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Case Report

Examining the Carbon Management Strategies of Diebold Nixdorf

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Abstract

Carbon management is imperative to curb global temperature increases and mitigating climate change impacts. This report explores the carbon management strategies employed by Diebold Nixdorf, a multinational financial and retail technology company. As of 2021, the company has not established specific reduction targets and has not committed to achieving net zero emissions. The company employs diverse carbon reduction strategies, such as carbon offsetting, solar energy, and fleet improvements, with notable projects like the "green roof" initiative and a tree planting program contributing to carbon offsetting. Despite a gradual reduction in Scope 1 and Scope 2 emissions since 2015 and notable decreases in energy consumption and natural gas emissions from 2020 to 2021, Diebold Nixdorf falls short in revenue-adjusted emissions compared to competitors. Critical challenges within Diebold Nixdorf's carbon management strategies revolve around controversies related to carbon offsetting and uncertainties regarding the effectiveness of specific initiatives. Although an improved Carbon Disclosure Project (CDP) score and efforts in product sustainability showcase progress, the lack of specific targets remains a notable pitfall. The potential misuse of green labelling, considering significant carbon emissions from products, adds complexity to Diebold Nixdorf's carbon management approach. This report underscores the imperative need for substantial enhancements in the company's carbon management practices,

emphasising a realignment of values and a firm commitment to carbon reduction and net-zero goals in response to the severity of the climate crisis.

Keywords
Carbon management; Diebold Nixdorf; corporate sustainability; climate change mitigation; environmental, social and corporate governance (ESG)

1. Introduction

Human activities, fuelled by the release of greenhouse gases, have unequivocally led to global warming, evidenced by a 1.1°C increase in global surface temperatures from 2011 to 2020 [1]. With ongoing contributions from various sources such as land use, energy consumption, and production patterns, the consequences of anthropogenic climate change are already affecting weather and climate extremes worldwide [1]. Recognising the urgency of this issue, 195 nations committed to the Paris Agreement in December 2015, pledging to limit global temperature increases to well below 2°C, with an aspirational goal of 1.5°C, and striving for net-zero emissions by 2050 [2]. This landmark agreement has catalysed global efforts to achieve the net-zero target, with corporations emerging as crucial players in mitigating climate change. Corporations, significant contributors to greenhouse gas emissions, are increasingly acknowledging their role in climate action [3]. Driven by pressures from various stakeholders, including governments, investors, and the public, companies are committing to ambitious targets for achieving net-zero emissions by 2050 [4]. This shift in corporate behaviour aligns with the growing importance of carbon management strategies in addressing climate change challenge [5]. Carbon management strategies encompass a range of initiatives aimed at reducing a company's carbon footprint. This includes setting greenhouse gas (GHG) reduction targets, developing environmentally friendly products, enhancing energy efficiency, and improving supply chain practices [6]. The implementation of such strategies not only aligns with the global imperative to reduce emissions but also brings tangible benefits, including cost efficiency and increased revenues [4]. Despite the evident benefits, some companies remain hesitant to adopt carbon reduction commitments due to the perceived conflict with short-term profit maximisation goals [4]. The tension between immediate financial interests and long-term environmental sustainability poses a challenge for businesses in transitioning to carbon reduction strategies.

Diebold Nixdorf, a major multinational technology company, has undertaken initiatives to reduce its carbon footprint. The purpose of this report is to investigate Diebold Nixdorf's commitments, targets, reported reductions in greenhouse gas (GHG) emissions, and the strategies employed for emission reduction. The primary data for this report was derived from Diebold Nixdorf's Environmental, Social, and Governance (ESG) reports and Carbon Disclosure Project (CDP) submissions. As of the present, Diebold Nixdorf has not established significant emission reduction targets and has not made a commitment to achieving net zero Noteworthy in their approach to carbon management is the implementation of a "green roof" project, estimated to remove 600 kg of CO_2 from the atmosphere annually, in conjunction with several other carbon reduction strategies. Furthermore, when compared to their competitors, Diebold Nixdorf excels in emissions reduction and the innovation of carbon management projects but falls short in setting clear goals and targets.

