THE MANY FORMS OF CO_2 (e)

HOW CARBON ENTERS THE

CAPITAL BUDGETING PROCESS

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The Many Forms of $CO_2(e)$: How Carbon Enters the Capital Budgeting Process

Abstract

This thesis explores how carbon is incorporated into the capital budgeting process of a global manufacturing company, Alpha. Drawing on a qualitative case study and mobilizing the analytical concepts of commensuration and 'styles of reasoning', in line with Samiolo (2012), the study aims to trace how carbon, already standardized and commensurated in regulatory and market-driven initiatives, is integrated into the capital budgeting process. The study finds that carbon is accounted for at several sites of calculation across the organization, each characterized by a distinct style of reasoning, leading to varied operationalizations of CO_2e. These findings add to the capital budgeting literature of intraorganizational practices and provide further insights on carbon management accounting. Further, by translating Samiolo's concepts to an intraorganizational setting, this study distinguishes an additional style of reasoning capturing the delegation of calculative practices 'elsewhere'. Finally, the observation of how many forms of CO_2e exist suggests that the commensuration of carbon at the field-level does not preclude 'recommensuration' at the organizational level. From a practitioner's perspective, the existence of various forms of carbon present in the capital budgeting process suggests that an articulated ambition of a green transition does not in itself result in practices that are coordinated and internally coherent or supportive of transformational investments.

Keywords:
Capital budgeting, Carbon accounting, Commensuration, Styles of reasoning, Transformational investments

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1. Introduction

Companies are facing a critical challenge to develop an effective strategy that meets the financial expectations of today while allocating enough resources to build an asset portfolio that adheres to the regulatory measures to address climate change (see e.g., Bui & Fowler., 2019; Burritt et al., 2011; Engels, 2009). This task involves navigating a range of complex strategic trade-offs, especially for capital-intensive sectors that need to invest in structural transformation projects. These companies must, for example, decide whether to adopt the readily available technology or await innovation looming on the horizon and assess whether the potential returns on these investments will pay off (Berger-Schmitz et al., 2023; Bui & Fowler, 2019; Hahn et al, 2010). In addition, an asset portfolio of significant size cannot be replaced overnight; it is a gradual, long-term endeavor. Meanwhile, market-driven initiatives, like carbon markets and the Science Based Targets Initiative, are gaining momentum, actively supporting and incentivizing organizations to adopt sustainable investment practices (Berger-Schmitz et al., 2023). This shift underscores the need for companies to align their financial strategies with sustainability objectives, a contemporary business challenge that requires immediate attention.

Management accounting tools and practices are integral to the identification and evaluation of these strategic tradeoffs in capital budgeting (Bennouna et al., 2010; Bui & Fowler, 2019; Emmanuel et al., 2010; Narayanan et al., 2021; Rankin et al., 2011). While capital budgeting has been described in various ways, as described by Miller & O'Leary (2007), I draw on their definition of how capital budgeting entails both the techniques for valuing capital investment[1] opportunities and the processes for managing and coordinating them. The existing literature has, to a high degree, focused on practical techniques employed (Miller & O'Leary., 2005; Kida et al., 2001; Sureka et al., 2022) however, researchers such as Hopwood (1983, 2009) (see also Bui & Fowler, 2019; Kida et al., 2001; King, 1974,1975) have highlighted the importance of understanding these processes in the context in which they are practiced. Moreover, with the increasing focus on accounting for the environment, demands for understanding new flows of accounting, such as those of capital budgeting decisions[2], are anticipated to grow (Hopwood, 2009). Studies on carbon management accounting, referring to the reporting of an organization's emissions in financial and non-financial terms, and the emergence of carbon markets have become increasingly prominent in past literature (Bebbington & Larrinaga-Gonzalez, 2008; Cook, 2009; Vesty et al., 2015). Engels (2009, p.487) expressed how "emissions trading requires companies operating under the new scheme [EU ETS] to develop new

[1] Capital investments refer to the acquisition of assets needed for the long-term growth of the company with a useful life over a year (Bennouna et al., 2010)

[2] In academic literature, the term "capital investment process" is occasionally used interchangeably with "capital budgeting processes." For consistency, I will refer to the latter term while reserving "capital investment" to denote significant capital expenditure (CAPEX) projects.

knowledge and competencies", yet the intersection of these two streams of literature is little explored in the literature to date (e.g., Berger-Schmitz et al., 2023; Bui & Fowler, 2019; Burritt et al., 2011; Vesty et al., 2015). Hence, by acknowledging this contemporary business challenge and the identified literature gap, I aim to answer the question:

> How is carbon pricing incorporated in the context of intra-organizational capital budgeting processes?

To address this question, a case study focused on the capital budgeting process of a public multinational manufacturing organization, 'Alpha', was conducted. This study has tracked the units and individuals involved in the company's capital budgeting process, from the initial project idea to a materialized asset. In the talk of carbon prices, this has referred to the EU ETS[3]. Twenty semi-structured interviews with 16 interviewees representing the different units involved in the capital budgeting process have been conducted. Hence, this has allowed for a holistic view of the various thoughts and reasonings underpinning these decisions.

Alpha's capital budgeting process is structured in a five-step tollgate process with two intermediate decision meetings, where the global teams would meet, discuss, and approve potential projects. Carbon emerged as a pivotal concern for the company, as it was within the scope of the EU Emissions Trading System (EU ETS) and committed to achieving Net Zero[4] emissions. This linked the notion of carbon to emissions costs, reductions, and its role as a financial instrument. Ultimately, it was a factor in the project evaluation calculations for all participants, albeit in different ways. The ongoing challenge was, therefore, finding a formula for investment that would not jeopardize shareholder returns while ensuring the fulfillment of their sustainability commitments. In other words, it became a balancing act of adhering to current financial expectations and fulfilling future image.

Within this context, to understand how carbon was factored into capital budgeting decisions, I draw on Samiolo's (2012) analysis of different forms of calculation in a complex capital budgeting process. She performed a field-level study of the development of a controversial public scheme for the protection of the Venetian lagoon. She used the concept of commensuration to explain the process by which they distinguish how different perceptions of costs emerged among the involved actors while trying to construct a cost-benefit calculation. Moreover, as a part of her analysis, she extends the theory of 'style of scientific reasoning' to characterize the different rationales underlying the perceptions. With Samiolo's (2012) work in mind, I conceptualize the process of commensuration and styles of reasoning as my theoretical lens. This has allowed me to identify how carbon was integrated into the calculations by various actors throughout the

[3] Emission Trading Schemes are not only limited to the EU, but similar markets also exist in for example, the United Kingdom, New Zeeland and Australia
[4] Net zero refers to the reduction of emissions by 100%

capital budgeting process, each employing unique calculative practices, thereby leading to different interpretations of the same metric that translate into the following three theoretical contributions.

First, this study delves deeply into the intra-organizational intricacies of capital budgeting, revealing how the notion of carbon permeates the capital budgeting process in numerous instances. With reference to the concept of commensuration (Espeland & Stevens, 1998; 2008; Samiolo, 2012) and how carbon is commensurated on field-level (MacKenzie, 2009), I have distinguished several instances in which the practices and interpretations of carbon differ within the organization. With this theoretical lens, I have, in the capital budgeting process, been able to identify various calculative practices and approaches related to carbon, to thereafter characterize the existence of various 'sites of calculations'. To understand the underlying reasoning for why and how these different 'sites of calculative' arise, I have drawn from Samiolo's concepts of 'styles of reasoning'.

This study makes three key contributions to existing literature. First, the recognition of several 'sites of calculation' and various calculative practices provides new insights into capital budgeting literature as it suggests that there is not one way that a company approaches capital investments; rather, it depends on the location of calculation. It also enriches the field of carbon accounting, as it analyses the effect of carbon markets in the context of internal capital investments, which has, to date, been uncommon. Second, Samiolo's framework does not transplant unproblematically into an intraorganizational setting. I extend on her conceptual framework, by introducing the reasoning of 'view from elsewhere'. This type of reasoning emerges in specific situations, where 'sites of calculations' avoid a part of their calculation by delegating it somewhere else in the organization and thus avoid being held accountable for this figure. Third, the study elaborates on existing literature on carbon management accounting, as it identifies how the commensurated object of carbon prices, undergoes 'recommensuration' within the organization at various 'sites of calculation', according to their specific rationale. Consequently, this results in the emergence of many forms of the same metric, CO_2e.

The remainder of this thesis is outlined as follows: Chapter 2 situates this study in relation to previous studies of capital budgeting and carbon accounting and proposes a conceptual framework to address an identified gap in the intersection of these literatures. Chapter 3 outlines the study design and its methodological implications. Chapter 4 presents the empirical findings which are subsequently analyzed using the conceptualization of commensuration and styles of reasoning inspired by Samiolo (2012) in Chapter 5. Chapter 6 provides a concluding discussion of the findings from a theoretical and practical perspective. Furthermore, the section discusses the academic and empirical implications of the results and suggests some possible avenues for future research.

2. Literature Review

2.1. Capital Budgeting: From Technique to Process

Capital budgeting is essential to business operations (Bennouna et al., 2010; Emmanuel et al., 2010; Warren & Jack., 2018) as it serves as a planning instrument that supports organizations in investments by fostering measurability and comparability among project alternatives and guiding capital budgeting decisions. However, capital budgeting decisions that fail to identify the risks and opportunities can adversely reduce firms' financial stability (Sureka et al., 2022). Because of the financial significance of these decisions, the use of appropriate capital budgeting techniques is critical in managing strategic change and long-term corporate performance (Bennouna et al., 2010; Emmanuel et al., 2010; Huikku et al., 2018; Verbeeten, 2006). Given that the typical useful life of property, plant, and equipment (PPE) assets ranges between 10-25 years, Unruh (2000) used the term 'lock-in' to describe this in the context of industrial economies, that have large interdependent systems built on specialized, durable, untradable assets that thus created organizational rigidity. Chua, Fiedler, and Boedker (2024, p.2) studied the effect of the long-term nature of investment practices and concluded that budgeting and forecasting are "well-established accounting techniques for narrating futures in financial terms".

In early studies on capital budgeting, researchers focused on the techniques that companies can apply when evaluating and planning for future investments (Miller & O'Leary., 2005; Kida et al., 2001; Sureka et al., 2022). The method that companies use in their evaluation of a prospective project can vary significantly in terms of sophistication (Warren & Jack, 2018; Harris & El-Massri, 2011). Emmanuel et al., (2010) found that technical complexity could be linked to investment size as these expenditures are often largely irreversible. The simplest types of calculations disregard the quantification of risk and the time value of money, yet become increasingly complex as project risk, discount rates, and future cashflows are accounted for, as is the case in Net Present Value (NPV) and internal rate of return (IRR) calculations. However, scholars and practitioners have not reached a census on a universal best approach (Alkaraan & Northcott., 2006). For example, Chittenden & Derregia (2015) and Hyvönen et al. (2024) found that companies apply several or a combination as best fit for the individual company.

One of the challenges to developing such a way is the practitioner's preference in the trade-off regarding technique sophistication and practical usefulness. Verbeeten (2006) argued that companies attempt to use more sophisticated methods, whereas Chittenden & Derregia (2015) found that the techniques used in practice are typically relatively simple. Bennouna et al. (2010) found in their study of eighty-eight Canadian firms that almost 80% still used a payback period alongside a discount model. Moreover, Chua et al. (2024) and Chittenden & Derregia (2015) observed that manufacturing companies, at odds with

theory, responded to high uncertainty by reducing the payback time or raising the rate of return and applying more conservative cash flow estimates. These findings align with Verbeeten (2006), who also concluded that the degree of sophistication in risk assessment tools for capital investment differs across industries. He expressed that the practices used in manufacturing organizations are more frequently 'naïve' when estimating uncertainty (see also Alkaraan & Northcott., 2006).

Uncertainty in capital budgeting can stem from several factors, such as long-term pricing, market stability, and unpredictable public policies (Warren & Jack, 2018). Kumarasiri and Gunasekarage (2017) found that high uncertainty was the most common reason organizations postponed decision-making and were reluctant to adopt a long-term perspective. According to Bui & Villiers's (2017) study, one particular source of uncertainty related to carbon and emission allowances as these required companies to anticipate future price changes and carbon allowance needs in a very politically unstable market. Put differently, they argued that ETS has added a tangible layer of complexity for in-scope organizations. However, a study by Vesty et al. (2017) suggested that uncertainty and complexity do not per se create organizational inertia. They found that when their case company, an Australian water facility plant, had introduced carbon emissions in their NPV calculations, the high complexity it had brought opened rather than narrowed the leadership viewpoint. Furthermore, they observed that the management could discuss and reflect upon potential projects more extensively once this refined calculative practice was integrated.

Capital budgeting not only refers to the process by which a project is evaluated; it also involves project prioritization. More specifically, once a company has evaluated a project, it is not uncommon that a limited corporate budget makes projects mutually exclusive (Baldenius et al., 2007), forcing the company to choose between projects. For example, if a company has several different business units that share the same investment budget, which unit receives more or less money for CAPEX must be coordinated. Similar to valuation practices, the way to prioritize has not been found to be a universal method in theory (Sureka et al., 2022).

The practical cluster of capital budgeting research elaborates on the critical role of accounting in capital budgeting decisions. However, an exclusive focus on technique omits the importance of context. Hopwood (1983, p.248) emphasized that "accounting both influences and is constrained by the meanings given to the organizational setting in which it operates", thus stressing the need to consider capital investment as a situated practice. Similarly, King (1974) argued that most literature had almost accepted a purely scientific approach, failing to support practitioners; thereby, he underscored the necessity for a sociological view. Other scholars argued similarly (e.g., Miller & O'Leary, 2007; Martin, 2021; Warren & Jack, 2018) and complemented the literature with their focus on the complex social process(es) from which capital budgeting decisions emerge.

Empirical findings nuance the assumption that economic rationality prevails in organizations' decision-making. Jørgensen & Messner (2010) described how their case organization went 'beyond the numbers' simply because the managers had already agreed to pursue the project as it aligned with the business strategy. The project calculations did not determine whether to proceed; instead, they elucidated future cash flows. Warren and Jack (2018) conducted an eleven-year study on the reactions and developments among British energy companies as the British government pushed regulations toward more sustainable practices. They found that the regulatory uncertainty initiated a process of reflection among companies concerning where they envisioned themselves strategically. Warren & Jack (2018) expressed that capital budgeting attained more than calculative importance; it filled the role of what they called a 'vehicle for communication'. The idea of capital budgeting as a mechanism with a role beyond its capacity as a valuation technique was discussed by Miller and O'Leary (2007) in their study of the American microprocessor market. They used the concept of 'mediating instruments' to examine how a technological roadmap would guide and coordinate numerous highly uncertain and confidential investments of firms in the industry.

