TECHNISCHE UNIVERSITÄT MÜNCHEN

TUM School of Management

Three essays on reconciling decarbonization and competitiveness

– The case of family firms

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Vollständiger Abdruck der von der TUM School of Management der Technischen Universität München zur Erlangung einer Doktorin der Wirtschafts- und Sozialwissenschaften (Dr. rer. pol.) genehmigten Dissertation.

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Die Dissertation wurde am 26.10.2023 bei der Technischen Universität München eingereicht und durch die TUM School of Management am 15.12.2023 angenommen.

Acknowledgment

First, I would like to express my deepest gratitude to my supervisor, Prof. Dr. Gunther Friedl. From the very start, I had the chance to pursue research in fields I am passionate about, namely decarbonization and family firms, within a dedicated research project. I continuously benefitted from his valuable feedback and various constructive discussions over the past two years, especially as a co-author of my first essay. I appreciate that he always trusted my abilities and assessment, and I felt 100% supported and backed up in all my research endeavors.

Second, I am thankful to the *Dr. Hans Riegel-Stiftung*, originating from the family firm *Haribo*, for supporting two essays in this dissertation through generous funding and valuable exchange as part of its initiative "Klima und Wirtschaft".

Third, I am thankful to the entire Chair of Management Accounting. I could not have imagined a better team and environment for pursuing a dissertation. The chair offers the perfect balance between rigor, dedication, and hard work on the one hand and comfort and fun on the other hand. In particular, I am deeply thankful to my dear friend and colleague, Alexandra. The dissertation rollercoaster would not have been the same without you. I will miss working so closely with you in the next few years, but I happily look forward to a lifelong friendship.

Fourth, I would like to express my gratitude to the co-author of my second essay, Sandra Briechle, for her hard work, endless problem-solving sessions, and for navigating through a novel research topic with me.

Fifth, I would like to thank my family, which taught me perseverance and dedication. Their support is constant and unlimited, which will always serve as the greatest motivation to me. Finally, I would like to thank my partner, Max. Your positive mindset, excellent problem-solving abilities, and endless love strongly contribute to this and any other achievements in my life.

Abstract

Decarbonization is regarded as one of the most significant challenges of our time. Decisive action requires enormous investments, which might not pay off in the short term under the current market conditions. Consequently, many firms are not contributing their share to decarbonization because of a perceived trade-off between economic and environmental goals. In addition, they often lack the necessary skills and resources to meet the challenges inherent in a firm's decarbonization journey.

This dissertation comprises three essays covering the integration of decarbonization into firms' processes from initiation to implementation and, finally, impact assessment. The research focuses on family firms for three reasons: (1) they constitute 90% of firms in Germany, (2) they differ in their motivation to decarbonize, and (3) they have earned a reputation for making substantial efforts into decarbonization.

In the first essay, I explore how family firms simultaneously manage economic and environmental goals in their strategic decision-making processes. Through a multiple case study, I derive a model that advances the *attention-based view*. It connects a firm's motivation and attitude toward decarbonization with a strategy for balancing economic and environmental goals.

In the second essay, I investigate the function and impact of supply chain collaborations to measure and reduce scope 3 CO_2 emissions (scope 3). Based on a multiple case study, I develop a framework that elaborates the *relational view* by explaining how inter-organizational linkages help to overcome firm, value chain, and macroeconomic challenges concerning scope 3. According to the findings in this study, measuring and reducing scope 3 can become a competitive advantage for firms.

Finally, in the third essay, I assess the link between corporate environmental performance (CEP) and corporate financial performance (CFP) for family firms. Based on a regression analysis with firm panel data from 74 firms, I demonstrate a positive relationship between CEP expressed as carbon intensity and CFP expressed as Return on Assets (ROA) and Return on Equity (ROE).

The presented essays advance the literature on decarbonization within the management accounting and family firm literature. By assessing how firms can successfully integrate decarbonization into their processes and how decarbonization activities affect their competitiveness, they integrate environmental and economic goals and reduce inherent tensions. As my results provide guidance for reconciling decarbonization progress and firm competitiveness based on empirical evidence, they incentivize practitioners to pursue decarbonization activities.

Summary in German

Die Dekarbonisierung gilt als eine der größten Herausforderungen unserer Zeit. Entschlossenes Handeln erfordert enorme Investitionen, die sich unter den derzeitigen Marktbedingungen möglicherweise nicht kurzfristig auszahlen. Weil sie einen Zielkonflikt zwischen wirtschaftlichen und ökologischen Zielen sehen, leisten viele Unternehmen den notwendigen Beitrag zur Dekarbonisierung nicht. Darüber hinaus fehlen ihnen oft die notwendigen Fähigkeiten und Ressourcen, um die mit der Dekarbonisierung verbundenen Herausforderungen zu meistern.

Diese Dissertation umfasst drei Artikel, in denen die Integration von Dekarbonisierung in Unternehmensprozesse von der Initiierung bis zur Umsetzung und schließlich der Folgenabschätzung untersucht wird. Die Forschung konzentriert sich aus drei Gründen auf Familienunternehmen: (1) sie machen 90% der Unternehmen in Deutschland aus, (2) sie unterscheiden sich in ihrer Motivation zur Dekarbonisierung, und (3) sie haben sich den Ruf erworben, erhebliche Anstrengungen für die Dekarbonisierung aufzubringen.

Im ersten Artikel erörtere ich, wie Familienunternehmen in ihrem strategischen Entscheidungsprozess gleichzeitig wirtschaftliche und ökologische Ziele verfolgen können. Basierend auf einer mehrfachen Fallstudie, entwickele ich die *attention-based view* weiter und leite ein Modell ab, welches die Motivation und Einstellung eines Unternehmens zur Dekarbonisierung mit einer Strategie zur Balance von wirtschaftlichen und ökologischen Zielen verbindet.

Im zweiten Artikel untersuche ich die Funktion und die Auswirkungen von Lieferkettenkooperationen auf die Messung und Reduktion von Scope 3 CO_2-Emissionen (Scope 3). Auf der Grundlage einer mehrfachen Fallstudie leite ich ein Modell ab, das die Ergebnisse der *relational view* weiterentwickelt, indem ich erkläre, wie interorganisatorische Verbindungen in Lieferkettenkooperationen dazu beitragen, die unternehmens-, werschöpfungskettenspezifischen-

und makroökonomischen Herausforderungen in Bezug auf Scope 3 zu überwinden. Folglich kann sich die Scope 3 Messung und Reduktion zu einem Wettbewerbsvorteil für Unternehmen entwickeln.

Im dritten Artikel schließlich analysiere ich den Zusammenhang zwischen der Umweltleistung (CEP) und der finanziellen Leistung (CFP) von Familienunternehmen. Auf der Grundlage einer Regressionsanalyse mit Firmenpaneldaten von 74 Unternehmen zeige ich eine positive Beziehung zwischen CEP, ausgedrückt als Kohlenstoffintensität, und CFP, ausgedrückt als Gesamtkapitalrendite und Eigenkapitalrendite.

Die vorgestellten Artikel erweitern die wissenschaftliche Diskussion zu Dekarbonisierung in den Literatursträngen Management Accounting- und Familienunternehmen. Indem sie analysieren, wie Unternehmen die Dekarbonisierung erfolgreich in ihre Prozesse integrieren können und wie sich Dekarbonisierungsaktivitäten auf ihre Wettbewerbsfähigkeit auswirken, verbinden sie wirtschaftliche und ökologische Ziele und reduzieren inhärente Spannungen. Da meine Ergebnisse Strategien für die Vereinbarkeit von Dekarbonisierungsfortschritt und der Wettbewerbsfähigkeit von Unternehmen basierend auf empirischer Evidenz liefern, bieten sie Managern einen Anreiz, Dekarbonisierungsaktivitäten zu verfolgen.

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List of Abbreviations

B2B	Business-To-Business
B2C	Business-To-Consumer
CapEx	Capital Expenditures
CDP	Carbon Disclosure Project
CEO	Chief Executive Officer
CEP	Corporate Environmental Performance
CFP	Corporate Financial Performance
CO_2	Carbon Dioxide
CO_{2e}	Carbon Dioxide Equivalent
COP27	27th Conference Of The Parties To The United Nations Framework Convention On Climate Change
CSRD	Corporate Sustainability Reporting Directive
DAX	Deutscher Aktienindex (German Benchmark Index)
ESG	Environmental, Social, Governance
EU	European Union
GHG	Greenhouse Gas
KPI	Key Performance Indicator
NFRD	Non-Financial Reporting Directive
NGO	Non-Profit Organization
NRBV	Natural Resource-Based View
OEM	Original Equipment Manufacturer
RBV	Resource-Based View

ROA	Return On Assets
ROE	Return On Equity
RV	Relational View
SBTi	Science-Based Targets Initiative
Scope 3	Scope 3 CO_2 Emissions
SD	Standard Deviation
SEW	Socioemotional Wealth
TCFD	Task Force On Climate-Related Financial Disclosures
TLGT	Too-Little-Of-A-Good-Thing
TMGT	Too-Much-Of-A-Good-Thing
TSR	Total Shareholder Return
UN	United Nations
VIF	Variance Inflation Factor

1 Introduction

1.1. Introduction to decarbonization

"Climate change is here. It is terrifying. And it is just the beginning. The era of global warming has ended; the era of global boiling has arrived. The air is unbreathable. The heat is unbearable. And the level of fossil fuel profits and climate inaction is unacceptable. Leaders must lead. No more hesitancy. No more excuses. No more waiting for others to move first. There is simply no more time for that. It is still possible to limit global temperature rise to 1.5 degrees Celsius and avoid the very worst of climate change. But only with dramatic, immediate climate action."

Antonio Guterres, United Nations Secretary-General (United Nations 2023)

1.1.1. Definition and regulation

In July 2023, United Nations (UN) Secretary-General Antonio Guterres drew a threatening image of global warming caused by human activity. Humans are responsible for increased greenhouse gas (GHG) emissions, especially since the transformation of economic activities during the Industrial Revolution (Intergovernmental Panel on Climate Change 2021). This has caused the greenhouse effect and a rise in the earth's surface temperature (University Cooperation of Atmospheric Research 2023). Although the urgency required to decarbonize and combat global warming becomes more pressing, it is not a new insight that decarbonization is perceived as one of the greatest challenges of our time. Already at the UN Climate Change Conference in 2015, German Chancellor Angela Merkel emphasized the unique role decarbonization would play in this century: "We must now agree on a binding review mechanism under international law so that this century can credibly be called a century of decarbonization" (Fereday 2019, p. 5).

Decarbonization is "the process by which countries, individuals or other entities aim to achieve zero fossil carbon existence" (Intergovernmental Panel on Climate Change 2022, p. 546).

For several years, non-economic topics, often bundled as environmental, social, governance (ESG), and their reconciliation with firms' economic goals have dominated discussions among firms, investors, and regulators (Serafeim 2021). Decarbonization forms part of the environmental topics, which is, according to previous research (Adams and Frost 2008; Adu et al. 2022), currently the primary focus of firms, investors, and regulators within ESG.

Decarbonization is represented through the key performance indicator (KPI) carbon dioxide, or, in short, CO_2. Among all GHG emissions, CO_2 is by far the dominant GHG produced by humans (German Environmental Agency 2021). It accounted for 87 % of all GHG emissions in Germany in 2020 (German Environmental Agency 2021) and it is clearly defined through globally accepted standards such as the Global Reporting Initiative and the GHG Protocol (Downar et al. 2021; Iwata and Okada 2011). Furthermore, CO_2 is the only GHG with a price tag, hence labeled with a quantifiable value, in the German national emissions trading system (Germany Environmental Agency - Emission Trading Office 2021).

The need to focus research on CO_2 is manifested by a new European Union (EU) regulation, the Corporate Sustainability Reporting Directive (CSRD), which obligates 50,000 firms in the EU to report and externally assure their carbon footprint and announce forward-looking information on their decarbonization targets (European Commission 2023a).

There are widely accepted standards on how firms can calculate their total CO_2. A firm that would like to identify its direct and indirect GHG emissions should measure and report three types of scopes (Greenhouse Gas Protocol 2004). Firms report GHG emissions "from sources that are owned or controlled by the company" as *scope 1* (Greenhouse Gas Protocol 2004, p. 25). In addition, firms label the "GHG emissions from the generation of purchased electricity consumed by the company" as *scope 2* (Greenhouse Gas Protocol 2004, p. 25). GHG emissions that "are a

consequence of the activities of the company, but occur from sources not owned or controlled by the company" are referred to as *scope 3* (Greenhouse Gas Protocol 2004, p. 25).

Regarding decarbonization regulation, the Paris Agreement from 2015 was considered a global breakthrough toward mitigating CO_2 emissions (United Nations 2022b). 195 countries agreed to limit the global temperature rise to 1.5 degrees Celcius till 2050 through substantial GHG emission reduction. As a further advancement of this goal, the EU climate law manifested binding decarbonization targets for the EU with 55% GHG emission reduction by 2030 (European Commission 2022).

1.1.2. The role of Germany and the private sector

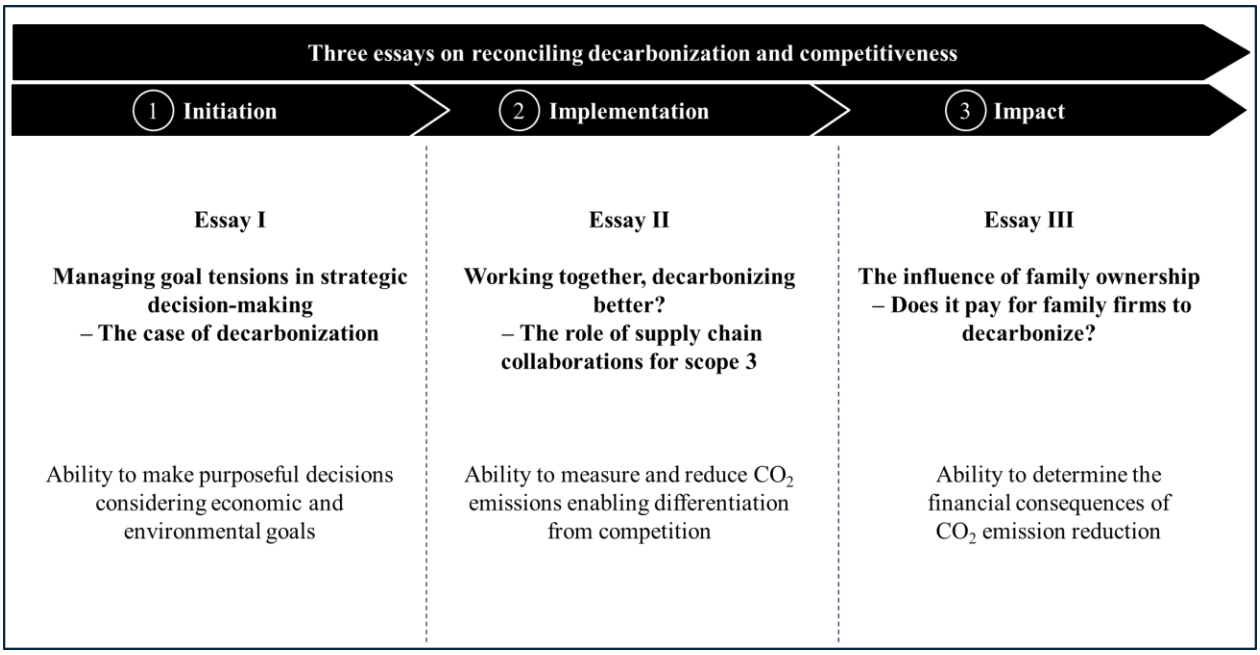
In absolute numbers, Germany is the largest emitter of CO_2 within the EU (German Environmental Agency 2023b), naturally assigning it a vital role in the EU's decarbonization. This is further exacerbated by the rule to define the emissions reduction target per country as a function of economic strength (European Commission 2023b). According to the EU's new strategic plan to reach its climate targets, Fit for 55 (European Council 2023), Germany has to reduce its emissions by 50% by 2030, in contrast to smaller countries with 10% targets.

In Germany, one-fourth of all GHG emissions originates from the activities of manufacturing firms (German Environmental Agency 2023a). Therefore, Germany's manufacturing firms must contribute to decarbonization if Germany seeks to reach its 2030 emission reduction target. An increasing number of German firms have recognized this responsibility and defined environmental goals in addition to economic ones. From a theoretical perspective, behavioral theory suggests that forward-thinking firms strive to achieve both economic and non-economic objectives concurrently (Argote and Greve 2007; Cyert and March 1992). However, the significant investments needed for effective decarbonization can create a

conflict between economic and environmental goals in the short term (Hahn et al. 2010; van der Byl and Slawinski 2015; Cespa and Cestone 2007).

Therefore, finding solutions to integrate decarbonization into firm processes that do not diminish but enhance competitiveness becomes crucial for firms (Song et al. 2017; van der Byl and Slawinski 2015). Figure 1.1. displays how this dissertation attempts to address this issue in three essays. More specifically, my research analyzes how decarbonization targets can be integrated into decision-making processes to overcome goal tensions, make purposeful decisions, and give decarbonization sufficient relevance (see Essay I). This serves as the ***initiation*** of decarbonization activities at firms. Subsequently, my research reviews how firms can effectively measure and reduce their scope 3 CO_2 emissions (scope 3) to ***implement*** decarbonization activities and leverage decarbonization progress as a competitive advantage (see Essay II). Finally, my research investigates how firms can assess the ***impact*** of their decarbonization activities on other firm metrics, such as financial performance (see Essay III).

Figure 1.1. Structure of the dissertation



Source. Own figure

1.2. Family firms as the backbone of decarbonization

"Only if we include family firms, climate change will actually work."

Nadine Kammerlander, Family Business Professor (Müller 2023)

Family firms play a crucial role across Germany since 90% of all firms are referred to as family firms (Altenburger and Bachner 2020; Stiftung Familienunternehmen 2019). "They generate more than 40 percent of all sales, develop almost three-quarters of patents, provide more than 60 percent of jobs, and 80 percent of apprenticeships" (Langenscheidt and May 2020, p. 12).

However, there is a lack of one single, irrefutable definition of the term family firm (O'Boyle et al. 2012; Posch and Speckbacher 2012). Nevertheless, following Chua et al. (1999), I regard two themes as essential for referring to a family firm. First, I consider a family firm as governed by a dominant coalition, expressed through ownership of the majority of property rights by one or a small number of families as well as family members forming part of the firm's executive

management or supervisory board. Second, a family firm is characterized by personalized control over the firm with the intention of transgenerational firm ownership.

Family firms are substantially different due to ownership by one or a small number of families. In 2017, Grewatsch and Kleindienst described that "ownership is among the most powerful forces that affect a firm's strategy and performance" (p. 26). Hence, findings from studies of non-family firms cannot necessarily be applied (Carney et al. 2015; Blumentritt 2006; Chrisman et al. 2005). Therefore, Langenscheidt and May stressed the lack of family-firm-specific research: "Ownership matters. The almost exclusive orientation on the model of the public company and the resulting neglect of the owners and the owners' perspectives is probably the greatest omission of the prevailing business administration theory" (2020, p. 13).

Family ownership also differentiates family and non-family firms with respect to decarbonization topics. A family firm's motivation to decarbonize is distinct, as family firms strive to protect their socioemotional wealth (SEW) (Sharma and Sharma 2011; Block and Wagner 2014; Garcés-Ayerbe et al. 2022; Gómez-Mejía et al. 2007). SEW can be described as "the non-financial aspects of the firm that meet a family's affective needs such as identity, the ability to exercise family influence, and the perpetuation of the family dynasty" (Gómez-Mejía et al. 2007, p. 106). As such, the protection of SEW serves as a non-economic point of orientation that can encourage the firm to make decisions that are not backed up by economic considerations (Zellweger et al. 2012; Berrone et al. 2010). The preservation of the SEW is "the single most important feature of a family firm's essence" (Berrone et al. 2012, p. 260) and distinguishes it from other organizational firm types.

Protecting SEW through environmental activities, family firms pursue and protect various non-economic goals (Dangelico et al. 2019), such as transgenerational value (Zellweger et al. 2012) and enduring ties with their employees, customers, and business partners (Le Breton-Miller and

Miller 2005). In family firms, decision-making is dominated by a long-term, transgenerational outlook (Brundin et al. 2014; Le Breton-Miller and Miller 2006). Through the family's interest in the firm's long-term persistence, family firms are willing to pursue investments that exceed the horizon of conventional payoff calculations (Brundin et al. 2014). This tendency aligns with the extended payback cycles associated with environmental initiatives that require high initial investments (van der Byl and Slawinski 2015). Furthermore, family firms tend to cultivate close relationships with their employees and foster a culture founded on shared values (Schulze et al. 2001). This practice results in heightened employee engagement and commitment to the firm's endeavors (Kammerlander and Prügl 2016; Huang et al. 2014; Craig and Dibrell 2006). Consequently, once a family firm decides to undertake decarbonization efforts, corporate environmental performance activities are anticipated to be executed more effectively, leading to increased innovation (Huang et al. 2014; Craig and Dibrell 2006).

Family firms have also built a distinct reputation for putting substantial efforts into decarbonization. Various German family owners confirm a strong feeling of responsibility toward the environment in their roles as family owners (Bochmann and Driftmann 2021). For instance, Henner Buhck, fourth-generation owner and manager of the *Buhck group*, a firm specializing in waste disposal services, highlights that family owners should leverage their independence from shareholders for decarbonization: "Who, if not we ourselves, who are endowed with this freedom, should take a leading role in climate protection" (Bochmann and Driftmann 2021, p. 156). Block and Wagner (2014) confirm that family ownership is positively linked to environmental aspects of corporate social responsibility. In addition, Sharma and Sharma (2011) concluded that high family involvement in firms leads to more proactive environmental management. Therefore, it is unsurprising that German family firms have proven competitive concerning environmental technologies (Die Stiftung für Familienunternehmen in Deutschland und Europa 2021). Among

the nominated firms for the German Sustainability Prize, family firms have won overproportionately in the last few years (German Sustainability Prize 2023). For instance, family firm *Brita* received an award for its innovative filter technologies that help to avoid billions of water plastic bottles per year, drastically decreasing customers' carbon footprints (German Sustainability Award 2023). Also, the family firm *Alfred Kärcher* received a prize as they launched a program called *Reduce, Reuse, Recycle*, mitigating carbon emissions through using recyclates and low-carbon packaging alternatives (Familienunternehmen im Fokus 2022). Besides family firms' individual dedication and innovative mindset concerning decarbonization, they also take essential roles in decarbonizing industries with their supply chain partners. A primary example is the chemical firm *Wacker Chemie*, one of the first members of the industrial alliance *Together for Sustainability*. The collaboration aims to shape the decarbonization of the entire chemical industry, including suppliers and customers from all tiers, by providing jointly derived ambitions, manuals, and tools to all involved parties (Together for Sustainability 2023).

Therefore, family firms are a specifically interesting context to study decarbonization in management accounting. Research on family firms in decarbonization is scarce, although family firms are the most common firm type in Germany and thus will play a central role in Germany's decarbonization. In addition, the derived strategies and solutions from the family firm context might serve as best practices in the market, as previous research shows that family firms may be more likely to achieve a win-win relationship between economic and environmental goals. SEW protection (Gómez-Mejía et al. 2007), the importance and synergistic pursuit of economic and non-economic goals (Kammerlander and Ganter 2015; Chrisman et al. 2012; Brundin et al. 2014), and common family firm assets and capabilities, e.g., high independence and flexibility in decision-making processes (Brundin et al. 2014; von Stietencron 2013) are proclaimed as strategic assets (Craig and Dibrell 2006; Garcés-Ayerbe et al. 2022).

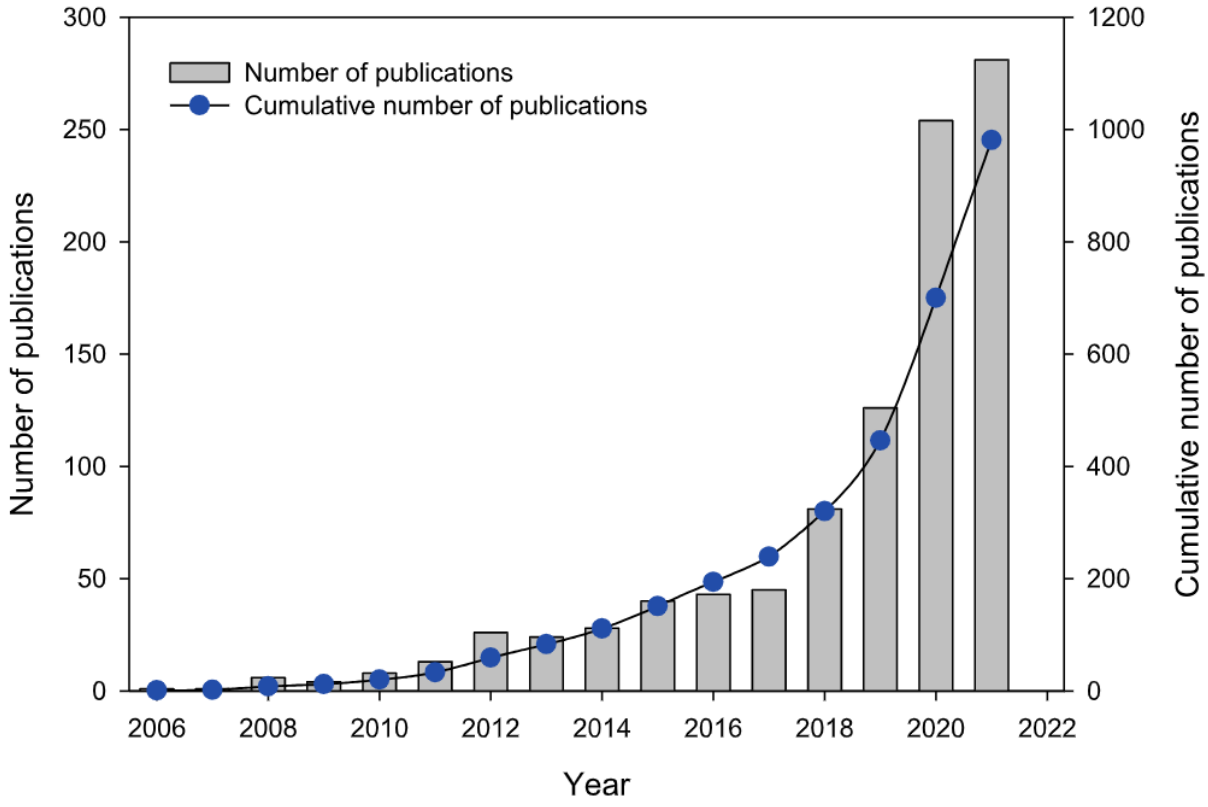
1.3. Research background and gap identification

1.3.1. Empirical and theoretical context of decarbonization

The three essays address different issues of firms along their decarbonization journey. While Essay I and III are written in a family firm context, Essay II includes family and non-family firms in its sample, as no purposeful differences have been identified between family and non-family firms for the focal topic. I commence this chapter by introducing the relevant theoretical background across essays before referring to essay-specific theories and empirical evidence.

As outlined in the introduction to decarbonization section, the pressure on firms to pursue ESG topics, including decarbonization, has manifested and increased over the last few years. Figure 1.2. illustrates that the number of annual publications in the domain of ESG has accelerated by more than ten times between 2006 and 2021.

Figure 1.2. Yearly and cumulative number of ESG-related publications from 2006-2022



Source. Senadheera et al. (2022)

Various theories and empirical findings explore the relationship between a firm's economic and environmental endeavors. The win-win approach aims to reconcile economic and environmental objectives. Elkington (1998) introduced the "triple bottom line approach" (p. 22), a construct balancing social, economic, and environmental goals. Similarly, Edmans (2020) introduced the "pie-growing mentality", in which a firm primarily focuses on the creation of social value rather than profits (p. 3), which results in positive long-term payoffs.

Conversely, proponents of the trade-off theory, as advocated by Hahn et al. (2010), suggest that there exists a trade-off between economic and environmental organizational outcomes due to competition for the same resources in the short term (van der Byl and Slawinski 2015; Margolis and Walsh 2003). Environmental activities may interfere with managers' short-term profitability

targets (Gaba and Greve 2019; Sarkis and Cordeiro 2001), suggesting managers prioritize economic or environmental goals (van der Byl and Slawinski 2015).

1.3.2. Management of goal tensions

"The conflict from multiple performance goals can create significant managerial challenges."

(Ethiraj and Levinthal 2009, p. 5)

The significant investments needed for effective decarbonization can create a perception of conflict between economic and environmental goals in the short term (Hahn et al. 2010; van der Byl and Slawinski 2015), leading to potential tensions (Cespa and Cestone 2007). Wrong decisions will likely be made when trade-offs between multiple goals exist because managers do not always act rationally or well-intended (Jensen 2000). Managerial actions are paused, and tensions arise (Ethiraj and Levinthal 2009; Obloj and Sengul 2020).

Goal tensions are particularly present in family firms. Stemming from the imbrication of the family and the business, the costs of inadequately balancing economic and environmental goals can be exceptionally high in family firms (Chrisman et al. 2012; Chua et al. 2018; Habbershon et al. 2003; Aparicio et al. 2017; Kotlar and De Massis 2013; Moores 2009). Due to a lack of analysis of how family firms can manage economic and environmental goals, relationships within the family firm may suffer, and the family firm's long-term survival may be at risk (Kammerlander and Ganter 2015; Diaz-Moriana et al. 2022).

In contrast to abundant research describing goal tensions in family firms (e.g., Kammerlander et al. 2015), the research on strategies for overcoming goal tensions is limited. In 2022, Diaz-Moriana et al. revealed that family firm decision-makers apply sense-making and sense-giving mechanisms to overcome goal tensions. However, while the study sharpens the understanding of the sense-making and sense-giving of family firm decision-makers, it does not

provide concrete, implementable strategies that practitioners can apply in the future. The study does not focus on environmental or decarbonization goals but investigates non-economic goals in general.

For this reason, there is a call for concrete, implementable strategies for how economic and environmental targets can be balanced (van der Byl and Slawinski 2015; Engert and Baumgartner 2016; Lozano 2015), especially within the family firm context (Chrisman et al. 2012; Chua et al. 2018; Habbershon et al. 2003; Aparicio et al. 2017; Kotlar and De Massis 2013; Moores 2009). Therefore, we analyze the following research question: *"Why and how do family firms manage economic and environmental goals in their strategic decision-making processes?"*

A highly relevant theory regarding the understanding of firms' strategic decision-making processes is the attention-based view (Ocasio 1997). I draw inspiration from Kammerlander and Ganter (2015), who applied the attention-based view to assess family firms' reactions to discontinuous technological change. The attention-based view is a theoretical framework that explores how organizations allocate attention to different issues and goals. Ocasio (1997) argues that decision-makers' attention to various internal and external factors shapes organizations' strategic behavior and actions. We[1] propose that analyzing organizational attention's[2] influence on strategies for managing multiple goals can yield new insights. For this purpose, we will conceptualize decision-makers' organizational attention through goals regarding decarbonization and goal systems (Chua et al. 2018) between economic and environmental goals.

[1] "We" refers to Johanna Schulze-Berge and Gunther Friedl as co-authors.
[2] The term "organizational attention" describes the "socially structured pattern of attention by decision-makers within an organization" (Ocasio 1997, p. 188).

1.3.3. Role of supply chain collaborations

"Technical limits, high transaction costs, data uncertainty, and the need for unprecedented collaboration across complex value chains combine to make scope 3 data collection for disclosure quite challenging."

(Schulman et al. 2021, p. 3)

As scope 3 accounts, on average, for 75% of a firm's carbon footprint (Carbon Disclosure Project, 2014; UN Global Compact Network UK, 2023), it plays a pivotal role in Germany's decarbonization (Greenhouse Gas Protocol, 2011). A recent examination of carbon reporting within the German benchmark index (DAX) has highlighted significant shortcomings in assessing and mitigating scope 3 (Bartels et al. 2022). This resembles that scope 3 measurement and reduction are multifaceted and difficult undertakings (Patchell 2018). The challenges faced by firms include insufficient internal resources and expertise (Patchell 2018; Blanco et al. 2016; Asif et al. 2022), a lack of validated data from supply chain partners (Klaaßen and Stoll 2020; Downie and Stubbs 2012), inadequate knowledge concerning the supply chain (Hansen et al. 2022; Patchell 2018) as well as the absence of a universally accepted methodology (Patchell 2018; Blanco et al. 2016; Hansen et al. 2022). Nevertheless, some firms have also realized benefits through scope 3 measurement and reduction (Sharfman et al. 2009). For example, improved awareness of climate-related risks throughout the value chain helps avoid costs resulting from non-compliance with climate regulations (Blanco, 2021; Li et al., 2020; Science-based Target Initiative, 2018), and it enables companies to improve their brand reputation and market value (Blanco, 2021; Li et al., 2020; Science-based Target Initiative, 2018).

In this situation, where scope 3 can pose challenges and opportunities for firms, firms and scholars started to investigate supply chain management more thoroughly (Jira and Toffel 2013).

As a result, numerous authors emphasize the significance of supply chain collaborations (Patchell 2018; Schulman et al. 2021; Blanco et al. 2017; Plambeck 2012) due to to a "need for unprecedented collaboration across complex value chains" (Schulman et al. 2021, p. 3). However, research on supply chain collaborations in the context of scope 3 remains limited, with no investigation into how these collaborations aid in scope 3 measurement and reduction. Furthermore, the existing evaluations have primarily focused on suppliers within single supply chains, disregarding more extensive supply chain networks (Theißen et al. 2014; Dahlmann and Roehrich 2019; Soosay and Hyland 2015; Sharfman et al. 2009) and different industries (Theißen et al. 2014).

Hence, we[3] explore the following research question*: "How do supply chain collaborations help firms to cope with scope 3 measurement and reduction?"*

The relational view (RV) highlights "value-creating linkages between organizations" (Dyer and Singh 1998, p. 46). It posits that inter-organizational relational rents can be generated through relation-specific assets, knowledge-sharing routines, complementary resources and capabilities, and effective governance within a pair or network of firms. Relational rents can be jointly earned and sustained by firms, potentially resulting in a competitive advantage. In the case of scope 3, the RV finds a special application, as the measurement and reduction efforts necessitate inputs from numerous supply chain partners that extend well beyond a firm's organizational boundaries. Therefore, we will apply the RV as the theoretical lens of this essay.

[3] "We" refers to Johanna Schulze-Berge and Sandra Briechle as co-authors.

1.3.4. Financial consequences of decarbonization

"When and how does it pay to be green?"

(Russo and Minto 2012, p. 10)

As pointed out at the beginning of chapter 1.3., researchers are debating whether and under which conditions firms can reap financial benefits from environmental activities. While theories like the natural resource-based view (NRBV) (Hart 1995) or the instrumental stakeholder theory (Donaldson and Preston 1995) point toward a positive relationship, other theorists claim a negative association (Andersson et al. 2018; Friedman 1970; Levitt 1958). A third group of researchers believes the relationship switches at specific inflection points (Trumpp and Günther 2017; Lewandowski 2017). Furthermore, internal and external moderating conditions help to refine the question of "When does it pay to be green?" (Grewatsch and Kleindienst 2017; Endrikat et al. 2014). Being a family firm has rarely been analyzed as a condition (Garcés-Ayerbe et al. 2022; Grewatsch and Kleindienst 2017).

In terms of empirical evidence, meta-studies in the field of corporate environmental performance (CEP) and corporate financial performance (CFP) (Orlitzky et al. 2003; Dixon-Fowler et al. 2013; Hang et al. 2018; Galama and Scholtens 2021; Busch and Lewandowski 2017) find a positive linkage between CEP and CFP. Also, in the course of single empirical studies, the opinion of a positive linear relationship (Fujii et al. 2013; Gallego-Álvarez et al. 2015; van Emous et al. 2021) or a positive relationship in a U-shaped setting (Trumpp and Günther 2017; Lewandowski 2017) dominate.

However, literature pertaining to the relationship between CEP and CFP with a specific emphasis on family firms is limited and displays strongly diverse findings (Adomako et al. 2019; Craig and Dibrell 2006; Garcés-Ayerbe et al. 2022; López-Pérez et al. 2018; Neubaum et al. 2012),

likely stemming from different definitions utilized for CEP. CEP is appropriately described as a multidimensional construct, making it unsuitable for transferring or comparing the results across different dimensions and definitions of CEP (Trumpp et al. 2015; Busch and Lewandowski 2017). Yet, in the family firm context, so far, each author deployed a different definition of CEP. While several authors utilize self-defined constructs for firms' corporate social responsibility, environmental orientation, or management (Adomako et al. 2019; Craig and Dibrell 2006; López-Pérez et al. 2018; Neubaum et al. 2012), Garcés-Ayerbe et al. (2022) are the first to utilize a clearly defined, quantifiable term for environmental performance: the annual amount of environmental investment. Their findings reveal a positive relationship between CEP and CFP, aligning with the results of Craig and Dibrell in 2006 and López-Pérez et al. in 2018. Conversely, Neubaum et al. (2012) and Adomako et al. (2019) find a negative relationship between CEP and CFP for family firms. At the same time, to our knowledge, no study has investigated the impact of corporate carbon performance on CFP for family firms, although it has manifested as the commonly recognized CEP measure in non-family firm literature (Delmas et al. 2015; Busch et al. 2020; Fujii et al. 2013; Trumpp and Günther 2017; Lewandowski 2017; Gallego-Álvarez et al. 2015). Consequently, the following research question emerges: *"Does it pay for family firms to decarbonize?"*

Based on a conjoint literature review on the relationship between CEP and CFP, e.g., the NRBV (Hart 1995), and family firms, e.g., SEW theory (Gómez-Mejía et al. 2007), I derive three hypotheses for validation via econometric techniques. Besides testing a positive effect of CEP on CFP for family firms, I will additionally test the hypotheses that firms from carbon-intensive, also referred to as "dirty" industries (see Appendix I), take longer to get paid for their environmental activities and that the voluntary public disclosure of corporate environmental performance positively moderates firms' CFP.

1.4. Methodology

I utilize two different research approaches in this dissertation, fitting the research questions at hand. While Essays I and II are based on qualitative research designs, Essay III deploys a quantitative panel regression analysis. Each essay offers a detailed explanation of the applied methodologies. Consequently, I will present condensed summaries of the methodologies in the following sub-chapters.

1.4.1. Qualitative, empirical research

In Essays I and II, my co-authors and I deploy a qualitative, empirical research method. More specifically, we adopt an inductive, multiple case study approach (Eisenhardt 1989; Yin 2018) similar to other authors in this research field (Diaz-Moriana et al. 2022; Strike and Rerup 2016). The given research approach is most suitable for several reasons: First of all, a multiple case study approach is well-suited for topics characterized by a dearth of existing theory and empirical evidence (Eisenhardt 1989), such as decarbonization in management accounting or family firm literature. Multiple case studies are particularly valuable when investigating exploratory topics and answering *how* questions (Yin 2018), aligning with the research questions of Essays I and II. Another advantage of this approach is the direct engagement with the subjects involved (Miles et al. 2014), including family owners, sustainability, purchasing, and product managers in our research. This allows for a more detailed and contextual understanding of each case analyzed before drawing cross-case conclusions (Eisenhardt 1989). Moreover, adopting an inductive research approach aids in comprehending insufficiently understood processes, such as the decision-making spanning economic and environmental goals and the functioning of supply chain collaborations for scope 3.

Based on Glaser and Strauss (1967), we pursue theoretical, multiple-step sampling approaches to explore similar firms with purposeful differences regarding decarbonization. Cases were collected till theoretical saturation was reached (Eisenhardt 2021).

In Essay I, the final sample consists of eleven private family firms with a yearly revenue range between 50 million and one billion euros, also referred to as "Gehobener Mittelstand" (Venohr and Langenscheidt 2015, p. 5). Thus, they are defined as large according to the German Commercial Code (German Federal Office of Justice 2023). This ensures a high level of professionalization to derive relevant learnings while still establishing a clear distinction from publicly listed companies in size. All sample firms are headquartered in Germany due to Germany's vital role in the EU's decarbonization (European Council 2023; German Environmental Agency 2023b) and the prevalence of family-controlled firms in Germany (Stiftung Familienunternehmen 2019). As all sample firms operate in carbon-intensive industries, decarbonization is naturally a relevant topic due to their emittance of CO_2.

In Essay II, the final sample also covers eleven German firms. On purpose, all sample firms are large based on their revenues (German Federal Office of Justice 2023), as large firms are required to report their scope 3 progress under the CSRD (European Commission 2023a) and are expected to drive scope 3 measurement and reduction throughout the value chain (Greenhouse Gas Protocol 2011). Original equipment manufacturers (OEMs), and first-tier and second-tier suppliers are equally represented to account for supply chains as multi-tier networks (Soosay and Hyland 2015). Similarly, the final sample is balanced with six *scope 3 leading*, and five *scope 3 lagging firms* resulting from a polar sampling strategy (Pettigrew 1990; Eisenhardt 1989). In contrast to lagging firms, leading firms are equipped with a comprehensive scope 3 measurement, a scope 3 specific reduction target, and an external validation of the scope 3 specific reduction target by the Science-Based Targets initiative (SBTi).

While the interviews with the sample firms serve as our primary data source in both studies, we enhance the results' robustness by triangulating findings with two other data sources (Kotlar and De Massis 2013; Theißen et al. 2014). First, archival data from the companies' websites, past press releases, sustainability reports, and firm guidelines represent empirical evidence for the firms' decarbonization activities and sophistication. Therefore, it serves as the basis for case selection, as an aid for familiarization with the firms in preparation for the interviews (Diaz-Moriana et al. 2022), and benefits the data analysis. Second, expert interviews complement the data. The expert interviews entail knowledge of industry standards and technical methodologies that exceed common knowledge by practitioners and thus enable in-depth queries during the interviews and enhanced interpretation during data analysis.

