the Greenhouse Gas Protocol (2022), an accounting and reporting standard, the scopes constitute three different categories of emissions. Scope 1 captures the direct emissions from a company's operations and activities such as manufacturing, vehicles owned or controlled by the firm, and electricity/heating in company facilities. Scope 2 considers the entirety of Scope 1 and adds the indirect emissions from the generation of, for instance, purchased electricity, heating, and cooling. Under the GHG protocol, Scope 1 and 2 are mandatory to report. Finally, Scope 3 captures everything outside Scope 1 and 2, that is all other indirect emissions in a company's value chain, both up-stream and down-stream. Scope 3 is currently not required to be quantified under the GHG protocol, however, Scope 3 accounts for over 70% of the global emissions (Global Compact, 2022; Downie & Stubbs, 2012; Huang et al., 2009). The scopes define emission for a given entity and are not directly related to the pricing mechanism. However, they can aid in the process of identifying carbon intensive areas and help determine the extent of which emissions should be priced.

Globally, carbon reduction efforts have resulted in a variety of interesting inventions. Carbon capture within the scope of geoengineering is one example which is gaining traction but which today remains too expensive and complicated in comparison to renewable energy technologies (read more: Abdelkareem et al., 2021; FWW, 2020; D'Alessandro, 2010). Furthermore, Geoengineering in general can spark large unwanted effects on oceans, flora, and wildlife (IPCC, 2022) and should not be considered a solution to human-induced climate change (Climate Analytics, 2018). Examples of efforts that have gained recognition without interfering with ethics & morale are the EU Emission Trading System (ETS) and the Social Cost of Carbon (SCC). The EU ETS price carbon through a market mechanism targeting the most carbon intensive industries, while the SCC is an academic term defining the marginal socio-economic cost connected to one additional ton of CO2 in the atmosphere (European Commission, 2022,

[4] World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD)

A; RFF, 2019). The SCC is estimated using models such as DICE[5] and is a common tool for policymakers in the United States when evaluating governmental initiatives (Nordhaus, 2017).

The distinction between carbon pricing and internal carbon pricing is rather blurry. The World Bank defines carbon pricing as; *"...an instrument that captures the external costs of greenhouse gas (GHG) emissions and ties them to their sources through a price, usually in the form of a price on the carbon dioxide (CO2) emitted"* (World Bank, 2022, Section What is Carbon Pricing?). As a subgroup of carbon pricing, the World Bank further defines; *"**Internal carbon pricing** is a tool an organization uses internally to guide its decision-making process in relation to climate change impacts, risks and opportunities"* (World Bank, 2022, Section. Main types of carbon pricing). The definitions suggest that "carbon pricing" defines the price level and, if adopted by an organization, is called "internal carbon pricing". This is not inherently wrong, however, as ICP currently is a voluntary practice, companies can arbitrarily set prices as they see fit and therefore, the authors will assume another definition more broadly explained by Gorbach et al. (2022). They review the literature on ICP and argue that all carbon pricing methodologies can be used within a jurisdiction or economy and when implemented into an organization, is referred to as internal carbon pricing. This allows for an otherwise separated merger of the two definitions, where this thesis distinguishes carbon pricing between an organizational level or anywhere else, where anywhere else refers to carbon pricing on an international or governmental level, such as the EU ETS system and the SCC. This will give no further implications for the thesis as a sole focus is directed at internal carbon pricing and the definitions will thus not be subject of discussion.

The literature on ICP generally boils down to four different methodologies, namely, emission trading systems (ETS), carbon fee, proxy/shadow price, and implicit price (Gorbach et al., 2022; Ahluwalia, 2017; Harpankar, 2019). An ETS on an organizational level implies that different BUs trade with a limited amount of carbon emission rights, and by this practice, create an internal market price for carbon. A carbon fee like an ETS results in actual transactions being made, thus forcing the external cost of carbon to be internalized. The carbon fee is allocated to an internal cost center that invests the money in carbon reducing activities, usually aligned with overarching company goals. As will be discussed in Chapter 6, the price charged between business units is not central in transaction-oriented schemes, rather the prerequisites to make it work. In principle, the structure and information required to adopt such a mechanism

[5] Dynamic Integrated model of Climate and the Economy - an integrated assessment model

is extensive and therefore, if done rigorously, the implementation can be extremely demanding. A *Shadow price* as a non-transaction-oriented mechanism aims to assess the carbon sensitivity of investments by applying a predetermined fictitious price of carbon, allowing companies to measure the sensitivity of investments and to identify how it affects the decision making process (Gorbach et al., 2022). The prerequisites for a shadow price is less demanding as no transactions are made, however, information on CO2 intensity and emission allocation are still central. An implicit carbon price is derived by retroactively calculating the money spent on an emission reducing investment divided by the amount of carbon emission it reduces (Ahluwalia, 2017). The prerequisites for the implicit price, like the shadow price, is less demanding compared to transaction-oriented mechanisms. However, as it is calculated retroactively, it cannot be applied operationally. This characteristic puts the implicit price outside the scope of this thesis and will therefore not be discussed or problematized further. The previous three mechanisms (ETS, carbon fee, and shadow price) are further elaborated in Table 1.

During 2020, over 5900 companies submitted reports on carbon pricing, among which over 2000 are using or planning to implement an ICP within the next two years. Within the group of companies reporting on ICP to CDP, over 50% are applying a shadow price. Furthermore, the same group of companies report that the top three objectives for implementing an ICP are; drive low-carbon investments, drive energy efficiency, and change internal behavior, in that order. Table 1 further outlines the differences between the methodologies where the transaction-oriented mechanisms are shaded gray.

	Carbon Fee	ETS	Shadow Price
Definition	A predetermined price, usually in CO2/ton, attached to the operational emission of a business unit.	Trading of emission rights among BUs within an organization to reach an internal market price for carbon.	Predetermined fictitious internal price to evaluate potential investments.
Key Objective	Raise capital that is allocated to a cost center with the purpose to drive change through business activities that reduce emissions by spending the money.	Create a cost incentive to reduce carbon emission within BUs.	Steer investment decisions towards green initiatives.
Calculation	Arbitrarily set, however, commonly determined by observing current market prices, policies, and regulation.	Supply and demand regulated price. Set by a finite supply of emission rights. Can involve a floor or a roof.	Arbitrarily set, however, commonly determined by observing current market prices, policies, and regulation.
Observed Price Range (CDP 2021)	$18 - $532	$27 - $71	$28 - $459
Investment and Revenue Allocation	A central department collects the fee paid to fund projects and emission reducing activities.	Emission rights are traded amongst the BUs, allowing for trading profits to be made.	-
Key Benefits	Drives change, both culturally and in behavior. As an actual monetary transaction is required, the funds are directly allocated to impact the carbon footprint of the company.	Drives change, both culturally and in behavior. Internal business units can gain benefits by introducing emission reducing behavior and investments.	Drives change, both culturally and in behavior. Help prioritize investments in CO2 reducing projects and serve as a preparatory guidance for future carbon prices. Often viewed as a risk management tool.
Key Challenges	Expensive to implement as it requires structural and administrative instruments to function properly. Different BUs face different challenges and some cannot justify greener methods as it might interfere with company interests.	Expensive to implement as it requires structural and administrative instruments to function properly. The market price can be non-beneficial for some business units as the emission intensity might differ. Can lead to some units neglecting the system as a whole due to substantial losses.	As the price is fictitious, it might not have the guidatory mechanism it intends.

Table 1: *Comparison of different carbon pricing methodologies. Based on Table 1, Ahluwalia (2017, p.18).*

3. Literature Review

As described in Chapter 1, this thesis regards ICP as a carbon pricing methodology implemented into an organization. As stated, there are four major methodologies used within organizations; ETS, carbon fee, proxy/shadow price, and hybrid systems, where a shadow price currently is the dominating methodology in the corporate landscape (CDP 2021). Having introduced the concept and defined different methodologies, this Chapter focuses on why companies implement an ICP and how they do it together with examples of the implementation processes, rooted in the theory of organizational change.

3.1. Why organizations implement an ICP

Numerous reasons underlying an ICP implementation can be found in the literature. However, sustainable reporting in some jurisdictions (such as within the EU) has become mandatory in recent years. As such, an ICP can function as a tool for companies to further develop their climate strategy. Therefore, the first sections will treat reasons for environmental initiatives in general and boil down to the literature on ICP.

DiMaggio & Powell's (1983) framework on institutional theory demonstrates reasons behind organizational homogeneity and that these similarities originate from three distinguished pressures referred to as isomorphism. The mechanism of which institutional isomorphic change occurs are defined as; coercive, normative, and mimetic. DiMaggio & Powell (1983) also finds legitimacy, external acceptance within the social and organizational norm, as a consequence of isomorphism within institutions and that legitimacy in extension sets the boundary for change within organizations. Donaldson & Preston (1995) finds empirical evidence supporting this claim by showing a positive relationship between organizational isomorphism and organizational legitimacy in an OLS setting. Coercive pressure is exerted through governmental actions or laws, where firms gain governmental legitimacy by following those requirements. Normative pressure is exerted through social and cultural changes and expectations upon a company, where a company gains external legitimacy by adhering to those demands. Mimetic pressure comes through uncertainty when homogenous companies or competitors make changes.