This understanding that broader strategic concerns, beyond the firm's boundaries, can frame the intra-organizational capital budgeting process is interesting to consider in light of the concerns with environmental, social, and governance (ESG) issues that have become core concerns over the past decades. As Hopwood (2009) stressed the time for more attention on the intersection of accounting and environmental matters. He noted that "as changes occur in our concepts and focus of accountability for the environment, the demands for different flows of information, accounting and otherwise, are also likely to grow" (p.433), suggesting that the intersection of these two would increase in the coming years. Furthermore, he argued that traditional accounting methods often overlook environmental aspects, creating incomplete organizational performance assessments. In his review of existing literature, he noted a rising trend of questioning the superiority of traditional approaches in his literature review, "in the process raising questions about the adequacy of prevailing understandings about costs and their association with very particular assumptions about the nature of organizations and their boundaries" (p.434). Hopwood's early interest in how accounting and sustainability intersect has since been elaborated on in the emerging carbon accounting literature.

2.2. Carbon Accounting: Converting Emissions to Investment Implications

Carbon is one form of accounting for nature that has become particularly important for many organizations' strategic sustainability work. This development had partly been induced by regulatory developments that require companies to manage and report on sustainability matters and to find ways to incorporate these into the financial statements. Notably, the introduction of the Kyoto Protocol and various artificial emission trading markets (He et al, 2021), to name a few, mark some of these changes that have driven

companies to internalize climate change. The European Union Emission Trading System (EU ETS) is one such example that has had a direct financial impact on organizations. This scheme has been described as a significant policy innovation (Voß, 2007) that forces approximately 11,000 installations in Europe to be accountable for their emissions by connecting each ton of carbon equivalent emissions (CO_2e) to an EU ETS allowance (European Commission, 2016), consequently creating a new line item in the financial statements (Cook, 2009; MacKenzie, 2009).

Carbon accounting emerged from introduction of carbon markets (Bebbington & Larrinaga-Gonzalez, 2008; Vesty et al., 2015) and entails the accounting system that accounts for and reports carbon-related financial statement items to inform the decision-making processes of internal managers and external stakeholders. The increase in regulatory requirements has spurred an increase of studies that target the question of how companies should record carbon allowances in the financial statements. One of the challenges that Bebbington and Larrinaga-Gonazalez (2008) identified was the multiple concurrent meanings that carbon allowances can have. It filled the role of a permit, functioned as a mandatory emission cap, and could be a financial asset that could be traded on the financial market. Moreover, despite the increased number of regulatory requirements and guidelines on sustainability reporting, companies still had a certain discretion in terms of what (not) to include in greenhouse gas emission scopes and the disclosure of its future sustainability actions (see also Bui & Fowler, 2019; Burritt et al., 2011; Gibassier & Schaltegger, 2015).

MacKenzie (2009) investigated the field-level work and effort required to "make things the same in carbon markets". In his study, he speaks of how different greenhouse gases, are and how emissions, once quantified, can be either a direct cost or an opportunity cost depending on if the company was in deficit or excess of free allowances. He concluded that the lack of guidance allows for variations in intra-organizational carbon treatments (see also Ascui & Lovell 2011; Burritt et al., 2011; Bui et al., 2019).

Research on intra-organizational behavior in regard to carbon accounting remains relatively unexplored despite the rapid growth in the field of carbon accounting (Hyvonen et al., 2024; Mikes & Metzner, 2023), especially in terms of its connection to capital budgeting (Bui & Fowler, 2019; Bui & Fowler, 2022; Bui & Villiers, 2017; Hyvonen et al., 2024; Warren & Jack, 2018). The papers that have targeted this intersection of practices are typically either focused on optimal calculation techniques (e.g., Lundgren et al., 2015) or energy companies (e.g., Bui & Fowler, 2019; Bui & Fowler, 2022; Bui & Villiers, 2017; Warren & Jack, 2018) or of a comparative nature (e.g., Burritt et al., 2011; Hyvönen et al., 2024).

Bui and Fowler (2019) explored the intersection of carbon and capital budgeting processes in a longitudinal study observing two New Zealand electricity generators' strategic response and carbon accounting practices between 2002 and 2012 while regulatory discussions of implementing ETS were ongoing. The authors found that

despite public commitment, energy efficiency initiatives “served as ceremonial practices to signal responsiveness to climate change issues while keeping their internal operations intact” (p.364). The risk of pursuing investment decisions based on faulty ETS costs was found to deter the two companies from any strategic change, partly due to the political uncertainty of whether or not a carbon tax would be realized. Once public and regulatory pressure grew, the companies displayed different strategic pathways. One of the companies chose to retire carbon-intense assets early due to social pressure and to avoid future carbon costs, marking “a point where social legitimacy and protecting a future bottom financial line outweighed the traditional competitive advantage" (Bui & Fowler, 2019, p.368). In contrast, the other company did not recognize the long-term benefits and invested in efficiency improvements in its current assets. Like Lundgren et al. (2015., p.402) observed that “carbon prices have been too low to create incentives for technological development” among manufacturing firms in Sweden, Bui and Fowler (2019, p.369) concluded that “it is going to take a pretty significant chunky price of carbon for it to be a significant decision driver”. Carbon prices had been incorporated into the investment decisions, yet concrete reduction action was “avoided”. Not long after the ETS was enforced, the companies began to, as the authors call it, 'avoid' emission matters. For example, the number of resources allocated to addressing carbon issues was reduced, and the companies did not require concrete numbers for projects' carbon-reducing impact. They identify that the lack of regulatory demand to report on reduction efforts enabled the companies to comply with regulations yet avoid the matter at a strategic level. Rather than including carbon costs in investments, carbon was perceived as a tradeable financial instrument. They concluded, among other things, that only considering carbon costs was insufficient to drive carbon reduction. However, they proposed that the combination of both financial and non-financial carbon information in capital budgeting could lead to substantial carbon reduction. Finally, they argued that regulations must be structured so that sustainable technologies would be the only option for firms to remain profitable and legitimate.

Berger-Schmitz et al. (2023) further explored the motives of why companies across different sectors would pursue sustainability commitments. They found that high-emission industries had formulated a target because the consequences of not having it were “immediately painful” (p.5592). They observed that the perceived challenges of carbon ‘lock-in’ and high technology investment barriers justified a green transition resistance. However, the understanding of how environmental matters are accounted for in capital budgeting process at an intra-organizational level is relatively limited (Bui et al., 2024; Vesty et al, 2015). MacKenzie (2009) concluded, like Burritt et al. (2011) and Bui et al. (2019), that in the lack of guidance, variations in the intra-organizational treatment of carbon may arise.

Capital investment and carbon figures have also been studied with one stream of literature exploring the power of quantifying carbon figures. Vesty et al. (2015) studied the process

related to the introduction of carbon figures in the NPV calculation of a state-owned water utility. They observed that the emergency of carbon emission figures could generate credibility and mobilize concrete changes, i.e., acting as mediating instruments in capital budgeting decisions.

Existing literature has unequivocally suggested the importance of capital budgeting decisions and how these processes should be studied in the setting they are practiced. Furthermore, Hopwood (2009) noted how the increasing aspects of accounting for naturehave an impact on the organizational practices. Meanwhile, the impact of carbon markets on companies has been acknowledged and gained ground in literature. Nevertheless, few studies have specifically focused on capital budgeting, and those have primarily examined it at a field level. In essence, the intersection of these two areas of literature presents a distinct gap that is important to further explore.

2.3. Theoretical Framework

To conceptualize how carbon takes shape in Alpha's capital budgeting process, I draw on Samiolo's (2012) analysis of different forms of calculation in a complex capital budgeting process. Specifically, following Samiolo's (2012) procedural steps, I analyze the observations of Alpha's capital budgeting processes, using the concept of commensuration (Espeland & Steven, 1998; 2008) and her adaptation of "style of scientific reasoning" (Hacking, 1983, 2002).

Samiolo's study focused on the creation of a cost-benefit calculation conducted for the environmental appraisal of a large, controversial public scheme for flood protection in Venice. The cost-benefit analysis was conducted as a part of an environmental impact assessment, intended to act as a tool to help "make visible potential trade-offs among projects, to set priorities, and to make interventions comparable" (Samiolo, 2012., p.387). The process engaged various actors, such as professional experts, international institutions, and the local government, to ensure impartiality, independence, and competence in the decision. This, in turn, required a common understanding of how to quantify risks and traits associated with the project in order to transform various qualities and figures into one standard metric. One such instance would be estimating, for example, the cost of citizens unable to commute to work because of flood damage or the cost of 'low waters'. As the project continued, different perceptions of how to calculate emerged, which Samiolo analyzed along three core analytical themes: the existence of various calculating actors, commensuration through calculation, and 'styles of reasoning' to analyze what gave rise to different forms of calculation among different actors. She concluded that the different ways of conceptualizing Venice and its lagoon led to

differences in calculative practices[5] and, thus, a multiplicity of cost-benefit numbers that were never reconciled. In sum, Samiolo foregrounded the contested process surrounding how to calculate an accurate cost-benefit analysis.

As part of her analysis, Samiolo borrowed the theory of commensuration from Espeland and Stevens (1998). This theory encompasses the translation of "qualities into quantities, difference into magnitude. It is a way to reduce and simplify disparate information into numbers that can easily be compared" (Espeland & Stevens, 1998, p.316). They explained how it is a complex process requiring work to organize and discipline various information, resulting in numerous aggregations of objects that are often fundamentally different. Moreover, it is a dynamic process in which the commensurate object can expand, contract, and evolve in terms of its encompassed elements, often occurring imperceptibly (Espeland & Stevens, 1998). In a later study, Espeland and Steven (2009) foregrounded how forms of quantification lead to commensuration. They wrote how "common forms of commensuration include the prices that assess the value of goods and services, votes that indicate political preferences, scores that evaluate the quality of wine or water, and standardized tests that assess ability or capacity" (Espeland & Steven, 2009, p.408) and requires considerable social and intellectual investment. Because commensuration often remains unseen, the extensive work it requires is often forgotten, something "especially true when numbers circulate to places that are removed from the bureaucracies that manufactured them" (Espeland & Steven, 2009, p.411).

Within carbon accounting literature, the notion of commensuration has been a powerful tool for researchers. MacKenzie (2009) used this term to problematize how different gases are made commensurate into one common metric and how emission allowances needed to be made equivalent and tradeable across different industries and geographies. His findings suggested how carbon allowances can have numerous impacts on the behaviors of organizations, such as not only incentivizing reductions based on cost but also the potential revenue from allowance sales. Lohmann (2009), used the term to conceptualize the work done to overcome:

> huge figurative distances between traders' conceptual, largely electronic universe of 'abstract', simplified, fungible carbon credit numbers and the universe of the 'concrete', diverse, particular, highly complex, often obscure local projects that produced them, together with the tangled chains of physical and social relationships that connected them to the ongoing history of the atmosphere (Lohmann, 2009., p. 506)

Similarly, Kolk et al (2008, p.11) referenced the concept of commensuration to capture how carbon reporting regulations attempted to "render complex organizational operations involving multiple gases and impacts in terms of a common carbon metric, tCO_2e" to

[5] Calculation styles and practices, according to this conceptual frame, is not limited to the performance of mathematical and numerical operations, it also encompasses how figures are engaged with (see also Espeland & Stevens., 1998; 2008; Vollmer, 2007)

create comparability between firms and sectors. They also argued how effective commensuration presented a significant challenge for companies to be justly compared. Chua et al (2024, p.16) also recognized the immense work and complexities underlying the calculations of carbon figures circulating on the market, yet also acknowledging how "the calculation of a carbon unit, being commensurate with a ton of CO_2e, set down allowable measurement methods and established a regulator to police compliance". Overall, this body of literature suggests that the concept of carbon results from intricate commensuration, thus encompasses a diverse range of metrics, and that carbon is commensurable at field-level.

However, Samiolo identified that this process involved complexities to 'make things the same', and varying perspectives on standardizing the costs for the Venetian lagoon's cost-benefit analysis was a prominent challenge. She used Hacking's (2002) 'style of scientific reasoning' to analyze these disputes. The "style of scientific reasoning" described by Hacking (1983; 2002) refers to the way people refer to a specific way of making discoveries or finding out about the world. Hacking (1983; 2002) also expressed how styles are developed by those who use them; thus, they only endure if practiced. Samiolo (2012., p.382) used Hacking's insights to describe how numbers were "debated, stabilized or disrupted, as differing appeals to realism and accuracy are advanced in the context of different modes of interventions and practical aims" across different groups of actors. With the argument that Hacking's proposed styles were difficult to apply in practice, she formulated three types of styles: 'view from nowhere', a calculative practice that is universal and impersonal; 'view from somewhere', based on local knowledge and experience; and 'view from everywhere', which could be considered a midway of the two others. These were then used to distinguish what she terms 'political centers' that had different calculative practices:

> Rather than achieving standardization and being presented as impersonal, calculations confirmed political divisions. (Samiolo, 2012 p. 397)

Samiolo's framework does not transplant unproblematically to this thesis's study on carbon in the capital budgeting process. In contrast to Samiolo's public controversy and the attempt to commensurate the idea of 'Venice and its lagoon', this study investigates what happens to an object, carbon, that has already been commensurate on the field level (see, e.g., MacKenzie, 2009), when it enters an organization. Moreover, unlike Samiolo (2012), who investigated a public matter at field-level, I study intra-organizational practices. However, parallels can also be made. I study the situation in which different business units (government bodies) in local 'spaces' apply the notion of carbon (flood damages) in the calculation and movement of carbon numbers (cost-benefit calculations), creating their own constructs. Drawing on Espeland and Stevens' (1998) assertion of commensuration as a continuous process, I reason that this remains true as the market's 'notion of carbon' enters the 'calculative spaces' of the capital budgeting process.