In the existing literature, a comprehensive exploration of how companies manage emissions, and the influencing factors has been notably lacking. Noteworthy exceptions include Kolk and Levy (2001) [7], Kolk and Pinkse (2004) [8], and Hoffman (2006) [9]. This article aims to fill a gap in the literature by offering a detailed examination of the specific dynamics and key factors influencing carbon management practices, focusing specifically on the retail and financial technology sectors.

2. Overview of Firm

Diebold Nixdorf is a multinational retail and financial technology company that specialises in the sale, installation, manufacture, and servicing of self-service transaction systems such as point-of-sale terminals (POS), ATMs, and software-related services for global financial, commercial, and retail markets [10]. The company is a partner to the majority of the world's top 100 financial institutions and top 25 global retailers. It is estimated that Diebold Nixdorf controls 35% of the global ATM market (See Figure 1) [10]. The firm has a presence in over 100 countries, approximately 22,000 employees, and an annual revenue of 3.9 billion (see Figure 1) [10].

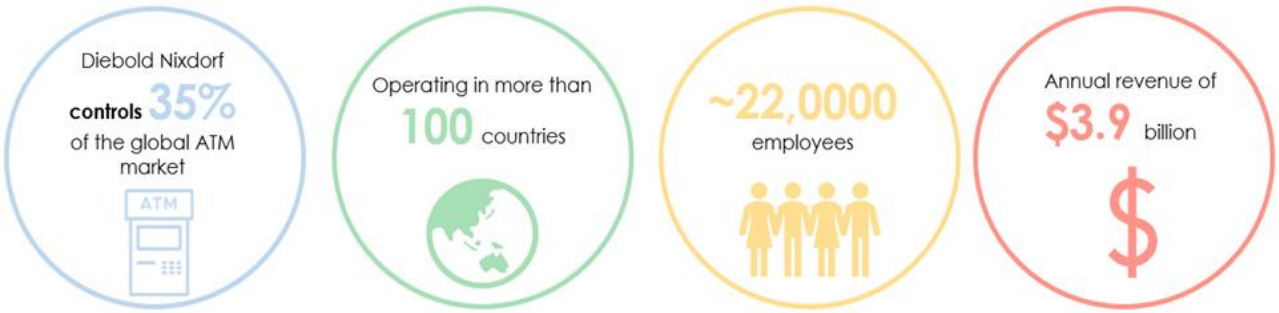

Figure 1 Diebold Nixdorf boasts a vast global presence, spanning 100+ countries, dominating 35% of the global ATM market, employing over 2000 people, and generating an annual revenue of 3 billion [11].

Diebold Nixdorf's operating structure is focused on two customer segments – Banking and retail. The banking product portfolio consists of ATMs, cash recyclers and dispensers, intelligent deposit terminals, teller automation, and kiosk technologies [10]. The retail product portfolio includes point-of-sale (POS) and self-service terminals. The firm has an emphasis on sustainable and "green products" in its marketing strategy [10]. Diebold Nixdorf states that they design their products with sustainability at the forefront [10]. This is done by reducing waste and product weight, which increases recycled materials/components to more than 90%, using energy-saving mobile processors, and using packaging with a minimum of plastic and more than 90% recycled paper [10].

2.1 Pledges

Diebold Nixdorf, as of now, has not publicly disclosed any specific emission reduction targets, except for a modest 10% reduction goal for their Ontario, Canada office, revealed in their 2017 Carbon Disclosure Project (CDP) questionnaire submission – the latest available for public access [10]. This target appears relatively inconsequential when juxtaposed with the company's expansive global footprint, including 62 office locations [10]. Given the substantial size and intricacy of the company, committing to specific is logistically challenging [10].

