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CARBON EMISSION REDUCTION AND PROFITABILITY: EVIDENCE FROM NABALTEC AG

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ABSTRACT

The connection between environmental sustainability and corporate profitability has become an increasingly important topic of discussion in modern economics. Manufacturing firms are under growing pressure to reduce carbon emissions while simultaneously maintaining financial performance and competitiveness. This study investigates the relationship between carbon emission reduction initiatives and profitability using the case of Nabaltec AG, a medium-sized German manufacturing company operating in the specialty chemicals industry. The research analyses five years of company data from 2021 to 2025. Secondary data were collected from annual reports, sustainability disclosures, and financial statements. The study evaluates changes in revenue, EBIT, operating cash flow, and sustainability-related operational strategies. The findings indicate that carbon reduction strategies, including energy recovery systems, recycling processes, and closed-loop production methods which contributed positively to operational efficiency and long-term profitability. Although profitability fluctuated due to broader market conditions, the company maintained relatively stable financial performance while strengthening environmental responsibility. The study concludes that carbon emission reduction can support long-term corporate profitability when strategically integrated into operational and business management frameworks.

Keywords: Carbon emissions, profitability, sustainability, manufacturing firms, environmental management, green production, corporate sustainability, industrial efficiency, Nabaltec AG, ESG, circular economy.

INTRODUCTION

Environmental sustainability has become a central issue in the global manufacturing sector due to rising concerns about climate change, industrial pollution, and resource depletion. Governments, investors, and consumers increasingly expect firms to reduce greenhouse gas emissions while maintaining economic growth. Manufacturing firms face particular pressure because industrial production remains one of the largest contributors to global carbon emissions, accounting for approximately 24% of total greenhouse gas output worldwide [1]. At the same time, firms must remain profitable in highly competitive international markets.

Many scholars argue that environmental responsibility and profitability are no longer contradictory objectives. Sustainable production methods may reduce waste, improve energy efficiency, strengthen corporate reputation, and create long-term competitive advantages [2]. However, some researchers suggest that environmental investments increase operational costs and reduce short-term profitability [3]. Therefore, the relationship between carbon emission reduction and financial performance remains an active and important area of research, particularly for manufacturing companies operating in cost-sensitive industries.

This study focuses on Nabaltec AG, a German specialty chemicals manufacturing firm that produces environmentally friendly mineral-based products. Nabaltec AG is particularly suitable as a case study because it represents a medium-sized industrial firm that has systematically integrated sustainability into its operational model without the substantial resources available to large multinational corporations. The company has implemented several sustainability initiatives, including heat recovery systems, recycling processes, renewable energy cooperation, and closed-loop production methods designed to reduce carbon emissions and improve resource efficiency.

The purpose of this research is to examine whether carbon emission reduction strategies contribute to corporate profitability. The study analyses five years of financial and sustainability-related data from 2021 to 2025 and evaluates the relationship between environmental practices and business performance over this period.

This study is guided by three interconnected objectives that collectively address the broader question of whether environmental responsibility and financial performance can be simultaneously achieved in the manufacturing sector. The first objective is to examine the relationship between carbon emission reduction initiatives and corporate profitability in a real industrial setting. This objective responds to ongoing debates in the literature, where some scholars argue that environmental investments create long-term value while others contend that such investments impose short-term financial burdens on firms [3, 4]. The second objective is to conduct a detailed analysis of the financial and sustainability performance of Nabaltec AG across the five-year period. This involves examining key financial indicators including revenue. By analysing both dimensions together, this study aims to identify patterns and connections between environmental commitments and financial results within a single industrial firm. The third objective is to determine whether sustainability initiatives, specifically those related to carbon reduction, contribute to long-term corporate resilience and profitability in medium-sized manufacturing firms. The findings are intended to contribute to the growing body of empirical literature on green manufacturing and to offer practical insights for firms navigating the dual challenge of sustainability and profitability.

LITERATURE REVIEW

Previous studies have extensively examined the relationship between environmental sustainability and firm performance. According to Porter and Van der Linde, properly designed environmental policies can stimulate innovation and improve competitiveness rather than reduce profitability [5]. Their influential theory suggests that environmental efficiency can lower production costs and increase productivity, challenging the conventional assumption that sustainability and profitability involve inherent trade-offs.