In terms of data analysis, we first perform a within-case analysis based on the compiled data from interview transcripts, archives, and expert interviews. Initial key themes are identified (Miles et al. 2014), and first-order categories are established. Second, we perform a cross-case analysis to seek similarities and differences among the findings from single case studies and draw overarching patterns (Eisenhardt 1989; Eisenhardt and Graebner 2007), enabling us to aggregate the assigned codes into second-order themes (Gioia et al. 2013). Last, through various rounds of iterations, we improve our themes and finally derive our final data structures. Through an iterative process between data analysis and literature revisitation, we eventually develop an inductive model for Essays I and II, respectively.

1.4.2. Quantitative, empirical research

The research approach for Essay III draws inspiration from other authors pursuing the question, "When does it pay to be green?" (Trumpp and Günther 2017; Busch and Lewandowski 2017; Iwata and Okada 2011). I deploy econometric techniques by utilizing an ordinary least square regression

analysis to test the hypothesis of the positive effect of CEP on CFP in family firms as well as the two related hypotheses reviewing the impact of a firm's industry and voluntary public disclosure.

For this purpose, I establish a new, unbalanced dataset encompassing 74 private family firms for nine years (2013-2021). The sample represents German family firms in terms of age and industries. Meanwhile, the sample firms are larger than the average German family firm, as the financial data availability is very limited for small and medium-sized firms without public reporting requirements of financial statements (German Federal Office of Justice 2022).

CEP is defined as corporate carbon performance, which is depicted as the inverse value of a firm's carbon intensity in this study. *CFP* considers a firm's profitability, expressed via the performance indicators *Return on Assets* (*ROA)* and *Return on Equity* (*ROE)*. In addition, I introduce two moderating dummy variables: the dirtiness of an *Industry* (Iwata and Okada 2011; Mani and Wheeler 1998) and the *Disclosure* of a firm's carbon performance (Delmas et al. 2015). Several control variables, namely *Size, Leverage, Capital Intensity, and Growth*, form part of the equations as they likely determine the dependent variable.

I employ three models in this essay. First, I establish Model 1 as a linear baseline model and apply it to the entire firm sample. Furthermore, Model 1 is applied to four subsamples to examine potential variations in estimation results among clean and dirty firms, as well as firms with and without public disclosure. This approach is consistent with previous studies (Kim and Bae 2022; Iwata and Okada 2011; Trumpp and Günther 2017). I introduce interaction terms to assess the significance of differences between these subsamples. In Model 2, I test the significance of the effect of industry affiliation by including the interaction term between *CEP* and *Industry*. Similarly, in Model 3, I separately examine the impact of public disclosure by evaluating the interaction term of *CEP* and *Disclosure*. Leonidou et al. in 2013 and Iwata and Okada in 2011 guide my procedure.

To address the endogeneity between *CEP* and *CFP*, I utilize a one-year time-lagged (t-1) measure of *CEP* (Trumpp and Günther 2017; Busch et al. 2020). My model is set up as a random effects model, based on a Hausman test and in line with the studies by Gallego-Álvarez et al. in 2015 and Fujii et al. in 2013.

1.5. Results and contribution

In this chapter, I provide insights into each essay's results and theoretical and practical implications. Table 1.1., at the end of this chapter, offers a comprehensive overview of the three essays, including their key characteristics, and can serve as guidance throughout the rest of this dissertation.

Essay I. Building on case-based evidence and the attention-based view (Ocasio 1997), my co-author and I derive a framework that explains why and how family firms have developed strategies to simultaneously manage economic and environmental goals. Our analysis reveals that firms deploy strategies depending on their motives for decarbonization and the perceived link between economic and environmental goals. As a result, four strategies centered around integrating CO_2 emissions for multiple goal management emerge.

The first strategy of CO_2 integration is characterized by the *presence of environmental information (incl. innovation)*. CO_2 is intricately woven into a firm's culture, and employees are naturally used to considering CO_2 in various processes, such as new product development. The second strategy is described as *designated capital expenditure (CapEx),* where the budget for decarbonization activities is centrally determined at the beginning of the year instead of a repeated consideration of CO_2 information in processes. A third strategy is introducing an *artificial CO_2 price* as a variable in a firm's investment calculations. For instance, this artificial CO_2 price can be calculated using projections of future CO_2 prices and compensation costs. Finally, as a fourth

strategy, some firms show *no integration* in their decision-making because they are unaware of their goal system, whether decarbonization poses a challenge or chance, and lack relevant capabilities in carbon management.

In terms of theoretical implications, these findings extend the existing body of research concerning multiple goal management in family firms (e.g., Diaz-Moriana et al. 2022) through concrete, implementable strategies and the insight that multiple goal management strategies should consider firms' goals and goal systems. To the best of our knowledge, we are the first to investigate strategies to overcome goal tensions that result from decarbonization despite these tensions' increasing prevalence.

Moreover, we uncover that the driving force behind environmentally conscious behavior in family firms arises not solely from non-economic, intrinsic firm objectives (Berrone et al. 2010; Sharma and Sharma 2011; Garcés-Ayerbe et al. 2022) but also from extrinsic motivations such as regulatory pressures and client demands. Last, we establish a connection between multiple goal management and the attention-based view (Ocasio 1997) by showcasing how firms' organizational attention, characterized by various goals and goal systems[4], gives rise to diverse strategies.

In terms of practical implications, this work goes beyond the extant knowledge of concrete goal management strategies to be applied by practitioners at family firms. We show that economic and environmental goals can be reconciled through an effective goal management strategy and thus hope to incentivize firms to pursue decarbonization goals next to their economic goals.

Essay II. Through inductive analysis and the RV (Dyer and Singh 1998), my co-author and I develop a model on supply chain collaborations for scope 3. The model illustrates that in measuring and reducing scope 3, firms usually encounter difficulties that must be resolved to avoid

[4] The term "goal system" describes in this research how a firm perceives the link between economic and environmental goals. The expression is inspired by Chua et al. (2018).

impeding progress and effectiveness. If managers cannot find solutions in isolation, they look for resources and capabilities in cooperation with existing and new supply chain partners. We identify five types of collaborations with the purpose of scope 3 measurement and reduction: *inter-functional, supplier, customer, industry, and cross-industry*. We reveal that these five forms of collaboration can address scope 3 challenges in the firm, value chain, and macroeconomic context through value-creating linkages between the involved parties. They are complementary in their function, as the different supply chain collaboration types deploy distinct collaborative activities that match the identified scope 3 challenges. We further demonstrate that scope 3 measurement and reduction can become a competitive advantage for firms once challenges are overcome.

The positive impact of supply chain collaborations on scope 3 measurement and reduction is resembled by our sample, as supply chain collaborations are more often pursued by leading than lagging firms. Moreover, following an arm's length transactional principle by exerting pressure and enforcing requests on value chain partners is perceived as inadequate by leading firms.

In terms of theoretical implications, we are the first to assess how supply chain collaborations help address scope 3 challenges and turn scope 3 into a competitive advantage. This advances the literature on scope 3 in terms of challenges and benefits (Blanco et al. 2016, 2017; Patchell 2018; Klaaßen and Stoll 2020; Hansen et al. 2022) and supply chain engagement (Lintukangas et al. 2022; Dahlmann and Roehrich 2019). Moreover, we elaborate the RV (Dyer and Singh 1998) by showing how inter-firm resources and routines are suitable for addressing deficiencies of firms. In 1998, Dyer and Singh aimed to show "that relationships between firms are an increasingly important unit of analysis for explaining supernormal profit returns" (p. 676). They motivate the formation of collaborations with above-normal profits, surplus gains, and specialization. Our analysis originates from the opposite viewpoint and leverages the RV and its determinants of relational rents, e.g., relationship-specific assets, as a model to assess the resolution

of challenges. Last, due to our conceptualization of supply chains as a vast network, we provide evidence for supply chain collaborations with five different stakeholder groups and their validity across industries.

In terms of practical implications, our efforts raise awareness about scope 3 challenges while providing advice on suitable supply chain collaboration types as effective solutions. We also foster advancements within scope 3 by underscoring the promise of competitive advantage. Non-profit organizations (NGOs) and regulators should contemplate including these insights into their standards and offer aid in forming resource-intensive supply chain collaboration types.

Essay III. My panel regression analysis results show a positive, linear relationship between CEP and CFP for family firms across model specifications, suggesting *a positive payoff through decarbonization*. Making these findings more refined, I reveal that whether a firm belongs to a clean or dirty *Industry* does not moderate the relationship between CEP and CFP. Finally, I show that *Disclosure* of carbon performance positively moderates the relationship between CEP and CFP.

In terms of theoretical implications, I am the first to establish a database for family firms that measures CEP as carbon intensity. This measure entails many advantages, such as clearly defined measurement standards and a direct link to climate change (Trumpp and Günther 2017). In addition, it allows me to perform an initial comparison between family and non-family firms regarding their ability to realize financial benefits through decarbonization. My results confirm the relationship between the NRBV and the SEW theory (Garcés-Ayerbe et al. 2022). Furthermore, my results extend the findings by Garcés-Ayerbe et al. (2022) by linking the SEW theory with the instrumental stakeholder theory (Donaldson and Preston 1995; Jones 1995).

The consideration of the variable *Disclosure* could reconcile contradictory empirical evidence regarding the CEP-CFP relationship in the context of family firms (Garcés-Ayerbe et al.

2022; López-Pérez et al. 2018; Adomako et al. 2019; Craig and Dibrell 2006; Neubaum et al. 2012). Drivers for the positive effect of disclosure practices include enhanced integrated performance measurement (Downar et al. 2021; Kaplan and Anderson 2007; Young and O'Byrne 2001), external assurance provision (Ioannou and Serafeim 2019), or proactivity of decarbonization strategies (Sharma and Vredenburg 1998; King and Lenox 2002; Endrikat et al. 2014; Russo and Fouts 1997).

In terms of practical implications, I show that decarbonization can pay off for family firms, encouraging additional corporate decarbonization activities. I inform regulators that future regulations' effectiveness would be optimized by focusing on public disclosure of carbon performance.

Table 1.1. Overview of the three essays

	① Initiation	② Implementation	③ Impact
Essay	**Managing goal tensions in strategic decision-making – The case of decarbonization** *(c.f. Chapter 2)*	**Working together, decarbonizing better? – The role of supply chain collaborations for scope 3** *(c.f. Chapter 3)*	**The influence of family ownership – does it pay for family firms to decarbonize?** *(c.f. Chapter 4)*
Research design			
Research question	Why and how do family firms manage economic and environmental goals in their strategic decision-making processes?	How do supply chain collaborations help firms to cope with scope 3 measurement and reduction?	Does it pay for family firms to decarbonize?
Empirical approach	Qualitative	Qualitative	Quantitative
Methodology	Exploratory inductive qualitative study based on multiple cases (Eisenhardt 1989; Yin 2009)	Exploratory inductive qualitative study based on multiple cases (Eisenhardt 1989; Yin 2009)	Panel regression analysis based on firm data from 2013 - 2021
Results			
Key findings	• Comprehensive framework depicting why and how firms integrate CO_2 in their strategic decision-making to manage multiple goals • Four archetypes derived stemming from different goals and goal systems	• Comprehensive framework illustrating that supply chain collaborations positively impact a firm's scope 3 measurement and reduction by overcoming challenges through value-creating linkages	• Consistent regression results stating that it pays to decarbonize under the condition of being a private family firm • Public disclosure of carbon performance with positive, moderating effect
Contribution			
Theory elaboration	• Attention-based view (Ocasio 1997)	• Relational view (Dyer and Singh 1998)	• Natural resource-based view (Hart 1995) • Instrumental stakeholder theory (Donaldson and Preston 1995)
Managerial implications	• Overview and guidance for strategies for balancing economic and environmental goals	• Consciousness about challenges and countermeasures regarding scope 3 • Incentivization to pursue scope 3 for competitive advantages	• Incentivization of firms to decarbonize for financial reasons and disclose carbon footprint even in the absence of regulation

Source. Own table

1.6. Dissertation structure

This dissertation is structured as follows: After the preceding overarching introduction, the three essays are presented in Chapters 2-4. The dissertation finishes with a comprehensive conclusion in Chapter 5, which covers a summary of the research findings, avenues for future research, and concluding remarks. Finally, the appendix comprises additional information about the three essays.

It is important to note that the three essays are connected as they jointly depict the decarbonization of a firm. Yet, the essays can exist on a stand-alone basis and be read independently, irrespective of the suggested order within this dissertation. Hence, some sections might include content overlaps.

2 Essay I

Managing goal tensions in strategic decision-making – The case of decarbonization[5]

Johanna Cecilia Schulze-Berge, Gunther Friedl [6]

This essay investigates how family firms balance tensions between economic and environmental goals arising in the course of decarbonization. Goal tensions and their resolution are particularly relevant in family firms due to the overlap between the family and the business. Employing the attention-based view, we conduct a multiple case study with eleven German firms and derive a model that connects a firm's motivation and attitude toward decarbonization with a strategy for balancing economic and environmental goals. We contribute through concrete, implementable strategies for multiple goal management. We further reveal that the motivation for environmental behavior in family firms stems not only from non-economic, intrinsic firm goals but also extrinsic goals. Moreover, we elaborate the attention-based view by illustrating how firms' organizational attention yields heterogeneous goal management strategies.

Keywords: Attention-based view, Decarbonization, Family firm, Goal tensions, Strategic decision-making process

[5] This essay has been accepted and presented at G-Forum 2022 in Dresden and the 43rd USAEE/IAEE Conference in Houston.

[6] Author contributions: JSB performed the interviews and data analysis and wrote the first draft. GF supported the development of the research idea and significantly contributed to the revision of the essay.

2.1. Introduction

Due to increasing climate change concerns, decarbonization[7] is perceived as one of the greatest challenges of our time. At the UN Climate Change Conference in 2015, Chancellor Angela Merkel emphasized the unique role decarbonization would play in this century: "We must now agree on a binding review mechanism under international law so that this century can credibly be called a century of decarbonization" (Fereday 2019, p. 5). Since then, the urgency for firms to decarbonize has increased rapidly through the introduction of binding climate regulations such as the European Union (EU) Green Deal (European Commission 2022) and the German Climate Change Act (Die Bundesregierung 2022). In Germany, one-fourth of all greenhouse gas (GHG) emissions originate from the activities of manufacturing firms (German Environmental Agency 2023a), of which 90% of firms are owned by families (Altenburger and Bachner 2020). Yet, at the same time, especially family firms have earned a reputation for investing substantial efforts into decarbonization in recent years. For instance, in 2022, the family firm *Alfred Kärcher* received the German sustainability prize as they launched a program called "Reduce, reuse, recycle", mitigating carbon emissions through the usage of recyclates and low-carbon packaging alternatives (Familienunternehmen im Fokus 2022). According to the chief executive officer (CEO), decarbonization investments are made "because it is in the genes of the family" (Familienunternehmen im Fokus 2022). The firm further proclaims it decarbonizes to act responsibly (Familienunternehmen im Fokus 2022). However, at the same time, family firms are challenged by the high costs of investments in decarbonization. For instance, the German family firm *Schlagmann Poroton*, a brick manufacturer, has led an industry initiative that ascertained

[7] Decarbonization refers to "the process by which countries, individuals or other entities aim to achieve zero fossil carbon existence." (Intergovernmental Panel on Climate Change, 2022, p. 546).

that 2.3 billion euros in investments will be required by 2050 for the German brick industry to reach climate neutrality (Knitterscheidt 2021).

According to behavioral theory, future-oriented firms simultaneously pursue economic and non-economic goals (Cyert and March 1992; Argote and Greve 2007). Nonetheless, due to the requirement of significant investments for effective decarbonization, economic and decarbonization goals can be perceived as conflicting in the short term (Hahn et al. 2010; van der Byl and Slawinski 2015), and tensions between managers may arise (Cespa and Cestone 2007).

Family-firm researchers have repeatedly stressed the urgency to resolve tensions between multiple firm goals to avoid severe consequences for the firms and their managers (e.g., Kammerlander et al. 2015). However, concrete, differentiated strategies for balancing economic and environmental targets along the entire strategic decision-making process are missing (Lozano 2015; van der Byl and Slawinski 2015; Margolis and Walsh 2003; Engert and Baumgartner 2016). This gap in the literature is specifically significant for family firms, as not only the presence of multiple goals but also the tensions between economic and non-economic goals are particularly strong in the family firm context due to the imbrication of the family and the business (Chrisman et al. 2014; Diaz-Moriana et al. 2022). A lack of analysis of how family firms can manage economic and environmental goals can lead to detrimental consequences for relationships within family firms as well as the family firms' long-term survival (Kammerlander and Ganter 2015; Diaz-Moriana et al. 2022). Therefore, family firms are a specifically interesting context to study strategies for multiple goal management within decarbonization.

Hence, we analyze the following research question: *"Why and how do family firms manage economic and environmental goals in their strategic decision-making processes?"*

This research question intentionally considers multiple goals in the context of strategic decision-making processes. Within this study, we define strategic decisions according to

Eisenhardt and Zbaracki (1992) and Wilson (2015). Strategic decisions are often linked to other decisions in an organization and can be complex, based on limited, contradicting information, and may entail trade-offs and risks (Wilson 2015). Strategic decisions are "important, in terms of the actions taken, the resources committed, or the precedents set" (Eisenhardt and Zbaracki 1992, p. 17). They are made by top management and impact the firm's survival (Eisenhardt and Zbaracki 1992).

Furthermore, we will use decarbonization goals, expressed through carbon dioxide, in short, CO_2, as a representation of environmental goals in this study (Delmas et al. 2015; Trumpp and Günther 2017). The need to focus research on CO_2 is manifested by a new EU regulation, the Corporate Sustainability Reporting Directive (CSRD), which obligates 50,000 firms in the EU to report and externally assure their carbon footprint (European Commission 2023a). Firms will be required to publicly announce forward-looking information on decarbonization targets, enhancing the pressure to pursue environmental next to economic goals.

To answer the research question, we conduct a multiple case study incorporating an inductive case analysis method, similar to other authors in this field (Diaz-Moriana et al. 2022; Strike and Rerup 2016). Through the qualitative analysis of interviews with eleven German family firms, enriched with archival firm data from 2018-2021 and ten expert interviews, an inductive model is derived based on the attention-based view by Ocasio (1997), answering *why* and *how* economic and environmental goals are managed in strategic decision-making processes. Going beyond previous research, the attention-based model not only provides four concrete strategies (*presence of environmental information (incl. innovation), designated capital expenditures (CapEx), artificial CO_2 price, and no integration*) for balancing economic and environmental goals but also explains why strategies are heterogeneous among family firms based on different motivations, firms' goals, and attitudes toward decarbonization, firms' goal systems.

Our study offers three theoretical contributions. First, our findings inform the literature on multiple goal management (Diaz-Moriana et al. 2022; Ivory and Brooks 2018; Epstein et al. 2015) by presenting strategies for how firms balance economic and environmental goals. Thus, we are answering calls for concrete, implementable strategies (van der Byl and Slawinski 2015; Engert and Baumgartner 2016; Lozano 2015), and we are the first to investigate strategies for goal tensions during firm decarbonization, representative of other environmental firm activities. In addition, our findings show that strategies for multiple goal management should consider firms' goals and goal systems (Chua et al. 2018).

Second, we reveal that the motivation for environmental behavior in family firms stems not only from non-economic, intrinsic firm goals but also extrinsic goals such as pressure from regulatory institutions, client demand, or a competitive advantage in tender situations. Third, we connect the research on multiple-goal management with the attention-based view (Ocasio 1997). We advance the attention-based view by illustrating how firms' organizational attention regarding diverse goals and goal systems yields heterogeneous strategies.

In terms of managerial implications, the insights of this paper serve as an inspiration for practitioners in balancing economic and environmental goals. We hope to increase the presence and pursuit of decarbonization activities at family firms.

2.2. Theoretical background

2.2.1. Family firm goals

Tensions between economic and non-economic goals

Family firms play a crucial role across Germany since 90% of all firms are family firms (Altenburger and Bachner 2020; Stiftung Familienunternehmen 2019). However, an indisputable and commonly aligned definition of the term family business does not exist (Posch and

Speckbacher 2012; O'Boyle et al. 2012). Despite the vagueness surrounding the term "family firm", there are two central themes that this study regards as relevant criteria for being classified as a family firm. First, we consider a family firm as governed by a dominant coalition, expressed through ownership of the majority of property rights by one or a small number of families as well as family members forming part of the firm's executive management or supervisory board (Chua et al. 1999). Second, a family firm is characterized by personalized control over the firm with the intention of transgenerational firm ownership (Sharma 2004; May 2012; Chua et al. 1999). This paper will focus on private family firms and exclude publicly listed family firms from the analysis, as ownership is less dispersed in private family firms, and the interests of family owners become more apparent (Cruz et al. 2015).

Furthermore, the connection of the family with firm ownership will empower the family to determine firm goals (Mitchell et al. 1997). Family firms are known for pursuing a wider set of goals than just economic goals, as non-economic goals are also highly important to them (Brundin et al. 2014; Sharma et al. 1997; Chrisman et al. 2012; Berrone et al. 2010; Gomez-Mejia et al. 2011). Non-economic goals are clustered around five dimensions. Non-economic goals of family firms include transgenerational value (Chua et al. 1999; Zellweger et al. 2012; Brundin et al. 2014), family reputation (Chrisman et al. 2012; Kammerlander and Prügl 2016; Berrone et al. 2012), power and control (Chua et al. 1999; Zellweger et al. 2013; Carney 2005), enduring ties (Le Breton-Miller and Miller 2005; Zellweger et al. 2013; Brundin et al. 2014; Kammerlander and Prügl 2016), and affect and emotion (Berrone et al. 2012; Chrisman et al. 2012).

By adhering to their non-economic goals, family firms preserve their socioemotional wealth (SEW) (Zellweger et al. 2012; Berrone et al. 2010; Gómez-Mejía et al. 2007; Berrone et al. 2012). The phenomenon SEW can be described as "the non-financial aspects of the firm that meet a family's affective needs such as identity, the ability to exercise family influence, and the

perpetuation of the family dynasty" (Gómez-Mejía et al. 2007, p. 106). The five dimensions of SEW match with the five types of non-economic goals previously described (Berrone et al. 2012; Gomez-Mejia et al. 2011). As such, the protection of SEW serves as a non-economic point of orientation that can encourage the firm to make decisions that are not backed up by economic considerations (Zellweger et al. 2012; Berrone et al. 2010). The preservation of the SEW is "the single most important feature of a firm's essence" (Berrone et al. 2012, p. 260) and distinguishes it from other organizational firm types.

The desire to reach non-economic goals and protect a firm's SEW has also been identified as the main driver of environmental behavior at family firms (Berrone et al. 2010; Sharma and Sharma 2011; Block and Wagner 2014; Garcés-Ayerbe et al. 2022). Family firms even prioritize environmental topics across corporate social responsibility topics to protect their SEW (Campopiano and Massis 2015). Non-economic goals like transgenerational value and power and control exerted by the family are closely linked to the desire to achieve excellent environmental performance in family firms (Dangelico et al. 2019).

However, pursuing environmental behavior does not diminish the relevance of economic aspects at family firms (Brundin et al. 2014; Argote and Greve 2007). Due to the imbrication of the family and the business, the costs of deficits in managing economic and environmental goals weigh particularly high in family firms (Chrisman et al. 2012; Chua et al. 2018; Habbershon et al. 2003; Aparicio et al. 2017; Kotlar and De Massis 2013; Moores 2009). A lack of analysis of how family firms can manage economic and environmental goals can lead to detrimental consequences for relationships within the family firm as well as the family firm's long-term survival (Kammerlander and Ganter 2015; Diaz-Moriana et al. 2022). At the same time, a desire for SEW protection and a long-term mindset might serve as strategic assets unique to family firms that could help them to find adequate strategies to reconcile economic and environmental goals

(Craig and Dibrell 2006; Garcés-Ayerbe et al. 2022). Therefore, family firms are a specifically interesting context to study strategies to simultaneously manage economic and environmental goals.

An attention-based view on goal tensions

A highly relevant theory regarding the understanding of firms' strategic decision-making processes is the attention-based view (Ocasio 1997). For instance, in 2015, Kammerlander and Ganter applied the attention-based view to family firms' decision-making on discontinuous technological change.

Ocasio (1997, p. 187) points out that "firm behavior is a result of how firms channel and distribute the attention of their decision-makers". He provides a theory that can help to explain why and how a firm makes certain strategic decisions, which he refers to as the structural distribution of attention (Principle 3) (Ocasio 1997). The strategic decision made is a result of the focus of attention (Principle 1) and the situated attention (Principle 2) of the decision-maker because each decision-maker can only adhere to a limited number of issues and answers (Ocasio 1997).

One particular part of the attention-based view that has gained scholarly attention is attention breadth, which is the number of topics a decision-maker adheres to at the same time (Pringle et al. 2001). In 2020, Ahn argued that sustainability requires a pronounced attention breadth, as economic and non-economic goals need to be considered simultaneously. While Ahn (2022) focuses on the influence of the CEO's attention breadth on the resulting sustainability performance, we want to detail the strategies that lead to this performance instead. We propose that analyzing organizational attention's influence on strategies for managing multiple goals can yield new insights. For this purpose, we will conceptualize decision-makers' attention through goals that drive the pursuit of environmental behavior as well as goal systems (Chua et al. 2018)

between economic and environmental goals. We will assess the decision-making processes that cope with economic and environmental goals in detail without consideration of the sustainability performance thereafter.

2.2.2. Multiple goal management

The behavioral theory of firms states that firms pursue a variety of non-economic and economic goals (Argote and Greve 2007; Cyert and March 1992), which are sometimes even conflicting (Unsworth et al. 2014; Meyer and Gupta 1994). Yet, when trade-offs exist between multiple goals and variables are unclear, no purposeful decisions are likely to be made because managers do not always behave rationally or well-purposed (Jensen 2000). They are boundedly rational and have cognitive limits (Eisenhardt and Zbaracki 1992). Hence, higher decision-making complexity also leads to a longer required decision time (Astley et al. 1982). The performance in decision-making declines with each additional goal pursued simultaneously (Obloj and Sengul 2020). Managerial actions are paused and downtime is created when goals point in different directions (Ethiraj and Levinthal 2009). However, organizations can accomplish multiple goals if effective strategies are derived and implemented (Obloj and Sengul 2020; Ethiraj and Levinthal 2009).

Multiple firm goals may be in alignment, independent, or in conflict (Obloj and Sengul 2020). While the win-win approach tries to reconcile environmental with economic goals, the trade-off approach highlights tensions and demands the choice for one of these goals (van der Byl and Slawinski 2015). On the one hand, in the course of the win-win approach, Elkington (1998) introduced the “triple bottom line approach” (p. 22), an attempt to balance social, economic, and environmental goals. Similarly, Edmans (2020) introduced the “pie-growing mentality”, in which a firm’s primary objective is the creation of social value rather than profits (p. 3). Thus, long-term payoffs can be positive, although the projects leading up to this value creation would not have

been approved by applying a classical shareholder value framework (Edmans 2020). Furthermore, there is abundant literature pointing out that "it pays to be green" (Hang et al. 2018, p. 738) via a positive link between environmental behavior and profitability (Busch et al. 2020; Hang et al. 2018; Fujii et al. 2013).

On the other hand, with adherence to the trade-off approach, Hahn et al. (2010) describe a trade-off between economic, environmental, and social organizational outcomes. Economic and environmental initiatives can benefit each other in the long run while they strive for the same resources in the short term (van der Byl and Slawinski 2015; Margolis and Walsh 2003). Hence, environmental initiatives can potentially prevent managers from reaching their short-term profitability goals (Gaba and Greve 2019; Sarkis and Cordeiro 2001).

Family-firm researchers have repeatedly stressed the urgency to resolve tensions between multiple firm goals to avoid severe consequences for the firms and their managers (e.g., Kammerlander et al. 2015). However, research developing strategies for resolving goal tensions in family firms is scarce. In 2022, Diaz-Moriana et al. demonstrated that family firm decision-makers apply sense-making and sense-giving mechanisms when they face goal tensions. While the study sharpens the understanding of sense-making in family firms, it does not provide concrete, implementable strategies that practitioners can apply in their firms to balance economic and non-economic tensions in the future. The study covers non-economic goals in general without focusing on environmental or decarbonization goals, potentially disregarding peculiarities in goal tensions and structures in this context.

In summary, there is a call for concrete, implementable strategies for balancing economic and environmental targets (van der Byl and Slawinski 2015; Engert and Baumgartner 2016; Lozano 2015), especially for family firms (Chrisman et al. 2012; Chua et al. 2018; Habbershon et al. 2003; Aparicio et al. 2017; Kotlar and De Massis 2013; Moores 2009).

2.3. Methodology

2.3.1. Research design and setting

To adequately answer the research question, we will pursue an exploratory, inductive qualitative study on the basis of multiple cases (Eisenhardt 1989; Yin 2018). Not only is public information about decarbonization limited (Martin and Moser 2012), but family firms are also known for their unwillingness to disclose information (von Stietencron 2013). Moreover, internal firm processes, such as strategic decision-making, are not externally accessible. Last, there is "limited extant knowledge about how and why non-economic goals affect adaptation processes" (Kammerlander and Ganter 2015, p. 364) and a scarcity of research spanning the fields of environmental behavior, strategic decision-making processes, and family firms. Therefore, we pursue an inductive, qualitative study that allows for the exploratory analysis of multiple cases (De Massis and Kotlar 2014). A multiple case study enables authors to build stronger theory, in contrast to a single case study (Yin 2018), by conducting within- and cross-case analyses (Eisenhardt 1989). Furthermore, case studies are useful for *why* and *how* questions (Yin 2018), such as the research question of this work. Last, it is a commonly applied research strategy in the analysis of processes at family firms (De Massis and Kammerlander 2021) and for studying "contradictions, tensions, paradoxes and dualities in family businesses" (Fletcher et al. 2016, p. 2), which often underlie strategic decision-making based on environmental goals in the short term (Gaba and Greve 2019; Margolis and Walsh 2003; van der Byl and Slawinski 2015).

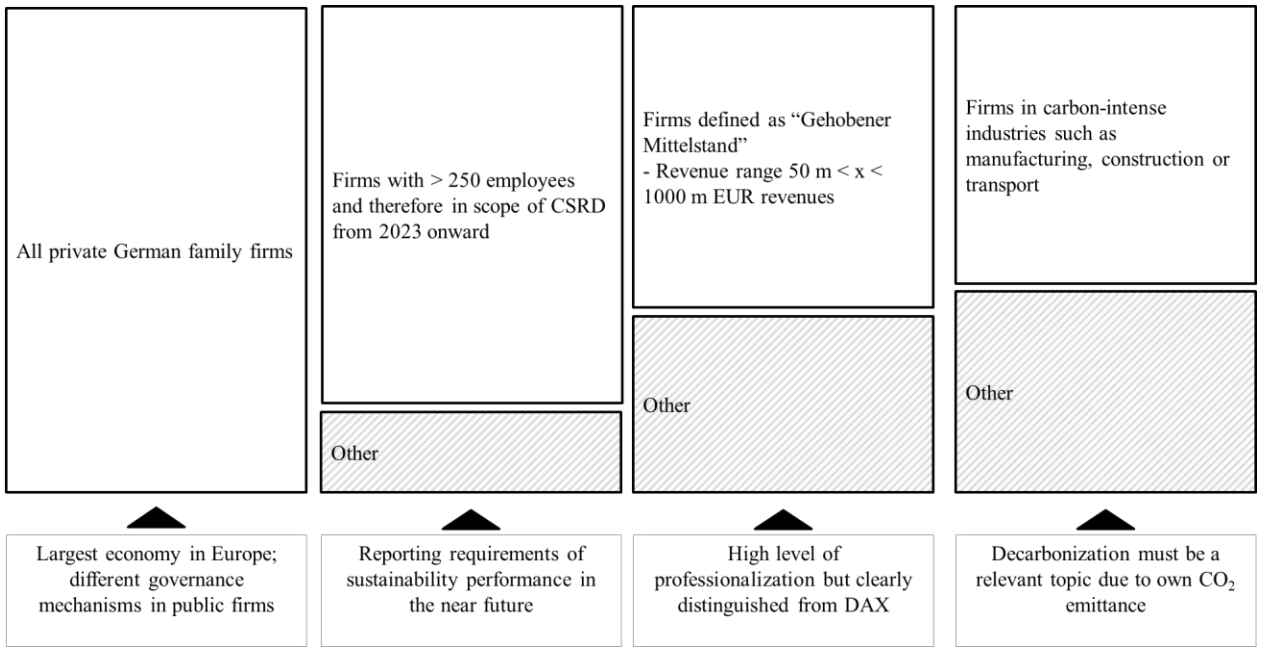
We will examine data from family firms with headquarters in Germany. The observation unit is the strategic decision-making process within the family firm. We will follow the definition of strategic decisions provided in the introduction. Mintzberg et al. (1976) point out that a strategic decision-making process starts with strategic decision identification, passes a

development phase, and ends with the selection phase. Based on Glaser and Strauss (1967), we pursue a theoretical four-step sampling approach to select the most suitable cases, as indicated in Figure 2.1. This is especially relevant for family firms that are known for their heterogeneity (Dibrell and Memili 2019; Chua et al. 2012; Miller and Le Breton-Miller 2021). Cases were chosen to replicate or extend the theory (Eisenhardt 1989).

The focus lies on firms headquartered in Germany since Germany is the largest economy in the EU and Germany has passed decarbonization targets early on (Die Bundesregierung 2022). Additionally, family firms are the dominant organizational firm type in Germany (von Stietencron 2013; Stiftung Familienunternehmen 2019). Furthermore, we will apply the definition of family firms from the theoretical background section of this paper. Publicly listed firms will be excluded, as existing research on large or publicly listed companies in Germany partially exists already (Günther and Günther 2017; Günther et al. 2018) and ownership is less dispersed (Cruz et al. 2015). Publicly listed family firms are commonly defined by a threshold of 20% control by family members (La Porta et al. 1999) in contrast to the 50% dominant influence definition in this paper. This finding is supported by Foss et al. (2021), who state that ownership competence will have a much higher effect if there is high ownership concentration. Similarly, Schulze and Zellweger (2021) point out that a high ownership creation enables the owners to personally create value based on their decision-making and business judgment. Moreover, we will consider only firms with more than 250 employees, as these are obliged to report their decarbonization performance from 2024 onward as part of the CSRD (European Commission 2023a). In addition, a range between 50 million euros and one billion euros in revenue is applied. This group is referred to as “Gehobener Mittelstand” in Germany (Venohr and Langenscheidt 2015, p. 5). The group “Gehobener Mittelstand” is unique to the world, as this group of medium-sized, industrial companies accounts for 68% of all German exports (Venohr and Langenscheidt 2015, p. 5). This

procedure ensures a high level of professionalization to derive relevant learning while still establishing a clear distinction in size from publicly listed companies in the DAX, the German benchmark index, via a limit to one billion euros in revenue. All firms are in carbon-intensive industries, such as the manufacturing, construction, or transport sector, as decarbonization must be a relevant topic to these firms due to their emittance of CO_2.

Figure 2.1. Sampling process



Source. Own figure

The final sample consists of eleven family firms (see Table 2.1.). The firms are affiliated with seven different industries, earned an average of ~500 million euros in revenue and employed an average of ~2,000 employees. We talked to family firm owners and sustainability managers who were directly involved in strategic decision-making and formed part of the top management team, as suggested by the definition of a strategic decision by Eisenhardt and Zbaracki (1992). If the family firm owner was not available, he was replaced by a leader and close advisor of his team, who also serves as a reliable source of knowledge according to Walker (1997). A sufficient level of variance in the sample is ensured by differing degrees of sophistication of decarbonization

reporting among the selected firms, which was derived based on publicly available information and validated in the interviews.

Table 2.1. Profiles of the organizations in the sample

Characteristics of the firms							Characteristics of the interviews				
Company	Industry	Firm age[1]	Generation[1]	Revenues[1] (in m EUR)	Employees[1]	Sophistication sustainability reporting	Interviews[2]	Interview minutes	Interview partners	Years with the firm	
Alpha	Waste / transport	120	4	200	1,200	High	1	61	CEO (family); Project Manager Sustainability, Climate, Innovation	25 4	Press releases, annual reports and company websites from 2018 - 2021
Beta	Construction	70	2	285	1,520	High	1	52	Leader Environment and Security	25	
Gamma	Paper / packaging	215	8	940	2,500	High	2	62	Head of Sustainability	4	
Delta	Mechanical engineering	110	3	210	1,800	High	2	90	Former CEO (family), currently advisory board; Head of Quality and Sustainability	34 6	
Epsilon	Consumer goods	70	3	890	1,100	High	1	46	Head of Sustainability; Head of Corporate Communication	4 14	
Zeta	Consumer goods	260	9	520	6,500	High	1	60	VP Engineering and Sustainability	7	
Eta	Consumer goods	140	4	760	2,350	Medium	1	49	Head of Sustainability and Assistant to Board	5	
Theta	Automotive supplier	30	2	130	300	Medium	1	60	CEO (family)	7	
Jota	Automotive supplier	170	5	270	1,350	Basic	1	60	Vice President Quality; Head of Sustainability & Employee Security	3 22	
Kappa	Chemicals	180	5	860	1,260	Basic	1	56	Head of Sustainability	25	
Lambda	Chemicals	50	2	640	1,730	Basic	1	55	CEO (non-family) Head of Production and Technology (incl. ESG)	8 10	
Not-case specific	Experts from various industries	-	-	-	-	Not applicable	-	-	Advisors from consultancies in the field of sustainability, representatives of family firm foundations, researchers in the field of decarbonization and family firms, German firms that are not part of "Gehobener Mittelstand"		

Note. 1. Based on the latest available year (2021/22); 2. Count of the interviews conducted

Source. Own table

2.3.2. Data collection

The primary source of data within this research will be semi-structured interviews conducted with the eleven selected firms. For the interviews, word-by-word interview transcripts are created in preparation for a subsequent coding process in MAXQDA[8].

The case study protocol according to Yin (2018) and the abbreviated interview guide can be found in Appendix A. The interviews took place in January and February 2022 and lasted on average 60 minutes per firm. Overall, we collected 660 interview minutes and more than 220 pages of transcripts. All interviews were performed virtually for both the interviewer's convenience and circumstances arising from the COVID-19 pandemic. To ensure the validity of the interview data, several steps were followed (Eisenhardt 1989). Each interview was extensively prepared with desk research and a review of archival data, which enabled in-depth conversations. We started the interviews by reassuring our interviewees that all interview contents would be subject to confidentiality to ease the interview atmosphere and encourage deeper, more trustful conversations. To further relax the situation, we always asked for explicit permission to record the interview before the actual interview started (Eisenhardt 1989).

After each interview, we reviewed the answers and refined the questions slightly if necessary. For instance, the section "Deep Dive strategic decision-making process with integration of CO_2 emissions" was enriched during the interviews, as decision rules were part of the theory-building process and could not have been formulated via a literature review (see Appendix A). Eisenhardt (1989) confirms that building theory from case studies allows for adjustments concerning new emerging topics. Finally, we sometimes exchanged relevant documentation with the interview partners, such as past sustainability reports, before entering the

[8] MAXQDA is a software used for qualitative and mixed-methods research, and it primarily supports researchers in coding and visualization of data.

analysis phase. After marginal, newly gained insights decreased, we did not conduct any further interviews in line with the recommendation from Eisenhardt (1989).

While the interviews of the selected family firms serve as our primary source of data, we triangulated all findings by incorporating two additional data sources (Kotlar and De Massis 2013; Theißen et al. 2014). First, archival data from the firms' websites and past press releases served as empirical evidence for the family firms' decarbonization activities, which not only benefitted the data analysis but also helped us to familiarize ourselves with the firms in preparation for the interviews (Diaz-Moriana et al. 2022). Second, ten expert interviews with advisors from consultancies in the field of sustainability, family firm foundations, and other researchers in the areas of environmental behavior and family firms, as well as German family firms that are not part of "Gehobener Mittelstand" (Venohr and Langenscheidt 2015, p. 5) complemented the data. For instance, the exchange with a representative from a family firm foundation provided additional insights into how goal tensions are discussed in family firm plenaries, helping to calibrate the perceptions from our private conversations with family firms. Furthermore, the exchange with advisors from sustainability consultancies helped distinguish and formulate the goal management strategies based on the interview input.

2.3.3. Data analysis

Our data analysis combined two methods - the multiple case study approach (Eisenhardt 1989) and the in-depth inductive case analysis method (Gioia et al. 2013), similar to other authors that conduct qualitative research on processes in family firms (Strike and Rerup 2016; Diaz-Moriana et al. 2022). As already illustrated by Diaz-Moriana et al. in 2022, the multiple case study approach by Eisenhardt enables the comparison within and across cases (Eisenhardt and Graebner 2007), while the inductive analysis allows the analysis of systematic similarities and differences

across cases and reveals comprehensive strategic decision-making processes (Corley and Gioia 2004). As such, our data analysis comprised three key steps.

First, we performed a within-case analysis based on the compiled data from interview transcripts, archives, and expert interviews. Initial key themes were identified (Miles et al. 2014) and first-order categories were established by focusing on materials covering decarbonization, goals and goal systems, as well as strategic decision-making. Triangulation between the data sources was crucial at this stage. While the support of findings among the data sources made the results more robust, discrepancies between data sources required us to approach the interviewees again (Theißen et al. 2014). The within-case analysis yielded eleven detailed case descriptions after repeatedly reducing, displaying, and concluding the data (Miles et al. 2014).

