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Corporate scope 3 carbon emission reporting as an enabler of supply chain decarbonization: A systematic review and comprehensive research agenda

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Abstract

Firms worldwide are currently investigating ways to decarbonize global supply chains. Corporate scope 3 carbon emission reporting is a critical first step but is not yet a common activity for most firms. The current literature on corporate scope 3 reporting is highly fragmented and does not offer a comprehensive overview, and findings from scopes 1 and 2 emission reporting are often not readily transferrable. Therefore, we conduct a systematic literature review, develop an encompassing research framework, and generate a comprehensive research agenda. Our results identify several patterns in the literature, such as the widespread use of the Carbon Disclosure Project as a data source, a broad agreement on poor comprehensiveness of scope 3 reports, and an overall low amount of empirical research. We contribute a holistic overview of the complex issue of scope 3 reporting and develop numerous promising research avenues.

KEYWORDS
carbon disclosure, carbon performance, corporate carbon emission reporting, scope 3 emissions, supply chain emissions

1 | INTRODUCTION

Society and corporations worldwide are dealing with the effects of climate change. To comply with the Paris Agreement's goal of limiting temperature increase to 1.5°C, companies are investigating ways to reduce their impact. A critical first step is to measure and report the impact a company has on climate change (Lee, 2012; Weinhofer & Hoffmann, 2010). For this purpose, the *World Business Council for Sustainable Development* and the *World Resources Institute* jointly founded the "Greenhouse Gas (GHG) Protocol", which has become the largest global standard for the assessment of corporate carbon emissions (Patchell, 2018).

A company's carbon emissions comprise three scopes which vary greatly in how complex they are to measure and report. The GHG Protocol defines scope 1 as "direct emissions from owned or controlled sources", scope 2 as "indirect emissions from the generation of purchased energy consumed by the reporting company", and scope 3 as "all other indirect emissions that occur in a company's value chain" (Callahan et al., 2011: p. 5). Scopes 1 and 2 emissions are relatively easier to measure and report as they lie mostly within the

Abbreviations: GHG, Greenhouse Gas; CDP, Carbon Disclosure Project; NGO, Non-Governmental Organization; FT50, Financial Times 50; CO_2, Carbon Dioxide; NGER, National Greenhouse and Energy Reporting; DEFRA, Department for Environment, Food & Rural Affairs; IPCC, Intergovernmental Panel on Climate Change; PCF, Product Carbon Footprint; CCF, Corporate Carbon Footprint.

operational sphere of a corporation. Scope 3 emissions are significantly more complex and harder to determine (Busch et al., 2022; Dahlmann & Rohrich, 2019; Downie & Stubbs, 2012). Consequently, the decarbonization of entire supply chains is a particularly complex challenge.

For the purpose of decarbonizing entire supply chains beyond the mere scope of individual corporations (i.e., scopes 1 and 2), firms need to develop targeted reduction actions with clear performance targets (Lewandowski, 2017). Transparency and accurate measurement of the carbon emissions that occur along supply chains (i.e., scope 3 emissions) are needed to develop such reduction actions (Dahlmann & Rohrich, 2019; Isil & Sebastianelli, 2020).

In practice, corporate scope 3 emission reporting is not yet a common reporting activity for most firms (Dahlmann & Rohrich, 2019), but it has gained attention over the last few years. A key reason is that it remains voluntary under all global regulatory frameworks even though, for many corporations, scope 3 carbon emissions make up 75% or more of their total carbon emission profile, primarily driven by the emissions generated by a firm's suppliers of purchased goods and services, and associated transportation (Blanco et al., 2016). Hence, firms that are not reporting scope 3 emissions may miss the bigger picture of their total carbon footprint and make poor decisions with respect to their decarbonization strategies (Dhanda et al., 2022; Weinhofer & Busch, 2013). Notably, however, the Carbon Disclosure Project (CDP), the largest global NGO promoting supply chain emission transparency, has seen a threefold increase in membership and suppliers disclosing information over the past 5 years (CDP, 2017, 2022; Matisoff et al., 2013).

The current literature on corporate scope 3 carbon emission reporting is highly fragmented and does not offer a comprehensive perspective. This is particularly problematic due to the above-described risk of missing the bigger picture for supply chain decarbonization. Previously, Hahn et al. (2015) and Velte et al. (2020) conducted literature reviews on general carbon disclosure and derived frameworks of theoretical perspectives, antecedents, consequences, and moderators of carbon reporting. However, they investigated only scope 1 and partially scope 2 emissions. Due to the complexity of scope 3 emission reporting (e.g., the need to engage external stakeholders), their findings from scopes 1 and 2 emissions might not readily transfer to scope 3 emissions. Consequently, there is an urgent need to review and integrate extant research specific to corporate scope 3 carbon emission reporting. Hence, we seek to answer two interrelated research questions: *(1) What is the current state of the academic literature on corporate scope 3 carbon emission reporting and how can the literature best be structured?* and *(2) What are promising areas for future research?*

The main goal of this article is thus to synthesize the current knowledge on corporate scope 3 carbon emission reporting and to outline a comprehensive research agenda. We first synthesize the existing literature specific to scope 3 emissions and iteratively develop a research framework for carbon emission reporting that comprises theoretical lenses, characteristics of emission reporting itself, as well as antecedents, consequences, and moderators of key relationships. We then outline patterns and gaps in the existing literature and finally identify additional research avenues based on critical research needs and impactful academic work previously undertaken on scopes 1 and 2 emissions.

This approach enables us to make four critical contributions. First, we create a holistic research framework that comprehensively structures the research landscape on corporate carbon emission reporting. This level of comprehensiveness is unique in the literature. Second, we break down the complexity of corporate scope 3 carbon emission reporting and describe it using the aforementioned framework. This may ultimately advance researchers' and practitioners' understanding of how the decarbonization of global supply chains can be achieved. Third, we identify patterns in the research in this field. This allows us to understand which approaches are common and which are underutilized. Lastly, we provide a comprehensive agenda for future research. We identify promising avenues to be pursued based on particularly striking patterns, literature gaps, and specific needs for scope 3 emissions. Thereby, we enable other researchers to effectively advance our understanding of corporate scope 3 carbon emission reporting.

2 | METHOD

We followed established processes for a systematic literature review to ensure a comprehensive account of the literature (Rousseau et al., 2008; Webster & Watson, 2002). In line with previous reviews (Hahn et al., 2015; Schaedler et al., 2022), we combined two individual journal lists from the fields of business management and sustainability, respectively. This ensures that our journal selection properly takes into account the novelty and cross-functional nature of the topic of corporate carbon emission reporting and ensures that no relevant high-quality journal is left out. First, we included all FT50 journals to ensure that a broad selection of very high-quality business journals is included (Schaedler et al., 2022). Second, we added the 16 journals ranked B or better by the German Academic Association of Business Research's scientific committee for sustainable management in its JourQual 3 ranking—which broadly aligns with other formal journal rankings globally—to further ensure that all high-quality journals specialized in the field of sustainable management are included (Graf-Vlachy et al., 2020). Overall, to be particularly careful, we aimed to err on the side of including too many rather than too few journals. This process yielded a total of 65 journals (listed in Table A1 in the online appendix, section 1 of the supporting information).

To identify relevant articles published in the selected journals, we performed two separate keyword searches in the Web of Science database in August 2022. First, we searched for *"scope 3" AND "emission*"* to include all articles explicitly addressing the topic of scope 3 emissions without any further restrictions. This search process led to 91 articles. Second, we searched for *"corporate" AND ("carbon" OR "CO2") AND "emission" AND ("reporting" OR "disclosure")*. This search process aimed to identify all relevant literature on corporate emission reporting in general, which may also be relevant for scope 3 emissions even if it only addresses scope 1 or scope 2. We explicitly

added the restrictions of "corporate" and "carbon" or "CO_2". The term "corporate" restricted the search results to corporate reporting and avoids articles focused on specific processes or products (e.g., waste incineration or broiler feeds) unrelated to corporate reporting. The terms "carbon" or "CO_2" restricted search results to articles focused on carbon emissions relevant to climate change and avoided articles discussing wider environmental pollution from other emissions not contributing to climate change (e.g., wastewater disposal). The second search process led to 124 articles. Both search processes jointly led to a total of 205 unique articles.

