Towards net-zero: Exploring greenhouse gas emission data utilization and integration in strategic decision-making for corporate decarbonization

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Abstract

Title: Towards net-zero: Exploring greenhouse gas emission data utilization and integration in strategic decision-making for corporate decarbonization

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This thesis examines the role of organizations in combating climate change through decarbonization. It studies the utilization and integration of greenhouse gas (GHG) emission data in firms' strategic decision-making processes. The study identifies a five-step process and internal and external influencing factors. 15 exploratory interviews with 16 industry sustainability experts and consultants were subject to a qualitative data analysis following the Gioia methodology, yielding several key findings.

The findings confirm previous research on carbon accounting identifying sound and granular corporate carbon footprint calculations as the prerequisite for integrating GHG emission data in strategic decision-making towards decarbonization. Findings suggest that predominantly formal carbon management control systems guide organizational action and decision-making towards decarbonization goals. Voluntary decarbonization standards, namely the Science Based Targets initiative, and regulatory pressure appear to be additional critical enablers of the identified process. The study empirically shows five organizational application fields of the process: exploitation of energy efficiencies, adjustments to products, portfolios, and business models, as well as novel approaches to development, sourcing decisions, and supplier development. The study highlights the importance of integrating informal carbon management systems to complement formal ones, ensuring alignment of corporate goals, establishing a cohesive GHG data management system, leveraging guidance from the Science Based Targets initiative, and addressing accounting uncertainties to support strategic decarbonization efforts.

Keywords: Carbon accounting, Carbon management accounting, Decarbonization, Sustainability, Management control systems, Environmental management controls systems

Abstrato[1]

Título: Rumo ao zero líquido: Explorando a utilização e integração de dados de emissões de gases de efeito estufa na tomada de decisões estratégicas para a descarbonização corporativa

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Esta tese examina o papel das organizações no combate às mudanças climáticas através da descarbonização. Estuda a utilização e integração de dados de emissões de gases de efeito estufa (GEE) nos processos de tomada de decisão estratégica das empresas. O estudo identifica um processo de cinco etapas e fatores de influência internos e externos. Foram realizadas 15 entrevistas exploratórias com 16 especialistas em sustentabilidade e consultores da indústria, analisadas qualitativamente seguindo a metodologia Gioia, resultando em várias descobertas importantes.

Os resultados confirmam pesquisas anteriores sobre contabilidade de carbono, identificando cálculos sólidos e granulares da pegada de carbono corporativa como pré-requisito para integrar dados de emissões de GEE na tomada de decisão estratégica voltada para a descarbonização. Os achados sugerem que sistemas de controle de gestão de carbono predominantemente formais guiam a ação organizacional e a tomada de decisão em direção aos objetivos de descarbonização. Padrões voluntários de descarbonização, como a iniciativa Science Based Targets, e a pressão regulatória parecem ser facilitadores críticos do processo identificado. O estudo mostra empiricamente cinco campos de aplicação organizacional: exploração de eficiências energéticas, ajustes em produtos, portfólios e modelos de negócios, novas abordagens para desenvolvimento, decisões de fornecimento e desenvolvimento de fornecedores. O estudo destaca a importância de integrar sistemas informais de gestão de carbono para complementar os formais, garantir o alinhamento dos objetivos corporativos, estabelecer um sistema coeso de gestão de dados de GEE, aproveitar a orientação da iniciativa Science Based Targets e abordar as incertezas contábeis para apoiar os esforços estratégicos de descarbonização.

Palavras chave: Contabilidade do carbono, Contabilidade de gestão do carbono, Descarbonização, Sustentabilidade, Sistema de controlo de gestão, Sistema de controlo de gestão ambiental

[1] The translation into Portuguese was done via ChatGPT

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List of abbreviations

ABS	Association of Business Schools
CA	Carbon accounting
CCF	Corporate carbon footprint
CMA	Carbon management accounting
CMCS	Carbon management control systems
CSRD	Corporate Sustainability Reporting Directive
EMA	Environmental management accounting
EMCS	Environmental management control systems
ESRS	European Sustainability Reporting Standard
EU	European Union
EU ETS	European Union Emission Trading System
GHG	Greenhouse gas
MCS	Management control systems
NFRD	Non-Financial Reporting Directive
SBTi	Science Based Targets initiative
SCS	Sustainability control systems
SMEs	Small and medium-sized companies

1 Introduction

"Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming" (Intergovernmental Panel on Climate Change [IPCC], 2023, p.4), presenting unprecedented threats to both environmental stability and societal welfare (European Commission, n.d.a). With rising societal awareness of climate change (Busch & Hoffmann, 2011), increasing pressure to disclose GHG emissions (Hahn & Lülfs, 2014; Schaltegger & Csutora, 2012), and shifting consumption patterns to more sustainable solutions (Busch & Hoffmann, 2011), firms are necessitated to reconceptualize their use of carbon in the long run (Busch & Hoffmann, 2011). Since 2014, the European Union's (EU) Non-Financial Reporting Directive (NFRD) has obliged larger firms within the EU to disclose their GHG emissions. With the introduction of the Corporate Sustainability Reporting Directive (CSRD) in 2024 as part of the "European Green Deal," the span of obligations for firms and the scope of firms widened. By 2027, approximately 50,000 large companies and small and medium-sized companies (SMEs) based in the EU (Deloitte, 2022) will have to disclose information on their decarbonization efforts, ranging from climate change mitigation plans, related targets, and actions and resources dedicated to these efforts (European Financial Reporting Advisory Group [EFRAG], 2022).

Carbon accounting (CA) is an essential tool that enables firms to quantify and understand the GHG emissions they cause through the calculation of a corporate carbon footprint (CCF) (Gibassier & Schaltegger, 2015; Tang & Luo, 2014). While in CA literature, the potential of GHG emission data integration into decision-making is acknowledged (Naranjo Tuesta et al., 2020; Tsai et al., 2012; Zvezdov & Schaltegger, 2016), the implementation of this integration remains less explored. Literature on management control systems (MCS) holds valuable concepts on how firms can deploy systems to manage and control organizational action and decision-making to align with a firm's overarching goals (Crutzen et al., 2017; Guenther et al., 2015), but the concept's application from environmental management or carbon management perspective remains limited. Given the narrow research on this issue, alongside the growing societal awareness and pressure on firms to decarbonize, and the pressing CSRD regulation that will affect tens of thousands of firms in the upcoming years, this study seeks to answer the following research question: *How do firms integrate and utilize GHG emission data to make strategic decisions towards decarbonization?*

To address this question, the mechanisms used by large German companies to utilize and integrate GHG data in strategic decarbonization decisions were examined. These companies

provided a solid foundation for the study, as they were already required to disclose GHG emissions data under the NFRD and, therefore, had to have preexisting GHG emission accounts. An explorative, qualitative method using semi-structured interviews was chosen for this study to understand the company's internal dynamics and grasp the complexity of the research subject holistically.

The study follows the structure of an academic research thesis. It is structured as follows: Section two comprises a literature review, establishing an in-depth understanding of CA and its drivers and MCS and its fragmented application to environmental and carbon-related contexts in current literature. Section three outlines why the qualitative research method was chosen and explains the sampling strategy, data collection approach, and data analysis method. Section four presents the study's seven main findings. Section five discusses the study's theoretical and managerial implications through the synthesis of findings in a process framework, as well as its limitations and future research opportunities. The final section summarizes the main findings and the theoretical and managerial implications.

2 Literature review

This literature review intends to understand the origin of corporate decarbonization efforts and provide an overview of current literature on carbon accounting, carbon management accounting, and management control systems in environmental and carbon issues.

This section reviews 49 articles from peer-reviewed journals; most of the academic articles included (71 percent) are rated 3, 4, or 4* in the journal ranking portal from the Association of Business Schools (ABS) (Association of Business Schools [ABS], 2024). The articles were identified via Google Scholar and the online archives of 4* and 4 rated journals within the "ETHICS-CSR-MAN" field of the ABS Journal Ranking (ABS, 2024); search keywords included "corporate decarbonization," "carbon accounting," "carbon management accounting," "carbon disclosure" "carbon reporting," "GHG accounting," and "carbon management controls" among others. In addition, three reports, four books, and seventeen websites were reviewed. The review of existing literature guides the study by identifying a research gap, and thereby supports the development of the research question and facilitates the contextualization of the findings.

2.1 Climate change and decarbonization

Climate change is seen as one of the most significant challenges of the 21st century that affects people and businesses worldwide (He et al., 2021; Howard-Grenville et al., 2014; Tsai et al., 2012). As one factor to combat climate change, firms from all industries are urged by scholars, regulators, and scientists to reduce carbon emissions and thereby limit changes in the climate system (He et al., 2021; IPCC, 2023; Schaltegger & Csutora, 2012). Therefore, regulators have developed policies that aim to induce organizations to reduce their GHG emissions (Haque & Ntim, 2020; He et al., 2021; Tsai et al., 2012).

As the first convention, the 1997 Kyoto Protocol positioned a framework to establish standards and reforms for mitigating GHG emissions, legally binding for the participating countries (Orazalin et al., 2024). With some European countries being among the first to ratify the treaty, European countries are recognized for leading carbon reduction initiatives (Haque & Ntim, 2020). This leadership is reflected, for instance, in the implementation of the EU Emission Trading System (EU ETS) (Haque & Ntim, 2020), which sets a carbon price for emissions from emission-intensive sources (European Commission, n.d.b), "making the emission […] no longer free of charge" (Busch & Hoffmann, 2011, p.239). In 2015, the Paris Agreement replaced the Kyoto Protocol, with the EU ratifying the new treaty in 2016 and thereby agreeing to industrial GHG emission reductions as one of its core goals to globally transform into a climate-resilient society (European Commission, 2016; Haque et al., 2021; Orazalin et al., 2024). With the "European Green Deal" launch in 2019, the EU introduced a package of policy initiatives aiming to reach climate neutrality by 2050. The European climate law turns the realization of this net-zero target into a legal obligation for the EU (European Council, 2024). The deal set out to move member states towards a low-carbon economy where economic growth is decoupled from resource use (Council of the European Union, n.d.). The EU member states further committed to cut GHG emissions by at least 55 percent by 2030, which sets the pace for emission reductions towards the overarching net-zero goal for businesses (Council of the European Union, n.d.).

2.2 Carbon accounting definition and process

CA serves as a baseline for carbon-related action, as it calculates a firm's carbon inventory, providing real-time visibility into firm-level GHG data (Luo & Tang, 2014). Management requires extensive carbon performance data of high quality to set firm-level carbon reduction targets and monitor progress (Busch et al., 2022). Hence, a firm's management of carbon issues

and performance is strongly tied to and reliant on CA (Zvezdov & Schaltegger, 2016). While "carbon," i.e., "CO2", is one of the seven GHGs according to the Kyoto Protocol (Greenhouse Gas Protocol [GHG Protocol], 2004), and regulation and accounting frameworks pertain to GHG emissions, literature discusses the terms interchangeably, without clear differentiation. "Carbon accounting" is an established term in the literature, and the entire research stream is commonly referred to as such. This study adopts "GHG" to align with the broader regulatory and accounting framework scope, while the study retains the original terms from cited sources for accuracy.

Carbon accounting definition. In literature, there is a multitude of definitions of CA. They vary depending on the scale on which CA is conducted (i.e., national, project, product, or organization) or the scope of activities (Stechemesser & Guenther, 2012). More narrowly, CA at the organizational scale can be understood as the basis for a company on which, for instance, emission reductions can be planned or energy efficiency potentials can be identified (Stechemesser & Guenther, 2012). Following this understanding and seeking a narrow definition with regards to the activity scope of CA, the following definition by Tang and Luo (2014) is chosen for this study: "Carbon accounting collects, summarizes and measures the GHG emission data" (p.89). This definition allows for differentiation between organizational activities related to CA and enables the analysis of their links and interdependencies.

Carbon accounting process. CA describes organizational practices that collect emissions data systematically to measure GHG emissions and obtain emission information from third parties (Hahn et al., 2015). Similarly to financial accounting, CA must be done accurately and comparably for external stakeholders to get transparency on a firm's carbon footprint (Gibassier & Schaltegger, 2015). A firm's carbon footprint also referred to in the literature as the CCF consists of three emission scopes. The GHG Protocol Corporate Standard – the most widely used CA standard (Gibassier & Schaltegger, 2015; Schaltegger & Csutora, 2012) – defines scope 1 emission as direct GHG emission occurring from sources controlled or owned by the company; scope 2 emissions as indirect emissions from purchased electricity; scope 3 emissions as indirect emissions resulting from the company's activities but occurring at sources it does not own or control (i.e., upstream and downstream emissions).

The GHG Protocol Corporate Standard holds standardized approaches, principles, and guidance for setting up a CCF and thus intends to increase GHG accounting's consistency and transparency between firms and GHG initiatives. Calculating GHG emissions involves identifying emission from scopes 1 and 2, while scope 3 emissions are voluntary. The most common approach to calculating GHG emissions is applying emission factors (GHG Protocol,

2004). When collecting activity data, scope 1 emissions are determined based on the quantities of fuels the firm bought; scope 2 emissions are determined based on electricity consumption and the related emission factor (GHG Protocol, 2004). Companies are encouraged to seek primary activity data or emissions data from their suppliers to ensure their specificity regarding the purchased product (GHG Protocol, 2013), making the collection of scope 3-emissions data more complex than the other scopes. Firms must use a mix of tools and their corresponding calculation methods to calculate a representative CCF (GHG Protocol, 2004). The tools and calculation methods range from cross-sector tools over country-specific tools to sector-specific tools. In the final step, the data must be summarized via secure databases and homogeneous reporting formats to report the firm's total GHG emissions (GHG Protocol, 2004).

2.3 Influences of external stakeholders

The CA literature discusses a variety of CA drivers. Since CA is viewed as the basis for further activities (Stechemesser & Guenther, 2012), the drivers identified for those related activities may indirectly apply to the CA process and should hence be considered.

Regulatory pressure. Regulation plays a vital role in CA; on the one hand, it enforces a price for a firm's GHG emissions, turning them into a cost factor, for instance, via the EU ETS (Busch & Hoffmann, 2011). On the other hand, it determines the reporting of a firm's emissions and thus conditions the existence of carbon management accounting mechanisms (Burritt et al., 2011).

The CSRD and the European Sustainability Reporting Standard (ESRS) are vital regulatory vehicles in the EU as part of the "European Green Deal" (European Commission, n.d.c), enforcing carbon reporting. In 2023, the CSRD became effective, "improving the quality and consistency of sustainable development reporting for companies operating in the EU." (EY, 2024). The directive will be phased in from 2024, initially affecting large companies already subject to the NFRD, with all other large companies and listed SMEs following in subsequent years (PwC, n.d.). Until 2027, approximately 50,000 companies will fall into the scope of the CSRD (Deloitte, 2022). The CSRD supplements existing requirements within the NFRD, for instance, by extending the scope of companies, requiring an audit of the reported information, and detailing the requirements further (European Commission, 2021). The European Sustainability Reporting Standard (ESRS), developed by the European Financial Reporting Advisory Group, specifies the sustainability information (related to environmental, social, and governance dimensions) a firm must disclose following the CSRD (Council of the European

Union, 2023). Firms must disclose scopes 1 through 3 GHG emissions (EFRAG, 2022) under consideration of the GHG Protocol Corporate Standard's framework. A central element of the ESRS is the double materiality assessment. It limits the sustainability report to information that is significant to the firm regarding impacts, risks, and opportunities (Rödl & Partner, 2023). The ESRS also mandates firms to disclose their climate change mitigation plan, related targets, and the actions and resources allocated to these efforts (EFRAG, 2022).

Pressures from other stakeholder groups. With climate change being a present topic in public debate (Busch & Hoffmann, 2011), non-market stakeholders like NGOs or the media exert social pressure on organizations to disclose their emissions (Hahn & Lülfs, 2014; Schaltegger & Csutora, 2012). Consumers shift established consumption patterns by making sustainable product features such as low-carbon impact or energy efficiency part of their purchasing decision (Busch & Hoffmann, 2011). Competition exerts additional pressure on a firm to shift towards sustainable practices, creating the risk of losing competitiveness (Busch & Hoffmann, 2011; Schaltegger & Wagner, 2006). Lastly, financial stakeholders exert pressure because "financial markets are increasingly becoming aware of climate change as a business issue" (Busch & Hoffmann, 2011, p. 247). For investors, understanding a company's exposure to climate and regulatory risks is crucial (Hahn et al., 2015). Hence, scholars find that this stakeholder group plays a vital role in urging firms to disclose GHG emission information (Busch & Hoffmann, 2011; Hahn et al., 2015; He et al., 2021).

Voluntary standards. Voluntary sustainability standards enable firms to reach sustainability goals by "hold[ing] organizations accountable for their practices, as they represent a way to evaluate the environmental […] performances of an organization and to communicate them to third parties." (Nava & Tampe, 2022, p.298).

