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# **The relationship between carbon emission disclosure and environmental performance on firm value: The moderating role of profitability**

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**Abstract**--The purpose of this study is to empirically examine the relationship between carbon emission disclosure and environmental performance on firm value, moderated by profitability. This research is grounded in legitimacy theory and stakeholder theory. The population includes companies listed in the energy, basic materials, industrials, consumer non-cyclicals, consumer cyclicals, and healthcare sectors on the Indonesia Stock Exchange for the period 2021–2023. The data were collected using a non-probability sampling method with a purposive sampling technique. Secondary data were used in this study, and the data were analyzed using Moderated Regression Analysis (MRA). The results show that both carbon emission disclosure and environmental performance have a positive and significant effect on firm value. Moreover, profitability strengthens the influence of carbon emission disclosure and environmental performance on firm value. The findings of this study support the legitimacy theory and stakeholder theory in explaining the factors considered by investors in making investment decisions.

**Keywords**---Carbon Emission Disclosure, Environmental Performance, Profitability, Firm Value.

## **Introduction**

The Global Carbon Project reported that carbon emissions from fossil fuels reached an all-time high in 2023, totaling 36.8 billion metric tons—an increase of 1.1% compared to 2022 and 1.5% compared to the pre-pandemic period (Zulkiflar,



2024). The report also highlighted three major contributors to global carbon emissions: coal (41%), oil (32%), and natural gas (21%). From 1850 to 2021, human activity generated an estimated 2,500 billion tons of CO<sub>2</sub> emissions (Sari, 2022). Given the substantial contribution of corporations to carbon emissions, companies are urged to consider the environmental impacts of their operations (Kalu et al., 2016), with the aim of minimizing environmental damage (Bui et al., 2020). In his article “*The 5 Countries That Produce the Most Carbon Dioxide (CO<sub>2</sub>)*” on Investopedia, Andriy Blokhin notes that China ranks as the world’s largest emitter of carbon dioxide.

Carbon emission disclosure reflects corporate engagement in reducing carbon emissions in Indonesia. This information is generally presented in companies’ sustainability reports. Although carbon emission disclosure is considered vital, many companies have yet to adopt it, as such disclosure in Indonesia remains voluntary (Astuti & Wirama, 2020). In carrying out their operations, companies are responsible to stakeholders by addressing the social, environmental, and economic dimensions—the so-called triple bottom line (Septiana & Ardiana, 2024).

Globally, carbon emission disclosure is a non-financial reporting mechanism aimed at managing environmentally impactful activities while informing potential investors about the company’s environmental commitments, which can influence financial decision-making (Zuhrufiyah & Anggraeni, 2019). Proper disclosure can be perceived positively by investors, signaling lower investment risk and reducing the company’s equity burden, thereby potentially impacting share prices and firm value (Bahriansyah & Ginting, 2022). In addition to standard financial statements, companies are increasingly expected to report on social aspects, including carbon emission disclosures (Septiana & Ardiana, 2024).

However, empirical studies on the effect of carbon emission disclosure on firm value have yielded mixed results. Sari & Budiasih (2022) found a positive effect in manufacturing firms, while Zuhrufiyah & Anggraeni (2019) reported similar results in Southeast Asian firms listed in the Carbon Disclosure Project. Positive relationships were also identified by Soleha & Isnalita (2022), Ezra & Santoso (2024), and Ramdani & Nugraha (2024). In contrast, studies by Agatha & Aryati (2024), Sandy & Ardiana (2023), and Hadiwibowo et al. (2023) found no significant effect of carbon emission disclosure on the firm value of companies listed on the Indonesia Stock Exchange (IDX).

Beyond carbon emission disclosure, environmental performance is another indicator of corporate environmental responsibility. Environmental performance refers to a company’s efforts to create pollution-free operations, voluntarily integrating environmental concerns into their operations and stakeholder relations beyond legal obligations (Cahyani & Puspitasari, 2023). Persistent environmental issues stemming from industrial activities highlight the lack of environmental attention in corporate production processes. Assessing environmental performance can motivate companies to promote ecological sustainability.

To encourage this, the Indonesian Ministry of Environment and Forestry has introduced the PROPER program (Program for Pollution Control, Evaluation, and Rating), which evaluates corporate compliance with environmental regulations through incentive and disincentive mechanisms (Kelly & Henny, 2023). PROPER ratings use color-coded indicators ranging from worst to best, aiming to drive environmentally positive behavior that benefits long-term corporate sustainability. In line with this, Law No. 40 of 2007 and Government Regulation No. 47 of 2012 require companies to fulfill social and environmental responsibilities, including reporting their environmental performance in annual director reports presented during general shareholder meetings (Sapulette & Limba, 2021).

Numerous studies, such as those by Pasau & Khomsiyah (2023), Sapulette & Limba (2021), Apriyanti et al. (2023), Asrizon et al. (2021), and Lestari & Khomsiyah (2023), found a positive relationship between environmental performance and firm value. Conversely, Dasgupta et al. (1998) observed a decline in firm value associated with poor environmental performance in developing countries such as Argentina, Chile, Mexico, and the Philippines. Other studies—including those by Ningtias et al. (2023), Adyaksana et al. (2023), Ramadhana & Januarti (2022), Hadiwibowo (2023), and Soedjatmiko et al. (2021)—found no significant impact of environmental performance on firm value among IDX-listed companies. This inconsistency suggests that strong environmental performance may not sufficiently convince the market that companies are managing environmental resources effectively (Soedjatmiko et al., 2021).