We read all articles' abstracts and, if necessary, their full texts, and retained those articles that either explicitly address or entail aspects that could be transferred to scope 3 emission reporting. We removed articles if they focused on specific products, processes, or structures that are not relevant in the corporate context (e.g., articles focused on biomass CO_2 capture or inorganic salt as a sustainable catalyst system for CO_2 utilization). Consequently, we removed 54 of the 205 articles, leaving us with a list of 151 peer-reviewed articles. Subsequently, we systematically coded each article regarding the characteristics of carbon emission reporting itself, the applied theoretical lenses as well as the discussed antecedents, consequences, and moderators of corporate scope 3 carbon emission reporting, following the basic logic of prior literature reviews in the field (Hahn et al., 2015; Velte et al., 2020). In our coding, we differentiated between articles that explicitly address scope 3 emissions and those that addressed scopes 1 or 2 emission reporting. Figure 1 summarizes the distribution of the 205 identified articles along whether they explicitly address scope 3, do not explicitly address scope 3 but entail potentially transferrable aspects, or are not relevant. It shows that most articles (43%) do not explicitly address scope 3 emissions but include potentially transferable aspects, 62 (30%) explicitly address scope 3 emissions, and 54 (26%) are not relevant to this work.

3 | DESCRIPTIVE OVERVIEW AND RESEARCH FRAMEWORK

3.1 | Descriptive overview of the literature

Figure 2 presents the number of articles per journal. It shows that the relevant literature is strongly concentrated in only a few journals. The top three journals are home to more than 75% of articles. Thus, the conversation around the topic of corporate carbon emission reporting appears to take place in a somewhat narrow set of outlets.

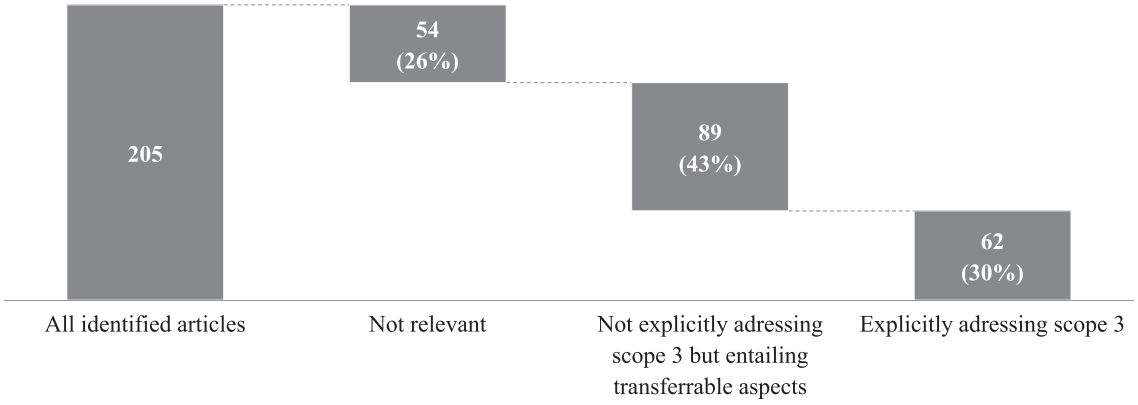

FIGURE 1 Distribution of identified articles along relevance for scope 3 reporting.

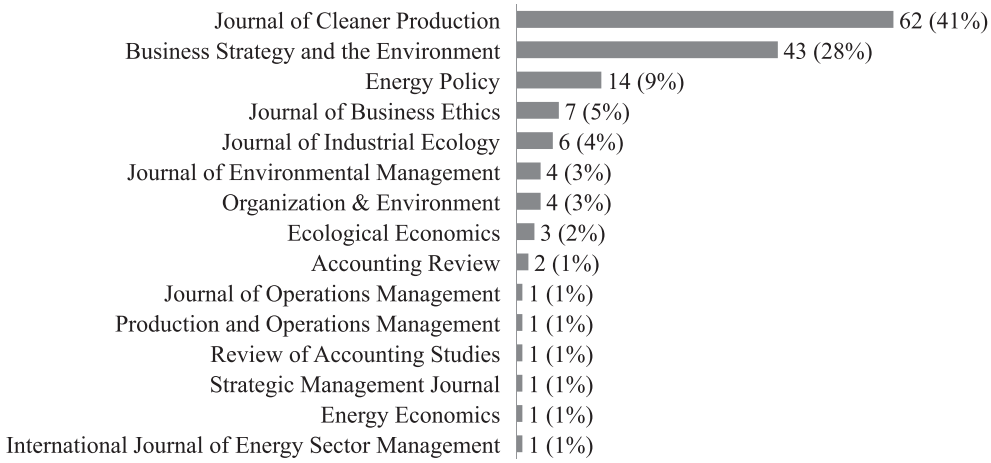

FIGURE 2 Distribution of identified articles along journals.

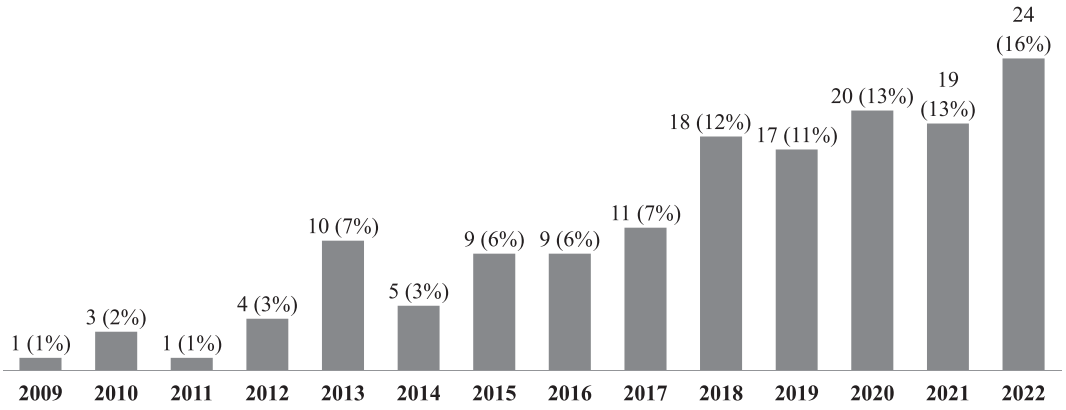

FIGURE 3 Distribution of identified articles over time.

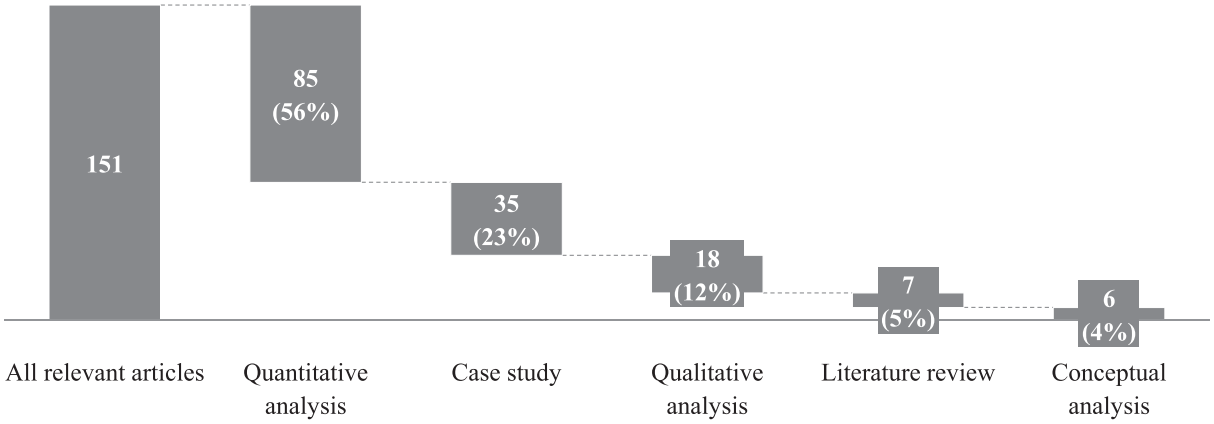

FIGURE 4 Research methodologies used in relevant literature.