Next to several voluntary carbon reporting schemes, such as the Carbon Disclosure Project, the Science Based Targets initiative (SBTi) is a relevant industry standard, with over 5,000 collaborating companies (SBTi, n.d.). The SBTi is an organization that facilitates the decarbonization of firms via standards, tools, and guidance. The "SBTi Corporate Net-Zero Standard," first published in 2021, enables firms to develop GHG emission reduction targets that are in line with limiting global warming to 1.5°C above pre-industrial levels, as agreed on in the Paris Agreement (SBTi, 2024). Setting net-zero science-based targets following SBTi standards includes setting a near-term target (five to ten years from the base year) and a long-term target for the achievement of net-zero emissions by no later than 2050 – both in line with a 1.5°C aligned emission pathway (SBTi, 2024). There are cross-sector and sector-specific 1.5°C aligned emission pathways (SBTi, 2021). For most firms, the cross-sector pathway is

applicable, encouraging firms to reduce emissions annually at a linear rate of 4.2 percent to achieve near-term targets (SBTi, 2021; SBTi, 2024). Hence, an emission pathway provides a firm with a yearly GHG emission budget. Scholars point out that these standards may fail to provoke more responsible environmental behavior (Nava & Tampe, 2022). There can be a decoupling of the formal adoption of the standard – to leverage the standard's benefits regarding legitimacy, reputation, and signaling power – and the actual implementation of its requirements due to the heavy investments that often come with the implementation of a standard without a distinct payoff (Aravind & Christmann, 2011; Nava & Tampe, 2022).

2.4 Carbon accounting data applications

As previously stated, CA can be viewed as the basis for other organizational activities (Stechemesser & Guenther, 2012). These related activities can have an internal or an external perspective (Schaltegger & Csutora, 2012; Stechemesser & Guenther, 2012), which are often interdependent.

External purposes. The concepts of carbon reporting and carbon disclosure are relevant in understanding external purposes of GHG data, as they both provide transparency on a firm's carbon emissions to external stakeholders. While a clear conceptual delimitation between the terms is often lacking, and they are often used interchangeably, carbon reporting is frequently associated with mandatory requirements (e.g., Tang & Demeritt, 2018), while disclosure is frequently associated with voluntary action (e.g., Kolk et al., 2008). Corporate carbon reporting serves as a window into the organizations for external stakeholders. It provides insight into the firm's carbon footprint and is primarily driven by the growing pressure on firms to report their GHG emissions and take responsibility for their impact (Bui & de Villiers, 2017a; Bui et al., 2020). Carbon disclosure can be viewed as firms responding to stakeholder demands for information on climate change by providing information on their carbon emissions (Hahn et al., 2015). Following the signaling theory argumentation, reporting emissions can reduce information asymmetries through increased transparency (Connelly et al., 2011; Hahn et al., 2015). Thus, signaling can improve a company's reputation, where investors and analysts value voluntary and proactive disclosures (Hahn et al., 2015), thereby achieving a competitive advantage (Bui et al., 2020).

Internal purposes. Stechemesser and Guenther (2012) claim that the internal perspective of CA focuses on "the controlling of processes and decision-making" (p.36) related to corporate GHG emissions. Carbon management accounting (CMA) can assist firms in their decision-making

regarding carbon emission issues via information (Naranjo Tuesta et al., 2020; Tsai et al., 2012; Zvezdov & Schaltegger, 2016) to attain organizational objectives (Bui & de Villiers, 2017a). For CMA, the literature often lacks a stringent definition, and the term is instead used as an umbrella concept for various mainly internal corporate mechanisms and tools (Qian et al., 2017). CMA aims to improve carbon management performance (Burritt et al., 2011; Zvezdov & Schaltegger, 2016). CMA activities relate to coordinating efforts aiming to obtain adequate and resource-efficient reductions of carbon emissions (Zvezdov & Schaltegger, 2016). Via accounting management systems, a firm can create a link between carbon management, the business, and its competitive strategy to manage a firm's carbon performance (Gibassier & Schaltegger, 2015; Schaltegger & Wagner, 2006).

Environmental management accounting (EMA) is a research field related to CMA, as it has a broader scope of inputs apart from GHG emission data (Guenther et al., 2016). EMA can align a firm's environmental agenda with corporate activities (Christ & Burritt, 2013), where "the establishment of a proper environmental information system may allow for […] the integration of environmental concerns within business routines." (Qian et al., 2017, p.1610). EMA encompasses tools that measure and analyze a firm's environmental data (such as CA), supporting environmental management decision-making (Guenther et al., 2016; Quin et al., 2017). The monetary and non-monetary information measurement highlights how EMA tools can evaluate the environmental costs and benefits of investment alternatives (Qian et al., 2017). Environmental information control systems are EMA control tools that collect, process, and store information for decision-making, coordination, and control (Pondeville et al., 2013; Qian et al., 2017).

Interdependencies. The literature identifies interdependencies between CA data's external and internal applications (Gibassier & Schaltegger, 2015). Pressure to disclose emissions may lead to improved carbon management (Hahn et al., 2015), which requires the process of measuring environment-related performance (Bouten & Hoozée, 2013) while it also encourages a deeper understanding of the issue (Tang & Demeritt, 2018). Therefore, some authors claim that carbon disclosure is the first step towards carbon management to combat climate change (Córdova Román et al., 2021).

2.5 Management control systems

A literature suggests the applicability of MCS to facilitate an organization's integration of environmental factors into its core business to achieve environmental goals (Guenther et al.,

2016; Qian et al., 2017). Management controls entail all systems in place to shape the action and decision-making of organizational actors to align with the firm's strategy and overarching objectives (Crutzen et al., 2017; Guenther et al., 2016; Malmi & Brown, 2008).

Types of controls. Management controls are commonly distinguished into formal and informal controls. "Formal controls comprise purposefully designed, information-based and explicit packages of structures, routines, procedures and processes" (Crutzen et al., 2017, p.1292), while the informal controls are related to cultural aspects through which behavior is guided, such as shared beliefs and firm culture (Crutzen et al., 2017). In a similar logic, Tessier and Otley (2012) propose an MCS framework – adapted from the "Levers of control" framework by Simons (1995) – that distinguishes between technical and social types of controls. Like formal controls, technical controls are based on rules, procedures, and standards that determine how tasks should be performed and how a workforce should be structured. In contrast, social controls work via emotions, encompassing values and beliefs (Tessier & Otley, 2012). Both types of MCS are complementary and can reinforce each other (Crutzen et al., 2017; Guenther et al., 2016; Malmi & Brown, 2008).

MCS package framework. The MCS package framework, developed by Malmi and Brown (2008), is a fundamental, widely applied, and discussed framework in management control literature alongside Simons' (1995) framework. Scholars have utilized and adapted Malmi and Brown's (2008) understanding of MCS to the sustainability and environmental context, highlighting its relevance (e.g., Crutzen et al., 2017; Gond et al., 2012; Guenther et al., 2016). Within the framework, the different types of controls are used simultaneously and in a complementary manner and form MCS packages; the emphasis on an MCS package stresses that various controls can function together (Guenther et al., 2017). The MCS package framework consists of: First, planning controls, establishing goals within a firm's functions, and enabling coordination across the functions to ensure that actions are in line with the organization's overarching targets (Malmi & Brown, 2008). Second, cybernetic controls are further differentiated into four types: (1) Budgets, which are systematic plans for the allocation of financial resources; (2) financial measures, which track financial performance against predefined metrics; (3) non-financial measures, which monitor performance based on metrics that are not directly related to financial outcomes; and (4) hybrid measures, which integrate both financial and non-financial indicators. Third, reward and compensation controls are set out to motivate individuals and increase their performance by creating conformity between their individual goals and actions and a firm's overarching targets (Malmi & Brown, 2008). Fourth, administrative controls are divided into three subcategories: (1) governance structure,

which entails formal authority and accountability and the coordination of activities; (2) organizational structure, in which the specification of that structure facilitates specific forms of relationships; and (3) policies and procedures, which is a bureaucratic approach to specify the processes and behaviors and to standardize operations (Malmi & Brown, 2008). Lastly, cultural controls consist of three aspects: (1) Clan controls, which relate to subcultures within the organization that spread specific values and norms through socialization processes; (2) value controls, which are explicit sets of organizational definitions aligning employees' actions with the organization's goals (Simons, 1995); and lastly (3) symbols, which are visible expressions of the firm's values aiming to influence behavior and cultivate an organizational culture (Malmi & Brown, 2008).

Environmental management control systems. Scholars study management controls in the context of managing sustainability within organizations (e.g., Crutzen et al., 2017; Gond et al., 2012; Guenther et al., 2016). Therefore, they introduce terms such as environmental management control systems (EMCS) (Guenther et al., 2017) or sustainability control systems (SCS) (Gond et al., 2012) to integrate existing findings within MCS research with how MCS may facilitate organizational action and decision-making in line with a firm's sustainability targets. On the one hand, authors find general MCS concepts to be applicable. Compensation systems, for instance, can help firms achieve both environmental and business goals by linking bonuses to the progress of environmental targets (Dutta et al., 2013; Gond et al., 2012; Lothe et al., 1999). On the other hand, the literature points to barriers that can obstruct the integration of traditional MCS and SCS, such as diverse managerial perceptions and mindsets (Gond et al., 2012). Corporate sustainability standards were found to positively influence the application of sustainability management tools (Windolph et al., 2014). The application of standards could also be a vehicle for firms to cope with uncertainty (Bansal, 2002; Windolph et al., 2014).

Carbon management control systems. The literature identifies multiple benefits from implementing MCS in carbon management that can improve carbon performance and could eventually contribute to competitive advantage (Bui & de Villiers, 2017b). First, MCS can enable organizations to pursue lower-carbon technologies or products or improve existing products or processes (Bui & de Villiers, 2017b). Second, MCS can facilitate emission reduction target setting and target adaption to individual functions and sites (Bui & de Villiers, 2017b). Third, MCS can facilitate carbon-based incentive systems, where bonus payments depend on carbon reduction performance (Bui & de Villiers, 2017b). Fourth, MCS can allow carbon emissions to be considered in investment decisions (Bui & de Villiers, 2017b). Fifth, MCS can facilitate factoring carbon information into a firm's product strategy (Ratnatunga &

Balachandran, 2009; Schaltegger & Csutora, 2012). Finally, MCS can enable decision-making and resource allocation to exploit operational efficiency potentials and supply chain relationships (Bui & de Villiers, 2017b). Despite these benefits, firms struggle to implement carbon management control systems (CMCS) because of low-quality carbon information and conflicting management objectives (Bui & de Villiers, 2017b).

2.6 Thesis relevance and research gap

Extensive research analyzes the relationship and impact of CA on organizational performance (Naranjo Tuesta et al., 2020). However, the detailed mechanisms of how this organizational performance is brought about remain less explored.

While an initial understanding was created that the integration of carbon information in strategic sense-making and planning processes of a firm yields significant benefits (Bui & de Villiers, 2017b), there are incentives for this integration (Stechemesser & Guenther, 2012), and that CMA has an influence on a wide range of managerial decisions (Burritt et al., 2011), the explicit influence of carbon accounts on decision-making remains theoretically less explored. Scholars have identified this as a blind spot in current CA research, as the firm-internal mechanisms associated with CMA have rarely been studied empirically in-depth (Gibassier & Schaltegger, 2015). Moreover, existing research on carbon management accounting "methods only support few decision situations" (Zvezdov & Schaltegger, 2016, p.27). Additionally, firms are struggling with managing carbon-related activities regarding the utilization of available emissions information (Burritt et al., 2011), underscoring the need for further empirical investigation.

Research on MCS may hold insights into how strategic decision-making towards decarbonization, as a firm's overarching objective, is shaped via management controls (Crutzen et al., 2017; Guenther et al., 2016; Malmi & Brown, 2008). Nonetheless, the application of MCS to the sustainability field is limited, theoretical, and conceptually vague (Guenther et al., 2016). With only a few empirical studies depending on singular case-based studies (Crutzen et al., 2017), there is a need for further empirical investigation.

Thus, this study sets out to explore the following research question to address the research gap identified above: *How do firms integrate and utilize GHG emission data to make strategic decisions towards decarbonization?*

3 Methods

Among the three common research approaches, namely qualitative, quantitative, and mixed methods, this study adopts a qualitative approach for the following reasons.

First, the inductive character of qualitative research appears to be appropriate to answer this study's research question, as it allows the uncovering and exploration of novel insights and clarifies the understanding of a phenomenon (Saunders et al., 2019), which is particularly appropriate in contexts that are understudied (Bansal et al., 2018), as it appears to be the case in this study.

Second, qualitative research allows for "holistic depictions of realities that cannot be reduced to a few variables" (Gephart, 2004, p.455). This study aims to explore the utilization and integration of GHG data in a firm's strategic decision-making towards decarbonization; hence, the latitude of the qualitative approach allows the study to capture the assumed complexities and dependencies of this relationship adequately.

Third, with its literary nature, qualitative research provides a humanistic focus by describing and interpreting human dynamics in real-world settings (Gephart, 2004). In this study, organizational stakeholders are the agents in the relationship between carbon accounts and the organizational strategic decision-making processes. Thus, qualitative research seems suitable for exploring, analyzing, and accounting for this human element.

Interviews are a valuable method for collecting primary data. They align with this study's research objective, which is exploratory, seeking to understand the interviewees' experiences with the research issue (Saunders et al., 2019). Interviews enable flexibility, which is useful during data collection. This allows the researcher to explore other information strands or even adapt the research question (Bansal et al., 2018; Saunders et al., 2019).

3.1 Sample strategy

A combination of non-probability sampling methods, i.e., convenience and purposive sampling, was utilized, leveraging the researcher's network and specific criteria to ensure a diverse and relevant sample.

The data collection was based on a selection of large German for-profit organizations, based on the researcher's judgment, adopting non-probability sampling to study the research topic (Trochim et al., 2016). The study focuses on this group for three reasons: First, in purposive sampling, participants are selected based on specific characteristics relevant to the research question, ensuring that the sample includes individuals who can provide in-depth and relevant

insights (Palys, 2008). Thus, to study the integration and utilization of corporate GHG data in a firm's strategic decision-making, firms that conduct CA to some extent must be selected. Larger German firms have been subject to the NFRD and the subsequent German CSR Directive Implementation Law; hence, they are obligated to calculate a CCF for reporting purposes mandated by the directive and, therefore, have access to their GHG emission data. This purposive approach ensures that only firms with relevant experience and data are included (Rapley, 2013). Second, to facilitate comparison, the study focuses on one country to ensure cohesion regarding overarching economic dynamics and regulation and helps control external variability, and thereby utilizes purposive sampling (Cresswell & Poth, 2018). Therefore, the choice of interviewees was determined by the following criteria:

(1) The interviewee is involved with an organization that is required to report its emissions under the German CSR Directive Implementation Law.
(2) The interviewee's role and expertise lie in sustainability.
(3) The interviewee has in-depth knowledge of GHG accounting.

Third, the study focuses on the German market to leverage the researcher's network to get access to industry experts on the one hand and her familiarity with the German economy and language on the other hand. This focus reflects convenience sampling, which involves selecting participants who are easily accessible (Rapley, 2013). Convenience sampling comes with potential biases, such as limiting the sample to available or cooperative firms to the detriment of credibility (Cresswell & Poth, 2018; Rapley, 2013). The researcher is aware of this potential bias and, hence, has reached out to a wide range of firms to ensure a diverse sample.

Furthermore, since the research question pertains to a firm's internal decision-making mechanisms independently of the firm's field of business, the sample was sought to encompass firms from a broad range of industries.

As a starting point for the initial outreach, the report 'CSR-Reporting in Germany 2021' – which provides a ranking of the 50 best German large-scale enterprises' sustainability reports (Institute für Ökologische Wirtschaftsforschung and future e.V., 2021) – was utilized. These 50 companies served as the foundation for the initial interview requests. Additionally, 21 individuals from the researcher's network were contacted. The sample is complimented by consultants, who serve as experts with firm-specific insights and overarching company perspectives, complementary to the interviewees from the large German firms.

The researcher reached out to potential interviewees via LinkedIn messages and emails. 112 people were contacted, resulting in 15 interviews with 12 industry experts and four

consultants (see Appendix 1). The interviews yielded explicit company insights on 14 firms and three overarching consultant perspectives (see Figure 1 for the sample distribution).

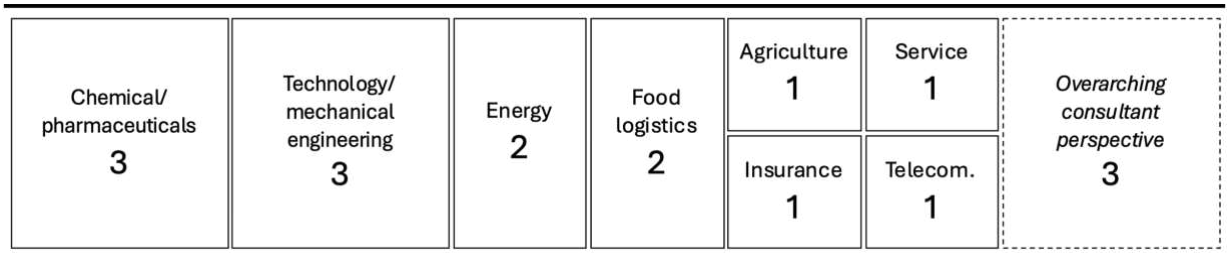

Figure 1: Sample distribution

Source: Own illustration

3.2 Data collection method

Following an inductive approach, qualitative primary data was collected via semi-structured interviews. This approach followed an exploratory and emergent course of action, allowing questions to evolve with the progression of analysis (Saunders et al., 2019).