Chen et al. (2018) investigates the extent of which institutional pressure fosters green innovation through a multivariate regression model on Chinese companies, where their main findings support the notion that coercive and normative pressures indeed facilitates green

innovation. Walker & Wan (2012) sheds light on the potential downside of green innovation in a Canadian setting. The authors distinguish between symbolic and substantive actions and find that symbolic actions could negatively impact financial performance if it is perceived as a means to make up for lack of substantive actions. Matejek & Goessling (2014) further argues that when a sustainable narrative has been perceived as substantive externally and later is revealed to be symbolic, the corporate legitimacy can be lost in an instant. A practical example can be found in the case of British Petroleum (BP) where the green "Beyond Petroleum" initiative failed to change the core business which in extension led to a lack of substantive actions. With recent introductions of sustainability reporting's in e.g., Europe through the Non-Financial Reporting Directive (NFRD) (European Commission 2022, B), investors are gaining increased insight into firms' non-financial conduit. Akhtaruzzaman et al. (2021) shed light on firms in an international context and find that those who do not disclose or disclose with low quality - which in their study infers ambiguous, hard to compare or incomplete reporting - could be punished.

Institutional theory can also be emphesized in a recent study by Deloitte (2021). Deloitte (2021) annually surveys global executives on how they respond to climate change and their greatest concerns. In their 2021 report, the top reason for organizations to motivate an increased sustainability focus was investor or shareholder demand, followed by societal and employee activism. Furthermore, the survey finds that investors together with the corporations are calling for more standardization on the measure of key issues, where 74% agree that public pressure from regulators has significant/moderate influence on the strategy adopted by the corporations. Gianfrate & Bento (2020) emphasize stringent and clear governmental policies in order to incentivize businesses carbon mitigation initiatives. Lister (2018) argues that without regulatory frameworks, authorities effectively allow the private sector to arbitrarily set their own rules, creating competitive advantages without contributing to absolute carbon reduction. Having established reasons why companies adopt sustainable initiatives in general, we now turn to ICP adoption.

Chang (2017) offered one of the first academic papers on ICP adoption. The author described how the incentive to reduce energy and carbon intensity for firms is primarily cost reduction, profit maximization and risk aversion. Furthermore, firms might use the ICP as means of risk management, used to evaluate potential investments to avoid stranded assets (see also, Wiess et. al., 2015; Bhan, 2016; Harpankar, 2019). Furthermore, Chang (2017) stated that the

resources allocated through the ICP has a multifunctioning effect, with the offsets both incentivizing low carbon transition and fund further carbon reducing investments. The carbon funding outcome can be seen in the case of Ben & Jerry's ICP scheme, where the offsets have funded different carbon emission reducing projects for their dairy farmers (Ben & Jerry's, 2014). The low carbon transition is exemplified by Microsoft, where their ICP reduces the energy consumption by $10 million per year (DiCaprio, 2015).

Ahluwalia (2017) discussed carbon pricing as an organizational risk mitigation mechanism. The author discussed various approaches, obstacles, and effects of different carbon pricing methods for companies. Similar to Chang (2017), the paper focused on the different effects that the main carbon pricing methods have on the organizational carbon reduction work. One of the core arguments for the implementation, that the examined companies disclosed, was risk hedging for future climate related costs (including policy related costs such as carbon taxes and environmentally related costs such as stranded assets) (Harpankar, 2019; Ahluwalia, 2017). Ahluwalia (2017) further stated that for companies adopting the shadow carbon price, it is important for the price not to be static, but rather to increase to fully mirror the developing social cost of carbon.

Ma & Kuo (2021) discussed the financial impact of ICP in multinational enterprises. The authors described how ICP is used as an innovative self-regulatory mechanism by companies to mitigate the risks associated with climate change and achieve sustainable development. By using panel data from 132 multinational enterprises from Europe, North America, and Asia, they examined the effect of an implementation of an ICP on the profitability of a given firm (measured by return on assets). Their study showed that implementation of an ICP statistically increased return on assets by 1.1%. Furthermore, ICP as a self-regulatory environmental mechanism can improve profitability primarily through cost reductions.

Emous et al. (2021) is closely related to the financial impact of ICP. They examined the relationship between carbon reduction on corporate financial performance to answer the question of whether "it pays to be green". The paper performed an OLS regression analysis on the reporting of 1785 firms, over 53 countries, where the results showed that a reduction in carbon emission had positive effects on short term performance indicators; return on assets, equity and sales, but did not influence stock market performance with regards to Tobin's Q and liquidity in terms of current ratio (ability to meet short term obligations).

3.2. How organizations implement an ICP

3.2.1. Implementation

The implementation complexity of an ICP is largely dependent on the pricing mechanism. Gorbach et al. (2022) conducted a meta-study summarizing a collection of literature on ICP. The study displayed different ICP methods and exemplified their outcome using a set of literary and practical examples, focusing on implementation techniques, barriers, and opportunities. The result of the study was an ICP identification process in the form of a flow-chart (see Figure 1)

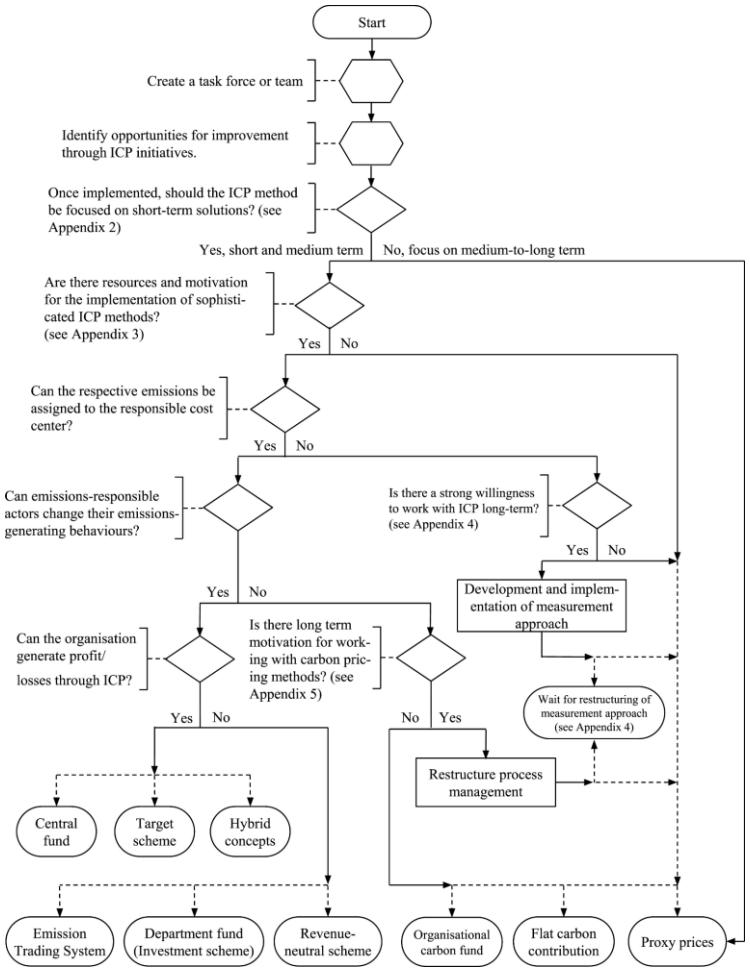

Figure 1. From "Review of internal carbon pricing and the development of a decision process for the identification of promising Internal Pricing Methods for an Organization", by O.G. Gorbach, C. Kost and C. Pickett, 2022, Renewable and Sustainable Energy Reviews, 154. Copyright © 2022 Elsevier B.V. or its licensors or contributors. Used with permission.

A company's desire to implement an ICP will take time, therefore, Gorbach et al. (2022) argues that ICP is not a question about resources, it is a decision. For sophisticated methodologies, a testing period of 1 - 3 years on processes with high levels of accountable emission (carbon

intensive areas and/or components) is ideal to build the initial competence needed to further implement the ICP. After the initial testing period, a company must decide whether to look for short-to-medium term mechanisms associated with structural implementations or medium-to-long term mechanisms with less prerequisites. Furthermore, the authors shed light on suitability of ICP between different BUs. For instance, a given BU can be in a situation where it to a limited degree can affect its operational emission. The ICP can in this situation have a limited effect without the threshold being addressed. They advocated that in such a situation where a total restructuring of the managerial process is not plausible, other mechanisms for carbon reduction are more reasonable.