3. Methodology

3.1. Research Design

3.1.1. The Research Approach: Designed to Explore

This study commenced because of an interest in exploring how industrial companies translate environmental sustainability commitment into practice. A qualitative approach was chosen, with the background of Vaivio's (2008., p.69) reasoning of how management accounting is not a "homogenous set of calculative practices, but is highly contingent and situationally specific", thus being a dynamic, organizationally embedded social phenomenon. A qualitative single-case study was therefore chosen for this study, as described Scapens (1990), is a suitable way to obtain an in-depth understanding of accounting practices and identify prevalent techniques, procedures and systems. Ahrens & Chapman (2006., p.823) noted that qualitative studies "seek to explore aspects of social order that are not objectively real but are instead subjectively created through the interactions of actors" and are often associated with a quest for meaning". A single-case study was specifically chosen because of its suitability when trying to illuminate why a decision or a set of decisions were taken, how were they implemented, and with what result (Schramm et al., 1971, p.6; see also Vaivio, 2008, p.74). Hence, with the study's purpose in mind, a qualitative single case study was deemed appropriate.

Initial contact with the case company, henceforth referred to as Alpha, was established prior to the start of the study, in which the subject of this thesis was undecided. However, following a pre-study discussion, the intricate challenge of reconciling short-term financial performance with long-term Net Zero planning was mentioned. Alpha had an ambitious sustainability commitment to fulfill (see section 5.1.2). Yet as a listed company, it also needed to meet the financial return expectations of shareholders. More specifically, Alpha experienced a complex strategic challenge to balance the financial business plan with the long-term sustainability commitments that extended more than 25 years ahead. In addition, because Alpha was an industrial manufacturing company based in the European Union, they were in the scope of EU ETS. This market was created with the ambition to incentivize investment decisions aligned with a green transition and climate neutrality (European Commission, 2016) by enforcing carbon costs on emissions. In other words, the EU ETS represented a cost of not pursuing transformational investments (see e.g., Bui & Fowler, 2019; Bui & Villiers, 2017). With the reasoning that the capital budgeting process is a process that ties the present with the future (see, e.g., Chua et al., 2024), the decision to investigate capital budgeting processes and the integration of EU ETS appeared appropriate.

However, during the pre-study interviews, it was expressed that the capital budgeting decisions and the impact of EU ETS could be explained in a brief "10-minute discussion".

The case company was therefore concerned that not enough empirical data would exist for this type of study and could initially only think of two potential interview candidates. These factors foreshadow the necessitated explorative nature of this study and aligns with Scapens' (1990, p.273) description of case study research being a "complex interactive process which a simple linear model cannot characterize". Moreover, because it was impossible to assert what empirics would be collected, it was not possible to more than speculate on the empirical direction and what type of theories could be relevant as a theoretical lens. This early abductive nature of the study was not only beneficial but necessary under these circumstances. As the empirical material started to build, patterns appeared, and the methodology became increasingly iterative. The study required much time to map and identify the details of the process, which resulted in high complexity. Therefore, a theoretical lens, able to provide analytical insights while not encroaching on the empirical complexity, was needed. These ongoing iterative align with Ahrens and Chapman (2006., p.836) description of how the "problem, theory, and data influence each other throughout the research process. The process is one of iteratively seeking to generate a plausible fit between problem, theory, and data".

With respect to the company and the sensitive nature of the material disclosed, information that could reveal its identity has been generalized and rounded. This includes aspects such as the number of business units and the exact number of employees.

3.1.2. The Case Study

For over 25 years, Alpha has engaged in sustainability endeavors and continuously advocated that it was a part of Alpha's core business, as represented in its public Net Zero commitment. Meanwhile, Alpha is an industrial manufacturer thus it has an extensive portfolio of long-lived assets causing relatively high production emissions. Hence, significant CAPEX expenditure and transformation investments are required to attain a Net Zero-compliant PPE portfolio. Even though Alpha has identified long-term benefits of this strategy, the short-term financial performance could be weakened. With the extensive exploration of previous research and consulting with my thesis supervisor, Alpha was again approached to approve the proposal to continue the study. Investigating the impact of carbon allowances in capital budgeting processes was received with high interest yet with the reservation of not being extensive enough in empirical data.

Alpha is a rich case to study regarding operational, strategic, and financial market perspectives. First, being an industrial manufacturer, emissions are particularly hard to avoid compared to service companies. With sales in over 100 countries and over 50 production facilities worldwide that need to be maintained, developed, and grown, Alpha has had annual capital investment for the last five years, equivalent to approximately 5% of annual revenue. This also meant that Alpha have well-established procedures for doing this that could be traced in this study. Second, Alpha has been vocal about its sustainability work for several years and has also been awarded for its progress. Hence,

given that external rating firms and analysts rate Alpha as an industry forerunner in sustainability and their sheer production size, its work is relevant when understanding the movements of its industry. Third, being a public company, it has pressure from shareholders to achieve appealing financial results. Therefore, in contrast to private companies, major expenditures must be planned and communicated so that it would not damage the share price negatively. Nonetheless, certain shareholders' expectations on a 'green transition' must be answered and considered. In other words, Alpha's investments cannot be considered profligate, nor can they avoid pursuing major restructuring investments required to achieve Net Zero emissions.

Alpha's organizational structure has many characteristics of a matrix organization (Figure 1), in which site managers operate with high own responsibility. Site managers are supported by various support functions such as finance, technology, reporting and procurement. These supporting departments have direct contact with the sites which can be either of a top-down nature or supportive.

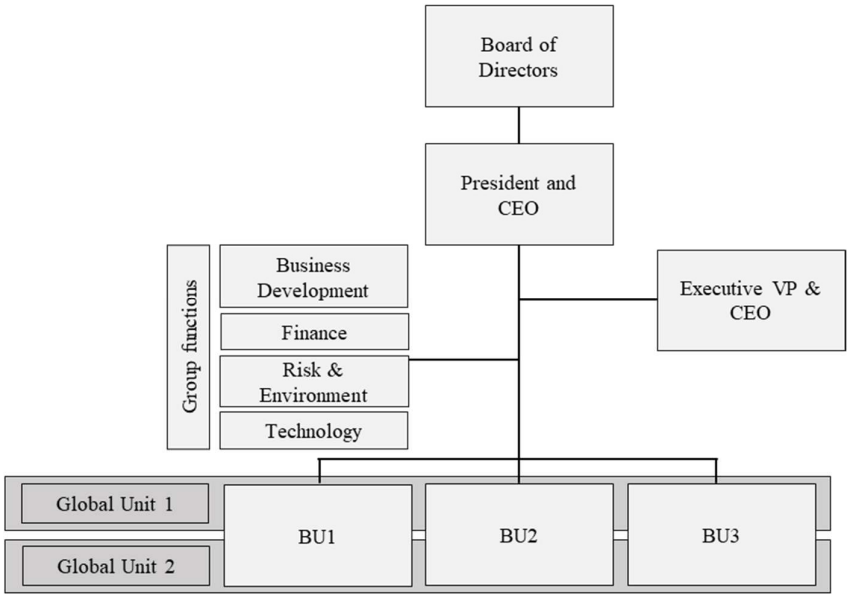


Figure 1. Illustrative representation of Alpha's organizational structure

3.2. Data Collection

3.2.1. Semi-Structured Interviews

The data collection of this study can be categorized into two distinct phases. The first was primarily concerned with understanding the capital budgeting process and mapping the individuals and units involved in the decision process and their respective roles. This was critical for understanding the process and served as the backbone for identifying which

units and individuals to approach for future interviews. Alpha expressed a worry about a possible scarcity of relevant interview participants at the study's inception, which foreshadows the explorative nature of this study. The second phase elaborated on the information of the first phase by targeting the then-identified capital investment relevant units.

The interviews were of a semi-structured nature, which was deemed appropriate given the occasional uncertainty of exactly how each unit related to the capital budgeting process and/or carbon. The semi-structured approach allows for modification and ordering of questions that can evoke the fullest responses of the interviewees (Dumay & Qu, 2011). Besides, this approach is especially apt given the study's sociological reference and aim to explore the interaction between figures and individuals (ibid.). The interviews followed a predeveloped interview guide inspired by the recommendations of (Dumay & Qu, 2011) (Appendix 2).

At the start of the project, only two potential interviewees of interest were identified. However, following the first two interviews that constituted the 'first phase', I could identify and request the contact details of other people of interest. Hence, all the remainder of the interviewees were approached via email, which included a short introduction of the study, who had provided their contact information, if they would be willing to participate. Once they agreed to participate, an interview was scheduled, and they received a consent form to participate to sign for the General Data Protection Regulation (GDPR). Each interview began with a more detailed introduction of the study, emphasizing that the study aimed to understand, not evaluate, Alpha's practices. Furthermore, given the topic's high confidentiality and strategic sensitivity, the interviewees were informed of how both the interviewees and the company would be pseudonymized and that I had signed a non-disclosure agreement. The interviewees were also asked if they permitted the interviews to be recorded and stored in compliance with GDPR, which all participants approved. Thereafter, the interviewee was asked to elaborate on their role at Alpha and its relationship to the capital budgeting process, which helped steer the structure of the rest of the interview. The open-ended interview questions were often followed by inquiries to ensure further clarification and elaboration, inspired by Qu & Dumay (2011).

Given the study's purpose, to understand how carbon emissions intertwined in capital budgeting decisions, both those who provided decision material and the decision makers needed to be approached. Given Alpha's capital investment decision guidelines and structure, this meant speaking to very high-level, often global heads and relatively small central supportive teams. This created a trade-off in terms of balancing depth and breadth regarding the relevance versus quantity of interviews.

Between October and November 2024, 20 interviews with 16 different individuals were conducted (Appendix 2). Interviews were performed both face-to-face and digitally.

Since the participants were situated across five different countries, face-to-face meetings were only pursued when geographic proximity allowed it. The interview guide for each interviewee was customized according to each respective role.

3.2.2. Internal and External Artefacts

As Vaivio (2008, p.65) recommended, several data types have been collected to achieve a nuanced representation of how Alpha's capital budgeting process relates to carbon. This approach aligns with Vaivio (2008, p.75), who stated that "a thorough qualitative study will complement interviews with other data sources", such as reports, manuals, corporate tools, and public documentation.

The artifacts referred to in this study are both internal and external materials collected throughout the data collection process. For instance, Alpha's internal guidelines on carbon accounting calculations and greenhouse gas reporting were provided as introductory material, while walkthroughs of internal software tools were conducted during the interview. Moreover, documents and guidelines mentioned during the interviews of interest have been shared after the interview. The latter was gathered as the study proceeded. Examples of this relate to the European Commission's publications and official guidelines on the greenhouse gas protocol, and EU ETS figures.

3.3. Data Analysis

The abductive approach of this study allowed for an open mind to acknowledge the various themes of reasoning that appeared in Alpha's capital budgeting process. Vaivio's (2008, p.76) description of how:

> in practice, theoretically valuable interpretation requires numerous iterations between theory and evidence. The layers of collected, often contradictory, pieces of field evidence gradually become more organized, and things start to make sense (Vaivio, 2008., p.76)

Soon after each interview, the transcription was revised to identify significant themes (e.g., ownership in the process, responsibilities, calculation practices) and topics for further investigation. The interviewees had different responsibilities in the Alpha and different attitudes and perceptions of matters in the capital budgeting process, which sometimes conflicted with another unit. Hence, follow-up interviews were conducted with four interviewees and email questions were conducted with other interviewees to test ideas that had arisen during the data collection. Inspired by Kreiner & Mouritsen's (2006., p.164) recommendation of "challenging the interviewee with a different line of thought". Moreover, when possible, interviews with members of the same team have been conducted to add additional layers of nuances.

It should be noted that interviewees did not have knowledge or insights regarding all matters covered in this thesis. Moreover, in the analysis, certain categorizations of the

empirical data observations have been necessary for understanding and conceptualization. This categorization has been done based on identified similarities in roles and responses among the respondents.

3.4. Data Quality

During the design of this study, measures were taken to achieve quality research in terms of authenticity and plausibility (Lukka & Modell, 2010). The former refers to how accurate a representation of reality the researcher can provide, often through sturdy data collection that provides nuances and details relevant to the context. The latter refers to the data analysis, in which the reasonability of the researcher's explanation is considered. Kreiner and Mouritsen (2005, p.172) noted that plausibility does not imply qualitative findings to be “unscientific" but instead “that they make a lot of sense within the analytical world that has been constructed through the interview”.

Several strategies have been implemented to ensure adherence to the quality metrics proposed by Lukka and Modell (2010). First, the study was designed and executed to include interviews with representatives from all units involved in the capital budgeting process. The empirical section provides further accounts of these interviews, by the high proportion of quotes from the respondents and excerpts from artifacts. This, in addition to the theoretical reasoning mentioned above, allows the reader to understand what the subsequent analysis was based on. Internal documentation, tools, and guidelines were collected whenever possible to substantiate the findings. Furthermore, my autonomy in sourcing potential participants, combined with the pseudonymization of all interviewees to protect their identities internally and externally, minimized the likelihood of 'refined answers' and raised the findings' plausibility.

As the data collection proceeded, new themes and ideas emerged. With inspiration from Kreiner and Mauritsen (2006), I continuously tested ideas on the interviewees. This approach of testing ideas on the interviewees in follow-up interviews and written questions, inspired by, helped develop ongoing themes and thus raise plausibility. Furthermore, since the abductive approach entails an ongoing revision and alteration of the analytical framework, any constraint imposed by adhering to a pre-selected theory was avoided. Instead, plausibility was enhanced as the analytical lens applied to analyze this case could be chosen on appropriateness. Separating the analysis and empirical data has been a conscious choice to match this case's iterative and exploring nature.