All interviews were conducted via Microsoft Teams, averaging 42 minutes. The time varied between 24 and 54 minutes and was determined by the interviewees' time constraints. The interviews were guided by an interview guide (Appendix 2), providing opportunities for open conversation and exploring the interviewee's insights (Saunders, 2019). The conversations were recorded and fully transcribed (Appendix 3) with the support of the software SpeechText.AI.

The interview guide's questions were structured in four thematic blocks: First, the interview explores the firm's GHG accounting history and evolution. Second, there were questions about understanding the GHG accounting technicalities. Third, the interview aimed to understand the purpose and utility of GHG information within the firm. Fourth, the final questions explored the impact of emissions data transparency on the firm's strategic decision-making. The interview guide was partially adapted for the consultant interviews to accommodate their broader perspective on the overarching findings beyond the individual company level.

3.3 Data analysis method

The Gioia methodology for qualitative content analysis was the basis for this study's data analysis. The methodology aims to build a data-based inductive model that captures the interviewees' experiences in theoretical terms (Gioia et al., 2013). It is inductive in that it allows one to account for the variations in interviewees' experiences and perspectives (Saunders et al.,

2019) and to capture the interviewees' true sense-making through which new concepts can be discovered (Gioia et al., 2013). The methodology refrains from imposing existing theories or concepts on interviewees' experiences as preferred ways of explaining them, as findings are directly derived from the interviewees' insights and related to the theory subsequently (Alvesson & Kärremann, 2007; Gioia et al., 2013). The qualitative data analysis tool NVIVO was used to facilitate the data analysis. It allowed for the classification of the non-standardized data into categories, as suggested by the Gioia methodology, and facilitated the iterative process of qualitative data analysis (Saunders et al., 2019).

In the Gioia methodology, the establishment of the data structure starts with a first-order concept analysis, where information from the interviewees is collected, and their original terminology is kept (Gioia et al., 2013). In the next step, second-order themes are formed, abstracting the interviewees' terminology and contributing to a larger narrative. This step elevates the analysis to the theoretical realms by identifying common concepts that might explain frequently observed phenomena (Gioia & Chittipeddi, 1991; Gioia et al., 2013). Lastly, the second-order themes are synthesized into aggregate dimensions (Gioia et al., 2013).

Simultaneously with data collection and analysis, the identified concepts, themes, and dimensions are synthesized with the literature to unveil precedents or show that the study introduced entirely novel concepts (Gioia et al., 2013).

The relationships of the aggregate dimensions are made transparent to advance the static picture displayed via the data structure into a more accurate representation of the dynamic phenomenon studied (Gioia et al., 2013). Adding this layer of interconnection to the data structure analysis forms theoretical insights within the model (Gioia et al., 2013).

4 Findings

The qualitative analysis of the semi-structured interviews reveals seven aggregate dimensions according to the Gioia methodology. The aggregate dimensions were developed to answer the research question: *How do firms integrate and utilize GHG emission data to make strategic decisions towards decarbonization?* They can be categorized into two groups: five aggregate dimensions relate to a process, while the remaining two relate to influencing factors of the processes. The aggregate dimensions were developed by analyzing 15 interviews with 16 interviewees. The analysis yielded 306 first-order concepts, which are translations of the German direct quotes[2], to stay close to the tonality and taxonomy of the interviewees. The first-

[2] The translation into English was done via ChatGPT

order concepts were pooled in 24 second-order themes, yielding the seven described aggregate dimensions. Figure 2 displays an overview of the structure and main findings; the detailed structure can be found in Appendix 4.

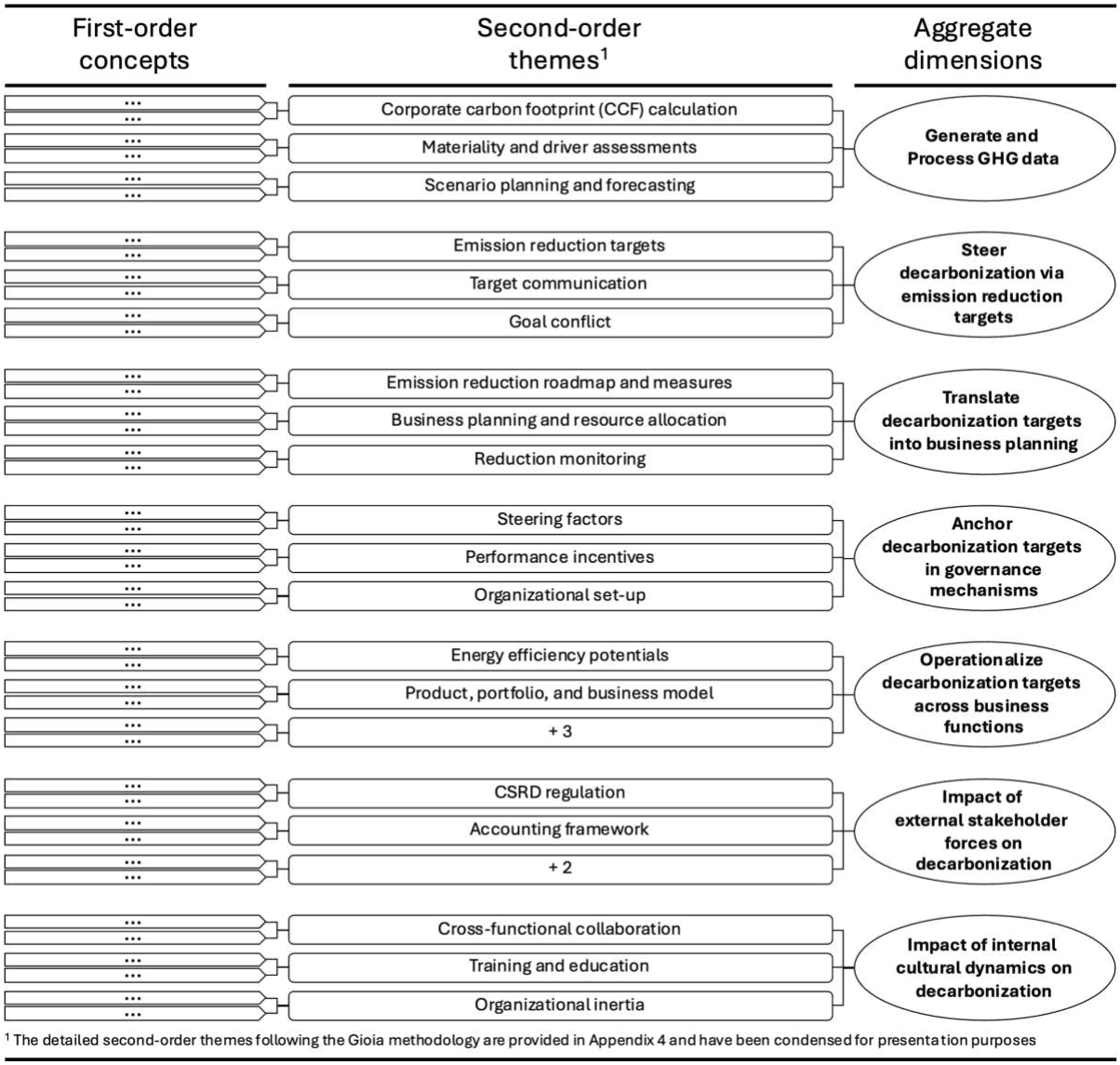

Figure 2: Overview of data analysis following the Gioia methodology

Source: Own illustration based on Gioia et al. (2013)

4.1 Generate and process corporate GHG data

Findings show that firms require granular data to calculate their CCFs, a process characterized by many challenges. Materiality and driver assessments can facilitate an understanding of which emissions scopes are significant for the firm and point to the factors that drive the CCF. Scenario planning or forecasts can be made based on the generated or collected data.

CCF calculation. "A resilient and thoroughly comprehensive CO2 balance" (ENERGY-2) is the baseline of the further utilization of GHG emission data "because transparency is always the starting point for everything" (CHEM-2). The data's granularity appears to be essential if a firm "truly want[s] to utilize this information" (CONS-1) to inform strategic decisions. In conflict with the need for granularity stands the commonly used "spend-based method" for emission calculations, where "we take Euros and multiply by an emission factor: very vague, very inaccurate." (ENERGY-1). The calculation approach loses the granularity of resource-specific emissions data in the sourcing process, yielding a "result [that] won't be very accurate because I don't know the underlying details" (TECH-3). Another hurdle interviewees stress is the lack of emissions data provision from suppliers – a core issue in the scope 3 emission calculation: "The supply chain is very long. […] We had suppliers who were either unable or unwilling to establish this transparency." (CHEM-2). Navigating the multitude of emission factor databases with diverging factors because they are "either outdated or specific to certain segments or countries" (ENERGY-1) appears to add another layer of complexity and effort to GHG emission calculation. Findings indicate that firms thus depend on comprehensive data management systems. Hence, aggregating and centralizing data within one platform or system appears to be a common theme. For instance, FOOD-1 "built a new data platform […], Snowflake, […] stor[ing] everything in a much more centralized manner […], so that the whole system could be used more efficiently." (FOOD-1).

Materiality and driver assessments. Once a CCF is calculated, a firm can identify "which suppliers or product categories are driving your footprint." (CONS-1). Hence, for firms to "start[…] with the materiality analysis" (SERV) to detect their significant emission scopes and identify emission drivers seems to be a common approach in a firm's initial exploration and understanding of its carbon footprint. The gained emission transparency helps firms "to first understand where the hotspots are, which plants are important, which units are important, and which scopes are particularly important for each unit." (TECH-3).

Scenario planning and forecasting. Findings suggest that firms further process the transparency of emissions data in scenario planning and emission simulations and forecasts, which can be input for strategic decision-making processes. Thus, processing GHG data and generating novel insights may affect strategic decision-making on multiple organizational levels, as findings indicate: Via scenario and forecasting analyses, firms can plan and calibrate their reduction targets on the executive level, as "the government might also set corresponding incentives" (CHEM-2). CHEM-2 was able to "anticipate the savings achievable with different measures and combined various action packages accordingly." based on scenario development.

Furthermore, firms may leverage forecasts and scenario analyses during the operationalization of decarbonization. For instance, the projection of future product carbon footprints may yield insights into "which products will grow, which will disappear, what materials we have, and what measures we can take at the product level to reduce our footprint." (CONS-1).

4.2 Steer decarbonization via emission reduction targets

Findings indicate that developing emission reduction targets is an integral aspect of a firm's strategic decision-making, as they appear to steer a firm towards decarbonization. These targets appear to be used to signal sustainability commitment externally. Findings further suggest that conflicting goals of decarbonization and profitability targets can hinder decision-making.

Emission reduction targets. All studied firms have defined decarbonization goals, predominantly under the guidance of the SBTi. SBTi appears to play a pivotal role in firms' decarbonization efforts, as "the value of such initiatives […] [is that] they tell industries: '[…] Here are the guidelines. […] These are our suggestions for setting goals.'" (CONS-2). Findings hint at the influencing effect of emissions data and insights into emission materiality informing how reduction targets and measures are constructed; at ENERGY-2, for instance, "the SBTi focuses on production […] as last year we had about 10 million tons from production out of the company's total emissions of 11 million tons." (ENERGY-2). Findings suggest two approaches for developing emission reduction targets: top-down and bottom-up. In the bottom-up approach, a firm's divisions or units are involved in the target development process. This inclusion appears to be especially important in somewhat decentralized organizations: "Involving people, including them in decision-making, and engaging them in the definition of the goals" (AGRI) appears to be essential to ensure commitment and buy-in and to guarantee that the targets are realistic and feasible for the respective division, as "they often know better how to decarbonize their own operations." (INSUR). In the top-down approach, a reduction target is set following the SBTi guidelines and verified by the initiative. Approaches like those observed at CHEM-3, where "we announced the goal of climate neutrality and SBTi, we didn't have a plan yet. We just said, that's how it has to be." (CHEM-3), are no isolated cases.

Target communication. This phenomenon appears to be caused by the firms' desire to communicate their decarbonization targets in the market. Findings show that many of the studied firms adopt an approach where they pledge net-zero targets before "know[ing] the technical details of how to get there" (CHEM-2). Findings suggest that companies tend to capitalize on SBTi's reputation by promoting their cooperation in the market. Findings indicate

that the SBTi is "the most relevant and prestigious certification goal for greenhouse gas accounting […], and it is also the most credible." (FOOD-1), serving as an authority which "external parties can rely on." (CONS-1). Further, findings suggest that firms tend to communicate their reduction targets to react to external stakeholder forces. For instance, regarding competition, "we set climate neutrality goals early on […] especially compared to our competitors." (ENERGY-2), or investors, where firms can "gain better market access to investors and bank loans" (FOOD-1) if they fulfill specific standards. Findings further hint at a reinforcing effect of the public commitment to decarbonization on the firm to adhere to their targets, where the SBTi commitment "acts as a […] self-imposed external pressure." (CHEM-1B).

Goal conflict. The overarching goal conflict between the sustainability and profitability of a firm appears to be an omnipresent issue in its decarbonization at the executive level: "Sustainability is expensive; it doesn't come for free. The money has to be earned somewhere." (CHEM-1A). Interviewees highlight heavy investments and additional costs tied to decarbonization, forcing top management to make strategic trade-off decisions between staying profitable and reducing emissions. The executive level "must have goals that are consistent. If you give them a sustainability goal, a growth goal, and a margin goal simultaneously, it becomes an impossible task." (CHEM-2). Factors such as the currently weak economic state of Germany or risk-imposing global geopolitical and financial uncertainty add further complexity to the dilemma. Findings hint at an attempt to resolve the goal conflict observed at TECH-1, where the integrated corporate and sustainability strategy interlinks the two goals by tying the future revenue goals to emission-low business models.

4.3 Translate decarbonization targets into business planning

Findings suggest that firms deploy different methods to translate the overarching strategic target to decarbonize into more granular and actionable implementation plans and measures and keep track of the subsequent reductions. At the same time, firms strive to align their emissions reduction targets and measures with corporate budgeting and investments.

Emission reduction roadmap and measures. Findings show that within firms, "action plans are created, and measures are recorded" (AGRI), breaking down overarching corporate reduction targets and making them tangible. Defining reduction measures and pathways is a complex, intertwined process often happening in tandem, where the targeted reduction pathway is "backed by concrete measures" (AGRI). The emission transparency gained through the CCF

calculation influences the roadmap development by "considering how our emissions are today, where they come from." (CONS-2). The insights gained via the materiality and driver assessment may determine the measure and roadmap development since the emission hotspots have the most significant reduction effect, as observed at ENERGY-2 (see previous explanation in section 4.2). "The Science Based Target Initiative is relevant when we talk about establishing a transition plan or pathway." (INSUR), as the initiative provides reduction pathways aligned with the firm's carbon budget to meet the reduction targets.

Business planning and resource allocation. Findings indicate decarbonization considerations in a firm's business planning and financial resource allocation, during which the decarbonization roadmap and measures are integrated and aligned with traditional business planning. Findings suggest various strategies for putting this into practice: One approach is to implement a separate sustainability budget for the implementation of reduction measures, where "the measures are incorporated into the capital expenditure plans for the coming years [...] [via] a separate package […] for sustainability projects." (AGRI). CHEM-1 "will invest [the dedicated decarbonization budget] into products where we expect the capital expenditure to be quickly recovered." (CHEM-1A). ENERGY-1 deploys an integrated approach, where in the mid-term business planning process, "now a column titled 'How much Carbon?' is being added to the table." (ENERGY-1). ENERGY-2 adopts a similar approach to mid-term planning. Thus, "decisions, which would have been unthinkable four or five years ago, such as acquisition or business development decisions, are now also dependent on whether they have a negative impact or steer us away from the 1.5-degree path." (ENERGY-1). Findings indicate that firms compare emission forecasts and business planning targets to inform their strategic investment decisions to align with the firms' reduction targets. For instance, at TECH-1, GHG data helps the firm to understand "[this is] where we are and where we need to be. And that forms the baseline of understanding: Now we need to invest more into [product X]. We need to put more [product Y] on the market." (TECH-1). The trade-off decision of having emissions in one scope to compensate or finance the emission reductions in another is a further pattern observed in the findings that can be relevant during firms' business planning: "[..] it might pay off to expand in scope 3 if I have a compensating or even positive effect in Scope 4." (TELCO).

Reduction monitoring. Lastly, findings suggest that monitoring the progress towards the emission reduction targets is an element of a firm's business planning for decarbonization. Firms compare the current emission levels to the planned reduction path: "The numbers we collect are used to see if we are on track to reach our goal." (CHEM-1B). This comparison can be relevant for the overarching corporate reduction goals or on the explicit reduction measure

"to see if my activities […] are effective both in terms of their impact and their timeline" (ENERGY-2).