One of the few practical case studies on ICP was conducted at Yale University between 2015 and 2016 (Carattini et al., 2017). The experiment included 20 buildings where each building randomly received one of four approaches: "*no carbon price; carbon pricing with 20% of the revenue earmarked for energy-efficiency actions; pricing with the revenue redistributed to buildings that reduced their emissions by at least 1% relative to their historic level of emissions; and pricing with revenue that was returned to buildings whose percentage reduction in emissions exceeded the average*" (Carattini et al., 2017, p. 29). The study found that because of increased awareness, competition, and increased cost of energy, buildings that were subject to a charged carbon price had used relatively less energy compared to those that were not. Furthermore, the experiment showed that efficiently communicating the purpose and establishing proper incentives was necessary for the ICP to change behavior.

British Petroleum (BP) implemented a scoreboard-like internal study in 1998 where the goal was to cut emissions by 10% by 2010. The implication of a "scoreboard-like" version is that no actual transactions are made, and the cap was not enforced. Victor & House (2006) examines the drivers of BP's success and find that above all, the trading system worked as a management device effectively assisting in targeting cost reducing activities in the ongoing operations. The core effect, that the emission trading system would create an internal market price was absent. Managers were able to issue new credit when needed and the price was therefore never above what anyone would be willing to pay, effectively counteracting the creation of an internal market price. BUs where prices soared never expected any enforced transaction as it would collide with the organization's greater goal. However, the goal of the scheme, to reduce BPs operational GHG emission by 10% was reached after 4 years in 2002. Victor & House (2006) argued that the study probably reveals little about the implementation of an ETS in a more demanding context, however, it still sheds light on potential challenges if such a system would

be put into place. A similar experiment was also conducted by Shell, in their Shell tradable emission permit system (STEPS) in 1998. Using the same systems and conditions as BP, the experiment showed a similar result. Due to its voluntary nature, participation in the program was low. Units that did participate often started off with relatively low emissions in their operations, resulting in a lack of active trading (Partnership for market readiness, 2015).

3.2.2. Barriers

Companies and organizations implementing an ICP are often subject to different organizational and technical barriers. The literature focusing on the issues faced by companies in, or prior to, their implementation process often explores the issue from a holistic perspective (Aldy & Gianfrate, 2019; Galán-Valdivieso et al., 2019).

Apart from the ICP experiments, studies on the subject have focused on the attitude and managerial aspects of the issue. Riedel et al. (2022) wrote about barriers to ICP implementations in German companies, where they combined a case study on company data on ICP disclosed to CDP with semi structured interviews with ICP experts. The aim of their study was to create a comprehensive understanding of the predominant issues facing companies in the decision to implement an ICP. Their study compiled several key barriers to the ICP implementation. The main obstacles disclosed by the companies and the interview experts were lack of technical knowledge of the practical implementation and theoretical knowledge of a sufficient price range. Smaller companies found themselves lacking both the technical knowledge and the financial opportunity to even consider implementing ICP. This issue was also found in larger companies, but rather than stemming from lack of financial opportunities it was rooted in lack of technical and theoretical knowledge on how to efficiently implement the ICP. Furthermore, larger companies found that their existing climate actions were sufficient and deemed ICP as unnecessary.

Internally, the effects of knowledge deficits were studied by Kubr (1996), who states that lack of know-how further can prevent an acceptance of change from the employees. The study sheds light on the importance of preparatory measures when implementing new concepts into an organization. Furthermore, while employees might be committed to a program initially, sustaining that program is equally important (Shapiro et al., 2015). In their study, maintaining change was more probable when the initial implementation was perceived to be relatively more justified, something that also affected latter implementation efforts positively.

Gorbach et al. (2022) argued that the choice of ICP method is a strong determinant of to what extent the companies find themselves being able to operate the implementation. Riedel et al. (2022) found in their combined case studies and interviews that technical knowledge, access to necessary data (such as the corporate carbon footprint) and efficient operational support, mainly for the administrative units, were key barriers that needed to be addressed to allow for a wider range of ICP implementation. Similarly, Kazimieras et al. (2022) in their macro study on CSR commitment in government and non-government organizations found that one of the key intrinsic barriers was the extent of which the company and its people were willing to participate in the sustainable transition, including but not limited to, willingness, attitudes, and time management. Modern organizations are an experience, not a systematic entity (McGrath, 2014). As such, companies need to motivate and incentivize their employees, mainly by providing clear overarching company goals complemented with well communicated visions to motivate people and justify change (Hayes, 2010).

3.3. The Analytical Model

The purpose of this Chapter is to state and clarify the central aspects, frameworks and barriers that a multinational enterprise might face during an ICP implementation. By mapping the literature, the thesis creates a foundation suitable for answering the stated research questions of the why companies implement an ICP and how they do it.

The ICP literature on why companies adopt an ICP stems from the institutional theory, rooted in why companies prusue sustainable initiatives. From a financial perspective, the literature shows that ICP has a positive effect both in terms of short-term performance indicators and as a risk mitigation tool. The ultimate purpose of absolute carbon reduction as a result of ICP is not as evident, however, companies working with ICP are perceived as ambitious and carbon initiatives are a top requirement for stakeholders. On the other hand, perceived sustainable action without substantive evidence could be destructive. Furthermore, as ICP requires companies to work and collect carbon footprint data it serves as a hedging mechanism to soften the transition in expectation of future regulations.

The implications from the literature focusing on how companies implement an ICP, through the studies of Gorbach et al. (2022) and Riedel et al. (2022), showed that the initial implementation process of a company should be clearly framed and be given sufficient prerequisites in terms of time and resources to create the technical and theoretical “know-how” of ICP. The implications of time and resources in this framework is the creation of elaborate

data management systems and proper emission accounting, where the need for extensive managerial investment and support constituted the foundation of a successful implementation. By applying a similar approach, this thesis evaluates both incentives and prerequisites for the implementation of an ICP on Volvo Cars by the means of a case study (combining both interviews and a market study) on the company. Figure 2 illustrates the analytical setup, where prerequisites is directly related to how companies implement an ICP, which indirectly is related to why they do it. Effects of an implementation is directly connected to why companies adopt an ICP. Both the prerquisites and effects, as well as the "How" and the "Why" of ICP are dependent on each other and are assumed to be interconnected. Finally, implementation of an ICP is face implementory barriers affecting the how, while simultaniously determining the prerequisites for a succesfull implementation.

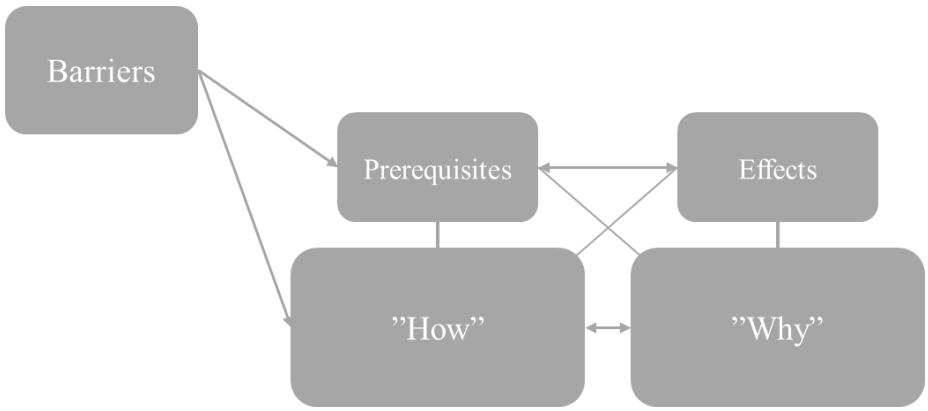

Figure 2, descriptive image of analytical model

4. Method

4.1. Research approach

Previous studies have often relied on official statements and other sources of publicly disclosed data (such as official reports through the CDP platform) when assessing the general effect of an ICP. Moreover, studies focusing on implementation often add interviews to the methodology. This thesis follows a similar approach, where interviews and other data are combined to evaluate the implementation of an ICP through the means of an exploratory case study. Exploratory studies can be applied in settings where large samples for generalization are absent, that is, an academic foundation and/or history is scarce or largely unavailable. Therefore, the purpose of exploratory research is not to statistically generalize an outcome, but rather to generate hypotheses for subsequent testing (through later large sample studies). Accordingly, case studies can be viewed as a method to develop a theoretically informed understanding of a given phenomenon. Since the case study displays an ongoing process; theory and empirical observations interplay during the course of the study (Ryan et al., 2002).

The initial contact with Volvo Cars was established in December 2021, where the outcome was a preliminary purpose and framework of the thesis. The following month was spent on preparations in terms of gaining a comprehensive understanding of carbon pricing by reading relevant literature, both at large and focused on ICP. Post course start (Jan 2022), a more elaborate understanding of ICP was achieved through several discussions with experts on carbon pricing, reading papers on transfer pricing - both including and excluding a carbon price - and meetings with key employees currently working with or connected to ICP at Volvo Cars. Thereafter, a framework for the continuous work of the thesis was set up together with representatives from Volvo Cars, where both parties agreed to include a theoretical foundation of ICP and how their commercial operations and procurement operations would respond to an implementation. To enable a deeper analysis of the company's implementation process, the factor of organizational adaptiveness was included in the form of interviews and recurring data collection. This kind of flexible research can be useful when exploring new topics or understanding the behavior of people involved in the process (Hennink et al., 2020). A few studies (Chang, 2017; Riedel et al., 2021) have evaluated the effectiveness of different carbon pricing models using a combination of quantitative and qualitative data to formulate the analysis.