Second, we performed a cross-case analysis to seek similarities and differences among the findings from single case studies and draw overarching patterns (Eisenhardt 1989; Eisenhardt and Graebner 2007), enabling us to aggregate the assigned codes into second-order themes (Gioia et al. 2013). In line with inductive qualitative research, we remained open to any concepts that appeared from the data, resulting in continuous iterations regarding the correct inferring, grouping, and labeling of the data.

Third, we started to search for theories that would be able to bind our second-order themes into aggregate dimensions. It became apparent that there are systematic differences in the strategies for multiple goal management, the *how*, and the reasons for pursuing decarbonization, the *why*. Hence, we searched for theories linking the findings of the *why* and the *how* questions. The strong relevance of the attention-based view by Ocasio (1997) became explicit at this stage because the focus and situation of attention (*why*) will influence the structural distribution of attention (*how*). We did not consider the attention-based view at the start of this research project but explored its value for our research throughout the analysis phase.

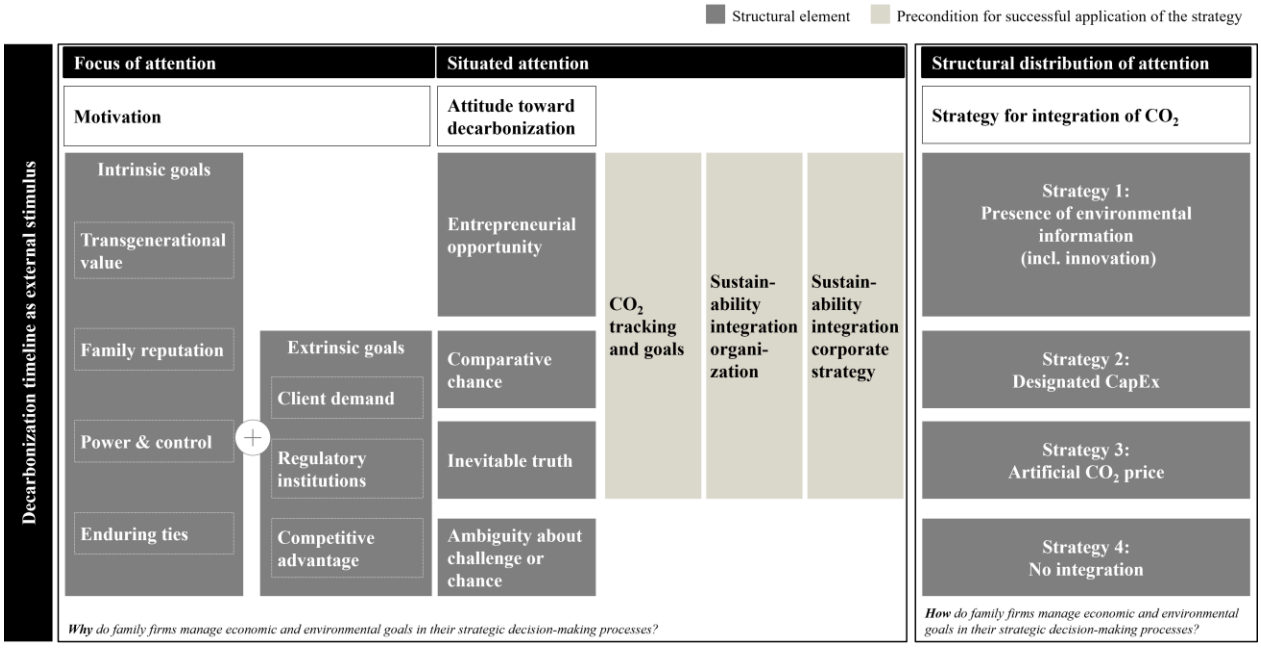
Last, through various rounds of iterations, we improved our themes and finally derived our final data structure (see Appendix B). We collected explanatory examples to facilitate external observers to comprehend our inferences (see Appendix C).

2.4. Results

2.4.1. An attention-based model for managing economic and environmental goals

Building on case-based evidence and the attention-based view of Ocasio (1997), this paper introduces an inductive model of family firm adaptation to decarbonization and arising firm decarbonization goals that exist in parallel to economic firm goals (see Figure 2.2.). The framework exhibits why and how family firms have developed strategies to manage economic and environmental goals simultaneously. Next, we will guide successively through our model. The rich evidence from the cross-case analysis can be reviewed in parallel in Appendix C.

Figure 2.2. An attention-based model for managing economic and environmental goals



***Source*.** Own figure

In our derived model, the strategic decision-making process starts with the decarbonization timeline postulated by scientists and policy-makers, which serves as the stimulus to which family firms react and which is external to all firms. As the first step and following Ocasio's first principle, the firm's "focus of attention" is represented by the motivation that encompasses intrinsic and extrinsic goals for decarbonization. While intrinsic goals drive all firms in the sample, some family firms are additionally driven by extrinsic goals on their decarbonization journey. Intrinsic goals observed reflect relevant categories of non-economic goals of family firms in the literature (Berrone et al. 2012; Gomez-Mejia et al. 2011). The observed intrinsic goals include transgenerational value (Chua et al. 1999; Zellweger et al. 2012), family reputation (Berrone et al. 2012), power and control (Chua et al. 1999; Carney 2005), and enduring ties (Le Breton-Miller and Miller 2005; Zellweger et al. 2013). Extrinsic goals are client demand, pressure from regulatory institutions, and a competitive advantage in contrast to other market participants when pursuing decarbonization successfully. Subsequently, Ocasio's second principle, "situated attention", is represented by the firm's attitude toward decarbonization. Attitudes vary enormously between firms arising from different goals, as discussed in terms of "the focus of attention", as well as from different goal systems, as to how the link between economic and decarbonization goals is perceived. Some firms regard decarbonization as an entrepreneurial opportunity irrespective of their market environment, while others perceive it as a comparative chance for their firm in contrast to other market participants, a sole necessity, or are unaware of whether decarbonization poses a chance or challenge for their firm. Together, the motivation and attitude toward decarbonization answer the question of *why or why not* firms manage economic and decarbonization goals in their strategic decision-making.

As the last step, the strategic decision-making process ends with Ocasio's "structural distribution of attention", illustrating strategies for *how* family firms manage economic and

environmental goals. They purposefully integrate or do not integrate decarbonization, expressed through the key performance indicator (KPI) CO_2, in their strategic decision-making process driven by their motivation and attitude toward decarbonization. The first strategy of CO_2 integration is depicted by the *presence of environmental information (incl. innovation)*. CO_2 is deeply integrated into a firm's culture, and employees are naturally accustomed to considering CO_2 in various processes. These include portfolio adaptation and innovation processes, where CO_2 serves as a relevant KPI to be improved with each new product. Furthermore, CO_2 is considered throughout the entire strategic decision-making process, e.g., via the presence of managers from specific departments or similar representation of economic and environmental information in a firm's balanced scorecard or other decision tools. Firms applying this strategy regard decarbonization as an entrepreneurial opportunity and pursue it solely based on intrinsic goals. The second strategy is a *designated CapEx*, where the budget size is determined top-down based on the list of activities required for a firm's successful decarbonization, also referred to as the decarbonization roadmap. Available funds are compared with the decarbonization roadmap and assigned to decarbonization projects accordingly. Firms applying a designated budget adopt the attitude that decarbonization is a comparative advantage for their firm in competition with other market participants, so they assign the required funds to decarbonize more effectively than the competition. A third strategy is the introduction of an *artificial CO_2 price* as a variable in a firm's investment calculations. This artificial CO_2 price can, for instance, be derived based on an expectation of future CO_2 prices as well as compensation costs. In contrast to the *designated CapEx* strategy, this is a calculation approach to be applied by employees across the firm and not mainly by top management. Firms using this strategy regard decarbonization as an inevitable, scientific truth to which they necessarily need to adhere. Therefore, this factual, numerical strategy enables the firm to make forward-looking investment decisions, which are still costly at

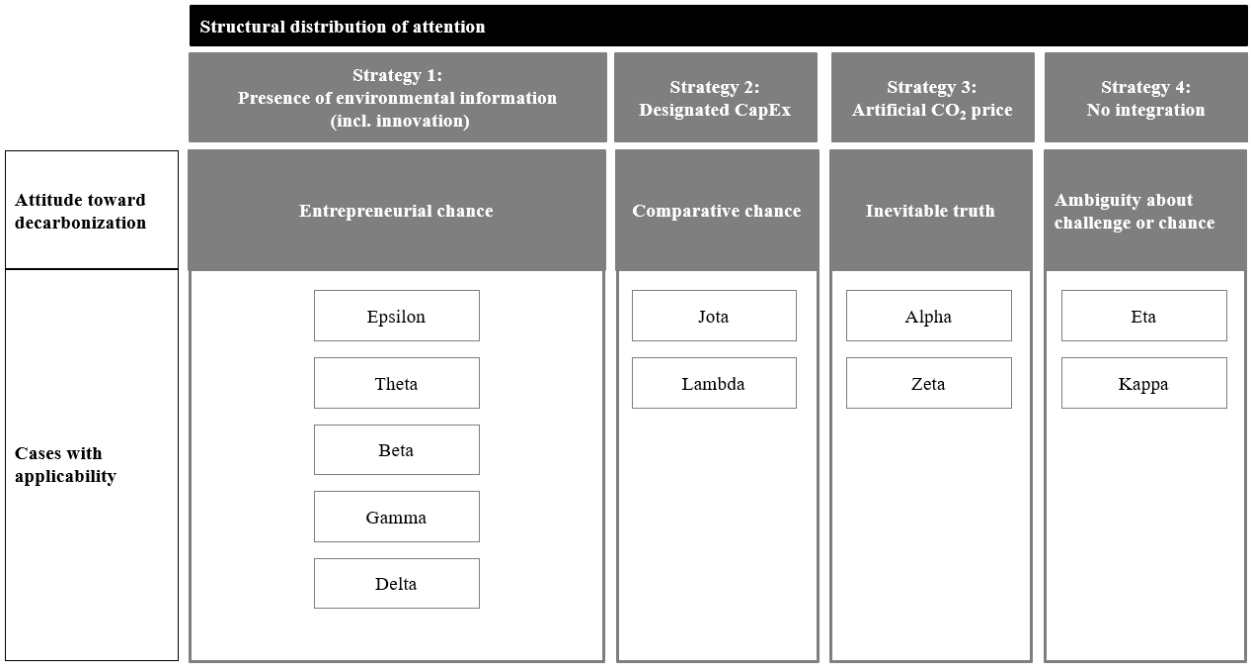
this point but are likely to pay off in the future. Finally, as a fourth strategy, some firms show a case of *no integration* in their decision-making and are unaware of their goal system, whether decarbonization poses a challenge or a chance to the firm's financial performance.

As our cross-case analysis shows, strategies to reconcile economic and environmental goals are deployed. Furthermore, there is no "one size fits all approach". The introduced strategies fit the divergent motivations and attitudes toward decarbonization of the corresponding firms. Additionally, no firm expressed the opinion that it would not want to integrate CO_2. Instead, a lack of deeper integration was due to internal capability gaps in emission tracking, integration of sustainability in the organization, or the corporate strategy, which are necessary preconditions to be fulfilled.

2.4.2. Representative case study per strategy

In the following, we will describe four case studies representing the four strategies introduced in the attention-based model in Figure 2.2. Following the advice of Eisenhardt and Graebner (2007), we summarize all cases applicable to each strategy in Figure 2.3. and only describe representative cases in detail to limit the richness of our qualitative data. We observe that the allocation of the cases to strategies shows no systematic differences arising from the industry, size, age, or current generation of firms. Subsequently, the case-by-case description will help to better understand the motivation, attitude, and preconditions under which the selected strategies emerged and how they function within the family firm business.

Figure 2.3. Case allocation to the attention-based model



***Source*.** Own figure

The presence of environmental information (incl. innovation). *Delta* sells advanced machinery and is therefore mainly active in business-to-business (B2B) markets.

Motivation. *Delta's* decarbonization achievements stem from its strong intrinsic goals. *Delta* is an energy-positive company, as it has various forms of renewable energy generation installed on its production site. It has further received prices for its sustainable performance and takes part in relevant consortia for climate change in Germany. *"The topic is in the genes of the family."* Transgenerational value has a high priority for the owner family. *"We adopt a long-term perspective, we want to be successful in the long term, we want to hand over a good and healthy company to our children in the long term."* Family reputation is also important. *"We want to take personal responsibility. We want to act sustainably."* The firm holds strong personal ties to the local community and nature and wants to show its gratitude by protecting the local circumstances.

Attitude toward decarbonization. *Delta* believes that sustainability and decarbonization are entrepreneurial opportunities. *Delta* believes that economy and ecology are not in contrast to

each other if one works with a long-term orientation across generations. *"If one does a good job - it does not get more expensive - definitively not. In the long run, it rather becomes cheaper."* For the firm, decarbonization is more than a competitive advantage. Instead, the firm adopts an entrepreneurial spirit. *"You might find areas where we have invested, although we could not calculate it exactly […]. If it serves the bigger purpose, one also has to accept a certain level of risk."* However, most of the time, sustainability initiatives are only pursued if a payoff is backed up by in-depth analysis. Due to its strong sustainability orientation, the firm even receives applications from personnel who are intrinsically motivated in the topic and want to work for a sustainable employer. In addition, all employees are specifically trained in the area of sustainability at the start of their job, and sustainability ambassadors can be found in all departments. The sustainability strategy is cross-functionally integrated into the corporate strategy. *"Sustainability has an impact on basically everything. It is a cross-functional strategy."*

Strategy for integration of CO_2. *Delta* integrates CO_2 information consistently within the company's processes and decision bodies. For instance, CO_2 and energy consumption are variables in the company's balanced scorecard, which is the key instrument for the company's strategy formulation. *"We work with a balanced scorecard […] in which sustainability is considered in the departments' goals, the strategic goals and then also the activities underlying the roadmap."* Furthermore, in addition to a central sustainability department, sustainability has been assigned per department so that an expert for environmental considerations forms part of any discussion and a simultaneous review of economic and environmental information is facilitated at all times.

Moreover, *Delta* integrates CO_2 via a distinct improvement mindset and adaptation of its innovation processes. The top management enforces a spirit to continually pursue decarbonization and to consider it in all decisions. The whole firm takes part in improvement initiatives.

"Everyone needs to take part and if everyone recognizes, which opportunities he sees in his direct environment, then the whole decarbonization journey also progresses well. We always review, also outside of the sustainability report, which progress has been made. In addition, this is natural and self-evident for our employees. If employees are asked about some new sustainability initiatives in terms of what this new initiative is and how it is calculated, employees reply that this is nothing special. Other firms would hold speeches about these improvements, but we just do it because it is part of our DNA." In addition, innovation processes are adapted. The first step was to adopt an important decision rule. *"The new product needs to have a better footprint than the previous one. Over time, you see how much you can get out of it in numbers."* The firm also acts pragmatically. *"We care more about a better solution than about the way to get there."* A distinct mindset enables *Delta* to continuously decrease its carbon footprint, and it strives toward *"decreasing its CO_2 emissions while increasing its revenues steadily."*

Designated CapEx. *Jota* is an automotive supplier with a focus on drive-train technologies operating in B2B markets.

Motivation. *Jota* is driven by intrinsic and extrinsic goals. Intrinsic goals include the transgenerational value of the firm, power and control, enduring ties, and family reputation. For instance, transgenerational value and family reputation mean for *Jota* not only that the firm shall be made future-proof for future family generations but also that the management team consists of family fathers who feel personally responsible and want to take ownership for making the company sustainable for the future. In line with this perception, CO_2 compensation is not an option, as *"it would not be truly sustainable."* Meanwhile, *Jota* is also strongly driven by two extrinsic motives. First, *"we are also a little bit pushed ahead by our clients"*, as the supplier selection criteria become increasingly stricter with regard to decarbonization. *"If clients visit us, it happens often that they do not want to talk to us about the product or the price, but instead*

review the sustainability systems." A second extrinsic motive is also linked to this. *Jota* perceives its decarbonization performance as a *"USP"* in comparison to other market players. *"If one can shine with scope 3[9], which is something that many suppliers do not have on the agenda yet, this serves as an advantage on the market."*

Attitude toward decarbonization. *Jota*, therefore, adopts the attitude that decarbonization is a competitive advantage compared to its competitors. *Jota* believes that the short-term, economic, and environmental goals could be in conflict. *"However, in the long term, there is no such conflict."* It constitutes a win-win situation for *Jota* that being sustainable helps to win clients and contracts. *"We also participate in benchmarks from firms or service platforms, and the regular result is that we are from our size and industry always in the upper midfield - sometimes even leaving large, publicly listed companies behind."* The progress in sustainability and decarbonization *"is fully supported by the owner-manager."* A new sustainability department was recently founded, carbon-neutral products are planned for 2035, and a decarbonization roadmap was established for this purpose.

Strategy for integration of CO_2. *Jota* experiences that it is increasingly difficult to make assumptions about CO_2 prices and energy costs for the future, which has also resulted in selected firm investments from the past not performing as expected. Despite these uncertainties, *Jota* is strongly convinced that the CO_2 price will rise and that it will imply high costs to not decarbonize effectively. Hence, *Jota* developed a CO_2 decarbonization roadmap with underlying decarbonization activities. At the end of the year, all funds that are available from firm profits are assigned to the decarbonization activities of this roadmap. Therefore, annual capital expenditures emerge. In contrast to larger firms, *Jota* does not have a designated percentage of CapEx that is

[9] GHG emissions that "are a consequence of the activities of the company, but occur from sources not owned or controlled by the company" are referred to as scope 3 (Greenhouse Gas Protocol 2004, p. 25).

invested every year, but instead the firm follows the rule to invest *"as many funds as required and available for the decarbonization activities."* The only restriction is that *"we want to be independent of financial institutions"*, so only the self-earned, available funds are invested and no external funds are added.

Artificial CO_2 price. *Zeta* sells stationery products and is, therefore, active in the business-to-consumer (B2C) business.

Motivation. *Zeta* is driven by intrinsic and extrinsic goals concerning decarbonization. Intrinsic goals comprise transgenerational value, power and control, and most importantly family reputation. The last family firm generation was represented by a family CEO who died a few years ago. He was intrinsically interested in sustainability and regarded the sustainability of products as a requirement at the firm, which is known for high quality. He further perceived it as a prerequisite of *"a good merchant"* to take responsibility for the environmental impact of the firm. Therefore, he decided to invest in forest projects in South America in the 1980s. These projects simultaneously served as a source of raw materials and as a form of CO_2 compensation. *"The topic of the forest projects and certified wood, was for the brand, as well as for the company and the family owner […] extremely important."* In recent years, sustainability was not only an established firm value due to the firm's early sustainability investments in the past, but extrinsic goals such as a new EU taxonomy and consumer demand for green products were the key drivers for the firm's decarbonization efforts.

Attitude toward decarbonization. Zeta sees decarbonization as an inevitable, scientific truth to which it necessarily needs to adhere. *"We realize that progress in sustainability is also in the interest of the consumer and legal requirements and that making progress is nothing that can be done at the side without asking some bigger questions. The low-hanging fruits have been collected, the quick fixes have been fixed and now we have reached a stage where we have to ask*

ourselves the question of how to allocate our capital. Otherwise, it will be difficult to progress." *Zeta* is convinced that investments in decarbonization are inevitable. *"These are costs or investments, which we carry out today, but that is value protecting. If we would not do it, my firm value will eventually erode."* Last, *Zeta* also stresses that its attitude has slightly changed over the last years. *"Back then, colleagues at the firm were probably not aware, of what challenges this world would face, if we would sincerely like to work toward the 1.5-degree goal."* The firm had technical and operational sustainability and decarbonization goals for its employees for years. Climate neutrality on the firm level was reached early due to the firm's own compensation projects in South America. However, in the last year, *Zeta's* decarbonization goals were publicly announced, and since then, stricter goals have also lived at the employee level.

Strategy for integration of CO_2. *Zeta* is implementing a new strategy for the integration of CO_2 in its strategic decision-making process. It will introduce an artificial CO_2 price in its investment calculations, e.g., based on assumptions of expectation of future CO_2 prices or CO_2 compensation costs. *"We will set a price once a year and then apply it for the economic efficiency calculations of investments."* By applying this new strategy, the firm hopes to make future-proof decisions. *"If we only consider the extra costs of switching to green alternatives, we would never be able to do it. However, we believe that we will save CO_2 via this approach. If we would source compensation externally in the future, we would have to pay much more money for it."* *Zeta* believes that this is the only feasible way to make a switch. *"I regard this as the absolutely right way to change the processes because otherwise, we will never leave the old economic management."* *Zeta* also has specific examples, where the strategy worked very well. *"For instance, recently in our Malaysia business, they wanted to switch to green electricity, but this would have led to increased electricity costs. From a classical investment viewpoint, this switch would have not been feasible."* This strategy of CO_2 integration enables *Zeta* to calculate the case

for future-oriented investments, which are still costly at this point but are likely to pay off in the future.

No integration. *Eta* offers toys and books and can therefore be classified as a B2C company.

Motivation. *Eta* is similarly driven by intrinsic and extrinsic goals. Non-economic goals have always had high importance for the family and firm. For instance, enduring ties to employees who are keen on making progress with regard to sustainability and decarbonization is an intrinsic goal, which drives sustainability and decarbonization efforts. Meanwhile, the firm is also extrinsically driven to strive for decarbonization since licenses, new partnerships, and collaborations are offered based on firms' sustainability performance. *Eta* is aware of regulatory requirements but does not perceive them as pressure.

Attitude toward decarbonization. *Eta's* attitude toward decarbonization is not clear. The firm believes that a lack of sustainable performance poses a risk of firm value destruction. Meanwhile, *Eta* is still discussing whether sustainable performance is also an opportunity for the firm in the form of value creation. Currently, the tendency is that whether sustainability and decarbonization represent a risk or a chance needs to be decided per product. Furthermore, the firm does not perceive itself as one of the largest emitters. *"We as a consumer goods industry are aware that we do not spin the biggest wheel in terms of total emissions."* Thus far, decarbonization has always been a cost topic for *Eta*. However, *Eta* also puts this into context by stating that *"we are still relatively new in the game."* A sustainability strategy was developed from scratch in 2019 as part of a larger strategic project. However, the sustainability strategy is still separate from the corporate strategy. As part of this new strategy, CO_2 has also been tracked since 2018, and a decarbonization roadmap was top-down derived. However, the roadmap only covers the footprint of operations. A small sustainability department exists, but it is the plan to establish sustainability ambassadors across the organization. Trust in the sustainability

department and its calculations are to be established in traditional departments such as purchasing, controlling and research and development, where CO_2 has not yet become a target variable. *"We have the idea that each firm department will live this topic and understand it, but there we are still at the beginning."*

Strategy for integration of CO_2. *Eta* has not yet integrated CO_2 into its strategic decision-making process. CO_2 is mainly considered a cost topic, e.g., via an assigned budget for CO_2 compensation that was derived with a high-level approximation of CO_2 costs. The CO_2 approximations here are not primarily technical or strategic but were mainly used for an employee involvement initiative. *Eta* wanted to specify a rough amount of its CO_2 to enable a poll where employees could vote on which CO_2 initiatives the firm should pursue. Otherwise, CO_2 is mainly measured and considered after a strategic decision is made. *"It is measured subsequently and then reduction measures are derived accordingly. However, the decision we make is not based on CO_2 at the highest level."* New investment decisions, e.g., into renewable energy assets, are based on an assessment of cost, resilience, and CO_2. However, *Eta* does not have a fixed system for how it weighs these aspects against each other. *Eta* believes that internal firm processes will likely have to be transformed severely, impacting the core firm's DNA. CO_2 will have to be prioritized as a target variable to pursue certain reduction initiatives despite hurdles such as increased complexity. *"That we become much more agile in product development […]. That we say we are open to new materials and will test new suppliers for qualification, which are smaller. This makes the supplier management generally more complex."* In summary, *Eta* is still *"in a phase of radical change."* The limited CO_2 integration does not arise from a lack of willingness but instead is rooted in a lack of prerequisites, e.g., the integration of the firm's sustainability strategy into the corporate strategy. Furthermore, the firm has just started its decarbonization journey in 2019, thus many processes are still in development.

2.5. Discussion

2.5.1. Contribution

Theoretical implications

Our findings entail theoretical implications concerning multiple goal management, family firm goals, and the attention-based view. Insights were derived by observing the tensions and their reconciliation between economic and environmental goals arising through decarbonization.

First, we contribute through three strategies for CO_2 integration, providing evidence that economic and environmental goals can be reconciled, even in the short term. These findings extend the research on multiple goal management (Diaz-Moriana et al. 2022; Ivory and Brooks 2018; Epstein et al. 2015) and follow the call for concrete, implementable strategies to address goal tensions (Engert and Baumgartner 2016; van der Byl and Slawinski 2015; Lozano 2015). According to the behavioral theory of the firm, it is clear that modern firms will tend to pursue multiple goals in the future (Cyert and March 1992), which manifests the value of these research findings.

We are among the first researchers (Diaz-Moriana et al. 2022) that not only state goal tensions and their consequences at family firms but also investigate mechanisms and strategies to overcome these. Beyond existing contributions, our attention-based model presents differentiated strategies for firms depending on their motivation and attitude toward decarbonization. These can also be referred to as firms' goals and goal systems. Some firms are mainly driven by intrinsic goals and perceive economic and decarbonization goals as a chance to pursue relatively unsystematic forms of CO_2 integration through the *presence of environmental information (incl. innovation)* or a *designated CapEx.* In contrast, other firms that are driven by both intrinsic and extrinsic decarbonization goals and perceive decarbonization to be a threat to their profits, at least

in the short term, deploy a systematic, fixed approach for CO_2 integration in the form of an *artificial CO_2 price*. It seems that the closer a firm perceives economic and environmental goals to be in alignment, with the propensity to a win-win relationship (Porter and van der Linde 1995), the less systematic is the design of the multiple goal strategy. In contrast, firms that are instead rather proponents of the trade-off theory (Andersson et al. 2018; Friedman 1970; Levitt 1958) reconcile environmental and economic goals through more clearly defined, strict methods. Thus, we elaborate the research on multiple goal management by illustrating that strategies should be assessed considering firms' goals and goal systems (Chua et al. 2018). In addition, unlike previous research (e.g., Diaz-Moriana et al. 2022), the derived strategies are concrete and implementable as they entail specific and practical mechanisms, such as introducing an artificial CO_2 price. Despite their increasing prevalence, no research of which we are aware investigates strategies to overcome goal tensions arising during firm decarbonization.

Second, based on the SEW theory and in line with previous literature (Berrone et al. 2010; Gomez-Mejia et al. 2011; Chrisman et al. 2012; Kammerlander and Ganter 2015; Sharma and Sharma 2011; Hüseyin et al. 2017), we show that non-economic goals, here so-called intrinsic goals, have an impact on organizational behavior of family firms such as the strategic decision-making. To protect a firm's SEW, they serve as a motivation for family firms to decarbonize (Berrone et al. 2010; Sharma and Sharma 2011; Campopiano and Massis 2015). However, we also reveal that the motivation for environmental behavior in family firms stems not only from non-economic, intrinsic firm goals but also extrinsic goals such as regulatory pressure, competitive advantage, and client demand. These findings contrast previous family firm research that stated that family firms are driven by the desire to pursue internal, non-economic firm goals through environmental behavior (Altenburger and Schmidpeter 2018; Dangelico et al. 2019). In contrast, non-family research has previously highlighted the relevance of extrinsic goals and

pressure (Garcés-Ayerbe et al. 2012; Böttcher and Müller 2015; Sangle 2010). An explanation for the enlarged applicability of extrinsic goals to family firms could be that regulatory decarbonization pressure has recently increased, e.g., through the European Climate Law in 2020 (European Commission 2022) and the announcement of the CSRD in 2021 (European Commission 2023a). Further, non-governmental stakeholders like investors (Li et al. 2020; Boukherroub et al. 2017; Blanco et al. 2017), customers (Hartmann and Moeller 2014; Jira and Toffel 2013), and society (Boukherroub et al. 2017; Eggert and Hartmann 2021) also increasingly request decarbonization progress from family firms. Future research should investigate whether external goals continue to drive environmental behavior in family firms and whether internal or external motivation prevails.

Third, the contributions of this paper are related to the attention-based view (Ocasio 1997). Like Kammerlander and Ganter (2015), this paper confirms that the connection of research on attention with the family firm literature is essential for an improved understanding of family firm behavior. We are among the first to contribute to the connection of research on multiple goal management and the attention-based view (Ahn 2022). However, instead of assessing the antecedents of organizational attention (Kammerlander and Ganter 2015; Ahn 2022), this study shows how organizational attention, in terms of diverse goals and goal systems (Chua et al. 2018), can explain heterogeneous strategies for managing economic and environmental goals in strategic decision-making processes. As an extension, we still encourage an in-depth exploration of the antecedents of organizational attention in the context of family firms and decarbonization. Firm founders' imprint has been proven as highly relevant in strategic decision-making (Tripsas and Gavetti 2000; Baron et al. 1999), which could be particularly interesting for family firms, as the family and the business are strongly intertwined (Habbershon et al. 2003).

Managerial implications

This work goes beyond the extant knowledge of concrete goal management strategies to be applied by practitioners at family firms. We show that economic and environmental goals can be reconciled through the usage of an effective strategy and accordingly hope to incentivize firms to pursue decarbonization goals next to their economic goals.

For firms to apply the findings of this paper, we propose the following *guidelines of application* based on Figure 2.2: 1) definition of a firm's goals for decarbonization; 2) evaluation of the attitude of the firm toward decarbonization based on a firm's goal system; and 3) application of the related multiple goal management strategy. Meanwhile, all firms interested in the proposed strategies should work on fulfilling the preconditions outlined in Figure 2.2.

2.5.2. Limitations and future research

Despite the abovementioned contributions, our study has a few limitations, which should also be regarded as an impetus for future research.

Although most family firms demonstrate similar values, they are heterogeneous in their nature (Chua et al. 2012; Dibrell and Memili 2019; May 2012), which might endanger the applicability of findings to other family firms. We are aware of these idiosyncrasies, and through awareness and a theoretical sampling strategy, heterogeneity was purposefully limited.

Furthermore, the study is limited to the context of large German family firms, so it cannot be immediately transferred to non-family firms, although the attention-based view (Ocasio 1997), as well as the phenomenon of decarbonization, are relevant across firm types. We, therefore, call for future research to conduct a comparative study between family and non-family firms to validate that multiple goal management strategies are not different.

The study only considers firms for which decarbonization is a relevant topic, not considering firms that do not engage in decarbonization. For building theory, any form of decarbonization reporting was required, so the sample serves this purpose. As the number of firms that do not engage in decarbonization will shrink rapidly in the coming years due to the CSRD, it will be interesting to test how often the derived strategies occur in a larger sample via a survey.

Moreover, this study does not assess the decision quality regarding family firms' effectiveness resulting from the three CO_2 integration strategies. The current focus is instead to understand which strategy is suited to which type of family firm than to assess which strategy leads to the best results. Given that many firms have been tracking carbon emissions only for a few years now, this might be an interesting topic to investigate in the future when more firms for analysis and prolonged empirical evidence are available.

Although environmental aspects weigh the highest among ESG considerations for many companies (Adams and Frost 2008; Adu et al. 2022), environmental goals are only one form of non-economic ESG goals. Therefore, this study could be repeated with an alternate non-economic goal.

2.6. Conclusion

Given the urgency to decarbonize, it is necessary to sharpen the theoretical and managerial knowledge of strategies for balancing economic and environmental goals in firms. Through evidence from multiple case studies in the German family firm context and the application of the attention-based view (Ocasio 1997), we provide a model that offers concrete, implementable strategies for multiple goal management and connects these to a firm's goals and goal system. While the findings entail theoretical implications regarding multiple goal management, family

firms' goals, and the attention-based view, they shall aid practitioners in operating profitably while decarbonizing efficiently.

3 Essay II

Working together, decarbonizing better?

– The role of supply chain collaborations for scope 3[10]

Johanna Cecilia Schulze-Berge, Sandra Briechle[11]

Mitigating scope 3 CO_2 emissions (scope 3) is crucial in combatting climate change, as scope 3 accounts, on average, for 75% of a firm's carbon footprint. Yet, firms usually face challenges in scope 3 measurement and reduction, but they can also benefit from it. In this context, supply chain collaborations are repeatedly mentioned as a promising solution but have yet to be assessed in their function and impact. Based on a multiple case study with eleven large German firms, we derive a model that elaborates the findings of the relational view by explaining how inter-organizational linkages in supply chain collaborations help to overcome firm, value chain, and macroeconomic challenges concerning scope 3. Subsequently, scope 3 can turn into a competitive advantage for firms. Our findings contribute to the literature on scope 3 and sustainable supply chain engagement. We elaborate the relational view by developing a model for resolving challenges and applying it to collaborative structures with stakeholder groups other than customers and suppliers. Our findings inform practitioners, NGOs, and regulators about the relevance and spectrum of scope 3 collaborations and incentivize their formation and support.

Keywords: Multiple case study, Relational view, Scope 3 emissions, Supply chain collaborations, Sustainable supply chain management

[10] This essay has been accepted and presented at the 18th IAEE Conference in Milan, 2023. A full paper version was published in the conference proceedings.

[11] JSB derived the research idea, conducted interviews and data analysis, derived the final framework, and wrote the essay. SB performed the structured literature review, completed interviews, and took part in the data analysis.

3.1. Introduction

The Paris Agreement was considered a breakthrough in global decarbonization regulation (United Nations 2022b). Yet, eight years later, scientists do not believe that limiting the global temperature increase to 1.5 degrees Celsius till 2050 is still realistic based on lacking decarbonization progress (Engels et al. 2023). Scope 3 carbon dioxide (CO_2) emissions[12] are crucial in reaching this target and limiting climate change because scope 3 comprises all emissions caused indirectly by a firm's activities in its value chain (Greenhouse Gas Protocol 2011; Huang et al. 2009). Following this definition, 75% of a firm's carbon footprint is, on average, defined as scope 3 (Carbon Disclosure Project 2014; UN Global Compact Network UK 2023; Huang et al. 2009). However, progress in pursuing reduction targets is lagging (Li et al. 2020), as scope 3 measurement and reduction are complex and demanding (Patchell 2018). A recent study on the current state of carbon reporting in the DAX, the German benchmark index, revealed immense deficiencies in scope 3 measurement and reduction (Bartels et al. 2022).

Firms' challenges underlying these drawbacks include a lack of internal resources and knowledge (Blanco et al. 2016; Asif et al. 2022; Patchell 2018), unavailability of validated inputs from supply chain partners (Klaaßen and Stoll 2020; Downie and Stubbs 2012), lack of knowledge about the supply chain (Hansen et al. 2022; Patchell 2018) as well as the absence of an undisputable methodology (Patchell 2018; Blanco et al. 2016; Hansen et al. 2022). Yet, firms that overcome scope 3 challenges can also leverage it as a competitive advantage (Sharfman et al. 2009). For instance, awareness of climate-related risks along the value chain avoids associated costs such as fees arising from non-compliance with climate legislation (Li et al. 2020; Blanco 2021; Science-

[12] Scope 3 CO_2 emissions will be referred to as "scope 3" throughout this paper to limit space and enhance the reading flow.

based Target Initiative 2018) or firms can establish an enhanced brand and market value (Kim and Lyon 2011; Bocken and Allwood 2012).

Meanwhile, supply chain collaborations have been repeatedly mentioned as crucial success factors for scope 3 (Patchell 2018; Schulman et al. 2021; Blanco et al. 2017; Plambeck 2012). Within this study, we define supply chain collaborations as "the ability to work across organizational boundaries to build and manage unique value-added processes to better meet customer needs" (Fawcett et al. 2008), similar to other authors in this field (Theißen et al. 2014). In the context of scope 3, supply chain collaborations shall maximize transparency and progress in scope 3 measurement and reduction (Theißen et al. 2014).

However, the literature assessing supply chain collaborations with the purpose of scope 3 is scarce, and it has not been analyzed how supply chain collaborations function and affect a firm's capabilities in scope 3 measurement and reduction. In addition, collaborations have been assessed concerning suppliers and sometimes customers in single supply chains or sectors, disregarding more complex supply chain networks (Soosay and Hyland 2015; Sharfman et al. 2009; Theißen et al. 2014) and an assessment of different industries (Theißen et al. 2014).

This leaves a crucial gap in the literature as scope 3 challenges and benefits, on the one hand, and supply chain collaborations, on the other hand, are insufficiently connected, resulting in lacking details on the function and impact of supply chain collaborations on firms' scope 3 capabilities. Moreover, the singular focus on supplier collaboration might neglect relevant collaboration with other supply chain partners. If the understanding of the role and function of supply chain collaborations does not become more pronounced, this can endanger the world's ability to reach the Paris Climate target (Li et al. 2020). Firms would not contribute their fair share to decarbonization (Blanco et al. 2016; Klaaßen and Stoll 2020), leaving the private sector's high potential for decarbonization untapped (Li et al. 2020).

The relational view (RV) assesses the value of inter-organizational linkages between organizations (Dyer and Singh 1998). Therefore, by applying the RV as the theoretical lens, we investigate: *"How do supply chain collaborations help firms to cope with scope 3 measurement and reduction?"*

To answer the research question, we follow a two-step research approach. First, we conduct a systematic literature review on the keyword scope 3 emissions, enriched with articles from adjacent topics like corporate carbon strategies and sustainable supply chain management. Second, we conduct an in-depth, multiple case study analysis of eleven German firms, collecting 640 interview minutes and analyzing over 180 single-line pages of transcripts. We triangulate the case interview data with five expert interviews and 117 pages of archival data.

Through an inductive analysis and the application of the RV, we derive a model on supply chain collaborations for scope 3. We identify five types of collaborations with the purpose of scope 3 measurement and reduction: inter-functional, supplier, customer, industry, and cross-industry. We reveal that these five forms of collaboration can address scope 3 challenges in the firm, value chain, and macroeconomic context through value-creating linkages between the involved parties. We further demonstrate that scope 3 can become a source of competitive advantage for firms.

Our research entails the following main contributions to the literature. We are the first to assess how supply chain collaborations help address scope 3 challenges and turn scope 3 into a competitive advantage, advancing the literature on scope 3 in terms of challenges and benefits (Blanco et al. 2016, 2017; Patchell 2018; Klaaßen and Stoll 2020; Hansen et al. 2022) and supply chain engagement (Dahlmann and Roehrich 2019; Jira and Toffel 2013; Eggert and Hartmann 2021; Lintukangas et al. 2022). Simultaneously, we elaborate the RV (Dyer and Singh 1998) by leveraging it as a model to address challenges instead of generating supernormal profits. In addition, we apply the RV to collaborative structures with stakeholders other than customers and

suppliers (Vachon and Klassen 2008; Lintukangas et al. 2022) as we consider supply chains holistically as a vast network of firms across industries. This enables us to enlarge the spectrum of relevant supply chain collaborations to five different stakeholder groups instead of highlighting collaborations only for suppliers (Eggert and Hartmann 2021; Theißen et al. 2014; Jira and Toffel 2013; Asif et al. 2022) or both suppliers and customers (Lintukangas et al. 2022). Finally, we show that scope 3 challenges and collaboration types do not differ between industries, following a call for research by Theißen et al. in 2014.

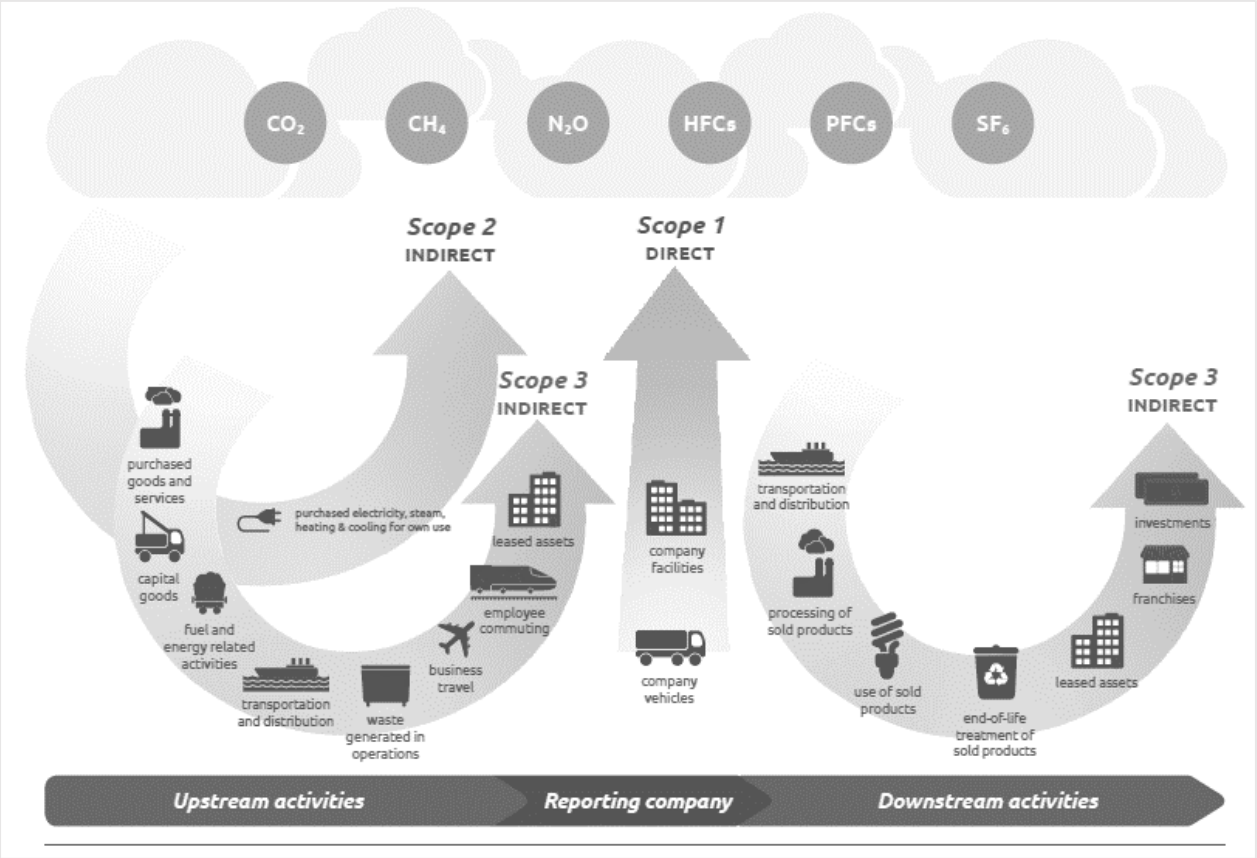
For practitioners, we increase consciousness about challenges regarding scope 3 while detailing which collaboration type is helpful as a countermeasure. We further incentivize progress in scope 3 through the prospect of competitive advantage. Non-profit organizations (NGOs) and regulators should consider incorporating these findings as best practices into their standards, improving the boundary conditions that often unleash the scope 3 challenges, and supporting the formation of resource-intensive supply chain collaboration types.