4.4 Anchor decarbonization targets in governance mechanisms

Findings indicate that decarbonization efforts are anchored throughout all levels of an organization and that multiple mechanisms enable strategic decision-making regarding a firm's decarbonization.

Steering factors. Findings observe several approaches to establish carbon-related steering factors to guide strategic decision-making. One example is the implementation of the KPI "CO2 intensity" at ENERGY-2 to indicate how the CO2 intensity of their energy generation evolves. "Internal carbon prices are a good instrument." (CONS-1), a vehicle many firms have implemented or are planning to implement. An internal carbon price establishes a carbon "budget for each business unit [and] whenever you purchase something or take some action, it essentially deducts from this pool" (CONS-1). The concept follows the logic that GHG emissions "will affect all departments if you truly have it included in your budget." (FOOD-2). Essentially, universal organizational steering factors related to GHG emissions "in procurement, development, production – essentially at all levels – […] ensure that [the emission impact] is properly integrated into existing processes as a fixed criterion." (CONS-3).

Performance incentives. Tying the decision makers' compensation to achieving emission reductions, especially concerning a firm's executive and board level, is another observed approach to anchor decarbonization within an organization. Because when "a significant […] amount of money is lost by the end of the year, […] then it becomes a strong incentive" (CONS-1) for decision-makers to make decisions that contribute to the decarbonization targets. At CHEM-3, emission reduction goals are "part of the corporate strategy and thus also part of the compensation for the executive board, […] and other people who are part of the direct management. Therefore, this whole issue takes on additional significance from a corporate governance perspective." (CHEM-3).

Organizational set-up. The firm's organizational structure is observed as another lever to anchor decarbonization and facilitate strategic decision-making. Apart from central sustainability teams, some firms "have a dedicated sustainability manager in every division" (AGRI) to break down high-level reduction targets and "integrate [decarbonization] into the departments, the business units, and the processes." (AGRI). ENERGY-1's "operating units are now installing sustainability specialists within the functional departments […] so […] there is

always someone considering these aspects and looking for where we can implement [measures] and decarbonize." (ENERGY-1). Similarly, at CHEM-1 it is believed that "sustainability staff […] should be distributed throughout the company, being knowledgeable about both topics: sustainability and the operational business." (CHEM-1B).

4.5 Operationalize decarbonization targets across business functions

A firm's divisions and different parts of the value chain operationalize decarbonization targets. Findings highlight five fields of action, where the strategic steering towards decarbonization manifests, and subsequent strategic decisions are made, utilizing raw and processed GHG emission data.

Energy efficiency potentials. Especially for manufacturing industries, the transition towards renewable energy or green hydrogen is observed to be a big lever in reducing scope 1 and scope 2 emissions. Unlike other fields, energy source decisions are within a firm's direct scope of control. Hence, "the company can directly make these changes" (CONS-2).

Product, portfolio, and business model. Findings suggest that firms can decarbonize by reconfiguring products, product portfolios, and business models. For instance, at FOOD-2, emission information on the material inputs of their products influences their compositions. At FOOD-1, "emission reduction can be achieved through […] changes in the product range" (FOOD-1). Interviewees reflect that the consideration of downstream scope 3 emissions forces firms to see their business models and products from a new perspective, where they are made accountable for the emissions caused by their products throughout their lifecycle: "If we manufacture vehicles […] we decide we will no longer introduce [vehicles] into the market that are powered by gasoline, or diesel, but rather are electrified." (CONS-1). CHEM-1 has solidified its product portfolio transition by making the expansion of emission-low products a strategic priority, which allows the firm to "significantly reduce the environmental footprint for the customer in applications" (CHEM-1A).

Development. "It's kind of for the rule of thumb that you are able to curb 80 percent [of emissions] in the concept phase of your product." (TECH-1). Among the manufacturing firms, findings show that some emphasize driving decarbonization via the research and development department of the organization. By considering the "environmental delta" (TECH-1) between different input materials, brought about by the data transparency on their emission levels, firms can make strategic trade-off decisions "to define and create more sustainable formulas" (FOOD-1) and develop emission-low products.

Sourcing decisions. Depending on the business model, some firms' CCFs may be significantly influenced by upstream scope 3 emissions. Findings show that the accessibility of that data is a significant challenge despite the suggested importance of emission transparency from suppliers in strategic sourcing decisions: "I first need transparency at the supplier and product level to know where to start." (TECH-2). Hence, firms are observed to establish supplier requirements, i.e., "the technical specification that we are demanding." (TECH-1). Firms with more extensive market power may "pass their requirements through the entire supply chain" (CONS-3) by saying, "'You must send us your […] product carbon footprints, along with verifiable proof of the actions you are taking.'" (CONS-1), to ensure that their own targets are met. The disclosure of this information by the suppliers can enable strategic decision-making in procurement, and "it should eventually lead to making informed decisions. The objective is to select supplier B over A due to their lower emissions." (CONS-3).

Supplier development. Findings show that organizations can develop their suppliers and jointly reduce emissions. To manage a firm's upstream scope 3 emissions, firms can "empower [their] suppliers to both comprehend their own footprint and decrease it." (CONS-1). To foster sustainable supplier relationships, firms "need to find common ways to set requirements for the suppliers and also help them understand how they can achieve these, where possible." (CHEM-3).

4.6 Impact of external stakeholder forces on decarbonization

External stakeholders seem to play a significant role in shaping a firm's decarbonization efforts. Various forces collectively influence firms' decarbonization decisions, including regulatory requirements, accounting frameworks, market pressures, and industry-specific conditions.

CSRD regulation. Interviews highlight that the CSRD, hence the "regulatory aspect, is the primary driver" (FOOD-1) for all firms to implement company-wide GHG accounting practices to calculate corporate-level emissions and disclose them annually. Through the gradual advancement of the directive and the growing scope and depth of its requirements, firms progressively fall into its scope, and their "data collection […] will be much more comprehensive and complete […], simply because it is required by regulation" (INSUR).

Accounting framework. Firms' compliance with the imposed regulation depends on accounting frameworks and guidelines, such as the "GHG Protocol as a reliable standard" (TELCO). Findings suggest that navigating existing accounting standards is difficult as "the entire field is highly dynamic" (CHEM-2). Interviewees point out that firms struggle with unspecified

accounting issues and missing guidelines, impeding decision-making: “We don’t know what the final guidelines will be. This means we can’t make proper decisions.” (CHEM-1B).

Market pressure. Interviewees describe that apart from the regulatory pressure, stakeholder groups such as customers, competitors, and financial stakeholders exert pressure on firms to decarbonize. For positive environmental ratings and support from investors, firms “must demonstrate relevant activities for reducing CO2 emissions and support this with data, facts, and figures” (ENERGY-2). Adding on earlier findings (see section 4.2), being certified by the SBTi appears to be a credibility-giving vehicle. Despite the SBTi being “technically voluntary, […] there is a certain pressure to announce targets” (CONS-3) to remain competitive.

Industry specificities. As “regulatory trends […] are uncertain” (CHEM-2), firms are forced to make strategic decisions despite the lack of information on subsidies or political framework conditions. Industry-specific regulations and market conditions can thus limit the action scope of firms in their options to decarbonize. For instance, the strategic portfolio decisions of TECH-1, active in the regulation-driven heating sector, are impacted by gas prices and the consequently changing demand for their products: “People are moving back towards boilers” (TECH-1). These dependencies and resulting fluctuations are “causing shifts in the emissions [...] causing us to revise the targets” (TECH-1). Lastly, findings suggest uncertainty in the availability and accessibility of emission-low resources such as renewable energy or green steel, as firms are unsure “whether the total amount will be available in the market” (CONS-1). Firms must factor these uncertainties into their strategic decision-making.

4.7 Impact of cultural dynamics on decarbonization

Decarbonizing a business is a complex endeavor involving every individual within the organization. The success of this endeavor appears to hinge on the workforce’s cultural readiness and commitment, which influences the entire decarbonization process.

Cross-functional collaboration. The involvement of stakeholders from all functions and divisions throughout the decarbonization process appears to be a critical factor “to get buy-in from everyone, to hear and include [all] viewpoints, perspectives, and reservations” (CHEM-2). Findings hint at cross-functional collaboration of stakeholders at multiple stages of the decarbonization process: During the development of AGRI’s decarbonization strategy, “the first step was to form a group sustainability team with representatives from each division to create a common platform for exchange and coordination” (AGRI). CHEM-2 “conducted several workshop series and developed this roadmap across all functions” (CHEM-2).

Furthermore, at TECH-1, "for the first time in 107 years lifetime of the company, […] we brought everyone to one table for the development of a new product." (TECH-1).

Training and education. Training and educating a firm's workforce on GHG data and decarbonization seems critical for a firm's successful transition towards net zero. Interviewees suggest that the goal is a sensitized workforce, where "every person making a decision [is] aware of the options and what they mean in terms of emissions." (CONS-1). On the one hand, findings hint at the need for further training for corporate executives to comprehend the complexity related to decarbonization, as "traditional executive positions are not trained for this. […] There needs to be a sensitization process. Because everything that is established at the top can be effectively implemented throughout the company." (CHEM-3). On the other hand, "making people more aware of how their decisions affect these numbers" (CONS-2), especially during the implementation of the decarbonization strategy and the daily doing of employees (see application fields in 4.6) appears to be mission critical.

Organizational inertia. A common seemingly culturally conditioned phenomenon in decarbonization is organizational inertia. Multiple factors appear to contribute to this inertia. First, in light of the earlier examined external factors, a firm must make strategic decisions under a range of complexities and uncertainties. Despite emerging regulation and highly dynamic accounting frameworks, firms must "act quickly, and acting quickly means not everything is fully formulated and predefined." (CHEM-2). Navigating the issue of systematic decarbonization considering these conditions is challenging, and "the best practice is missing" (TECH-1), but "waiting won't make it any cheaper" (CONS-3). Second, organizations appear to invest significant effort, time, and money in perfecting CA tools, reduction measures, and transition roadmaps, only to find out that they are running out of time – "I am now wasting a lot of resources just to develop a model, thinking it will eventually be perfect. And then I end up sleeping through three years without implementing anything." (CONS-1). Third, the morale of the workforce, which decarbonizes a firm through their daily doing, is affected by the complexity and bureaucracy of regulations and requirements: "Willingness decreases whenever there is an abundance of requirements or guidelines, and it's unclear where they are leading." (INSUR).

5 Discussion

The findings explore how firms make strategic decisions towards their decarbonization via the angle of GHG data integration and utilization, yielding a novel process framework and

dependent internal and external factors (see Figure 3). The study largely confirms previous research on CA and MCS, highlights novel academic contributions through new insights and further nuances in existing knowledge and holds managerial implications; however, it is important to note its limitations.

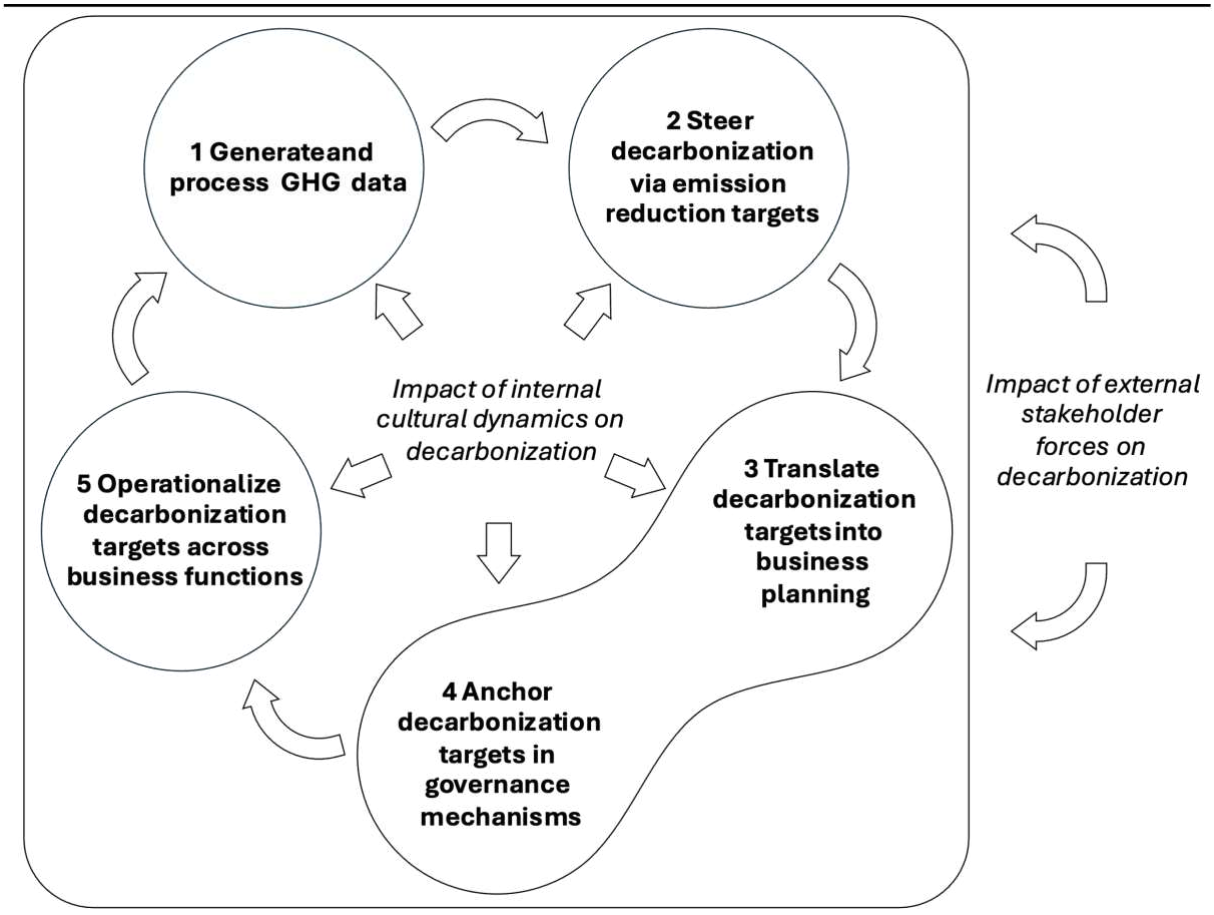

Figure 3: Process framework

Source: *Own illustration*

5.1 Theoretical and managerial contributions

The study's first substantial contribution is the synthesis of findings that map out a process outlining how GHG data is utilized in a firm's strategic decision-making towards decarbonization. The framework is driven by GHG data integration, which in and of itself yields a novel perspective, empirically exploring interfaces and dependencies of CA and MCS literature. Therefore, the framework strives to connect these research streams, explore entirely novel elements, and add nuances to existing literature. Hence, the findings may enrich the currently scarce literature on carbon MCS (CMCS) via empirical clues and possibly advance the field of CMA through the framework's process perspective.

In summary, the framework entails the following elements: First, the firm calculates its CCF in line with the baseline character of CA stated in the literature (Hahn et al., 2015; Stechemesser & Guenther, 2012; Tang & Luo, 2014). Second, the firm develops GHG emission reduction targets based on GHG emission transparency (Busch et al., 2022; Bui & de Villiers, 2017b). Third, the firm breaks down overarching targets and makes them actionable in short and mid-term planning (Bui & de Villiers, 2017b; Gond et al., 2012), while in the fourth element, the firm establishes supporting governance mechanisms such as GHG emission-related compensation schemes (Bui & de Villiers, 2017b; Dutta et al., 2013; Gond et al., 2012; Lothe et al., 1999) or KPIs. The third and fourth elements can be seen as inseparable in their sequence because they can influence each other mutually. For instance, findings indicate that GHG emission KPIs may determine a firm's business planning process. Or business division-specific reduction targets may influence the individual compensation scheme. The mechanisms and organizational actions summarized in the framework's elements two to four appear to align with MCS literature due to their influencing effect on employee behavior and decision-making (Crutzen et al., 2017; Guenther et al., 2016; Malmi & Brown, 2008). In the fifth element, enabled by the preceding steps, the firm utilizes GHG emission data to operationalize decarbonization targets through decision-making in different business areas, such as product innovation (Ratnatunga & Balachandran, 2009; Schaltegger & Csutora, 2012), or sourcing. Next to the process, two groups of influencing factors – external stakeholder forces and internal cultural dynamics – were identified. Their effects on a firm's decision-making towards decarbonization remain either partially or entirely uncharted in current CA and MCS literature despite the challenges they appear to impose on firms, which will be further discussed in the following.

The study yields many novel contributions that have yet to be recognized in the literature.
First, the study indicates the presence of an overarching goal conflict between profitability and sustainability at the executive level as a critical obstacle in steering a firm's decarbonization, thereby affecting the entire process. The impeding effect of inconsistent executive priorities and the lack of integration of decarbonization targets with other firm-overarching targets remains largely undiscussed in literature – existing research primarily recognizes goal conflicts as possible hindrances to CMCS implementation (Bui & de Villiers, 2017b). The study observes different approaches firms adopt to soften this conflict and create shared value for both perspectives: A firm can interlink the dual business goals in their strategy by tying future revenue goals to emission-low business models. Alternatively, a firm may initially prioritize

investments in emission-reducing products where they expect quick capital expenditure recovery.