The research plan's final version included a stylized study on two markets regarding the theoretical cost and profit effect of an implemented ICP at Volvo Cars, an interview study conducted with several key persons working directly or indirectly with ICP in the organization, and recurring collection of material (because of the authors' presence at Volvo Cars) through supervisory meetings, annual reports and company actions affecting the implementation process. Furthermore, a Volvo Cars internally developed framework, illustrating how Co2 can be integrated as a decision criterion in the sourcing process, was included to gain a deeper understanding of the procurement unit's response to the ICP.

This thesis will analyze market case outcomes together with interview study and a collection of supplementary material, including observations at meetings, information from annual reports and data from sustainability reports, to create an understanding of the financial and operational response to an ICP implementation. Aggregated, the sources of data creates the case study of Volvo Cars. The aggregated setup, including the analytical model derived in chapter3, is shown in Figure 3 below.

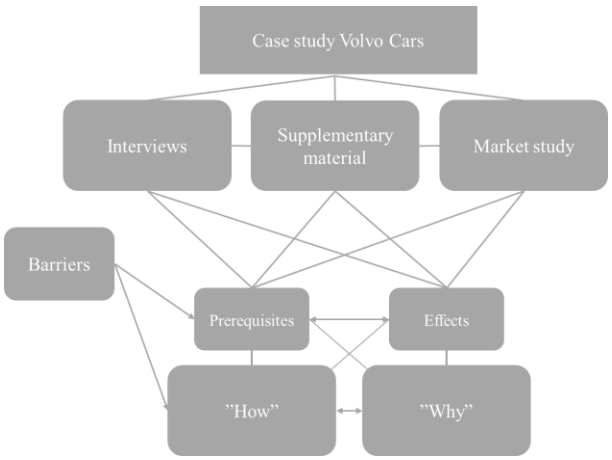

Figure 3, descriptive image of case study setup

4.2. Case setting

The case setting is designed to capture the purpose of the thesis; provide a deeper understanding of why organizations adopt an ICP and how they do it. Practical case studies in the field of ICP are scarce, mainly due to the sensitive nature of the factors related to its implementation (Carattini et al., 2017; Chang, 2017; Gorbach et al., 2022). Companies are in general not prepared to broadcast operational information beyond their public statements, thus creating a cavity in the accessible data. Previous case studies have either conducted controlled studies on public entities (e.g., study at Yale university) or have applied a retroactive approach, effectively reducing the sensitivity of the findings (e.g., case study of BP). Therefore, a desired case would

be a relatively large company, in the process of adopting (or which have recently adopted) an ICP, giving access to relevant information regarding the implementation, including affected employees.

The thesis collects its results from both the knowledge and insights gathered during the continuous interaction with Volvo Cars during the course of the project, as well as the findings from the applied studies. Together, the insights gathered from these sources creates the foundation for the understanding of the implementation process. The interviews were conducted to capture the subjective experience of different employees from different departments and levels within the company, that all were, to some extent, affected by the introduction of the ICP. The market study was conducted to illustrate the effect of a practical implementation of an ICP on the commercial operations of Volvo Cars by applying different price levels on the sales distribution in the respective case markets, Norway and Spain.

Acquirement of the data was influenced by altering access and limited disclosure. The information regarding actions and responses to the ICP implementation at Volvo Cars is, as stated previously, considered sensitive. The framing of the interview questions therefore had to take into consideration that the answers from the interviews were intended to be published, and too sensitive or revealing data could be excluded from the findings. Furthermore, the market study data consists of classified information regarding sales distribution and earnings. To be able to use the findings in the thesis, data from 2020 was used, and the scope of analysis limited to just including the aggregated effect of the ICP.

The setting takes a stamp in this initial implementation phase together with the current climate goals of Volvo Cars. As of 2022, Volvo Cars's sustainability initiative states that the company will become a climate-neutral, circular, and responsible business by 2040. Amongst these goals, climate neutrality is directly connected to the ICP and will therefore be the focus of this case study. Volvo Cars's most ambitious mid-decade climate goal is to reduce the carbon footprint in their sales distribution, per average vehicle, by 40% between 2018 and 2025. This is driven by sub-goals, specifying a reduction of tailpipe-, supply-chain-, and operation-emissions, where the largest contributor is the target to increase the sales of BEV to 50% by 2025. As one of the main parts of the case setting is related to the commercial markets, the 50% target holds a central contributory aspect when analyzing the effects of the ICP.

4.2.1. Case methodology

The methodology of the case study follows an exploratory approach as proposed by Ryan et al. (2002), similarly pursued by Chang (2017) and Riedel et al. (2021). Together with the stylized market study, the thesis applies a qualitative research method including interviews, observations of meetings, and assessment of action outcomes (see Table 2) (Ryan et al., 2002). The interviews were semi-structured (see Bell et al., 2019) organized as a discussion with a set of base questions (see Appendix 1) from which we developed additional questions and follow-up queries. As described by Bowen (2009), both observations at meetings and assessment of action outcomes refers to the collection of and/or assessment of observations and documents of a given subject unconnected to formal interviews or statistical data that is deemed beneficial to answer the research question. Examples of this can be strategies discussed during meetings or information disclosed in annual reports. The methods considered for the study are presented in table 2 below:

Type of evidence collection	**Interviews**	**Observations from meetings**	**Assessing the outcome of actions**
Explanation	Can be structured or semi-structured. Structured interviews follow an exact set of questions, letting all interviewees answer the same ones under the same circumstances. Semi-structured interviews lets the interview develop and the interviewers ask counter-questions to develop a good understanding of the subject	Includes participation in meetings and ongoing operations regarding the subject. Used to create an understanding of the subject out of an operational context.	Record and assess the outcome of a given action with regards to the subject. Used to create an understanding of the subject out of a response context.
Will it be used in the paper?	Yes, semi-structured interviews	Yes, partly	Yes, partly
		Summarized as: Collection of supplementary materials	

Table 2: Description of qualitative data collection

Interviews

Interviews were conducted with employees in operating positions connected to the commercial and procurement BUs as well as employees from different managing BUs. The respondents were chosen to capture the voice of employees and managers working with, or affected by, the

ICP implementation. The questions were designed to target both the current carbon reduction work of the BUs, their initial response to the ICP implementation, preferred target area of implementation, and anticipation of its effects. To be prepared for potential follow up questions and open discussions, a comprehensive review of literature and questions was undertaken before each interview. The questions follow a similar structure as the interviews conducted in the studies of Chang (2017) and Riedel et al. (2021), where focus is on understanding the effects of an ICP on the BUs in question, how and where in the business unitBU the price initially would be implemented, and what the expected effect would be.

The interviews were conducted both at Volvo Cars headquarter and were held using online meeting platforms. As the subject of discussion, the ongoing ICP implementation at the company, is of a rather sensitive nature, the interviews were not recorded. Instead, all answers and the ongoing discussion were noted and transcribed the same day as the interview took place. 10 different employees at Volvo Cars were interviewed, including representatives from Commercial Operations, Procurement Operations, Finance and Sustainability; with representatives working as Department heads, Product managers, Business developers and Controllers. Each interview lasted for circa 45 minutes and took place between the 4th of April to 3rd of May 2022. The questionnaire used for the interviews is found in appendix 1.

Respondent	Respondent title	Department
1	Department head	Business control and transformation
2	Department head	Finance and business control
3	Department head	Finance
4	Department head	Sustainability & Strategy
5	Department head	Strategy execution
6	Department head	Finance
7	Business Developer	Business and retailer development
8	Business Developer	Global Procurement sustainability
9	Product Developer	Product Development
10	Controller	X-cluster controlling

Table 3: Title and department of respondents

Market study

The stylized market study setting includes two of Volvo Cars commercial markets; Norway and Spain. The markets were selected due to their different characteristics with respect to electric mobility, Norway as a mature market and Spain as a lagging market. The markets were chosen in consultation with representatives from the management segment at Volvo Cars, with the purpose to produce results of high comparability and applicability. Since the two markets are on two sides of the spectrum with regards to electric mobility, they are to a higher extent able to resemble a company-wide ICP implementation. Norway, resembling the developed market example, holds the feature of a high degree of electric vehicles (as can be seen in Figure 4), however, the market is exposed to a large degree of governmental incentive programmes targeting BEV purchases. As this on the one hand aids in the transition towards the 50% BEV goal of Volvo Cars, it also constitutes a bias in the case study of the ICP (as the effect of the ICP cannot be distinguished from the effects of the governmental support). Spain, resembling the lagging market example, holds the feature of low electric mobility (also shown in Figure 4). Similarly, to the critique of the Norwegian market, the theoretical effects of the ICP on the Spanish market is subject to biases, as one cannot tell whether the sales of BEVs would be higher if the market was subject to the same governmental incentive program as in Norway. To further demonstrate the differences between the two commercial markets, the feature of electric mobility is illustrated by the number of new electric cars sold per country, displayed in Figure 4. The data is collected from the European Environmental Agency and shows the proportion of electric vehicles constituting newly registered vehicles (either BEVs, PHEVs). Norway and Spain are approximately 75% and 5%, respectively.