While internal sustainability goals and guidelines have been established with a focus on minimising environmental impact and CO_2 emissions, the company emphasises its commitment to enhancing communities and conserving natural resources through a responsible supply chain and a socially aware workplace [10]. Diebold Nixdorf takes concrete steps every day to reduce its global energy consumption, including targeted improvements in building efficiency, personal practices and responsibilities, and reducing the total square footage of its facilities and offices around the world without significantly reducing output. Despite the absence of specific reduction targets, Diebold Nixdorf aligns with several sustainable development goals [10, 11]. In their 2021 ESG report, the company expressed an aspiration to move towards zero emissions in the future [11, 12]. While internal sustainability goals and guidelines have been established with a focus on minimising environmental impact and CO_2 emissions [10, 11, 13], it's crucial to note the absence of a specific commitment to net zero. This lack of a formal pledge could be attributed, in part, to economic considerations [14-16]. Additionally, the complexity of Diebold Nixdorf's operations, given its size, may present challenges in setting explicit targets [13, 14].

3. Results

3.1 Emissions Estimates

Diebold Nixdorf discloses its carbon emissions estimates through its annual Environmental, Social, and Corporate Governance ESG report. As per the GHG protocol corporate standard, a company's greenhouse gas emissions fall into three scopes [12, 13]. As shown in Figure 2, Scope 1 or direct emissions are produced by the company, Scope 2 or indirect emissions are from the generation of electricity consumed by the reporting company, and Scope 3 emissions are produced in the company's supply chain [16].

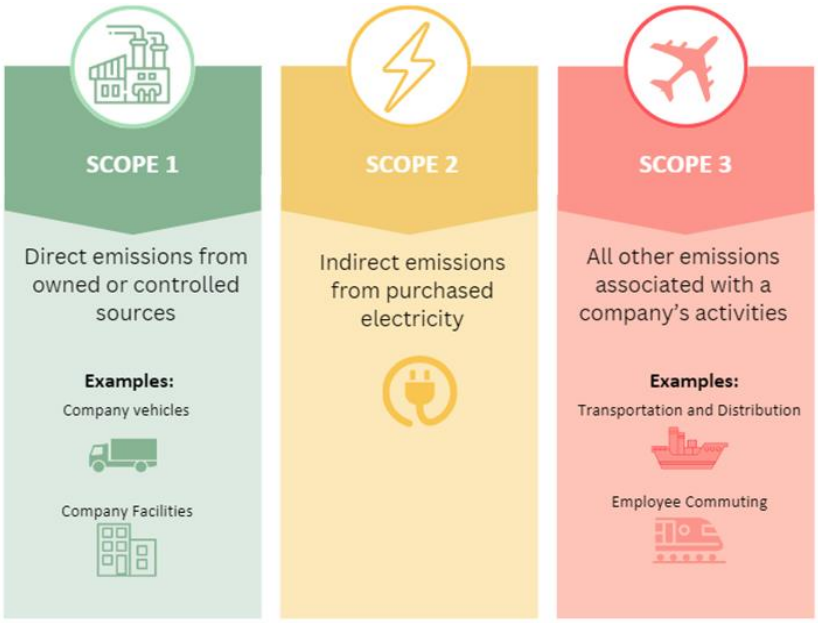

Figure 2 Summary of Greenhouse Gas (GHG) Protocol scopes and emissions throughout the entire value chain [11].

As shown in Figure 3, total Scope 1 emissions peaked in 2015 at 101,839 tons of carbon dioxide emissions (t CO_2-e). Since then, there has been a gradual decline, reaching 81,180.4 tons in 2021, with a temporary spike to 86,661.9 in 2020. Over the six years of recording, Diebold Nixdorf has successfully reduced its Scope 1 emissions by 20,659 tons (see Figure 3).