Second, the role of the SBTi must be discussed as an apparent enabler of a firm's entire decarbonization processes, influencing and supporting strategic decision-making in various factors. Although MCS literature suggests that standards influence the implementation of management controls and guide optimal sustainability management (Bansal, 2002; Windolph et al., 2007), this may not fully capture the extensive and holistic influence the SBTi appears to exert on decarbonization of firms across industries. The fact that the reduction targets of all firms have either been developed under the SBTi's guidance or verified through the initiative underscores its profound influence. Findings suggest that firms rely heavily on the SBTi when constructing emission reduction pathways and measures. Further, they utilize approved reduction goal paths to compare to actual emission reductions and monitor their progress. Despite the initiatives' observed substantial impact on firms and industries, there is minimal research on the initiative itself, the impact it elicits, or its effect on third parties.

Third, the study identifies three factors that appear to constrain, decelerate, or postpone a firm's strategic decision-making towards decarbonization to some degree that lie outside a firm's control. Dynamic and partly insufficient or incomplete accounting frameworks challenge most firms studied. These issues appear to create significant sources of uncertainty for firms. Without a clear understanding of how their emission accounting will impact them, firms struggle with strategic decisions, which delays the implementation of decarbonization efforts. Industry specificities are another factor that may constrain a firm's strategic decision-making towards decarbonization. Regulatory frameworks, the market being dependent on exogenous factors (e.g., gas price dependence on geopolitics), or insecurity on low-emission resource supply impose uncertainty and limitations to the decarbonization action scope of a firm. Nonetheless, the challenges largely depend on the individual case of the firm as well as the German market and regulations. While previous studies have observed the lack of granular and high-quality data as a challenge (e.g., Bui & de Villiers, 2017b), this study offers novel contributions to its causes. Insufficient calculation methods, missing information from suppliers, and ambiguous emission factor databases result in low data quality, granularity, and even data gaps. These apparent dependencies have yet to be recognized in the literature despite appearing to be very present issues in organizational reality.

Fourth, the study identifies supplier development and GHG-integrated sourcing as novel application fields in which firms integrate GHG data into strategic decision-making towards decarbonization. While literature already acknowledges that GHG emission information can

facilitate the exhaustion of energy efficiency potentials (Bui & de Villiers, 2017b; Stechemesser & Guenther, 2012) and alterations to products or portfolios towards emission-lower versions (Bui & de Villiers, 2017b; Ratnatunga & Balachandran, 2009; Schaltegger & Csutora, 2012), the impact on GHG data on supplier relationships remains less explored. The findings suggest that firms depend on suppliers to reduce their scope 3 emissions. To manage this dependency, companies may incorporate GHG emission as a decision factor in their sourcing decisions, enabling them to purchase emission-low resources and thus manage their scope 3 emissions. Furthermore, firms may engage in supplier development by treating decarbonization as a systemic issue and collaborating with suppliers across the supply chain to address new requirements and develop joint solutions.

The study further advances existing CA and MCS literature and provides nuances to theory through the GHG data integration perspective.

This study's findings provide further empirical clues suggesting the applicability of the MCS concept in the carbon context, which enables the integration of GHG data in strategic decision-making.

Findings throughout elements two to four in the process framework hint at a variety of mechanisms that could be classified as formal (or technical) CMCS, as they appear to influence employee behavior and decision-making towards decarbonization targets (Crutzen et al., 2017; Guenther et al., 2016; Malmi & Brown, 2008), and have been previously acknowledged in EMCS and CMCS literature. Findings, for instance, suggest the deployment of CMCS to develop reduction targets (Bui & de Villiers, 2017b) or monitor emission reductions (Bui & de Villiers, 2017b), among others.

Drawing from the MCS package framework, additional mechanisms that the study identifies may be classified as MCS, whereby the study could contribute to the discovery of further so far undiscussed CMCS: The development of a GHG emission reduction roadmap may be classified as a planning control because it enables the coordination across functions towards a firm's holistic decarbonization (Malmi & Brown, 2008). Explicit budgeting for the implementation costs of reduction measures may be classified as a budget cybernetic control because it is a systematic plan for allocating financial resources (Malmi & Brown, 2008). Or, a carbon price or similar carbon-related KPIs may be considered administrative controls because they act as decision indicators that direct behavior in a standardized manner across the organization (Malmi & Brown, 2008), to name a few examples.

Compared to the range mechanisms that may be classified as formal CMCS, findings suggest that the deployment of informal CMCS falls short, as findings indicate the deployment of one informal CMCS, namely cross-functional collaboration. Interviewees convey that for some firms, the collaborative and, more importantly, cross-functional working mode enables strategic decision-making towards decarbonization. It allows for an integration of various perspectives and an enhancement of the reliability and robustness of the resulting plans, measures, or products stemming from this mode of working. Hence, cross-functional collaboration may be viewed as a hybrid control, being both formal and informal, because both formal and informal definitions apply: Cross-functional collaboration can be seen as a purposively designed process while also having a cultural appeal (Crutzen et al., 2017). This MCS or CMCS type has yet to be accounted for in current frameworks or observed empirically.

Further, findings indicate the importance of the individual in strategic decision-making towards decarbonization. Interviewees stress employees' lack of awareness about the impacts of their decisions, their insufficient responsibility, and the lack of top management attention and infer that these issues are culturally conditioned. Thus, training and further education are identified as mechanisms that could alleviate these issues by guiding the individuals' decision-making via values and beliefs, hence training and education may be classified as an informal CMCS (Crutzen et al., 2017; Tessier & Otley, 2012). While the individual's awareness of their impact has been recognized as being critical for decision-making towards decarbonization (Gond et al., 2012), training and education as CMCS have not been accounted for in current frameworks or observed empirically.

One could argue that the observed organizational inertia stems from the suggested imbalance of formal and informal CMCS. Because findings indicate that a firm's workforce and its morale are key factors in strategic decision-making towards decarbonization, which could be shaped by informal controls. Hence, the study suggests that the complementary and reinforcing nature of formal and informal is critical for their effectiveness, in line with general MCS literature (Crutzen et al., 2017; Guenther et al., 2016; Malmi & Brown, 2008).

Lastly, the study could extend the current literature on the signaling effect of voluntary carbon disclosure by presenting empirical findings that suggest these effects apply to the SBTi as a voluntary standard. Multiple firms within the sample announced emission reduction targets verified through the SBTi without organizational backing on how to achieve them. Thus, the study indicates that firms may participate primarily in the voluntary disclosure scheme to address stakeholder pressure (Bui et al., 2020; Bui & de Villiers, 2017a) and improve their reputation to gain access to investors (Hahn et al., 2011). Findings suggest that some firms

initially exploit the standard's credibility, reputation, and signaling effect while avoiding the necessary investments for decarbonization (Aravind & Christmann, 2011; Nava & Tampe, 2022). The study further indicates that the SBTi collaboration and commitment and its external communication may serve as an internal pressure to act on reduction commitments to safeguard one's reputation.

The study yields six relevant managerial implications derived from the discussion of findings, which are valuable for practitioners who are experienced with decarbonization efforts and those who are just starting out, as well as policymakers.

First, while formal CMCS appear to already be widely used in practice and essential in enabling GHG data-driven decision-making, the study suggests the absence of informal CMCS. Findings are in line with existing MCS literature underlining that formal MCS should be reinforced and complemented by informal MCS. Hence, managers are encouraged to implement packages of suitable formal CMCS and complementary informal CMCS. Thereby, managers could shape corporate culture and further enhance the effectiveness of formal CMCS to facilitate GHG data integration in strategic decisions and counteract organizational inertia.

Second, the study's insights on the conflict between decarbonization and profitability goals hold significant managerial implications. Overarching corporate goals and prioritization should be consistent and unambiguously defined at the top management level and transparently communicated throughout all levels of the organization to ensure efficient and effective translation into decision-making regarding decarbonization action.

Third, in line with CA literature, the study highlights the importance of a granular, high-quality, and homogeneous GHG data foundation for further organizational carbon management activities. In addition, EU regulators mandate these various emissions-related information via the CSRD and ESRS, whose scope and granularity will increase in upcoming years. Thus, managers should develop and maintain a cohesive "single source of truth" data management system and cultivate coherent and granular data as the foundation of GHG data-driven decisions. Interviewees highlight that the complexity and effort required to establish appropriate systems and mechanisms for GHG data collection and management can be substantial and resource-intensive for companies starting their decarbonization efforts. Thus, managers should quickly create initial emission transparency as a baseline to facilitate the start of decarbonization action and not fall victim to perfectionism in detailing a perfect, granular, and accurate system, thereby losing time on implementing emission reductions.

Fourth, collaborating with the SBTi has been observed to have a trailblazing and facilitating effect for firms in the identified process framework. Thus, especially for managers starting with integrating GHG emission data into their firm's strategic decision-making towards decarbonization, the findings suggest that leveraging guidance from the SBTi is beneficial.

Fifth, the study yields managerial suggestions on how firms could operationalize decarbonization targets via strategic decision-making enabled by the utilization of GHG data. It highlights five application fields where the process framework may facilitate emission reductions (see section 4.5). Practitioners may find these cases useful as initial best practices.

Lastly, despite the study's insights suggesting that mandatory carbon reporting as a regulatory vehicle has led to firms establishing CA and CMA systems (Bouten & Hoozée, 2013), the study also suggests that continuous changes and a lack of clarity in GHG reporting management regulation, and accounting frameworks are sources of uncertainty for firms, impeding their decision-making. Thus, regulators should close gaps, dissolve existing framework ambiguities, and provide firms with applicable and actionable guidance supporting their decarbonization.

5.2 Limitations and further research

Despite the researcher's efforts to provide a sound account of the decarbonization process in large German companies to answer the research question, several noteworthy limitations prevail.

First, all interviewees hold a position and expertise related to sustainability. Hence, their depictions might be biased by personal beliefs or environmental activism. Further, all interviewees' roles focus on sustainability-related activities such as GHG reporting. Hence, their perception of how their firm's business is done stems from an isolated place and is not contrasted by other functions. This concern extends to the complementary consultant perspectives, with their core expertise in sustainability. While their specialized and industry-overarching knowledge is valuable, it may lead to an emphasis on sustainability issues over other business considerations. Third, the findings were solely derived from the description of one employee of each firm (except for CHEM-1). Therefore, it would be beneficial to have complementary data sources to triangulate their perspectives. Fourth, while including consultant perspectives may have enriched the overall data collection, they may limit the theoretical saturation in some categories due to their outside-in perspective. Fifth, the findings are contingent on the general size and German location of the organizations studied, and due to the non-probabilistic nature of the sample, they cannot be generalized (Saunders et al., 2019).

Most of the firms have been subject to the NFRD regulations and hence have been faced with sustainability considerations and challenges for some time, in contrast to SMEs that will move into the scope of the CSRD in upcoming years. Thus, the studied firms are of a size and caliber where resource investments in decarbonization efforts could be of another proportion compared to the possibilities of smaller organizations.

While this study provides cross-industry insights and adopts a process perspective on how firms integrate GHG data into strategic decision-making towards decarbonization, this perspective may offer a valuable edge for future research. First, further research on singular industries could yield insights into industry-tailored challenges and mechanisms. The interviews revealed patterns within industries that were out of the scope of this study but warrant further investigation for theoretical saturation. Second, the observed effect of organizational culture on decarbonization efforts and GHG data-driven decision-making may warrant further exploration to gain more insight into the phenomenon of organizational inertia. Third, further studying the observed correlation between a firm's proximity to end customers and the firm's respective approach to decarbonization could be valuable following explorations such as those by Gong et al. (2019). Fourth, the sampled firms appear to have different maturity levels in their organizational decarbonization efforts. Thus, an in-depth exploration of the timing and relevance of the identified process elements along a firm's decarbonization journey could add value to existing literature. Lastly, future research could investigate the physical effectiveness of the identified process and its elements in actual emission reductions, specifically linking management controls to tangible and quantitative GHG emission reductions.

Finally, it is essential to acknowledge that the outlined process and its dependent internal and external factors are an aggregation of findings on 14 organizations supported by consultant perspectives. While the study provides an overview of adopted practices throughout industries, it is neither a one-size-fits-all approach nor the best practice practitioners may seek. The appropriate approach for each organization may depend on innumerable factors: the industry, the organizational size and structure (Christ & Burritt, 2013), the firm's business models and products, contingent value and supply chains, market role, corporate culture, leadership agenda and commitment, or the decarbonization maturity (CDP & Capgemini Invent, 2023) which in turn depends on the imposed regulation, and market, among many other factors that remain to be explored.

6 Conclusion

With over 50,000 companies falling under the scope of the CSRD in the EU by 2027, understanding how firms can leverage GHG data into decarbonization action is more critical than ever. Reviewing current literature revealed little theoretical and empirical investigation on how firms utilize and integrate GHG information in strategic decision-making towards corporate decarbonization. This study attempts to address this research gap by seeking to understand this utilization and integration via qualitative research based on 15 interviews with representatives of large German firms and sustainability consultants. The empirical investigation and data analysis based on the Gioia methodology yields a five-step process framework, depicting how corporate GHG data feeds strategic decision-making towards decarbonization: From generating a CCF over the installed CMCS enabling strategic decision-making towards decarbonization to the actual emission-reducing actions in respective functions or business fields. The study further identifies internal and external factors and their interdependencies with the process.

The study yields theoretical contributions and managerial implications for how firms utilize GHG data in strategic decision-making towards decarbonization. The findings confirm that sound GHG data collection, management, and processing form the baseline of the process. Many predominantly formal CMCS appear to anchor the integration of GHG data in strategic decision-making towards decarbonization. Currently, firms seem to overlook the implementation of informal CMCS despite their suggested complementary effect on formal CMCS. Thus, findings confirm the general literature on MCS and may add nuances to the literature on CMCS. Finally, the process appears to facilitate firms in making effective decisions to operationalize their decarbonization targets align with existing findings in broader CA literature and possibly add to it.

While the process holds managerial implications on how firms can approach GHG data-driven decarbonization in and of itself, the challenges associated with that process brought to light are of significant value to practitioners. This study suggests that by deploying suitable CMCS, resolving goal conflicts, building a cohesive GHG data management system, utilizing SBTi guidance, and leveraging industry best practices, firms can strategically use GHG emission data to drive decarbonization forward.

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Appendix 1: Interviewees and sampled firms

#	Name	Position	Industry	Quote	Date	Recording
1	JL	Manager Environment & Climate	Telecommunications	TELCO	27.03.24	00:54:17
2	TS	Senior Manager Sustainability	Chemical/ pharmaceuticals	CHEM-1A	28.03.24	00:53:24
	SLU	Analyst Sustainability & Life Cycle Management		CHEM-1B		
3	JT	Global Manager Product Sustainability and Circularity	Technology/ mechanical engineering	TECH-1	05.04.24	00:46:31
4	UK	R&D Principal Scientist Sustainability & Manager Corporate Regulatory Affairs	Chemical/ pharmaceuticals	CHEM-2	10.04.24	00:37:11
5	MP	Head of ESG Data & Reporting	Energy	ENERGY-1	10.04.24	00:35:01
6	AV	Consultant	Food logistics	FOOD-1	16.04.24	00:24:23
7	ME	Senior Consultant	*Overarching consultant perspective*	CONS-1	19.04.24	00:52:23
8	SLE	Senior Manager Sustainability Reporting & ESG Ratings	Chemical/ pharmaceuticals	CHEM-3	22.04.24	00:53:37
9	RP	Specialist for Special Tasks in Environmental and Energy Management Environment	Energy	ENERGY-2	23.04.24	00:43:05
10	MR	Senior Consultant	*Overarching consultant perspective*	CONS-2	23.04.24	00:39:09
11	TF	Managing Consultant	Technology/ mechanical engineering	TECH-2	23.04.24	00:31:24
			Technology/ mechanical engineering	TECH-3		
			Overarching consultant perspective	CONS-3		
12	JJ	Director Corporate Sustainability	Agriculture	AGRI	24.04.24	00:35:12
13	AB	Manager Group Sustainability	Insurance	INSUR	25.04.24	00:35:00
14	IB	Sustainability Manager	Food logistics	FOOD-2	25.04.24	00:23:45
15	RW	Tax Advisor & Sustainability Expert	Service provider	SERV	25.04.24	00:26:11