4. Empirics

4.1. Setting the Scene

4.1.1. Need for Investment and the Aspect of Reporting

Alpha, as a large industrial manufacturing company, is regularly engaged in capital investments. They make capital investments yearly, totaling approximately 5% of its revenue. These billions of Euros impacted not only the financial statements but also how they were allocated across business units and projects, dictated how Alpha's operations would look in the future. In other words, as Alpha had a limited investment budget, it was an ongoing discussion of how much would be allocated for strategic purposes, high-growth segments, and innovation versus business continuity in terms of maintenance of buildings and machinery. The Upper Management Director expressed it as follows:

> To keep our capital efficiency, we reinvest in growth alongside our depreciation. In other words, we strive to grow while ensuring that our reinvestments match the pace of our growth and asset depreciation. […] We also prefer to invest where we can grow and achieve the best margins (Upper Management Director)

At first sight, the capital budgeting process at Alpha was a relatively straightforward process, which could, according to one of the central team managers, be explained in approximately ten minutes, including a discussion of how carbon was accounted for. The fundamental process was built on the principle that "the sites have to ask for money to execute projects" (CO Director 1) in a five-step tollgate (TG) process (Figure 2), that included two intermediate decision points. The first two TGs could be categorized as pre-investment due diligence stages: both succeeded by a decision meeting. The third and fourth step focused on the operationalization of approved projects. Once the project had been operationalized, it would be summarized in a report, marking the last TG. At this point, the project would have materialized into a physical asset and be an integral part of a site's operations and asset portfolio for its useful life, typically ranging between 15-40 years. Carbon would be included in this calculation to represent the asset's energy efficiency and type. This, in turn, would impact Alpha's greenhouse gas (GHG) inventory and be in the scope of the EU ETS, as described below:

> To ensure long-term success in a competitive and increasingly climate-regulated environment Alpha must understand and manage GHG risks. Alpha's corporate GHG inventory serves business goals, including but not limited to: (i) Mandatory reporting e.g., ESRS (ii) Public reporting and participation in voluntary GHG programs and initiatives, e.g., CDP and SBTi (iii) Managing GHG risks and identifying reduction opportunities, (iiii) GHG trading programs, e.g., EU and UK ETS. [Alpha's GHG accounting principles manual]

All in all, marking the tie between capital budgeting, EU ETS, and carbon accounting.

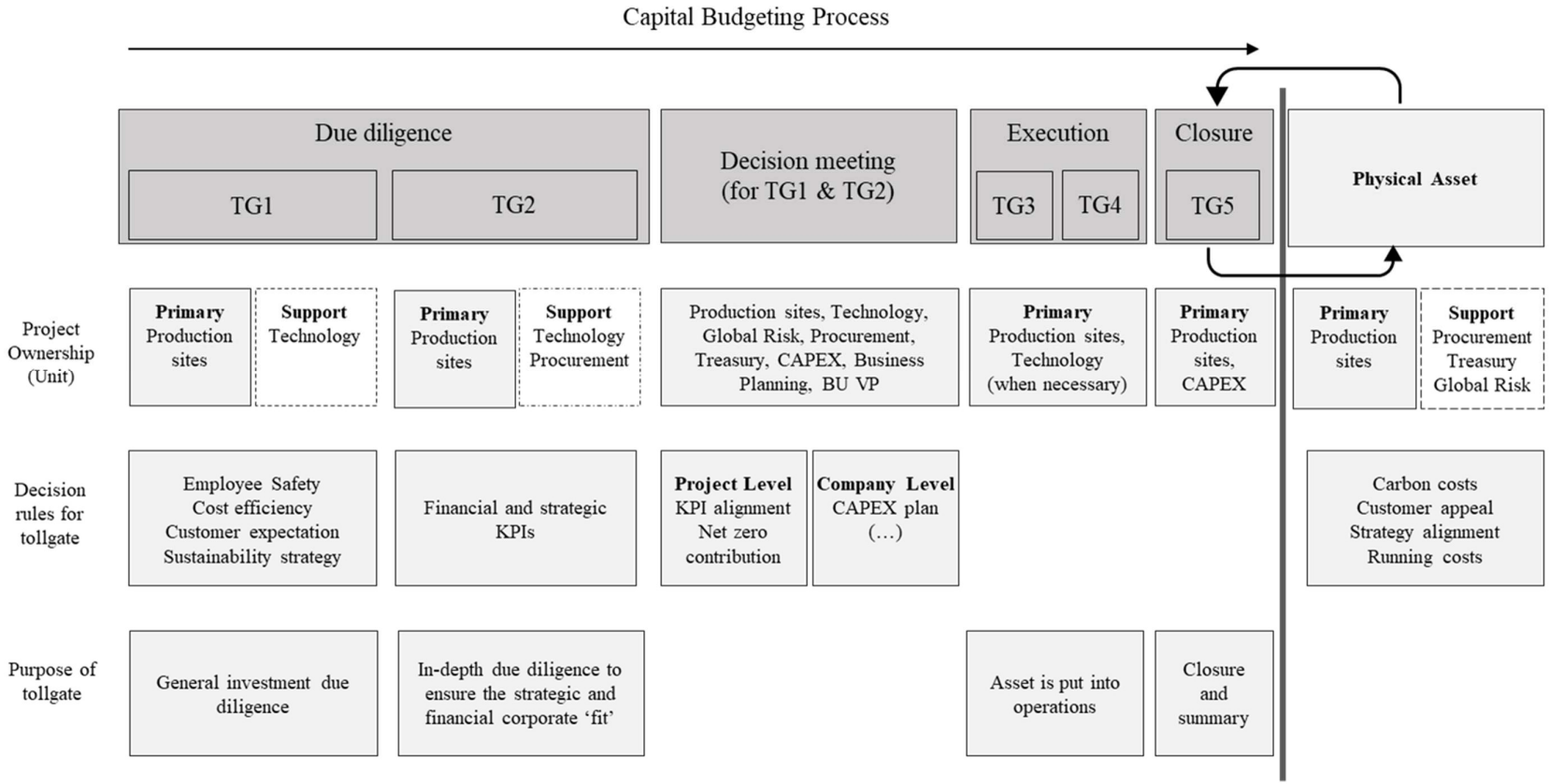


Figure 2: Illustration of Alpha's capital budgeting process. Note that representatives from all units involved in the decision meeting have been interviewed for this thesis.

4.1.2. The EU Carbon Market

In March 2000, the EU decided to respond to the threat of climate change by introducing an emission market known as the EU emission trading system (EU ETS). Companies operating within the scheme's scope[6] would need to possess, either through free allocation or by purchase, one emission allowance for every ton of CO_2e emission generated in production (European Commission, 2016). This system was structured like a "cap-and-trade" market, with the reasoning that putting a price on emissions would spur organizations' green CAPEX expenditure. These allowances would progressively decline in numbers up to 2030, in order to achieve emissions reductions of 55% relative to the 2006 benchmark. The production activity of a manufacturing site referenced the fuels used for production (Figure 3) and was represented in tons of carbon dioxide equivalents (CO_2e). The conversion of various fuels into the CO_2e metric, was done using standardized calculation formulas (European Commission, 2015).

With the gradual decline in allowance, it was projected that allowance prices would increase (GF manager 1;2[7]). However, prices had historically been volatile and, combined with their close tie to European politics, were considered challenging to forecast with accuracy. As seen in Figure 4, they had historically fluctuated between EUR 5 and 106 per ton of carbon equivalent emitted.

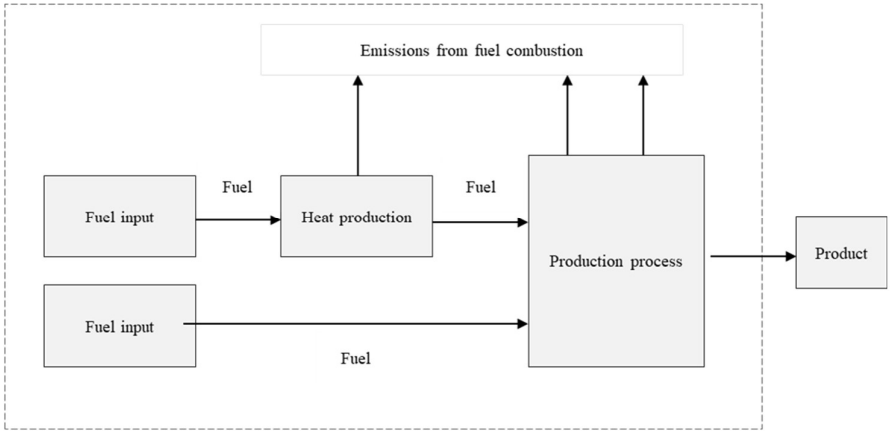
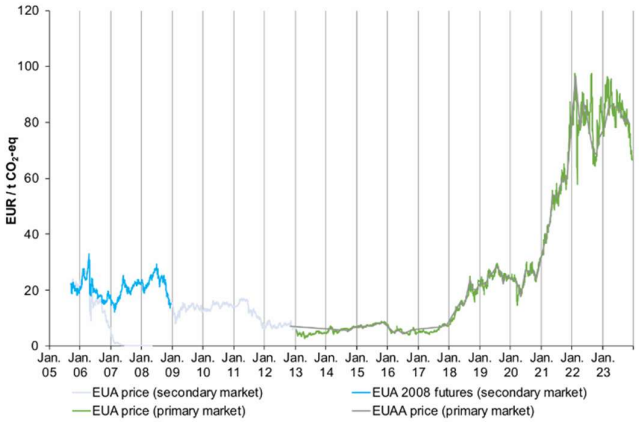


Figure 3. Representation of the scope of EU ETS emissions recreated from EU Commission guidelines (European Commission, 2015)

[6] As of date, companies in the sectors of energy production, industrial manufacturing, and aviation
[7] Substantiated by analyst report shared by Global Function Manager 1



Note: © European Topic Centre on Climate change mitigation, 2023

Figure 4. Illustration of the EU ETS allowance price development 2005-2023 (Graph published by European Topic Centre on Climate change mitigation, 2023)

In Alpha, the ETS impacted both reporting and budgeting practices and was displayed in the annual report (Figure 5) and had a direct impact on the income and balance sheet statements, whereas the latter referred to how Alpha had chosen to include it as a cost item in investment calculus, measured in EUR per metric ton.

The EU Emissions Trading Scheme (EU ETS) [redacted]					
	2023	2022	2021	2020	2019
EU ETS					
Average market price, EUR/ton	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Emission allowances, ton	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Figure 5. Illustration of Alpha's mandatory ETS reporting

Even though Alpha had an expert to manage ETS trading, hedging, and price forecasts for capital investment calculations, etc., much uncertainty remained. He explained that on paper, these prices were relatively easy to calculate given that the decline of allowances, the growth rate of European industry, and the activity of trading were all public information, yet because the system is 'politically rigged' (GF Manager 1) unforeseeable action could occur. However, because it was a system backed by the EU, there was a standardized way to calculate future prices, seen below (equation 1). which would be the fundament for the internally published figures (Figure 6) and provided whenever a request for forecasts occurred internally. This meant, as exemplified below (equation 2), a conservative price development going forward.

$$ETS\ price_{\ year\ 0+\ i} = Spot\ price_{\ 0} \times (1 + European\ mortage\ rate_{\ 0})^{i} \qquad (1)$$

Where i = years ahead.

$$69.3\ EUR_{\ year\ 0+4} = 61 \times (1 + 3.24\%)^4 \quad (2)$$

Where $Spot\ price_{\ today} = 61$ EUR and European government bond rate $= 3.24\%$

Note: Calculations provided by GF Manager 1

This type of calculation projected a relatively steady development of ETS prices in the coming years, which was a questionable assumption. He elaborated on how market analysts (e.g., Morgan Stanley, SEB[8]) predicted market prices reaching EUR 150-300 by 2030 because of the expected upcoming allowance deficit in a few years (Figure 4). Nonetheless, he acknowledged that even though these predictions were held in relative consensus in ETS expert forums, they were still speculative and, thus, "would be wrong to act on." He reasoned that even though it was unlikely, the EU could end up not keeping to its target; otherwise, customers would end up paying the cost. But any other opinion that the prices would jump was "rare." But regardless, it was a prominent uncertainty, thus worth considering in a risk scenario analysis. The complexity of this market was similarly perceived by another member of the team, who explained that they had taken certain measures to raise accuracy:

> We try to have two people involved in these calculations and review the same thing. There are so many components to account for and to determine whether it has an impact or not. (GF Manager 2)

Even though they could not depart from the normative calculation, both were confident that prices would rise in four to five years. Yet, the magnitude of the rise was unclear.

In contrast, other internal stakeholders were less confident that any price increase would occur. The CO Director 1, who reasoned that the combination of political forces historically not keeping to their promises along with the estimates that gas prices would decline, concluded the following:

> I don't expect that the gas price will increase significantly. It's rather the opposite. It will eventually go down […] With the latest political developments in Europe, it [EU ETS market] could be jeopardized as there is a tendency in Europe to lose track. (CO Director 1)

However, it was also so that ETS prices were not discussed internally to a high degree. The production sites received no guidance or information on these matters (GF Director; Production Site 2); hence, historical prices and internally published estimates were used. Given that the current price levels were not that high nor estimated to be high (according to the internal portal), no risk analysis was considered in contrast to other cost items with high impact (Production Site 2). Similarly, it was not something that the upper management would frequently discuss; when it would be relevant, it would be checked whether the procurement team objected to the estimates. When asked about the expected

[8] Acronym for European Bank

price levels of ETS, the Upper Management Director took up the internal price estimates, noting:

> The ETS prices were around 2 EUR/ton when I worked with this. But of course, it could be so that by 2030 or 2035, they reach 150 or 300 EUR/ton. It is a big risk factor, yet I cannot say that assumptions of ETS prices are something I come across frequently (Upper Management Director)

He added that it had been a very different discussion during COVID-19 when prices had soared (see figure 3), but this was not topical now.