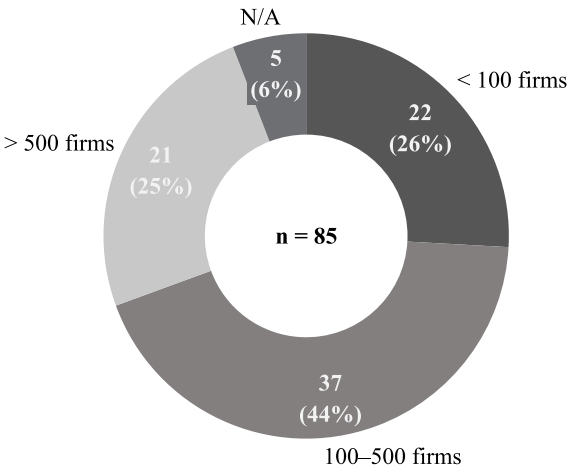

FIGURE 5 Sample sizes used in quantitative analyses.

Figure 3 illustrates the number of articles published per year and it shows that the topic is quite new. Almost all research (93%) on the topic has been conducted from 2013 onwards, and the vast majority of articles (65%) have been published in the past 5 years.

The research methods applied in the identified articles are highly heterogeneous. Figure 4 shows the number of articles by research method. Around half (56%) of the articles perform a quantitative analysis, 23% of the identified articles are based on a case study method, while 12% applied a different type of qualitative analysis. Only 5% of articles are literature reviews and 4% contain a conceptual analysis. This distribution is largely in line with the distribution found in a previous literature review on general carbon reporting by Hahn et al. (2015), except for the share of case studies, which is significantly higher in our sample.

Figures 5–7 provide further details on the identified quantitative analyses. First of all, it is important to note that ~80% of studies used panel data and ~20% used cross-sectional data. This indicates that developments over time are frequently incorporated in quantitative analyses. Figure 5 indicates that scholars work with samples of very different sizes, showing an almost equal distribution among less than 100, 100–500, and more than 500 firms.

Figure 6 further shows the share of data sources used. It underpins the importance of the CDP as the leading data source as almost half of the quantitative analyses (46%) used their database.

Figure 7 additionally outlines the share of different standards applied to generate the underlying data used in the quantitative

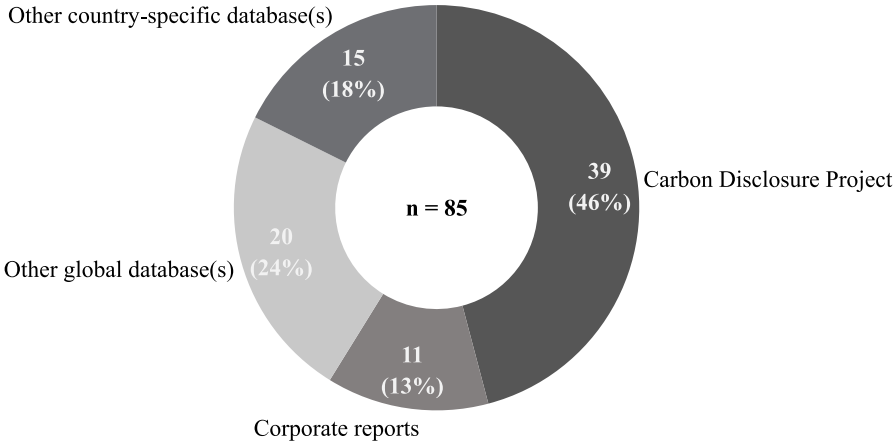

FIGURE 6 Data sources of quantitative analyses.

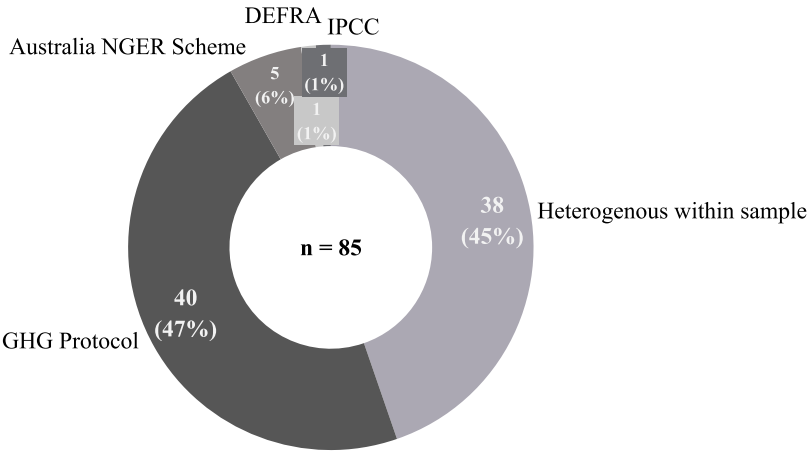

FIGURE 7 Standards used for emission data in quantitative analyses.

analyses. It shows that a high share of articles (45%) utilize data samples with varying calculation standards, which means that databases are used without ensuring that the same calculation standards are applied. Furthermore, it reinforces the importance of the GHG Protocol as the leading global standard, which is likely primarily driven by the fact that the CDP consistently applies the GHG Protocol as the standard of choice in their questionnaires.

Lastly, Figure 8 illustrates the different settings in which researchers conducted case studies. It shows that settings in universities, specific industries or sectors (e.g., cement production), and cities/states are dominant with more than 80% of case studies. In contrast, case studies of corporations, which would be the setting arguably most relevant to the corporate perspective of carbon emission reporting, are very rare (6%).

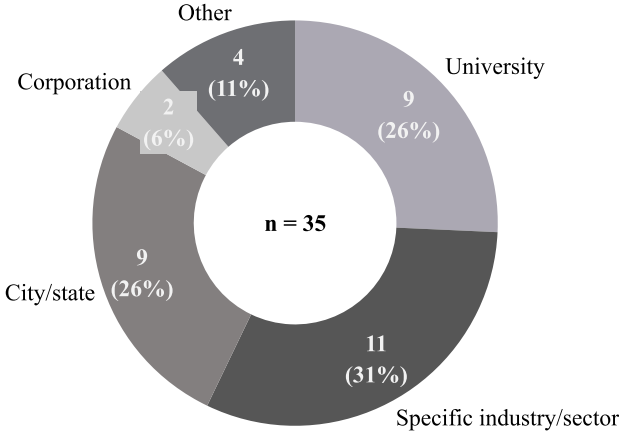

FIGURE 8 Setting of identified case studies.

3.2 | Framework of corporate carbon emission reporting research

During the process of our review, we iteratively structured the literature on corporate carbon emission reporting along a framework comprising the applied theoretical lenses, the characteristics of carbon emission reporting itself as well as its antecedents, consequences, and moderators. Figure 9 shows the final framework. A detailed description of the individual constituents of the figure can be found in the online appendix, section 2 of the supporting information.

4 | THE LITERATURE ON SCOPE 3 EMISSIONS

In the following chapter, we systematically lay out the results of the 62 articles that explicitly address scope 3 emissions along the structure of our research framework. The results of our analyses regarding theoretical lenses are provided in the online appendix, section 3 of the supporting information.

4.1 | Antecedents

4.1.1 | Regulation

Regulatory framework

As of today, corporate scope 3 carbon emission reporting is not mandated within any national or international regulatory frameworks. Consequently, this type of corporate reporting is currently entirely voluntary (Blanco, 2021).

This voluntary nature hinders a widespread adoption of corporate scope 3 emission reporting in practice. For example, Patchell (2018) argued that as long as it is voluntary, firms will only report scope 3 emissions if they envision a tangible financial benefit. Tang and Demeritt (2018) found that regulatory pressure was the strongest factor for firms to perform carbon emission reporting according to the respective regulatory guidelines and explicitly suggest the hypothesis that if the regulatory framework included scope 3 emission reporting, firms would comply accordingly. In line with Patchell's findings, they add that perceived financial and/or reputational benefits are not sufficiently large to outweigh the efforts and potential disadvantages of disclosing scope 3 emissions. Hickmann (2017) seconds this by stating that firms need to receive a signal of upcoming regulatory changes in order to adopt novel carbon emission reporting and reduction practices.