Appendix 2: Semi-structured interview guide

1 Introduction	
Thank you for taking the time to talk to me today. - ***Personal introduction**: I would like to introduce myself properly: My name is Jule Schütt, I am a Management Master's student at Católica Lisbon School of Business and Economics. Currently, I am writing my thesis on carbon accounting and strategy under the supervision of Filipa Lancastre – Assistant Professor of Strategy, Organization and Entrepreneurship.* - ***Interview Purpose**: As quickly described in my message, I am interested in [Company name]'s approach to carbon accounting and if and how the information gathered here influences the firm's strategy.* - ***Disclaimer**: I would like to ask your permission to record our conversation. Please let me know if you wish for me to anonymize the data and findings related to [Company name] as well as yourself.*	
2 Interviewee	
Role	What is your current role at [Company name] and what does it entail?
Involvement	How and to what extend are you involved in carbon accounting, carbon reporting, and strategy development?
3 Carbon Accounting – Background & History	
Go/ No Go	Does [Company name] track its carbon emissions currently?
History	Tell me about the evolution/ progression of [Company name]'s carbon accounting journey (e.g., initiation, changes over time, etc.).
Initial motivation	Why has [Company name] initially started carbon accounting efforts?
Standard	Do you know what the underlying standard under which [Company name] conducts carbon accounting is (e.g., GHG protocol, CSR-RUG)?
Regulation	To what extent is [Company name] currently regulated and what does this regulation imply for [Company name]?
Voluntary action	To what extent does [Company name] currently engage in voluntary carbon accounting and what does this voluntary action imply for [Company name]?
4 Carbon Accounting – Technical	
In the following I would like to get an understanding how the carbon accounting process at [Company name] looks like. Therefore, I have prepared specific questions.	
Process	As a starting point, I would be interested if you could briefly outline the general process of carbon accounting at Viessmann?
Data types	What physical and/ or monetary data is collected?
	Physical data - *physical carbon emission flows*

	Monetary data - *monetary impact of emission savings or reductions* - *costs associated with carbon certificate trading* - *investing in carbon reduction related technologies or projects*
Emission scopes	What emission scopes are covered by the carbon accounting process (scope 1-3 emissions)?
	Clarification of emission scopes if necessary - *Scope 1: Direct emissions caused by company facilities and vehicles* - *Scope 2: Indirect emissions from purchased energy* - *Scope 3: Indirect emissions from up- and down-stream activities*
Time frame	Is the collected data, past, present, or future oriented?
	- *Past: Physical emissions and/ or related monetary impacts that happened in the past* - *Present: Currently ongoing physical emissions and/ or related monetary impacts* - *Future: Planning/ accounting for future physical emissions and/ or related monetary impacts*
Information frequency	With what frequency is the information generated?
	e.g., routinely, ad-hoc/ project related, project management control supporting measure
Length of time	Does the collection/ aggregation of carbon data (physical and/or monetary) have a long-term or short-term focus?
	e.g., short-term: consideration of CO2 reduction effect of a project in the next accounting period *vs. long-term: calculation of total CO2 reduction effect of clean production investment*
Past obstacles	Were there any obstacles or challenges in the past when it comes to implementing carbon accounting at [Company name]?
Current obstacles	What are current obstacles or challenges you are facing when it comes to carbon accounting?
5 Carbon Accounting – Purpose	
Purpose	What is/ are the purpose(s) of carbon accounting at [Company name]? Apart from the reporting obligations?
Motivation evolution	Has the initial motivation to start carbon accounting prevailed or is carbon accounting at [Company name] now motivated by other additional factors?
Utility	What is the information gained from carbon accounting used for?
6 Strategy	
Governance/ Org. structure	How is sustainability governed? What does the organizational set-up look like?

Sustainability Strategy	Please describe the relationship of carbon accounting and the sustainability strategy.
Strategy integration	In your perception and experience, is information gained through carbon accounting is integrated and or utilized in strategy development or strategic decision making at [Company name]?
SI_Yes Strategic decision making	To what extend do you think the information gained through carbon accounting is integrated and or utilized in strategy development or strategic decision making? In what ways?
SI_Yes Strategy development process	At what stage of the strategy development process would you say the information gained through carbon accounting is utilized or integrated?
SI_No Opportunity	Do you think the information gained in carbon accounting can be useful to inform strategic decision making? In what ways?
SI_No Strategic decision making	Why do you think [Company name] does not utilize carbon information when formulating its strategy? Are there any obstacles that stand in the way of utilization?
(Strategic) Benefits	What are the (strategic) benefits of carbon accounting for [Company name]?
Additional benefits	Do you think there could be other benefits from conducting carbon accounting that [Company name] is not capturing at the moment? Why do you think these benefits are not captured?
Disadvantages	Do you see any disadvantages of doing carbon accounting? If so, why?
Lessons learned	Are there any major pitfalls or lessons learned when it comes to implementing carbon accounting (and linking it to strategic decision making)? What would you do differently from today's perspective and why?
Decision makers	Who are the key decision makers when it comes to decisions in regard to carbon emission management? Would it be possible to talk to one of these decision makers?
7 Closing	
Additions	Is there anything you would like to add to our conversation?
Network	Do you feel like there is anybody within your organization who I could talk to about this regarding carbon accounting and strategy at [Company name]? Or do you have any contacts within the industry that I could reach out to?
Thank you for taking the time to talk to me today. I really appreciate your time, openness and help in conducting this study.	

Appendix 3: Interview transcripts

All interview transcripts can be viewed on the researcher's personal SharePoint via the following link: https://shorturl.at/cL9iB

Appendix 4: Analysis of data structure based on Gioia methodology

First-order concepts[3]	Second-order themes	Aggregate dimensions
CHEM-1B “And within this database, we have also added, let's say, supplementary databases. Because we know our standard database covers 80 percent. But we have 20 percent more. This means we need additional databases.”	Calculate a CCF with relevant data at the needed granularity, quality, and reliability	Generate and process GHG data
CHEM-1B “TFS is a system within the chemical industry that aims to establish a unified calculation basis for emissions, specifically for raw material emissions, and also to share carbon footprints with each other.”		
CHEM-2 “And ways need to be developed to manage these increasingly granular data, ensuring they are properly and accurately included in the calculations.”		
CHEM-2 “Because transparency is always the starting point for everything.”		
CHEM-2 “So, we are working with the Sphera GaBi database, which is the leading database in the chemical industry. There is also the EcoInvent database, which we initially worked with and now actually have to work with in parallel.”		
CHEM-2 “We naturally need to obtain as much information as possible from the supplier and their supplier. And the supply chain is very long. And creating transparency there was one of the biggest challenges at the beginning. We had suppliers who were either unable or unwilling to establish this transparency.”		
CHEM-3 “We are also working on calculating product carbon footprints for some of our products ourselves.”		
CONS-1 “Because, in many cases, the primary data isn't available yet. They haven't provided it, or they haven't collected the primary data yet.”		
CONS-1 “Integrating this emissions calculation into all processes is essential. I know it's a significant investment in terms of time and resources, but if we truly want to utilize this information, doing it at this level simply makes sense.”		
ENERGY-1 “And the issue of the supply chain remains a challenge, whether for supply chains specifically or for value chains overall.”		

[3] All translations from German into English were done via ChatGPT

First-order concepts[3]	Second-order themes	Aggregate dimensions
ENERGY-1 “But I would say that this is the biggest issue that needs to be addressed so that in the future, there is a better understanding of which materials are being used. We need to differentiate between green steel and non-green steel, recycled materials and virgin materials, and these have different emission factors and should be evaluated differently for a circular economy.”		
ENERGY-1 “It also has a downside because the databases and emission factors available on the market are either outdated or specific to certain segments or countries.”		
ENERGY-1 “So that we have a reliable and as complete as possible CO2 balance.”		
ENERGY-1 “So, today we use a spend-based approach, meaning we take Euros and multiply by an emission factor: very vague, very inaccurate.”		
ENERGY-1 “So, we didn't really mess around with Excel or anything like that. It's not super state-of-the-art, but we have been using an ESG solution for a long time to collect data within the group.”		
ENERGY-1 “These are the kinds of challenges and difficulties that affect me less directly but are more related to the generation of data, which serves as the basis for determining the associated CO2 emissions.”		
ENERGY-2 “The subsidiaries, and I'm always referring to the consolidated group values, meaning all fully consolidated subsidiaries and affiliates, are included in this process. They have access to this software and enter the data independently. They have the relevant guidelines on which data we need, and they input it accordingly.”		
ENERGY-2 “This is only possible if I have a resilient and thoroughly comprehensive CO2 balance.”		
FOOD-1 “And the data that is available, especially from manufacturer brands, is not available in the right quality.”		
FOOD-1 “Challenges then arise for a company like *[censored]*, where the data is either not available at all or not in the correct format.”		
FOOD-1 “Especially starting from the reporting year 2025, we will need to provide a vast amount of data at a very granular level.”		
FOOD-1 “There is something similar in retail, called GS1, which is also an external cooperation platform where various industries and standards work together to implement		

First-order concepts[3]	Second-order themes	Aggregate dimensions
things in a more standardized way."		
FOOD-1 "They have built a new data platform, in this case, Snowflake, where they wanted to store everything in a much more centralized manner rather than in siloed data structures, so that the whole system could be used more efficiently."		
INSUR "Because we are so digitally oriented, we sometimes don't have uniform systems for these policyholder data. We need to ensure we get them standardized, especially for the companies we insure, and we need to find a way to obtain their emissions data."		
INSUR "We use the same accounting system for non-financial reporting as we do for financial reporting, so we have a common interface."		
TECH-1 "Where our suppliers did not have data when we started talking to them and they didn't know what was the recycled content of steel in their steel raw materials."		
TECH-3 "And if I have similar data for materials, I can map it against various factors, but the result won't be very accurate because I don't know the underlying details."		
TECH-3 "And the second issue related to data was data quality. It was a disaster, what sometimes came back."		
TECH-3 "So, a major issue is data availability. Often, the data you need simply isn't there."		
TELCO "And by that, I don't mean Excel, but a software that serves as a single source of truth for environmental metrics and also provides waste metrics. We use this to maintain all data on a monthly basis."		
TELCO "For example, suppliers may not provide any information at all. Recently, we received a Product Carbon Footprint from a supplier, and it was nearly impossible to understand how they arrived at the values or which standards they used. It's just a completely non-transparent information situation."		
TELCO "The challenge, of course, is that they don't have to do this yet. No one can currently force them to. I believe the Digital Product Passport initiative will help address this."		
CONS-1 "In the end, you have your footprint and can then see, for example, which suppliers or which product categories are driving your footprint."	Conduct materiality assessment for emission scopes and identification of emission drivers	
CONS-2 "And in this process, we also conduct discussions or workshops where we say, 'Okay, we looked into this, and for some reason, a lot of energy is being used in your plant Y. Why is that?'"		

First-order concepts[3]	Second-order themes	Aggregate dimensions
CONS-3 “This means starting quickly and initially getting a rough understanding of where the hotspots are and focusing on what is essential […] set the right focus.”		
ENERGY-2 “This is because we have a few categories that are very dominant, and for materiality reasons, we have mainly focused on four categories out of the 15 in Scope 3 in the past.”		
INSUR “So, for both financed emissions and insured emissions, we need to look at which categories in Scope 3 are material and which are not. As part of the CSRD, a materiality analysis will be conducted anyway, and then some of the Scope 3 categories will be classified as material.”		
SERV “We started with the materiality analysis first.”		
TECH-3 “So, what needs to be reported? Which scopes are relevant and which can be omitted? For example, in this case, Scope 3-14 (Franchises) does not apply.”		
TECH-3 “To first understand where the hotspots are, which plants are important, which units are important, and which scopes are particularly important for each unit.”		
CHEM-2 “We are now, of course, looking into how we can incorporate and consider supplier-specific data. How can we leverage the specific feedstock advantages that we already ensure for many of our raw materials in our accounting?”	Explore scenario planning, simulations and forecasts based in GHG emission data as decision making input	
CHEM-2 “We simulated: What theoretical possibilities are there? Then we approached it from the conservative side and considered, if the investment willingness in the overall industry for these topics is low, what can we rely on? However, if it is high because the government might also set corresponding incentives, where will it lead? And the developments that arise from this are, of course, very different. Then a corridor emerged, and we looked at what we believe. What is the realistic approach? How progressive do we want to be in our assumptions?”		
CHEM-2 “We then developed scenarios to anticipate the savings achievable with different measures and combined various action packages accordingly.”		
CHEM-2 “Why do we need to model? These accounting models always consider which feedstock is used exactly, which processes are involved, from which regions sourcing occurs, and, along with all that, the energy mix used by a specific supply chain or manufacturer.”		
CONS-1 “And basically, it's about modeling the product carbon footprint of all products, allowing us to project much better into the future. We can determine which products will grow,		

First-order concepts[3]	Second-order themes	Aggregate dimensions
which will disappear, what materials we have, and what measures we can take at the product level to reduce our footprint."		
ENERGY-1 "For GHG emissions, we have also included forecast data, taking into account the planning data used in the company for expansion, production, or energy generation, etc."		
FOOD-1 "And based on this baseline, it naturally makes sense to conduct certain scenario and forecasting analyses in the future. This will allow for better planning and the achievement of SBTI targets, which are, in some cases, very long-term."		
TECH-3 "And on the other hand, it has laid the foundation for many scenario analyses, such as determining when we want to fully convert the entire fleet, meaning forklifts, to electric."		
TECH-3 "And really consider scenarios for how they can achieve net zero."		
TELCO "We do scenario planning primarily in a positive direction. For example, we know the share that Apple currently represents in our balance sheet, and we know that they also set climate targets."		
AGRI "And I knew I needed a minus 30. So, I went to a division where I knew they might have some buffer, they have a lot of emissions, and also high pressure from customers. I went to the board and asked the executives if they could contribute even more, beyond the minus five percent."	Develop emission reduction targets predominantly under the guidance of SBTI	Steer decarbonization via emission reduction targets
AGRI "But in the end, I spoke with each division, and the first query was 'What can you achieve by 2030? What can you deliver? What can you commit to?'"		
AGRI "Or rather with very strong divisions. It doesn't work for us to sit in Mannheim as a corporate entity, develop something, and then everyone says, 'Hooray, of course, *[censored]*, great idea.' Instead, it's more about involving people, including them in decision-making, and engaging them in the definition of the goals."		
CHEM-1B "*[censored]* has been SBTI-committed since 2021, with the base year 2021. We aim to establish a solid foundation, so we need to calculate the emissions accurately and reliably."		
CHEM-1B "So, the mentioned number simply comes from the requirements of SBTI."		
CHEM-1B "This target applies to the entire *[censored]*, broken down into smaller business units. Then we look at how they are progressing. If necessary, they set their own targets and track their progress against these targets."		

First-order concepts[3]	Second-order themes	Aggregate dimensions
CHEM-2 “And we have shared this with the WWF and a couple of other partners, asking them to provide feedback and challenge it.”		
CHEM-3 “So, we naturally took a top-down approach, deciding where we wanted to go. Then we brainstormed with some smart people to figure out how we could get there.”		
CONS-2 “For me, best practice would be when companies have these goals.”		
CONS-2 “In my opinion, the good thing about such initiatives is that they provide a very good guideline. I believe that the most important point is whether or not you participate in the initiative, but at least they have done the work of figuring out how companies can set goals, what makes sense, and what fits within the 1.5-degree threshold or well below two degrees. They also develop guidelines for specific industries. This is the value of such initiatives, in my opinion. They tell industries, ‘You don't necessarily need to figure this out on your own. We've done the work for you. If you want to contribute to environmental efforts, here are the guidelines. This is how you can calculate your impact. These are our suggestions for setting goals so that we can all move in the right direction.’”		
ENERGY-1 “So, we submitted the ‘Way below two degrees’ target in 2019. Over time, we have continually revised the baseline methodologically.”		
ENERGY-2 “But at the moment, the targets are there, and the departments are also encouraged to set their own targets. However, it must be noted that the companies operate independently in this regard.”		
INSUR “However, when it comes to our own operations, we naturally reach out to colleagues in all the units, especially those in Latin America. They often know better how to decarbonize their own operations.”		
INSUR “The countries receive individual emissions reduction targets. This could be, for example, 25 percent over the next two years, but it can also vary depending on how the countries are currently positioned.”		
TECH-1 “We have science-based targets. So these targets at *[censored]* are not absolute but are based on a percentage of reduction per year on EBIT.”		
TELCO “The first target we validated with them uses figures from 2015 and 2016.”		
CHEM-1A “Exactly, why did we commit to SBTI? [...] I think one reason is that SBTI is a recognized platform. Being SBTI-committed has a certain communicative impact.”	Communicate emission reduction	

First-order concepts[3]	Second-order themes	Aggregate dimensions
CHEM-1A “That's why we chose SBTI, which isn't regulatory, but still acts as a kind of self-imposed external pressure.”	targets or efforts externally via verified SBTI commitment, despite knowing how to get there	
CHEM-2 “Of course, we didn't yet know the technical details of how to get there. It was somewhat, I wouldn't say a shot in the dark, but there was certainly a lot of optimism involved.”		
CHEM-3 “So, when we announced the goal of climate neutrality and SBTI, we didn't have a plan yet. We just said, that's how it has to be.”		
CONS-1 “So, an independent entity examines what companies need to achieve, what goals are scientifically validated and recognized as reduction measures, and what external parties can rely on.”		
CONS-2 “The challenge I have seen is that sometimes a goal comes from the top without being thought through or integrated with a roadmap. As a result, it's not entirely clear whether these goals can be achieved.”		
CONS-2 “Unfortunately, for many, it's mostly about marketing.”		
CONS-3 “But it's certainly also a matter of reputation, which we see frequently. And this varies among customers. There are, of course, some who are genuinely intrinsically motivated, and there are many who do it because they feel they have to.”		
ENERGY-1 “Of course, we are now convinced, but it is also due to the pressure when a commitment has been made, communicated externally, and investors are already on board.”		
ENERGY-2 “We set climate neutrality targets early on and were pioneers in terms of the timeline, especially compared to our competitors.”		
FOOD-1 “And certainly, the issue of investors and collaboration attractiveness comes into play. By meeting or exceeding standards, we gain better market access to investors and bank loans.”		
FOOD-1 “And the second aspect, which I briefly mentioned earlier, is that they are pioneers in sustainability transparency. This helps attract customers and become more appealing from a customer perspective, as sustainability is becoming increasingly important there as well.”		
FOOD-1 “And they also communicate quite strongly to the public that they have now set these goals.”		
FOOD-1 “I think the main reason is that it is simply the most relevant and prestigious		

