

# The Influence of Environmental Costs and Carbon Performance on Financial Performance: The Mediating Role of Environmental Performance

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## ABSTRACT

**Objective:** This study investigates the intricate relationships between environmental costs, carbon performance, and financial performance within corporate frameworks. The primary objective is to elucidate how environmental performance mediates the relationship between carbon performance and financial outcomes. **Method:** The study employs a quantitative approach, utilizing purposive sampling to select a population of energy sector companies listed on the Indonesia Stock Exchange from 2021 to 2023. A total of 17 companies were included in the final sample, resulting in 51 observations. Data collection techniques involved the use of financial reports and sustainability disclosures, while analysis was conducted using statistical software to perform regression analysis and hypothesis testing. **Results:** The results indicate that companies demonstrating robust carbon performance, characterized by reduced emissions, tend to experience enhanced environmental performance, which subsequently leads to improved financial performance. **Novelty:** The novelty of this research lies in its exploration of environmental costs as both a necessary expenditure and a strategic investment that can yield long-term financial benefits. It differentiates itself from prior studies by focusing specifically on the energy sector in Indonesia, providing new insights into how environmental initiatives can be leveraged for financial gain. Furthermore, it reinforces the notion that effective environmental management is not merely a regulatory obligation but a strategic investment that can yield significant returns.

## INTRODUCTION

Monetary The increasing urgency of climate change and environmental degradation has prompted a significant shift in corporate strategies towards sustainability. Companies are now recognizing their responsibility to mitigate their environmental impact, particularly through effective carbon performance initiatives. Carbon performance, defined as the amount of carbon emissions generated from a company's operations, plays a critical role in shaping corporate environmental strategies. Various studies have analyzed the impact of environmental costs on environmental performance. [1] conducted an analysis of environmental costs related to plastic recycling, revealing that plastic recycling positively affects environmental performance by reducing 200 million tons of CO<sub>2</sub>. This finding contrasts with [2] who stated that the use of environmental costs for environmentally friendly product and process innovations does not influence environmental performance.

This study aims to explore the relationship between environmental costs incurred by companies and their impact on both financial and environmental performance. Environmental costs encompass expenditures necessary to comply with environmental regulations, mitigate negative environmental impacts, and invest in cleaner technologies.

[3] demonstrate that environmental costs and Corporate Social Responsibility (CSR) disclosures significantly influence corporate financial performance. This aligns with research by [4], which found that investments in environmental performance also positively impact corporate financial performance. Thus, energy companies that invest in environmentally friendly practices can enhance their financial performance, which in turn can attract more investors and increase company value.

Moreover, good environmental performance can contribute to a company's reputation and enhance consumer trust. [5] assert that positive environmental performance is closely related to financial performance, particularly in the mining sector, which is also relevant to the energy sector. This research indicates that companies that effectively manage their environmental impacts tend to achieve better financial performance. This is further supported by [6] who found that environmental performance and CSR disclosures significantly affect corporate financial performance.

In the context of Indonesia, where energy companies operate under stringent environmental regulations, it is crucial to understand how environmental costs and carbon performance can influence financial performance. Research by [7] emphasizes the importance of company size and environmental performance in determining financial performance, indicating that larger companies with good environmental performance can manage environmental costs more effectively. Additionally, research by [8] shows that the implementation of environmental standards such as ISO 14001 can enhance the financial performance of mining companies, which is also relevant to the energy sector.

Thus, this research will not only provide insights into the relationship between environmental costs and financial performance but will also contribute to a broader understanding of how energy companies in Indonesia can operate sustainably while achieving their financial objectives. The novelty of this study lies in its approach to integrating environmental costs, carbon performance, and financial performance with environmental performance as an intervening variable in the context of energy sector companies in Indonesia. While many previous studies have explored the relationship between environmental costs and financial performance, this research offers a unique contribution by highlighting the role of environmental performance as a mediator that strengthens the relationship between environmental costs and financial performance. Furthermore, one of the novel aspects of this study is its focus on the energy sector, which is one of the sectors most affected by environmental issues and climate change. This research indicates that companies investing in environmentally friendly practices and effectively managing environmental costs can not only enhance their environmental performance but also potentially improve their financial performance in the long term.