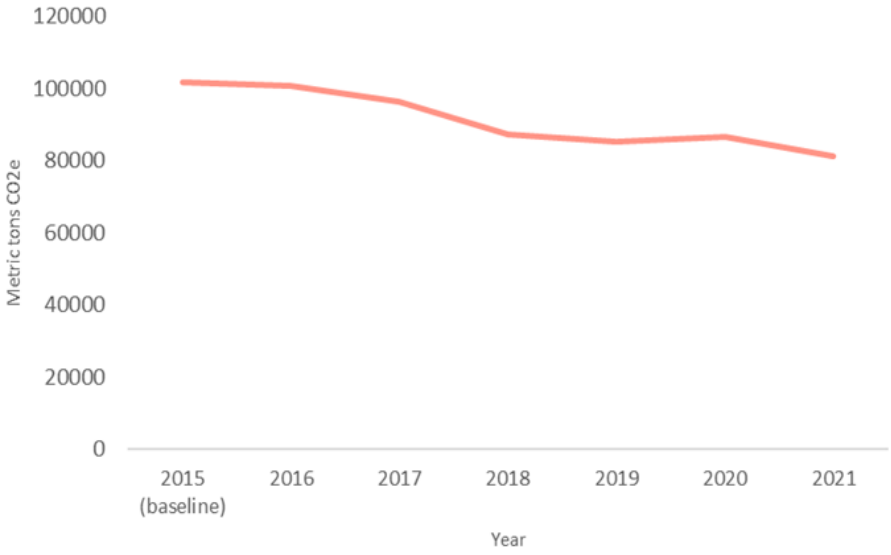

Figure 3 Diebold Nixdorf's Gross Scope 1 Emissions [11, 16].

Table 1 displays Diebold Nixdorf's Scope 2 emissions since the baseline year of 2020. In 2020, the firm's emissions peaked at 31,360.2 t CO_2-e and have been reduced by 2,720 tons t CO_2-e to 28,640.9 t CO_2-e (see Table 1). The reduction is notable in natural gas emissions, decreasing from 286.9 TJ in 2020 to 279.2 in 2021, and energy consumption dropping from 239.4 TJ in 2020 to 218 in 2021 (Table 2). Diebold Nixdorf reports a 6% reduction in emissions from Scope 1 and 2 between 2020 and 2021 [11]. Diebold Nixdorf's 2021 ESG report states that challenges arise due to the company's size, leading to the use of extrapolations when data is unavailable [11]. Continuous improvement is pursued, with new data and sources incorporated [11]. The inventory covers sites under operational control, and emissions are calculated using the GHG Protocol, with the base year as 2020. Emissions from operations and service fleet vehicles [11].

Table 1 Diebold Nixdorf's Global GHG Emissions for years 2020 and 2021 [11].

Diebold Nixdorf's Global GHG Emissions	2020	2021
Diebold Nixdorf's Gross Scope 2 Emissions (metric tons CO_2e)	31360.2	28640.9
Diebold Nixdorf's Gross Scope 1 and 2 (metric tons CO_2e)	118032	109821

Table 2 Diebold Nixdorf's Global Energy Consumption for years 2020 and 2021 [11].

Diebold Nixdorf Global Energy Consumption	2020	2021
Electricity (TJ) (Scope 2)	239.4	218
Natural Gas (TJ) (Scope 1)	286.9	279.2

Diebold Nixdorf emerges as a prominent emitter compared to its industry counterparts when considering revenue-based emissions, as highlighted in Table 3 and Figure 4. With a revenue of $3

billion, Diebold Nixdorf's emissions contrast sharply with Fiserv, which has a $16 billion revenue (see Table 3 and Figure 4). This results in a substantial disparity of 23,224 t CO_2e between the two companies. Notably, Fiserv, with double the workforce and $13 billion higher revenue, underlines the significance of these findings (see Table 3). Data for previous years for Fiserv, NCR Corp, and ADT are difficult to access, suggesting a lack of willingness to report emissions across the financial technology industry.