First-order concepts[3]	Second-order themes	Aggregate dimensions
certification goal for greenhouse gas accounting that can currently be implemented, and it is also the most credible."		
FOOD-2 "Yes, of course, you also have to be able to assure SBTI that this is a valid target, but I don't think there was any discussion of specific measures at that point."		
SERV "External representation, marketing, market positioning, the position of our subsidiaries, advertising effect – all these things."		
TELCO "No forecasts are shared. It's often just a lot of guesswork."		
CHEM-1A "And that is the dilemma we are in. Sustainability is expensive; it doesn't come for free. The money has to be earned somewhere first."	Manage overarching goal conflicts between sustainability and profitability of a firm	
CHEM-1A "The company or leadership must be convinced that sustainability is worth its cost and will ultimately move us forward."		
CHEM-2 "Because we also know that we can't pass everything on to the consumer. We also know that our consumer actually expects the industry to solve the sustainability problem and doesn't want to be involved in the cost of it."		
CHEM-2 "The dominant learning for the company is that goal conflicts must be resolved at the highest level. [...] They must have goals that are consistent. If you give them a sustainability goal, a growth goal, and a margin goal simultaneously, it becomes an impossible task."		
CHEM-2 "The issue of costs is omnipresent because the more sustainable solutions are almost universally more expensive at the moment and are not yet available in large quantities. [...] Therefore, the willingness to bear these transformation costs is a huge issue. [...] Naturally, as a publicly traded company, our shareholders need to be satisfied. They are happy when the numbers are right, and the numbers are right when we generate sales and make significant profits. Thus, the cost issue and the additional costs that sustainability will temporarily offset are always a point of conflict."		
CHEM-2 "The old technology still needs to be produced while the new one is already in production. As a result, I double my product range. For the transition period, my product range is doubled, and I have to be able to manage this logistically as a company."		
CHEM-3 "And then someone from our management makes a decision because we're short on cash."		

First-order concepts[3]	Second-order themes	Aggregate dimensions
CONS-1 “But the main problem is that companies often say they want to grow, grow, grow, and as a result, all the reduction measures they plan only balance things out a bit. However, they never really reduce their level from where they currently stand.”		
CONS-1 “How much of a penalty could that bring? For some companies that are well-off and have enough money, it’s not a business case for them. They think ‘Well, then I’ll just pay the fine, no big deal.’”		
CONS-3 “But then questions arise like choosing between purchasing price or CO2 reduction – What is more important to you? If I have a savings target, I can’t reduce emissions at the same time because, in many cases, it involves an initial investment. Even if it eventually pays off, it's an investment at first, and for my short-term, year-over-year goals, it doesn’t help me, so I don't do it.”		
ENERGY-1 “But fundamentally, the biggest threat to the target path is that the world around us is not changing as quickly, and we may face geopolitical, financial, and other risks if we insist on implementing the path no matter what.”		
ENERGY-1 “We are currently having this discussion about sustainability and carbon measures. We always need to carefully consider, when a new wind farm is auctioned, how much Green Steel we can include, which costs significantly more, or how many Recycled Blades, which also cost more, without pricing ourselves out of the competition or driving up investment costs to the point where the wind farm is no longer profitable.”		
TECH-1 “But the sustainability strategy was merged into the business model into the corporate strategy. And That's why you see for example if you look at that building block of the strategy: You see a target such as 2030 goals 30 % of revenue should come from circular business models. That's why it's not two strategies, it's one.”		
TELCO “Everyone has their own issues. I think it’s simply competing for attention.”		
AGRI “This means it's not just a number, like minus 50, but also the measures that go along with it. And indeed, by 2030, the climate targets in the Scope 1 and 2 areas are backed by concrete measures.”	Develop emission reduction roadmap and measures via SBTI guidance and based on CCF calculations	Translate decarbonization targets into business planning
AGRI “We have a working group led by Corporate EHS, where experts from the divisions are involved. In this group, such action plans are created, and measures are recorded.”		
CHEM-2 “And we said that the savings needed for Net Zero 45 by the year 2032, for example,		

First-order concepts[3]	Second-order themes	Aggregate dimensions
because we need to define interim targets, would require these specific measures."		
CONS-2 "Or that we really sit down and create a real roadmap, considering how our emissions are today, where they come from, reduction measures, and so on. We calculate this and then make a proper forecast. With these reduction measures, I expect to make this kind of progress."		
CONS-2 "When companies have these goals, let's say including measures, because that would naturally be the next step if they don't already have them."		
ENERGY-1 "So, the strategic anchoring for GHG is the strongest, and we derive our actions from the SBTI target pathways."		
ENERGY-2 "And precisely in these timelines and schedules, when I want to make changes, that is an aspect that plays a role."		
ENERGY-2 "The primary focus of the corporate goal is on production and the reduction targets within production, as we had about 10 million tons last year, and the corporate target is around 11 million."		
FOOD-1 "And these goals, that was always the first step. They were set according to the SBTI standard for different years or time periods."		
INSUR "The Science Based Target Initiative is relevant when we talk about establishing a transition plan or pathway."		
INSUR "We naturally look at which measures are recognized in the market. What are others doing? That's a good starting point."		
TECH-2 "And the next step is to really anchor this, in addition to the SBTI validation, within the operational units. This means that an R&D department is now given a target to reduce CO2 emissions and can start thinking about how to develop their Net Zero Truck. The procurement department also gets a corresponding target and has to figure out how to implement it, while ensuring that it doesn't cost more."		
AGRI "The measures are incorporated into the capital expenditure plans for the coming years. Last year, we also revised our capital expenditure process. There is now a separate package, or pool, specifically for sustainability projects."	Consider GHG emissions as a factor in medium-term business planning and financial	
CHEM-1A "And a crucial factor for us is the CO2 price. We need to determine whether the investments we make to meet the goals *[censored]* mentioned within a certain timeframe will		

First-order concepts[3]	Second-order themes	Aggregate dimensions
pay off. Will they be cost-effective or not?"	resource allocation	
CHEM-1A "And of course, as I said, this is purely a monetary perspective. We will only invest the 700 million that we plan to spend by 2030 in products where we believe the CapEx requirement will be recouped relatively quickly."		
CHEM-1B "The idea was to create a kind of calculation for various measures to determine how much CO2 we can save at what cost. We essentially developed a ranking of measures to prioritize. By implementing these measures, we can reduce CO2 emissions and save money at the same time."		
ENERGY-1 "And then this planning picture aligns with the forecast, which increasingly influences decision-making."		
ENERGY-1 "Then comes the medium-term planning process, where specific projects are planned. And now, a column titled 'How much Carbon?' is being added to the table."		
ENERGY-1 "We already see that decisions, which would have been unthinkable four or five years ago, such as acquisition or business development decisions, are now also dependent on whether they have a negative impact or steer us away from the 1.5-degree path."		
ENERGY-1 "Yes, but what if it's economically interesting and can finance the expansion of renewables?"		
ENERGY-2 "And we have a medium-term plan that spans three years. This plan covers production volumes and also examines how the top performance metric of CO2 intensity will develop over the next three years."		
TECH-1 "So the data from carbon accounting helps us understand. So that kind of sets us as a meta Target, right? And then it helps us kind of disperse that for example carbon budget into our products and into our sales, right? […] It helps us understand, okay, where we are and where we need to be. And that forms the baseline of understanding: Now we need to invest more into [product X]. We need to put more [product Y] on the market."		
TELCO "The translation of what a decarbonization roadmap actually is – it's essentially an investment plan."		
TELCO "What CO2 effects do I achieve there? The whole topic of Scope 4. This is something where I would say it might pay off to grow in scope 3 if I have a compensating or even positive effect in Scope 4."		

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CHEM-1B “The numbers we collect are used to see if we are on track to reach our goal. This is, so to speak, the foundation.”	Monitor reductions and calibrate targets by comparing actual emission paths to SBTI goal paths	
CHEM-1B “We also do it to improve our internal processes. We want to see how we can use the information we gather to become better.”		
CONS-2 “So, you save a lot of time and resources later, and you can access this information at any time. Where do we stand with emissions this year? Have our measures worked? Have they not worked?”		
ENERGY-1 “On the chart, you can clearly see what the target for the year was, where we ended up, whether we overperformed or underperformed.”		
ENERGY-1 “So, I would say it's essentially about internal control of the target path, which aligns with the overall goal. By collecting data, I better understand where I can take action to make changes. [...] This indirectly informs us about suitable measures, where we stand, where we want to go, and how we can get there accordingly.”		
ENERGY-2 “Exactly, these developments or predictions lead to adjustments. Or at the very least, verifying whether the current approach is still correct or if changes need to be made.”		
ENERGY-2 “To see if my activities and the measures I've established are effective both in terms of their impact and their timeline. Am I on the right track, or do I need to make corrections?”		
TELCO “By doing this, you can monitor the development. For example, if the curve has risen too quickly, it isn't going down as expected.”		
CONS-1 “And basically, you can just take the CO2 emission value and multiply it by this price. These are, for example, the external costs—the costs incurred per ton of CO2. We've always seen it as a strategic reference point when looking at the total amount a company emits into the atmosphere with what they do.”	Establish firm-overarching carbon related steering/ decision-making factors and KPIs	Anchor decarbonization targets in governance mechanisms
CONS-1 “There is a sort of budget for each business unit. This means that whenever you purchase something or take some action, it essentially deducts from this pool.”		
CONS-1 “This means that internal carbon prices are a good instrument. For this, a solid data foundation is, of course, very important.”		
CONS-2 “Since last year, there is this new regulation coming into effect in Europe, the CBAM, if you're familiar with it, the Carbon Border Adjustment Mechanism. And I think with		

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this new mechanism, which is essentially a carbon tax for imports, this management process will be integrated for the first time."		
CONS-2 "The goal for a company should be to have every step and every department make decisions with emissions in mind, so that everyone is aware. You can still choose A or B, but you understand the resulting impact."		
CONS-3 "In procurement, development, production—essentially at all levels—I need to ensure that it is properly integrated into the existing processes and included as a fixed criterion."		
ENERGY-2 "Yes, we have management KPIs like these. These are top performance indicators published in the annual report. Regarding CO2, we calculate CO2 intensity from our own power generation divided by the production volume."		
FOOD-2 "How can we establish a CO2 price within the company?"		
FOOD-2 "It will affect all departments if you truly have it included in your budget."		
FOOD-2 "So, I believe that if you really want to do it right, a company must have a carbon price. That's why I think carbon accounting is the backbone of it."		
TELCO "So, it is a management KPI in the organization."		
CHEM-3 "This goal, along with a few others, is part of the corporate strategy and thus also part of the compensation for the executive board, including myself and other people are part of the direct management. Therefore, this whole issue takes on additional significance from a corporate governance perspective."	Link emission reductions to individuals' compensation through performance incentives	
CONS-1 "And that's the point when it personally affects you. If a significant portion or some amount of money is lost by the end of the year, or if you gain something by doing it, then it becomes a strong incentive."		
CONS-1 "Another issue, of course, is that, for example, executives are targeted to achieve specific goals and reductions."		
CONS-2 "So, if you really want that, then all VPs, management, and so on must have some goal related to the KPIs that goes in this direction."		
TELCO "Hard target incentivization. So, incorporating a few percent into the executive board bonus is also good."		
AGRI "And the colleagues are noticing that this involves a lot of work for the entire company,	Establish an	

First-order concepts[3]	Second-order themes	Aggregate dimensions
as various departments are involved to ensure the topic remains integrated. Otherwise, it would stay somewhere in Mannheim, represented but nobody would actually integrate it into the departments, business units, and processes."	organizational set-up that ensures decarbonization expertise throughput the organization	
AGRI "So, by now, we truly have a dedicated sustainability manager in every division."		
CHEM-1B "I believe it's essential not to have an ivory tower where the sustainability staff sit, they rather should be distributed throughout the company, being knowledgeable about both topics: sustainability and the operational business."		
CONS-3 "And based on our experience, it really gets integrated into the individual units. There are either SPOC (Single Point of Contact) roles, where someone from R&D is the sustainability SPOC, and there is someone from procurement who is responsible for this and then further communicates and implements it accordingly."		
ENERGY-1 "With carbon, it's even the case that the first operating units are now installing sustainability specialists within the functional departments. This is actually the ideal outcome. So, in procurement, engineering, and operations, there is always someone considering these aspects and looking for where we can implement and decarbonize."		
CONS-2 "And this is done without any strategy behind it, just simply put into action. I switch my energy provider today. Overnight, I have green electricity. So, I think it's much easier for the other department to see which option is right or which option positively impacts their own emissions. And the company can directly make these changes. They don't need to collaborate with anyone."	Decarbonize by exploiting energy efficiency potentials in all departments	Operationalize decarbonization targets across business functions
CONS-2 "Everything else can be implemented relatively easily. It doesn't require any strategy behind it; it's simply done. I switch my energy provider today, and from one day to the next, I have green electricity."		
CONS-2 "It's not a huge investment because there are several things that can use multiple energy sources. Many have made the investment to simply put solar panels on an unused roof. This way, you achieve a reduction, not necessarily in consumption, but at least in emissions."		
CONS-3 "Because this roadmap includes items like switching to green electricity at my production sites, trying to electrify my production, or making it more energy-efficient through hydrogen or other means."		
FOOD-2 "Yes, it was only for Scope 1 and 2, and it specifically focused on converting our		

First-order concepts[3]	Second-order themes	Aggregate dimensions
own productions and offices to renewable energy. There was also an internal policy that required switching to renewable energy when new contracts were made, for example."		
INSUR "What we did is completely switch our sites in Germany to green electricity."		
SERV "We want to purchase renewable electricity, meaning green power. [...] We have installed a photovoltaic system on the roofs of our buildings here."		
CHEM-1A "And then, of course, we will have to decide in the long term what this means for the product portfolio. Where will we stay, and where will we not stay?"	Decarbonize via alterations in products, portfolios, and business models	
CHEM-1A "We are moving into so-called Next Generation Solutions products. These are products that are significantly better in terms of sustainability compared to competing products. For example, they can significantly reduce the environmental footprint for the customer in applications more effectively than competing products, and those are the ones we will focus on."		
CHEM-2 "Products will also change. They will look different and might feel a bit different."		
CONS-1 "And the other thing you can decide for yourself is what kind of products you develop and which ones you bring to the market. This downstream issue is also relatively new for many because it is based on these assumptions and, on the other hand, it completely affects your business model. So, what is my product, how do I make money with it? For example, if we manufacture some vehicles or something along those lines, like forklifts, for instance, we might say, okay, we will no longer bring forklifts to the market that are powered by gasoline, diesel, or whatever, but rather electrified ones."		
ENERGY-2 "Nevertheless, with the fuel switch, we took the first step by converting coal power plants to gas."		
FOOD-1 "The emission reduction can be achieved through market effects and partly through changes in the product range."		
FOOD-2 "So, maybe not the food ingredients themselves, but rather the concepts of recipes to holistically reduce the emissions of the entire menu."		
INSUR "And it is also likely, at least from my perspective, that emissions will eventually be factored into pricing. So, at some point, we might say, we are increasing insurance premiums or making insurance premiums dependent on the emissions the customer has."		
TECH-2 "I need to look at everything on the level of the product group strategy. So, how can I		

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proceed in the different product groups, what leverage do I have there?"		
CHEM-2 "However, it must be said that when it came to the topic of Net Zero, it was a laborious process, but we actually drove it a bit from the driver's seat in R&D."	Decarbonize through the development process of new products and offerings	
CONS-1 "And you can influence it from this perspective because you are also manufacturing your product. And R&D is another major area that you can influence."		
FOOD-2 "How can we influence our specialized product development teams to define and create more sustainable formulas?"		
TECH-1 "And then this comes into system design."		
TECH-1 "Moving from metals to plastic, what's your environmental delta, right?"		
TECH-1 "So for product development, it's a lot of functions now and it's kind of for the rule of thumb that you are able to curb 80 percent in the concept phase of your product."		
TECH-1 "So the transport has emissions itself, right? The supply chains are interconnected, which is not always clear for engineers or supply chain managers as well. A lifecycle assessment practice, the life cycle materialization, helps us to map it out. Yeah, and then once we have mapped it out, you have environmental impact and cost optimizations with that."		
TECH-1 "We are buying this much steel. We need to have this Target by 2030 to have a recycled content or we must be buying this much green steel. Same for copper, aluminums, Plastics and so on and then that helps us also, you know provide guidelines for engineers to optimize between materials."		
CONS-1 "'You must send us your product-level CO2 footprints, known as product carbon footprints, along with verifiable proof of the actions you are taking to achieve them.'"	Decarbonize via sourcing decisions based on increased emission transparency	
CONS-1 "A striking example is the automotive industry, where companies like *[censored]* and others pass their goals down the supply chain. By exerting significant power over their suppliers, they push these requirements down the chain. As a result, companies like *[censored]* have to deal with these demands extensively to meet them; otherwise, they risk not selling enough."		
CONS-1 "As I mentioned, a company like *[censored]* or *[censored]* has a huge position in the market. They can simply push these requirements down and say, this is how it is now, have fun, and you need to send us your CO2 footprints at the product level, meaning Product Carbon Footprints, and also show us verifiable measures of what you are doing to achieve this.		