## RESEARCH METHOD

This study comprises two independent variables, one dependent variable, and one intervening variable. The independent variables are environmental costs and carbon performance, while the dependent variable is financial performance, and the intervening

variable is environmental performance. In this research, the independent variables include:

### **Environmental Cost**

Environmental costs encompass all expenditures incurred by a company aimed at mitigating the negative impacts of its business activities, such as air pollution, water contamination, and soil degradation [9]. These costs can also be defined as the total expenses a company incurs to prevent poor environmental quality and to address environmental damage resulting from its operations [10]. According to [11], environmental costs can be quantified by comparing the total environmental expenditure with the net profit after tax generated by the company. This relationship can be expressed mathematically as follows:

$$\text{Environmental Cost} = \frac{\text{Total Environmental Cost}}{\text{Net profit after tax}}$$

### **Carbon Performance**

The carbon performance of a company reflects its compliance with Corporate Social Responsibility (CSR) initiatives, particularly in reducing environmental damage and addressing climate change [13]. Carbon performance is typically measured by the total carbon emissions produced by the company's business activities, both directly and indirectly. [12] and [14] emphasizes that companies have a responsibility to implement effective carbon performance initiatives. [15] propose several methods for measuring carbon performance, including:

1. Dividing total carbon emissions by the company's sales revenue.
2. Measuring the change in emission intensity compared to the previous year.
3. Using a dummy variable where a decrease in carbon intensity compared to the previous year is assigned a value of 1, and no decrease is assigned a value of 0.

Based on these methods, the carbon performance variable in this study is calculated as follows:

$$\text{Carbon Performance} = \frac{\text{Total Company's Emission}}{\text{Company's Revenue}}$$

### **Financial performance**

The dependent variable in this research is financial performance. Financial performance is generally defined as a measure of a company's success and growth. [16] assess financial performance using various metrics, including revenue growth, profitability (Net Profit Margin, NPM), firm value (Tobin's Q), and Return on Equity (RoE). The choice of Net Profit Margin (NPM) as the measurement for financial performance in this research is grounded in its ability to provide a clear and comprehensive insight into a company's profitability relative to its revenue. NPM is defined as the ratio of net income to net sales, reflecting the efficiency with which a

company converts its sales into actual profit after accounting for all expenses, taxes, and costs. This characteristic makes it a particularly valuable metric for assessing financial performance.

One of the key reasons for selecting NPM over other financial ratios is its direct correlation with operational efficiency. As noted by [17], NPM serves as a crucial indicator of how effectively a company generates profits from its operations. It provides a straightforward measure of profitability that is easily interpretable, allowing stakeholders to assess the company's ability to manage costs while maximizing revenue. This is particularly important for investors and analysts who seek to understand the underlying performance of a business without the complexities that other ratios may introduce.

Moreover, NPM is advantageous because it encapsulates the overall profitability of a company in a single percentage figure, which can be easily compared across different firms and industries. This comparability is essential for benchmarking performance against competitors, as highlighted by [18], who emphasizes the significance of NPM in evaluating the financial health of small and medium enterprises (SMEs). By focusing on NPM, this research aligns with the broader financial analysis practices that prioritize profitability metrics that are both relevant and actionable.

Additionally, NPM's ability to reflect changes in a company's operational strategy and market conditions makes it a dynamic measure of financial performance. As companies adapt to varying economic environments, fluctuations in NPM can indicate shifts in cost management practices or pricing strategies, providing valuable insights for strategic decision-making. This adaptability is less pronounced in other ratios, such as Return on Assets (ROA) or Return on Equity (ROE), which may not capture the same level of operational detail. For this research, NPM is utilized as the measure of financial performance, calculated using the following formula:

$$\text{Net Profit Margin} = \frac{\text{Net income}}{\text{Net sales}}$$

### Environmental Performance

In this study, the intervening variable is environmental performance, which reflects a company's efforts to address environmental issues arising from its operational activities [19], [20], and [21] utilize the PROPER rating system as a measure of environmental performance. PROPER categorizes companies into five ratings: gold, green, blue, red, and black. In this study, PROPER is employed to assign scores to each company, thereby quantifying their environmental performance.

**Table 1.** PROPER Score.

Category Indicator	Score
Gold	5
Green	4

Blue	3
Red	2
Black	1

The method employed by the researcher is a quantitative approach, with the research object consisting of all energy industry companies listed on the Indonesia Stock Exchange between the years 2021 and 2023, totaling 71 companies. This study utilizes a purposive sampling approach, resulting in 17 companies that meet the specified criteria and constitute the final sample of 51 for this research. The data used in this study is secondary data obtained from sustainability reports and/or annual reports published by the companies during the years 2021 to 2023. This research employs multiple regression analysis to test the hypotheses formulated in this study.