Furthermore, low levels of experience with required corporate processes for scope 3 emission reporting make current policymaking ineffective. For example, Meng et al. (2017) argue that a feedback loop exists between corporate emission reporting and policymaking. Therefore, firms need to inform policymakers on their processes and experiences so that policymakers can take those into account when designing new regulation. Ozawa-Meida et al. (2013) and das Virgens et al. (2020) conducted case studies in which they both concluded that their specific insights from their case studies should be considered by policymakers to improve future regulation. Similarly, Klein-Banai and Theis (2013) analyzed 135 university emission reports and derived specific policy-related recommendations. Lai (2014)

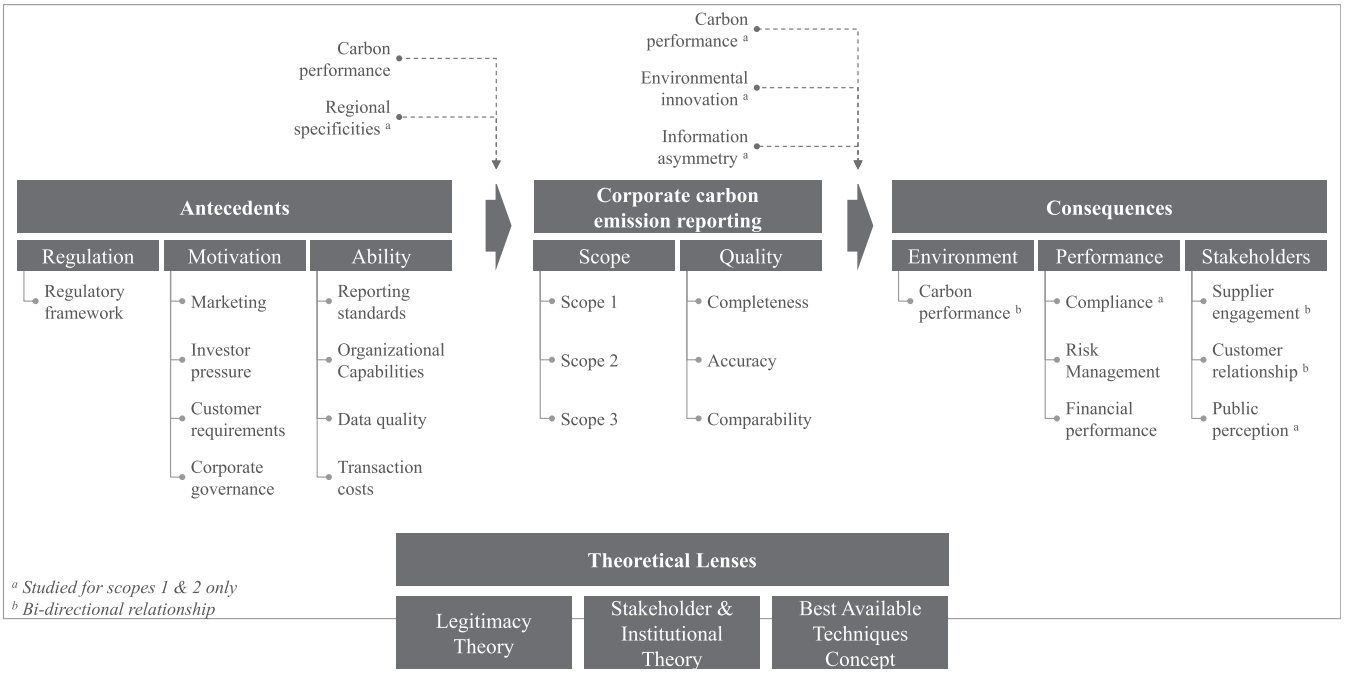

FIGURE 9 Research framework of corporate carbon emission reporting.

conducted a stakeholder survey in the building industry asking whether scopes 1, 2, or 3 carbon reporting should be mandatory. He found that the more experienced the stakeholders were with the topic, the higher the agreement to mandatory reporting was. However, their agreement was also higher for scopes 1 and 2 than for scope 3.

4.1.2 | Motivation

Marketing

Several studies found that corporate scope 3 carbon emission reporting is used as a marketing tool. For example, Tang and Demeritt (2018) demonstrate that perceived image benefits are a strong motivational factor for firms to voluntarily disclose carbon emission information. They add that it contributes to a public perception of professionalism and strong leadership. de Abreu et al. (2021) added nuance by suggesting that the expected image benefits from scope 3 reporting vary by region and sector.

However, not impairing a firm's image can also be an important reason *not* to use scope 3 reporting in marketing. For example, Linares-Rodríguez et al. (2022: p.1) argue that "companies are not willing to disclose information that sends a negative signal of their environmental actions to the stakeholders". Consequently, a firm's carbon performance, that is, its carbon emissions over time and compared to its peers, has a moderating effect on using scope 3 reporting for marketing purposes.

Researchers further found that corporate scope 3 reporting is often used for greenwashing, that is, purposely spinning the disclosure of information so that it leads to a better perceived image or idea of a firm than the actual behavior of the firm would justify. For example, Blanco (2021) conducted an analysis of voluntary climate change disclosures of global firms and found that firms purposely disclose positive climate-related information while withholding negative information. Depoers et al. (2016) further suggest that managers adapt their strategy for voluntary carbon information disclosure based on the needs of the addressed stakeholder groups. They would interpret information with respect to the firm's image which, among other things, leads to firms disclosing different information in annual corporate reports and reports to the CDP.

Investor pressure

As is the case for many other corporate activities, pressure exerted by investors to disclose information is a key antecedent of corporate scope 3 carbon emission reporting. For example, Busch et al. (2022) expect corporate scope 3 emission reporting to ramp up as investors continue to request scope 3 emission information. In a survey-based analysis, Tang and Demeritt (2018) collected several statements from corporate representatives who pointed out that investors increasingly request information concerning scope 3 carbon emissions and potential reduction pathways. Similarly, Linares-Rodríguez et al. (2022) suggest that investors increasingly consider environmental criteria in their investment decisions and firms therefore tend to provide more transparency on their carbon emissions.

In support of this idea, investors increasingly use scope 3 emission information as a proxy for firms' risks associated with their supply chain and potential climate regulation. One researcher explicitly identified this association in a quantitative analysis of climate change disclosures of global firms (Blanco, 2021). He argues that along with engaging suppliers on carbon footprint information, other risks such as physical, regulatory, or market impact risks can be identified.

Customer requirements

Scholars further consider adhering to customer requirements in the form of scope 3 emission disclosure as another important driver toward more widespread reporting. For example, Patchell (2018) points out that for a firm to determine its scope 3 carbon emissions, the firm's suppliers need to support it with data exchange and information sharing, that is, they need to fulfill additional requirements of their customers. Dahlmann and Rohrich (2019) analyzed this in more detail and compared types of customer–supplier engagement along multiple dimensions (e.g., purpose, timeframe, and information asymmetry). Their analysis supports Patchell's view on the pursued collaboration that suppliers show when addressing customer requirements on carbon emission information.

Corporate governance

Corporate governance is an important driver for climate-related behavior of a firm, including scope 3 emission reporting. For example, Ben-Amar and McIlkenny (2015) found a positive association between board effectiveness and voluntary disclosure to the CDP. In addition, Hansen et al. (2022) found that despite having very similar value chains, some firms in the food industry do and some do not report scope 3 emissions. They argue that this cannot be solely attributed to a lack of common methodologies but must also be due to a firm's governance and leadership's sense of urgency on sustainability.

The adoption of a corporate carbon management strategy can have a positive impact on corporate carbon emission reporting. For example, the results of Linares-Rodríguez et al. (2022) suggest a positive relationship between the adoption of a corporate carbon management strategy and emission reporting for scopes 1 and 2. They also investigated corporate scope 3 reporting, but the corresponding results were not conclusive.

4.1.3 | Ability

Reporting standards

As of today, the standardization of corporate carbon emission reporting, and scope 3 emission reporting in particular, is primarily driven by NGOs, namely the GHG Protocol. Hickmann (2017: p.5) explicitly underlines this: "the GHG Protocol has filled a regulatory gap in global climate policy-making by providing the means for individual companies to comprehensively calculate and communicate their emissions."