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They can exert tremendous pressure."		
CONS-1 "One aspect is how can I decarbonize my supply chain? This involves my suppliers and the materials I purchase."		
CONS-1 "Or it might involve switching to suppliers who are already more advanced or understanding the current processes of existing suppliers."		
CONS-2 "So, it would be great if you could directly see in your procurement process, for example, that choosing a specific element would mean either an increase or decrease in emissions for my company."		
CONS-3 "On the other hand, OEMs like *[censored]* and *[censored]* pass their requirements through the entire supply chain."		
CONS-3 "Whether I consider this as weighted or just as an FYI, it should eventually lead to making informed decisions. The objective is to select supplier B over A due to their lower emissions."		
FOOD-1 "Not all expected greenhouse gas reductions can be accounted for through planned supplier and product-specific measures."		
FOOD-2 "Because if you really look at the food product itself, it's more about the details of how it is produced, and for that, you need to focus more on the suppliers."		
INSUR "The second point is that we have defined exclusions for coal, for example, or for Arctic drilling, such as oil and gas extraction in the Arctic. These exclusions mainly affect CO2-intensive industries, leading us to exclude certain companies."		
TECH-1 "Specifically speaking from scope 1 and 2 it helps us identify our supplier criteria, right? […] What is the technical specification that we are demanding and what they need to give us. "		
TECH-2 "And in our project, it's now a lot about really anchoring this. That means in purchasing, in the purchasing decision, and in the tender process. [...] That I include it in a Sourcing Awarding Decision, meaning all awarding criteria, accordingly."		
TECH-2 "Exactly, and for that, I first need transparency at the supplier level and product level to know where to start."		
TELCO "In two years, we will place another order for our new routers, or commission them, and we need to consider the following in the tendering process. This will also be weighted		

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accordingly. I believe this is how you integrate these procurement processes into decision-making. And CO2 is also a simple control factor."		
CHEM-3 "Now we have 90,000-80,000 suppliers, so we can't do this with everyone, but we do prioritize the larger ones. For example, if we realize we are buying a large amount of chemicals from a particular supplier, we can then consider how we can achieve our goals with them."	Decarbonize via supplier development and collaboration	
CHEM-3 "These are topics we are heavily focused on, and in Scope 3, we are very involved in supplier development and hope that it will be successful. [...] We need to find common ways to set requirements for the suppliers and also help them understand how they can achieve these, where possible."		
CONS-1 "Either you empower your suppliers to both comprehend their own footprint and decrease it themselves. This can be the case, for example, with *[censored]*."		
INSUR "So we look at our investments, examine which ones have particularly high CO2 intensities, such as CO2 emissions per euro of revenue or similar metrics. We then select a significant portion of these investments and engage in dialogue with them on how to reduce their CO2 intensity and promote decarbonization."		
INSUR "We actively engage in dialogue with them. When we, as an industrial insurer, insure large chemical or cement manufacturers, we discuss how we can achieve this together as partners, rather than putting a gun to their head and saying, if you don't do anything, we won't insure you anymore. We believe it has to be a collaborative approach because, from our perspective, it cannot work any other way."		
TECH-2 "I am trying to motivate suppliers to both reduce emissions and develop an understanding of the issue so that they can provide me with a Product Carbon Footprint (PCF) for their products and also work towards reducing this PCF."		
AGRI "With regard to the CSRD, the new reporting directive, how can we identify and address any gaps we still have in terms of IT tools and systems? How can we improve in this area?"	Regulatory pressure via CSRD to initially implement carbon accounting practices	Impact of external stakeholder forces on decarbonization
CONS-1 "And a very important issue is that if you don't comply and fail to meet the requirements, there will certainly be penalties in the future."		
CONS-1 "Yes, but as I said, it either comes through regulation."		

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CONS-2 “For larger companies that are already moving towards ESG reporting or preparing for CSRD, it is, of course, a significant leverage point because it is not only a regulatory requirement.”		
FOOD-1 “[…] primarily due to regulations, especially driven by CSRD, but also by other specific retail regulations.”		
FOOD-1 “Yes, so really, the regulatory aspect is the primary driver.”		
FOOD-2 “CSRD was a big topic. That's why there was a significant increase in data point collection not just for SBTI last year, but also because of other reasons.”		
INSUR “But due to regulatory requirements starting next year, it will be mandatory to disclose something in this area.”		
INSUR “Data collection has been somewhat incomplete and is still incomplete, but will be much more comprehensive and complete when the CSRD is introduced next year, simply because it is required by regulation.”		
TECH-1 “No company would have done it four, five years ago, If they did not see regulations such as CSRD coming in. CSRD is the biggest umbrella.”		
CHEM-1B “There's uncertainty regarding certain guidelines. One of them is the GHG Protocol. There are already some documents, but additional documents are currently being revised. And right now, we don't know what the final guidelines will be. This means we can't make proper decisions because we don't know if we will eventually be able to count this as an advantage or not.”	Accounting framework dependence in conflict with its dynamic framework development	
CHEM-2 “And then there's the question of who gets the credit since there can't be double accounting. Is it the company that provides its emissions data? [...] For example, this is something that really needs to be clarified, and currently, there isn't much legal guidance to follow.”		
CHEM-2 “The entire field is highly dynamic.”		
ENERGY-1 “And these framework conditions, which must be set by the government and supported by society as a whole, are essential for a company to even adhere to the 1.5-degree target.”		
FOOD-2 “If a supplier has something like regenerative chicken, for example, one had this in the Netherlands, it couldn't be captured in the data. This highlights the challenge of how to get		

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suppliers to conduct a proper LCA (Life Cycle Assessment) so that we can incorporate it. We can initiate great projects and really make a difference, but if we can't capture it in the data, it's a problem."		
INSUR "But also because the calculation methods are now more readily available, which wasn't the case in the past few years. This is simply a method that has evolved over time."		
TELCO "We have to recognize the GHG Protocol as a reliable standard and trust that it incorporates the latest findings from the IPCC and other political developments, as well as what is happening on the accounting side from the ISB. This ensures that, as a company, you have a practical and actionable accounting guideline at your disposal."		
AGRI "And that was simply because we realized that climate is the most important issue for our stakeholders, such as investors and customers."	Market pressure to increase emission transparency via customers, competitors, and financial stakeholders	
CONS-1 "I would say a major issue is that everyone is starting to set these public SBTI targets and wants to be seen as a leader in doing so. No one wants to appear as if they are not participating or starting too late."		
CONS-2 "I've noticed that many larger companies have participated, primarily because others in the same industry are doing it or because the entire industry is gradually moving in that direction. There's a certain pressure from the industry or the market to participate as well."		
CONS-2 "Investors also have a strong interest in these issues and are pushing for these developments to be advanced."		
CONS-2 "It's driven by public pressure. For example, in the case of *[censored]*, it was definitely driven either by consumers or by NGOs that exert a lot of pressure."		
CONS-3 "Also, the pressure on companies has increased over the past few years, particularly from the consumers' perspective. It depends on whether the companies serve end customers directly or operate in a B2B environment."		
CONS-3 "Regarding investments, the financial market reacts strongly to ESG ratings, etc., and as a result, companies have to engage with these issues."		
CONS-3 "Yes, I believe the SBTI is technically voluntary, but not entirely so, because there is a certain pressure to announce targets accordingly."		
ENERGY-1 "For at least nine, almost ten years now, there has been noticeable pressure from financial ratings and rating agencies, which in turn influences different standards. The GHG		

First-order concepts[3]	Second-order themes	Aggregate dimensions
Protocol, for example, is not a legally mandated standard but rather a voluntary one that has gained increasing influence. Essentially, we have been increasingly motivated by financial stakeholders or have observed negative impacts in this area."		
ENERGY-2 "In the capital market, when a company wants to make investments that require external investors, it must demonstrate relevant activities for reducing CO2 emissions and support this with data, facts, and figures."		
TELCO "Nevertheless, there is indeed a reputational risk if a company fails to meet its climate targets. This can certainly be seen as a risk with a potential financial impact."		
AGRI "Because the political framework conditions also change. What can be credited? EU biomass plans, how much wood or wood pellets can be used? What will be credited? How expensive will biogas be? How much sense does electrification make?"	Industry specific regulatory, political, market, or supply related uncertainties imposing industry or firm specific challenges	
CHEM-2 "We need to examine where these raw materials are indispensable for the cosmetics industry in the long term and where there might be alternatives. We also need to consider the regulatory trends, which are uncertain. Therefore, we must form or seek expert opinions to always use a risk assessment system to promote technological development in one way or another. Additionally, we need to find cooperation partners who can offer solutions."		
CHEM-3 "Regarding renewable raw materials, it's not that simple either. We need to ensure that the quantities are actually available."		
CHEM-3 "We have an energy consumption of 35,000 terajoules, which is a lot. Of that, 12,000 terajoules are for electricity consumption. These are gigantic dimensions, so it's not simple to just go to an energy provider like RWE and say, 'Give me energy from normal sources,' especially if I'm here in the Rhineland, where unfortunately, we still have brown coal power."		
CONS-1 "The next question, which is why everyone is somewhat concerned, is about figuring out how much we need, whether the total amount will be available in the market later, if we can purchase it, and how much it will cost us."		
ENERGY-1 "But, for example, the implementation of biomass is always a topic of discussion, politically always a bit on the edge, depending on pricing or subsidies. And there's always the question of whether we should continue to rely on this strategy."		
ENERGY-1 "Decarbonizing gas depends on transitioning to hydrogen, and this is influenced		

First-order concepts[3]	Second-order themes	Aggregate dimensions
by national political frameworks and the availability of hydrogen. We plan based on what we see and assume about these frameworks, while simultaneously communicating with policymakers in different countries about the conditions we need."		
ENERGY-2 "But that does play a role because we also have the coal phase-out, and we want to exit coal earlier than what the legislator has mandated. In fact, we moved the phase-out up to 2028 last year."		
ENERGY-2 "But we only partially control our CO2 emissions because we are obligated to ensure energy supply. Market disruptions directly impact the operation of our power plants. The operation of our power plants is controlled by the market and the grid operator, the transmission system operator. For example, do you know what a redispatch operation is?"		
ENERGY-2 "We also have the issue of energy security. I'm not sure if you're familiar with the Südlink project, which involves transmission lines bringing wind power to the south. The south doesn't have offshore wind energy. As long as we don't have that, or conventional power plants are needed to ensure energy security in southern Germany, there could be some shifts."		
TECH-1 "And that is causing shifts in the emissions and that is causing us to revise the targets"		
TECH-1 "Then as soon as the Ukraine war erupted. Yeah, there was a massive policy shift from gas to electricity based. And it created a huge market of heat pumps but and so *[censored]* along with you know other players in the market invested in Heat pumps […] So now the heating industry is completely driven by regulations. […] So the price of gas went high - people move towards heat pumps. Now the price of gas is even lower than it used to be - people are moving back towards boilers."		
AGRI "The first step was to form a group sustainability team with representatives from each division to create a common platform for exchange and coordination."	Cross-functional collaboration and bringing all perspectives to one table	Impact of cultural dynamics on decarbonization
CHEM-2 "We have conducted several workshop series and developed this roadmap across all functions to get buy-in from everyone, to hear and include the viewpoints, perspectives, and reservations from all areas early on."		
CONS-2 "Then, the leads from Operations, the lead from various departments, and so on, come together to get everyone on board, ensuring that the initiative reaches every last employee."		

First-order concepts[3]	Second-order themes	Aggregate dimensions
TECH-1 “For the first time in 107 years lifetime of the company, but the first time we have actually finished and okay finalized the first draft of the process where we brought everyone to one table for the development of a new product, right?”		
AGRI “I think that the colleagues are sensitized,”	Need for training and education to raise awareness, and consciousness on decarbonization and one’s individual impact	
CHEM-1B “That everyone uses the same wording internally and externally, and communicates with the same figures and data. This is sometimes not easy.”		
CHEM-3 “Traditional executive positions are not trained for this. It needs to be handled differently. There needs to be a sensitization process. Because everything that is established at the top can be effectively implemented throughout the company.”		
CONS-1 “Every person making a decision should also be aware of the options and what they mean in terms of emissions.”		
CONS-1 “For many, this is really the first time they are seeing it, and they might be wondering where it comes from and so on.”		
CONS-2 “But there are certain topics that need to be drilled into people so that it's clear how important they are. It requires company-wide training and giving the topic the importance it deserves. There should be a dedicated team that handles this, utilizing the data collected and providing the right information and measures to the employees. It’s crucial to have management on board. This can be the hardest part for many companies when one person thinks it’s important and another does not, leading to mixed messages from the top.”		
CONS-2 “Making people more aware of how their decisions affect these numbers.”		
CONS-2 “That's the direction we want to go eventually, but it's a significant investment for any company. Training your employees to understand what this really means is a massive task. Integrating this into the company culture is huge work. [...] This way, every employee engages with it and feels they can contribute to this reduction.”		
CONS-2 “The motivation of the individuals.”		
ENERGY-2 “What is important is to involve the leadership of the subsidiaries. It must be clear that every employee, even at the lowest level, needs to understand what is important.”		
TECH-1 “We see especially with corporate communications with marketing with sales, certain information, that was given which was incorrect and kind of had made us wonder about running into green claims from any NGO from any watchdog.”		

First-order concepts[3]	Second-order themes	Aggregate dimensions
TELCO “A clear example: the person entering the diesel and gasoline consumption values for our fleet might think, "I’m just entering the values, but I’m not responsible for how much people drive." They are the last person to take responsibility for the value skyrocketing. At most, they can warn that the value is rising, which they didn’t even do this year.”		
TELCO “I wouldn't exclude anyone. I would say everyone. Even if we push a guideline through that outlines what needs to be done, the people still need to implement it in the end.”		
TELCO “People felt for the first time last year that they saw the upstream and downstream impact they are responsible for with what they do.”		
CHEM-1B “Measuring is important, but it's even more important to implement actions. So, if we say we invest a lot of money into perfect measurement and creating proper guidelines, that’s important and I wouldn’t doubt that. Nevertheless, if I have a million euros and need to choose between measuring accurately or implementing measures, we need to consider how to allocate the funds. In the end, what helps the planet the most is implementing actions.”	Organizational inertia due to the complexity of data systems and regulatory environment, overall uncertainty, the workforce's lack of insight into decarbonization	
CHEM-2 “We know we need to act quickly, and acting quickly means not everything is fully formulated and predefined. It's a bit of "move and improve" here and there, and that's definitely a challenge. We also have internal discussions where someone might say, "If you can't tell me exactly how much this will save, I won't approve the investment." Sorry, but whether it's 50 or 53 percent doesn't matter. We need to do this, and we've developed a bit into the unknown with this approach.”		
CONS-1 “Yes, that's another issue. I am now wasting a lot of resources just to develop a model, thinking it will eventually be perfect. And then I end up sleeping through three years without implementing anything.”		
CONS-3 “I would say that starting quickly is important because, sure, it might cost more initially, but waiting won't make it cheaper.”		
CONS-3 “Initially, gather transparency to pragmatically, yet quickly and focused, tackle the issue. Then, as we move towards decarbonization, continue learning and refining the process iteratively.”		
CONS-3 “So, we're working on both fronts. We don't have complete transparency and need to refine it, but at the same time, we must already start reducing to achieve any goal. If we don't start now, we won't meet the 2050 targets either.”		

First-order concepts[3]	Second-order themes	Aggregate dimensions
ENERGY-2 “There's always a bit of a gap between the strategic and operational levels. [...] The question is to what extent the message gets through to the lower levels and how aware employees are that their activities, such as CO2 data collection, contribute to the overall effort. Even if their contribution may not be directly measurable, it's still a crucial link in the chain.”		
INSUR “Willingness decreases whenever there is an abundance of requirements or guidelines, and it’s unclear where they are leading.”		
TECH-1 “The best practice is missing. So for example, if you are stuck as you know, what needs to be done, you just don't have a best practice.”		
TELCO “Companies typically budget one year ahead and don't really set goals or plan measures for 2040 in any concrete way. I can definitely confirm this. If you ask someone about 2040, they usually respond with, ‘Ask me again tomorrow.’”		
TELCO “We have, of course, discussed whether to tell people 2035 or 2040. I mean, they can't really imagine what that means. But yes, this issue with the time horizon is a bit detached from the harsh business reality.”		