Table 3 Diebold Nixdorf's Top 3 Industry Competitors general information [17-19].

Company	Employees (approx.)	Revenue (billion)
Fiserv	44000	16
NCR Corp	38000	7
ADT	25000	5
Diebold Nixdorf	22000	3

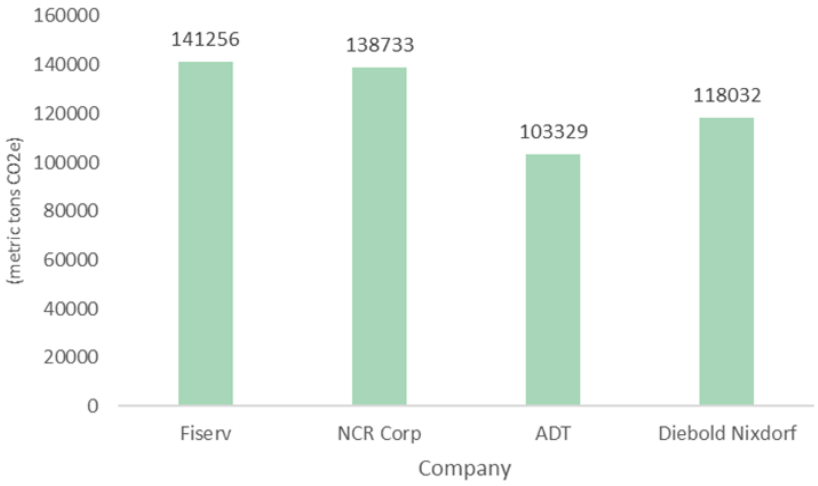

Figure 4 Diebold Nixdorf's scope 1 and 2 emissions (metric tons CO_2e) [17-19].

3.2 Emissions Reductions

Diebold Nixdorf's carbon management aims to reduce carbon emissions through both its operations and products. These main strategies include carbon offsetting, the implementation of the solar photovoltaic energy system (renewable energy system), improvements in service fleet vehicles, and investment in renewable energy. Diebold Nixdorf participates in carbon offsetting schemes as one of its primary emissions reduction plans. Carbon offsetting can be loosely defined as a mechanism by which an organisation contributes to a scheme that works to either remove carbon dioxide from the atmosphere or deliver carbon dioxide emission reduction [20]. The term 'offsetting' is used because the contributions are used to balance an organisation's carbon emission [20]. Carbon offsetting is a controversial form of carbon management. Kevin Anderson (2012) states, "Offsetting is worse than doing nothing. It is without scientific legitimacy, is dangerously misleading and almost certainly contributes to a net increase in the absolute rate of global emissions growth" [21].

Diebold Nixdorf has implemented two carbon offsetting projects: the installation of a "green roof" on their primary manufacturing facility and a tree planting program. A 750 m^2 "green roof"

has been installed on the surface of the Paderborn manufacturing facility in Germany alongside a photovoltaic energy system [11]. The roof is specifically designed to absorb CO_2, thereby acting as a carbon offset. Diebold Nixdorf estimates the roof absorbs more than 600 kg of CO_2 annually [11]. The benefits of a green roof include energy cost savings, decreased water retention, and a longer operational life [11]. While green roofs are effective in reducing CO_2 due to their ability to reduce energy consumption, the roof system components may cause CO_2 emissions during their lifetimes [22].

Diebold Nixdorf partnered with Telemark Diversified Graphics (TDG), a provider of thermal receipt paper for ATMs, where they pledged to plant one new tree for every 115 pounds of paper purchased through TDG [11]. The company claims that through this partnership, 60,000 trees have been planted, offsetting those used in the production of receipt paper [11]. However, there is currently no publicly available data confirming the planting of trees and the amount of CO_2 this project absorbs. An adult tree can absorb 22 kg of carbon every year, so assuming all the trees grow to adulthood, they would absorb 132 tons of CO_2 annually [23]. However, it can take up to 20 years for a newly planted tree to absorb these amounts [23]. These carbon offsetting schemes are essentially ineffective as a carbon management scheme as they don't target the issue of reducing the amount of GHG produced by the company.