Two standards are relevant for corporate scope 3 carbon emission reporting. For one, there are product carbon footprint (PCF) standards, that is, standards that determine how the footprint of individual products or product groups needs to be calculated to enable suppliers to communicate the footprint of their products to their customers. For another, there exist corporate carbon footprint (CCF) standards, that is, standards that determine how the footprint of a firm, split into scopes 1–3, needs to be calculated to enable firms to report and communicate their emissions to the public.

Several researchers investigated existing standards for PCF and CCF, and many have criticized them as being incomplete, inaccurate, and difficult to execute in practice. For example, Patchell (2018) has created a comprehensive evaluation scheme for the GHG Protocol "Corporate Value Chain (Scope 3) Accounting and Reporting Standard", in which he evaluates the standard along six dimensions: Transaction cost, power, responsibility allocation, uncertainty, location contingency, and production costs. Overall, he doubts that current standards are sufficient to enable firms to fully report their scope 3 emissions.

Many other researchers also find the current standards to be partially unclear and causing inaccurate corporate scope 3 emission reporting, and therefore request more standardized approaches and solutions. For example, Robinson et al. (2015: p.8) investigated scope 3 carbon emission reporting at a university and concluded that "methods for assessing Scope 3 emissions urgently need refining and standardizing". In a recent study within the food industry, Hansen et al. (2022: p.9) further argue that "Sector-specific guidance and reporting requirements for companies in the food system could distinguish an additional Scope 3 category". Similar findings were obtained by Wei et al. (2020), Feng et al. (2015), Li et al. (2013), Guereca et al. (2013; Talbot and Boiral), Talbot and Boiral (2013), and Sykes et al. (2019) in their various case study analyses.

In addition, multiple other researchers propose more accurate calculation techniques compared to those in the current standards. For example, Yu et al. (2020) developed a specific framework for emissions accounting of industrial parks in China. Brander (2017) compared the accuracy of "attributional" (i.e., emissions determined via allocation key) and "consequential" (i.e., emissions determined via bottom-up calculation) calculation methods. He concluded that attributional calculations, as mostly used in standards, may not capture all emissions while consequential calculations are more accurate. Vasquez et al. (2015), Clabeaux et al. (2020), Kulkarni (2019), and Robinson et al. (2018) all conducted similar analyses on the advantages of a bottom-up approach for calculating a university's carbon footprint and confirmed Brander's view. Alvarez et al. (2019) analyzed the application of a compound hybrid analysis for the improvement of carbon footprint calculations as part of a case study of a Spanish timber firm. They found that their approach improves accuracy and efficiency, and reduces costs. Similar findings on the application of hybrid calculation methods were obtained by multiple other research teams (Alvarez et al., 2014; Brown et al., 2012; Lenzen & Murray, 2010; Li et al., 2021; Lin et al., 2013; Lin et al., 2019; Qi et al., 2018).

Researchers have also found evidence that corporations actively use the disadvantages and shortcomings of the current standards to their own advantage. For example, Depoers et al. (2016) found that managers adapt their disclosure strategy to address the preferences of different stakeholder groups and that the vagueness of standards allows them to do this. In support of this notion, Dragomir (2012: p.1) concluded that "given the sophistication of emissions data collection and estimation tools such as the Greenhouse Gas (GHG) Protocol, it comes as a surprise that [studied companies] have issued reports containing unexplained figures and methodological inconsistencies".

Organizational capabilities

Early research on corporate scope 3 carbon emission reporting often argues that a lack of know-how and capabilities in corporations is a critical factor for limited in-practice application of scope 3 reporting. For example, one research team found that a lack of knowledge on how to measure and report scope 3 emissions was a key reason why firms did not disclose information to the CDP at all (Blanco et al., 2016). Isil and Sebastianelli (2020) further found that awareness levels for value chain carbon emissions are generally limited and are lower for firms' downstream compared to their upstream activities.

Researchers also pointed toward the need for additional guidance from academia, NGOs, or regulators. For example, Downie and Stubbs (2013: p.156) suggested already in early research that "more comprehensive guidance on relevant emission sources by industry or sector would likely improve the completeness and relevance of inventories in accordance with the Greenhouse Gas Protocol". In support of that, Blanco et al. (2016) specifically point out that the execution of scope 3 reporting can be more complicated in some industries than in others.

Researchers have also identified learning effects from the execution of scope 3 reporting over time. For example, Matisoff et al. (2013) found evidence for a positive learning effect from participating in the CDP. However, they also point out that this can vary by segment or emission type. Isil and Sebastianelli (2020) identified a similar pattern and suggest that the more advanced general carbon reporting practices are, the better is the awareness of scope 3 carbon emissions.

Furthermore, studies indicate that effective corporate scope 3 reporting requires specific organizational structures and systems to be established. For example, Patchell (2018) outlines that a key contributor to transactions costs is coordination effort, which primarily entails setting up the organizational structure and internal communication needed to coordinate the execution of data management, stakeholder engagement, accounting, and reporting. Tang and Demeritt (2018) add that the amount of additional organizational effort depends on sector and other previous experiences of a firm. For example, highly energy-intensive firms have an advantage because their operational units are already used to handling similar energy-related information and can therefore transfer their reporting structures more easily, while non-energy intensive firms often need to establish entirely new processes and departments from scratch.

Lastly, over the past years, carbon reporting has grown into a board-level topic with a strong bearing on the job of key executives. For example, Tang and Demeritt (2018) found that in many firms, a board-level sign-off of annual corporate emission reports is now required. They conclude that the topic receives increasingly more attention from top management, and we might therefore see an uptick in adoption. Furthermore, one study found that a growing number of firms have introduced incentives and employee awards for the advancement of a firm's knowledge and impact on climate change (Blanco, 2021).

Data quality

Many researchers identified data quality, or rather a lack thereof, as a key problem in corporate scope 3 reporting. For example, Busch et al. (2022) comprehensively evaluated the data quality of corporations for scopes 1–3 emissions separately and demonstrated that availability, comparability, and consistency of data remain problematic, particularly for scope 3 carbon emission reporting. Similarly, Wegener et al. (2019) emphasize effects of low data quality as they suggest that it causes uncertainty, which in turn reduces the comparability of scope 3 reports.

Scholars also point toward the importance of data quality for the emission calculation procedure. For example, Ghaemi and Smith (2020) argue that a lack of high-quality data strongly hinders the accurate quantification of the full carbon emission profile. Other studies highlight the issue of double counting as a critical problem for completeness and accuracy driven by misunderstandings on the responsibility for certain emissions (e.g., transportation emissions), the application of varying standards, or other reasons (Busch et al., 2022; Patchell, 2018; Robinson et al., 2018). Furthermore, the use of secondary emission factors instead of original primary data from lifecycle assessment models further contributes to inaccurate scope 3 emission reporting (Downie & Stubbs, 2012). This finding is reaffirmed by Busch et al. (2022) who underscore that data stemming directly from reporting companies are significantly more reliable than secondary data from survey data, third-party estimation methods, or global average emission factors.

Several researchers also acknowledge that obtaining high-quality data for corporate scope 3 emission reporting is very difficult. For example, Patchell (2018) points out that it requires high operational efforts, particularly driven by the data gathering process. Multiple research teams further emphasized that complex lifecycle analyses are needed to produce high-quality data (Cankaya & Pekey, 2019; Khoo et al., 2017; Villena & Dhanorkar, 2020). For example, Villena and Dhanorkar (2020) specifically outline that large operational efforts are needed to engage with a firm's supplier base to receive and evaluate the data.

Transaction costs

The high organizational and operational efforts required for corporate scope 3 carbon emission reporting create significant transaction costs. Several researchers emphasize this as a key issue (Dahlmann & Rohrich, 2019; Isil & Sebastianelli, 2020; Patchell, 2018). For example, Patchell (2018) provides a comprehensive view on the individual factors that drive transaction costs and defines five main contributors to transaction costs: Complexity, information quality, coordination, opportunism, and real costs of transactions. He mainly attributes the problem of high transaction costs to the efforts of engaging with stakeholders to measure and manage emissions, setting up the required organizational structure for coordination, and ensuring sufficient reporting quality. He describes transaction costs as the most critical antecedent hindering a more successful implementation of corporate scope 3 carbon emission reporting in practice.