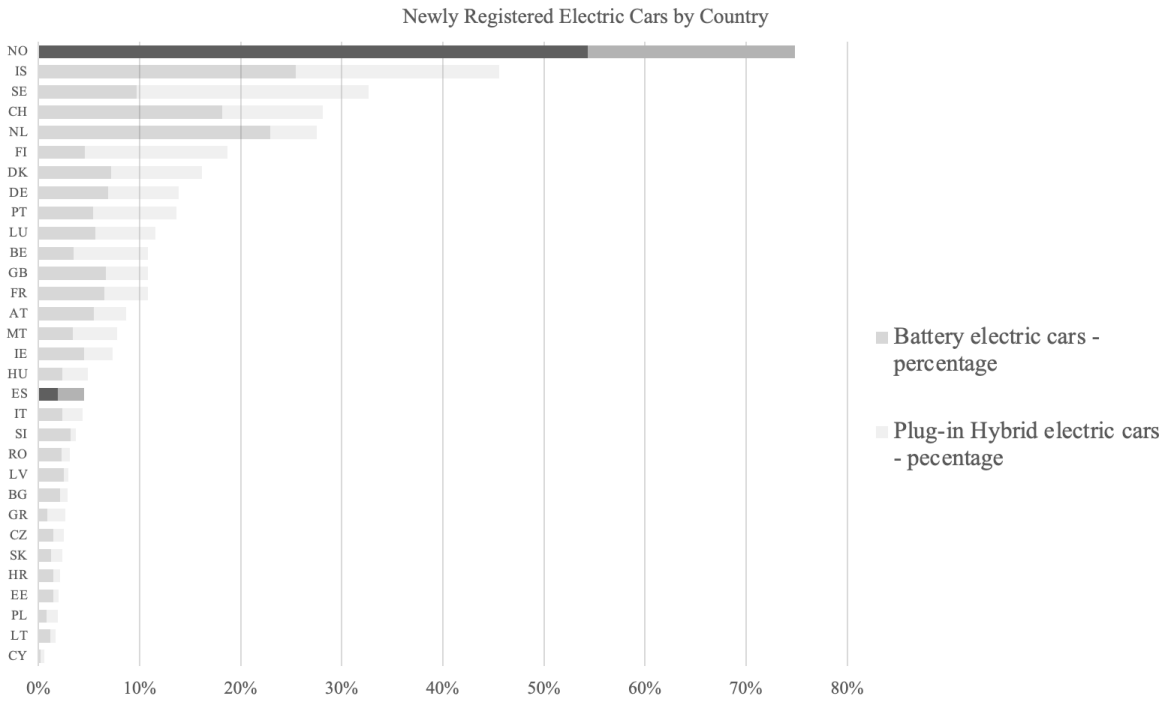

Figure 4, Registered BEVs & PHEVs in Europe 2021 by Country, https://www.eea.europa.eu/data-and-maps/figures/new-electric-vehicles-by-country

The selection of data to analyze the effect of the ICP implementation on the commercial markets was chosen due to the connection to the potential effects of the ICP. Variables 1, 2 and 3 in Table 4 summarizes the characteristics of one car model. Variables 4 and 5 include the emission intensity of the car model. Variable 6 represents the profit of a sale of the car model, and variables 7 and 8 combine the emission intensity, units sold and profit to capture the effect of the potential ICP implementation.

Variable number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Variable name	Carline	Engine type	Units sold	Co2/km	TTW/car	Cont.marg	Cont.marg with appl Co2 price	Tot.Mark.Earn with appl Co2 Price
Variable Characteristic	String	String	Numeric	Numeric	Numeric	Numeric	Numeric	Numeric
Derivation example	XC90	T8 Twin	2354*	41,5	13*	€9843*	€8534**	€50 000*

Table 4: Descriptive statistics of variables used in the practical study. (=Arbitrary example numbers, ** = €9834 - (13 * €100))*

Variables 1 - 6 are given values supplied by Volvo Cars. Variable 7, "*Contribution margin with applied Co2 price*", is derived in equation (1);

$$Cont.marg * TTW/Car = Cont.marg\ with\ appl\ Co2\ price \quad (1)$$

TTW (Tank To Wheel) is a sum of all GHG emitted by a car including production emission, emission during the driving lifecycle, and an estimate for emission of components (including production and supply chain). Variable 8, "*Total Market Earnings with applied Co2 price*", is derived in equation (2);

$$Cont.marg\ with\ appl\ Co2\ price * Units\ sold = Tot.Mark.Earn\ with\ applied\ Co2\ Price \quad (2)$$

The data for the market study was collected internally at Volvo Cars. Market operation data was provided by the two commercial market teams while the data on emission was provided by the sustainability team at Volvo Cars. Tabel 5 displays the distribution of data points for the two markets. The Spanish market includes 31 datapoints, with the 8 variables present in all. The Norwegian market includes 21 datapoints, with the 8 variables present in all. The different number of datapoints stems from the fact that a wider range of car models is sold on the Spanish market in comparison to the Norwegian market.

Market	Spain	Norway
No. of data points	31	21

Table 5: Number of observations per case-market

Collection of supplementary materials

During the thesis process, the authors attended different forums at Volvo Cars headquarters and remotely on the topic of ICP. These forums included, for instance; recurring meetings with representatives of the targeted BUs, employees within the sustainability and financial management department, and access to the intranet (e.g. internal analysis of emission reducing activities and potential ICP effects). Furthermore, information regarding carbon reducing actions in the form of current and planned operations were gathered from publicly available documents, including annual reports, carbon footprint reports, and press releases.

4.3. Research quality

When assessing the collected data, validity (to which extent the data reflects the "true world") and reliability (to which extent the data is independent of the person using it) needs to be considered. Following the recommendations of Ryan et al (2002) for exploratory case studies, this thesis considers procedural reliability and contextual validity as measures of research quality. Procedural reliability means that the research follows a structured design such that an independent user can follow the framework and understand the process. Contextual validity is a different version of the classic validity criteria, where contextual validity combines different methods of data collection, also known as triangulation. Triangulation is described by Ryan et al. (2002) as combining outcomes from different study methods to validate the hypothesis. We rely primarily on method triangulation and data triangulation. Method triangulation combines several methods collecting the qualitative data, while data triangulation refers to a combination of qualitative and quantitative data to validate the outcome. This paper mainly relies on qualitative data collection approaches for the method triangulation stated in table 2. The stylized market study conducted will together with the method triangulation create a data triangulation. The data triangulation is shown in Figure 5

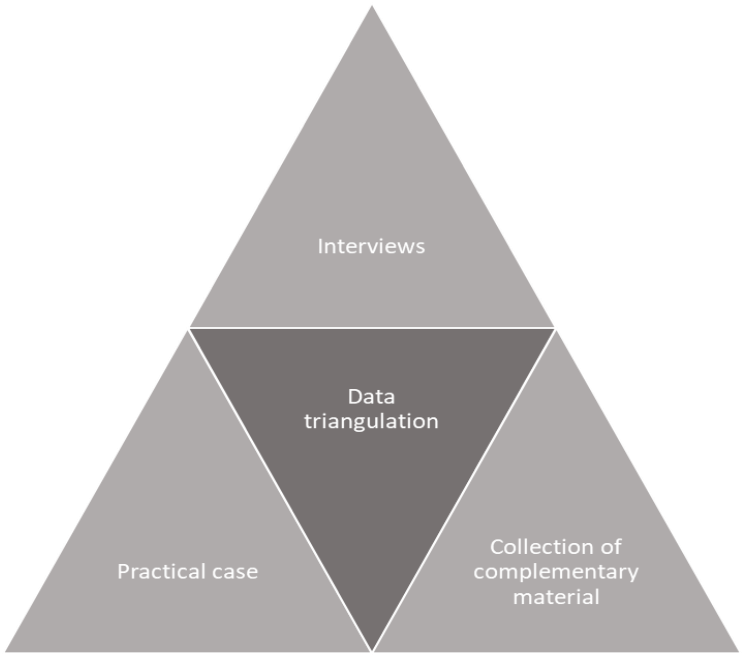

Figure 5*: Graphic example of triangulation*

4.4. Interview Data Analysis

Following Nowell et al. (2017) we rely on a thematic analysis to decode the interviews and organize the interview-data into analytically significant connections between theory and data. The approach suggests an initial preparation before each interview to guide towards appropriate questions. After each interview session, the interview answers are decoded separately by the researchers and after the completion of the first decoding, the data is categorized into different "themes", which allows for connection in a larger sense to be made to the research question of the study. To strengthen the validity of the material, the derived themes and connected representative interview answers (code) are decoded in a second round. This results in a more holistic perspective of the interview answer which in extension allows superfluous data to be removed and for previously neglected, yet important, aspects to be added. Finally, the resulting themes of the thematic outcome are included in the triangulation process. Table 6 exemplifies the decoding procedure, as explained above, in this thesis's setting.