Hart argued that firms adopting environmentally sustainable strategies gain long-term competitive advantages through resource efficiency and innovation capacity [6]. This natural-resource-based view of the firm has been influential in strategic management, suggesting that environmental capability is a source of sustained competitive advantage. Similarly, Elkington introduced the Triple Bottom Line framework, emphasising that companies should simultaneously balance economic, environmental, and social performance to achieve lasting success [7].

Eccles, Ioannou, and Serafeim found that firms with strong sustainability practices generally outperform firms with weak sustainability policies in terms of both stock market and accounting performance [8]. Their longitudinal study demonstrated that sustainability-oriented firms attract long-term institutional investors and develop superior organisational processes. Clark, Feiner, and Viehs also reported that sustainability practices positively affect operational performance and reduce risk exposure [9], emphasising that environmental management systems may improve resource allocation and investor confidence.

While Friedman's classical position holds that the primary responsibility of firms is profit maximisation [10], modern sustainability scholarship increasingly challenges this view. Freeman's stakeholder theory provides an alternative perspective, arguing that firms must satisfy not only shareholders but also employees, consumers, governments, and broader society to achieve long-term success [11]. This theory has been particularly influential in justifying corporate sustainability investments as a means of strengthening stakeholder relationships and reducing regulatory and reputational risks.

King and Lenox analysed manufacturing firms and discovered that pollution prevention strategies often improve financial performance through increased efficiency and waste reduction [12]. Similarly, Russo and Fouts found that firms with better environmental performance generally experience higher profitability due to improved reputation and innovation capacity [13]. Waddock and Graves concluded that socially responsible firms often achieve stronger financial performance because sustainability improves stakeholder relationships and corporate image [14]. Orlitzky, Schmidt, and Rynes also identified a positive relationship between corporate social performance and financial performance across multiple industries through meta-analysis [15].

More recent sustainability research has increasingly focused on carbon reduction in manufacturing industries. Lee found that energy efficiency and carbon reduction strategies can decrease operational costs in industrial production [16]. Busch and Hoffmann demonstrated that carbon performance is positively associated with financial performance in energy-intensive industries, particularly when firms adopt proactive rather than reactive environmental strategies [17]. Delmas and Blass further noted that firms that invest in pollution reduction often benefit from improved operational processes and stronger reputations among institutional investors [18].

In the context of the European manufacturing sector, Horváthová conducted a meta-analysis of studies examining the relationship between environmental performance and financial performance in European firms. The results revealed an overall positive but heterogeneous relationship, with firm size, industry type, and time horizon all moderating the effect [19]. This finding is particularly relevant to Nabaltec AG as a medium-sized German industrial firm operating in a sector subject to strict EU environmental regulations.

Regarding circular economy practices, Geissdoerfer et al. argued that circular business models which emphasise recycling, waste reduction, and closed-loop production can generate cost savings and create new revenue streams alongside environmental benefits [20]. These insights are directly applicable to Nabaltec AG's recycling systems and energy recovery programmes, which represent practical applications of circular economy principles in specialty chemical manufacturing.

Overall, the literature consistently indicates that sustainability initiatives can generate long-term economic benefits despite short-term implementation costs. However, there remains a need for firm-level empirical studies focusing on medium-sized manufacturing companies. This study contributes to the literature by analysing the specific experience of Nabaltec AG over a five-year period.

METHODOLOGY

This study employs a quantitative case study approach based on secondary data analysis. Financial and sustainability-related data were collected from the annual reports and sustainability disclosures of Nabaltec AG for the period 2021 to 2025. The case study methodology is appropriate because it allows for a detailed examination of a single firm's experience over time, enabling a nuanced understanding of how sustainability strategies interact with financial performance in a real industrial context [21].

The study evaluates the relationship between sustainability initiatives and financial performance through descriptive financial analysis. Four primary indicators were analysed: revenue, earnings before interest and taxes (EBIT), operating cash flow, and EBIT margin. The research also examines operational sustainability practices documented in the company's reports, including recycling systems, renewable energy cooperation agreements, heat recovery technologies, and closed-loop production methods.

To measure financial trends, the following formulas were applied. The profitability growth rate was calculated as:

Growth Rate = [(Current Year − Previous Year) / Previous Year] × 100

The EBIT margin was calculated as:

EBIT Margin (%) = (EBIT / Revenue) × 100

These indicators were analysed across the full five-year period to identify trends and assess the financial implications of sustainability investments. The limitations of this study include its focus on a single firm, which restricts the generalisability of findings, and its reliance on reported data, which may not fully capture all sustainability-related financial effects.