A key method implemented by Diebold Nixdorf for reducing carbon emissions is the improvements to the service fleet vehicles, followed by the photovoltaic energy system. Diebold Nixdorf has one of the largest concentrations of service technicians in the United States as well as in certain other countries [11]. To reduce fuel consumption and subsequent carbon emissions, service fleet vehicles are outfitted with vehicle telematics [11]. Through this monitoring, driving reports are generated, which inform driver training tools to develop fuel-efficient driving behaviours for service technicians. Due to this method of implementing smarter driving decisions and behaviours, the U.S. service fleet reduced carbon emissions by 1,449 t CO_2e in 2021 [11]. This management strategy could be improved by implementing this system globally.

Additionally, the Paderborn manufacturing facility has installed a roof-mounted solar photovoltaic energy system consisting of 266 solar panels [11]. Solar panels do not have zero energy emissions due to the fact that the components are made of materials that are mined and not processed [24]. However, the lifetime emissions from solar power are significantly less than those produced by fossil fuels, making them an ideal low-carbon solution [25]. By the firm's predictions, the panels reduce the amount of electricity purchased for the building by 8% and prevent 42 t CO_2e from entering the atmosphere [16].

Other carbon reduction strategies include waste management, converting office and production sites to LED light sources, adapting working arrangements in corporate offices, product improvement, and investment in renewable energy. Diebold Nixdorf has made significant improvements to its point-of-sale line, reducing the energy consumption of the product by 2/3rds since 2008 [16]. Similarly, Diebold 429 ATM operates on 70 watts of power and is constructed of 40% recycled materials, reducing CO_2 emissions in both manufacturing and transportation [16]. The product has gradually improved since 2005, when its lifetime power consumption was 2567 kWh, and in 2015, it is now 809 kWh (see Figure 5). Since 2018, Diebold the company has reduced its physical operating footprint by 40% by leveraging remote and flexible arrangements [11]. It should be noted that this transition is most likely a result of the coronavirus pandemic and government

legislation. These management strategies do not have emissions data available to measure their effectiveness in comparison to the primary methods.

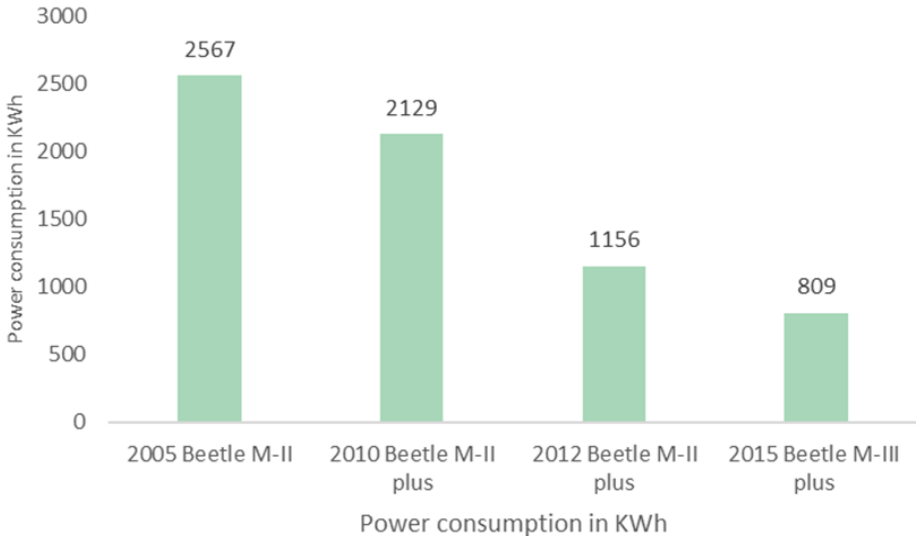

Figure 5 Diebold Nixdorf's ATM power efficiency improvement 2005-2015 [11].