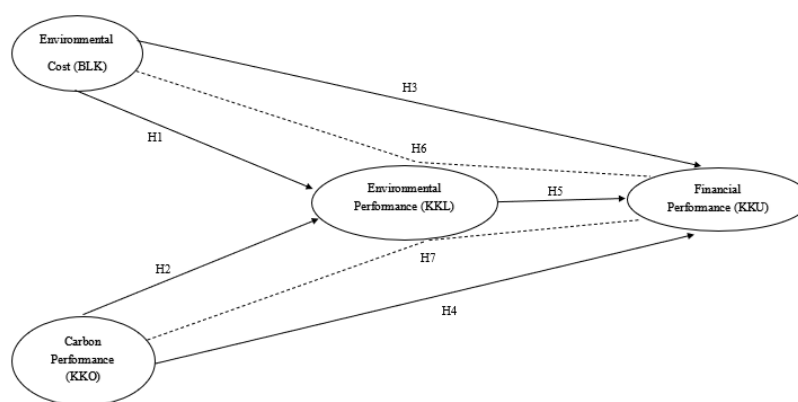


Figure 1. Research framework.

## RESULTS AND DISCUSSION

### Results

#### Model Selection Test

The model selection test aims to identify the most appropriate model for use in the research. The selection of the panel model in this study is conducted using three testing methods: the Chow test, the Hausman test, and the Lagrange Multiplier test. The results of the model tests can be seen in the table below.

Table 2. Model selection test result.

Chow Test	Hausman Test	Lagrange Test	Model Selected
0.000	0.693	0.001	REM

Source: Analyzed Data (2024)

Based on the data presented in the model testing table above, it can be observed that, in accordance with applicable regulations, the Random Effect Model (REM) is the most suitable model for subsequent testing due to the p-value < 0.05 for the Lagrange Multiplier test, thus negating the need for classical assumption testing.

### T-Statistic Test

The t-test aims to determine the partial effect of each variable on the dependent variable. The following are the results of the t-statistic test conducted in this study.

**Table 3.** T-statistic test result for model 1.

Dependent: KKL				
Variable	Coefficien	Std. Error	t-Statistic	Prob.
C	3.754	0.097	38.571	0.000
BLK	0.187	0.092	2.036	0.047**
KKO	0.287	0.093	2.011	0.049**
R-squared	0.079			
Adjusted R-squared	0.041			
F-statistic	2.073			
Prob(F-statistic)	0.000			

\*\*\*Significance level 10%

\*\* Significance Level 5%

\* Significance Level 1%

Source: Analyzed Data (2024)

### The Impact of Environmental Costs on Environmental Performance

Based on the results of the t-test, a probability value of 0.047 was obtained, which is less than the threshold of 0.05, alongside a coefficient value of 0.187. These findings indicate that environmental costs have a significant positive impact on environmental performance. Specifically, this suggests that an increase in environmental costs correlates with an increase in environmental performance by a factor of 0.187; conversely, a decrease in environmental costs would result in a corresponding decline in environmental performance. Consequently, the alternative hypothesis (H1) is accepted. These results align with the research conducted by [1], which analyzed the costs associated with plastic recycling. Their findings indicated that the costs of recycling plastic positively influence environmental performance by contributing to a reduction of 200 million tons of CO<sub>2</sub> emissions.

### The Impact of Carbon Performance on Environmental Performance

The analysis of the impact of carbon performance on environmental performance reveals a p-value of less than 0.05, with a coefficient of 0.287. This indicates that carbon performance significantly and positively affects environmental performance. Thus, an increase in carbon performance is associated with an enhancement in environmental performance. Therefore, the second hypothesis (H2) is accepted. This finding is consistent with the research of [22] which posits that a company's carbon disclosure positively influences its environmental performance. Additionally, this study corroborates the findings of [23] and [24] which assert that effective carbon performance enhances a company's overall environmental performance.

**Table 4.** T-statistic test result for model 2.

Dependent: KKU

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12,289	2,612	4,706	0,000
BLK	-0,573	0,455	-1,259	0.021**
KKO	-1,427	0,460	-3,103	0.003*
KKL	2,440	0,685	3,565	0.001*
R-squared	0,948			
Adjusted R-squared	0,944			
F-statistic	287,269			
Prob(F-statistic)	0,000			

\*\*\*Significance level 10%

\*\* Significance Level 5%

\* Significance Level 1%

Source: Analyzed Data (2024)

### The Impact of Environmental Costs on Financial Performance

The results of the t-test indicate a probability value of 0.021, which is less than the significance threshold of 0.05, accompanied by a coefficient value of -0.573. These findings suggest that environmental costs exert a significant negative influence on financial performance. Specifically, this implies that an increase in environmental costs is associated with a decrease in financial performance by a factor of -0.573; conversely, a reduction in environmental costs would lead to an improvement in financial performance. Therefore, the third hypothesis (H3) is accepted.