4.2 | Consequences

4.2.1 | Environment

Carbon performance

Corporate scope 3 carbon emission reporting is an important enabler for effective carbon emission reduction. For example, Rietbergen et al. (2015) found that accurate emission reporting is a critical prerequisite for subsequent target setting which is in turn needed to ensure effective emission reduction. This is reaffirmed by Downie and Stubbs (2013: p.156) who argue that "a lack of knowledge of scope 3 emissions inhibits a firm's ability to pursue the most cost-effective carbon mitigation strategies". Furthermore, multiple researchers point out that accurate scope 3 reporting creates the required transparency to pinpoint emission sources that leads to more effective steering of reduction actions (García Alaminos et al., 2022; Liu et al., 2021; Takayabu et al., 2019). In accordance with that, several researchers explicitly showed that scope 3 reporting is critical for target setting, monitoring, and steering of reduction pathways (Meng et al., 2017; Ozawa-Meida et al., 2013; Sudmant et al., 2018; Villalba et al., 2013; Wiedmann et al., 2021).

Scholars further identified the currently voluntary nature of corporate scope 3 emission reporting as an inhibitor for scope 3 emission reduction. For example, Alvarez et al. (2019) claim that because it is voluntary, many firms currently do not report their scope 3 emissions, which in turn slows down scope 3 emission reduction.

In addition, poor scope 3 carbon emission reporting can lead to "carbon leakage", that is, actually occurring carbon emissions not being captured in reporting and thus not being accounted for. For example, Wei et al. (2020) consider opacity around reporting standards and deliberate or accidental exclusion of certain activities as the key reasons for leakage of scope 3 carbon emissions.

Furthermore, the relationship between scope 3 emission reporting and scope 3 emission reduction can also be interpreted as bidirectional. For example, Braam et al. (2016) indicate that firms' decisions to report scope 3 emissions are influenced by their emission performance relative to their peers. They argue that, according to legitimacy theory, poor performers would need to report more comprehensively on scope 3 emissions than high performers to reach the same level of legitimacy.

4.2.2 | Performance

Compliance

Compliance is not yet established as a consequence of corporate scope 3 carbon emission reporting. As of today, scope 3 reporting is not mandatory anywhere and therefore a firm cannot be compliant with any regulatory framework in that regard. However, prior research has acknowledged compliance as a consequence of general corporate carbon emission reporting (Patchell, 2018).

Risk management

Researchers identified corporate scope 3 carbon emission reporting as a supply chain risk management tool. Corporations' risk management often focuses on its supply chain, and scope 3 emissions are interpreted as an indicator of climate-related risks and opportunities along the supply chain (Dahlmann & Rohrich, 2019). For example, one researcher explicitly argues that "measuring supply chain carbon emissions can lead to the discovery of potentially hidden risks related to climate change" and emphasizes the potential consequences of severe weather conditions, floods, and droughts (Blanco, 2021: p.4). Nguyen et al. (2021) developed a machine learning approach intended to predict corporate carbon footprints and thereby identify risks related to climate change.

The extent of associated risks can vary between developed and developing countries. In this regard, Blanco (2021) explains that the occurrence of such risks and available resources to withstand them can vary regionally. For instance, suppliers may be located in countries where such conditions may occur more frequently, and consequently, customers of such suppliers are exposed to higher risk. In-depth transparency on scope 3 emissions can allow firms to identify such suppliers and associated risks.

In addition to that, corporate scope 3 emissions can approximate regulatory risk. Potentially changing regulation has been identified as an important new risk type for businesses in the era of climate change, and firms employ various strategies to better understand their regulatory risk (Dahlmann & Rohrich, 2019). One researcher points out that the higher the emissions from a certain area in the supply chain, the higher the impact of potentially tightening regulation. Consequently, suppliers may not be able to supply certain goods or services anymore or even go bankrupt. He concludes with "firms that do not measure their Scope 3 may not realize the magnitude of their contribution to climate change and their potential physical and regulatory exposures to risks" (Blanco, 2021: p.14).

Financial performance

Corporate scope 3 emission information is an important parameter for investors when making an investment decision. Blanco (2021) claims, as previously outlined, that investors interpret scope 3 emissions as a proxy for regulatory and supply chain-related risks and are therefore highly interested in this type of information. He points out that investors already use scope 3 disclosures to inform their investment decision. Busch et al. (2022) further emphasize that improvements in the quality of available data are critical to providing investors with full transparency.

Scholars have not yet conducted relevant research on a direct relationship between corporate scope 3 emission reporting and profitability. Patchell (2018) provides a line of reasoning to suggest that scope 3 reporting is only financially beneficial if in line with customer environmental demands. His argumentation assumes that environmental reporting, if demanded by customers, drives a higher willingness to pay, that is, a "green premium". However, this research does not contain empirical results on a direct relationship.

4.2.3 | Stakeholders

Supplier engagement

As a result of corporate scope 3 reporting, engagement with suppliers becomes increasingly collaborative, especially due to the need to exchange growing amounts of data. For example, Dahlmann and Rohrich (2019) found that engagement differs across various dimensions (e.g., purpose or information handling) and that firms apply three types of engagement: Basic, transactional, and collaborative engagement. In a case study of the UK food supply chain, Tidy et al. (2016) found that engagement became increasingly collaborative as a result of the pursuit of scope 3 emission reporting and subsequent reduction. Consequently, there exists a bidirectional relationship between firms' scope 3 carbon emission reporting and supplier engagement.

Various studies identified a need for dedicated approaches or strategies for supplier engagement. For example, Villena and Dhanorkar (2020) found that coercive pressures (i.e., rules and regulation) from buyers are the strongest driver for suppliers to increase carbon emission reporting. They further found that suppliers without climate change incentives are more vulnerable to coercive and mimetic pressure (i.e., imitating of or seeking superiority over competition), while suppliers with climate change incentives are more receptive to normative pressure (i.e., norms in and expectations of society). Dhanda et al. (2022: p.1) reaffirm these findings in their analysis on institutional and stakeholder consequences on carbon mitigation strategies by stating that "our research indicates that different types of institutional pressures [...] lead to different and, in certain situations, more active responses from firms. We find that coercive pressures are about equal or more effective than normative or mimetic pressures for adoption of mitigation strategies".

The balance of negotiation power further influences the willingness of suppliers to provide information. For example, Patchell (2018) points out that firms with high negotiation power over their suppliers are more likely to convince them to share primary data than firms with lower negotiation power.

Customer relationship

In line with the findings on supplier engagement, customer relationships become more collaborative as well. As outlined in the section on antecedents, adhering to customer requirements is an important driver for scope 3 carbon emission reporting. The different types of customer–supplier engagement, as outlined by Dahlmann and Rohrich (2019), apply to the consequence of customer relationships as

TABLE 1 Research agenda for antecedents.