Interview question	Respondent 1	Respondent 2
If a carbon price were to be implemented today at 100€/ton CO2, what effect would that have on your operations (short- and long term)	*It would drive the incentives as a sales organization to sell more electric vehicles. It would likely have large effects on cars with low contribution margin. When the contribution margin of those cars reach zero, they will likely be "replaced" by sales of BEVs. Maturity of the market gives a "free-rider" push to reach the current 50% target.*	*It would likely have a marginal effect. However, the sales of BEVs are already incentivised efficiently with the current "50% BEVs by 2025" target. The ICP would assist in this target, but not be the sole determinant. Furthermore, adaptiveness of the market regarding electric mobility is a prerequisite for the target to fully be reached.*
1st decoding: Author 1	ICP will drive transition to electric vehicles. Market maturity is a prerequisite	ICP might be superfluous, as current targets already are driving the change. Market maturity might constitute a threshold.
1st decoding: Author 2	ICP will probably drive the transition to electric vehicles. The current target together with an adaptive market might be enough.	ICP will add an additional marginal effect to the current target, further pushing the transition to electric vehicles. Market maturity might constitute a threshold, but not an obstacle.
Assigned theme:	Commercial unit	
2nd decoding	On mature markets, the transition towards electric vehicles is assisted by the high adaptiveness towards electric mobility. ICP might have a marginal effect, but the company target of 50% BEV by 2025 will likely be reached without it. On less mature markets, the ICP will likely have a more predominant effect on the transition, but the adaptiveness with regards to electric mobility might constitute a threshold.	
Final theme:	Commercial Unit	

Table 6, Example of decoding process

The thematic analysis of the interview outcome is summarized in 3 different themes of answers ("Management", "Commercial", & "Procurement") representing the two BUs targeted within the case as well as representation from the managerial perspective. The thematic outcome is further supported by a sample of quotes from the interview sessions.

5. Results

The interviews combined with the stylized market study are core findings to understand the implications of an ICP implementation on multinational enterprise. The empirical outcome of the case study is sorted into three themes. Each theme consists of a combination of the thematic analysis of the interview study with the findings from the stylized market study and the proprietary procurement data. The first theme is labeled "Management", summarizing the findings of the ICP implementation that is associated with a managing and controlling position. The following theme is labeled "Commercial" which disclose the findings with a distinct focus on ICP implementation from the perspective of the commercial operations unit. The third theme is labeled "Procurement", disclosing findings of the ICP implementation associated with supply chain and sourcing related perspectives.

5.1. Theme 1: Management Perspective

An analysis from a managerial perspective allows for a holistic view of both reasons for implementation and the reasons behind the outcome of the implementation process. From the starting point of "Why", most managerial answers were in line with the official standpoint; to steer investments decisions towards green initiatives and to future-proof the organization by staying ahead of the regulatory curve. The managerial consensus was that ICP essentially is a mechanism that makes people think twice and prioritize green alternatives when possible. Citation (1) and (2) shows a previously unofficial reason as to why Volvo Cars decided to implement an ICP.

"*A carbon reduction target is not tangible enough, ICP as a cost mechanism and the corresponding price is easier to grasp*"
(1) Department head, Management

"*People have requested a price on carbon emission to make it easier to work with, more tangible*"
(2) Department head, Management

Other interview answers suggest that why companies adopts an ICP could change over time. ICP has a great initial steering effect in that it helps the company identify carbon intensive processes. However, in the long run sustainability must be as important as safety (culturally integrated) to reach and sustain the long-term goals.

From the perspective of how companies conduct the implementation, ICP is to a high degree applied to investment decisions. Two examples are given in property investments and when evaluating future logistic structures. However, ICP is not the sole determinant as other important measurements, for instance, property certifications also have an impact in deciding upon an investment.

5.2. Theme 2: Commercial Perspective

As a major part of the case setting, the commercial operations capture the direct effect of an implemented ICP. All respondents answering "Why" the company decided to introduce an ICP started off with the significance of the 50% BEV goal. With the ongoing target to increase sales of electric cars to 50% by 2025, the commercial BUs are already changing their incentive structure towards low carbon intensity promotion. As commercial units generally have worked with revenue incentives, ICP would facilitate a line of thinking towards differences between carlines and their respective emissions, and thus increase the incentive towards the 50% BEV goal even further.

The answers on the "How" with employees from the commercial BU focused on both the receptiveness of an ICP as well as the prerequisites for the implementation. While respondents agreed that ICP can facilitate BEV sales even further, questions on "who bears that cost" arose, insinuating that the cost of the ICP needs to be executed either on the customer, the sales unit or centrally at Volvo Cars. To shed light on potential effects on an ICP implementation, a question on the effects of transaction oriented ICP was asked to the respondents on the commercial side. An answer on the speculative line of thinking - where ICP enforces a cost incentive - is shown in citation (3).

"If the ICP is to be fully implemented, it would likely increase our sales of BEVs. The cost incentive would be largest at our least profitable vehicles"

(3) Department head, Commercial

The prerequisites for the ICP to be operational on the commercial market builds on the internalization of the cost and the adaptivity of the market. Citation (4) emphasizes that different markets also have different prerequisites for increasing the sales of BEVs, usually because of the degree of governmental support.

"*Maturity of the market gives a "free-rider" push to reach the current 50% target"*

(4) Department head, Commercial

Markets with relatively mature electric mobility, because of a high degree of governmental support, are better situated to increase the relative number of BEVs sold. Markets with lower degree of electric mobility development, because of relatively low governmental support, will face barriers (infrastructure, cost etc.) that do not, to the same extent, justify buying BEVs.

This statement is supported by the outcome of the stylized market study, shown in Figure 6. The accumulated contribution margin of the two markets are affected when a €100 ICP is implemented across the sales distribution of 2020. The contribution margin on the Spanish market decreases by 55% while the contribution margin on the Norwegian market decreases by 26.74%.

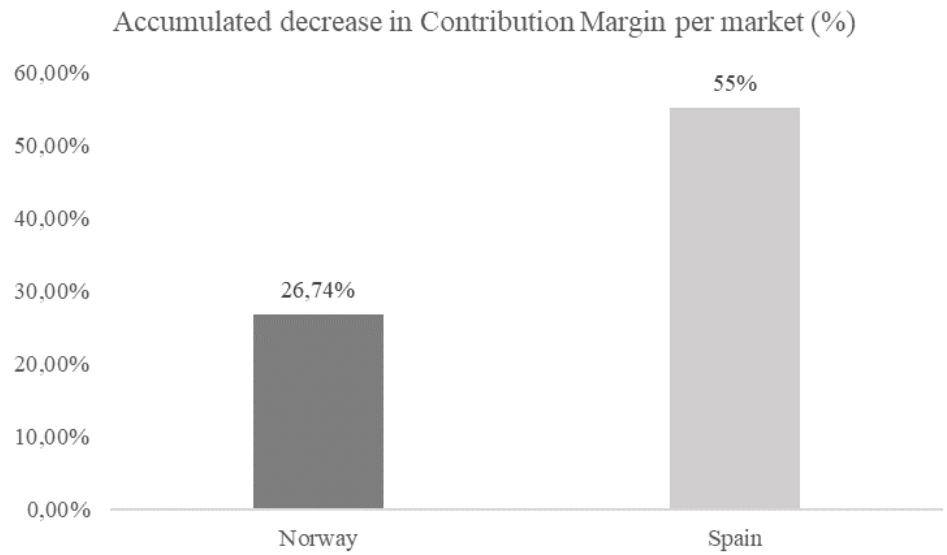

Figure 6: Effect of €100 ICP implementation on Contribution Margin.

5.3. Theme 3: Procurement Perspective

Most of the interview outcomes, constituting answers from among the managerial, commercial and procurement business units, suggested that the ICP would have the largest effect in sourcing decisions, as stated in citation (5).

"An implementation on direct material would render an effect reaching the entire value chain"

(5) Department head, Management

As the procurement unit deals with the purchasing of direct materials used in the production, they will have the ability to fundamentally decrease the operating emission of the company. The above constitutes the perspective of "Why" in a procurement setting.