4. Discussion

Effective carbon management involves acknowledging that an organisation's activities generate greenhouse gas emissions [26]. Minimising these emissions in an ongoing and economically viable manner is crucial [26]. A comprehensive carbon management approach should cover six essential categories: a commitment to reducing emissions, enhancements in product sustainability, improvements in processes and supply chains, initiatives for new market and business development, active organizational involvement, and the development of external relationships [20, 27, 28]. Table 4 below assesses the extent to which Diebold Nixdorf proactively adopts and implements carbon management activities in its general operational and strategic activities based on the information provided in their reports:

Table 4 Scope and level of carbon management activities in Diebold Nixdorf [29].

Scope of Carbon Management Activity	Level of Carbon Management Activity
Emissions Reduction Commitment	**Low** (e.g., Has the intention to set targets)
Product Improvement	**Medium** (Has examples of product improvement, e.g., DN Series ATMs, but does not estimate product emissions)
Process and Supply improvement	**Medium** (Has examples of process improvement within the firm, e.g., installing energy-efficient lighting)
New Market and Business Development	**High**
Organisational Involvement	**Low** – Has shown intention for organizational involvement (e.g., Task force)

External Relationship development	**High** – Takes initial action with regard to voluntary climate change initiatives and/or market mechanisms – CDP report

Diebold Nixdorf demonstrates proactive engagement across the six categories of carbon management activities. They have consistently reported on Scope 1 emissions since 2015 and included Scope 2 emissions since 2020. However, their carbon emission estimates lack comprehensiveness. While the 2021 ESG report provides information on energy and natural gas usage, Scope 3 emissions remain undisclosed. Despite intentions to report on Scope 3 data collection and baseline establishment by 2022, no reporting has occurred to date [10]. Addressing Scope 3 emissions proves challenging, constituting 65-95% of a company's carbon footprint beyond its direct control [30]. Estimating and monitoring them can be inherently difficult [30]. Notwithstanding, the emission reduction commitment should quantify the entire value chain's carbon footprint, enabling clear targets and preparatory measures [30].

Diebold Nixdorf has effectively reduced carbon emissions, evident in their improved CDP score from E in 2015 to B- in 2021, indicating a transition to managing environmental impact. However, the failure to set specific targets and commit to net zero is a pitfall. Establishing ambitious GHG reduction targets offers various benefits, including enhanced reputation, cost savings, innovation encouragement, and staying ahead of regulatory shifts [31].

The company's commendable product development with "green products" aligns with sustainability goals. Despite this, the green label might be misused, given the significant carbon emissions from their products. Comparatively, Diebold Nixdorf excels in emissions reduction and accessible data through ESG reports. While competitors like Fiserv, ADT, and NCR set targets and have Scope 3 data, Diebold Nixdorf outperforms in reducing emissions and having the highest CDP score. Notably, they have not generated new GHG emissions since the baseline, a noteworthy achievement considering the company's economic growth.

A pitfall in Diebold's carbon management is the failure to set specific targets and not commit to net zero. Firms that set ambitious GHG reduction targets will gain a competitive advantage in the coming years for a number of reasons [31]: credible targets boost a company's reputation, gains in efficiency result in cost savings; ambitious goals encourage innovation and transformational change, which can generate opportunities for growth, and targets will assist companies to stay ahead of shifting regulations and policies [31]. Additionally, Diebold Nixdorf reports how they manage and assess climate-related risks and opportunities through the Carbon Disclosure Project, where they received the result of B-. This score is a significant progression from the Diebold Nixdorf is commendable in their product development with the introduction of "green products." A green product is a sustainable product designed to minimize its environmental impacts during its whole life cycle and after its functional use [32]. Green products have two primary functions: reducing waste and maximising resource efficiency. This labelling can improve stakeholder engagement. However, Diebold Nixdorf's sustainable performance as a company, coupled with the fact that their products are still significant carbon emitters, the green label is misused.