3.2. Theoretical background

3.2.1. Challenges and benefits of scope 3

Scope 3 defines emissions along the upstream and downstream value chain of a company (see Figure 3.1.) that are incurred as “a consequence of the activities of the company, but occur from sources not owned or controlled by the company” (Greenhouse Gas Protocol 2004, p. 25).

Figure 3.1. Overview of the emissions along the value chain



Source. Greenhouse Gas (GHG) Protocol (2011)

Scope 3 emissions comprise 15 categories (Greenhouse Gas Protocol 2011), among which Category 1 *purchased goods and services* and Category 11 *use of sold products* account on average for the highest share (Carbon Disclosure Project 2016). Since 75% of a firm's carbon emissions arise on average in a firm's value chain (Carbon Disclosure Project 2014; UN Global Compact Network UK 2023), scope 3 serves as the most critical element of a firm's decarbonization (Greenhouse Gas Protocol 2011). Furthermore, the share of scope 3 in comparison with scope 1 and 2 CO_2 emissions has grown over-proportionately over the past decades (Hertwich and Wood 2018). In 2024, the Corporate Sustainability Reporting Directive (CSRD) becomes effective

(European Commission 2023a) so that 50,000 large[13] European firms will be legally required to report their scope 3 and employ an auditor for external assurance (European Commission 2023a).

Unfortunately, large firms cannot naturally rely on the support of smaller market players for their scope 3 progress (Lee and Klassen 2008). As no mandatory regulation and standard apply to those firms, many of them do not yet measure and reduce their scope 1 and 2. Therefore, larger firms must actively manage their progress in scope 3 (Plambeck 2012), which is more demanding than for other scopes, as firms must audit emissions outside their direct sphere of influence (Patchell 2018).

As a result, Blanco et al. demonstrated in 2016 that large firms reported only 22% of their scope 3 to the *Carbon Disclosure Project (CDP)*. This trend seems to apply across industries, as Klaaßen and Stoll highlighted in 2022 that a sample of global technology firms had missed half of their scope 3, while Hansen et al. showed in 2020 that roughly 50 to 70% of scope 3 was omitted in the food industry. Moreover, a recent study on the state of carbon reporting of firms in the DAX revealed immense deficits in scope 3 measurement and reduction at German-listed firms (Bartels et al. 2022). Six firms reported solely two or fewer of the 15 scope 3 categories (Bartels et al. 2022). Less than half of the firms accounted for the most relevant categories 1 and 11, and various methodologies have been used, making comparisons inconclusive (Bartels et al. 2022).

For this reason, it is not surprising that literature on scope 3 reviews challenges extensively. Challenges that are discussed include a lack of internal resources and knowledge on scope 3 (Blanco et al. 2016; Asif et al. 2022; Patchell 2018), unavailability of validated inputs from supply chain partners (Klaaßen and Stoll 2020; Downie and Stubbs 2012), limited influence on supply chain partners to enforce decarbonization actions (Patchell 2018; Mahapatra et al. 2021), lack of

[13] Large companies that meet two of the following three criteria will have to comply with the CSRD: €40 million in net turnover, €20 million in assets, 250 or more employees.

knowledge about the upstream and downstream supply chain (Hansen et al. 2022; Patchell 2018) as well as the absence of an undisputable methodology (Patchell 2018; Blanco et al. 2016; Hansen et al. 2022) and uniform data collection mechanism (Boukherroub et al. 2017).

However, simultaneously, it has been shown that firms can seek benefits from scope 3 (Sharfman et al. 2009). Through a comprehensive measurement of scope 3, firms can effectively identify emission hotspots (Blanco 2021; Bocken and Allwood 2012), which forms the basis for effectively formulating and prioritizing reduction measures (Patchell 2018; Jira and Toffel 2013). In addition, financial benefits can be achieved. To effectively measure and reduce scope 3, firms need to improve their understanding of the critical processes of their value chain partners. This knowledge of processes outside of the firm's territory enables process optimization, which can yield cost savings and increased operational efficiency (Science-based Target Initiative 2018; Solomon et al. 2011; Greenhouse Gas Protocol 2011; Jira and Toffel 2013; Bocken and Allwood 2012). Furthermore, awareness of climate-related risks along the value chain avoids associated costs such as fees arising from non-compliance with climate legislation (Li et al. 2020; Blanco 2021; Science-based Target Initiative 2018). Moreover, there is the potential for product development, either in the form of products with a scope 3 optimized footprint or products that serve as an enabler of scope 3 optimization (Blanco et al. 2017; Science-based Target Initiative 2018; Greenhouse Gas Protocol 2011; Jira and Toffel 2013). Last, firms can improve their brand and market value (Blanco et al. 2017; Greenhouse Gas Protocol 2011; Kim and Lyon 2011; Bocken and Allwood 2012; Li et al. 2020), as non-governmental stakeholders like investors (Li et al. 2020; Boukherroub et al. 2017; Blanco et al. 2017; Hansen et al. 2022), customers (Hartmann and Moeller 2014; Jira and Toffel 2013), and civil society (Boukherroub et al. 2017; Eggert and Hartmann 2021), reward firms which disclose and reduce their carbon emissions (Da Silva Monteiro and Aibar-Guzmán 2010).

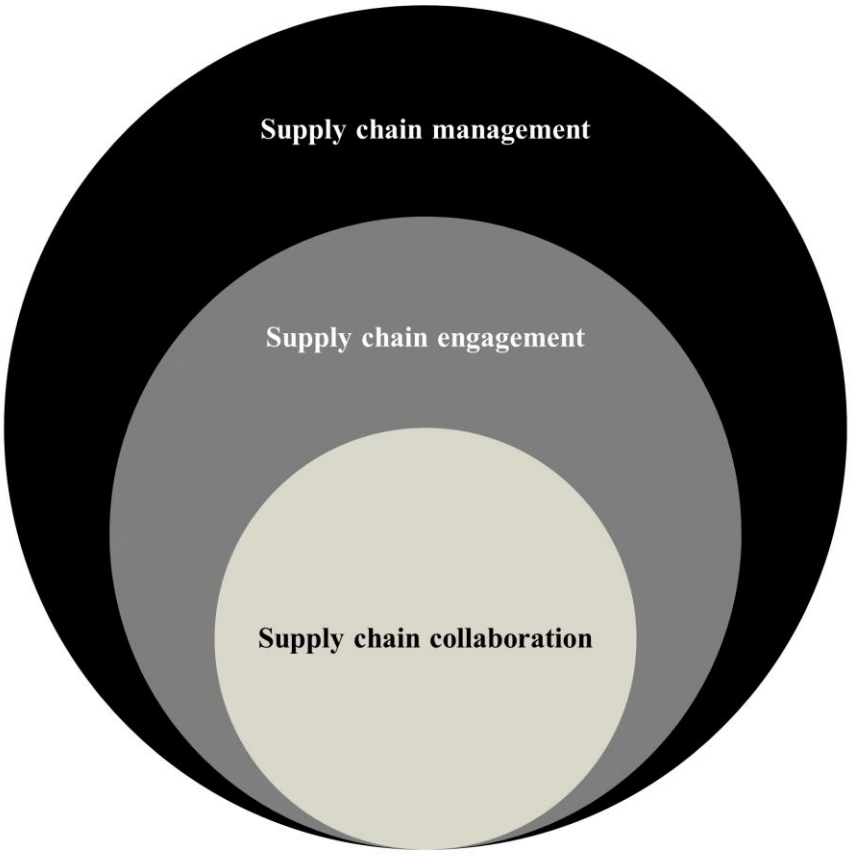
Therefore, a firm's motivation to measure and reduce scope 3 can be rooted in regulatory requirements but also in the desire to achieve scope 3 benefits. While certain firms with the ability to measure and reduce scope 3 enjoy benefits, others are discouraged by severe challenges, potentially facing business risks and failing to contribute their fair share to mandatory climate targets (Sharfman et al. 2009; Steger 1996).

3.2.2. Supply chain collaborations

Sustainable supply chain management

A situation in which scope 3 can serve as a challenge or benefit has encouraged firms and researchers to further explore supply chain management (Jira and Toffel 2013). This topic forms part of sustainable supply chain management. Figure 3.2. describes the integration of concepts within sustainable supply chain management.

Figure 3.2. Supply chain management - integration of concepts



Source. Own figure inspired by Tidy et al. (2016)

Supply chain engagements differ in how much a firm works with its supply chain partners (Dahlmann and Roehrich 2019). Two fundamental forms of supply chain engagement are "arms-length, transactional relationships and collaborative relationships" (Lintukangas et al. 2022, p. 2). Arms-length, transactional relationships are often referred to as monitoring practices that are unidirectional and control-oriented, as the focal firm solely defines requirements for its supply chain partners and expects them to fulfill those (Sancha et al. 2019; Vachon and Klassen 2008). In contrast, collaborative relationships are bi-directional, with interactions, investments, and knowledge exchange involving the firm and its supply chain partner, yielding jointly derived procedures, processes, and solutions (Sancha et al. 2019; Vachon and Klassen 2008).

Although many authors stress the relevance of supply chain collaborations (Patchell 2018; Schulman et al. 2021; Blanco et al. 2017; Plambeck 2012), the list of authors assessing supply chain collaborations for scope 3 is limited. In the field of scope 3, antecedents and preconditions of supply chain collaborations have been explored (Theißen et al. 2014; Lintukangas et al. 2022; Jira and Toffel 2013), and their typology with regards to information processing (Dahlmann and Roehrich 2019). Last, it has been shown that the involvement of the supply base reduces scope 3 (Eggert and Hartmann 2021; Asif et al. 2022). However, no research of which we are aware has analyzed the fundamental question of how supply chain collaborations help to measure and reduce scope 3. Moreover, collaborations have been assessed predominantly with suppliers in single supply chains or sectors, disregarding more extensive supply chain networks (Soosay and Hyland 2015; Sharfman et al. 2009; Theißen et al. 2014; Dahlmann and Roehrich 2019) and an assessment of different industries (Theißen et al. 2014). Even customers have often been disregarded as supply chain partners in this context (Soosay and Hyland 2015).

Irrespective of scope 3, literature on sustainable supply chain collaboration claims it as a promising solution (Vachon and Klassen 2008), as it can overcome transaction costs (Patchell 2018) and reduction activities can be implemented where they are most effective in the value chain instead of only within the focal firm's activities (Carballo-Penela et al. 2018). Environmental goals can be jointly derived (Eggert and Hartmann 2021), and partners can learn from each other and leverage their collective knowledge (Sharfman et al. 2009). Collaborative approaches incentivize all involved supply chain partners to engage, for instance, via an increased level of disclosure (Jira and Toffel 2013; Lintukangas et al. 2022), which reduces information asymmetries drastically (Dahlmann and Roehrich 2019).

Following this line of argumentation, we assess the potential of supply chain collaborations for scope 3. In addition, the dominant topic of challenges and benefits of scope 3 has never been

discussed in the context of supply chain collaborations, leaving a crucial gap to be filled. Finally, we investigate whether the strong focus on supplier collaborations has neglected relevant collaborations with other supply chain partners.

A relational view on supply chain collaborations

The RV serves as the theoretical foundation of this research. The RV, which was introduced by Dyer and Singh in 1998, is an extension of the pronounced resource-based view (RBV) introduced by Hart in 1995. The critical difference between the two theories is that the RBV highlights that a firm's strategy and level of competitiveness depend on its own resources and capabilities. At the same time, the RV stresses the "value-creating linkages between organizations" (Dyer and Singh, p. 46). According to the RV, inter-organizational relational rents can be generated through relation-specific assets, knowledge-sharing routines, complementary resources and capabilities, and effective governance between a pair or a network of firms. Firms can jointly earn and sustain relational rents and leverage them as a competitive advantage.

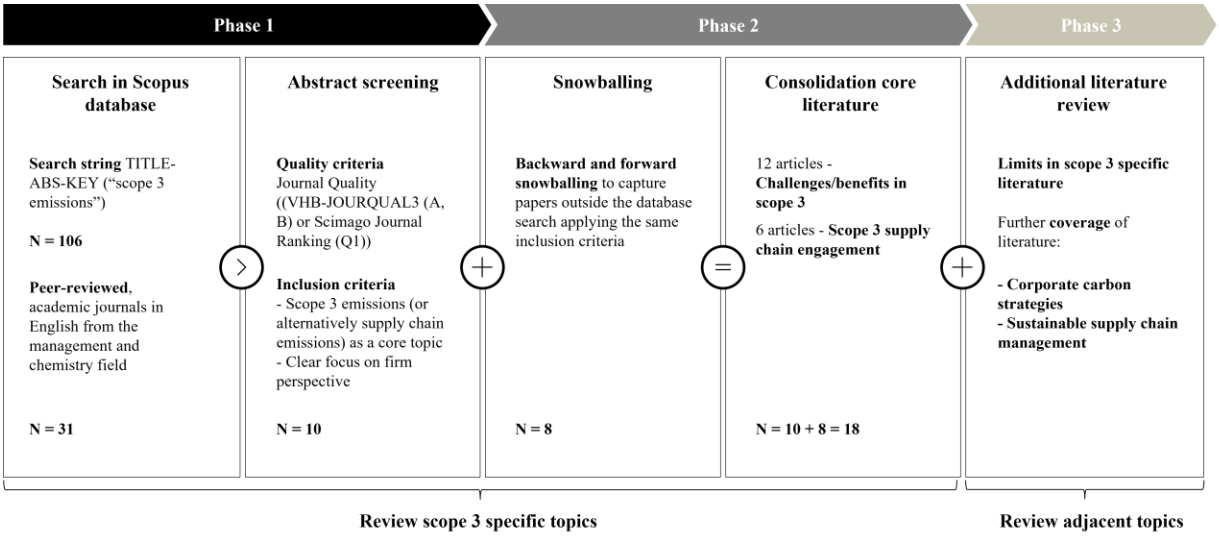
The RV is well-suited to assess the function and impact of collaborative structures (Mesquita et al. 2008; Cao and Zhang 2011), such as supply chain collaborations for scope 3. Previous research has demonstrated the applicability of the RV regarding supply chain management in conjunction with climate change (Lintukangas et al. 2022; Sancha et al. 2016; Zimmermann and Foerstl 2014). Among climate change topics, the RV finds a unique application for scope 3, as the measurement and reduction of scope 3 require exchange with many supply chain partners far outside a firm's organizational boundaries. In this context, the RV "offers a useful theoretical lens through which researchers can examine and explore value-creating linkages between organizations" (Dyer and Singh 1998, p. 676).

3.3. Methodology

3.3.1. Research design and setting

To answer the research question, we followed a two-step research approach. First, we conducted a systematic literature review on the keyword scope 3 emissions. The procedure of our literature review can be reviewed in Figure 3.3., while an overview of the results is available in Appendix D. Scope 3 challenges and benefits, as well as supply chain engagement, emerged as the two dominant topics.

Figure 3.3. Procedure for systematic literature review



Source. Own figure

As scope 3 specific literature was limited, adjacent literature streams, including corporate carbon strategies and sustainable supply chain management, were reviewed as a next step. The reviewed adjacent literature provided further evidence that the literature on scope 3 challenges and benefits, and supply chain engagement, were insufficiently connected. In addition, the prominent relevance of supply chain collaborations was stressed. In summary, the insights gained from this systematic literature review informed the interview-based data collection, analysis, and development of our overarching framework.

Second, we pursued an inductive, multiple case study approach (Eisenhardt 1989; Yin 2018). This approach is most suitable for investigating the research question for several reasons. It was applied by various authors who explored topics with limited extant knowledge (Diaz-Moriana et al. 2022; Kammerlander and Ganter 2015; Strike and Rerup 2016). Based on the exploratory analysis of multiple cases (De Massis and Kotlar 2014), the theory explaining new phenomena is more generalizable and accurate (Yin 2018; Eisenhardt and Graebner 2007). Findings from multiple case studies become even more robust because they allow for the parallel usage of various data sources (Eisenhardt 1989), spanning case interviews, expert interviews, and archival data in this study. As multiple case studies consider exploratory topics, they are used for *how* questions (Yin 2018), similar to the research question of this study. Last, multiple case studies allow a direct exchange with the subjects (Miles et al. 2014) - in this study, sustainability, purchasing, and product managers - generating more detail and context per individual case analyzed (Eisenhardt 1989). In addition to the above aspects, inductive research helps to make sense of insufficiently understood processes (Gioia et al. 2013; De Massis and Kammerlander 2021), such as the way how supply chain collaborations function and generate impact for firms in the field of scope 3.

Based on Glaser and Strauss (1967), we limited the group of cases via a five-step theoretical sampling approach to explore similar organizations with purposeful differences in scope 3 measurement and reduction for analysis (Miles et al. 2014; Eisenhardt and Graebner 2007). The theoretical sampling approach is visualized in Figure 3.4.

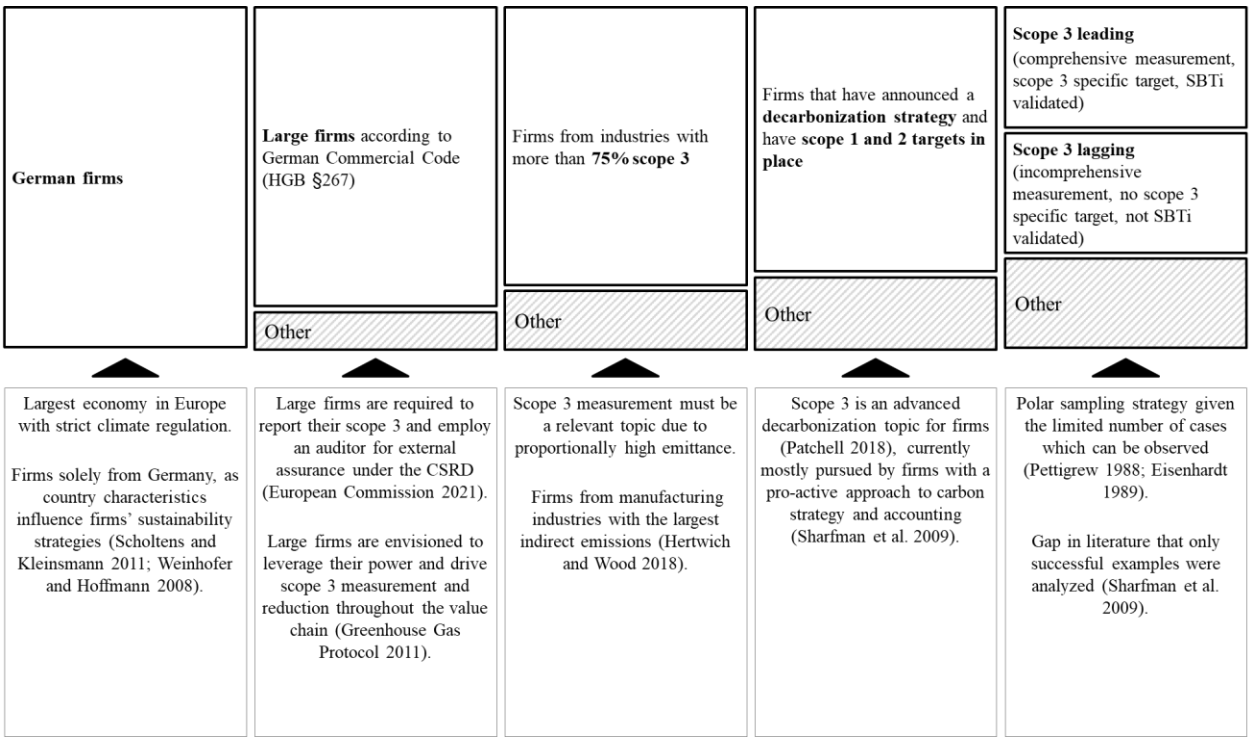
We focused on firms headquartered in Germany, as this is the largest economy in the European Union (EU), characterized by ambitious decarbonization targets compared to other countries. For high comparability of results, we analyzed only firms that are headquartered in Germany (Theißen et al. 2014), as external factors may differ between countries (Scholtens and Kleinsmann 2011; Habisch et al. 2011; Weinhofer and Hoffmann 2008). We analyzed firms that

are defined as large according to the German Commercial Code, with more than 40 million euros in revenue and more than 250 employees (German Federal Office of Justice 2023), as large firms are required to report their scope 3 progress under the CSRD (European Commission 2023a). Furthermore, according to the Greenhouse Gas Protocol (2011), large firms are specifically envisioned to leverage their power and drive scope 3 measurement and reduction throughout the value chain. Moreover, only firms with more than 75% of their CO_2 emissions allocated to scope 3 form part of the sample, primarily manufacturing firms (Hertwich and Wood 2018). The high proportion of scope 3 elevates the need for firms to engage in scope 3 measurement and reduction (Klaaßen and Stoll 2020). As scope 3 is an advanced decarbonization topic, only firms are approached that have an overall pro-active approach to decarbonization, represented through a decarbonization strategy and scope 1 and 2 CO_2 emission targets in place.

Last, we apply a polar sampling strategy given the limited number of cases that can be observed (Pettigrew 1990; Eisenhardt 1989). While half of the firms are regarded as *leading in scope 3*, the others are defined as *lagging in scope 3* since they do not meet the following three criteria. First, to be considered as leading, firms need a comprehensive measurement, which is fulfilled if a firm measures all scope 3 categories that are material to a firm's specific context, following the guidelines of the GHG protocol (Greenhouse Gas Protocol 2011). Comprehensive measurement is a reflection of the high scope 3 sophistication of a firm, as a recent study on the DAX revealed that many firms report only two or fewer of the 15 scope 3 categories and that less than half of the firms accounted for the important categories 1 and 11 (Bartels et al. 2022). Second, a scope 3 specific reduction target serves as a quality criterion of the scope 3 capabilities of firms. During an expert interview, a sustainability consultant confirmed that "*specific emission reduction targets are important key performance indicators (KPIs) that are increasingly included in tenders*." Third, the scope 3 specific reduction target should be validated externally by the Science-Based

Targets initiative (SBTi), ensuring that the reduction target is based on comprehensive scope 3 measurement and aligned with the ambitions of the Paris Agreement (Science-based Target Initiative 2023). On average, firms with SBTi-validated targets achieve more significant emission reductions than their peers without validated targets (Science-based Target Initiative 2022). In combination, the three criteria serve as an appropriate foundation to differentiate between leading and lagging firms in scope 3.

Figure 3.4. Sampling process



Source. Own figure

Cases were collected till theoretical saturation was reached (Eisenhardt 2021), yielding a final sample of 11 firms, which can be reviewed in detail in Table 3.1. For anonymity purposes, fictional names were assigned to the cases (Theißen et al. 2014). Original equipment manufacturers (OEMs), first-tier and second-tier suppliers are equally represented to account for supply chains as multi-tier networks (Soosay and Hyland 2015). All firms primarily operate in business-to-business

(B2B) markets and generate more than 80% of their business internationally. Similarly, the final sample is balanced with six scope 3 leading and five lagging firms.

Table 3.1. Profiles of the organizations in the sample

● Installed ◑ Partially installed ○ Planned ○ Non-existent

	Firm	Industry	Firm age[1]	Value chain position	Ownership	Firm size		Sophistication carbon management			
						Revenues[2] (in m EUR)	Employees[2]	Firm's current scope 3 focus	Scope 3 measurement	Scope 3 target	Scope 3 target SBTi validated
Scope 3 Leading	**Alpha**	Machinery / Transport	176	1st tier supplier	Non-family	72000	311000	Upstream & Downstream	●	●	●
	Beta	Transport	53	OEM	Non-family	58800	134000	Upstream & Downstream	●	●	●
	Gamma	Machinery	56	OEM	Non-family	15900	63000	Upstream & Downstream	●	●	●
	Delta	Chemicals	109	2nd tier supplier	Family	8210	15700	Upstream	●	●	●
	Epsilon	Chemicals	160	OEM	Non-family	50700	101000	Upstream & Downstream	●	●	●
	Zeta	Transport	122	1st tier supplier	Family	4400	16800	Upstream	●	●	●
Scope 3 Lagging	**Lambda**	Transport	65	1st tier supplier	Family	5100	74000	Upstream	●	○	○
	Eta	Transport	185	2nd tier supplier	Non-family	1250	4700	Upstream & Downstream	◑	○	○
	Theta	Glass	138	2nd tier supplier	Non-family	2800	17200	Upstream	○	○	○
	Jota	Semiconductor	24	OEM	Non-family	14200	56200	Upstream	◑	○	○
	Kappa	Machinery	88	OEM	Family	3092	14400	Upstream	◑	○	○

Note. 1. Compared with 2023; 2. 2022 as latest reporting year

Source. Own table

3.3.2. Data collection

The primary data of this research constitutes semi-structured interviews. The semi-structured interview guide was created based on the RV (Dyer and Singh 1998) and the results of the structured literature review (see Appendix D). It consists of four main sections, in which most of the questions are open-ended, which fits the exploratory character of this work (see Appendix E). The interview guide was pre-tested with researcher colleagues who are not experts in scope 3 and supply chain engagement to ensure that the interview guide had an easy-to-follow structure, straightforward questions, and included relevant definitions.

Twelve semi-structured interviews were conducted with 16 company representatives between February and April 2023, lasting between 34 and 70 minutes. All interviews were tape-recorded and transcribed within 24 hours. Data from more than 640 interview minutes was collected, comprising more than 180 single-line transcript pages. The word-by-word transcripts formed the basis of our coding process in MAXQDA[14]. The interviews were performed virtually to enable remote participation by interviewees from various locations. Most interviews were conducted by two researchers, allowing the interviewer to interact personally with the respondent, while the notetaker can complement with a more distant perspective (Eisenhardt and Bourgeois 1988; Bechhofer et al. 1984).

The interviews were conducted with managers responsible for scope 3 at their respective firms, including managers from the sustainability, purchasing, and product management departments. This diverse spectrum of interviewees' functions resembles that scope 3 impacts various firm domains. While the sustainability department is the traditional owner of

[14] MAXQDA is a software used for qualitative and mixed-methods research, and it primarily supports researchers in the coding and visualization of data.

decarbonization activities at a firm, equipped with technical sustainability know-how, the purchasing department is most knowledgeable about the upstream value chain, and the product management team is best situated to handle a firm's downstream footprint. We included two representatives per firm where possible to control for personal interpretation bias. Detailed information about the firm representatives and a summary of all the data sources is provided in Table 3.2.

While the interviews with the eleven sample firms serve as our primary data source, we enhanced the results' robustness by triangulating findings with two other data sources (Kotlar and De Massis 2013; Theißen et al. 2014). First, archival data from the company's website, past press releases, sustainability reports, and firm guidelines represents empirical evidence for the firm's sophistication in scope 3 measurement and reduction. Therefore, it serves as the basis of the polar sampling approach, as an aid for familiarization with the firms in preparation for the interviews (Diaz-Moriana et al. 2022), and benefits the data analysis. Second, five expert interviews with sustainability consultants, fellow researchers in sustainable supply chain management or scope 3, and a founder of a firm specialized in carbon management software complemented the data. The expert interviews enhanced our knowledge of methodologies and industry standards regarding scope 3.

Table 3.2. Characteristics of the respondents and data sources

Firm	Interviews	Role (Interviewees)	Years with the firm (Interviewees)	Management level (Interviewees)	Number of transcript pages	Minutes	Archival data	
Alpha	2	• Governance Lead Sustainability in the Supply Chain • Team Lead Climate	32 15	Top Management Higher Management	17 10	70 34	2 Sustainability reports 8 Company websites	2 Press articles 1 Guideline
Beta	1	• Supply Management & External Regulation Expert	20	Middle Management	14	60	2 Sustainability reports 6 Company websites	3 Press articles 6 Guidelines
Gamma	1	• Corporate Sustainability Officer	2	Top Management	16	60	2 Sustainability reports 7 Company websites	5 Press articles
Delta	1	• Head of Corporate Sustainability • Manager Carbon Measurement & Reporting	12 >20	Higher Management Middle Management	17	60	2 Sustainability reports 4 Company websites	1 Press article 3 Guidelines
Epsilon	1	• Project Manager Impact Management	5	Middle Management	19	70	2 Sustainability reports 5 Company websites	2 Press articles 4 Guidelines
Zeta	1	• Purchasing Expert Sustainability	10	Middle Management	15	60	1 Sustainability reports 1 Company websites	5 Press articles
Lambda	1	• Corporate Sustainability Officer • Governance for Procurement	5 35	Middle Management Middle Management	13	55	5 Sustainability reports 1 Company websites	3 Press articles 2 Guidelines
Eta	1	• Corporate Sustainability Officer	<1	Top Management	15	60	3 Company websites 3 Press articles	1 Guideline
Theta	1	• Product Manager	2	Middle Management	14	50	2 Company websites 3 Press articles	3 Press articles 4 Guideline
Jota	1	• Senior Manager Sustainability • Vice President Procurement	12.5 10.5	Higher Management Higher Management	16	60	2 Sustainability reports 6 Company websites	10 Press articles
Kappa	1	• Director Sourcing & Procurement Governance • Manager Sustainability & Energy	12 8	Middle Management Middle Management	19	60	1 Sustainability reports 4 Company websites	
Non-case specific	5	• Sustainability Consultancies (2) • Researchers (2) • Founder of Carbon Management Software Provider (1)						

Source. Own table

3.3.3. Data analysis

Our data analysis follows the structure of our combined research approach - the multiple case study approach (Eisenhardt 1989) and the inductive case analysis method (Gioia et al. 2013). Integrating multiple cases allows the identification of similarities and differences within and between cases (Eisenhardt and Graebner 2007), yielding higher robustness of findings when focusing on repeatedly observed patterns (Strike and Rerup 2016). Meanwhile, we considered the inductive analysis appropriate as it allowed us to reveal the uncovered processes of how and with which intention firms enter supply chain collaborations for scope 3 (Diaz-Moriana et al. 2022; Langley and Abdallah 2011). We performed the data analysis in three phases.

First, the three data sources were combined, forming bundles of individual case data for analysis. A detailed within-case analysis was performed. Initial themes emerged by coding the data, reflecting our research question (Miles et al. 2014). We specifically reviewed data concerning emergent topics from our literature review, including scope 3 challenges, measures against challenges (including collaborative structures), and scope 3 benefits. To ensure consistency and avoid investigator bias, both researchers coded the data independently and then compared their codes on an individual case basis (Yin 2018; Bechhofer et al. 1984). In cases of discrepancies, we discussed them until we reached a consensus to ensure inter-rater reliability (Belotto 2018). Over time, this resulted in first-order codes and initial categories (Gioia and Chittipeddi 1991). If codes did not align with the preliminary categories, categories were revisited. At times when discrepancies between data sources arose during this process, we consulted our informants again. Once all discrepancies were resolved and a prolonged data-reduction process (Miles et al. 2014), the within-case analysis resulted in eleven detailed case descriptions.

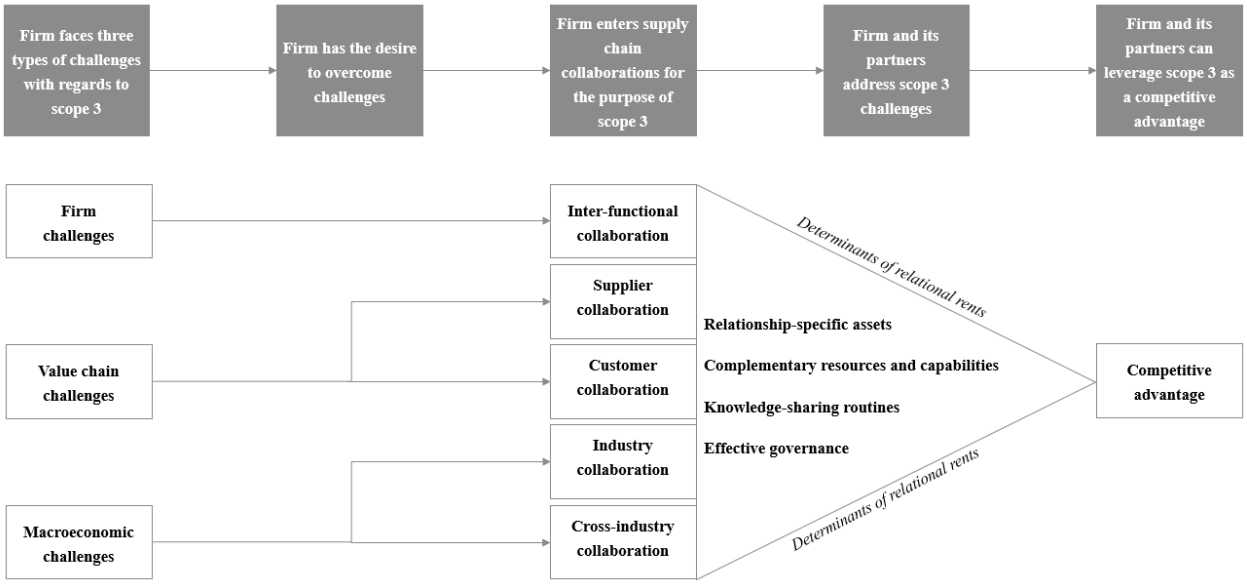
Second, a cross-case analysis was conducted to compare the findings from single cases and search for common patterns. Over time, this allowed us to move from a case-based to a category-based viewpoint (Theißen et al. 2014). In line with inductive approaches, we were open to new concepts arising in an iterative process. For instance, at this stage, several supply chain collaboration types manifested, matching with more expansive and diverse scope 3 challenges than expected from the literature review. In addition, we realized that none of the supply chain collaboration types were similar in their function, but they were all complementary to each other. We concluded this phase with a final list of second-order themes.

Third, we tried to find a theory that could help to understand the relations between the second-order themes and how these could be bundled in aggregate dimensions. The applicability of the RV manifested at this stage. It provided a basis to understand why supply chain collaborations can help firms to overcome scope 3 challenges and realize scope 3 benefits through value-creating linkages between organizations. Our aggregate dimensions were continuously refined as part of an iterative process (Reay 2014) until we reached our final data structure (see Appendix F). Furthermore, we compiled illustrative evidence for our findings to help external observers understand our derived conclusions (see Appendix G).

3.4. Results

Through an iterative process between data analysis and literature revisitation, we derived an inductive model on supply chain collaborations for scope 3. Addressing our research question, the framework demonstrates that supply chain collaborations help firms to overcome scope 3 challenges and generate a competitive advantage (see Figure 3.5). Although our approach to data analysis was inductive, we will present the framework deductively to limit space (Gioia and Chittipeddi 1991).

Figure 3.5. Model on supply chain collaborations for scope 3



Source. Own figure

The framework illustrates that firms usually face challenges when measuring and reducing scope 3, as it is an intricate and vast topic. We further find that these challenges arise in the firm, value chain, and macroeconomic context. As challenges impede the firm's progress and effectiveness in scope 3, firms seek to overcome them. If managers cannot find solutions in isolation, they look for resources and capabilities in cooperation with existing and new supply chain partners. With different partners, different collaborations with the purpose of scope 3 are formed inter-functionally inside the firm, with the supplier and customer in the direct value chain or within the industry and across industries. As these supply chain collaborations, in line with the RV (Dyer and Singh 1998), generate relational rents through relationship-specific assets, complementary resources, knowledge-sharing routines, and effective governance, they enable firms not only to address their scope 3 challenges in the first place but turn scope 3 subsequently into a competitive advantage. Although supply chain collaboration depicts collaborations outside of the firm's organizational boundaries (Fawcett et al. 2008), we intentionally also include inter-functional collaboration as part of our framework as it is complementary to the four other collaboration types

and entails the initial creation of value-creating linkages between previously distinct departments of a firm.

Supply chain collaborations are not equally distributed across our sample but are more often pursued by leading than lagging firms (see Table 3.3.). On average, scope 3 leading companies have implemented 3.6[15] of the five identified types of collaboration, compared to only 1.4 among lagging companies. Hence, assuming that scope 3 leading firms have already overcome many scope 3 challenges, we conclude that supply chain collaborations yield a significant, positive impact on firms' scope 3 sophistication. This finding is further supported by various firm representatives who stress the high relevance of supply chain collaborations for scope 3. *Delta's Head of Corporate Sustainability* highlights: *"[Scope 3] can't be done alone, so to speak, and you actually have to think about it together."* Similarly, *Alphas' Governance Lead Sustainability in the Supply Chain* points out: *"I would like as many companies as possible to participate. And as I said, you can only do that together. This understanding cannot end in Germany or Europe. It has to expand."* The relevance of supply chain collaborations is further manifested, as exerting pressure and enforcing requests on value chain partners, following an arm's length transactional principle, is perceived as inadequate by leading firms. The *Corporate Sustainability Officer* of *Gamma* believes that only collaboration yields the right level of incentivization: *"I think it is the more sustainable approach … I am convinced that together is always better … more motivating [for suppliers] when I speak at eye level."* In addition, *Beta's External Regulation Expert* even refers to a lack of alternatives to supply chain collaborations, as large firms have to develop their supply chain partners: *"But at some point, there will be no more suppliers because the suppliers can't do that, but you have to give them the time to grow with this issue [scope 3]. You have to support them. This is done with*

[15] Calculation logic: Fully installed collaboration accounts for "1" and partially installed collaboration accounts for "0.5".

tools, with knowledge, with know-how, with workshops, with webinars, and with personal discussions."

Table 3.3. Supply chain collaboration occurrence in the sample

● Installed ◑ Partially installed ○ Planned ○ Non-existent

	Company	❶ Inter-functional collaboration	❷ Supplier collaboration	❸ Customer collaboration	❹ Industry collaboration	❺ Cross-industry collaboration
Leading	Epsilon	●	●	●	●	○
	Alpha	●	●	●	○	◑
	Delta	●	●	◑	●	○
	Beta	●	●	●	●	○
	Gamma	●	●	●	◑	◑
	Zeta	●	●	○	○	◑
Lagging	Lambda	●	●	○	○	◑
	Eta	◑	○	◑	◑	○
	Jota	●	○	○	◑	○
	Kappa	◑	○	○	○	◑
	Theta	◑	○	○	○	○

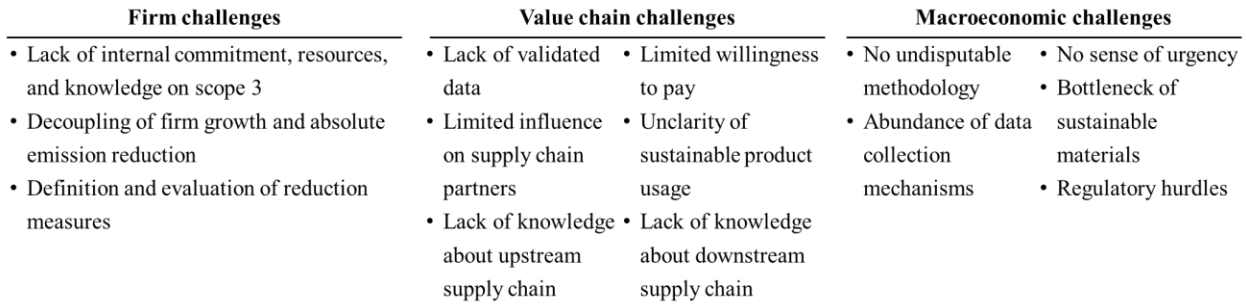
Note. Leading firms in comparison to lagging firms characterized by a comprehensive scope 3 measurement, a scope 3 specific reduction target, and an external validation of the scope 3 specific reduction target by SBTi

Source. Own table

In this section, we provide a description and definitive evidence for each of the critical components (second-order themes) of our model (see Appendix F). In addition to this section, further cross-case evidence per component is available in Appendix G.

Challenges. We identified that challenges regarding scope 3 incur not only in a value chain context but also internally within a firm and externally in a macroeconomic context. An overview of the fourteen derived challenges can be reviewed in Figure 3.6.