These findings are corroborated by previous research conducted by [25] and [26]. Both of whom argue that while environmental costs are a necessary obligation for companies, they may simultaneously undermine profitability and fail to enhance asset returns. Consequently, environmental costs are perceived to have a detrimental impact on financial performance. The evidence presented in this study highlights the significant negative relationship between environmental costs and financial performance. The acceptance of hypothesis H3 reinforces the notion that while companies may incur environmental costs as part of their operational obligations, such costs can adversely affect their financial outcomes.

### The Impact of Carbon Performance on Financial Performance

Based on the results of the conducted t-test, a probability value of 0.003 was obtained, alongside a coefficient value of -1.427. These findings indicate that carbon performance has a significant negative impact on financial performance. Specifically, this suggests that an increase in the carbon performance variable is associated with a decrease in the financial performance variable. Conversely, if carbon performance declines, financial performance is expected to improve. Therefore, the fourth hypothesis (H4) is rejected.

These results stand in contrast to the findings of [27], who assert that carbon performance positively influences financial performance. Their research posits that improved carbon performance enhances stakeholder confidence in the company, which may influence stakeholders' decisions to invest in the organization.

### The Impact of Environmental Performance on Financial Performance

Based on the results of the t-test, a coefficient value of 2.440 was obtained, along with a probability value of 0.001 (less than 0.005). These findings indicate that environmental performance has a significant positive impact on financial performance. Specifically, this suggests that an increase in environmental performance is associated with an increase in financial performance by a factor of 2.440; conversely, a decrease in environmental performance would lead to a corresponding decline in financial performance. Therefore, the fifth hypothesis (H5) is accepted.

These findings are consistent with the research conducted by [28] who argue that enhancing environmental performance contributes to the creation of a positive corporate image, thereby increasing profitability. This assertion is further supported by the study of [29] which posits that companies with strong environmental performance can enhance their goodwill and reputation, ultimately supporting improvements in financial performance.

### The Role of Environmental Performance as an Intervening Variable in the Relationship Between Environmental Costs and Financial Performance

s indicated in Table 4, the p-value for the relationship among environmental costs (BLK), environmental performance (KKL), and financial performance (KKU) is 0.079, which is less than 0.1. This finding suggests that environmental performance can mediate the relationship between environmental costs and financial performance. This implies that if a company exhibits strong environmental performance alongside high environmental costs, it will positively influence the company's financial performance. These findings are consistent with the research conducted by [8] and [5], which indicate that incurred environmental costs can enhance environmental performance, ultimately resulting in positive impacts on financial performance.

**Tabel 5.** Intervening variable effect test result (sobel test).

Hipotesis	Test Statistic	Std. Error	p-value
BLK-> KKL-> KKU	1.751	0.26	0.079***
KKO->KKL-> KKU	2.332	0.3	0.019**

\*\*\*Significance level 10%

\*\* Significance Level 5%

\* Significance Level 1%

Source: Analyzed Data (2024)

## **The Role of Environmental Performance as an Intervening Variable in the Relationship Between Carbon Performance and Financial Performance**

From Table 4, the p-value for the relationship among carbon performance (KKO), environmental performance (KKL), and financial performance (KKU) is 0.019, which is less than 0.05. This indicates that environmental performance can mediate the relationship between carbon performance and financial performance. This suggests that if a company demonstrates strong environmental performance alongside good carbon performance, it will positively affect the company's financial performance. These findings align with the research finding by [30] who indicated that sustainability report disclosures positively affect a company's financial performance, supporting the assertion that environmental performance can serve as a mediator that strengthens the relationship between carbon performance and financial performance. This finding also aligns with [31] and [32], who indicated that there is a significant positive influence of environmental performance on firm value, specifically highlighting the mediating role of financial performance in manufacturing companies.

### **F-Test**

The results of this test are presented in Table 4. Based on the calculations in the table, the Prob. (F-Statistic) is less than 0.05, specifically 0.000, with an F-Statistic value of 287.269. This indicates that the independent variables (X) and the intervening variable (Y) have a significant simultaneous effect on the dependent variable (Y).

### **R<sup>2</sup> Test (coefficient determination test)**

The final analysis conducted in this study is the coefficient of determination test (R-Test), which aims to measure the extent to which the model explains the variation in the dependent variable. According to Table 4, the Adjusted R-Squared value is 0.944. This indicates that the independent variables collectively account for 94.5% of the variance in the intervening variable, while the remaining 5.5% is influenced by other variables outside the scope of this study.