Compared to other e-commerce and financial technology firms, Diebold Nixdorf underperforms and excels in a number of ways. The main competitors, Fiserv, ADT, and NCR have all set targets, pledged to net zero, and have data on their Scope 3 emissions. These factors are the key drawbacks to Diebold Nixdorf's carbon management. However, Diebold Nixdorf excels in achieving emissions

reduction and having accessible data through its ESG reports. As seen in Table 5, Table 6 and Figure 6 Diebold has been one of two firms to successfully reduce emissions and has the highest CDP score. Regarding actions to reduce climate change, Diebold Nixdorf has implemented a wide variety of projects and management schemes, while many of the competitors have simply made pledges and targets. Furthermore, another key area where Diebold excels in comparison with its competitors is the fact that it has not generated any new GHG emissions. The company has successfully avoided generating new emissions since the baseline, a noteworthy achievement given the company's economic growth. For further improvement in Diebold Nixdorf's Carbon management practices, it is recommended that a comprehensive and integrated framework should be developed. This framework should extend beyond emissions reduction and encompass aspects such as optimising the supply chain and conducting product life cycle analysis. Additionally, enhancing visibility into Scope 3 emissions can be achieved by implementing advanced tracking and reporting mechanisms. Another innovation the company could consider is evaluating the effectiveness and sustainability of its carbon offset projects. By taking these measures, the company can ensure a more accurate assessment of its complete carbon footprint, reinforcing its commitment to sustainability and environmental responsibility.

Table 5 Carbon Disclosure Score: Diebold Nixdorf [33].

Year	Score
2015	E
2016	C
2017	C
2018	C
2019	C
2020	C
2021	B-

Table 6 Carbon Disclosure Score: Industry comparison 2021 [33].

Year	Score
ADT	F
NCR	D
Fiserv	C
Diebold Nixdorf	B-

Figure 6 Comparison of Scope 1 and 2 across Industry [33].

5. Conclusions

Diebold Nixdorf has succeeded in reducing carbon emissions and has implemented a range of carbon management projects. Scope 1 and Scope 2 emissions have clearly been reduced since the baseline of reporting. Similarly, there has been a reduction in purchased energy since measuring began. The carbon offset projects implemented by the company are a successful move towards being more sustainable and reducing its carbon footprint. However, carbon offset projects are highly controversial due to the fact that they are essentially ineffective as a carbon management strategy, given their small scale in comparison to the amount of CO_2 released by the company. The limitations of this report stem from the limited amount of sustainability reporting published by Diebold Nixdorf coupled with a lack of public access to documents. The key areas for improvement are setting emissions reduction targets, reporting and measuring Scope 3 emissions, and implementing more effective carbon reduction strategies. To enhance innovation, Diebold Nixdorf can further improve by developing a comprehensive framework that includes supply chain optimisation, product life cycle analysis, advanced tracking of Scope 3 emissions, and a thorough evaluation of carbon offset project effectiveness. While this case study provides insights into Diebold Nixdorf's carbon management, future research could explore the effectiveness and sustainability of specific carbon offset projects, conduct comparative analyses across industries, and investigate the impact of regulatory frameworks on multinational corporations' carbon reduction targets. These avenues may contribute to a more nuanced understanding of sustainable practices in the corporate sector.

Author Contributions

Jessica White: Conceptualisation data curation, formal analysis, and visualization, Writing - original draft, and Writing - review and editing. Tom Deweerdt: Writing - review - editing - correspondence.

Competing Interests

The authors have declared that no competing interests exist.

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