Figure 3.6. Overview of scope 3 challenges



Source. Own figure

Firm challenges. First, some firms are challenged by their employees' lack of dedication to scope 3. This attitude is further intensified through a need for more resources and knowledge on scope 3, as measurement and reduction are time-consuming and complex with high technical knowledge requirements. *Epsilon's Project Manager* highlights, *"It's just very, very resource-intensive on our side as well as on the supplier side."* Consequently, *Epsilon* also faces *"internal resistance because, of course, many colleagues shy away from this effort, since it is a large-scale task to carry out such calculations."* Second, it is a challenging task to define and accurately measure the impact of reduction levers, as pointed out by *Eta's Corporate Sustainability Officer*: *"Our data basis is not yet good, and it's not yet good enough to…derive measures like this and to track them."* Last, *Gamma's Corporate Sustainability Officer* highlights the difficulty of aligning absolute reduction targets and business growth. *"That's an absolute goal, and we have to have growth. Ultimately, we want to grow. We have to somehow balance it out with that."*

Value chain challenges. Firms often face both upstream and downstream value chain challenges. A lack of validated data and upstream knowledge and limited influence on supply chain partners challenge firms upstream. Meanwhile, little knowledge of the downstream value chain, limited willingness to pay, and the unclarity of sustainable product usage are encountered in the downstream value chain. More specifically, firms often have limited knowledge of how their

products are used and in which end products they are integrated. The reason for this is *"a lack of knowledge of the application area, ... I think a raw aluminum manufacturer can also hardly say whether his aluminum will be converted into a car or will just lie around as a shapely paperweight* (*Vice President Procurement, Jota)."* In addition, many firms do not even know *"where it actually disappears, in the individual products, in the individual sectors* (*Product Manager, Theta*)*."* The unclarity of sustainable product use refers to the limited ability of firms to track whether customers leverage opportunities like an eco-mode or other forms of usage with low carbon intensity. *"But who decides what the plane is filled up with? It's no longer us* (*External Regulations Expert, Beta*)*."* Another downstream challenge is that not all customers are willing to pay a premium for scope 3 reduced products. However, the development and production of scope 3 reduced products incur additional costs, which cannot necessarily be passed on to customers. *"As of today, I yet have to see a customer say, despite all the requirements, I'll pay you significantly more just for the product to be more sustainable (Purchasing Expert Sustainability, Zeta)."*

Macroeconomic challenges. Since scope 3 reaches far beyond the companies' boundaries, firms are also hindered by macroeconomic challenges. Certain challenges are directly linked to scope 3, such as the lack of an undisputable methodology and abundant data collection mechanisms. However, we further identify challenges more indirectly related to scope 3. Significant scope 3 reductions can be achieved by switching to more sustainable materials. However, *Delta's Head of Corporate Sustainability* highlights a severe limitation: *"I can't even get the quantities of renewable materials I need today."* Moreover, regulatory hurdles regarding the unclarity of reporting requirements significantly stress firms, as *Gamma's Corporate Sustainability Officer* highlighted*: "[We, as a company] still have no draft of the CSRD on the table. Not a final one. And companies are supposed to be preparing for it by 2025. That's crazy."* Last, many market participants are unaware of the urgency at which scope 3 needs to be effectively

measured and reduced. *Kappa's Director Sourcing & Procurement Governance* highlights that not all firms feel directly affected: *"However, I believe it hasn't fully sunk in yet. The pain of why we have to do this [scope 3] has not yet reached many companies."*

Supply chain collaborations. We further observed that supply chain collaborations with five stakeholder groups are formed. Figure 3.7. systematically compares the various supply chain collaboration types regarding participants, distance from the focal firm, purpose of formation, objectives, and collaborative activities. Most importantly, the different supply chain collaboration types deploy distinct collaborative activities that match the identified scope 3 challenges (see Figure 3.8.). In the following, we will review each supply chain collaboration type and discuss purposeful examples to illustrate how the value-creating linkages between firms help to master scope 3 measurement and reduction. The four mechanisms from the RV, namely complementary resources and capabilities, knowledge-sharing routines, relationship-specific assets, and effective governance, are applicable across collaboration types.

Figure 3.7. Introduction to supply chain collaborations for scope 3

	❶ **Inter-functional** collaboration	❷ **Supplier** collaboration	❸ **Customer** collaboration	❹ **Industry** collaboration	❺ **Cross-industry** collaboration
Participants	Various firm departments	Firm and supplier	Firm and customer	Firms from one industry	Firms from different industries
Distance from firm	Within firm	Within firm's supply chain	Within firm's supply chain	Within firm's industry	Beyond firm's industry
Formation	New / reinforced	New / existing	New / existing depending on distribution channel and importance of customer	Existing but new workstreams	New
Objective	Frequent exchange and new way of working between departments with the purpose of scope 3 management	Exchange on scope 3 management in addition to regular business	Provision of information to the customer about CO_2 reduction levers and exchange on CO_2 reduced products	Establishment of industry-wide working group to generate agreed scope 3 materials, standards, approaches, tools	Agreement of overarching standards across industries and derived from existing industry materials
Collaborative activities	Inter-functional process set-up, data analysis, and formulation of reduction initiatives Education of workforce concerning decarbonization Incentivization of workforce and top management concerning decarbonization	Education and support of supplier Alignment on data calculation (incl. tool) and reduction measures Joint target setting New product and process development	Education and support of customer New product development	Connection of experts and resources Joint target setting Joint data collection tool Alignment on data calculation methodology	Leverage and extension of existing knowledge Alignment on uniform data calculation methodology (incl. tool) Formation of a joint business interest group

Source. Own figure

Inter-functional collaboration. Inter-functional collaboration refers to collaboration across different firm departments, primarily the sustainability, purchasing, and product management departments. *"Collaboration is then ensured via the central sustainability department, which then also coordinates activities with purchasing or sales (Director Sourcing & Procurement Governance, Kappa)."* Within an inter-functional process set-up of departments, relational rents are created through ***effective governance***. Based on the strategic involvement of functional experts, firms can define and evaluate reduction measures more accurately and reliably. *Epsilon's Project Manager* explains, *"The topics are also passed on to more specific departments, which then have more in-depth knowledge or information."* An integrated set-up further enables an upskilling of the workforce regarding decarbonization. *Zeta's Purchasing Expert Sustainability* points out *"that they [Firm Zeta] spend a lot of capacity on taking colleagues internally by the hand and getting them on board to train them and create awareness for the topic."* *Eta's Corporate Sustainability Officer* argues that this leverage of ***complementary resources and capabilities*** is

necessary to enhance the excitement level of colleagues. *"To onboard this group [blue collar workers] on why is sustainability important? What does it mean in terms of our business strategy? What can everyone contribute?"* In addition, a firm-wide decarbonization roadmap serves as a ***relationship-specific asset,*** further incentivizing the management and the workforce. For instance, at *Eta*, departments are instructed to reach specified reduction goals: *"Department XY, your goal is to get so much percent of the pie down by then, and now please think about how."*

Supplier collaboration. Supplier collaboration depicts collaboration with a firm's suppliers, encompassing different tiers. While collaboration with suppliers is not new, the dedicated collaboration with suppliers on scope 3 is still relatively novel. A supplier collaboration aims to align data calculation and reduction measures, derives joint targets, and develops CO_2-reduced products and processes jointly. In addition, many suppliers need education and support to provide high-quality scope 3 data and sufficient scope 3 reduction progress. *Alpha's Governance Lead Sustainability in the Supply Chain* explains this approach: *"That's why the idea was to take suppliers there first. Explaining to them what CO_2 is and what levers exist. In other words, not just to give an assessment as a query: what are you already doing? But to give information about what you can do."* This procedure is a form of ***knowledge-sharing*** and helps to decrease the amount of unvalidated data by suppliers. Similarly, *Zeta's Purchasing Expert Sustainability* points out how the firm questions its impact on suppliers by asking: *"Do we have any real influence on our suppliers to deliver more sustainable products?"* To increase the influence on suppliers over the long term, *Zeta's Purchasing Expert Sustainability* explains how the firm establishes a joint target within its supplier collaborations: *"Take the large suppliers and arrange an initial meeting with them and then define a roadmap together. Where do we see ourselves in the long-term, and what do we want to achieve together?"* A common target system serves as a ***relationship-specific asset,*** leading to reconciliation between supply chain partners.

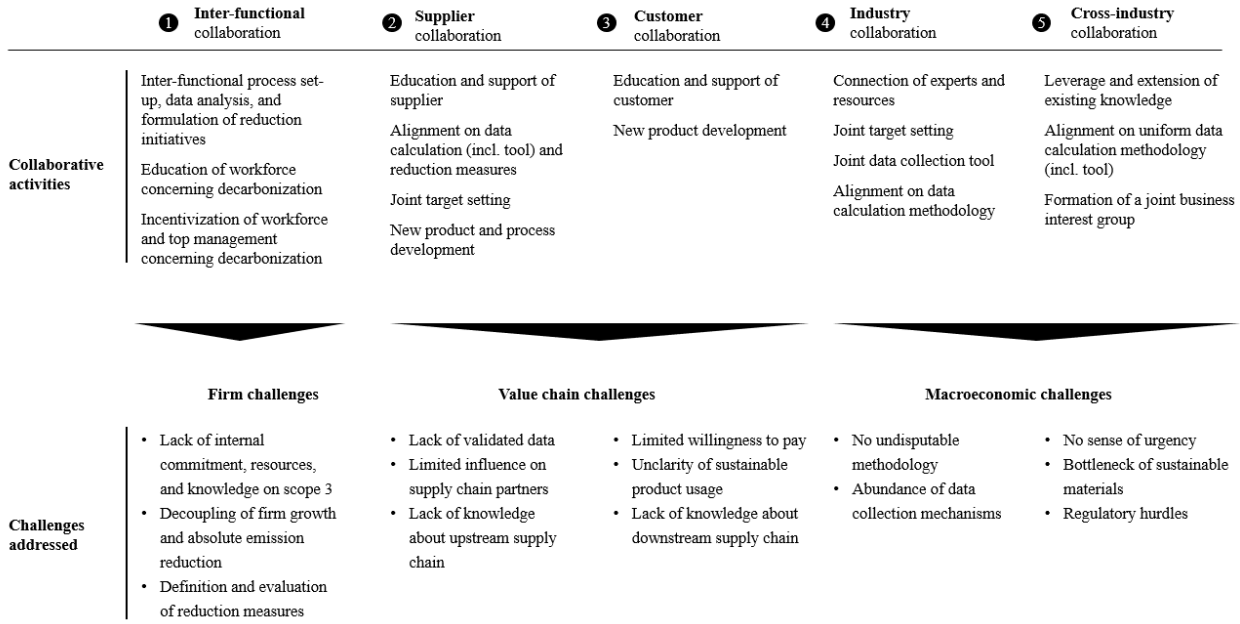
Customer collaboration. Firms further seek to collaborate with their customers on scope 3 in two ways. On the one hand, customers ***complement the resources and capabilities*** of a firm's research and development department as they express ideas for new products. For this reason, *"downstream is known for its product redesign efforts* (*Governance Lead Sustainability in the Supply Chain, Alpha*)*."* On the other hand, customers are educated and informed about carbon-neutral ways to use certain products. For instance, *Epsilon's Project Manager* describes: *"I would say that plans and actions have been considered to put farmers in a position to reduce their CO_2 emissions. On the one hand, training materials are given to them, but also related products, where one knows that this enables certain forms of cultivation and then one can also reduce CO_2 emissions in the agricultural sector."* Through these ***knowledge-sharing routines,*** firms can systematically enable their customers to use the products more purposefully and limit scope 3.

Industry collaboration. Industry collaborations usually originate from existing collaborations between firms, but dedicated workstreams are added for the work on scope 3. The objective is to generate and establish common scope 3 materials, standards, approaches, and tools for the industry. This goal can be reached by connecting various experts and resources from all collaborating firms, the definition of joint targets, standard data collection tools used by all collaboration partners and their respective value chain partners, and an alignment on utilized calculation methods, including industry-specific emission factors. *Beta's External Regulation Expert* describes how the firms ***complement their expert knowledge and financial capabilities***: *"Everybody who is part of it brings his experts into this association with the knowledge ... and additionally also brings money to buy what we do not know ourselves."* Particularly the chemical industry has already achieved a lot with their collaboration called "Together for Sustainability". For instance, *Delta's Head of Corporate Sustainability* mentions the creation of ***relationship-specific assets***: *"This Product Carbon Footprint Guidance document has been created, and it is*

also a calculation guidance for the scope 3.1 category." The collaboration's subsequent asset is already in the pipeline. *"The next step is to create a joint system on how these values can then be collected from suppliers."* By ***effectively governing*** the industry with common standards and materials, all firms in the chemical industry benefit. *Delta's Head of Corporate Sustainability* summarizes: *"And that, of course, helps us in turn, because we all have comparable data."*

Cross-industry collaboration. Cross-industry collaboration is a further advancement of industry collaboration. Therefore, the goals are comparable to industry collaboration, such as an aligned methodology, yet applied at a larger scale. In addition, the idea of cross-industry collaborations is to form a joint, strong interest group for discussions with NGOs and regulators. By ***effectively governing*** their interests and the exchange with the government, firms' requests in a cross-industry collaboration are more likely to be listened to and implemented. For instance, *Lambda's Corporate Sustainability Officer* explained, *"We had an exchange with the Climate Economy Foundation. ... to exchange our views in the direction of politics and to make demands on the laws."* Furthermore, knowledge from single industries can be compiled, leveraged, and extended instead of generating new concepts from scratch in every sector. ***Complementary resources and capabilities*** facilitate that progress is made faster and based on the best knowledge available. The *Corporate Sustainability Officer* of the machinery producer *Gamma* mentions significant overlaps with other industries: *"I think we also need cross-industry initiatives because, for example, concerning the topic of steel, aluminum, what the automotive industry is doing, we also need this."*

Figure 3.8. Function of supply chain collaborations for scope 3



Source. Own figure

Competitive advantage. We explore contrasting viewpoints on scope 3, depending on the firm's inter-organizational linkages available in supply chain collaborations. While lagging firms with few supply chain collaborations deployed highlight scope 3 still as a severe burden and challenge, scope 3 leading firms see it as an opportunity and source of competitive advantage. *Theta's Product Manager* indicated: *"So for us, it [scope 3] is clearly a challenge. Why is it like that? Currently, the trend is accelerated through pressure from the top. The pharmaceutical industry marks itself green or would like to become green. They are also aware of their immense footprint and are now allocating it back into the supply chains. However, from my point of view, the links in the chain below are not yet capable of dealing with all the pressure."* In contrast, scope 3 leading firms have overcome challenges and already see scope 3 as an opportunity and distinguishing feature: *"We actually see it [scope 3] primarily as an opportunity. ... And we actually want to be one of the companies leading the way because we believe that we can also benefit (Head of Corporate Sustainability, Delta)."*

In detail, we observed four forms of competitive advantage related to scope 3. A scope 3 assessment adds strategic value when it is embedded in other strategic supply chain exercises, such as switching back to local sourcing in times of geopolitical insecurities, the new Supply Chain Act (German Federal Government 2021), and the reporting of the Task Force on Climate-related Financial Disclosures (TCFD)[16]. *Delta's Head of Corporate Sustainability* explains the connection between the topics: *"Because you also mentioned the Supply Chain Act. These are, of course, issues that not only affect us, but also all of these human rights issues, etc. That's why we also work on this in tandem with purchasing and sustainability."* Furthermore, the measurement and reduction of scope 3 emissions is perceived as an excellent tool for achieving full transparency of complexities or inefficiencies in the supply chain that companies would otherwise not be aware of. *Gamma's Corporate Sustainability Officer* states: *"Companies have a competitive advantage that manage to create as much transparency as possible in the supply chain."* Moreover, the likelihood of firms winning in competitive tenders increases with a reduced scope 3 footprint *"as it currently serves as a differentiator between firms (Team Lead Climate, Alpha)."* Finally, firms confirm the ability to enter new business segments. *Gamma's Corporate Sustainability Officer* articulates a chance in new market segments: *"We also want to develop our portfolio to bring more energy-efficient products to the market."*

3.5. Discussion

Based on an extensive collection of qualitative data, with eleven case studies as the primary data source, our study demonstrated the importance of supply chain collaboration for scope 3 measurement and reduction by assessing its function and impact. First, the different supply chain collaboration types deploy distinct collaborative activities that match the identified scope 3

[16] TCFD is an organization that has developed a framework for firms to disclose climate-related risks and opportunities through existing reporting processes effectively.

challenges. Second, our sample represents that firms that engage in supply chain collaborations are leading in scope 3. In sum, this study advances the literature on scope 3 challenges and benefits (Blanco et al. 2016, 2017; Patchell 2018; Klaaßen and Stoll 2020), sustainable supply chain engagement (Dahlmann and Roehrich 2019; Jira and Toffel 2013; Eggert and Hartmann 2021; Lintukangas et al. 2022) and the RV (Dyer and Singh 1998).

3.5.1. Contribution

Theoretical implications

Our research entails four theoretical implications. First, we contribute to the list of scope 3 challenges and benefits discussed in the literature. All scope 3 challenges identified from previous literature can be confirmed (Patchell 2018; Downie and Stubbs 2012; Blanco et al. 2016; Klaaßen and Stoll 2020; Boukherroub et al. 2017). Yet, in contrast to previous literature, our list of scope 3 challenges is longer and more diverse than expected, doubling the total number of challenges and covering the firm, value chain, and macroeconomic perspectives. Firm challenges, e.g., decoupling of firm growth and absolute emission reduction, value chain challenges concerning the customer, e.g., unclarity about sustainable product usage, and most importantly, indirect macroeconomic challenges, e.g., a bottleneck of sustainable materials, have been insufficiently addressed in discussions on scope 3 before. This shows that scope 3, encompassing 15 categories and an abundance of stakeholders, has rarely been investigated in its entirety.

Furthermore, the list of benefits becomes more pronounced as we not only confirm the findings that scope 3 may enable the exploration of new products and business segments (Blanco et al. 2017; Science-based Target Initiative 2018; Greenhouse Gas Protocol 2011; Jira and Toffel 2013), but we further find out that scope 3 also leads to an enhanced likelihood of acceptance in tenders of existing business segments. This finding makes the literature (Blanco et al. 2017; Kim

and Lyon 2011; Bocken and Allwood 2012) stating an enhanced market and brand value through scope 3 more explicit. In line with the literature (Science-based Target Initiative 2018; Solomon et al. 2011; Greenhouse Gas Protocol 2011; Jira and Toffel 2013; Bocken and Allwood 2012), firms explain that scope 3 helps to identify inefficiencies and complexities in the supply chain, but we further find that it adds particularly high strategic value as it is embedded in other supply chain exercises such as local sourcing in times of geopolitical insecurities, the new Supply Chain Act (German Federal Government 2021), and the reporting of the TCFD. Through this extension of the literature, we increase the relevance of research on supply chain collaborations for scope 3, given the need to overcome a more extensive list of challenges while realizing various scope 3 benefits.

Second, we confirm the positive effect of supply chain collaborations on scope 3 measurement and reduction (Asif et al. 2022; Eggert and Hartmann 2021). Supply chain collaborations are significantly more often pursued by leading than lagging firms in our sample, and interviewees stress that scope 3 measurement and reduction can only be adequately performed with the help of supply chain collaborations. In line with our definition of supply chain collaborations in the introduction of this paper, the five types of supply chain engagement that we identified can be regarded as collaborative, as they involve bi-directional interactions and investments, yielding jointly derived procedures, processes, and solutions. In contrast, firms in our sample considered arm's length transactional engagement approaches with reduced buyer involvement as insufficient for scope 3 measurement and reduction, confirming the findings from Dahlmann and Roehrich as well as Eggert and Hartmann in 2021. Firms perceive dialogue as a requirement to implement complex topics, such as a switch to recyclates, and work successfully together towards decarbonization targets in the long term.

Following a call for research (Dahlmann and Roehrich 2019; Lee 2012), we are the first to advance these findings by assessing how supply chain collaborations positively affect scope 3

measurement and reduction. Our qualitative research approach and inductive data analysis revealed the uncovered processes between scope 3 challenges, supply chain collaborations, and scope 3 as a competitive advantage. This was further corroborated through our sampling approach encompassing successful and unsuccessful cases (Sharfman et al. 2009), as only the comparison revealed the effectiveness and function of supply chain collaboration types. While the connection between collaborations, relational rents, and sustained firm benefits was inherent in the RV before, we contribute by showing how challenges drive these collaborative efforts and how collaborations can actively address the challenges. This finding can also be applied to other topics where firms face challenges they cannot overcome with their own resources and capabilities, requiring engagement with partners beyond the companies' barriers.

Third, we contribute theoretically by considering supply chains holistically as a vast supply chain network of firms across industries (Lintukangas et al. 2022; Soosay and Hyland 2015; Theißen et al. 2014; Patchell 2018), yielding more insights into an intricate topic like scope 3 than linear supply chain interpretations (Hearnshaw and Wilson 2013). We identify supply chain collaborations with five different stakeholder groups instead of focusing only on suppliers (Eggert and Hartmann 2021; Theißen et al. 2014; Jira and Toffel 2013; Asif et al. 2022) or both suppliers and customers (Lintukangas et al. 2022; Dahlmann and Roehrich 2019). This is adequate for the longer and more diverse list of challenges identified.

Among the five collaboration types, we also find and describe inter-functional collaboration as relevant (see Figure 3.5.). Inter-functional collaboration slightly contrasts our definition of supply chain collaboration at the beginning of this study, where we refer to collaborations outside a firm's organizational boundaries (Fawcett et al. 2008; Theißen et al. 2014). However, we intentionally cover inter-functional collaboration as part of our findings, as firm challenges can only be overcome through internal, collaborative levers such as an inter-functional process set-up

and incentivization and education of the workforce. Value-creating linkages are newly created between departments that previously have not worked together, resembling collaboration between external supply chain partners. Last, we conclude that collaborative relationships within the firm form the foundation of other collaboration types, confirming the findings from Theißen et al. in 2014 that firms need to understand their approach to carbon emission management before defining requirements for their partners.

In line with this, our findings show that the more distant a supply chain collaboration is from the firm's core business, the less frequently it is currently pursued by firms. While all sample firms at least partially pursue inter-functional collaboration, supplier collaboration is also often in place. In contrast, customer and industry collaborations are rarely adopted, and cross-industry collaboration is still in its infancy (see Table 3.3.). We derive from this that the further a collaboration is away from a firm's core, the more resource intensive its establishment and maintenance will likely be, which stresses how important it is to increase awareness and support for these collaboration types. Moreover, we postulate that the high occurrence of supplier collaborations in our sample might also result from previous research's focus on supplier collaborations (Eggert and Hartmann 2021; Theißen et al. 2014; Jira and Toffel 2013) and the lack of awareness of other collaboration types.

As part of our broader conceptualization of supply chains, we also purposefully consider a broader set of industries, such as machinery, transport, and chemical. Previous literature has often concentrated on the scope 3 topics of a single industry, such as the technology industry (Klaaßen and Stoll 2020) or the food and retail industry (Hansen et al. 2022; Asif et al. 2022; Schulman et al. 2021). It was argued that the motivation and ambition level (Klaaßen and Stoll 2020; Hansen et al. 2022), external pressure (Hansen et al. 2022) as well as the degree of disclosure concerning scope 3 differ per industrial sector, so the deficiencies and solutions should also be assessed

separately. Yet, our findings contribute to the literature by showing that challenges and collaboration types do not differ between industries (Theißen et al. 2014). Firms from various sectors can source from the same suppliers or sell their products to the same customers. In contrast to calling for sector-specific analyses (Blanco et al. 2016), we, therefore, encourage cross-industrial perspectives for scope 3 topics.

Fourth, we elaborate the RV (Dyer and Singh 1998) by showing how inter-firm resources and routines are suitable for addressing deficiencies of firms. In 1998, Dyer and Singh aimed to show "that relationships between firms are an increasingly important unit of analysis for explaining supernormal profit returns" (p. 676). They motivate the formation of collaborations with above-normal profits, surplus gains, and specialization. Our analysis originates from the opposite viewpoint and leverages the RV and its determinants of relational rents, e.g., relationship-specific assets, as a model to assess the resolution of challenges. Consequently, the RV has explanatory power for firm performance at both extremes: how firms overcome below-normal performance on the one hand and how firms generate above-normal performance on the other hand. Furthermore, we show that the RV is well-suited to assess collaborative structures with stakeholder groups other than customers and suppliers (Vachon and Klassen 2008; Lintukangas et al. 2022), including internal firm departments, industry, and cross-industry partners. Given that supply chains are increasingly described as related networks, requiring the comprehensive analysis of various stakeholders and tiers, the RV can be increasingly used as a theoretical lens for future research projects in supply chain management. Our research also manifests the RV's relevance in sustainable supply chain management as a more specialized field (Lintukangas et al. 2022; Sancha et al. 2016).

Managerial and regulatory implications

For practitioners, we increase consciousness about challenges regarding scope 3 while detailing how the pursual of supply chain collaborations helps to overcome challenges and can enable a firm to turn scope 3 into a competitive advantage. Our findings demonstrate that firms should actively seek to collaborate with existing or new supply chain partners to measure and reduce scope 3 successfully. Furthermore, our research incentivizes firms to manage scope 3 irrespective of regulations and stakeholder pressure, as firms confirm that it can serve as a sustained competitive advantage in terms of financial considerations, e.g., new business segments, as well as strategic considerations, e.g., in alignment with the Supply Chain Act (German Federal Government 2021).

NGOs and climate organizations should incorporate these findings about prevalent challenges and collaborations into their standards and materials. In particular, customer, industry, and cross-industry collaborations should be covered comprehensively to enhance awareness and their occurrence in the market. For regulators, this research revealed that firms' scope 3 measurement and reduction activities are also hindered by macroeconomic challenges such as the availability of sustainable materials. Regulators should improve these boundary conditions as no single market player has the funds and scale to overcome macroeconomic challenges in its entirety. Regulators should further help initiate and fund industry and cross-industry collaborations, which might be difficult and resource-intensive to start from a firm perspective due to the vast coverage of parties and processes outside the organizational boundaries of firms.

3.5.2. Limitations and future research

Irrespective of the previously outlined contributions, our study entails four limitations that can inspire future research. First, our findings can only be transferred to other research contexts with high caution. For instance, German firms might be peculiar in their limited willingness to share

emission data without collaborative structures. Yet, we do not expect significant country-specific peculiarities, as Damert and Baumgartner did not identify any differences between the countries' climate regulations and firms' adopted climate response strategies in 2018.

Second, the scope 3 sophistication of a firm is in this study conceptualized through scope 3 measurement comprehensiveness, a scope 3 specific reduction target, and the additional validation of this goal by SBTi (see Figure 3.4.). To assess the impact of supply chain collaborations, it would be better to track firms' actual scope 3 reduction progress in a longitudinal study over time instead of analyzing the status quo of scope 3 capabilities at the firms in detail. However, since most firms have been starting to track scope 3 only recently, a study with coverage of several years is not feasible yet. Nevertheless, with the introduction of the CSRD, the availability of scope 3 information per firm and across firms will soon drastically increase, facilitating long-term studies.

Third, this study introduces five types of supply chain collaboration and highlights their significant role in addressing scope 3 challenges. Future research could investigate the success factors contributing to making these supply chain collaborations the most effective.

Finally, the propositions developed in this qualitative study could be tested for a larger sample through deductive empirical methods such as a survey.

3.6. Conclusion

A transition toward a decarbonized future will only be feasible if also the private sector effectively reduces scope 3 and contributes its fair share to decarbonization. Based on rich evidence from a multiple case study and the elaboration of the RV (Dyer and Singh 1998), we show that supply chain collaborations are essential to overcoming scope 3 challenges at the firm, value chain, and macroeconomic level through value-creating linkages. Hence, supply chain collaborations consequently enable firms to leverage scope 3 as a source of competitive advantage. While NGOs

and climate organizations should highlight the relevance of supply chain collaborations in their standards, regulators should help to initiate collaborations, and practitioners should improve their scope 3 capabilities and strive for a competitive advantage.

4 Essay III

The influence of family ownership – Does it pay for family firms to decarbonize?[17]

Johanna Cecilia Schulze-Berge

This essay assesses the linkage between corporate environmental performance (CEP) and corporate financial performance (CFP) in family firms via econometric techniques. I add to the question, "When does it pay to be green?" by investigating the condition of being a family firm. Existing research on the linkage between CEP and CFP for family firms is scarce, yields inconclusive findings, and lacks studies that express CEP via corporate carbon performance. Based on firm panel data from 74 private German family firms, I demonstrate a positive relationship between CEP expressed as carbon intensity and CFP expressed as Return on Assets (ROA) and Return on Equity (ROE). Moreover, I provide evidence for a moderating effect within the family firm dataset: the disclosure of a firm's CEP. My findings inform practitioners and regulators that decarbonization is financially incentivized in the absence of regulation, while widespread disclosure of corporate carbon footprints yields additional financial benefits.

Keywords: Corporate environmental performance, Carbon emissions, Corporate financial performance, Family firm, Ownership structure

[17] This essay has been accepted, presented, and published in the proceedings at the 45th EAA Annual Congress in Helsinki in 2023 and at IFERA23 "Back to the Core" in Krakow in 2023. A full paper version was published in the Academy of Management Proceedings (2023; Issue 1).

4.1. Introduction

Although it is unimaginable to exclude decarbonization from any economic, political, or societal agenda, decarbonization progress is lacking. On the 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27), United Nations (UN) Secretary-General Antonio Guterres highlighted the urgency of successful decarbonization yet again: "Greenhouse gas emissions keep growing. Global temperatures keep rising. And our planet is fast approaching tipping points that will make climate chaos irreversible" (United Nations 2022a). On top of this, French President Macron recognized that changes in the conditions under which firms decarbonize must not impede decarbonization progress: "We won't sacrifice our commitments under Russia's threat" (French Embassy India 2022). UK Prime Minister Rishi Sunak agrees and even suggests decarbonization activities should be even more prioritized, as "diversifying our energy supplies by investing in renewables is precisely the way to insure ourselves against the risks of energy dependency" (UK Government 2022).

Since one-fourth of all greenhouse gas emissions in Germany were incurred by manufacturing firms (German Environmental Agency 2023a), firms feel addressed by the above statements, highlighting that decarbonization is a necessity irrespective of arising challenges (Åhman et al. 2017). Yet, despite the high relevance of decarbonization for the industrial sector, firms might feel torn between their decarbonization and economic goals in the short term, for instance, via high initial investments (Hahn et al. 2010; van der Byl and Slawinski 2015; Haque 2017). Evidence for a win-win relationship, in which decarbonization improves financial performance, could aid in reconciling decarbonization and economic goals (Song et al. 2017; van der Byl and Slawinski 2015). Therefore, the question "Does it pay to be green?" has emerged as a relevant question, which has also been manifested by empirical research in this field since the 1970s

(Bragdon and Marlin 1972; King and Lenox 2002; Busch et al. 2020). Due to at times diverging results, the question has further evolved to "When does it pay to be green?" (Busch and Lewandowski 2017; Trumpp and Günther 2017; Lewandowski 2017) to make more targeted statements about the conditions that enable companies to benefit financially from environmental initiatives (Garcés-Ayerbe et al. 2022; Grewatsch and Kleindienst 2017; Endrikat et al. 2014).

One condition that has rarely been investigated thus far is the condition of being a family firm (Garcés-Ayerbe et al. 2022; Grewatsch and Kleindienst 2017), although "ownership is among the most powerful forces that affect a firm's strategy and performance" (Grewatsch and Kleindienst 2017, p. 26). Hence, family firms are substantially different from non-family firms and therefore, findings from the study of non-family firms cannot necessarily be applied (Carney et al. 2015; Blumentritt 2006; Chrisman et al. 2005). In line with this, a family firm's motivation to decarbonize is distinct, as family firms strive to protect their socioemotional wealth (SEW) (Berrone et al. 2010; Sharma and Sharma 2011; Block and Wagner 2014; Garcés-Ayerbe et al. 2022). In addition, two relevant theories for the CEP-CFP relationship find a particular application for family firms. First, family firms are equipped with unique characteristics and capabilities to be assessed within the natural resource-based view (Garcés-Ayerbe et al. 2022; Neubaum et al. 2012). Second, also the stakeholder theory varies in its application due to the family as an additional stakeholder group (Zellweger and Nason 2008; López-Pérez et al. 2018).

While there is abundant literature on the linkage between corporate environmental performance (CEP) and corporate financial performance (CFP) for non-family firms, predominantly pointing towards a positive relationship (e.g., Fuji et al. 2013; Gallego-Álvarez et al. 2015, van Emous et al. 2021), the research on family firms is not only rare but has also yielded diverging results (Garcés-Ayerbe et al. 2022; Neuman 2013; Craig and Dibrell 2006; Huang et al. 2014). These could be rooted in the usage of different measurement approaches for CEP (Busch

and Lewandowski 2017; Günther and Hoppe 2014; Trumpp and Günther 2017; Song et al. 2017) since a commonly recognized measurement framework is missing (Trumpp et al. 2015; Günther and Hoppe 2014). Corporate carbon performance is a good exception, as the measurement of carbon dioxide (CO_2) emissions is clearly defined through globally accepted standards such as the Global Reporting Initiative or the Greenhouse Gas Protocol (Downar et al. 2021; Iwata and Okada 2011). It has evolved to be the commonly recognized CEP measure used within non-family firm literature (Delmas et al. 2015; Busch et al. 2020; Fujii et al. 2013; Trumpp and Günther 2017; Lewandowski 2017; Gallego-Álvarez et al. 2015). A lack of analysis of the CEP-CFP relationship, where CEP is measured accordingly, leaves a crucial gap in the family firm research.

Furthermore, 90% of all German firms are family firms, which makes them the central backbone of successful German decarbonization (Stiftung Familienunternehmen 2019). It is, therefore, essential to explore whether family firms, as a special organizational form, can achieve a win-win situation between CEP and CFP. Hence, the following research question emerges: *"Does it pay for family firms to decarbonize?"*

To address this research question, I build a new, unbalanced dataset encompassing 74 private family firms for the timeframe of nine years (2013-2021). CEP is defined as corporate carbon performance, which is depicted as the inverse value of a firm's carbon intensity in this study. CFP considers a firm's profitability, expressed via the performance indicators Return on Assets (ROA) and Return on Equity (ROE). In addition, I introduce two moderating variables: the dirtiness of an *Industry* (Iwata and Okada 2011; Mani and Wheeler 1998) and the *Disclosure* of a firm's carbon performance (Delmas et al. 2015).

The panel regression's results on the relation between CEP and CFP show a positive, linear relationship between CEP and CFP for family firms. More precisely, the linear relationship is between CEP, thus the inverse of the logarithm of carbon intensity, and CFP. Consequently, it pays

off more for firms to decarbonize once a moderate carbon intensity has been reached. Concerning the two moderating effects, I do not find evidence for a significant impact of *Industry* on the CEP-CFP relationship, while *Disclosure* has a significant, positive effect on the CEP-CFP relationship.

Compared with previous literature, I contribute in three distinct ways. First, I comply with the call for analyses assessing the impact of family ownership on the CEP-CFP relationship, aiming to reconcile conflicting results from the past and draw more refined conclusions about when to expect positive future returns (Grewatsch and Kleindienst 2017; Garcés-Ayerbe et al. 2022).

Second, I show a moderating effect through voluntary public disclosure of carbon performance, which has rarely been investigated in the literature before (Delmas et al. 2015). Through consideration of this moderating variable, contradictory empirical evidence from the past might be reconciled. While disclosure of CEP has already gained importance (Methven O'Brien and Dhanarajan 2016), I postulate its importance will even increase through its function as a competitive advantage and differentiator of firms. Subsequently, the reasons for this effect should be further explored, covering topics such as target performance measurement (Young and O'Byrne 2001), external assurance provision (Ioannou and Serafeim 2019), or proactivity of decarbonization strategies (Endrikat et al. 2014).

Third, to the best of my knowledge, I am the first paper to utilize corporate carbon performance to measure CEP for family firms. Corporate carbon performance data is rare, as family firms are not yet obliged by law to report it, and there exists no official directory that bundles the voluntarily shared data. Carbon performance has many advantages over other CEP measures, such as unambiguity through international reporting standards. Its' usage further enables me to bridge two previously distinct literature streams on the CEP-CFP relationship and family firms and perform initial comparisons between family and non-family firms regarding their ability "to be paid to be green".

For practitioners in family firms, I show that decarbonization, on average, pays off with increasing financial returns along the decarbonization journey. The relationship between CEP and CFP further improves with carbon performance disclosure. Consequently, firms can deploy a win-win mindset, increasing their decarbonization activities and reporting while benefitting financially.

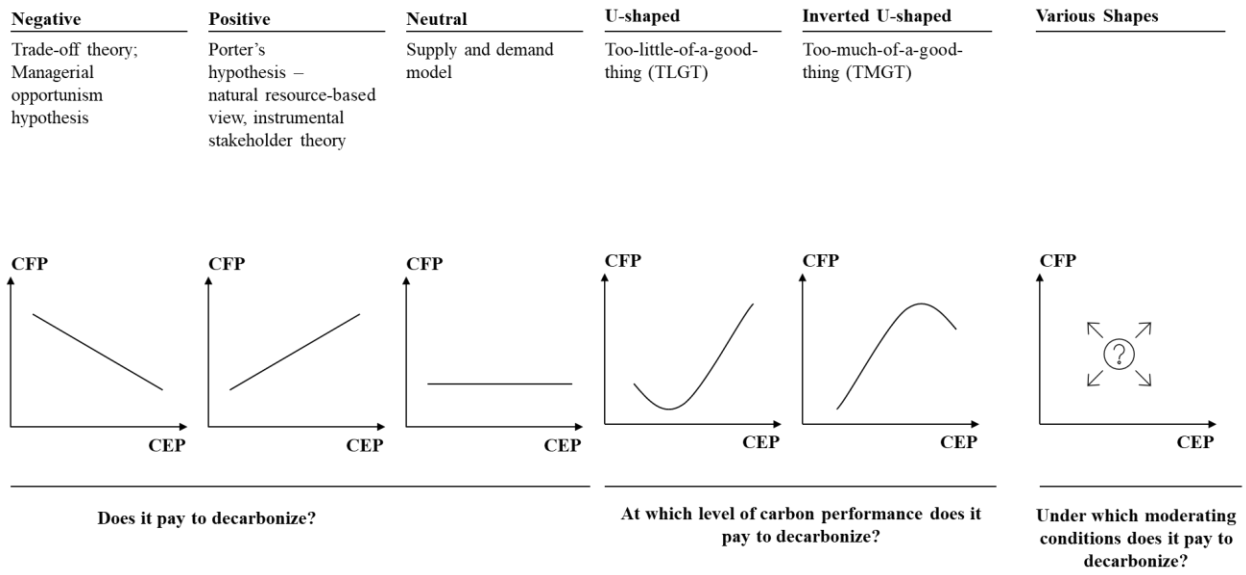
My findings can further inform future climate laws and regulations. I show that family firms are financially incentivized to decarbonize even in the absence of regulation. While future regulation should not primarily focus on differentiation between industries, more firms should be informed, incentivized, or even obligated to disclose their environmental performance publicly.

4.2. Literature review

4.2.1. Theoretical foundation

A considerable amount of theorizing has been done regarding the relationship between CEP and CFP. While some scholars claim that firms are financially rewarded for engaging in environmental performance, others claim the opposite. Figure 4.1. visualizes the different perspectives and the underlying theories on the CEP-CFP relationship.

Figure 4.1. CEP-CFP relationships



Source. Own figure developed from Tumpp and Günther (2017), López-Pérez et al. (2018), Fuji et al. (2013)

Supporters of a win-win relationship (Porter and van der Linde 1995) stress that environmental performance leads to an enhancement of financial performance, as firms correct for inefficiencies and invest in innovations, which leads to increased competitiveness of their offerings and consequently to higher profits. In light of this viewpoint, two complementary theoretical frameworks have manifested: the natural resource-based view (NRBV) and the instrumental stakeholder theory. First, the NRBV developed by Hart in 1995 stresses that "a firm can obtain sustainable competitive advantages from strategic resources and capacities for the environmental sustainability of its economic activity" (Garcés-Ayerbe et al. 2022, p. 4). At the core of this theory are strategic resources and capacities that are rare and inimitable, thus leading to a sustained competitive advantage (Sharma and Vredenburg 1998; Menguc and Ozanne 2005; Hart and Dowell 2011; Russo and Fouts 1997; Hart 1995). Second, the instrumental stakeholder theory (Donaldson and Preston 1995; Jones 1995) also advises a positive relationship between CEP and CFP, as meeting the environmental expectations of various stakeholders leads to an improved financial

performance by unlocking competitive advantages such as enhanced reputation and management attention or faster adaptation to external demands (Orlitzky et al. 2003).

Another group of researchers argues that the relationship between CEP and CFP follows a classical supply and demand model, in which a cost-benefit analysis reveals the optimal level of environmental investment that maximizes a firm's profits (McWilliams and Siegel 2001). Last, proponents of a trade-off theory claim that environmental investments generate costs that negatively reduce firm profits (Andersson et al. 2018; Friedman 1970; Levitt 1958). Accordingly, the managerial opportunism theory explains that managers adjust their environmental investments depending on the firm's financial performance (Preston and O'Bannon 1997). While managers tend to maximize profits by reducing environmental investments in times of good financial firm performance, managers invest heavily in environmental investments in times of bad financial firm performance to justify the lack of profits (Hang et al. 2018).

To reconcile these contrasting theories regarding the impact of CEP on CFP, the research focus has shifted from "Does it pay to be green?" to "When does it pay to be green?". Two theories, "Too-much-of a-good-thing" (TMGT) in the form of a U-shape and "Too-little-of-a-good-thing" (TLGT) in the form of an inverted U-shape are the prevalent theories in this field (Lewandowski 2017; Trumpp and Günther 2017). Both of these theoretical concepts include inflection points where the relationship between CEP and CFP switches as an optimal or minimum level of CEP has been reached so that more differentiated statements are made based on a firm's environmental performance level (Trumpp and Günther 2017; Lewandowski 2017). Also, analyzing internal and external moderating conditions helps to further differentiate the question of "When does it pay to be green?" (Grewatsch and Kleindienst 2017; Endrikat et al. 2014). One condition that has rarely been investigated thus far is the condition of being a family firm (Garcés-Ayerbe et al. 2022;

Grewatsch and Kleindienst 2017), although "ownership is among the most powerful forces that affect a firm's strategy and performance" (Grewatsch and Kleindienst 2017, p. 26).