From a perspective of "How", respondents emphasize the importance of practically being able to differentiate between Co2-corrected and regular cost of sourcing. If you apply an ICP on component level without the proper knowledge of its emission origin, it might be hard to define distinct Co2 drivers. The complexity of implementing carbon emissions as a decision criterion in sourcing decisions is illustrated in Figure 7, showing different steps (methodologies). The different bars, A, B, and C represent three different suppliers being considered with different costs (dark gray) and emissions (light gray). Step #1 has a target on costs and "considers" Co2/ton but use no tangible target for emissions, step #2 has a target on both costs and Co2/ton which implies steering on both, step #3 is the same as #2 with the addition of emission being priced based on an ICP, and step #4 integrates the two separate decision criteria in #3, merging the target into one metric using ICP.

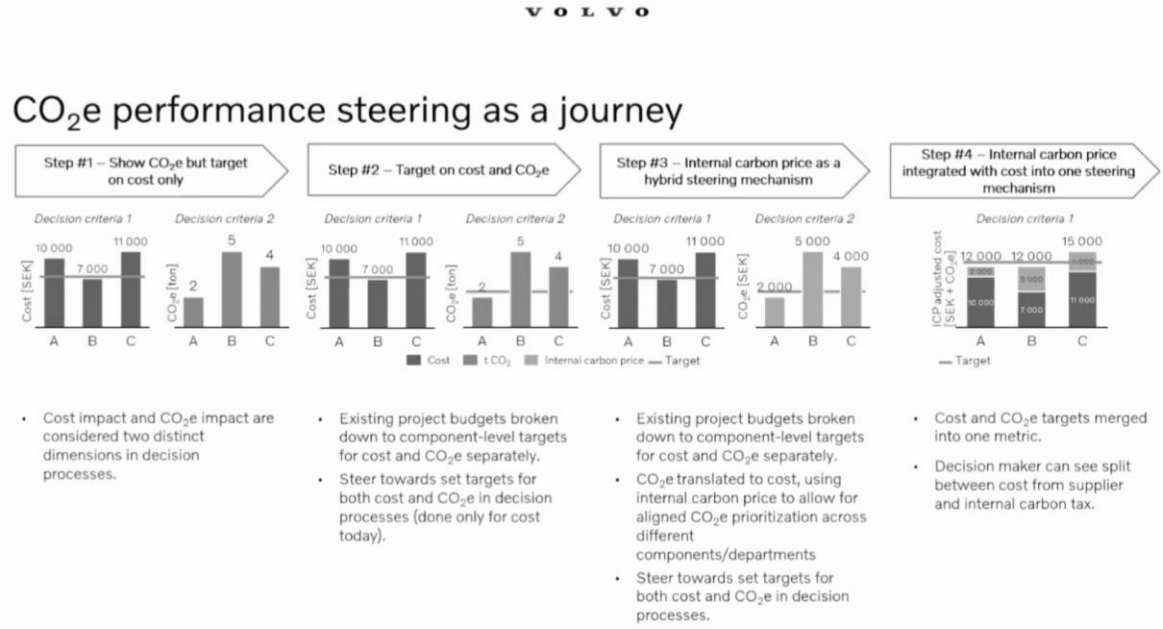

Figure 7: Different ways to apply carbon as a decision criterion in sourcing decisions (Volvo Cars, 2022 - proprietary data)

The consensus amongst the interview subjects on the procurement operations boiled down to three distinguished prerequisites; allocation of time, knowledge, and resources.

Knowledge

Findings from the interviews shows that by initially focusing the ICP on components with clear emission data and greater reduction potentials, the unit can build competence that allows for more elaborate use of the ICP, as stated by citation (6). As the unit deals with rather complex decision processes, lack of knowledge can result in inefficiency in the procurement process.

"Start with more rewarding targets, that is, the most carbon intensive components to create know-how"

(6) Department head, Procurement

Resources

The ICP increases the complexity of the sourcing process. The procurement unit operates with KPIs focusing on cost and quality efficiency, and the addition of a variable (the emission connected ICP) renders more layers to the equation. Clear expectations of the balance between emissions, cost, and quality are emphasized.

"The procurement unit has always worked with a cost reducing focus. Implementing the ICP require a fundamental shift in the operating framework"

(7) Business developer, Procurement

Time

Time spent on sourcing (with the additional emission variable) will exceed the benefit if resource and knowledge prerequisites are not fulfilled. In practice, the benefit of working with a new KPI without proper tools will come at the expense of either time or quality.

5.4. Other Unified Remarks

All sectors interviewed focused on the development of emission related data and information systems as a central prerequisite for the implementation of an ICP. To be able to efficiently reallocate the resources and efforts to reduce carbon dioxide emissions, good data on carbon intensity of the material, components and processes is a requirement.

"To be able to set and reach emission targets, a main prerequisite is data derived on scientific grounds"

(8) Controller, Management

This includes information on both the actual emission during the production process, but also how other aspects of the sourcing and distribution operations can be optimized to minimize the carbon footprint to the greatest extent.

Both operative units, commercial and procurement, agreed that the organization must be willing to pay to reduce company Co2. For instance, this includes the increased cost associated with choosing less carbon intensive manufacturers (not always more expensive) during sourcing decisions, or by promoting carbon efficient cars with lower contribution margin in the commercial process.

"Regardless, our long-term sustainability strategy will increase costs which is an important aspect to remember"

(9) Department head, Management

6. Discussion

Volvo Cars has decided to implement an ICP and the official reason for the adoption is to use the mechanism as a steering tool towards green initiatives in anticipation of future regulation. This is in line with previous studies on reasons underlying an ICP adoption. The current state of the implementation in Volvo Cars largely resembles the proposed structure of Gorbach et al. (2022), stating that an initial trial period with a task force - to build the initial infrastructure and identify areas where ICP will be effective - is a sufficient recipe for a successful ICP implementation.

From a perspective of institutional theory, companies within an established field (geography, industry etc.) become increasingly similar to one another as a result of adhering to norms, social pressure and regulations, which in extension creates legitimacy. The global need for companies to take responsibility for their emissions has resulted in an increase of sustainability integrated business strategies. This is emphasized in the case, where Volvo Cars work towards integrating sustainability into the company culture by setting a long-term goal to become climate neutral by 2040, where they in extension stand to gain legitimacy. Therefore, sustainability is no longer optional, but necessary for companies to survive in the sustainable evolution among corporate practices. As such, Volvo Cars does not gain a competitive advantage from a sustainability integrated business plan. However, being the first car manufacturer to implement a company-wide ICP could create a competitive advantage within the sector. The price level of €100 per ton of CO2, above the IMF (as of 2022) advocated $40-$80, further increases Volvo Cars legitimacy as it signals ambition in their sustainable targets. Furthermore, insecurity could also be a fundamental reason for the implementation as Volvo Cars anticipate future regulatory requirements; "*we aim to future-proof our organization and be ahead of the regulatory curve*" (Volvo Cars, 2022, p. 161). Moreover, the interview results do not suggest that Volvo Cars directly expect to gain financially from the adoption. However, the results emphasize the importance of the cost-reducing element of the mechanism and that it creates a new line of thinking, indicating that Volvo Cars are aware of the magnitude of the sustainable transition, which renders an indirect financial incentive for the implementation of an ICP.

Findings from the interview study shows that the commercial units are reaching their internal emission targets - 40% emission reduction between 2018 and 2025 - working with the already existing 50% BEV goal. However, the implementation of an ICP is not necessarily superfluous in this setting. Based on the result of the stylized market study (shown in Figure 6), showing

that the aggregated contribution margin of the two separate markets decreased, the ICP could have a transitory effect on a revenue-oriented market unit. The Norwegian market has the advantage of a higher degree of electric mobility in comparison to the Spanish market. Arguably, this could constitute a barrier to the transitory effect of an ICP upon a lagging market. However, the mechanism still has the characteristics of a cost incentive. Therefore, without regards to the external macro-mechanisms, the ICP could still change the line of thinking, preparing for the electric future of the automotive industry.

However, there is reason to believe that the motive for an ICP might change over time as the initial steering effect in some BUs will be diminished in the long run. On the commercial side, when Volvo Cars's sales distribution consists of 100% BEVs, the effect of ICP will practically be gone in this BU (unless there are future inherent differences among electric vehicles with regards life cycle analysis (LCA) and emissions). Generalizing this result, if an ICP has exhausted its purpose within an organization - effectively going from substantive to symbolic - the company should consider discontinuing the practice or run the risk of losing legitimacy (as a result of greenwashing). A similar line of thinking cannot as easily be applied to the procurement operations and investments. As there is no immediate future where components and infrastructure can be built in an absolute zero emission way, the steering effect of the ICP will not be exhausted in the near term. Moreover, organizations will always have indirect emissions as a result of their existence - Scope 3 emissions - and ICP will therefore always be applicable in an organizational setting. Processes with a high degree of emission can be addressed using targeted actions (excluding ICP), but when the marginal utility of the CO2 reduction diminishes, ICP can become an effective tool to target the remaining carbon emission in the journey to absolute zero.