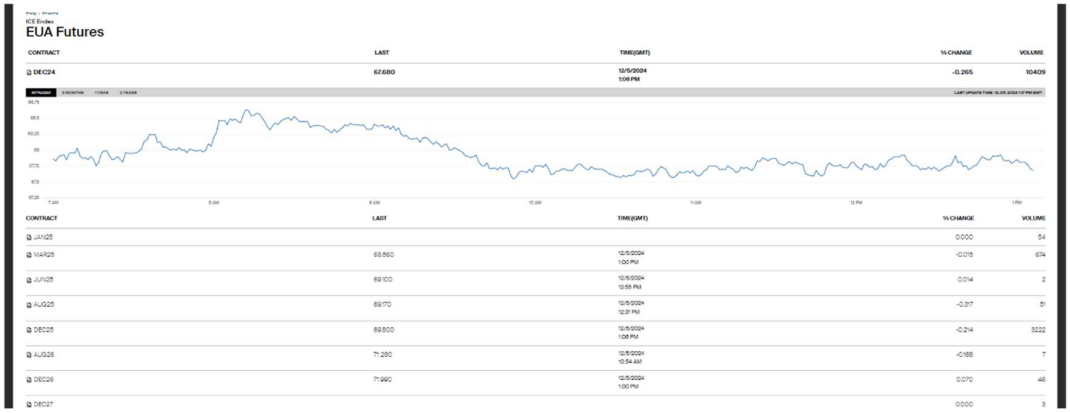
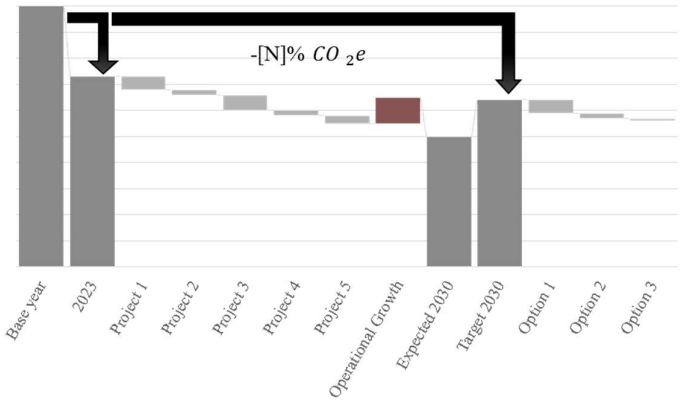


Figure 6. Image from Alpha's internally published ETS price forecast

4.1.3. The SBTi

Carbon did not only represent ETS in the capital budgeting, but it was also a strategic line item expressed in "CO_2e reduction". This was a consequence of Alpha's long-standing commitment to ESG, which had recently been concretized in a validated SBT Net Zero commitment. The Science Based Target Initiative (SBTi) was a climate action organization launched in 2015 by the CDP, the United Nations Global Compact, and the World Resource Institute, among others, as a tool to help and guide companies in establishing reduction targets for greenhouse gas (GHG) emissions. Once a company had submitted targets and been validated, it was required to submit annual progress figures. The approval had been a "milestone" for Alpha and was used for guiding the corporate agenda going forward (Sustainability Reporting 2). Particularly the part-goal of [N]% reduction by 2030, had often been used in internal discussions and as a fundament for Alpha's internally developed 'Road to Net Zero' map (Figure 7).



Note: Alpha had as a part of its Net Zero target, a near term target for 2030

Figure 7. Visualization of Alpha's internal road to 2030 including planned projects and potential options (Net Zero). Recreated from notes

One of the challenges with the SBTi was calculating emissions, which the sustainability reporting and procurement team had first-hand experience with. When Alpha committed to SBTi, they reported using a location-based rather than a market-based calculation. The former would use the site's grid-average emission factor data. In contrast, a market-based approach would reflect the emissions the site purposely had chosen to use, regardless of the active purchase of EACs (Energy Attribute Certificates, aka "green electricity")(GHG Protocol Scope 2 Guidance, 2015). Since Alpha used the location-based approach, a site's Scope 2 emissions would be calculated as seen below (equation 3):

$$CO_2e^{Site\ X}_{scope\ 2} = Electricity\ consumption^{Site\ X} \times \text{average emission factor for the grid mix}^{site\ X} \quad (3)$$

Formula based on Alpha Internal guidelines, 2024

The GF Manager 2 expressed how this meant that sites could only lower their emissions if the grid mix became greener, or if they lowered their energy consumption. He exemplified it as follows:

> It is what's in the pipe that we are being judged from. So, if we buy from a wind farm, it will still come through the grid, so it wouldn't help; it would not give us any green value (GF manager 2)

In practice, this meant that with everything else the same, the location of the sites would determine who would be granted an energy efficiency improvement project. This was because different locations had different emission factors and thus would the one with the highest carbon saving, be the one granted it.

In sum, Alpha's incentives to drive a green transition could be categorized into two main categories: the external financial pressure created by the artificial EU carbon market and the internal strategic pressure reflected in the SBTi commitment. The Global BU Head, however, emphasized that the strategic pressure was expected to have financial

consequences in the future. However, these had not yet been quantified. Both categories were inevitably tied to Alpha's property, plant, and equipment assets and, thus, capital budgeting processes.

4.2. The Capital Budgeting Process: A Step-by-Step Walkthrough from Idea to Asset

4.2.1. Initiation and Initial Assessment: Bottom-up Ideas and Corporate-Level Tools

Before starting the capital budgeting process, the idea of a capital investment had to arise. Because Alpha had a relatively decentralized structure, it was often relied upon that the site managers would bring forward suggestions. Every other year, each site would create a proposed CAPEX plan with proposed investments for the central team, which in turn assembled a global cashout plan. The CO Director 1 described it as a bit of a wish list that could be more or less realizable.

> They [sites] put in everything they want to have. It's a kind of wish list. And then they get feedback from central controlling that no, we cannot afford it. So, you have to reduce, or you cannot spend more than XYZ (CO Director 1)

Approved projects would then be accounted for in Alpha's global CAPEX plan and provide direction - like a 'north star' (Sustainability Reporting 2) - for future spending. It was repeatedly emphasized that the sites should drive the investment process, even though approval was given centrally. The CO Director 1 explained:

> [The site managers] have the mandate to really drive the sites to success and to define what is important and what is not. Because we are a big company, certain things are mandatory and top-down, but they are not always. [W]e have a couple of colleagues, former Beta guys, and there it is more top down. […]. The freedom box is much narrower than what our guys have. (CO Director 1)

In a similar vein, another manager noted that upper management only tracked whether the subdivisions followed corporate guidelines and goals, meaning that they only impacted the direct operations 'if necessary' (GC Head). So, while site managers could be made 'aware' of specific challenges (CO Director 1), it was always preferred that projects arose internally at the site. The GC Head confirmed, and stated how "the ownership always lies locally in the project teams".

When assessing potential projects, there were two companywide support tools at the site's disposal:

> We call it the cocktail catalog. It's a best practice summary, where we collect more than 500 best practices and progress installations in our portfolio. So, if, for example, a site wants to improve its energy consumption in the drain system, it can simply click on the cocktail catalog for the drain system, and they have then access to everything applicable there. This could be one starting

> point. There is another global tool available if they [production sites] feel as if they need to do something in for example the drain system. It's called [X], and it collects on a monthly basis the energy consumption data for every machine and sub-process globally. (CO Director 1)

Not only were the site managers provided with tools, but Alpha had highly engaged central teams to support the sites. The CO Manager explained his role as follows:

> We scan globally what technologies are out there and which ones we can implement. We also talk and lecture about these matters to the site managers. This often results in site managers coming to us, asking for help to pursue these projects (CO Manager)

When considering a potential project, sites typically prioritize four key drivers in the following order of importance: safety improvement, business continuity, cost improvements, and sustainability. Depending upon the categorization of a project, the criteria for a project would differ. For example, a safety measure would not be rejected and did not require any payback. Similarly, were business continuity typically approved and prioritized in the budget, as machines needed to be replaced, or else the site could not operate (CO Director 1). This meant that in those years which Alpha had to pursue more 'business continuity' investments, it was harder to find the money for major sustainability projects. On a similar note, The GC Head expressed that it was often not a matter of will if Alpha would pursue sustainability investments, but it was whether Alpha had the money available at that specific time, hence referring to the term 'phasing'. It was a constant need to find balance, as strategic investments "cost a hell of a money" (GC Head).

However, Alpha had taken measures to ensure that an annual share of sustainability investments would be done, by the establishment of an SBT budget. The Upper Management Director explained it as follows:

> One type of investment we have emphasized these recent years concerns SBT related investments. We are committed to achieving our goals, and that requires different types of improvements and efficiencies in our operations to achieve. Hence, we have allocated a certain sum of money to stimulate these types of investments as they otherwise risk being deprioritized (Upper Management Director)

The GC Head chose to view it differently, connecting sustainability investments to the Net Zero commitment. He argued that these investments intended for the progress towards the corporate sustainability goals, could be compared to those of business continuity. Even though they did not achieve the same return, they had to be done. Whether this had materialized was debated. The CO Manager struggled to remember the last time when a major investment had been approved unless it fulfilled the financial KPIs.

4.2.2. Building the Business Case: Documentation and Calculation

Once a potential project had been identified and deemed interesting, it was funneled into the typical TG process. It would be investigated in terms of costs, business cases, and impact relative to Alpha's strategic and financial objectives, as seen in a specific entry for CO_2e reduction (Figure 8). These findings would be collected and gathered in a global planning tool, Adata (Figure 8), which enabled higher transparency and simplified the tracking of all Alphas projects over the globe" (GC Head). The information gathered in Adata would be referred to in a global decision meeting, in which the project team would need to prepare:

> a narrative, a rough business case, and the content, the rough impact, and the CAPEX accuracy, and it should be plus or minus 30%. So, it is not super accurate, but it should be a kind of maturity already in there. (CO Director 1)

The interviewees stressed that this stage was very basic to keep the cost of fundamental due diligence reasonable, not overburden stakeholders with requests for price estimates, and ensure that no extensive resources were used for a project that did not fit the company's strategy. Further resources would not be employed before the project received approval and could be moved to TG2.

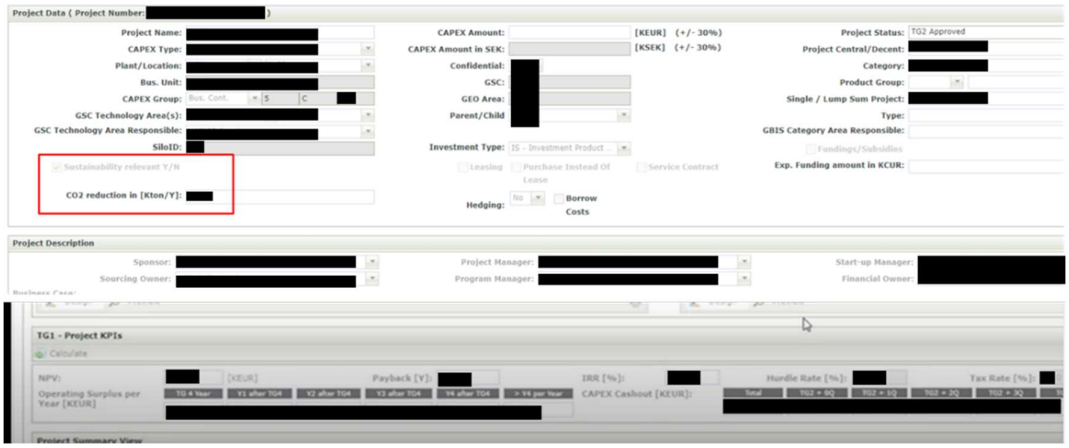


Figure 8: Photo of a project page in Alpha's Adata tool.

If TG 1 was simple, TG 2 could be considered "really the decision" (CO Director 1) with a new dimension of sophistication. The project manager would be required to prepare numerous additional documents to elaborate on the intention, rationale, risk analysis, and congruence between project and corporate financial goals etc., as well as provide financial analysis with much higher accuracy. However, the precision of these calculations, found in Adata, was questioned across the organization. CO Manager explained that it lacked the sophistication to accurately account for reality and allowed an excessive proportion of cost estimates. Moreover, it had no control over ensuring the user was qualified to make estimates. CO Manager expressed how: "best case, it is an engineer that inserted

the cost estimates, but it does not mean that the person has the expertise to do it". Finally, Adata was a tool for summarizing data, not calculating it. Hence, calculations were typically done in an offline document (Sites 1, CO Manager).

Whenever a project has a significant energy component or is SBT-related, carbon would be accounted for. For example, the replacement of a machine could mean a reduction in energy use or the type of energy source. A recurring example in the interviews was the replacement of a gas-driven with an electricity-driven component. The latter would not require any gas and, therefore, no ETS costs or emissions. This theoretical saving would then be considered for financing the electrical component. In the actual project calculation, this would be represented as an add-on to the energy consumption of the assets in operations. An illustrative example of the cost calculation, provided by the CO Director 1, was as follows:

$$70EUR/ton \times 0.185 = 13\ EUR + TTF\ price = Energy\ cost \quad (4)$$

(ETS price x conversion rate MW of gas) + TTF price = artificial total gas price

However, to calculate this price for the upcoming years, ETS and energy prices had to be estimated. The person or unit doing this would differ depending on size and complexity. For example, if it involved a minor expenditure, the sites themselves would perform the cost calculations, and as the complexity and required CAPEX increased, these estimations would be done elsewhere, with clear variation in the method. If the project required more expertise, the internal operation team was consulted. They would, too, use the internal public estimates, together with know-how and experience (CO Director 1). The CO Manager explained how he would always do risk analysis of prices based on probabilities, yet this was done based on his own expertise.

According to many central-level interviewees, it was often difficult to motivate investments based on carbon costs rather than carbon saving. A few interviewees recalled an instance a few years back, where the ETS estimates had been the make-or-break factor of an investment. More specifically, it was a project that was under discussion during COVID-19 when ETS prices were high (Figure 4). Thus, given Alpha's way of forecasting ETS prices, the cost saving from lower energy and thus allowance needs had made the project NPV positive. However, once the ETS prices and gas prices dropped the project no longer broke even and was stopped. GF Manager 2 described how:

> It can be frustrating for the one developing [the project] when you're in the money, then suddenly, you're out of the money, and it is stopped. And now we, talking about a 15-year project (GF manager 2)

Nonetheless, according to Production Site 3, EU ETS was important, but highlighted how "It [ETS] is not something that the average person is aware of, yet people who work with investments should be". CO Director 1, who had on one hand argued how price uncertainty made it difficult to build business case on EU ETS, did nonetheless

acknowledge the influence of carbon costs. He illustrated this by referencing the situation in the Netherlands in which an additional emission cost had been introduced:

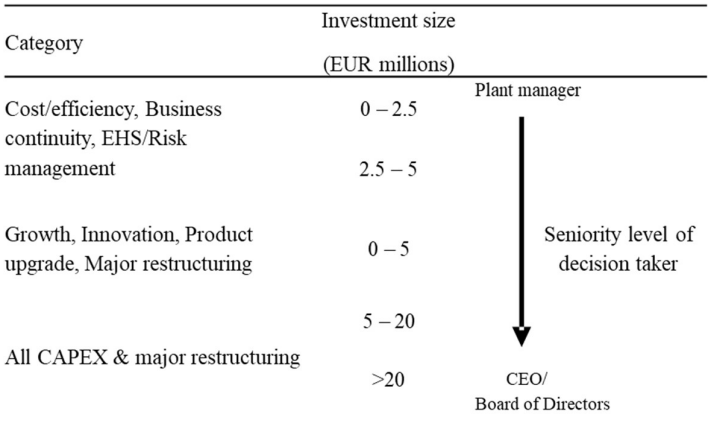
> Right now, they have quite a huge additional cost in addition to the EU ETS; I think the gas price now is artificially raised to €80 per MW. So, it's two times higher, and then you have a different discussion (CO Director 1)

The GF manager 2, who worked actively with EU ETS and recognized the risks, also highlighted that sustainable investments could not be captured only in terms of prices. He explained how the political situation in Europe created an immense operational risk, as reflected in supply chain disruptions. Alpha had operations in Austria and was therefore reliant on Russian gas. If this supply of gas suddenly stopped, the production facility would not be able to operate. The Global BU Head, the high uncertainty in terms of ETS prices meant that it could not properly be accounted for in NPV calculations:

> I think there is a big question mark around the ETS system going forward. After 2030, we do not know what is going to happen, so at the end of the day, I think what it boils down to are the [SBT] commitments you have done (Global BU Head)

4.2.3. Time for Discussion: Decision Criteria, Prioritization and Story Telling

After preparation, all projects in TG1 and TG2 would be discussed in a global meeting that occurred every other week to once a month, depending on the specific business unit. These meetings would typically last three hours, during which around 15-30 projects would be discussed. Projects would be presented before representatives of global units, the functional units, business unit heads, and the Supply chain manager. Together, these different units would discuss the project, and depending on the project, the final say would be allocated, as seen in Figure 9.