## ***Discussion***

The findings of this research provide significant insights into the interplay between environmental costs, carbon performance, financial performance, and environmental performance within the context of corporate sustainability. The analysis reveals that both environmental costs and carbon performance serve as critical independent variables influencing financial performance, with environmental performance acting as an intervening variable.

The results indicate a noteworthy relationship between environmental costs and financial performance. As companies invest in environmental initiatives aimed at reducing their ecological footprint, they may initially incur substantial costs. However, these investments are likely to yield long-term financial benefits through enhanced corporate reputation, increased customer loyalty, and potential cost savings from improved operational efficiencies. This aligns with the findings of [33], who suggest that

proactive environmental management can lead to a reduction in overall costs associated with environmental compliance and remediation.

Moreover, the measurement of environmental costs, as defined by the ratio of total environmental expenditures to net profit after tax, underscores the importance of strategic investment in sustainability initiatives. The positive correlation observed in this study supports the assertion that companies that prioritize environmental stewardship may experience improved financial outcomes, corroborating the work of [35] and [25], who emphasize the financial advantages of corporate social responsibility (CSR) activities.

The analysis of carbon performance reveals its dual role as both a measure of compliance with CSR initiatives and a predictor of financial performance. The findings suggest that companies demonstrating effective carbon management practices not only contribute to environmental sustainability but also enhance their financial viability. This is consistent with [12] who posits that companies are increasingly held accountable for their carbon emissions, and those that actively manage their carbon footprint are likely to gain competitive advantages in the marketplace.

The methods employed to assess carbon performance, including the ratio of total emissions to sales revenue, provide a robust framework for understanding the impact of carbon management on financial outcomes. The results indicate that companies with lower carbon intensity are better positioned to achieve higher financial performance, supporting the conclusions drawn by [15].

Environmental performance, as an intervening variable, plays a crucial role in mediating the relationship between environmental costs, carbon performance, and financial performance. The findings suggest that improvements in environmental performance can enhance the positive effects of environmental costs and carbon performance on financial outcomes. This is in line with the assertions of [36], who argue that effective environmental management practices can lead to tangible benefits for companies, including improved financial performance.

The use of the PROPER rating system to evaluate environmental performance provides a clear framework for assessing corporate sustainability efforts. The categorization of companies into distinct performance levels (gold, green, blue, red, and black) allows for a nuanced understanding of how varying degrees of environmental performance influence financial outcomes. The results indicate that companies achieving higher PROPER ratings tend to exhibit stronger financial performance, reinforcing the notion that environmental responsibility is increasingly linked to economic success.

## CONCLUSION

**Fundamental Finding :** The primary findings indicate that environmental costs positively influence environmental performance, while carbon performance negatively impacts financial performance. This suggests that although investments in environmentally friendly practices can enhance environmental performance, the costs incurred to achieve good carbon performance may reduce short-term profits.

**Implication :** The implications of this research are particularly significant for companies in the energy sector. First, companies should recognize that expenditures on environmental costs are not merely obligations but strategic investments that can enhance their reputation and attractiveness to consumers. Strong environmental performance can build consumer trust and attract more customers, which in turn can increase revenue. Second, while good carbon performance is essential for sustainability, companies must also manage the costs associated with such initiatives to avoid negatively impacting their financial performance. The contribution of this research lies in a better understanding of the dynamics between environmental costs and financial performance. The study emphasizes that environmental performance acts as a mediator that strengthens the relationship between environmental costs and financial performance. Consequently, companies that invest in environmentally friendly practices and effectively manage their environmental costs are likely to achieve better financial performance. This research also provides empirical evidence supporting stakeholder theory, wherein companies demonstrating a commitment to social and environmental responsibility can gain the trust of the public and other stakeholders. **Limitation :** The study's sample is limited to companies listed on the Indonesia Stock Exchange (BEI) from 2021 to 2023. This focus may restrict the generalizability of the findings to other contexts or regions. **Future Research :** Future studies should consider a more diverse range of companies across different industries and geographical locations to enhance the applicability of the results. Future research should explore the longitudinal effects of these variables over time and across different industries to further validate the findings of this study. Future research can consider the use of company size as a moderating variable to achieve more optimal result. The use of company size as a moderating variable is expected to provide a deeper understanding of its impact on other variables. Additionally, investigating the potential moderating effects of external factors, such as regulatory frameworks and market conditions, could provide a more comprehensive understanding of the dynamics at play in corporate sustainability efforts.

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