RESULTS

Table 1. Financial Performance of Nabaltec AG (2021-2025)

Year	Revenue (€ million)	EBIT (€ million)	Operating Cash Flow (€ million)	EBIT Margin (%)
2021	187.0	24.6	33.2	13.2
2022	218.8	29.2	32.4	13.3
2023	200.1	18.3	16.5	9.1
2024	203.6	22.3	35.2	10.9
2025	197.0	15.2	15.8	7.7

Source: Nabaltec AG Annual Reports (2021-2025)

The financial analysis reveals that Nabaltec AG maintained relatively stable revenues during the five-year period despite significant economic volatility in the European chemical manufacturing industry. Revenue increased from €187.0 million in 2021 to €218.8 million in 2022, representing approximately 17% growth. This expansion coincided with rising industrial demand and the company's broader operational development. EBIT also reached its peak of €29.2 million in 2022, while the EBIT margin held steady at approximately 13%. These results indicate that sustainability investments did not impair profitability during the company's strongest financial period.

Following 2022, the company experienced declining profitability as EBIT fell to €18.3 million and the EBIT margin contracted to 9.1% in 2023. This deterioration was influenced largely by broader economic instability, inflationary pressures, energy market volatility, and weakening industrial demand across Europe. Critically, despite these pressures, Nabaltec AG continued implementing carbon reduction strategies throughout this challenging period. The recovery in operating cash flow to €35.2 million in 2024 suggests that efficiency improvements from sustainability investments supported operational resilience. However, 2025 saw further margin compression to 7.7%, reflecting continued market difficulties.

DISCUSSION

The findings of this study provide empirical support for the proposition that carbon emission reduction strategies can contribute positively to long-term profitability in manufacturing firms, although the relationship is nuanced and mediated by external economic conditions. The five-year data from Nabaltec AG demonstrate a pattern consistent with the theoretical predictions of the Porter Hypothesis: environmental innovation, when properly integrated into operational management, can generate efficiency gains that strengthen rather than undermine financial performance [5].

The most instructive aspect of Nabaltec AG's experience is not the financial results in any single year but rather the firm's behaviour during periods of financial stress. Despite declining EBIT margins in 2023 and 2025, the company maintained its commitment to sustainability investments. This pattern aligns with Busch and Hoffmann's finding that firms adopting proactive environmental strategies those that invest in sustainability regardless of short-term financial pressure tend to achieve superior long-term financial outcomes compared with reactive firms that reduce environmental spending during downturns [17]. By continuing to invest in recycling systems, energy recovery, and closed-loop production even during difficult periods, Nabaltec AG demonstrated that sustainability was embedded in its operational identity rather than treated as a discretionary expenditure.

The recovery in operating cash flow to €35.2 million in 2024, even as EBIT remained subdued, provides a particularly meaningful signal. Operating cash flow measures the efficiency of the firm's core production processes independently of financing and investment decisions. A strong recovery in operating cash flow while EBIT remained compressed suggests that sustainability-driven operational improvements waste reduction, energy recovery, and material recycling - contributed to greater cash generation efficiency relative to reported earnings. This finding is consistent with King and Lenox's argument that pollution prevention strategies generate financial value through process improvements that reduce input costs and improve resource utilisation [12].

The relationship between sustainability and stakeholder confidence is also relevant to interpreting Nabaltec AG's performance trajectory. Freeman's stakeholder theory predicts that firms maintaining strong environmental commitments attract long-term institutional investors and strengthen relationships with regulators, customers, and business partners [11]. The publication of Nabaltec AG's first comprehensive sustainability report during the study period represents an important step in transparency and governance, potentially improving the firm's ability to attract sustainability-oriented investment and commercial partnerships. Eccles, Ioannou, and Serafeim's research supports this interpretation, demonstrating that enhanced sustainability reporting is associated with superior long-term financial performance across a broad sample of firms [8].

From a circular economy perspective, Nabaltec AG's operational model exemplifies the practical application of principles described by Geissdoerfer et al. [20]. The company's recycling initiatives and waste-to-energy cooperation programmes reduce material input costs, lower waste disposal expenses, and generate value from materials that would otherwise represent costs. These circular economy practices not only reduce the firm's carbon footprint but also contribute directly to cost efficiency, supporting the argument that environmental and economic objectives can be aligned rather than treated as competing priorities.