Note: The decision at all levels would be made with the incorporation of insights of the parties involved illustrated in Figure 2.

Figure 9: Illustration of the location of final decision say, relative to capital investment type. Reconstructed from notes.

Before each meeting, all participants were expected to have reviewed the preparatory documents shared by the project managers, ensuring they had what CO Director 1 called "done their homework." This also included that any questions or concerns about a project would be raised and resolved with the project manager before the meeting. He clarified that "the expectation is that all the open questions are pre-discussed." The CO Director 1 elaborated:

> I receive all the project lists one week in advance. I read the documentation, and then when I spot something related to energy, I cross-checked with the project manager, 'If you consider this and this? […] I would say 95% of the projects will be decided on the spot (CO Director 1)

GF Director, added how the meetings had "a timetable by minute," and it would play out as follows:

> The site would present the project and then the VP could ask, did you talk to XX about that? Then I echo in the background that we investigated it and identified this risk, but it was OK. (GF Director 1)

This ultimately meant that all decision participants had all the project information available, yet they would foremost engage with what concerned their role. The GF Manager 2 explained the high level of confidence in each participant's expertise, stating how "they [central management] trust what we are present."

Moreover, it was important that the project fulfilled certain corporate KPIs, such as payback time and internal rate of return. The former was discussed in several interviews to have the ability to make, or break point potential projects. CO Director 1 explained how "the company is currently very focused on optimizing financial KPIs, and therefore we have been asked not to bring forward projects above a [N]-year payback." CO Manager shared this perception and phrased it as "unless the target achieves a payback of [N] years it will not be approved". Also, Production Sites 2 expressed that it did depend on the project; however, formally, "it should be less than [N]-years to be attractive".

This cutoff had also been enforced in the criteria for SBT projects that were communicated to the sites (Figure 10). This specific budget would abide by different criteria and be allocated by a central team. However, this budget was not endless. Hence, it would be necessary for the deciding team to prioritize the ones that contributed the most towards the SBT targets. Because Alpha used the location-based metric, carbon saving was calculated using the local grid CO_2e levels. Thus, in countries where these were

relatively low, SBT projects were highly unlikely to be approved. The Production Site 2 expressed:

> Of course, we are investigating CO_2 investments locally, but then, unfortunately, we are fighting for the same sort of money as the other sites. So, if the same one million Euros investment will bring more carbon savings to another site, then we are not getting that money (Production site 2)

Hence, for some the Net Zero target approval and the associated changes in investment criteria, which caused investments focused on carbon to be put on the sidelines (Production sites 2).

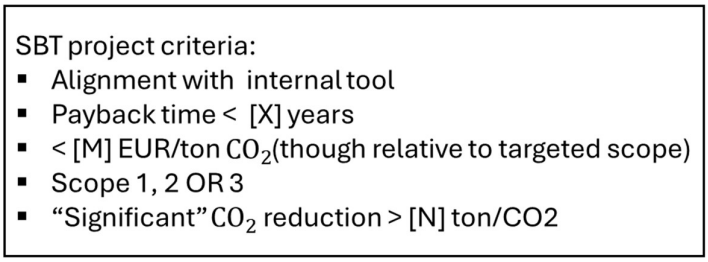


Figure 10. Illustration of Alpha's SBT investment guidelines. Reconstructed from notes.

Alpha did nonetheless have major CAPEX projects in the pipeline that did not fulfill the set payback time. CO Director 1 expressed:

> We still do, of course, have strategic projects, but it's not that we have this huge open bucket of money right now, where we can be sure that they are getting approved (CO Director 1)

When asked what made him bring forward these projects despite the request not to do so, he reasoned that without these, Alpha would not reach their targets. The global heads and upper management did not fully recognize this emphasis on payback time. They spoke of it as a guideline rather than a rule and could not recollect where this [N]-year cutoff had come from. The Upper Management Director expressed: "When it comes to my level, this is not a question", yet when asked to elaborate on Alpha's emphasis on payback versus the other KPIs, he said:

> It is not the most important one, but it also depends on the project at hand. We evaluate projects on a project-to-project basis. But yes, we need to have a return on the investment money within a certain amount of time to be able to reinvest. But the bottom line will be that the project is profitable. (Upper Management Director)

The Global BU Head also highlighted that it would depend on the project at hand. Projects with CAPEX lower than two million EUR should be recovered fast, whereas bigger ones were a bit of a 'grey zone.' The GC Head emphasized the concept of 'phasing'. He reasoned that it often came down to whether "we have the money available and what is the best point in time to do the investment" and continued by stating:

> It's not saying in general no or a final no, but often it's more a project phasing. Maybe it can be done at a later point in time when the situation is different. Meanwhile, we have other projects in the pipeline which have higher priority (Global Central Head)

Even though payback time was less used among the upper management, the focus on growth was even more prominent and drippled down in the organization. The GC Head stated:

> Nowadays, they [upper management] are talking about organic growth. This is now our specific target for next year. Most of the highest priorities are the growth projects. (Global Central Head)

Upper-level management appeared to have their own priorities and concerns, too. In contrast to the operational teams and partly the CO team, they had a more oversight perspective. For example, it hinted that Alpha's top management had set a new agenda for growth, which ultimately dripped down in the organization.

Moreover, to a certain extent, major investments required top-level strategic discretion, further obscuring the way to prioritize projects across units. The Upper Management Director described it as:

> We come in from a group perspective and take a more long-term perspective regarding whether the projects align with our long-term plans (Upper Management Director)

For example, whether a particular business unit would receive prioritization in the capital investment budget would be a decision for upper management, or directive on decision KPI would be a matter for management. This high-level management control steering was expressed in more detail:

> To keep our capital efficiency, we reinvest in growth alongside our depreciation. In other words, we strive to grow while making sure our reinvestments match the pace of our growth and asset depreciation. […] We also prefer to invest where we can grow, and achieve the best margins (Upper Management Director)

A forward-looking aspect also concerned the trade-off between investing in the known technology versus anticipated future technology for achieving the reduction targets. The CO Director 1 reflected on this aspect and pondered: "if this [new technology] is looming on the horizon, and how much money do we spend on the current equipment?" This was a thought among most interviews, yet with various perspectives. The higher up in the organization, the confidence in new technology for achieving Net Zero became more common. The fear of making major expenditures today in PPE, that risked being outdated in terms of carbon reductions in a few years, was prominent. The CO Manager explained:

> There are low-hanging fruits [carbon-reducing investments] with a payback of around 8-10 years, but they have not been taken. However, it could be so that we have new technology ready in 6-8 years. And then you are too afraid to do it. You do not dare take the step (CO Manager)

On this topic, the GS Head also reflected upon the risks associated with new technology investments. He elaborated by saying that it is never fully certain whether the technology would work. Hence, it was also a significant risk to operations. The GF Director recalled an instance in which a new, more efficient machine, once installed, showed itself not to be compatible with the system, causing major production stops.

A final key aspect to consider was the power of good project storytelling, in which the notion of carbon played a big role. The CO Director 1 described how he had used Alpha's carbon commitments to promote projects by arguing: "If we don't get this executed, we will not make our 2030 targets". At the production site level, external stakeholder expectations on sustainability had a major impact. Sustainability Reporting 2 recalled one instance in which a site had approached her regarding a potential solar panel investment. She had informed them that it would not help Alpha's Net Zero targets (because of Alpha's location-based reporting (see section [4.1.3]), by which the site had responded that it was the local expectation and thus, it needed to be done. At a different manufacturing site, Production Site 1 explained how governmental conditions for certain grants were an important selling point as they sought central-level approval for projects. He explained with a smile that Alpha had to:

> Invest energy saving projects in Site X even though it would not be the most efficient CO2 reduction based on the internal guidelines, or else they lose the funding (Production Sites 1)

Storytelling was also key in external communications. The Global Support Head discussed a recent major investment as "a very good sustainability story". The Global Central Head elaborated on this note, drawing connections to Alpha being a public company. He explained it as follows:

> We must consider the outside world and the shareholders. They need to be aware of our strategy and target to understand why we need to make an expenditure of 50 million. You must sell it [the project], and you need a good story to convince them. If you do not have a good story, then you will not survive. (Global Central Head)

In a subsequent interview, this was elaborated on, and the Global Central Head stated: "If you have a good story, then you can get all the investments you would like". He recalled a sustainability project from a few years ago that required over fifty million EUR in investment. Failing to make the investment a good 'story', it would not have been certain that it would have received upfront governmental funding, corresponding to almost 8% of the total CAPEX. If this had been the case, the project would never have been launched.

4.2.4. Operationalization: In the Capital Budgeting Process and Beyond

Once a project had received TG1 and TG2 approval, it was ready to be operationalized. The TG3 was described as a "standardized thing" to mark the start of a project. The actual

commissioning and operationalization would occur in TG4. The number of support functions supporting this phase would depend on the individual project's complexity.

Once a project had been fully rolled out, a summary was documented in TG5, varying in extensiveness based on the project's CAPEX level. The summary would encompass the learnings and the progress throughout the project and compare the promise and outcome of the KPIs established in TG2 (CO Director 1). The experiences and appreciation of this phase varied among the interviewees. The Global Central Head, having recently reviewed major investments and observed only minimal deviations, which he attributed to "phasing effects" caused by unforeseen events, as explained below:

> If you have a good reason, then everybody can understand, especially in cases where you're looking at the CAPEX amount and you need supplements or more money because of the high inflation in the last few years, causing prices to increase like hell. So, if you have good reasons, then it is also clear for the management. Impacts coming from the outside world, from the market, from the prices, from the suppliers. Well, that's normal life. You have good things and bad things. The most important is that we have always lessons learned from it (Global Central Head)

To him, deviations from the plan did typically not stem from mishaps in execution but rather from underestimation of external costs. This positive experience was not shared with other central team members. In another interview, the following was said:

> To be frank, it's a document that could be very helpful, but not a lot is prepared. Perhaps, except for big strategic ones. Significant money is involved, but as you might know, we have hundreds of projects in the organization that are ongoing all the time. (CO Director 1)

Another interviewee did not have the same opinion regarding budget versus outcome difference. In his experience, not only did projects not follow the budget, but no one also questioned it. A while back, he had asked upper management: "Why do the projects not follow a budget?". Upon this, management had drawn the connection to the incompleteness of the TG5 report, but it had not pinpointed what he saw missing: the full picture. He gave the following example: "The economic life of a motor is ten years and the associated electricity components fifteen. But it does not matter; it's a combined product". He continued by referring to the lack of accuracy controls in the calculations. He explained that some project managers took 'safety' precautions in the calculations and "put something on top" or the other way around, underestimate upcoming invoices.

Finally, once operationalized, the asset would contribute to the site's emissions and thus require emission allowances. The production sites would report current and two to three-year forecasts of energy and allowance surplus/deficits to the central procurement team, which would, among other things, create internal and external trading of ETS allowances and energy sourcing. Because ETS allowances were allocated per installation, each site would receive a bill (check) for any allowance purchases (sales). Any deficit/surplus among ETS allowances would first be handled internally; then, to the extent necessary,

allowances would be purchased from the market. Production Site 2 elaborated on what it meant for them:

> We have balances of ETS from previous years, and then, of course, we get additional allowances on top of that. We save, but in the interest of Alpha, we sell as much as possible because there is a deficit at other production sites. We have calculations for how to save, so we can be sure not to be in a deficit in the next year (Production Site 2)

The CO Manager explained that despite not being the most considerable revenue or cost item, production sites had strategically planned their production levels to need to lower their free allocation[9]. More specifically, it has been so that productions had, if necessary, boosted their production to keep a certain level of allocated allowances. The GF Director also perceived that the ETS allowances were relevant and needed to be kept an eye on. He explained that he had a few years back done his own offline tracking of the ETS estimates of a few sites, for analytical purposes, as he knew of no central source that did this, nor was there guidance for production sites in regard to how they could approach this matter.

> Nobody is supporting them [production sites] apart from me, telling them to pay attention to this excel [ETS and energy levels]. It [tracking of ETS and activity levels] is not coordinated, not in my eyes. For example, I do not know if anybody is keeping track of the historical activity level and following up on where it is going. […] I would if it was my company. (GF Director)

Little did he know that at least one other interviewee had done similar offline Excel files.

[9] The EU ETS free allocation was constructed in such a way that if a productions sites manufacturing levels would change by more than 15%, adjustments to the number of free allocations would occur.