Antecedent	Exemplary references from literature on general carbon emission reporting	Exemplary insights from references	Future research pathway
Regulation: Regulatory framework	Ana et al., 2019; Bauckloh et al., 2022; Grauel & Gotthardt, 2016; Hahn et al., 2015; Haque & Ntim, 2018; Kansal et al., 2018; Kim et al., 2022; Kozlovski & Bawah, 2015	Positive relationships between implementation of regulation and emission reporting	Measure consequences of regulation around scope 3 emission reporting on a local, sectoral, or other level (once introduced)
	-	-	Apply qualitative research methods to assess how managers deal with uncertainty around regulation on scope 3 reporting
	Allini et al., 2018; Kouloukoui et al., 2021; Mateo–Márquez et al., 2022; Muttakin et al., 2021; Muttakin et al., 2022; Patnaik, 2020; Scholtens & Kleinsmann, 2011; Velte et al., 2020; Zhang et al., 2022	Regional aspects (common-law tradition, related environmental and social policies, culture, democratic values, level of economic development, etc.) influence relationship	Investigate moderating effects of regional specifics on relationship between regulation and corporate scope 3 reporting
	Khan et al., 2022; Zhang et al., 2020	Availability of human resources and established processes are critical for effective auditing	Assess capabilities and requirements for auditing of corporate scope 3 reports
	Bauckloh et al., 2022; Kirsten, 2014; Qian et al., 2020; Yu et al., 2022	Most studies found positive relationships between regulation and carbon performance; Kirsten (2014) criticized "carbon leakage" via accounting loopholes	Investigate potential direct relationship between regulation and scope 3 carbon performance
Motivation: Marketing	Coen et al., 2022; Cong et al., 2020; Guo et al., 2020	Firms with poor carbon performance often do not report scope 3 to not impair image; however, not reporting at all may be worse than reporting poor performance	Assess if and how carbon performance moderates relationship between marketing and corporate scope 3 reporting
	Wedari et al., 2021	Found evidence for greenwashing among poor environmental performers while such evidence could not be found among good environmental performers	Review "greenwashing" practices among corporate scope 3 reporting
Motivation: Investor pressure	Albarrak et al., 2019; Herbohn et al., 2019	Investors increasingly request carbon risk information	Investigate role of investors in motivating firms to disclose scope 3 (e.g., via quantitative analyses of actual investment cases and public announcements)
	Velte et al., 2020	Variations in shareholder rights, investor protection, tax law, and other factors may moderate this relationship	Analyze if and how regional specifics moderate relationship between investor pressure and corporate scope 3 reporting
Motivation: Customer requirements	-	-	Explore what (non-)financial benefits customers associate with the reported information (e.g., via case studies in high-emission industries with a large share of scope 3 emissions, for example, the automotive industry)
Motivation: Corporate governance	Ben-Amar et al., 2022; Bento & Gianfrate, 2020; Hsueh, 2019; Karim et al., 2021; Moussa et al., 2020; Reid & Toffel, 2009; Sullivan & Gouldson, 2017; Weinhofer & Hoffmann, 2010	Application of such tools positively influence corporate carbon reporting	Assess impact of corporate strategy tools (e.g., overarching decarbonization strategy, internal carbon pricing or governance on capital expenditure) on corporate scope 3 reporting

(Continues)

TABLE 1 (Continued)

Antecedent	Exemplary references from literature on general carbon emission reporting	Exemplary insights from references	Future research pathway
	Adu et al., 2022; Ben-Amar et al., 2017; Bui et al., 2021; Nuber & Velte, 2021	Found positive relationships for general carbon reporting	Assess role of corporate leadership (e.g., via board gender diversity or board salary incentives) on corporate scope 3 reporting
Ability: Reporting standards	Nordenstam et al., 2018	Some aspects of GHG Protocol standard for scope 1 could influence managerial decision-making in counterproductive ways	Run additional reviews on scope 3 reporting standards beyond the review by Patchell (2018) (e.g., investigate or compare other standards, or dive deeper into how standard affects managerial decision-making)
	-	-	Conduct quantitative analyses on how adherence to different scope 3 standards affects completeness, accuracy, and/or comparability of scope 3 reports
Ability: Organizational capabilities	Jabbour et al., 2020	Conducted specialist interviews and applied analytical approach called "mechanisms of responses" to design action-oriented framework for managers	Apply qualitative research on how required capabilities can be identified, assessed, and developed
	Jabbour et al., 2020; Weinhofer & Hoffmann, 2010; Zhang et al., 2020	Point towards need to develop additional know-how, instill organizational change through overarching corporate carbon management strategies, and prevent a lack of talent	Dive deeper into organizational implications of corporate scope 3 reporting (e.g., via qualitative/case study research within corporate settings)
Ability: Data quality	Diniz et al., 2021; Seles et al., 2018	Blockchain can significantly improve accuracy, traceability, and verification processes of underlying data; big data unlocks opportunities in carbon management	Better understand accuracy and data quality differences between primary data from suppliers and secondary emission factors/ industry averages (e.g., via application of emerging technologies such as blockchain, artificial intelligence, or big data)
	Goldhammer et al., 2017; Qian et al., 2018; Seles et al., 2018; Shahgholian, 2019	Application of novel environmental management accounting tools improves corporate carbon management and disclosure quality	Conduct analyses on organizational data management tools and their effectiveness
	-	-	Apply qualitative research methods to assess how managers deal with uncertainty around scope 3 emission data
	-	-	Analyze how comparability among scope 3 reports can be improved (e.g., review if managers compare absolute scope 3 figures or if they compare scope 3 to scopes 1 and 2)
	-	-	Review if and how firms measure scope 3 even if they do not report yet
	-	-	Explore potential solutions for improving data quality and mitigating associated operational efforts and costs (e.g., collaboration on data collection, regulatory

TABLE 1 (Continued)

Antecedent	Exemplary references from literature on general carbon emission reporting	Exemplary insights from references	Future research pathway
			changes, application of novel technologies, etc.)
Ability: Transaction costs	Diniz et al., 2021	Blockchain can reduce costs associated with emission reporting	Identify pathways for transaction cost reduction (e.g., via application of emerging technologies such as blockchain, artificial intelligence, or big data)
	Robinson et al., 2018	Developed "cut-off criteria" system (incremental improvement of reporting quality vs incremental transaction cost) to find optimum between reporting quality and transaction cost	Analyze impact of incremental scope 3 reporting quality improvements onto transaction costs
All	-	-	Conduct citation mapping to identify further promising avenues for future research

well. Therefore, the relation between scope 3 reporting and customer relationships can also be described as bidirectional. However, Lintukangas et al. (2022) found that scope 3 reporting practices do not affect customer relationships as strongly as supplier relationships.

Public perception

There is no dedicated research on the particular impact of scope 3 reporting on a firm's public perception. Extant research so far only focused on general carbon reporting (e.g., Khan et al., 2022).

5 | AGENDA FOR FUTURE RESEARCH

In this chapter, we build on our review to identify gaps in the literature on scope 3 emissions and leverage studies on general carbon emission reporting to develop a comprehensive research agenda for corporate scope 3 reporting. We do so along the research framework for corporate carbon emission reporting shown in Figure 9. Table 1 illustrates the research agenda for antecedents, and Table 2 illustrates the research agenda for consequences. The research agenda for theoretical lenses is provided in the online appendix, section 4 of the supporting information.

6 | DISCUSSION

The conversation around corporate scope 3 carbon emission reporting within the academic literature on sustainable management experienced a significant uptick in recent years. In the following chapter, we aim to lay out patterns and gaps that we identified.

The studies displayed a few striking methodological commonalities and differences. First, the large majority (~80%) of quantitative studies used panel data instead of cross-sectional data. Thus, researchers deemed it important to analyze temporal developments rather than momentary statuses. Second, we identified a wide discrepancy among the sample sizes used for quantitative studies as almost as many studies used samples with less than 100 firms as with more than 500 firms. Conclusions drawn from studies with smaller sample sizes might have to be treated with more caution. Third, the literature comprises a relatively high share of case studies and low share of quantitative research. This suggests that we are early in the development of the field, where a lot of work is still theory building rather than theory testing, and that there may not be enough data available, so researchers are limited to more qualitative work.

Furthermore, operationalization (i.e., data collection, measurement, and calculation procedures) of carbon emission reporting appears to be of upmost importance but still requires additional research regarding scope 3 emissions. The issue of obtaining high-quality data for scope 3 reporting is emphasized by several studies specifically referring to key pain points such as double counting, the use of lifecycle assessment models, and the accuracy of secondary and survey data (Busch et al., 2022; Patchell, 2018; Robinson et al., 2018; Wegener et al., 2019). However, scholars have yet to investigate whether firms actually measure scope 3 emissions internally even if they do not report them, and how firms use and compare scope 3 emission figures in practice. Furthermore, future research might also wish to focus on exploring potential solutions for improving data quality and mitigating associated operational efforts and costs (e.g., collaboration on data collection, regulatory changes, and application of novel technologies such as blockchain, artificial intelligence, or big data).

The way firms manage uncertainty (regarding the comprehensiveness, reliability, and validity of scope 3 emission reports) constitutes another critical area for additional research in this space. Overall, several researchers acknowledge this issue and point toward low levels of comprehensiveness (Blanco et al., 2016; Busch et al., 2022; Hansen et al., 2022). The high use of CDP data is most likely attributable to the fact that the CDP consistently applies the same questionnaire

TABLE 2 Research agenda for consequences.