4.2.2. Empirical evidence

There is an abundance of literature focusing on the CEP-CFP relationship, usually covering accounting-based and market-based financial performance (Busch and Lewandowski 2017; Endrikat et al. 2014). As private family firms are not listed on any stock market, market-based financial performance in terms of Tobin's *q* and Total Shareholder Return (TSR) is not available. Therefore, this paper will only consider accounting-based financial performance, with a particular interest in ROA and ROE as commonly accepted and prevalent metrics investigated (Lewandowski 2017; Gallego-Álvarez et al. 2015; Busch et al. 2020).

Meta-studies in the field of CEP and CFP (Orlitzky et al. 2003; Dixon-Fowler et al. 2013; Hang et al. 2018) find a positive linkage between CEP and CFP. The same holds for meta-analyses specifically focusing on CEP, defined as corporate carbon performance (Busch and Lewandowski 2017; Galama and Scholtens 2021). Also, in the course of single empirical studies, the opinion of a positive linear relationship (Fujii et al. 2013; Gallego-Álvarez et al. 2015; van Emous et al. 2021) or a positive relationship in a U-shaped setting (Trumpp and Günther 2017; Lewandowski 2017) seem to prevail. The only study in this field focusing on Germany by Velte in 2017 also shows a positive relationship between CEP, expressed as environmental, social, governance (ESG) performance, and CFP.

Outliers constitute the studies of Delmas et al.in 2015 and Busch et al. in 2020, where the latter is a replication and extension of the study of Delmas et al. in terms of the temporal and geographical scope. Both show a negative relationship between CEP and CFP. The different findings could be rooted in the usage of partially extrapolated data instead of real values (Busch et

al. 2020). Both authors use *Trucost* as the database, of which around 50% of the data are *Trucost's* estimations (Busch et al. 2020). Moreover, Delmas et al. (2015) recognize that the effect on the financial accounting performance might be hindered by the utilized data between 2004-2008 when there was still significant insecurity regarding upcoming GHG regulation. From a market-based perspective, Delmas et al. (2015) find a positive relationship, showing that investors expected changes in external conditions such as regulation but that no passed regulation has impacted firms' accounting performance yet.

Meanwhile, there is also an additional, smaller research stream that specifically targets family firms. Various definitions of a family firm exist (Posch and Speckbacher 2012; O'Boyle et al. 2012). A key feature of family firms is the dominant influence of the family (Chua et al. 1999; König et al. 2013), which I define as 50% of the ownership rights to be in possession of one or a small number of families. The 50% threshold contrasts the 20% ownership rights rule, which is commonly applied for publicly listed family firms (La Porta et al. 1999). Interests of the family are more evident in private family firms, as ownership is less scattered (Cruz et al. 2015). In addition, only 10% of firms on the German benchmark index DAX are considered family firms according to the 20% ownership rights definition (Stiftung Familienunternehmen 2019). Thus, the findings of generic CEP-CFP work cannot be applied to private family firms.

The CEP-CFP literature with a specific focus on the condition of being a family firm is not only scarce but also shows diverse results (Garcés-Ayerbe et al. 2022; López-Pérez et al. 2018; Craig and Dibrell 2006; Huang et al. 2014; Adomako et al. 2019; Neubaum et al. 2012), stemming most likely from different measures of CEP. CEP is adequately described as a multidimensional construct, where the results cannot be transferred or compared between different dimensions and definitions of CEP (Busch and Lewandowski 2017; Trumpp et al. 2015). For instance, different environmental challenges affect firms' operations differently (Fujii et al. 2013) and stakeholder

reactions vary depending on the type of environmental problem (Iwata and Okada 2011). Among the literature on the relationship between CEP and CFP, each author uses a different definition of CEP. While several authors apply self-defined constructs for firms' corporate social responsibility, environmental orientation, or management (Adomako et al. 2019; Craig and Dibrell 2006; Neubaum et al. 2012; López-Pérez et al. 2018), Garcés-Ayerbe et al. (2022) are the first to use a clearly defined, quantifiable term for environmental performance: the annual amount of environmental investment. In this manner, they find a positive relationship between CEP and CFP, which matches the results of Craig and Dibrell (2006) and López-Pérez et al. (2018). Meanwhile, Neubaum et al. (2012) and Adomako et al. (2019) obtain no significant relationship between CEP and CFP for family firms. No study has considered the impact of corporate carbon performance on CFP for family firms.

4.2.3. Hypotheses development

Family firms' motivation to engage in CEP is rooted in the phenomenon called socioemotional wealth (SEW), which can be described as "the non-financial aspects of the firm that meet a family's affective needs such as identity, the ability to exercise family influence, and the perpetuation of the family dynasty" (Gómez-Mejía et al. 2007, p. 106). Family firms engage in environmental activities to protect their SEW (Berrone et al. 2010; Block and Wagner 2014), e.g., expressed via an excellent corporate reputation, transgenerational value, or close relationships with their employees, because of the imbrication of the family and the business (Berrone et al. 2012; Brundin et al. 2014; Habbershon et al. 2003).

Linking the SEW with the NRBV is a new pathway, which was introduced by Garcés-Ayerbe et al. in 2022 in the course of discussions about the financial performance implications of environmental investments. In family firms, decisions are made with a long-term, transgenerational

mindset (Brundin et al. 2014; Le Breton-Miller and Miller 2006). Through the family's interest in the firm's long-term strategic development, family firms may be willing to pursue investments that go beyond standard payoff calculations (Brundin et al. 2014). This fits longer payback cycles of environmental initiatives that often require significant investments in the short term (van der Byl and Slawinski 2015). Moreover, family firms are known for establishing social capital and long-term relationships (Carney 2005; Kammerlander and Prügl 2016). This leads to reduced costs for managing diverse and sometimes complex alliances for environmental initiatives (Mohr and Puck 2013) and faster credibility gains for environmental initiatives in the public (Debicki et al. 2017). Family firms are further notable for carefully selecting their strategic investments (Kammerlander and Prügl 2016; Craig and Dibrell 2006), as their wealth is directly linked to the family firm (Cruz et al. 2010; Carney 2005). A more careful selection of environmental projects can enable a superior CFP in the long run (Craig and Dibrell 2006). Furthermore, family firms often establish close ties with their employees and practice a culture built on shared values (Schulze et al. 2001) so that employees feel more involved and committed to the firm's activities (Huang et al. 2014; Craig and Dibrell 2006; Kammerlander and Prügl 2016). Once a family firm has decided to decarbonize, corporate environmental performance activities are therefore expected to be executed more effectively and generate more innovations (Huang et al. 2014; Craig and Dibrell 2006). High independence and flexibility in decision-making processes (Brundin et al. 2014; von Stietencron 2013), in contrast to hierarchical decision-making structures, also serve as a facilitator of environmental innovations (Craig and Dibrell 2006). In conclusion, family firms possess intangible resources that help them select and pursue environmental activities, which can enable better financial performance as postulated by the NRBV (Garcés-Ayerbe et al. 2022).

Moreover, applying the SEW to the stakeholder theory is also a promising pathway. Stakeholder theory in the context of family firms is different due to the existence of an additional

stakeholder group: the family (Zellweger and Nason 2008). Family firms have a special incentive to satisfy a growing number of stakeholders (Berrone et al. 2010; Sharma 2004; Zellweger and Nason 2008; Sharma 2001) due to the overlap between the business and the family systems (López-Pérez et al. 2018). Family firms integrate "stakeholders' expectations into their strategic choices to protect their family identification and image" (García-Sánchez et al. 2021, p. 1016). Therefore, meeting the environmental claims of stakeholders is strongly relevant for family firms (López-Pérez et al. 2018; Habbershon et al. 2003). In 2018, López-Pérez et al. show that the positive effect of environmental activities on the financial firm value is more pronounced for family firms than non-family firms. This holds for the direct impact of environmental activities as well as the indirect impact of environmental activities via corporate reputation (López-Pérez et al. 2018). Therefore, the SEW theory, in conjunction with the NRBV and the instrumental stakeholder theory, respectively, form the foundation to hypothesize the following:

Hypothesis 1 (H1): *The CEP-CFP relationship for family firms is positive, i.e., the lower a family firm's CO_2 intensity, the higher its CFP.*

Past literature in the field of CEP and CFP has shown that it is reasonable to further divide a sample of firms depending on their industry affiliation. Kim and Bae postulate in 2022 that firms follow diverse production processes so that they will also react differently to climate regulations. In 2011, Delmas et al. also find that industries that vary in their carbon intensity will face different regulations and deploy different strategies against pollution. Iwata and Okada (2011) provide empirical evidence for the link between the dirtiness of industries based on emissions per unit of output (see Appendix I) and their environmental performance. It seems that firms from carbon-intensive, so-called "dirty industries" face higher costs until they meet regulations and achieve a reasonably good environmental performance. Consequently, it takes longer for them to generate

additional revenues through the recognition of environmentally friendly products and corporate image. For this reason, I hypothesize:

Hypothesis 2 (H2): *The positive effect of CEP on CFP will be weaker for family firms from dirty industries than for family firms from clean industries.*

Albeit German family firms are not included in mandatory carbon disclosure agreements such as the Non-Financial Reporting Directive (NFRD) (European Parliament 2014), many family firms disclose their carbon emission information publicly on their website or in sustainability reports. In 2021, Downar et al. found that firms that disclose their carbon performance publicly are more strongly incentivized to improve their emissions than their counterparts that report emissions only in the inner firm context. They base this on the so-called targeted disclosure cycle theory by Fung in 2007, which states that disclosure triggers the real effects of the disclosed variables. The underlying reason is that disclosure influences stakeholders' behavior (Fung 2007). Firms forecast these changes in behavior and pursue initiatives to improve the disclosed results (Fung 2007). Next to more dedicated management of the disclosed variables, public disclosure leads firms to include the variable of interest in their performance evaluation and incentive system (Kaplan and Anderson 2007; Young and O'Byrne 2001), enabling the dual pursual, tracking, and achievement of carbon and financial performance goals. In addition, firms that report their CO_2 emissions publicly are more likely to pay for external insurance provisions and follow accepted reporting guidelines, which improves the quality of the CO_2 information (Ioannou and Serafeim 2019), making a positive linkage between CEP and CFP more feasible. Last, firms that voluntarily report their CO_2 information to the public can further be regarded as proactive in their strategic approach toward carbon performance. Proactive approaches to CEP lead to a better CFP (Sharma and Vredenburg 1998; King and Lenox 2002; Endrikat et al. 2014) through process restructuring, material savings,

and more process innovation (Russo and Fouts 1997). In conclusion, I state the following hypothesis:

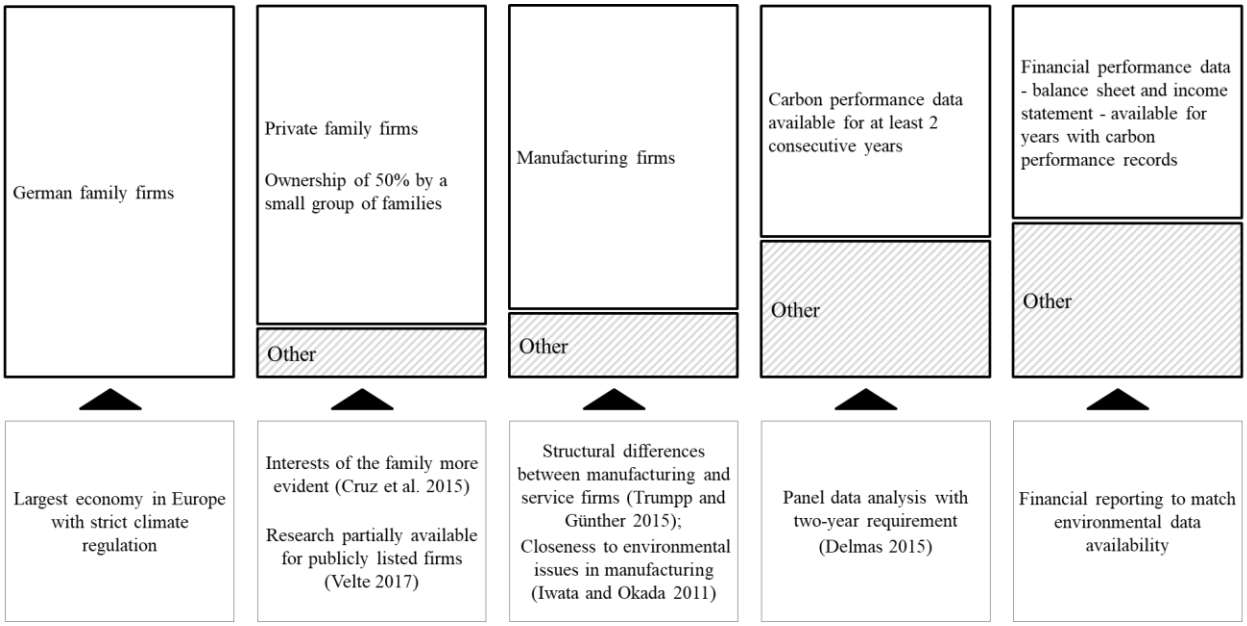
Hypothesis 3 (H3): *The positive effect of CEP on CFP will be stronger for family firms that publicly disclose their CEP than for family firms without public disclosure.*

4.3. Empirical analysis

4.3.1. Sample description

To test my hypotheses, I have built an unbalanced panel dataset for German family firms from the manufacturing sector. Since there is no official registry for family firms in Germany, several publicly available lists[18] and databases[19] were used to find German family firms. Identified firms were analyzed along the sampling process depicted in Figure 4.2.

Figure 4.2. Sampling process



Source. Own figure

[18] "Lexikon der Deutschen Familienunternehmen" (Venohr and Langenscheidt 2015); "Top 500 German Family Businesses - the economy most dependent on family enterprises" by Family Capital (2022)
[19] Carbon Disclosure Project (CDP) and Science-Based Target initiative (SBTi)

Publicly listed firms are ruled by different governance mechanisms (Cruz et al. 2015) and are often defined by a threshold of only 20% family ownership (La Porta et al. 1999). Service firms are structurally different from manufacturing firms (Trumpp and Günther 2017) and not as heavily impacted by environmental issues (Iwata and Okada 2011). Therefore, all publicly listed firms and private family firms with less than 50% ownership rights by the family, as well as service firms, were excluded before environmental data availability was investigated.

In this study, environmental data is defined by corporate carbon performance. I purposefully use CO_2 emissions, as they are directly linked to climate change (Trumpp and Günther 2017), crucial for ~50,000 European firms to comply with the Corporate Sustainability Reporting Directive (CSRD) (European Commission 2023a) and clearly defined and quantifiable through global reporting standards like the Global Reporting Initiative or the Greenhouse Gas Protocol instead of any arbitrarily defined environmental scores (Iwata and Okada 2011). More specifically, I collect the annual sum of scope 1 and 2 CO_2- (equivalents) per year and firm, excluding scope 3 emissions. Scope 1 and 2 are sufficient to incorporate relevant "investments, innovations and operational changes" (Misani and Pogutz 2015, p. 153) and the emission scope does not impact the empirical outcome (Busch et al. 2020). While carbon performance can be expressed in relative or absolute terms, I use a relative measure by dividing total carbon emissions by sales, similar to many other studies in this field (Busch and Lewandowski 2017; Busch et al. 2020; Trumpp and Günther 2017; Downar et al. 2021). In this manner, extraordinary growth and size-related events, such as acquisitions or process outsourcing, are incorporated (Busch and Lewandowski 2017; Busch et al. 2020; Trumpp and Günther 2017; Downar et al. 2021). I utilize the inverse of carbon intensity to signal that a low value indicates good corporate carbon performance (Busch et al. 2020; Trumpp and Günther 2017). To avoid inconsistencies in the definition of CEP with previous studies for non-family firms (Busch et al. 2020; Delmas et al. 2015; Iwata and Okada 2011), I use annual

reported emissions in contrast to rarely used measure of year-on-year changes in carbon performance.

The analysis draws the environmental data from three sources - sustainability reports and sustainability sections of companies' websites, the *Carbon Disclosure Project (CDP),* and an online survey developed for this research project. The online survey is developed according to the concepts of Neuman (2013) and is run in German. The survey guide was tested with researcher colleagues who were not experts in the topic to ensure that questions were straightforward and to the point. The survey framework can be reviewed in Appendix H. The survey is concise, focusing on the measured carbon footprint of the firms. In summary, 421 firms were contacted with a personalized letter that included the survey link. Some firms were asked to provide their whole emission data, while other firms were asked to enrich the set of already available environmental data found online. I controlled for social desirability bias through various means, such as a disclaimer of strict anonymity and confidentiality (Bergen and Labonté 2020), self-administration of questionnaires, and the neutral formulation of items (Nederhof 1985). The response rate is 11%, similar to other survey-based family firm studies, such as Kammerlander et al. (2020: 12%) and Cruz et al. (2010: 11%). In terms of controlling for a nonresponse bias (Armstrong and Overton 1977), I ensured that there were no significant differences between respondents and nonrespondents in terms of size, age, and industry mix. Ultimately, 5% of the firms that provided survey data form part of the final sample since many firms filled in CO_2 emission data for only one year, were adversely impacted by company restructuring, or did not publish all needed financial performance figures.

The list of firms with emission data for at least two consecutive years, which is a criterion also applied by other authors (Delmas et al. 2015), was complemented with financial data for the independent and control variables. CFP can cover four aspects: liquidity, profitability, growth, and

stock market performance (Hamann et al. 2013). In this work, I focus on CFP expressed as profitability via financial ratios, namely ROA and ROE, which are generally accepted measures of a firm's financial performance and in line with previous studies (Busch et al. 2020; Lewandowski 2017; Gallego-Álvarez et al. 2015). Data is retrieved from *Dafne*, a database provided by *Bureau van Dijk* that contains comprehensive information on private companies in Germany. Potential data lags were filled up with the Federal Gazette (Bundesanzeiger), which is Germany's central platform for pronouncements, announcements, and legally relevant company news. Through this separate financial data collection, I controlled for common-method bias (Podsakoff et al. 2003).

Table 4.1. illustrates the distribution of the sample observations. The final sample comprises an unbalanced panel dataset of 74 German manufacturing firms containing historical CO_2- (equivalent) and financial data from 2013 to 2021, yielding 242 observations in a time-lagged scenario and 296 observations in a non-time-lagged scenario. The panel is unbalanced because the number of firm-year observations varies between two to nine years. Since family firms are not regulated by any mandatory environmental reporting yet, firms can deliberately decide whether they measure their carbon performance in CO_2 or CO_2 equivalents (CO_2e), also encompassing other greenhouse gases next to carbon dioxide. As firms do not share the input factors for their CO_2e calculations, the translation back to pure CO_2 emissions is not feasible. However, in Germany in 2021, CO_2 accounted for 87% of all greenhouse gases, so the impact of the additional greenhouse gases is rather small (German Environmental Agency 2021). Therefore, 50 firms in my sample report their carbon performance in CO_2e, while 24 firms report their carbon performance in CO_2. In addition, I ensure that there are no significant differences between the subgroups in terms of their industry affiliation, size expressed as revenues or employees, and probability for public disclosure, so it is not necessary to differentiate the sample accordingly. In chapter three, I also control whether the descriptive statistics are similar (see Appendix J).

I tested the representativeness of my sample in terms of firm size, age, and industry. The firms in my sample earned an average of ~2,800 million euros in revenue in 2020, while they employed an average of ~15,000 employees. Consequently, they are significantly larger than a typical German family firm, which consists of up to 49 employees (Gottschalk and Lubczyk 2019) and one million euros in revenue (Gottschalk and Lubczyk 2019). Yet, I purposefully intended a larger firm size, as the financial data availability is very limited for small and medium-sized firms without public reporting requirements of a detailed balance sheet and profit and loss statement as defined by German law (German Federal Office of Justice 2022). In terms of age, most firms were founded between 1900 and 1950, with an average age of 112 years in 2022, when the research was administered. This figure matches the average age of German family firms described in other analyses (Family Capital 2022; Gottschalk and Lubczyk 2019). Moreover, the sample represents the split between clean and dirty firms (see Appendix I) in Germany well, with 69% of firms from clean industries in this sample, compared to 61% of clean industries observed by the German Federal Statistical Office (German Federal Statistical Office 2019). The distribution of the single industries within the German manufacturing sector is also adequately represented. Minor differences can be observed regarding the glass and ceramics industry, which is underrepresented by 5%, while the pharmaceutical industry is overrepresented by 3% (German Federal Statistical Office 2019). In sum, the characteristics of my sample indicate the results may not be generalizable for smaller family firms, while otherwise, a good representation of a German family firm is given.

Table 4.1. Distribution of the sample

		Sample distribution	
		N	**%**
Environmental data availability	2-3 years	39	52.7
	4-5 years	16	21.6
	>5 years	19	25.7
Unit of measurement	CO_2	24	32.4
	CO_2e	50	67.6
Environmental data disclosure	Public disclosure	48	64.9
	No public disclosure	26	35.1
Founding year	1800-1900	26	35.1
	1901-1950	36	48.6
	1951-2000	12	16.2
Employees	**Average, in 2020**		
	<500	9	12.2
	500-2000	22	29.7
	>2000	43	58.1
Revenues	**Yearly, in 2020**		
	<500 m €	33	44.6
	500-1000 m €	14	18.9
	>1000 m €	27	36.5
Industry	**“Clean” industries**		
	Transportation equipment	13	17.6
	Machinery	11	14.9
	Electric appliances	9	12.2
	Other manufacturing	9	12.2
	Foods	8	10.8
	Glass and ceramics products	1	1.4
	“Dirty” industries		
	Metal products	10	13.5
	Rubber and plastic products	6	8.1
	Pharmaceutical	3	4.1
	Chemicals	2	2.7
	Paper and pulp	2	2.7
Total		**74**	**100**

Source. Own table

4.3.2. Methodology

I utilize an ordinary least square regression analysis to measure the effect of CEP on CFP in family firms. While *i* denotes the firm, *j* describes the industry, and *t* represents time.

First, I set up Model 1 as a linear baseline model, which I apply to the whole firm sample to test hypothesis 1 (H1). I will further apply Model 1 to four subsamples. Thus, I investigate whether the estimation results differ for the subgroups that I mention in the course of hypothesis two (H2), namely clean and dirty firms, and three (H3), firms with public disclosure and firms without public disclosure. Other researchers proceed similarly (Kim and Bae 2022; Iwata and Okada 2011; Trumpp and Günther 2017). Subsequently, I assess whether any differences between these subsamples are significant through the introduction of interaction terms. Model 2 tests whether the effect of industry affiliation is significant by introducing the interaction term between *CEP* and *Industry*. Model 3 tests separately whether public disclosure has a significant impact by assessing the interaction term of *CEP* and *Disclosure*. This procedure resembles the approaches by authors like Leonidou et al. in 2013 and Iwata and Okada in 2011. *Industry* is a dummy variable stating whether firms are from clean industries (see Appendix I). The variable *Disclosure* depicts whether firms share their environmental data publicly.

Model 1: Baseline model

$$\boldsymbol{CFP'} = ß_0 + ß_1 * \boldsymbol{CEP_{i,t-1}} + ß_2 * \boldsymbol{Leverage_{i,t}} + ß_3 * \boldsymbol{Size_{i,t}} + ß_4 * \boldsymbol{Growth_{i,t}} + ß_5 * \boldsymbol{Capital\ Intensity_{i,t}} + \boldsymbol{u_{j,t}} + \boldsymbol{\epsilon_{i,t}}$$

Model 2: Industry model

$$\boldsymbol{CFP'} = ß_0 + ß_1 * \boldsymbol{CEP_{i,t-1}} + ß_2 * \boldsymbol{Leverage_{i,t}} + ß_3 * \boldsymbol{Size_{i,t}} + ß_4 * \boldsymbol{Growth_{i,t}} + ß_5 * \boldsymbol{Capital\ Intensity_{i,t}} + ß_6 * \boldsymbol{Industry_{i,t}} + ß_7 * \boldsymbol{CEP_{i,t-1}} * \boldsymbol{Industry_{i,t}} + \boldsymbol{u_{j,t}} + \boldsymbol{\epsilon_{i,t}}$$

Model 3: Disclosure model

$$\boldsymbol{CFP'} = ß_0 + ß_1 * \boldsymbol{CEP_{i,t-1}} + ß_2 * \boldsymbol{Leverage_{i,t}} + ß_3 * \boldsymbol{Size_{i,t}} + ß_4 * \boldsymbol{Growth_{i,t}} + ß_5 * \boldsymbol{Capital\ Intensity_{i,t}} + ß_6 * \boldsymbol{Disclosure_{i,t}} + ß_7 * \boldsymbol{CEP_{i,t-1}} * \boldsymbol{Disclosure_{i,t}} + \boldsymbol{u_{j,t}} + \boldsymbol{\epsilon_{i,t}}$$

with $\boldsymbol{CFP'} = \{\boldsymbol{ROA}|\boldsymbol{ROE}\}$

The multivariate framework includes several control variables that are likely to determine the dependent variable. I include a variable to control for *Size* measured as a firm's number of employees (Garcés-Ayerbe et al. 2022; Trumpp and Günther 2017; Kim and Bae 2022). While some authors claim that the firm's size has a positive impact on the profitability due to the higher availability of assets and resources (Trumpp and Günther 2017) and the increased visibility of these firms (Bansal and Roth 2000), other authors claim that a large size may hinder profitability via a more hierarchical, inflexible structure (King and Lenox 2002). I further control for a firm's *Leverage* measured as a firm's total debt divided by a firm's total assets (Delmas et al. 2015; Trumpp and Günther 2017; Velte 2017). As high leverage is associated with high financial risk or worsened supplier conditions, leverage is expected to harm CFP (Iwata and Okada 2011; Busch et al. 2020). Furthermore, I consider *Capital Intensity* calculated as capital expenditures divided by total assets (Trumpp and Günther 2017; van Emous et al. 2021). Capital intensity could yield growth opportunities via additional assets and investments (Busch et al. 2020; Busch and Lewandowski 2017), while some authors also demonstrate its' negative impact (King and Lenox 2002). Last, I control for *Growth* expressed as a firm's annual sales ratio, which also potentially impacts a firm's profitability positively (Trumpp and Günther 2017; Delmas et al. 2015) or negatively (Iwata and Okada 2011; Gallego-Álvarez et al. 2015).

In line with existing research (Busch et al. 2020; Trumpp and Günther 2017), I seek to address the presence of endogeneity between *CEP* and *CFP* by using a one-year time-lagged (*t-1*) measure of CEP. To correct for skewed distributions, *CEP* and *Size* are transformed using logarithms. A Hausman test shows no systematic differences between the random and fixed effects model (Prob > chi2 > 0.05). Therefore, I choose the random effects model for efficiency reasons, similar to Gallego-Álvarez et al. in 2015 and Fujii et al. in 2013. In addition, to control for the unobserved industry- and time-specific effects (Iwata and Okada 2011; Baird et al. 2012; van Emous et al. 2021), I introduce u in addition to ϵ, the remainder stochastic disturbance term. Since the time horizon for the average firm in my sample is relatively short, this study controls for the industry instead of the firm-specific effects (Iwata and Okada 2011).

4.4. Results

4.4.1. Econometric analyses

Table 4.2. illustrates the descriptive statistics after winsorizing all continuous variables at the fifth and 95th percentiles. The sample means of the profitability ratios *ROA* and *ROE* are positive, which shows that the firms in the sample have been operating profitably between the years 2013-2021. Furthermore, Appendix J compares the descriptive statistics of firms using CO_2 and firms using CO_2e as the unit of measurement. Due to similar reported statistics, I will proceed with the regression analysis for the joint sample of firms.

Table 4.2. Descriptive statistics

Variable	Description	Mean	Median	SD	Minimum	Maximum
ROA	Net income divided by total assets	0.042	0.042	0.036	-0.027	0.112
ROE	Net income divided by equity	0.097	0.091	0.092	-0.077	0.309
CEP	Log of the inverse of carbon intensity (Scope 1 and 2 CO_2(e) / sales)	10.480	10.425	1.174	8.475	12.701
Size	Log of number of employees (yearly average)	8.040	7.956	1.569	5.382	11.070
Leverage	Total debt / total assets	0.374	0.389	0.161	0.118	0.638
Capital Intensity	Total capital expenditures / total assets	0.069	0.061	0.040	0.006	0.155
Growth	Annual change in sales ratio	0.018	0.018	0.085	-0.152	0.176
Industry	Indication whether a firm belongs to a clean industry	0.682	1.000	0.467	0	1
Disclosure	Indication whether a firm publicly disclosed its' carbon performance	0.599	1.000	0.491	0	1

Note. Descriptive statistics for the entire sample, covering 242 observations with a one-year time lag. The sample covers observations over the period 2013 –2021. All continuous variables are winsorized at the 5 and 95 percentiles. ROA = return on assets; ROE = return on equity; CEP = corporate environmental performance; Growth = sales growth; Size = firm size; Industry = dirtiness defined as carbon intensity (Appendix I), dichotomous variable is equal to unity if industry is clean, zero if dirty; Disclosure = dichotomous variable is equal to unity for a firm with external CEP disclosure, zero otherwise

Source. Own table

Table 4.3. shows the bivariate correlation coefficients for the variables in the empirical analysis. There is a positive association between *CEP* and profitability expressed as *ROA* and *ROE*. The comparably high correlation between *ROA* and *ROE* is uncritical, as both are dependent variables that are used in separate analyses. As the variance inflation factors (VIFs) of all explanatory variables are below 2 (mean VIF = 1.04), multicollinearity does not impact the analysis.

Table 4.3. Summary of bivariate correlation coefficients

	1	2	3	4	5	6	7	8	9
1. ROA	1.000								
2. ROE	0.758	1.000							
3. CEP	0.001	0.006	1.000						
4. Size	-0.090	-0.043	-0.049	1.000					
5. Leverage	-0.270	0.126	0.002	0.022	1.000				
6. Capital Intensity	0.026	0.024	0.030	0.100	0.186	1.000			
7. Growth	0.262	0.104	0.014	-0.017	0.026	0.139	1.000		
8. Industry	-0.055	0.028	-0.244	0.090	0.191	-0.019	-0.030	1.000	
9. Disclosure	0.027	-0.003	0.141	0.046	-0.048	0.040	0.019	0.002	1.000

Note. The coefficients are based on the full sample of 242 observations. The variables are defined in Table 4.2.

Source. Own table

4.4.2. Estimation results

I present the results of panel regression analysis on the relation between CEP and CFP for the whole sample in Table 4.4. According to Model 1, if CO_2 intensity is decreased by 1%, *ROA* increases by 0.005% or 0.00005 units ($p < 0.01$) and *ROE* by 0.01% or 0.0001 units ($p < 0.05$). More precisely, the functional form describing the CEP-CFP relationship is a linear relationship between *CEP*, so the inverse of the logarithm of carbon intensity and CFP expressed as *ROA*. The graph decreases more slowly with increasing carbon intensity. Therefore, it pays off more for firms to decarbonize once a moderate carbon intensity has been reached. Firms will experience relatively smaller gains in *ROA* at the beginning of their decarbonization journey compared with the gains in *ROA* after they have already partially reduced their carbon intensity. For *ROA*, the coefficients of the control variables *Size*, *Leverage*, and *Growth* are all statistically significant, while *Capital Intensity* shows no significant effect. *Size* and *Leverage* have a negative impact on ROA, whereas *Growth* exerts a positive influence. Overall, *ROE* yields very similar results to *ROA*. However, only *Growth* and *Size* are significant. The explanatory power of the model inferred from the adjusted R-squares is ~23% for *ROA* and ~16% for *ROE*, which is higher than the findings from

comparable studies by Busch et al. in 2020 as well as Lewandowski in 2017 and slightly lower than the work by Gallego-Álvarez et al. in 2015. In conclusion, I accept hypothesis 1, stating a positive relationship between CEP and CFP.

Table 4.4. Regression analysis on the CEP-CFP relationship

Model 1 – Full sample		
Dependent variable	**ROA**	**ROE**
CEP	0.005 (0.002)***	0.010 (0.005)**
Size	-0.003 (0.001)**	-0.009 (0.004)**
Leverage	-0.060 (0.014)***	0.058 (0.038)
Capital Intensity	0.033 (0.051)	-0.078 (0.142)
Growth	0.144 (0.024)***	0.366 (0.065)***
R^2	0.247	0.178
Adjusted R^2	0.231	0.160

Note. Standard errors are in parentheses. The variables are defined in Table 4.2.

* p < 0.1; ** p < 0.05; *** p < 0.01

Source. Own table

I show the estimation results of the panel regression analysis on the relation between CEP and CFP for the clean and dirty firm samples separately in Table 4.5. On the one hand, the findings for ROA from the main regression analysis do still apply for the firms from clean industries with a coefficient of 0.05 ($p < 0.05$) and an adjusted R-squares of 20%, while I do not obtain any significant results in terms of ROA for firms from dirty industries. On the other hand, findings for ROE are significant for firms from dirty industries ($p < 0.1$) and not for firms from clean industries. Despite these differences between the subsamples, neither the dummy variable *Industry* nor the interaction term *CEP x Industry* is significant in Model 2. Therefore, I can't find evidence for a significant moderating effect of *Industry* on the CEP-CFP relationship. Hence, I reject hypothesis 2.

Table 4.5. Regression analysis on the CEP-CFP relationship moderated by industry

	Model 1 – "Clean" Firms		Model 1 – "Dirty" Firms		Model 2 – Interaction Industry x CEP	
Dependent variable	**ROA**	**ROE**	**ROA**	**ROE**	**ROA**	**ROE**
CEP	0.005 (0.002)**	0.007 (0.007)	0.005 (0.003)	0.012 (0.007)*	0.004 (0.003)	0.014 (0.009)
Size	-0.003 (0.002)*	-0.005 (0.005)	-0.006 (0.002)***	-0.018 (0.006)***	-0.004 (0.001)**	-0.009 (0.004)**
Leverage	-0.029 (0.018)	0.108 (0.052)**	-0.129 (0.022)***	-0.062 (0.053)	-0.060 (0.014)***	0.054 (0.041)
Capital Intensity	-0.007 (0.062)	-0.128 (0.180)	0.143 (0.088)	0.045 (0.216)	0.034 (0.052)	0.034 (0.052)
Growth	0.139 (0.028)***	0.358 (0.082)***	0.187 (0.042)***	0.445 (0.102)***	0.144 (0.024)***	0.107 (0.145)***
Industry					-0.010 (0.041)	0.112 (0.119)
CEP x Industry					0.001 (0.004)	-0.009 (0.011)
R^2	0.221	0.171	0.430	0.325	0.247	0.170
Adjusted R^2	0.196	0.145	0.390	0.277	0.225	0.145

Note. Standard errors are in parentheses. The variables are defined in Table 4.2. The definition of industries into "clean" and "dirty" is depicted in Appendix I.

* p < 0.1; ** p < 0.05; *** p < 0.01

Source. Own table

I review hypothesis 3 by running model 1 for a subset of firms that disclose their CO_2 information publicly as well as for a subset of firms without publication of this information. The results can be reviewed in Table 4.6. The subsample of firms with public disclosure shows a positive, strongly significant effect of *CEP* on *ROA*. If CO_2 intensity is decreased by 1%, *ROA* increases by 0.009% or 0.00009 units ($p < 0.01$) and *ROE* by 0.014% or 0.00014 units ($p < 0.05$), respectively. The coefficient increased in size, while the significance level also improved compared with the baseline estimations of the full model. Also, the explanatory power in the form of adjusted R-squares increases to 39% for *ROA* and 24% for *ROE*. Meanwhile, the results of the firms without public disclosure do not show significant results for the variable *CEP*, irrespective of whether *ROA* or *ROE* is used as the financial performance variable. In addition, the interaction term *CEP x Disclosure* is positive and significant for *ROA* ($p < 0.05$) and *ROE* ($p < 0.1$). Although the coefficient of *CEP* is not significant in this model specification, the null hypothesis that both

coefficients *CEP* and *CEP x Disclosure* are simultaneously zero can be rejected via an F-test ($p < 0.01$). Consequently, these findings stress that disclosure positively moderates the relationship between CEP and CFP and I accept hypothesis 3.

Table 4.6. Regression analysis on the CEP-CFP relationship moderated by disclosure

	Model 1 – "Disclosure" Firms		Model 1 – "No Disclosure" Firms		Model 3 – Interaction CEP x Disclosure	
Dependent variable	**ROA**	**ROE**	**ROA**	**ROE**	**ROA**	**ROE**
CEP	0.009 (0.002)***	0.014 (0.006)**	0.006 (0.005)	0.016 (0.013)	-0.001 (0.003)	-0.003 (0.009)
Size	-0.010 (0.002)***	-0.021 (0.005)***	-0.002 (0.003)	-0.006 (0.009)	-0.003 (0.001)**	-0.008 (0.004)**
Leverage	-0.061 (0.016)***	0.057 (0.046)	-0.115 (0.030)***	-0.075 (0.083)	-0.063 (0.014)***	0.053 (0.039)
Capital Intensity	0.064 (0.057)	-0.030 (0.168)	0.068 (0.083)	0.038 (0.226)	0.044 (0.051)	-0.054 (0.142)
Growth	0.114 (0.025)***	0.296 (0.075)***	0.144 (0.036)***	0.381 (0.100)***	0.140 (0.023)***	0.355 (0.065)***
Disclosure					-0.092 (0.042)**	-0.195 (0.116)*
CEP x Disclosure					0.009 (0.004)**	0.019 (0.011)*
R^2	0.409	0.262	0.312	0.174	0.264	0.190
Adjusted R^2	0.387	0.235	0.274	0.129	0.242	0.165

Note. Standard errors are in parentheses. The variables are defined in Table 4.2.

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Source. Own table

Finally, I performed several robustness analyses to see if the results for ROA in Model 1 would change through model specifications. Within my robustness checks, my findings are largely identical, which can be reviewed in Table 4.7. Irrespective of whether the control variable *Size* is expressed as total assets instead of the number of employees, a two-year time lag is applied instead of a one-year time lag, or the winsorization is changed to 1% and 99% percentiles instead of 5% and 95% percentiles, the coefficients do not seem to be impacted by the selection of the estimation methodology and the significance prevails ($p < 0.05$ / $p < 0.1$). I further demonstrate that the linear relationship is the most suitable model specification, as the quadratic term of CEP is not statistically significant. Consequently, there is no evidence for a curvilinear relationship.

Table 4.7. Robustness checks

	Model 1 – Total assets as firm size	Model 1 – Two-year time lag	Model 1 – Winsorization 1st percentiles	Model 1 – U-shaped Model (curvilinear)
Dependent variable	**ROA**	**ROA**	**ROA**	**ROA**
CEP	0.004 (0.002)**	0.004 (0.002)*	0.005 (0.002)**	-0.241 (0.127)*
CEP^2				0.708 (0.624)
Size	-0.004 (0.002)**	-0.003 (0.002)	-0.005 (0.002)***	-0.004 (0.001)**
Leverage	-0.062 (0.014)***	-0.049 (0.016)***	-0.069 (0.016)***	-0.058 (0.014)***
Capital Intensity	0.035 (0.051)	-0.058 (0.060)	0.035 (0.052)	0.031 (0.051)
Growth	0.143 (0.024)***	0.169 (0.028)***	0.140 (0.025)***	0.144 (0.024)***
R_2	0.244	0.241	0.227	0.249
Adjusted R_2	0.228	0.219	0.210	0.230

Note. Standard errors are in parentheses. The variables are defined in Table 4.2.

* p < 0.1; ** p < 0.05; *** p < 0.01

Source. Own table

4.5. Discussion

4.5.1. Contribution

This study makes not only a relevant contribution to the pronounced research stream on the relationship between CEP, defined as corporate carbon performance, and CFP, expressed as profitability (Fujii et al. 2013; Gallego-Álvarez et al. 2015; van Emous et al. 2021; Delmas et al. 2015; Lewandowski 2017; Trumpp and Günther 2017; Busch et al. 2020; Galama and Scholtens 2021; Busch and Lewandowski 2017), but adds also to the rare literature concerning the impact of CEP, as a multi-dimensional construct, on family firms (Garcés-Ayerbe et al. 2022; Huang et al. 2014; Craig and Dibrell 2006; López-Pérez et al. 2018). Last, my findings entail management implications for practitioners in family firms and policy implications for regulators.

Theoretical implications

I follow the call for papers to assess the conditions underlying the relationship between CEP and CFP to reconcile conflicting results from the past and draw more refined conclusions about when

to expect positive financial performance from CEP in the future (Grewatsch and Kleindienst 2017; Endrikat et al. 2014; Busch and Lewandowski 2017; Galama and Scholtens 2021). My results show a positive, linear relationship between CEP and CFP for the group of family firms, which is also robust to various changes in the model specifications (see Table 4.7.). Thus, I support the findings by Garcés-Ayerbe et al. in 2022 that the improvement of CEP, if measured through clearly defined, quantifiable metrics, such as the amount of environmental investment or carbon emission, has a positive impact on the profitability of family firms.