5. Analysis

This study aimed to investigate the broader question of how carbon prices were accounted for in the capital budgeting process in the specific context of a large multinational manufacturing company with a clear commitment to achieving Net Zero. The practical processes that underlie capital budgeting decisions have been relatively unexplored in previous literature, and even less so in terms of how they have been influenced by the introduction of carbon management accounting (e.g., Berger-Schmitz et al., 2023; Bui & Fowler, 2019; Burritt et al., 2011; Vesty et al., 2015). Nonetheless, carbon has become increasingly important for organizations as it represents various market initiatives, such as EU ETS markets and the SBTi, aimed to incentivize more sustainable business practices. In the literature on carbon accounting, field-level and comparative studies on the intersection of firms and carbon have been discussed by researchers such as Bui & Fowler (2019) (see also Burritt et al.,2011; MacKenzie (2009); Hyvönen et al. (2024) who testify to the complexities and intricacies at play. Meanwhile, a detailed disclosure of how carbon is expressed in a firm's capital budgeting process remains relatively unexplored (except for Vesty et al., 2015).

Using a conceptual framework highlighting the process of commensuration and the 'style of reasoning' within an organization, this study elaborates on two research fields: capital budgeting and carbon accounting. With this theoretical framework, I have discovered that carbon is utilized in different ‘sites of calculation’ with diverse calculative rationales. This suggests how multiple forms of the carbon metric circulate in the capital budgeting processes. The capital budgeting process was a forum that would bring together representatives from all of Alpha to ensure that investment decisions were well thought-through and aligned with Alpha’s corporate objectives. Whatever Alpha wanted to become, aligning capital budgeting decisions accordingly would be essential; this process was a strategic nexus.

5.1. Multiple Sites of Calculation: ‘Same’ Gas but Different Calculative Practices

In contrast to Samiolo, the different spaces in which calculations would occur were distinguished by organizational roles rather than organizational boundaries. In the capital budgeting process, every role and team represented a particular business concern; for example, the energy procurement handled energy and ETS purchases, whereas the Central Management Team[10] would consider a more holistic level of Alpha’s business. This separation of responsibilities and fields of expertise, yet all tied to carbon somehow, caused different calculative practices to arise. This could be distinguished by three key themes: carbon as an operational or strategic metric, carbon uncertainty and its

[10] Refers to units represented by Upper Management Director, Global Central Head, Global BU Head

implication on investment, and practices of carbon price estimates (Summarized in Figure 11).

The first theme coincides with how all units involved in the capital budgeting process encountered carbon in some regard. Carbon was the metric to measure Alpha's emissions reduction progress (Figure 7); thus, it had a strategic connotation and an operational association, such as emission allowances. However, whether carbon was emphasized as an operational concern, such as emission allowances, or as a strategic concern varied significantly depending on the respondent.

The former was prominent in the talks with the production sites. Because the sites themselves would pay (gain) for any allowance purchased (sold), carbon costs were discussed in association when identifying potential projects and accounted for in calculations. In addition, the production sites recognized the implications of being in a deficit, as shown by how the site set aside parts of surplus allowance to mitigate the risk of allowance deficits. Additionally, as CO Director 1 and GF Director indicated, some sites had adjusted their production levels based on the ETS distribution to maximize the gap between required and received allowances. In other words, getting the optimal emission levels for ETS allowances sometimes overpowered the effort for emission reduction. MacKenzie (2009) hypothesized in his study regarding the commensuration of carbon at the field level that the potential revenue from excess allowances could incentivize organizations to cut their emissions further. The findings of this study support this hypothesis, as it reflected how the ETS allowance had a financial impact beyond the costs of emitting.

The strategic aspect was instead the focus for central management teams because of Alpha's articulated target of Net Zero. It tracked the emissions of Alphas operations, as seen in the Adata tool entry, and carbon savings were used to motivate sustainability investments. Several interviewees spoke of it being *the way* to overcome otherwise relatively strict investment criteria. In a way, the carbon roadmap with a clear goal of -100% emissions could be compared to what Miller and O'Leary (2007) termed a mediating instrument. It constituted a frame from which capital spending decisions could be evaluated. In a context with high uncertainty regarding actual payoff, the Net Zero became a mobilizing strategy to guide Alpha beyond the numbers, like Jørgensen & Messner (2010). However, it was also observed that the Net Zero target evoked different behaviors across the units. For example, in contrast to central management teams' perception of this commitment being a milestone marking an accelerated sustainability effort, this 'milestone' was for the production sites rather than the point that had meant new investment criteria that obstructed their ability to receive financing for SBT and energy efficiency investments.

For the CO team[11], there was no apparent distinction between viewing carbon as an operational or strategic concern. They worked ongoingly with the production sites to achieve emission reductions and calculated ETS prices. Meanwhile, they also balanced the strategic aspect of carbon, as reflected in their way of promoting projects internally.

The second theme concerned the discussion of carbon risk and its impact on when to pursue capital investments. The concept of uncertainty and risk has, in earlier studies, been associated with political, pricing, and technological factors and been associated with both decision inertia and postponing (Bui & Fowler, 2019; Berger-Schmitz et al., 2023; Kumarasiri & Gunasekarage, 2017; Warren & Jack, 2018). However, it can also, as found by Vesty et al. (2017), generate discussion and new ideas and give cause for sustainable investments. Support for both these somewhat contradictory findings was observed at Alpha.

Among the production sites, carbon prices entailed an operational risk as they had a high level of responsibility for their business. They would be the first to pay the costs of rising ETS prices or the risk of losing customers due to not living up to green expectations. Moreover, given the political uncertainty and the absence of central guidance regarding carbon beyond those internally published, it was a topic characterized by high uncertainty. However, rather than postponing sustainable investments due to uncertainty, the internal budget and investment criteria prevented this type of action, and thus, it was not relevant.

In the central management team, uncertainties evoked different implications compared to the production sites. For example, the Global Support Head described the inherent uncertainty of how well new low-emission technology investment would function in practice. Therefore, he argued that transformational investments had to be pursued cautiously and stepwise, as it could be a high operational risk to the company. On a different note, the Global BU Head reasoned how the uncertainty of the carbon market was too high to act on. Hence, it could not be accounted for at this point, and sustainability investments would need to come at a later point in time. Moreover, it was a matter of timing and the availability of technology. As was explained by the CO Director 1 and the CO Manager, central management (except for the GC Head) relied on the upcoming technology and hence felt that the potential of these motivated a delay in sustainability investments. This type of behavior illustrates how carbon in the capital budgeting process was a strategic trade-off, resembling the characteristics of what Bui & Fowler (2019) (see also Berger-Schmitz et al.2023) observed.

However, uncertainty in ETS prices could also spark discussions, as was observed by the CO team. Even though they expressed high skepticism as to whether the EU politicians would keep to their word, hence considering the carbon market to be very uncertain, the

[11] CO Director 1 and CO Manager

certainty of not achieving the Net Zero commitment if specific projects were pursued drove a different type of discussion, more like the one described by Vesty et al. (2017).

The third theme that could be observed was the different approaches to carbon price estimates. Even though this referred to the same line item, different ways of calculating and interpreting the figures changed across the units. The observations made in Alpha reflect how the level of sophistication varied intra-organizationally within the same capital budgeting process. Production sites would perform the calculation for smaller investments, and they reportedly referenced historical figures as this was what was known. Their knowledge of EU ETS pricing was limited, nor were they participating in such education; thus, risk scenario analysis was not performed. The CO team would similarly refer to the internally available prices and often consider the production sites predictions to be adequate. When they instead were responsible for the calculation, they would either base it on the internally available data or forward the task of estimation to the GF managers and perform a risk analysis, dependent on the individual's own personal expertise and know-how. However, price exposure was considered negligible given the fluctuating nature of EU ETS prices and its connection to political forces. Finally, the internal experts, GF managers, were advised on larger, more complex projects. Even though they would refer to a 'normative' calculation formula, they possessed much expertise in this matter and saw a need for risk analysis, given the expected 'jump' in prices in the coming years. In sum, these observations suggest that field-level findings of variations in sophistication between organizations (e.g., Warren & Jack, 2018; Harris & El-Massri, 2011) also exist intra-organizationally. Moreover, this study suggests that levels of knowledge and expectations on price developments also impact the level of sophistication.

As outlined in the dimension above, not one but several forms of carbon existed in Alpha. Like how Samiolo (2012) reasoned how different political centers involved in the cost-benefit analysis of the Venetian lagoon constituted separate 'sites of calculation,' the different intraorganizational units of Alpha represented different 'sites of calculation' (Figure 11). On one hand, the inclusion of numerous units ensured that the investment decisions would be thought through, while on the other, it allowed various forms of carbon calculation to circulate while not needing to be discussed officially. In relation to earlier studies, the analysis nuances the current discussions of capital budgeting techniques by suggesting how field-level observations, such as calculation sophistication and response to uncertainty, also vary intra-organizationally. More specially, with the conceptual lens of 'sites of calculations,' this study provides an alternative view to previous studies, as it finds how numerous approaches to the capital budgeting process within the organization, that consistent with different earlier studies, that at times, are contradictory. Finally, in addition to the contribution to capital budgeting literature, these findings elaborate on carbon management literature by tracing the different roles of carbon prices (not) have in the capital budgeting processes.

5.2. Styles of Reasoning About Carbon: Nowhere, Everywhere, Somewhere – Elsewhere!

Once different sites of calculation had been characterized, the possibility of conceptualizing the underlying rationales of each site could be pursued. This analysis draws from Samiolo's' concepts of: 'view from nowhere,' a calculative practice that is universal and impersonal; 'view from somewhere,' based on local knowledge and experience; and 'view from everywhere,' which could be considered a midway of the two others. However, as mentioned earlier, this study was situated in an intra-organizational context which entailed a different dynamic between the sites. Hence, a fourth view of reasoning could be observed, here conceptualized as a 'view from elsewhere,' to denote how calculations were at times outsourced elsewhere in the organization (Figure 11).

First, a view from nowhere characterized the calculations of the high-level central management teams (Upper Management Director, Global Heads). They made decisions based on what was best for the company. Hence, the local perspective was not prominent. Moreover, as demonstrated in the allocation of the CAPEX budget, much focus was placed on growing the organization in segments with the most growth potential and ensuring a fast return on investment. Long payback times were reasoned to lock money into a specific project, hence preventing new investments. Furthermore, several interviewees referred to central management as having a 'holistic view,' not focusing on the details but on the big picture of operations and strategy.

Second, Samiolo (2012) describes it as a view from somewhere that could be reflected among the production sites and GF managers. More specifically, given the decentralized structure of Alpha, production sites were held directly accountable for managing their business. This was reflected in the expectation of them to identify and suggest investment projects. While it was observed how sites referenced corporate guidelines, such as the Net Zero target, their reasoning often had a layer of local reasoning to these objectives, both because of the little central guidance and because of tailoring to local needs and expertise. This was demonstrated in the example from Sustainability Reporting 2, when a site that wanted to pursue a PPA proposal despite having a Net Zero contribution of null, but the local appeal was high. GF managers' reasoning could be considered local because of the high technical combined and strong focus on matters within their formal responsibilities observed in the interviews. Instead, it emphasized the financial aspects of carbon and energy matters, hence not being local in geographical terms but in an organizational one.

Third, the "view from everywhere" was prominent in the CO team. They were organizationally positioned between production sites and upper management and worked closely with both. Their reasoning could be described as a balancing act of both local and general perspectives. They worked with the sites on an ongoing basis, finding and discussing solutions that would be fit for their specific needs. They also handled the SBT budget that had been built on corporate guidelines and prioritized qualified projects based on what was best for Alpha as a company.

One instance, in which the reasoning of all different views became evident was the importance of the payback time investment criteria. For the CO team this had much of a disciplinary meaning and was perceived to be enforced by central management. Only on rare occasions would a project be able to circumvent this, and even the projects that were deemed important enough to bring forward were perceived unlikely to make it past this rule. On the contrary, upper management and the global heads acknowledged this cutoff but spoke of it as a 'guideline' and refuted the idea of it as a strict rule. It was argued to be a tool that helped ensure that Alpha, as a company, could keep up their annual investments, as money quickly came back in and was not locked up long-term in one single project. Also, the payback time was more thought of as a guideline for the production sites. They would focus on the local needs and create what CO Director 1 called a 'wish list'. All in all, this reflects how payback time was on a local level not considered essential; hence, any project could be proposed, whereas on the central management level, looked after the company's best hence appreciated the short payback as it ensured that enough money would exist for upcoming other projects in other parts of the company. Meanwhile, the central team had to balance these two takes.

Fourth, in some instances, the sites of calculation would delegate the need to calculate elsewhere in the organization. For example, it was observed when sites encountered issues perceived as too complex or entailing too much risk to take on for themselves. Instead, the figure that needed to be calculated was outsourced elsewhere, as with EU ETS price forecasting. At low CAPEX exposure, calculations would be performed by the production sites; however, as the project grew, the CO team would take over. When the project was so complex or lengthy that even the CO team sought further expertise, Alpha's global function team would calculate these figures. It would then send them back as readymade numbers for use. These estimates, published internally and at request, would be taken as definite, and their validity was little questioned. Whether or not these figures would be further considered in terms of a risk analysis depended on the judgment of the receiving unit and individual and their competence and awareness of doing so. All in all, this illustrates what can be called a 'view from elsewhere.' The act of delegating the calculative responsibility 'elsewhere' within the organization ultimately renounces responsibility for its accuracy.

In sum, Samiolo's (2012) conceptual framework explains why and how different sites of calculations arose within Alpha's capital budgeting process. The findings of this study extend upon her framework by situating it in an internal capital budgeting setting. However, Samiolo's theoretical framework does not transplant unproblematically from a field-level to an intraorganizational context. Instead, this study identifies another style of reasoning, a 'view from elsewhere.' This type of reasoning would emerge when it was convenient to delegate and use calculative practice, thereby avoiding accountability for the resulting figure. Hence, unlike the other styles of reasoning proposed by Samiolo (2012), it was context-contingent and could be used across all sites.