Consequence	Exemplary references from literature on general carbon emission reporting	Exemplary insights from references	Future research pathway
Environment: Carbon performance	Bang et al., 2019; Bauckloh et al., 2022; Greenblatt, 2015; Luo et al., 2020; Sun et al., 2022; Wu et al., 2010	Applied analytical approaches such as forecasting, development of new KPIs, benchmarking exercises, case studies in corporate settings, or impact analyses of recent events	Investigate if and how firms use information contained within scope 3 reporting to generate insights that ultimately improve carbon performance
	Ioannou et al., 2016; Rietbergen et al., 2015	Targets are often not ambitious enough to drive sufficient carbon performance; high-quality reporting can improve target setting process	Assess how scope 3 emission reports can help managers formulate carbon performance targets (especially aim to understand how effect sizes of reduction actions are measured and evaluated)
	Wedari et al., 2022	Identified positive moderating effect from environmental innovation on relationship between general carbon performance and financial performance	Analyze potential moderating effect of environmental innovation on relationship between scope 3 reporting and carbon performance
	Cong et al., 2020; Giannarakis et al., 2017; Velte et al., 2020; Wedari et al., 2021	Contradictory results: Most suggest that the better a firm's carbon performance, the more likely the firm is to extensively report and vice versa. On the other hand, Cong et al. (2020) found evidence that firms with poorer carbon performance tend to disclose emissions more extensively to mitigate the consequences of their poor performance	Assess the reverse effect of scope 3 performance on scope 3 carbon reporting
Performance: Compliance	Jung et al., 2018; Kouloukoui et al., 2021; Kouloukoui et al., 2019; Lemma et al., 2020; Sakhel, 2017	Consider compliance as a key consequence of general emission reporting; identified regulatory changes as a key risk perceived by managers	Assess compliance as a potential consequence of corporate scope 3 carbon emission reporting (e.g., expert interviews)
Performance: Risk management	-	-	Analyze how scope 3 reporting can mitigate supply chain-related risks (supply shortages, supplier bankruptcy, etc.) using quantitative analyses/case studies in recently effected sectors like semiconductor industry promising
Performance: Financial performance	Alsaifi et al., 2020; Gallego-Alvarez et al., 2014; Gerged et al., 2021; Lemma et al., 2019; Lemma et al., 2021; Lewandowski, 2017; Matsumura et al., 2014; Morrone et al., 2022; Palea & Santhia, 2022; Tuesta et al., 2021; Yu et al., 2021; Zhou et al., 2018	Positive relationships between carbon reporting and profitability and stock price; for cost of capital, some suggest that investors penalize disclosure while others indicate that investors appreciate disclosure	Investigate direct relationship between scope 3 reporting and financial performance—for example, quantitative analyses based on scope 3 data and financial indicators (profitability, stock price, cost of capital, etc.)
	Busch et al., 2022; Ferrat, 2021; Hassan & Romilly, 2018; Lewandowski, 2017; Misani & Pogutz, 2015	No clear picture: Some indicate positive relationship while others suggest emission reduction affects financial performance negatively (For example, Lewandowski (2017) found U-shaped carbon performance curve while Ferrat (2021) found that short-term financial performance was negatively affected by improved carbon performance and that solely	Investigate moderating effect of carbon performance on relationship between scope 3 reporting and financial performance

TABLE 2 (Continued)

Consequence	Exemplary references from literature on general carbon emission reporting	Exemplary insights from references	Future research pathway
		high-materiality firms derive improved financial performance in long run)	
	-	-	Analyze how carbon pricing affects financial performance (simulate carbon missions as actual cost in financial analysis)
	Lemma et al., 2021; Yu et al., 2021	Reduced information asymmetry makes investors lower costs of capital	Assess how information asymmetry moderates relationship between scope 3 reporting and financial performance
Stakeholders: Supplier engagement	-	-	Apply qualitative research/case studies to explicitly investigate collaborative engagements of firms with suppliers to collect primary data and include PCFs in supplier selection processes
Stakeholders: Customer relationship	Tang & Demeritt, 2018	Voluntary scope 1/2 reporting considered as unique selling point	Investigate benefits of using PCFs at point of sale—industries in which PCF varies strongly by supplier (e.g., metals/mining) promising
Stakeholders: Public perception	Albarrak et al., 2019; Khan et al., 2022	Higher scope 1/2 reporting quality leads to better public reputation	Assess impact of scope 3 reporting on public perception or media coverage
All	-	-	Conduct citation mapping to identify further promising avenues for future research

structure and therefore represents a trustworthy data source. Also, the high use of CDP data may have further led to the observation that the GHG Protocol is by far the most frequently used reporting standard. The high share of samples with heterogeneous application of reporting standards must be seen as problematic as it threatens comprehensiveness and comparability. The methodological approach of manually collecting data from annual reports or using global databases may be the root cause of that problem as it is not very robust because it theoretically allows the inclusion of firms with different standards in samples. Overall, poor data quality and high uncertainty may be the reason for the rather limited empirical research focus so far.

Additionally, we need to establish a better understanding of the motivations for scope 3 reporting, conceivably via the explicit application of theoretical lenses. So far, theoretical lenses have been applied scarcely in scope 3 emissions research. However, results from studies on scopes 1 and 2 indicate that they could help understand how managers deal with uncertainty and why they decide for or against scope 3 reporting.

Overall, we strongly emphasize the need for additional research, especially for the consequences of scope 3 carbon emission reporting. Particularly, we urge scholars to conduct additional research on carbon performance to better estimate the importance of scope 3 reporting for subsequent carbon emission reduction as a means to advance supply chain decarbonization. Studies on scopes 1 and 2 emissions indicate promising results in this regard.

7 | PRACTICAL IMPLICATIONS

Our findings also have important implications for practitioners. First, our insights on operationalization and uncertainty management may influence how managers conduct scope 3 emission reporting. For example, transaction costs and financial performance, especially investor reaction, are critical parameters in managers' decision making. Poor reporting may cause managers to miss the bigger picture of their firms' emission profile and ultimately slow down supply chain decarbonization.

Second, our findings, especially on regulation, reporting standards, and firm capabilities, may help policymakers design future regulations. The extant literature makes it clear that the voluntary nature of scope 3 reporting hinders wider adoption in practice. Hence, policymakers may want to re-design regulation, while considering what today's firms are capable of, to effectively promote scope 3 reporting.

8 | LIMITATIONS

Naturally, this literature review is subject to limitations. Most importantly, there are limitations inherent in the process of identifying relevant literature. While we aimed for a comprehensive search in the field of business and sustainable management, our review may have missed some relevant articles due to filtering by keywords or journals.

In addition, the terms "carbon reporting" and "carbon performance" are often used in a more general manner. Therefore, differentiation between scopes is not always entirely clear and can potentially mislead as statements about scope 1 could be interpreted as if made about scope 3. Therefore, we treated potentially affected articles with particular caution.

9 | CONTRIBUTION AND CONCLUSION

With respect to the academic understanding of corporate carbon emission reporting, we contribute to the literature in the form of providing a comprehensive research framework, laying out the extant research on corporate scope 3 carbon emission reporting, breaking down its complexity, and enabling other researchers to efficiently advance the academic understanding in this field. Our research framework is compatible with but substantially extends prior frameworks into a more comprehensive version by integrating additional parameters and outlining critical relationships. The results of our review further provide an easy-to-understand and holistic structure that allows researchers to quickly absorb the key aspects of the academic literature on this topic. The identified patterns may help further stimulate the discussion on this important topic and pinpoint valuable insights.

We further contribute through our extensive agenda for future research. Beyond suggesting that researchers consider a wider range of theoretical approaches, our research agenda highlights various potential pathways for future research based on both qualitative and quantitative research. The provision of key insights from referenced work on scopes 1 and 2 emissions may be particularly helpful in that regard. As of today, scholars have seized only a fraction of the rich research opportunities that this field has to offer. Thus, we are hopeful that our review will enable researchers to make use of existing knowledge more effectively, build on it to contribute to the advancement of the field, and ultimately contribute to the actual decarbonization of supply chains.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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