The procurement unit is also affected by the overarching 50% BEV target but not to the same extent as the commercial unit. The complexity of the procurement operations makes such a static target less tangible and therefore, harder to integrate into the ongoing work. With proper frameworks, especially related to the cost and time management, the procurement unit would constitute a good initial implementation ground for the acquisition of knowledge and experience of ICP at Volvo Cars. This setting solves one of the main findings of Riedel et al. (2022) who stated the need for technical and theoretical knowledge as one of the main barriers for large companies to implement an ICP. As can be seen in Figure 7, ICP can effectively be used as a decision criterion in step #3 and #4 which affects the sourcing operations. However,

as results from the interview study reveals, it is important to have a data framework that distinguishes between Co2-corrected and non-co2-corrected prices on components.

The practical experience of BP and the theoretical findings in the Yale case study showed that for an implementation to be successful, decision-makers need to be prepared to allocate resources to create the fundamental operating frameworks. Similarly, findings from the interviews showed that access to data on carbon footprints and emission intensity is essential to effectively use the ICP in investment related and operational work. This is stated as a necessity for the operationality of the ICP, but can also be the solution to its own purpose. The pricing mechanism is intended to shift the operating framework of the BU, incentivising the targeting of low emission solutions. If a BU is forced to add the cost of carbon emission to its daily work, it is also forced to create the infrastructure surrounding it. On a company level, this can result in emission accounting becoming a more predominant standard in all operating and managerial activities, suggesting that the price on the ICP (e.g. Volvo Cars €100) does not matter unless the foundation of the mechanism is in place. Therefore, the ICP is not as important as the behavior that it drives. Moreover, it is imperative that management is committed, that the employees have an understanding of the process, and that there is a clear vision justifying the implementation. In the case of Volvo Cars, the interviews showed that a price, in comparison to other more abstract CO2 reducing programmes, are requested within the organization, mainly due to its graspable features.

The importance of the quality of the implementation cannot be understated. A company's initial intention to implement an ICP might be an honest attempt to be green. However, if the mechanism is not properly implemented, the effect of the ICP is next-to-none and the company could become subject to greenwashing accusations. Therefore, an organization-wide ICP will most likely not be subject to greenwashing accusations if the mechanism can be proven to have a substantive effect. Companies must consider this when evaluating the reason behind an implementation, as some mechanisms (primarily transaction-oriented) more "easily" can be proven to have a substantive effect due to their cost enforcing element. Volvo Cars's initial implementation has the characteristic of being non transaction oriented and as such, it will be harder for the company to validate the effect of the mechanism (relative to a transaction oriented ICP).

The validity of a transaction oriented mechanism stems from its monetary features. However, this thesis argues that the price of ICP does not hold the same importance as the structure of the mechanism itself, potentially contradicting the previous statement. A shadow price can in this setting yield the same emission reducing effect as the transaction oriented ICP as long as it is being enforced properly. With a clear vision and proper structure, the implementation of a non transactional mechanism can therefore be as efficient as a transaction oriented, and thus yield the same validity. Furthermore, with no regulations controlling for the structure of the pricing mechanism, absolute carbon reduction is hard to quantify. As capital is not earmarked, the amount of funds allocated through a transaction oriented mechanism might replace investments already intended for that purpose, effectively creating a discounting effect previously seen in the example of the Yale study.

7. Conclusion

This thesis is based on an in depth analysis of ongoing ICP implementation within a multinational enterprise, Volvo Cars. In anticipation of more stringent regulation, Volvo Cars' aim of the implementation is to future-proof the organization by staying ahead of the regulatory curve. An ICP serves both as a risk mitigation tool and provides a cost incentive for companies to reduce their emission. Ten semi-structured interviews together with the collection of complementary material explored the response of the continuing implementation of the ICP in the BUs of the company, with the stylized market study evaluating the potential applied effects of the mechanism on the commercial operations of Volvo Cars. With the assumption that the ICP will operate as an incentive guidance towards low emission transition, the thesis examines the motivations and prerequisites for a full implementation of the mechanism on a BU level.

The exploratory setting has revealed several interesting results in the field of ICP. In the case study on Volvo Cars four distinguised results emerged.

- **Stakeholder pressure & Risk mitigation constitute the most important financial incentives for the adoption of an ICP**

  ICP's ability to identify carbon intensive areas mitigates the risk for stranded assets, in extension providing a "cost-saving" incentive to work with the mechanism. Stakeholders are becoming increasingly aware of the risks associated with the sustainable transition and therefore value such efforts.

- **The ICP infrastructure is bilateral**

  To efficiently run the ICP mechanism, access to rigorous and structured data is vital, regardless of the mechanism adopted. However, when applying the cost incentive that the mechanism creates, the infrastructure is "forced" to be created. This implies that the ICP both needs and creates the prerequisites for its own operationality.

- **ICP's suitability among business units differ and evaluation of the purpose is imperative**

  Applying the ICP in a supply-chain setting allows for the effect to reach the entire organization and in extension commercial operations. This allows a company to integrate carbon emissions into the final product, effectively internalizing the cost by addressing the root of the problem, speaking for the suitability of implementing the mechanism on the procurement operations. Applying the ICP on the commercial unit, being the final distributing entity, would be a case of "treating the problem but not the

cause". It could potentially have a transitory effect in decreasing the sales of ICE vehicles in favor of BEVs, but the effect diminished as the sales distribution of BEV approaches 100%. As such, companies must continuously evaluate the effect of the ICP to maintain external legitimacy.

- **Managerial Support in implementation and adaptation**
  Sourcing decisions have traditionally been cost-oriented. The addition of an emission KPI through the means of an ICP adds another layer to an already complex process. It is therefore essential to integrate effects of an ICP in the evaluation of managerial performance.

The findings of this thesis targets supply chain emission as an important area for the ICP mechanism. The academic foundation of ICP would gain from more elaborate research of the effect of an ICP implementation in this area, especially with regards to scope 3 emission. For multinational enterprises looking to implement an ICP, it is important to consider the effects on different markets. Our study reveals that a market that is relatively mature with regards to electric mobility is more susceptible to an ICP implementation. Due to Volvo Cars ongoing implementation, our research is limited in the field of how the operationality differs and therefore, more research would provide a deeper understanding of the disparity. Another suggestion is to investigate the effect of an ICP on absolute carbon reduction, preferably in a "before and after" setting, such as applying the difference-in-difference estimator to enable assessment of the impact of an ICP. Finally, a comparison between ICP and alternative tools in the venture towards decarbonization would shed light on the performance of available tools in the corporate field.

7.1. Limitations

The research question "What are the effects of implementing an ICP on a MNE" is limited to the finding of Volvo Cars and might not generalize to other situations. Selection of interview respondents was based on their connections to the operative units analyzed (commercial and procurement) and their relevance to the research topic. However, the selection was limited with regards to access and availability. Furthermore, as all respondents are employees within the organization, their responses could be subject to bias as a result of loyalty or responsibility, as in line with Ryan et al. (2002). To an extent, the bias is mitigated by anonymizing the interviews. The supplementary material collected apart from the interview and practical study might also be subject to bias. Materials published to the public are often not shared for research

purposes and might thus lack certain information needed for academic studies. The thesis has been subject to a Non-Disclosure Agreement. This might constitute a restriction in the sense that information that is important for the analysis of the subject is not allowed in the public version of the study. However, the NDA allows the thesis to explore aspects of the implementation close-up, enabling more in-depth insights to be drawn compared to an external approach.

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Appendix

Appendix 1. Interview Questions

Introducing question: Why did Volvo Cars decide to implement an ICP in the first place?
Following question 1: Is your business unit currently working with any carbon reduction activity? (Including or excluding carbon pricing). If yes, please explain. *Anticipated answer:* *-A disclosure of the ongoing carbon reducing activities in the business unit and providing an explanation of the initiated and planned carbon operations.*
Following question 2: Volvo Cars announced its 100€ at the COP 26 summit in 2021. Has that price had any effect on your current operations? *Anticipated answer:* *-Yes/No. An explanation to which extent (if any) the set price at 100€ is affecting their operations today. (projects, data management etc.)*
Following question 3: If a carbon price were to be implemented today at 100€/ton CO2 (transaction oriented), what effect would that have on your operations (short- and long term) *Anticipated answer:* *-A nuanced explanation to how the price would affect the short- and long term operations. (A speculative answer is anticipated here, including pros and cons)*
Following question 4: How would a potential implementation take place and which operating areas would you focus on in your business unit? *Anticipated answer:* *-This question might have been dealt with earlier in the interview. Otherwise an initial disclosure of <u>where</u> and <u>why</u> the price is implemented. (A speculative answer is anticipated here, including pros and cons)*
Finalizing question: The targeted effect of a carbon price is reduced CO2 emission. Do you think that the anticipated effect will be reached, both on Volvo Cars at large and at your business unit? *Anticipated answer:* *-(A speculative answer is anticipated here, including pros and cons)*