Although corporate carbon performance data of family firms is rare and needs to be collected individually, to the best of my knowledge, I am the first to establish a database for family firms that measures CEP as carbon intensity. This measurement technique encompasses many advantages, such as clearly defined measurement standards and a direct linkage to climate change (Trumpp and Günther 2017) as well as a direct relevance for 50,000 firms in meeting the requirements of the CSRD (European Commission 2023a). In addition, since I am the first to use the measure of carbon performance for family firms, it allows me to perform a novel comparison between family and non-family firms in this field. The predominant opinion of a positive relationship between CEP and CFP seems to apply to the organizational firm type “family firm” as well. While some authors in the non-family firm literature also contend a positive, linear relationship (Fujii et al. 2013; Garcés-Ayerbe et al. 2022; van Emous et al. 2021), other authors show a positive, curvilinear relationship (Lewandowski 2017; Trumpp and Günther 2017), for which I did not find evidence. I will purposefully not assess the effect size of CEP on CFP between family firms and non-family firms, as these analyses are highly sensitive to model specifications (Endrikat et al. 2014; Galama and Scholtens 2021; Busch and Lewandowski 2017) and, therefore, a comparison between separate projects in this detail is not reasonable. Nonetheless, my study

serves as an initial bridge between two previously distinct research streams: the CEP-CFP relationship and family firms.

Making these findings more refined, I reveal via an insignificant interaction term that the dummy variable *Industry*, stating whether a firm belongs to a clean or dirty industry, does not moderate the relationship between CEP and CFP. Yet, the calculations in the clean subsample show significant results for a positive relationship between CEP and CFP for ROA, while the dirty subsample yields no significant results, which matches the findings by Iwata and Okada in 2011 and Galama and Scholtens in 2021. In the past, literature covering the CEP-CFP relationship rarely evaluated the significance of the interaction term in addition to the calculations in subsamples. I show that performing this extra step of the analysis leads to a new assessment of the results, relativizing industry differences in this context.

Moreover, to the best of my knowledge, I am the first, in the context of the CEP-CFP relationship, to show that *Disclosure* of carbon performance positively moderates the relationship between CEP and CFP. The majority of literature only tested whether the carbon measurement was voluntary or mandatory, often even yielding insignificant results (Busch and Lewandowski 2017; Galama and Scholtens 2021). The only study to test the significance of disclosure before is the study by Delmas et al. from 2015, which observes all environmental firm data and not only carbon performance. However, their study dates back to the years 2004-2008 and was adversely impacted by regulatory uncertainty. In addition, the authors were surprised that the *Disclosure* variable was insignificant in their analysis (Delmas et al. 2015). Via reconsidering this moderating variable, contradictory empirical evidence from the past might be reconciled. While disclosure of CEP has already gained importance (Methven O'Brien and Dhanarajan 2016), I further postulate that its importance will further increase as diligent tracking and reporting of carbon performance are increasingly perceived as a competitive advantage and differentiator among firms. As a next step,

the reasons and their weighting for this effect should be further explored, covering topics such as enhanced target performance measurement and integration into management systems (Downar et al. 2021; Kaplan and Anderson 2007; Young and O'Byrne 2001), external assurance provision (Ioannou and Serafeim 2019), or proactivity of decarbonization strategies (Sharma and Vredenburg 1998; King and Lenox 2002; Endrikat et al. 2014; Russo and Fouts 1997).

Regarding the theoretical framework underlying my findings, my results provide evidence for the applicability of the NRBV and the instrumental stakeholder theory in the context of family firms. I confirm the linkage of the SEW theory with the NRBV (Hart 1995) as recently introduced by Garcés-Ayerbe et al. (2022), while extending it by linking the SEW theory also with the instrumental stakeholder theory (Donaldson and Preston 1995; Jones 1995). Due to the imbrication of the family and the business (Habbershon et al. 2003), meeting stakeholder expectations concerning CEP strongly influences CFP in family firms (López-Pérez et al. 2018).

Managerial and regulatory implications

For practitioners in family firms, I show that decarbonization can pay off and hope to incentivize an increase in decarbonization activities, especially before regulation for large family firms becomes active with the CSRD in 2024, obligating family firms to report their carbon performance in 2026 for the first time (European Commission 2023a). In addition, these findings might help practitioners to reconcile environmental and financial goals in firms' strategic decision-making, which has also been the target of previous studies (Diaz-Moriana et al. 2022; Epstein et al. 2015; Smith and Lewis 2011). Through my findings, firms are encouraged to deploy a win-win mindset, increasing their decarbonization activities and benefitting from proactively sharing their carbon performance with the public.

My policy implications for regulators include that firms are financially incentivized to decarbonize in the absence of regulation, while the effect size is larger once a moderate level of

carbon performance has already been reached. This knowledge should be reflected upon to optimize the number and timing of newly introduced regulations. While future regulation should not primarily target the differentiation between industries, more initiatives for public disclosure should be launched, incentivizing more firms to share their carbon performance publicly.

4.5.2. Limitations and future research

Despite the abovementioned contributions, my study has a few limitations, which should also be regarded as an inspiration for future research. First, data collection in this field of research is very challenging since private family firms do not have to disclose environmental data and are also often excluded from financial disclosure obligations. Therefore, there is a limitation to my sample, which contains 74 manufacturing firms that simultaneously provide carbon and financial data. In 2013, Fujii et al. were similarly challenged to find consolidated firm data. Moreover, in my sample, not all of the 74 manufacturing firms report CO_2 already since 2013. While some firms have data available for nine years, the average only reports CO_2 emissions for four years. Hence, performing the same study with an enlarged panel data set would be a promising future investigation. With the introduction of the CSRD in 2024, the number of firms with CO_2 tracking and reporting will drastically increase, so collecting a larger sample is more feasible.

Second, all firms in my sample are headquartered in Germany and are defined as large based on their number of employees. Investigating family firms in non-European countries might be interesting, as European firms are all impacted by somewhat similar climate regulations and consumer sentiments characterized by high decarbonization ambitions. Furthermore, it should be tested whether small firms also reap financial benefits from decarbonization, given potential resource constraints.

Third, all firms in the database currently voluntarily track their carbon performance without legal obligation. The positive moderating effect of proactive environmental strategies on the CEP-CFP relationship is undisputed (Sharma and Vredenburg 1998; King and Lenox 2002; Klassen and Whybark 1999; Endrikat et al. 2014). Yet, I would argue in this sample, only those firms can be defined as proactive that share their carbon footprint publicly.

Fourth, just like other studies in this field, my study is subject to endogeneity and CEP and CFP could reinforce each other (Busch et al. 2020). However, I addressed this by lagging CEP by one year in the main analysis and two years in the robustness check (Trumpp and Günther 2017; Busch et al. 2020) as well as introducing multiple control variables (van Emous et al. 2021). I further reduce the risk of endogeneity by controlling for unobserved industry and time heterogeneity (Iwata and Okada 2011).

Fifth, our study only covers accounting-based financial performance and does not consider market-based financial performance, as Tobin's q or TSR do not exist for private family firms. Therefore, I might not capture the long-term value of decarbonization to a full extent because market-based measures are regarded as more long-term oriented than accounting-based measures (Busch et al. 2020; Delmas et al. 2015).

4.6. Conclusion

The implications of this research regarding the question "When does it pay to decarbonize?" are twofold. First, I show that it pays to decarbonize under the condition of being a private family firm, which matches the prevailing opinion in extant non-family firm literature. The theoretical framework is the SEW theory in conjunction with the NRBV and the instrumental stakeholder theory, respectively. Second, public disclosure of carbon performance positively moderates the CEP-CFP relationship. While practitioners in family firms are encouraged to further decarbonize,

both practitioners and regulators should strive for more transparency in corporate carbon performance.

5 Conclusion

5.1. Summary of the research findings

This dissertation consists of three essays investigating the reconciliation of firms' decarbonization and competitiveness. By covering the integration of decarbonization into firms' processes from ***initiation*** to ***implementation*** and, finally, ***impact*** assessment, this dissertation aims to comprehensively represent a firm's decarbonization journey to offer insights for firms at various stages. Subsequently, I will summarize and discuss each essay's core implications before highlighting the synthesized takeaways of this dissertation.

Essay I. We explain *why* and *how* family firms have developed strategies to manage economic and environmental goals in their strategic decision-making process. Family firms are driven not only by different internal and external decarbonization goals but also by a distinct goal system between economic and decarbonization goals. Consequently, three goal management strategies for economic and environmental goals (*presence of environmental information (incl. innovation), designated CapEx, and artificial CO_2 price*) have been identified, all based on integrating CO_2 in the strategic decision-making process. In contrast, a fourth strategy is labeled as *no integration* of CO_2 information, implying no intended multiple goal management strategy at firms due to unawareness of their goal system and a lack of relevant capabilities. Hence, Essay I contributes to the literature on multiple goal management through concrete, implementable strategies. We advance the attention-based view (Ocasio 1997) by illustrating how firms' organizational attention in terms of diverse goals and goal systems yields heterogeneous strategies. In sum, Essay I allows firms to make decisions considering CO_2 emissions, reducing goal tensions, and, thus, ***initiating*** decarbonization activities at firms.

Essay II. We assess the impact and function of supply chain collaborations for scope 3 measurement and reduction. We reveal that five forms of collaboration can address scope 3 challenges in the firm, value chain, and macroeconomic context through value-creating linkages between the involved parties. Supply chain collaborations are formed in an *inter-functional, supplier, customer, industry, and cross-industry* setting. By pursuing supply chain collaborations and overcoming prevalent scope 3 challenges, scope 3 measurement and reduction can become a source of competitive advantage for firms. Therefore, Essay II advances the literature on scope 3 regarding challenges and benefits and supply chain engagement covering supply chain collaborations with five different stakeholder groups. Simultaneously, we elaborate the RV (Dyer and Singh 1998) by showing that it can also be leveraged to address challenges rather than generate supernormal profits. Essay II enables firms to effectively measure and reduce their scope 3, the most complex and demanding form of carbon measurement and reduction (Patchell 2018). Consequently, by equipping firms with the skills to quantify and track carbon initiatives, Essay II lays the foundation for efficiently ***implementing*** decarbonization activities. Resulting progress in carbon reporting and reduction can differentiate firms from the competition, e.g., regarding transparency of inefficiencies in the value chain and developing a carbon-reduced product portfolio.

Essay III. I investigate whether *decarbonization activities pay off* for family firms. I find a positive, linear relationship between CEP and CFP across model specifications. I further illustrate that the affiliation to a clean or dirty *Industry* does not moderate the relationship. In contrast, *Disclosure* of carbon performance positively moderates the relationship between CEP and CFP. By reconsidering the moderating variable *Disclosure,* contradictory empirical evidence from the past might be reconciled. Through a newly established database encompassing family firms' carbon performance, expressed as carbon intensity, I draw these findings from a clearly defined

measure of CEP. My results confirm the relationship of the SEW theory with the NRBV (Hart 1995) as recently introduced by Garcés-Ayerbe et al. (2022) while extending it by linking the SEW theory with the instrumental stakeholder theory (Donaldson and Preston 1995; Jones 1995). In conclusion, Essay III encourages family firms to pursue decarbonization also for economic reasons and benefit from publicly disclosing their carbon performance. Therefore, Essay III inspires a win-win mindset at family firms by illustrating a positive financial ***impact*** through decarbonization activities.

These collected insights into decarbonization in management accounting can be regarded as symbolic of various environmental topics. By deriving solutions for firms to successfully integrate decarbonization activities into their business processes and assessing how decarbonization impacts firms' competitiveness, this dissertation aims to integrate environmental and economic topics and reduce inherent tensions. In the course of pursuing this objective, classical managerial theories, including the attention-based view (Ocasio 1997), the RV (Dyer and Singh 1998), the NRBV (Hart 1995), and instrumental stakeholder theory (Donaldson and Preston 1995), have been applied and further elaborated.

Furthermore, this dissertation purposefully focuses on the research context of family firms, which have been previously underrepresented in this field of research despite their relevance and unique propositions driving environmental behavior. As a result, this research confirms that firms moderated by family ownership are an interesting and insightful context for studying the topic of decarbonization.

Most importantly, all three essays align in their main message that decarbonization and competitiveness can be reconciled and decarbonization activities can yield competitive advantages. It will be a priority to share this message across firms to incentivize accelerated decarbonization progress and reach climate targets. Decarbonization should become a core pillar of firms'

competitive strategies. In addition, this finding calls for a higher degree of integration between decarbonization and economic decision-making, reporting, and performance measurement to realize the full potential of the interplay between decarbonization and competitiveness. This implies that sustainability managers must be inter-functionally integrated and involved in more meetings and decisions. Given its implications, this dissertation contributes to limiting climate change by providing inspiring solutions to researchers, regulators, and practitioners for operating profitably while decarbonizing efficiently.

5.2. Avenues for future research

With their findings, all three essays advance existing literature and practice. Yet, the analyses and conclusions do not come without limitations, stressing the relevance of additional research in five directions.

First, the three essays are limited in their research context, intentionally observing a) large firms, 2) those headquartered in Germany, and 3) those already engaged in decarbonization. Concerning firm size, it might be interesting to also investigate family firms of smaller size, although large firms are expected to be the initiators and drivers of decarbonization activities (Greenhouse Gas Protocol 2011), and their size enables more established processes (Davila 2005) and sustainability efforts (Lintukangas et al. 2022). Nevertheless, in the long term, small firms must also find solutions to decarbonize under resource constraints, which may shrink viable solutions to be deployed. Moreover, while European firms are all impacted by somewhat similar climate regulation and consumer sentiments, the analysis of non-European countries might yield additional insights in contrast to German firms. The relation between country-specific characteristics and firms' goals and goal systems concerning decarbonization (see Essay I) could serve as a promising avenue for future research. Finally, the essays only consider firms that already engage in

decarbonization activities. Many of these firms are further perceived as proactive (Russo and Fouts 1997; Sharma and Vredenburg 1998), voluntarily tracking and reporting their carbon performance without legal obligation. However, any form of decarbonization reporting was required for building theory, so the samples serve this purpose. Future research could test whether firms engaged in decarbonization early on are distinct, leveraging different processes for integration of decarbonization and generating a different impact through decarbonization. It is a promising research question to test whether the relationship between firm competitiveness and decarbonization differs for first-and late-movers or whether late-mover firms can quickly adopt learnings from pioneering firms.

Second, due to the long-term character of decarbonization activities, it would be best to assess their effectiveness in a longitudinal study over time in addition to analyzing the status quo and short-term implications. This also refers to Essay III, where the analysis of private family firms reviews accounting-based financial metrics like ROA and ROE, which might not capture the long-term value of decarbonization to a full extent because market-based measures are regarded as more long-term oriented than accounting-based measures (Busch et al., 2020; Delmas et al., 2015). Since many firms have engaged in decarbonization activities only for a few years, long-term empirical evidence is often unavailable. Nevertheless, with the introduction of the CSRD, the availability of information per firm and across firms will soon drastically increase, facilitating long-term-oriented studies.

Third, insufficient prior research in my fields of interest made it impossible to develop hypotheses for Essays I and II in advance (Ferreira and Merchant 1992). However, as a next step, the propositions developed in the qualitative studies of Essays I and II could be tested for a larger sample, thereby aspiring to enhance their generalizability. As data from private family firms is rarely publicly available, deductive empirical methods like surveys, such as those applied for Essay

III, are most likely to yield meaningful data sets. Accordingly, I call for more frequent exchanges among researchers regarding collected data and encourage practitioners in family firms to become more receptive to sharing their firm data with researchers. Family firms' risk-averse strategies and protective behaviors linked to the desire for SEW (Gomez-Mejia et al. 2010) result in limited data, restricting family firm research in management accounting.

Fourth, although environmental aspects weigh the highest among ESG considerations for many companies (Adu et al. 2022; Adams and Frost 2008), it is imperative to acknowledge that ecological objectives represent merely one facet of the broader array of ESG goals. Therefore, this study could be repeated with social or governance goals and performance. I postulate that the arising tensions could be even more severe, given that environmental topics receive specifically high attention from investors (Li et al. 2020; Boukherroub et al. 2017; Blanco et al. 2017; Hansen et al. 2022) and customers (Hartmann and Moeller 2014; Jira and Toffel 2013). In contrast, selected research has already proven that social responsibility and profitability intersect in the long term (Margolis and Walsh 2003; Orlitzky et al. 2003). Therefore, it is crucial to test the applicability of this dissertation's findings regarding social and governance topics and otherwise derive alternative solutions.

Fifth, like other studies in this field, my studies might be subject to endogeneity because decarbonization and economic activities could reinforce each other (Busch et al., 2020). In Essay III, I approach this by lagging CEP by one year in the main analysis, two years in the robustness check (Busch et al. 2020; Trumpp and Günther 2017), and multiple control variables (van Emous et al., 2021). In addition, I limit the risk of endogeneity by controlling for unobserved industry and time heterogeneity (Iwata and Okada 2011). Nevertheless, controlling for endogeneity will need to remain a priority in future research projects.

5.3. Concluding remarks

To conclude this dissertation, I will revert to the two opening quotes on decarbonization by Antonio Guterres and on family firms by Nadine Kammerlander. First, I would like to draw a less threatening, more optimistic picture of a decarbonized future than the UN Secretary-General. Although slightly enforced through regulation, German firms have invested high efforts to get well-acquainted with decarbonization topics in the last few years. The initial adaptation to new phenomena is always the hardest, and pioneering firms have developed valuable solutions. Furthermore, all three essays deliver evidence for competitive advantages to be achieved by firms via decarbonization, hopefully motivating those firms that have been reluctant to decarbonization activities so far.

Second, concerning the group of family firms, I agree with Mrs. Kammerlander that decarbonization will not be successful without the participation of family firms. Yet, this is not only because family firms constitute 90% of firms in Germany but also because family firms show high ambitions in decarbonization progress and have derived strategies and processes that might even serve as best practices in the market. For this reason, it is not surprising that German family firms usually survive multiple generations and are regarded worldwide as the backbone of the German economy for many years. The German family firm’s farsightedness could also pave the way for decarbonizing Germany’s private sector.

Appendix

Appendix to Essay I

Appendix A. Case study protocol, interview guide and interview questions

The **case study protocol** is based on the recommended structure of Yin (2018):

Objective of the research study:
Understand which strategies family firms deploy to manage economic and environmental simultaneously

Research team:
Johanna Schulze-Berge; Gunther Friedl

Research question:
- Why and how do family firms manage economic and environmental goals in their strategic decision-making processes?
- Which family firm goals or goal systems lead to different strategies?

Interview guide
- Personal introduction of the researcher (background and prior experience, research interests and objective) as well as personal introduction of the interviewee (educational and professional background)
- Information on interview (explanation of recording practice and interviewee's active consent to record, clarification of next steps after the interview)
- Interview questions Part 1: Background of the family firm, family essence and economic and non-economic goals (incl. environmental)
- Interview questions Part 2: Integration of decarbonization in the strategic decision-making process
- Interview questions Part 3: Outlook (incl. questions interviewee)

Interview questions (abbreviated version)

Part 1: Background of the family firm, family essence, and economic and non-economic goals (incl. environmental)

This part of the interview intends to
a.) complete the basic information on the firm *[only if not publicly available]*
b.) learn about the essence of the family firm
c.) identify the key goals of the firm (incl. environmental)

Part 1.a.)

Firm industry:
- In which industry does the firm operate?
  - ☐Manufacturing
  - ☐Construction
  - ☐Transport (incl. waste disposal services)

- If manufacturing, what is the focus of the business?
  - ☐Automotive supplier
  - ☐Consumer goods
  - ☐Chemicals

☐Paper/packaging
☐Other

Firm age:
- When was the firm founded?

Firm size:
- What has been the revenue in euro in the last year?
- How many employees does the firm currently employ?

Firm owner:
- What is the ownership structure of the firm?
- Is there a dominant business-owning family? Which ownership share of the firm is held by this family?

Part 1.b.)

Firm identity:
- Does the firm consider itself a family firm? If so, how are firm identity and family identity linked?

Family involvement:
- How many family members from the business-owning family are active in the top management? Which positions do family members fill? Are the successors involved yet and how?

Family values & vision:
- What are the most important non-economic goals and values of the business-owning family? Have they changed over time? How strongly are they lived at the firm level?
- How does the family's vision (aspirational picture of the firm in 10 years) for the family firm look like and did it change over time?

Part 1.c.)

[Only if relevant - Definition: Decarbonization refers to "the process by which countries, individuals or other entities aim to achieve zero fossil carbon existence." (Intergovernmental Panel on Climate Change 2022, p. 546)]

Attitude toward decarbonization:
- What does the firm aspire as the most important economic and environmental goals? How are they considered in the firm's strategy?
- How would you describe the relation of the economic and environmental goals over time? Has it changed? If so, why?
- How does the business-owning family judge the market environment/ impact of decarbonization and which potential options for decarbonization does it consider for the firm?

Current environmental behavior:
- Does the firm have a sustainability department? Where is it located in the organization and who does it report to?
- Do you measure CO_2 emissions scope 1,2 and 3 (in t CO_2 equivalent)?
- Do you currently report your CO_2 emissions internally (e.g., with employees) or externally (e.g., website/business partners)? If so, how?

Future environmental behavior:
- Does the firm have decarbonization targets?
- How did the firm derive these firm decarbonization targets (e.g. regulatory framework, Science-Based Targets Initiative, competitors, etc.)? Did you publicly announce them? If so, how?

Motivation:

- Do you feel pressure from stakeholders such as customers, suppliers, and the local community to implement CO_2 reductions?
- Do you expect to be obliged to report your emissions externally? If yes, when?

Progress:

- How would you rate your current progress with regard to decarbonization?
- Which decarbonization activities did you already carry out and which do you plan for the future?

Part 2: Integration of CO_2 emissions in the strategic decision-making process

The part intends to understand why and how the strategic decision-making processes were or will be adapted concerning decarbonization and the management of multiple goals.

[Only if relevant - Definition: A strategic decision is "'important, in terms of the actions taken, the resources committed, or the precedents set" (Eisenhardt and Zbaracki 1992, p. 17). A strategic decision is made by top management and impacts the firm's long-term organizational health and survival (Eisenhardt and Zbaracki 1992). Wilson (2015) confirms these aspects and adds that strategic decisions can be complex or need to be based on limited, contradicting information. He further states that strategic decisions often entail trade-offs and risks and are linked to other decisions (Wilson 2015). The strategic decision-making process starts with a strategic decision identification and ends with the strategic decision selection (Mintzberg 1976).]

- Do you integrate decarbonization in your strategic decision-making process? -> *depending on the answers different follow up questions*

***a) No adapatation to decarbonization** in the strategic decision-making process:*

- Why did you decide to not integrate decarbonization (CO_2 emissions) in your strategic decision-making?
- How was your firm performance at that point in time?
- Who was involved in the decision not to integrate decarbonization (CO_2 emissions) into the firm's strategic decision-making?
- What would change your mind with regards to this decision?
- Do you have a perspective on how your approach for the integration of decarbonization (CO_2 emissions) could look like?

***b) Adaptation to decarbonization** in the strategic decision-making process:*

- Do you integrate decarbonization (CO_2 emissions) in your strategic decision-making process?
- For which type of decision is it useful to consider decarbonization (CO_2 emissions)?
- Why did you decide to integrate decarbonization (CO_2 emissions) in your strategic decision-making process for these decisions (see above question)?
- Who was involved in the decision to integrate decarbonization (CO_2 emissions) in strategic decision-making?
- How was your firm performance when you made the decision to integrate decarbonization (CO_2 emissions)?

Deep Dive strategic decision-making process with integration of CO_2 emissions:

- Please describe the decision-making process in detail and provide an example decision illustrating how it works. -> *depending on answer different follow up questions*

Decision-makers:

- Who makes the strategic decisions? How is the business-owning family involved and which other employees/departments are involved?

Decision-making process:

- Is there a standardized approach for making strategic decisions or does it always differ?

- What are the start and the end of the strategic decision-making process?
- Since when do you apply this approach for decision-making?

Information basis & decision rules:

- Based on which set of information do you make decisions (financial and non-financial)?
- Do you have decision rules?
  - Do sustainable investments have to pay off? If so, after which time?
  - Do you have a strategy to make environmental and financial aspects comparable (e.g. via a common unit, weighting system, etc.)?
  - Does your company consider an internal or external CO_2 price? If so, how do you calculate it and how do you apply it?
  - How relevant is managerial judgment in these decisions (incl. entrepreneurial risk)?

Part 3: Outlook

This part of the interview intends to provide some perspective on how the firm's decarbonization strategy and decision-making process could change in the future. Moreover, the aim is to give the interviewee the opportunity to mention any important point referring to the interview topic that had not been addressed before and exchange relevant documentation.

Distinction family firm:

- In your opinion, would your business have adapted its strategic decision-making differently if it had not been owned and/or managed by a family (e.g. in comparison to publicly listed companies)?

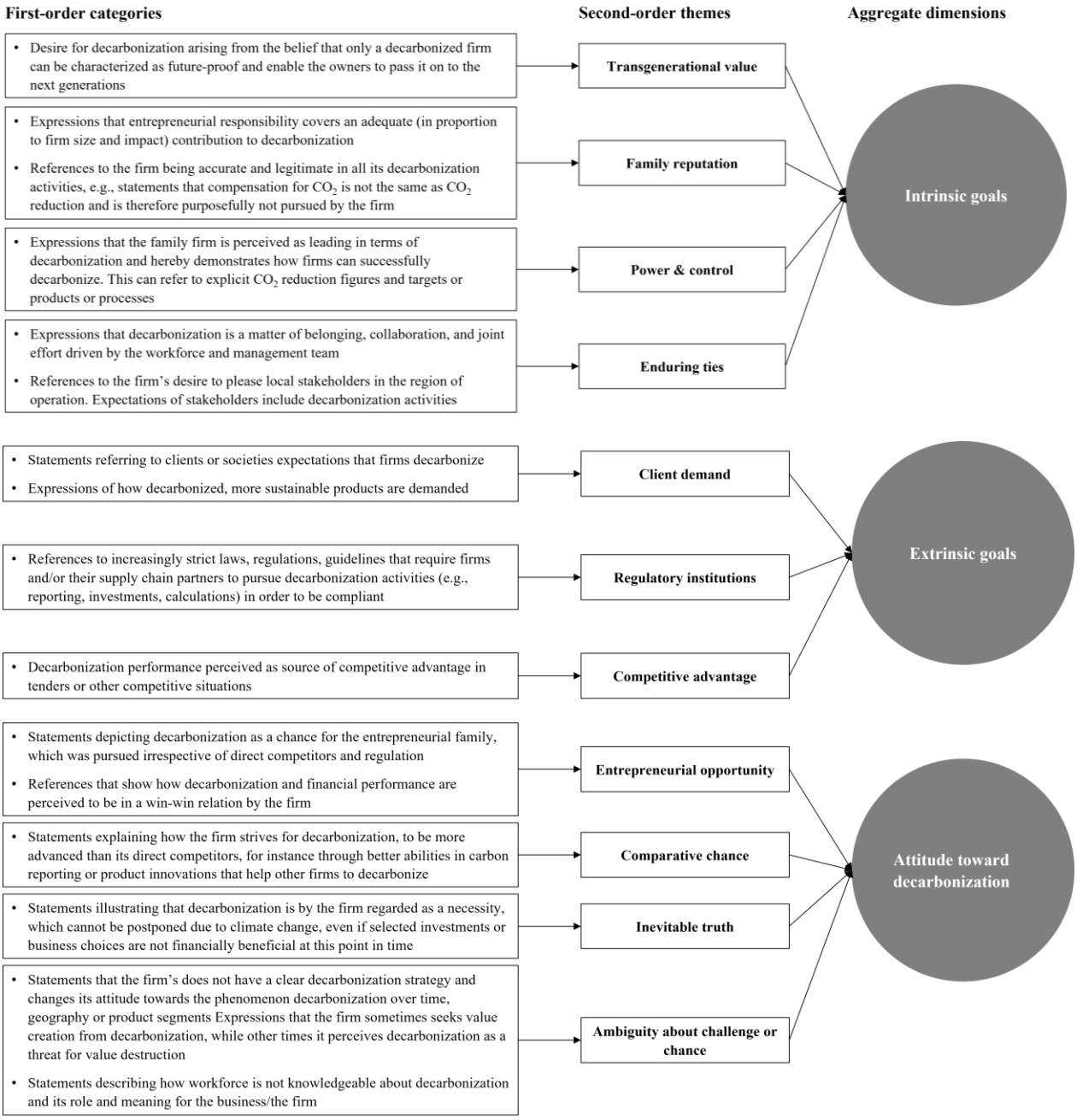
Future decision-making:

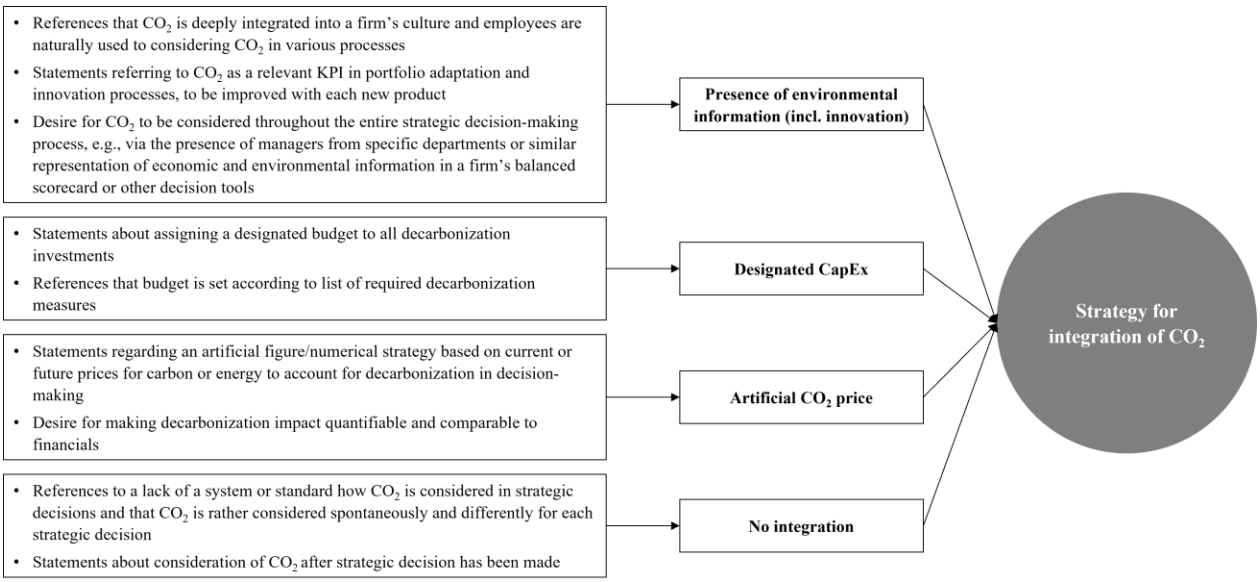
- Are you planning to change/enhance the decision-making process in the future? If so, why?

Additional remarks & information:

- Are there any other thoughts and considerations which you would like to share with regards to the interview topic?
- Do you have any documentation supporting the above findings (e.g., family charter, decision-making process requirements, etc.)?

Appendix B. Data structure




• References that CO_2 is deeply integrated into a firm's culture and employees are naturally used to considering CO_2 in various processes
• Statements referring to CO_2 as a relevant KPI in portfolio adaptation and innovation processes, to be improved with each new product
• Desire for CO_2 to be considered throughout the entire strategic decision-making process, e.g., via the presence of managers from specific departments or similar representation of economic and environmental information in a firm's balanced scorecard or other decision tools
Presence of environmental information (incl. innovation)
• Statements about assigning a designated budget to all decarbonization investments
• References that budget is set according to list of required decarbonization measures
Designated CapEx
• Statements regarding an artificial figure/numerical strategy based on current or future prices for carbon or energy to account for decarbonization in decision-making
• Desire for making decarbonization impact quantifiable and comparable to financials
Artificial CO_2 price
• References to a lack of a system or standard how CO_2 is considered in strategic decisions and that CO_2 is rather considered spontaneously and differently for each strategic decision
• Statements about consideration of CO_2 after strategic decision has been made
No integration
Strategy for integration of CO_2

Appendix C. Selected case-based evidence

Aggregate dimension: Intrinsic goals	
2nd-order codes	Selected evidence on 1st-order codes
Transgenerational value	"It is important to build the company sustainably, that we make it future-proof, and we do this for future family generations." (*Delta*) "It is important that the focus is on the family business that we build up this family business sustainably, that we build it up for the future and position ourselves in such a way, also that we do it for the next generations." (*Epsilon*)
Family reputation	"Yes, the issue of sustainability has always been very important to the family, which has always actually been there to act as a very responsible company, and there we refer to this concept of the ordinary businessman." (*Zeta*) "but we are really concerned about our impact as a company, what carbon footprint we leave behind, we would like to keep that as low as possible, because we would like to do all which is in our power for climate protection." (*Alpha*)
Power & control	"And that we also manage to keep up this momentum, so that we don't get left behind, I would say, because we've come so far as pioneers and so much is happening now, and I think it's important that we keep on track and continue to implement it as well as we have so far." (*Delta)* "So in this respect, we already have the claim to be number one. That's not just size, but we want to, we invest a lot in technology. We want to be sustainable because casting has been around for 5,000 years and without that technology, men will not be able to sustain the way of living on earth right now." (*Kappa*)
Enduring ties	"Two main factors: One came from within, namely employees and the management team. I would say that our employees have a very strong penchant for sustainability issues in general. I would even go so far as to say that most of them live or want to live very sustainably." (*Eta*) "In terms of the environment, there are very high expectations from the neighborhood, which need to be seen and considered." (*Gamma*)
Aggregate dimension: Extrinsic goals	
2nd-order codes	Selected evidence on 1st-order codes
Client demand	"So, we have to make the product carbon neutral and with that we have noticed very clearly in the last two years that there was a lot of pressure from outside that we have to move, and that is, I think, within the consumer goods industries or products especially strong." (*Zeta*) "because for the last year and a half, they've all been coming around the corner with their questionnaires... and if you can also show corresponding certifications, then you definitely have plus points." (*Theta*)
Regulatory institutions	"If we, as a small business, wait now until the regulation does apply to us and everyone is sharp, then we will be too late. And then we will no longer be able to catch up. That means we always have to be a little bit ahead of the wave." (*Jota*) "Yes, that, one does not come to it like the virgin to the child, but is yes already in such a way, that the topic has rolled over us in the last 2 years actually by the legislation and by the requirements, which come then, so that one is also forced." (*Lambda*)
Competitive advantage	"But of course, so for us sustainability is a big, a competitive factor." (*Delta*) "We partly leave the biggest, big stock companies behind us - and that's a USP for us." (*Jota*)
Aggregate dimension: Attitude toward decarbonization	
2nd-order codes	Selected evidence on 1st-order codes

Entrepreneurial opportunity	"We have been doing this for 25 years by now, even if it was sometimes unpleasant, some stories were sometimes more effort, that was worth it in the end. What many companies are upset about right now, we've have mastered for a long time." (*Beta*) "that's the beauty of it, that if we, if we find value creation that can make an ecological contribution on top of it." (*Gamma*)
Comparative chance	"If one can shine with scope 3, which is something that many suppliers do not have on the agenda yet, this serves as an advantage on the market." (*Jota*) "I think the big opportunity we see now is that all the black sheep will be forced out of the market and in the other countries, where you might think environmental protection has never played a role, they will now take huge steps to do so as well. And then, of course, our technological leadership helps...with technologically leading products, where we help customers to achieve CO_2 neutrality." (*Lambda*)
Inevitable truth	"We realize that progress in sustainability is also in the interest of the consumer and legal requirements and that making progress is nothing that can be done at the side without asking some bigger questions. The low-hanging fruits have been collected, the quick fixes have been fixed and now we have reached a stage where we have to ask ourselves the question of how to allocate our capital. Otherwise, it will be difficult to progress." (*Zeta*) "Yes, we have also come to the conclusion that we should and must take responsibility for our own activities." (*Alpha*)
Ambiguity about challenge or chance	"So, if at some point in five years it turns out that the firm's product does not comply with the practices of sustainability, then it will very strongly and seriously reduce the market value, but then also represent a breach of trust. This is value protection, and we agree on that. Value creation in the sense of a clear USP or unique selling proposition, also vis-à-vis competitors. We are not yet in agreement on that. However, this will probably be viewed in a more differentiated way in the business unit or portfolio segments." (*Eta*) "That was the Green Deal once, that was also the trigger, why I said, I have to raise my hand here for a moment, something is happening here ... But the second is also things like taxonomy. Yes, the taxonomy regulation. Green bonds, yes, advantageous criteria to get and so on." (*Kappa*)
Aggregate dimension: Strategy for integration of CO_2	
2nd-order codes	Selected evidence on 1st-order codes
Presence of environmental information (incl. innovation)	"Sustainability is integrated into all processes, so that the sustainability manager is always involved in upcoming topics, e.g. new product development or packaging." (*Epsilon*) "The new product needs to have a better footprint than the previous one. Over time, you see how much you can get out of it in numbers." (*Delta*) "There are corporate performance indicators that are included in the balanced scorecard. There we have in a classical way anyway 4 dimensions. There are finances, processes, personnel and or what it's called, I think potential and what's the fourth one called? I can't think of it right now, and we've added a fifth dimension, namely energy and environment." (*Theta*)
Designated CapEx	"Okay, so the decision-making process: We look at which measures are needed to get the CO_2 footprint controlled and they are financed." (*Jota*) "We always have 10 to 20 million capital expenditures per year... 15-20% always ESG investments, …they bring us really forward in the environmental ... we can invest the cash flow sensibly, and for decades there has always been something going into ESG, in particular environmental protection." (*Lambda*)
Artificial CO_2 price	"We will set a price once a year and then apply it for the economic efficiency calculations of investments." (*Zeta*) "That means that the responsible managing directors now also have a cost factor. This is the only way how they can calculate that if I invest in something that incurs less CO_2, then I will have a positive effect and save money. So, that means that many things can be calculated." (*Alpha*)

No integration	"It is measured subsequently and then reduction measures are derived accordingly. But the decision we make is not based on CO_2 at the highest level." (*Eta*) "That is different from product to product. We have to look in detail." (*Kappa*)

Appendix to Essay II

Appendix D. Overview of the results of the systematic literature review on scope 3

Article	Title	Method	Overarching topic	Detailed topic	Key findings
Blanco et al., 2016 Journal of Cleaner Production	The state of supply chain carbon footprinting: analysis of CDP disclosures by US firms	Quantitative	Scope 3 challenges/benefits	Analysis of comprehensiveness of corporate scope 3 measurement of largest firms in the US	In 2013, companies disclosed only 22% of their scope 3 emissions and reporting varied significantly across industries, indicating substantial room for improvement in measuring and disclosing scope 3 emissions. Companies with many suppliers can still successfully capture a large portion of their scope 3 emissions.
Blanco et al. 2017, Business Horizons	An inside perspective on carbon disclosure	Qualitative	Scope 3 challenges/benefits	Analysis of companies' experiences with emission reporting in the context of CDP	Companies can derive various advantages from reporting their emissions, such as operational and strategic benefits, as well as internal and external advantages, and in doing so, they can achieve greater emission reductions than originally anticipated.
Blanco, 2021 Production and Operations Management	Supply Chain Carbon Footprinting and Climate Change Disclosures of Global Firms	Quantitative	Scope 3 challenges/benefits	Influence of scope 3 carbon footprinting on content and nature of a company's climate change disclosure	Encouraging companies to measure scope 3 emissions is crucial as it is linked with more comprehensive CDP disclosures and also makes companies more aware of the risks associated with climate change.
Downie & Stubbs, 2012 Business Strategy and the Environment	Corporate Carbon Strategies and Greenhouse Gas Emission Assessments: The Implications of Scope 3 Emission Factor Selection	Qualitative	Scope 3 challenges/benefits	Evaluation of scope 3 emissions in terms of emission factors	The use of diverse emission factors has resulted in a significant disparity in reported scope 3 emissions, making it challenging to compare results across companies and implement effective carbon

					reduction strategies.
Downie & Stubbs, 2013 Journal of Cleaner Production	Evaluation of Australian companies' scope 3 greenhouse gas emissions assessments	Qualitative	Scope 3 challenges/benefits	Assessment of corporate methods and data for calculating scope 3 emissions	Due to a significant variation in the number of emission sources reported, there is a pressing need for industry-specific guidelines that outline the most critical emission sources and factors.
Hansen et al., 2022 Journal of Cleaner Production	The status of corporate greenhouse gas emissions reporting in the food sector: An evaluation of food and beverage manufacturers	Quantitative	Scope 3 challenges/benefits	Status and quality of companies' emission reports and targets in the food sector	Given the incomplete and inconsistent reporting of scope 3 emissions, there is a need for improvement in the reporting and management of scope 3 emissions since around 53% to 77% of the total emissions remain unreported, thus necessitating the requirement for sector-specific scope 3 guidelines. Over 33 % of scope 3 emissions were not part of corporate reduction targets.
Hertwich &Wood, 2018 Environmental Research Letters	The growing importance of scope 3 greenhouse gas emissions from industry	Quantitative	Scope 3 challenges/benefits	Analysis of the influence that various industries have on value chain emissions	The industry sector was the primary contributor as global scope 3 emissions increased by 84% between 1995 and 2015, and currently, they account for over 50% of the world's emissions with a growing share.
Huang et al., 2009 Environmental Science and Technology	Categorization of Scope 3 Emissions for Streamlined Enterprise Carbon Footprinting	Quantitative	Scope 3 challenges/benefits	Identification of upstream scope 3 emission sources of economic sectors in the US	Data from only a few direct suppliers can capture a significant proportion of a company's upstream emissions. More industry-specific scope 3 guidelines on emission sources are needed. More than 75% of total carbon emissions result

					from the supply chain.
Klaaßen & Stoll, 2021 Nature Communications	Harmonizing corporate carbon footprints	Quantitative	Scope 3 challenges/benefits	Framework to harmonize scope 3 emissions by addressing boundary incompleteness, inconsistent reporting, and exclusion of activities	Incomparability and underreporting of scope 3 emissions result from variations in corporate reporting of scope 3 emissions across different channels, omissions of relevant scope 3 categories, and incomplete application of the minimum boundaries of emitting activities.
Li et al., 2020 Environmental Science and Technology	Enabling full supply chain corporate sustainability: scope 3 emissions targets for ambitious climate change mitigation	Quantitative	Scope 3 challenges/benefits	Targets for industry sectors to reduce scope 3 emissions	To achieve a significant reduction in upstream scope 3 emission intensities, an extra 54% reduction is needed. This entails reducing emissions from manufacturing by 50-52%.
Matisof et al., 2013 Business Strategy and the Environment	Convergence in Environmental Reporting: Assessing the Carbon Disclosure Project	Qualitative	Scope 3 challenges/benefits	Analysis of convergence in carbon reporting and extent of accounting for indirect emissions	While the CDP has achieved mixed outcomes in enhanced transparency, it has not led to improved quality and transparency of scope 3 emissions due to the wide variations in disclosures.
Patchell, 2018 Journal of Cleaner Production	Can the implications of the GHG Protocol's scope 3 standard be realized?	Qualitative	Scope 3 challenges/benefits	Framework of six interdependent challenges to outline the limited success of the GHG scope 3 standard	Six factors hinder the success of the standard: transaction costs, supply chain power, responsibility allocation, uncertainty and competition, location contingency, and production costs. Scope 3 emissions measurement is difficult and complex due to the lack and limited data quality. Full scope 3 reporting according to the GHG standard distracts

					companies from more efficient emission mitigation efforts.
Asif et al., 2022 Corporate Social Responsibility and Environmental Management	Case study research of green life cycle model for the evaluation and reduction of scope 3 emissions in food supply chains	Quantitative and Qualitative	Scope 3 supply chain engagement	Analysis of Walmart's best supplier management practices	Implementing Walmart's green best practices in an upstream food value chain resulted in a scope 3 emission reduction of up to 10%.
Dahlmann & Roehrich, 2019 Business Strategy and Environment	Sustainable supply chain management and partner engagement to manage climate change information	Qualitative	Scope 3 supply chain engagement	Use of information processing as part of climate change engagement with supply chain partners	Three types of information processing exist: basic, transactional, and collaborative. With relational practices and collaborative actions, supply chain engagement reduces information asymmetry and eases the interpretation of sustainability information received.
Eggert & Hartmann, 2021 Journal of Purchasing and Supply Management	Purchasing's contribution to supply chain emission reduction	Quantitative	Scope 3 supply chain engagement	Factors influencing reduction of scope 3 emissions through stronger environmental purchasing and supplier management (EPSM)	EPSM reduces significantly scope 3 emissions of a buying firm. This effect is stronger for firms in industries with material emission management and prior experience in EPSM, while the power of a buying company has no effect. Collaboration based on support rather than pressure is more fruitful.
Jira & Toffel, 2013 Manufacturing and Service Operations Management	Engaging supply chains in climate change	Quantitative	Scope 3 supply chain engagement	Factors for making suppliers more likely to share their CO_2 information with manufacturers	Suppliers are more likely to share their CO_2 information based on various factors, including when multiple buyers request it and are committed using it.
Lintukangas et al., 2022 Journal of Business Ethics	Determinants of Supply Chain Engagement in Carbon Management	Quantitative	Scope 3 supply chain engagement	Motives and preconditions for supply chain collaborations	Companies are driven by moral motives in their effort to engage suppliers and customers. The engagement is positively influenced by

					high-emission industries and profitability, while regulation has no effect.
Theißen et. al., 2014 Journal of Supply Chain Management	Reducing the Carbon Footprint within the Fast-moving consumer goods supply chains through collaboration: The manufacturer's perspective	Qualitative	Scope 3 supply chain engagement	Factors for transfer of sustainability skills between manufacturer and suppliers	With whom and based on which standards supplier engagements are conducted depends on the maturity of the carbon accounting of the manufacturer as well as on the industry. A six-step implementation process for supplier-manufacturer collaboration is proposed, which includes defining the goal, selecting partners, defining standards, driving the relationship, and measuring success.