It is important, however, to acknowledge the limitations of this interpretation. The financial fluctuations observed across the study period particularly the EBIT decline in 2023 and 2025 - cannot be attributed solely or primarily to sustainability investments. External factors including European energy price volatility following geopolitical disruptions, inflationary pressure on raw

material costs, and weakening demand in key industrial markets all contributed significantly to the firm's financial performance. This underscores a critical point made by Horváthová: the relationship between environmental performance and financial performance is moderated by macroeconomic context, industry conditions, and firm-specific factors [19]. Sustainability investments do not insulate firms from economic cycles but may enhance resilience by improving operational efficiency and reducing resource dependency.

The study also reflects on the tension between short-term and long-term perspectives in evaluating sustainability investments. Walley and Whitehead's argument that environmental compliance increases short-term costs is not entirely refuted by this study [3]. Initial investments in heat recovery infrastructure, emissions monitoring systems, and recycling technologies require capital expenditure that may not yield immediate returns. However, the evidence from Nabaltec AG suggests that over a five-year horizon, these investments supported operational stability and contributed to a more resilient production model. This finding is consistent with the broader literature reviewed, which generally identifies positive long-term financial effects of sustainability investments despite potential short-term costs.

For medium-sized manufacturing firms operating in regulated industrial sectors, the experience of Nabaltec AG offers a practical illustration of how sustainability and profitability can be managed together. Rather than treating carbon reduction as a compliance burden, the company integrated environmental initiatives into its core operational strategy, using sustainability as a driver of efficiency and competitive positioning. This approach aligns with Hart's natural-resource-based view of the firm, which identifies environmental capability as a source of sustainable competitive advantage for industrial companies [6].

CONCLUSION

This study set out to examine whether carbon emission reduction strategies are compatible with corporate profitability, using Nabaltec AG as an empirical case. The five-year analysis covering 2021 to 2025 provides a detailed picture of how a medium-sized German specialty chemicals manufacturer managed the dual challenge of environmental responsibility and financial performance in a period of considerable economic turbulence.

The findings demonstrate that sustainability and profitability are not mutually exclusive objectives for manufacturing firms. Nabaltec AG maintained relatively stable financial performance across the study period despite significant external economic pressures, while simultaneously advancing its carbon reduction agenda through heat recovery technologies, material recycling systems, closed-loop production methods, and cooperation with renewable energy and waste-to-energy facilities. The company's financial results particularly the strong recovery in operating cash flow in 2024 suggest that sustainability investments contributed meaningfully to operational efficiency and resource cost management, even during periods when headline profitability was under pressure.

The study confirms the theoretical insights of Porter and Van der Linde, King and Lenox, and Hart, all of whom argue that environmental investment can generate competitive value through process innovation, efficiency improvements, and enhanced stakeholder relationships [5, 6, 12]. The findings also support stakeholder theory in demonstrating that a medium-sized industrial firm can strengthen its institutional credibility and transparency through sustainability reporting and environmental commitment, which may contribute to long-term investor confidence and business partner relationships [11].

At the same time, this study acknowledges important limitations. The case study design restricts generalisation beyond the specific firm and sector examined. The external economic

environment including European energy market volatility and post-pandemic industrial adjustment significantly affected the company's financial performance independently of sustainability decisions. Future research should examine the relationship between carbon reduction and profitability across larger samples of manufacturing firms, including cross-industry and cross-country comparisons, to identify whether the patterns observed in this study are broadly applicable or context-specific.

From a policy perspective, the experience of Nabaltec AG suggests that regulatory frameworks encouraging or requiring sustainability investment in the manufacturing sector need not necessarily compromise industrial profitability. When environmental initiatives are integrated into operational strategy rather than imposed as isolated compliance requirements, they can serve as catalysts for process innovation and efficiency improvement. Policymakers designing carbon reduction incentives for industrial firms should consider how regulatory design can support the kind of operational sustainability integration observed in this case.

In conclusion, the evidence from this study supports the view that carbon emission reduction can be a long-term driver of corporate value in manufacturing when embedded in strategic and operational management. Nabaltec AG's experience offers a constructive model for medium-sized industrial firms navigating the transition to a lower-carbon economy, demonstrating that environmental responsibility and financial performance can be pursued as complementary rather than competing strategic objectives.

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