Calculative Site	Unit(s)	Involvement in the Capital Budgeting Process	View on Carbon Operational/Strategic	Time for Carbon Action	Carbon Price Forecasting	Styles of Reasoning (Samiolo, 2012)
1	Central Operations team	Engaged at varying degrees depending on the project's CAPEX size. Involved in the decision	**Operational & Strategic** Carbon accounted for both a strategic and operational matter	**Current & Future** Strategic risk of not achieving corporate targets. ETS pricing is considered volatile and, hence, difficult to account for	**Competent** Skilled in calculating forecasts and conducting risk analysis when needed. Little expectation of price development over normative levels	**'View from Everywhere'** Ongoing balance the local demands and needs while also needing to attend to corporate goals and targets
2	Production Sites	Responsible for the project from idea to operationalization.	**Operational** Operational aspects (energy efficiencies, customer demands) are emphasized	**Current** As directly responsible for the cost/revenues that may arise and important to maintain customer appeal	**Beginner** Forecasts are based on historical figures and internally available data. Do not perform any risk analysis.	**'View from Somewhere'** High local focus on individual production site
3	Global Function Managers	Involved in the decision meeting and post-implementation	**Operational** Operational concern as shown on emphasis on risk and price exposure	Not enough data to provide a just assessment	**Expert** High expertise	**'View from Somewhere'** High technical focus on matters within own formal responsibilities
4	Central Management Team	Involved in the decision meeting and having the ultimate responsibility for subunits	**Strategic** Focus on carbon reduction (though it was found that this could vary with ETS market prices)	**Future** High uncertainty and focus on short payback time	**Beginner** Little emphasis. Refers to internally published price forecasts	**'View from Nowhere'** Consideration for the whole company

'View from Elsewhere'

Applied at convenience

Note: The Central Management team includes the Global Central Head, Upper Management Director, Global BU Head

Figure 11. Illustrative representation of Alpha's identified 'sites of calculations' and categorization of the style of reasoning along with brief description

5.3. Recommensuration

The study of how carbon prices enter the capital budgeting process of Alpha, unlike Samiolo (2012), has not been the case of attempts to commensurate an object. Instead, this study traced how carbon was accounted for in the capital budgeting processes, a metric already commensurated in the market to represent emissions (Chua et al., 2024; Lohmann, 2009; MacKenzie, 2009). The observations made in Alpha confirmed that carbon prices were accounted for by being an additional cost to energy prices (see equation 3) in project valuation calculations. However, as it became increasingly evident as this study was prolonged, the carbon metric was accounted for in more ways than one as it entered the capital budgeting process.

After identifying four sites of calculation and each site's different characterizing style of reasoning, it was evident that different forms of the carbon metric circulated. For instance, the procurement team emphasized the price aspect of the EU ETS, considering both current and future prices. In contrast, central management emphasized the overall cost picture; hence, the EU ETS prices are not particularly relevant as of now. This would, however, vary over time, as the Upper Management Director recalled what had been the case during EU ETS price spikes in 2022 (see section 5.1 for a more elaborate discussion).

Drawing on Espeland & Stevens (1998, 2008), commensuration is an ongoing social process that requires significant effort. The events and reasoning within Alpha can be seen as the continuous work of carbon commensuration within the organization, ensuring it is suitable for each site of calculation. Unlike the studies by Lohmann (2009) and MacKenzie (2009), this study examines what happened to the carbon metric beyond the field-level analysis. The capital budgeting process illustrated an instance in which CO2e was reworked across different sites of calculation to fit according to each site’s specific calculative practices and take the part of different social processes that were not necessarily connected.

In sum, this study elaborates on earlier studies of carbon commensuration (e.g., Chua et al., 2024; Lohmann, 2009; MacKenzie, 2009) by studying the phenomenon as it plays out at an intraorganizational level. In this context, the observations show how the field-level commensurated carbon is fragile as it undergoes further work and is ‘recommensurated’ into new forms across several sites of calculation (Figure 12).

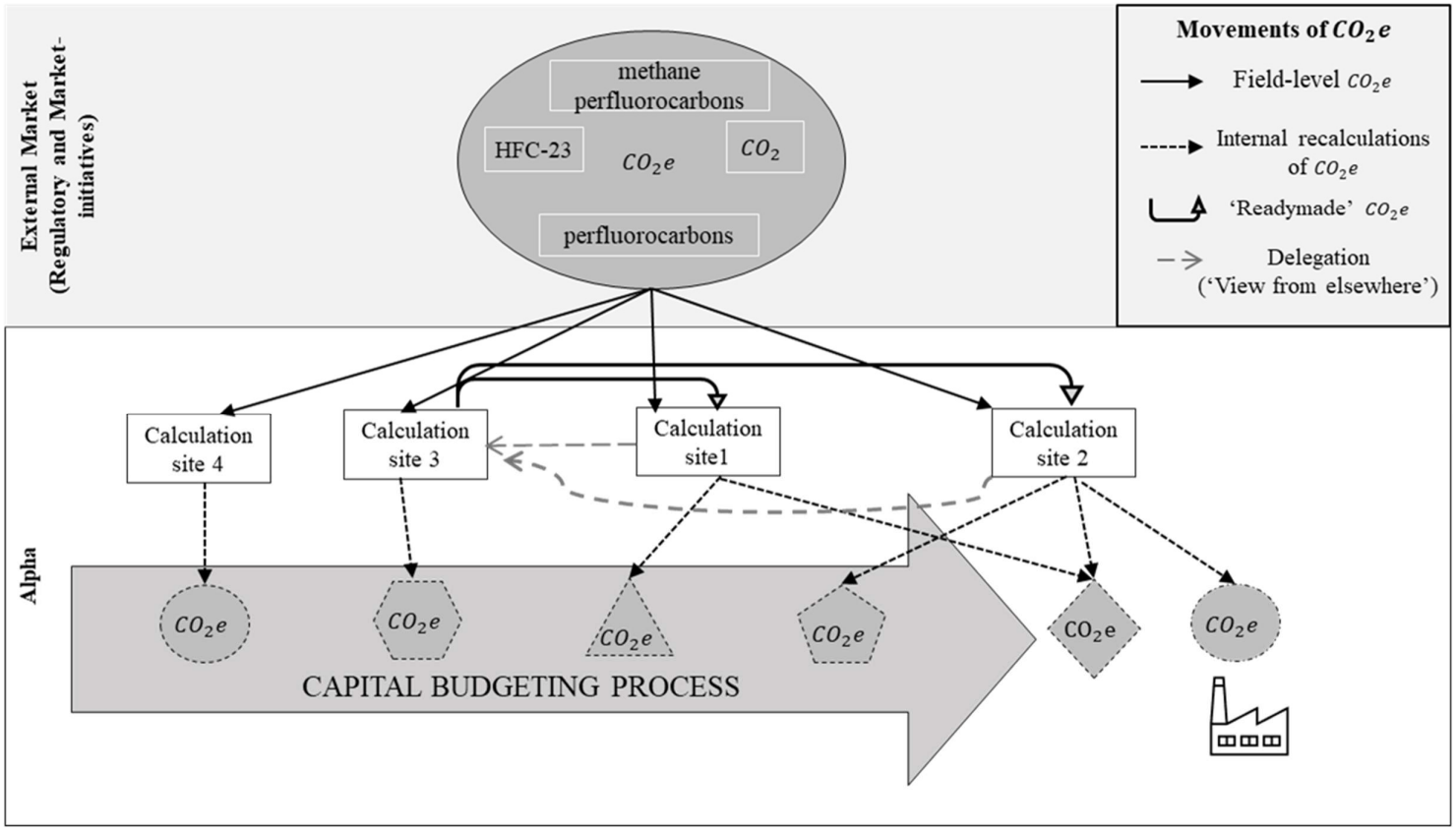


Figure 12. Illustrative representation of how the regulatory and market-initiative commensurate object, carbon, is incorporated into multiple sites of calculation throughout the capital budgeting process. Depending on its specific needs, each site translates this into different forms of carbon. This demonstrates how calculations can be delegated and returned as 'readymade' figures.

6. Conclusion

This study began with an interest in addressing the gap in the literature concerning the intersection of capital budgeting and carbon accounting. Specifically, it aimed to explore how the existence of the carbon market, EU ETS, established by regulators to incentivize green investments, influences the capital budgeting process. Hence, addressing the following research question:

> How is carbon pricing incorporated in the context of intra-organizational capital budgeting processes?

Drawing on a qualitative case study and mobilizing the analytical concepts of commensuration and 'styles of reasoning', in line with Samiolo (2012), the study identifies how the metric CO2e is accounted for in more ways than just a cost. Hence, being true to the abductive design of this study in which "problem, theory, and data influence each other throughout the research process. The process is one of iteratively seeking to generate a plausible fit between problem, theory, and data" (Ahrens and Chapman 2006., p.836), the focus of this study has been refined.

This study makes three key contributions to existing literature. First, by identifying different calculative practices, the recognition of several 'sites of calculation' and various calculative practices provides new insights into capital budgeting literature as it suggests that there is not one way that a company approaches capital investments; rather, it depends on the location of calculation. It also enriches the field of carbon accounting, as it analyses the effect of carbon markets in the context of internal capital investments, which has, to date, been uncommon in previous literature. Second, Samiolo's framework does not transplant unproblematically into an intraorganizational setting. I extend on her conceptual framework, by introducing the reasoning of 'view from elsewhere'. This type of reasoning emerges in specific situations, where 'sites of calculations' avoid a part of their calculation by delegating it somewhere else in the organization, thus renouncing accountability for this figure. Third, the study elaborates on existing literature on carbon management accounting, as it identifies how the commensurated object of carbon, is 'recommensurated' within the organization at various 'sites of calculation', according to their specific rationale. Consequently, this results in the emergence of many forms of CO_2e.

In addition to the theoretical contribution, this study also provides practical implications. First, the existence of various forms of carbon and the separation of practices within the capital budgeting process indicates a level of unsynchronized practices. Put differently, a clear corporate-level sustainability target does not in itself result in practices that are coordinated and internally coherent or supportive of transformational investments. Second, the insights of this study also provide an understanding for policymakers and regulators, in how carbon markets are accounted for within the organizations.

This study is subject to certain scope conditions that should be accounted for. First, as earlier scholars highlighted (e.g., Warren & Jack, 2018; Bui & Fowler, 2019; Berger-Schmitz et al., 2023), capital budgeting tools, such as key performance indicators, calculative practices, and emphasis on sustainability, differ across industries and sectors. Moreover, as mentioned by Hopwood (1983; 2009), accounting practices should be studied in the context in which they are practiced. The observations of Alpha should be considered with this in mind. However, it can inspire similar studies of companies operating within the same industry and across different sectors. Second, because Alpha operates as a decentralized organization, empirical details have been lost. The ratio between the production sites represented in this study and Alpha's total number of production sites is one such instance in which the authenticity and plausibility are weakened. However, this impact has been counteracted by active complementary recollections of central teams working globally with all sites. Moreover, the production sites did not directly impact the actual decision of transformational projects, as this was made centrally. However, future research could address this weakness by performing an even more extensive study to assert the local perceptions of production sites.

Finally, this study set out to explore how carbon pricing was incorporated into the capital budgeting process of a large multinational manufacturing company. What had once been described as a '10-minute discussion' was found to be a complex system containing various forms of the same metric, created by different emphases and rationales of the individuals and units involved. It underscores the intricate complexities of pursuing a green transition and emphasizes the immense work required to reach Net Zero.

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8. Appendices

8.1. Appendix 1: Definitions

CO_2e – Carbon Dioxide Equivalents

EU ETS – European Union Emission Trading System

GHG – Greenhouse Gas

Net Zero – the term commonly used to reference the achievement of -100% emissions.

SBT(i) - Science Based Targets (Initiative)

8.2. Appendix 2: Illustrative Interview Guide

Formalities:

- Recording of the Interview
- GDPR Form
- Anonymity
- Pseudonymization of the Company

Selection of Questions

Note: This was the original template used as fundament for the interviews. This has ongoingly been adjusted to accommodate for each interviewee's specific role, and to findings and themes that emerged during the data collection

- Can you please describe your current role with Alpha?
- How is your role connected with the capital budgeting process and decision?
- Can you describe what is included in capital budgeting decisions and when you do use it? Are there any special parameters, such as investment size, that dictate what processes are to be used?
- Who is involved in this process? Who provides what information?
- Who makes the final decision?
- In your experience what are typically the most important factor(s) in this process and why?
- Is there any time when you haven't followed the standard objectives? Why/Why not? Can you give an example?
- In your experience, how does sustainability weigh in? Where in this process does Alpha's sustainability agenda impact these decisions?
- In your experience, are carbon emissions included in these valuations? Why/Why not? Are there any challenges associated with this? Can you give an example?
- I heard that emission allowances are one way of pricing carbon. Do you have any experience of this?
- Is there any time when the sustainability aspect has outweighed the financial aspect?
- Before we end, I am curious to understand how the development historically. Have you experienced any pivotal events? Also, in the future, do you identify any specific developments and changes?

Forecasting unit:

- Can you take me through the forecasting procedure? What do you use to develop these numbers? How does forecasting EU ETS differ from ordinary forecasting?
- In your experience what is the role of EU ETS and carbon accounting in Sigma?

- Can you describe how you work with these figures? How does it differ from other forecasts?

Group Finance:

- How are emission allowance costs distributed across the organization? Are they distributed to the facilities that they are connected to?
- How do you account for price developments on the carbon market?

8.3. Appendix 3: List of Interviews

Interview	Interviewee and role (short)	Date	Duration
1	Central Operation Director (CO Director 1)	10th October 2024	40 min
2		16th October 2024	65 min
3	Global Function Manager 2 (GF Manager 2)	17th October 2024	110 min
4	Global Function Director (GF Director 1)	18th October 2024	55 min
5		15th November 2024	55 min
6	Global Central Head (GC Head)	18th October 2024	110 min
7		11th November 2024	70 min
8	Central Operations Manager 2 (CO Manager 1)	21st October 2024	80 min
9	Sustainability Reporting 1	22nd October 2024	75 min
10	Sustainability Reporting 3	23rd October 2024	90 min
11	Global Function Manager 1 (GF Manager 1)	23rd October 2024	75 min
12		15th November 2024	45 min
13	Upper Management Director	29th October 2024	80 min
14	Sustainability Reporting 2	5th November 2024	50 min
15	Global Support Head (GS Head)	8th November 2024	65 min
16	Global Business Unit Head (Global BU Head)	8th November 2024	40 min
17	Production site 1	11th November 2024	90 min
18	Production site 3	11th November 2024	55 min
19	Production site 2	18th November 2024	50 min
20	Central Operations Director 3 (CO Director 3)	2nd November 2024	Written email interview

Note: Global Function does not pertain to one specific unit.

8.4. Appendix 4: AI use statement

AI tools have not been used to collect or analyze the data of this thesis.