Appendix E. Case study protocol, interview guide, and interview questions

Case study protocol
The case study protocol is based on the recommended structure of Yin (2014):

Objective of the research study:
Identify how supply chain collaborations help in scope 3 measurement and reduction
Explore the relation between supply chain collaborations and scope 3 challenges and benefits

Research team:
Johanna Schulze-Berge; Sandra Briechle

Research question:
How do supply chain collaborations help firms to cope with scope 3 measurement and reduction?

Interview guide

- Personal introduction of the researcher (background and prior experience, research interests and objective) as well as personal introduction of the interviewee (educational and professional background)
- Information on interview (explanation of recording practice and interviewee's active consent to record, clarification of next steps after the interview, clarification of scope 3 definition in case of unclarities)
- Interview Questions Part 1: Background of the company
- Interview Questions Part 2: Scope 3 measurement & reduction
- Interview Questions Part 3: Collaboration with supply chain partners for scope 3 measurement & reduction
- Interview Questions Part 4: Outlook
- Potential questions from the interviewee

Interview questions (abbreviated version)
Part 1: Background of the company
The intention of this section is to gather core information about the company and to capture the company's general attitude toward decarbonization and scope 3 measurement and reduction.

1.1 General information:

- How many people does your company employ?
- What turnover, denoted in euros, did your company achieve in the last fiscal year?
- When was your company founded?
- In which industry is your company active?
  - Core products
  - Sales channel (B2B, B2C)
- Please describe your supply chain for one/several core products in a representative market (preferably Germany), including the core parties along the supply chain.

1.2 Family ownership** (if applicable)**:

- Does your company identify as being a "family business"?
- Is there a dominant owner family?
  - What percentage of the company's shares are held by this family?
  - How many family members are part of the company leadership? How many generations of the family are active in the leadership and the company in general?
  - When did the last generational change of company leadership take place?

1.3 Attitude of the company toward scope 3:

- What is the attitude of your company on the topic of decarbonization?
  - Do you consider decarbonization as a company as an opportunity or as a challenge?
- Why does your company measure and reduce scope 1 and 2 and especially scope 3? Does your company see advantages and/or disadvantages?
- How does your company perform to its competitors with regard to scope 1 and 2 and particularly scope 3? How does your company compare to regulatory standards (e.g., NFRD, CSRD) with regard to scope 1 and 2 and particularly scope 3?

Part 2: Scope 3 measurement & reduction

The intention of this section is to understand the current sophistication level and evolution of scope 3 measurement and reduction at the company.

2.1 Scope 3 measurement of the company:

- Does your company measure scope 1, scope 2, and scope 3? How have you developed as a company over time in the measurement of the different scopes?
  - How does your company measure scope 3 (e.g., methods, data sources, tools, external support)?
  - Does your company already cover all 15 scope 3 categories from the GHG Protocol? If not, which categories are covered and why?
- What is your assessment of your current scope 3 measurement in terms of completeness and quality? Is your data externally validated and do you submit your data to organizations like CDP?
- What are the main challenges and benefits regarding scope 3 measurement?

2.2 Scope 3 reduction of the company:

- Have specific scope 1 and 2 reduction targets been set (e.g., % of CO_2 footprint within specified timeframes)?
- Have specific scope 3 reduction targets been set (e.g., % of CO_2 footprint within specified timeframes)?
  - Does your company already formulate targets according to a recognized methodology, e.g., SBTi[20] for scope 3? If not, please briefly describe how your company has set its scope 3 targets.
  - Were the goals communicated internally and/or externally?
- Which scope 3 reduction measures does your company currently deploy? Please briefly describe them, including their most important features.
- How does your company select scope 3 reduction measures?
- Is scope 3 considered solely in the context of carbon accounting or is it also analyzed in the context of supply chain transformation (TCFD, supply chain regulation, resourcing, etc.)? If so, how?
- What are the challenges and benefits of scope 3 reduction with regard to the previously mentioned reduction measures?
  - Have there been measures in the past which are no longer used today? If yes, why?
  - Are there also certain measures that you do not want to/cannot implement? If yes, why?

[20] Science Based Targets initiative is a methodology that determines the necessary emissions reduction to meet the goals of the Paris Climate Agreement.

Part 3: Collaboration in scope 3 measurement & reduction

The intention of this section is to discuss the role of collaboration[21] for scope 3 measurement and reduction with supply chain partners. It is important to clarify how previous collaborations have been established, what characterizes them, and how successful they have been in overcoming previous scope 3 challenges.

3.1 Status quo of collaborations for scope 3:

- Does your company pursue scope 3 measurement/reduction collaboration(s)? Please describe with which supply chain partners collaborations are formed and explain the **procedures** for the 2-3 most relevant ones:
  - Supplier
  - Customer
  - Any other supply chain partners
- How important are collaborations to achieve scope 3 carbon neutrality, especially when you compare them with other scope 3 measurement and reduction measures (see part 2)?

3.2 Background of collaborations *(the following questions are to be clarified per supply chain partner with whom collaborations are formed; follow-up questions dependent on previous description of collaboration(s))**:***

- How did the collaborations arise? Who was the initiator?
- To what extent was your company able to draw on previous long-term relationships/networks?
- How did your company select/was your company selected for collaboration? How do the capability profiles and resources of the collaboration partners differ or resemble each other?
- Who bears the costs of the joint scope 3 efforts? How do you manage collaboration effectively and avoid transaction costs[22]?
- What knowledge/skills were you able to absorb as a company through the collaboration?
- Who (e.g., which department/ colleague) is leading the collaboration from your company side? Which functions are involved?

3.3 Evaluation of collaborations *(the following questions are to be clarified per stakeholder collaboration type; follow-up questions dependent on previous description of collaboration(s)):*

- Does the scope 3 collaboration differ from other sustainability and decarbonization collaboration?
- Have collaborations evolved over time in terms of sophistication (e.g., from pure data exchange to product redesign)?
- Is the success of the collaboration measured (non-financial/financial)? If yes, how? What improvements have been realized in the past? Have incentive systems been introduced?
- From your experience, what are the basic requirements or obstacles to a successful scope 3 collaboration?

[21] The ability to work across organizational boundaries to build and manage unique value-added processes to better meet customer needs (Fawcett et. al. 2008) The objective is to work together to maximize CO_2 reduction to better meet customer expectations, mitigate risks related to climate change, lower energy costs, and improve public reputation (Theißen et al. 2014).

[22] Transaction costs cover for example, complexity, information quality, coordination, opportunism.

Part 4: Outlook

The intention of this section is to give a perspective on how scope 3 measurement and reduction could still change at the company and overarchingly in the economy. Furthermore, the interviewee may address any topics regarding scope 3 that have not yet been mentioned before and share relevant documentation.

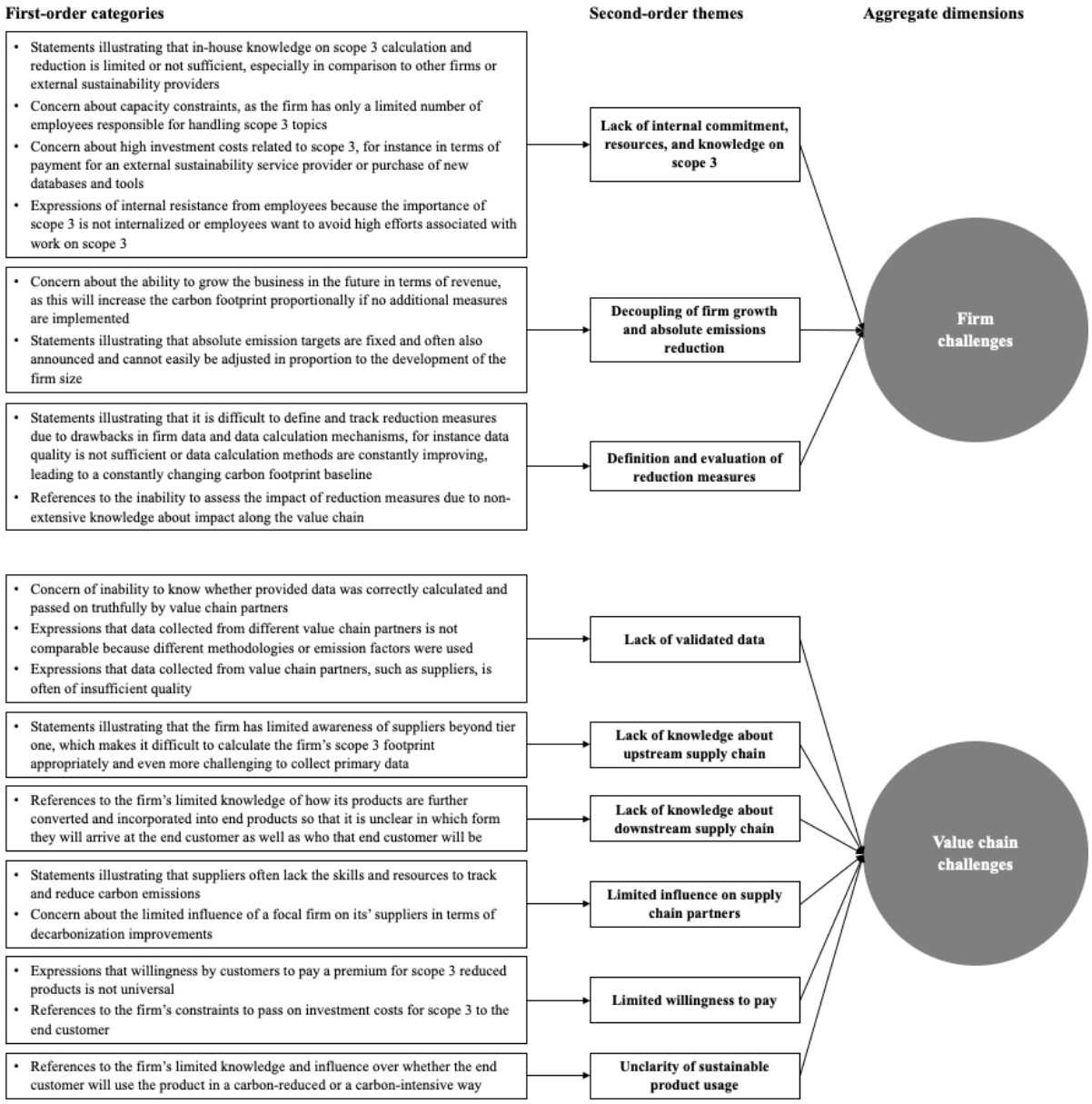
4.1 Future scope 3 measurement and reduction:

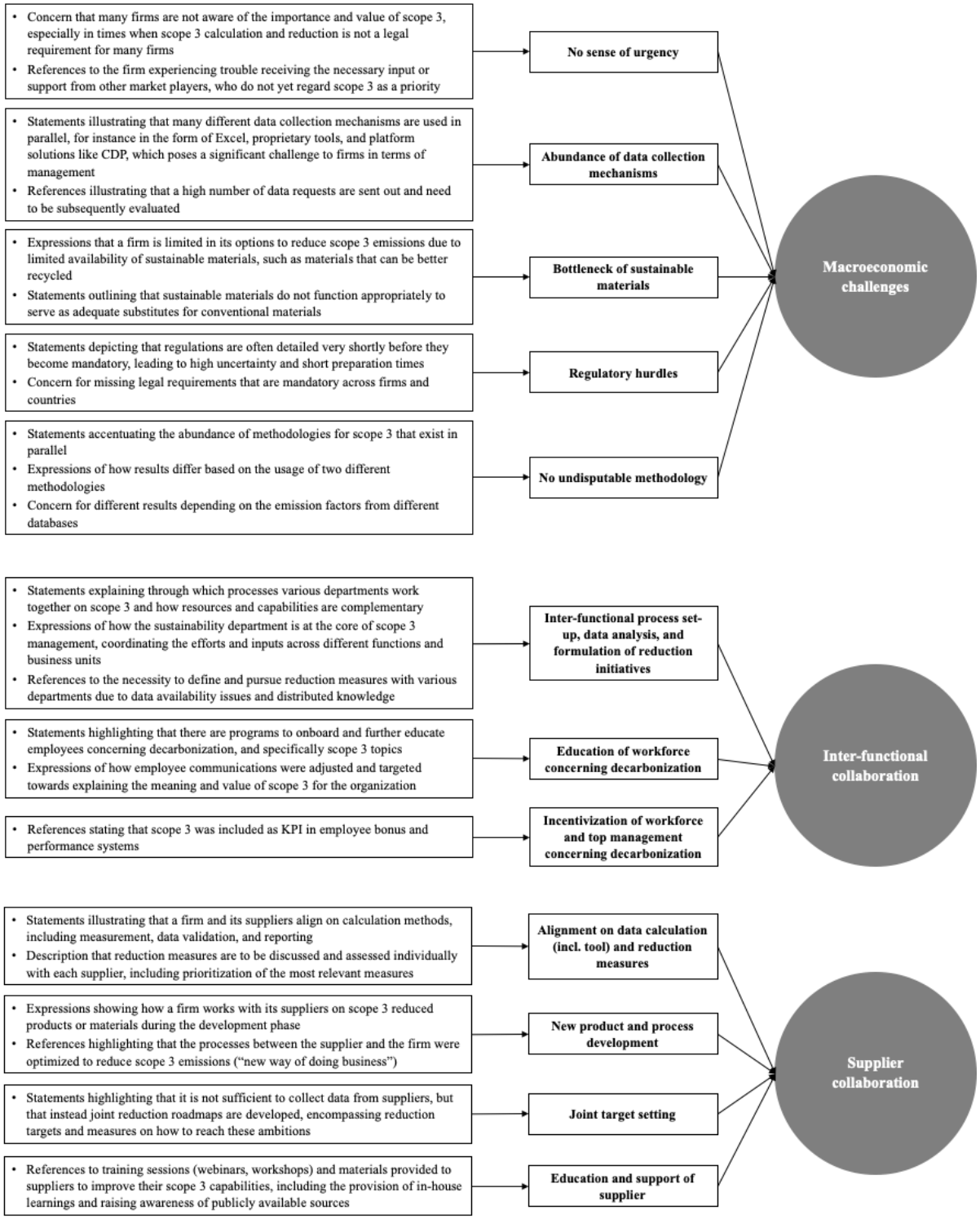
- How could your company best be supported in measuring and reducing scope 3?
  - Are the current regulatory frameworks sufficient? If not, why?
  - Do you consider the current measurement guidelines (e.g., GHG Protocol, SBTi) to be easily usable and sufficient? If not, why?
- Do you expect to achieve climate neutrality in scope 3 with your current efforts/collaborations? If not, what ideas for improvement do you have?

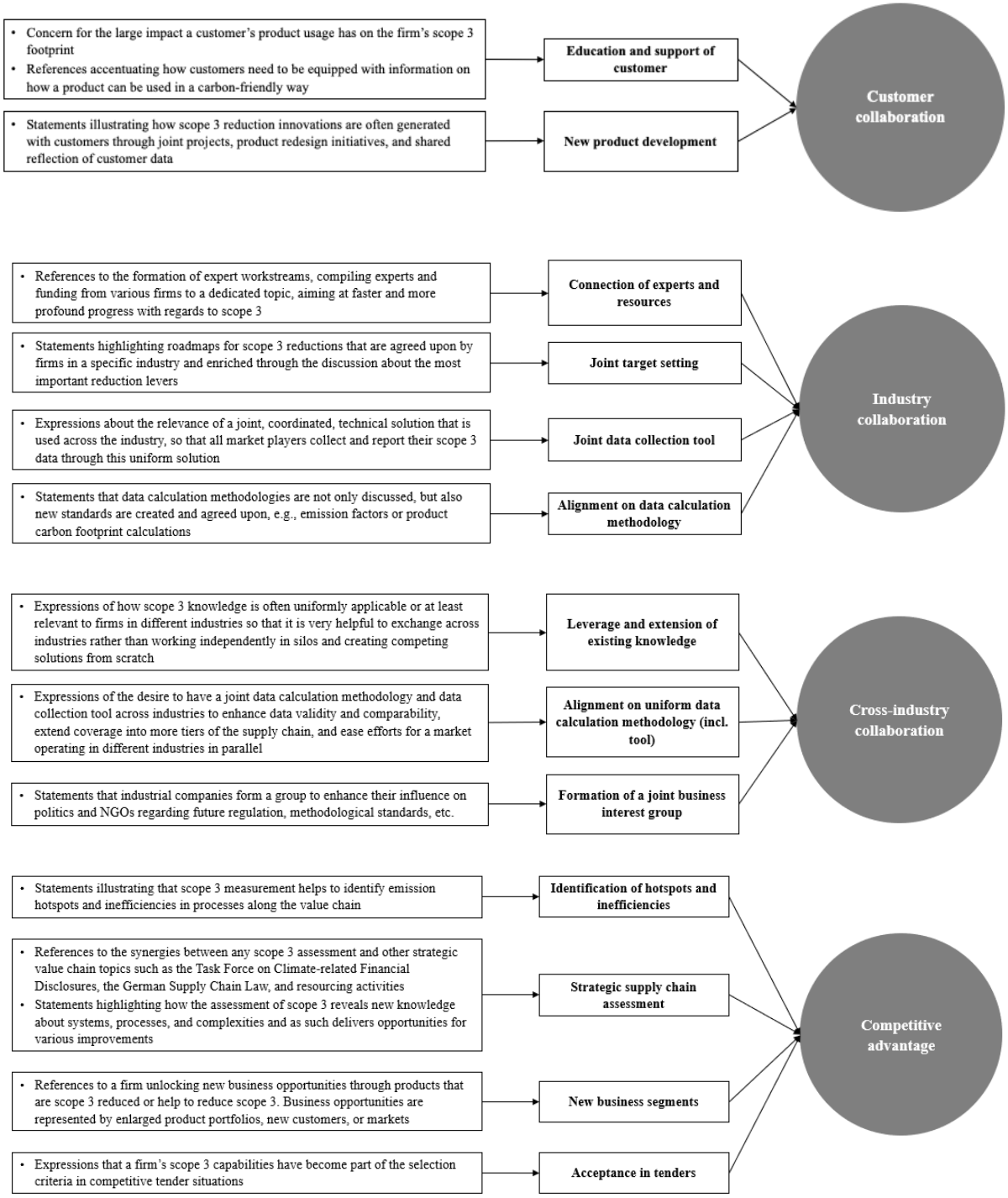
4.2 Additional notices / information:

- Are there any other topics or considerations that we have not covered that you would like to share regarding the topic of scope 3?
- Is there any documentation you can share with me?

Appendix F. Data structure




• Concern that many firms are not aware of the importance and value of scope 3, especially in times when scope 3 calculation and reduction is not a legal requirement for many firms
• References to the firm experiencing trouble receiving the necessary input or support from other market players, who do not yet regard scope 3 as a priority
No sense of urgency
• Statements illustrating that many different data collection mechanisms are used in parallel, for instance in the form of Excel, proprietary tools, and platform solutions like CDP, which poses a significant challenge to firms in terms of management
• References illustrating that a high number of data requests are sent out and need to be subsequently evaluated
Abundance of data collection mechanisms
• Expressions that a firm is limited in its options to reduce scope 3 emissions due to limited availability of sustainable materials, such as materials that can be better recycled
• Statements outlining that sustainable materials do not function appropriately to serve as adequate substitutes for conventional materials
Bottleneck of sustainable materials
• Statements depicting that regulations are often detailed very shortly before they become mandatory, leading to high uncertainty and short preparation times
• Concern for missing legal requirements that are mandatory across firms and countries
Regulatory hurdles
• Statements accentuating the abundance of methodologies for scope 3 that exist in parallel
• Expressions of how results differ based on the usage of two different methodologies
• Concern for different results depending on the emission factors from different databases
No undisputable methodology
Macroeconomic challenges
• Statements explaining through which processes various departments work together on scope 3 and how resources and capabilities are complementary
• Expressions of how the sustainability department is at the core of scope 3 management, coordinating the efforts and inputs across different functions and business units
• References to the necessity to define and pursue reduction measures with various departments due to data availability issues and distributed knowledge
Inter-functional process set-up, data analysis, and formulation of reduction initiatives
• Statements highlighting that there are programs to onboard and further educate employees concerning decarbonization, and specifically scope 3 topics
• Expressions of how employee communications were adjusted and targeted towards explaining the meaning and value of scope 3 for the organization
Education of workforce concerning decarbonization
• References stating that scope 3 was included as KPI in employee bonus and performance systems
Incentivization of workforce and top management concerning decarbonization
Inter-functional collaboration
• Statements illustrating that a firm and its suppliers align on calculation methods, including measurement, data validation, and reporting
• Description that reduction measures are to be discussed and assessed individually with each supplier, including prioritization of the most relevant measures
Alignment on data calculation (incl. tool) and reduction measures
• Expressions showing how a firm works with its suppliers on scope 3 reduced products or materials during the development phase
• References highlighting that the processes between the supplier and the firm were optimized to reduce scope 3 emissions ("new way of doing business")
New product and process development
• Statements highlighting that it is not sufficient to collect data from suppliers, but that instead joint reduction roadmaps are developed, encompassing reduction targets and measures on how to reach these ambitions
Joint target setting
• References to training sessions (webinars, workshops) and materials provided to suppliers to improve their scope 3 capabilities, including the provision of in-house learnings and raising awareness of publicly available sources
Education and support of supplier
Supplier collaboration


• Concern for the large impact a customer's product usage has on the firm's scope 3 footprint
• References accentuating how customers need to be equipped with information on how a product can be used in a carbon-friendly way
Education and support of customer
• Statements illustrating how scope 3 reduction innovations are often generated with customers through joint projects, product redesign initiatives, and shared reflection of customer data
New product development
Customer collaboration
• References to the formation of expert workstreams, compiling experts and funding from various firms to a dedicated topic, aiming at faster and more profound progress with regards to scope 3
Connection of experts and resources
• Statements highlighting roadmaps for scope 3 reductions that are agreed upon by firms in a specific industry and enriched through the discussion about the most important reduction levers
Joint target setting
• Expressions about the relevance of a joint, coordinated, technical solution that is used across the industry, so that all market players collect and report their scope 3 data through this uniform solution
Joint data collection tool
• Statements that data calculation methodologies are not only discussed, but also new standards are created and agreed upon, e.g., emission factors or product carbon footprint calculations
Alignment on data calculation methodology
Industry collaboration
• Expressions of how scope 3 knowledge is often uniformly applicable or at least relevant to firms in different industries so that it is very helpful to exchange across industries rather than working independently in silos and creating competing solutions from scratch
Leverage and extension of existing knowledge
• Expressions of the desire to have a joint data calculation methodology and data collection tool across industries to enhance data validity and comparability, extend coverage into more tiers of the supply chain, and ease efforts for a market operating in different industries in parallel
Alignment on uniform data calculation methodology (incl. tool)
• Statements that industrial companies form a group to enhance their influence on politics and NGOs regarding future regulation, methodological standards, etc.
Formation of a joint business interest group
Cross-industry collaboration
• Statements illustrating that scope 3 measurement helps to identify emission hotspots and inefficiencies in processes along the value chain
Identification of hotspots and inefficiencies
• References to the synergies between any scope 3 assessment and other strategic value chain topics such as the Task Force on Climate-related Financial Disclosures, the German Supply Chain Law, and resourcing activities
• Statements highlighting how the assessment of scope 3 reveals new knowledge about systems, processes, and complexities and as such delivers opportunities for various improvements
Strategic supply chain assessment
• References to a firm unlocking new business opportunities through products that are scope 3 reduced or help to reduce scope 3. Business opportunities are represented by enlarged product portfolios, new customers, or markets
New business segments
• Expressions that a firm's scope 3 capabilities have become part of the selection criteria in competitive tender situations
Acceptance in tenders
Competitive advantage

Appendix G. Selected case-based evidence

Aggregate dimension: Firm challenges	
2nd-order themes	Selected evidence on 1st-order codes
Lack of internal commitment, resources, and knowledge on scope 3	"Somebody from outside has more know-how, because we are actually a solution manufacturer and a not CO_2 calculator." (*Kappa*) "We are only 1.5 Full Time Equivalents - we can't handle it at all." (*Zeta*) "Resource bottleneck. Who does it now?" (*Delta*) "Internal resistance because, of course, many colleagues shy away from this effort, since it is a large-scale task to carry out such calculations." (*Epsilon*) "And the other one just says, I don't know, I don't want to." (*Alpha*)
Decoupling of firm growth and absolute emission reduction	"And the big challenge now is to reduce emissions and at the same time achieve economic growth by decoupling CO_2 emissions from business growth." (*Epsilon*) "That's an absolute goal and we have to have growth. Ultimately, we want to grow. We have to somehow balance it out with that." (*Gamma*)
Definition and evaluation of reduction measures	"We're still having a hard time quantifying and accurately classifying each measure." (*Epsilon*) "Our data basis is not yet good and it's not yet good enough to⋯derive measures like this and to track them." (*Eta*) "It is difficult to really plan measures in scope 3, for example, when the calculation models behind them are actually improving again and again." (*Delta*)
Aggregate dimension: Value chain challenges	
2nd-order themes	Selected evidence on 1st-order codes
Lack of validated data	"I think it will be really difficult to get data." (*Theta*) "Unfortunately, still very low and poor data availability, if I as an internationally operating company really look at my suppliers." (*Jota*) "If I ask five suppliers for a scope 3 footprint for a material, I get five different values, all calculated according to different methodologies." (*Delta*)
Lack of knowledge about upstream supply chain	"Who's your tier n? ⋯ I simply have no idea." (*Gamma*) "The challenge is simply to gain complete transparency over the supply chain, because you can clearly say in tier 1 where the material comes from, but you can't always say one hundred percent where in tier 2 to tier N." (*Kappa*)
Lack of knowledge about downstream supply chain	"Due to a lack of knowledge of the application area, it is difficult. I think a raw aluminum manufacturer can also hardly say whether his aluminum will be converted into a car or will just lie around as a shapely paperweight in a university." (*Jota*) "Especially transparency in all the downstream stuff, where does it go in somehow. ⋯ in some cases, you don't even know where it actually disappears, in the individual products, in the individual sectors." (*Theta*) "If I knew where our products were used. That would be cool." (*Alpha*)
Limited influence on supply chain partners	"And do we have any real influence on our suppliers to deliver more sustainable products?" (*Zeta*) "Getting them to reduce their emissions accordingly is not easy for them either, of course, and certainly not in the timeframe necessary." (*Epsilon*) "If emissions come from a mine, then we as a company have no influence on it." (*Zeta*)
Limited willingness to pay	"As of today, I have yet to see a customer say, despite all the requirements, I'll pay you significantly more just for the product to be more sustainable." (*Zeta*) "On the customer side, there is still a limited willingness to pay a premium for green products." (*Delta*) "But the willingness to spend more on high-quality CO_2-neutral products is then only given to a very limited extent." (*Jota*)
Unclarity of sustainable product usage	"But who decides what the plane is filled up with? It's no longer us." (*Beta*) "It's incredibly more difficult to anticipate how customers will use the device for example." (*Kappa*)
Aggregate dimension: Macroeconomic challenges	
2nd-order themes	Selected evidence on 1st-order codes
No sense of urgency	"However, I believe it hasn't fully sunk in yet. The pain of why we have to do this [scope 3] has not yet reached many companies." (*Kappa*)

	"that this scope 3 reporting is still voluntary; if I go by GHG, there is hardly any awareness of it either." (*Theta*)
Abundance of data collection mechanisms	"Only because of the mass, 66,000 suppliers or at least 20,000, which certainly make up the largest part of this pie. No one can manage that anymore. If a CDP report comes back every time and you then have pages and pages of information that you have to put in connection somewhere." (*Alpha*) "Were trying to answer these questionnaires. And at some point, it was clear that we would not be able to cope with this flood." (*Gamma*) "And I think the road to hell would be if I got 20 questionnaires like that, because 20 of them thought, we'll make our own methodology." (*Alpha*)
Bottleneck of sustainable materials	"The issue of availability. I can't even get the quantities of renewable raw materials I need today." (*Delta*) "The issue is: Do we even have as much recyclate as everyone will need now?" (*Gamma*)
Regulatory hurdles	"Multitude of regulatory hurdles ... we still have no draft of the CSRD on the table. Not a final one. And companies are supposed to be preparing for it by 2025. That's crazy." (*Gamma*) "There is no legal requirement for the provision of appropriately verified CO_2 input emissions data." (*Jota*)
No undisputable methodology	"Uncertainty about the methods ... The Greenhouse Gas Protocol is not so clear on this." (*Epsilon*) "There is no uniform standard and so much room for leeway." (*Zeta*) "There are thousands of different calculations and there are 1000 different assumptions." (*Beta*)
Aggregate dimension: Inter-functional collaboration	
2nd-order themes	Selected evidence on 1st-order codes
Inter-functional process set-up, data analysis, and formulation of reduction initiatives	"The topics are also passed on to more specific departments, which then have more in-depth knowledge or information." (*Epsilon*) "Collaboration is then ensured via the central sustainability department, which then also coordinates activities with purchasing or sales." (*Kappa*) "Determines a central confluence or can give a central definition of measures" (*Theta*) "However, the development of measures and the tracking of measures is always the responsibility of the specialist department." (*Eta*)
Education of workforce concerning decarbonization	"That's why the topic of internal communication is so important, and we spend a lot of capacity on taking our colleagues internally by the hand and getting them on board to train them and create awareness for the topic." (*Zeta*) "But of course we also hope to arouse interest in such topics through the internal media and internal communication." (*Alpha*) "To onboard this group [blue collar workers] on why is sustainability important? What does it mean in terms of our business strategy? What can everyone contribute?" (*Eta*)
Incentivization of workforce and top management concerning decarbonization	"We have implemented ESG targets, which have relevance for the corresponding top management compensation." (*Jota*) "So it has to be the case that the supplier doesn't get a target from Alpha, … but the buyer has to get the target himself. He has to be told that you have to save 5% on the price and also another 3% or 7% on CO_2. ... There are long-term incentives with the Board of Management, ... And I have heard that the topic [scope 3] will soon be anchored there as well." (*Alpha*) "Department XY, your goal is to get so much percent of the pie down by then, and now please think about how." (*Eta*) "Incentivization, in executive salaries, that's also a component." (*Delta*)
Aggregate dimension: Supplier collaboration	
2nd-order themes	Selected evidence on 1st-order codes
Alignment on data calculation (incl. tool) and reduction measures	"Potential reduction measures. This has to be negotiated bilaterally, because the suppliers' initial situation is very individual." (*Gamma*) „The standard query looks like this, a request is sent to the supplier with an information package sent, including a costing model etc." (*Lambda*)
New product and process development	"Two cooperations ... where we also consciously use CO_2-optimized materials. Depending on the situation, it also means that production processes have to change." (*Gamma*) "Projects with suppliers, because you think together, okay, how can we develop joint products, and then the supplier already has an active part in the development phase." (*Epsilon*)
Joint target setting	"Take the large suppliers and arrange an initial meeting with them and then define a roadmap together. Where do we see ourselves in the long-term, and what do we want to achieve together?" (*Zeta*)

	"Pay attention, these are the targets. We're talking about so and so many millions of tons of CO_2. Those are kind of the hotspots. Only these suppliers were invited. So how do we get an appropriate target path mapped here?" (*Gamma*)
Education and support of supplier	"Best practice can be given to the hand. They [suppliers] also want trainings." (*Zeta*) "Trainings, but there will be this type of workshops sessions." (*Epsilon*) "You have to offer workshops, you have to offer webinars." (*Beta*)
Aggregate dimension: Customer collaboration	
2nd-order themes	Selected evidence on 1st-order codes
Education and support of customer	"But I would say that plans and actions have been considered to put farmers in a position to reduce their CO_2 emissions. On the one hand, training materials are given to them, but also related products, where one knows that this enables certain forms of cultivation and then one can also reduce CO_2 emissions in the agricultural sector." (*Epsilon*) "Inform the user. In Europe, I don't know, we kind of put out a brochure like that with washing. How do I use a dishwasher?" (*Gamma*) "We can provide the information what our products can do, with what sustainable aviation fuel share they can fly." (*Beta*)
New product development	"Downstream it is more product redesign." (*Alpha*) "On the customer side it is really innovation." (*Eta*) "On the customer side, there are actually joint projects all the time." (*Delta*)
Aggregate dimension: Industry collaboration	
2nd-order themes	Selected evidence on 1st-order codes
Connection of experts and resources	"Association of well-known aircraft manufacturers and all suppliers. Everybody who is part of it brings his experts into this association with the knowledge ... and additionally also brings money to buy what we do not know ourselves." (*Beta*) "I think there is simply a lot of knowledge coming together from different companies. And the good thing is that many of the companies have already accumulated a great deal of knowledge, and this exchange has also taken up a great deal of time and energy. But that's also the only way to get something on paper." (*Epsilon*)
Joint target setting	"You talk as an industry and agree on a common goal line." (*Gamma*) "Ambitious goals of the semiconductor industry worldwide." (*Jota*)
Joint data collection tool	"The "Together for Sustainability" initiative also discussed a technical solution for transferring data from supplier to supplier. An application was also selected." (*Epsilon*) "The next step is to create a joint system on how these values can then be collected from suppliers." (*Delta*)
Alignment on data calculation methodology	"The initiative called "Together for Sustainability" and together we have now developed a standard or guidance on how to calculate a product carbon footprint." (*Delta*) "This product carbon footprint guidance document has been created and it is also a calculation guidance for the scope 3.1 category." (*Epsilon*)
Aggregate dimension: Cross-industry collaboration	
2nd-order themes	Selected evidence on 1st-order codes
Leverage and extension of existing knowledge	"I always realize, no matter with which company we talk ... everyone faces the same challenges and the same questions." (*Zeta*) "So we know, we like to benchmark ourselves with friendly companies where we know, okay, they also invest more in future topics per se. Regardless of whether it's the CO_2 footprint or something else, we know that they simply invest more in more resources, in human nature, or human resources, or financial resources. And that's where we like to exchange ideas and get our information from." (*Kappa*)
Alignment on uniform data calculation methodology (incl. tool)	"So our goal would be if all, preferably not only the chemical industry, but also all other industries calculate [scope 3] according to this standard, because then we also have it much easier." (*Delta*) "We just want it to go deeper into the supply chain, that as many companies as possible join. And that can't just be our supplier, it can also be, … , BMW, Bayer, … , who can now acquire this tool." (*Alpha*)
Formation of a joint business interest group	"We try to point out via the associations what could possibly be good [regulatory] solutions and we also try to prevent the greatest possible nonsense." (*Gamma*) "We are currently involved primarily in the World Business Council for Sustainable Development. ...The GHG Protocol will now be revised over the next few years. This means that it will certainly be a focus for us to get involved." (*Alpha*)

Aggregate dimension: Competitive advantage	
2nd-order themes	Selected evidence on 1st-order codes
Identification of hotspots and inefficiencies	"You can then get a certain overview of where the firm, first of all, a) incurs the most CO_2 and b) where, according to this, the greatest savings opportunities are in the CO_2 area." (*Beta*) "Companies have a competitive advantage that manage to create as much transparency as possible in the supply chain." (*Gamma*)
Strategic supply chain assessment	"... because you also mentioned the Supply Chain Act. These are, of course, issues that not only affect us, but also all of these human rights issues, etc. That's why we also work on this in tandem with purchasing and sustainability." (*Delta*) "So,the transparency that I will create in the course of the supply chain law will also help me later with regard to the issue of CO_2 emissions." (*Kappa*)
New business segments	"We have many products that contribute to the transformation, so to speak. First, we see a business opportunity there for ourselves." (*Delta*) "Therefore, I believe that the chemical industry, at least in part, also sees a business potential in this. If you take BASF, for example, which would like to sell biobased products." (*Epsilon*)
Acceptance in tenders	"Ensure in new projects that suppliers are selected that support us in the topic of sustainability." (*Zeta*) "currently it serves as a differentiator between firms." (*Alpha*)

Appendix to Essay III

Appendix H. Abbreviated survey outline

1. Company Identification
2. GHG emission measuring technique & recorded values
2.1. Used Standard (Global Reporting Initiative / Greenhouse Gas Protocol)
2.2. Unit of Measurement (CO_2 / CO_2e)
2.3. Emissions for the years 2013-2021
2.4. Special occurrences explaining discontinuities in the emission figures
3. Anonymity Disclaimer

Source. Own figure

Appendix I. Classification of industries based on emissions per unit of output

Clean	**Dirty**
Foods	Paper and pulp
Textiles and Apparels	Chemicals
Oil and coal products	Pharmaceutical
Machinery	Rubber and plastic products
Glass and ceramics products	Iron and steel
Electric appliances	Nonferrous metals
Transportation equipment	Metal products
Precision instruments	
Other products	

Note. Classification according to Mani and Wheeler (1998); similar representation by Iwata and Okada (2011)

Source. Own figure

Appendix J. Supplementary descriptive statistics

	Sample with CO_2 as unit of measurement			Sample with CO_2e as unit of measurement		
Variable	**Mean**	**Median**	**SD**	**Mean**	**Median**	**SD**
ROA	0.041	0.048	0.038	0.042	0.400	0.034
ROE	0.093	0.082	0.101	0.100	0.098	0.084
CEP	10.537	10.522	1.037	10.440	10.179	1.262
Size	7.720	7.612	1.559	8.261	8.040	1.542
Leverage	0.353	0.358	0.156	0.389	0.400	0.164
Capital Intensity	0.064	0.061	0.035	0.072	0.062	0.043
Growth	0.014	0.014	0.085	0.021	0.019	0.085
Industry	0.768	1.000	0.486	0.622	1.000	0.486
Disclosure	0.626	1.000	0.495	0.580	1.000	0.495

***Note*.** Descriptive statistics for 99 observations with CO_2 as unit of measurement and 143 observations for CO_2e as unit of measurement. The sample covers observations over the period 2013–2021. All continuous variables are winsorized at the 5 and 95 percentiles. The variables are defined in Table 4.2.

Source. Own table

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