Given the inconsistent findings regarding the relationship between carbon emission disclosure, environmental performance, and firm value, this study introduces profitability as a moderating variable. Profitability is believed to influence this relationship by enhancing or weakening the effects of disclosure and performance on firm value.

Profitability reflects a company's operational efficiency in generating profits. It signals that a firm is in a favorable condition, thereby attracting investors (Soedarman et al., 2023). Higher profitability is likely to encourage greater transparency in carbon emission disclosure and environmental performance, as companies with ample resources can implement sustainability strategies without compromising financial performance. Conversely, firms with lower profitability may prioritize short-term operational needs and limit environmental disclosures.

Profitable companies that actively engage in environmental responsibility are more likely to attract investors, which in turn increases share prices and enhances firm value (Wulandari, 2016). Investors tend to be more aligned with companies that prioritize environmental protection and stakeholder interests (Hutabarat & Siswantaya, 2015). Zulkifli (2025) found that profitability moderates the effect of carbon emission disclosure on firm value, while Marini & Herawaty (2024) and Pangestu et al. (2025) found no such moderating effect. These results suggest that investors may consider other factors beyond carbon emission disclosure, particularly in the energy and basic materials sectors (Pangestu et al., 2025). However, Kelly & Henny (2023) reported that profitability strengthens the effect of environmental performance disclosure on firm value, while Hafid & Wahyudin (2020) found no significant relationship.

This study aims to provide empirical evidence on the relationship between carbon emission disclosure and environmental performance on firm value, with profitability as a moderating variable. The theoretical framework is grounded in legitimacy theory and stakeholder theory. Legitimacy theory posits a social contract between businesses and society, whereby companies must act in accordance with societal values to maintain legitimacy and ensure long-term survival. Stakeholder theory emphasizes corporate social responsibility influenced by both internal and external stakeholders. From this perspective, disclosures communicate a company's environmental implications and its role in sustainability to stakeholders.

## **Literature Review and Hypothesis Development**

Carbon emission disclosure is a component of non-financial reporting that reflects corporate accountability in environmental responsibility, aligning with the triple bottom line framework—social, environmental, and economic dimensions. Under legitimacy theory, such disclosure is seen as a means for companies to gain public approval by aligning their environmental actions with societal norms and expectations. As companies reveal their carbon emissions, they signal transparency and ethical conduct, which can enhance their legitimacy and corporate image (Trevanti & Yulianti, 2023).

Empirical studies have supported this theoretical foundation. Sari & Budiasih (2022) found a positive effect of carbon emission disclosure on firm value in manufacturing companies, while Zuhrufiyah & Anggraeni (2019) reported similar results in Southeast Asian firms under the Carbon Disclosure Project. Qiu et al. (2014) and Saka & Oshika (2014) also found that environmental disclosure, especially related to carbon emissions, can influence investor perception and thus increase firm value. These findings suggest that transparency in environmental performance builds investor confidence, enhancing the firm's valuation.

H1: Carbon Emission Disclosure Positively Affects Firm Value

Environmental performance reflects a firm's efforts to mitigate ecological harm through effective environmental management practices, such as waste treatment and pollution control. Grounded in stakeholder theory, companies are expected to address not only economic goals but also environmental and social impacts to meet stakeholder expectations. Effective environmental performance can enhance a company's image and signal long-term sustainability.

Research by Pasau & Khomsiyah (2023), Sapulette & Limba (2021), and Wardani & Sa'adah (2020) shows that strong environmental performance positively influences firm value. These findings suggest that companies with high environmental ratings—such as those receiving favorable PROPER scores—are perceived as less risky and more sustainable, making them more attractive to investors. Thus, integrating environmental considerations into corporate strategy contributes not only to ecological sustainability but also to financial success.

H2: Environmental Performance Positively Affects Firm Value

Profitability reflects a company's financial strength and operational efficiency, which enables it to invest in sustainability efforts without compromising financial performance. According to legitimacy theory, higher profitability allows firms to

allocate more resources toward environmentally responsible practices, including carbon emission disclosures. These actions enhance corporate legitimacy and appeal to environmentally conscious investors.

Empirical evidence supports profitability as a moderating variable. Tana & Bernadetta (2021) and Setiawan et al. (2022) found that profitability influences carbon disclosure practices. Furthermore, Zulkifli (2025) showed that profitability strengthens the positive effect of carbon emission disclosure on firm value. This suggests that investors are more inclined to support companies that are both profitable and environmentally transparent, perceiving them as financially secure and socially responsible.

H3: Profitability Strengthens the Relationship Between Carbon Emission Disclosure and Firm Value

Implementing effective environmental performance often incurs substantial costs, such as investments in cleaner technologies and waste treatment systems. Companies with high profitability are better equipped to bear these costs, allowing them to maintain or enhance environmental practices without impairing financial stability. Stakeholder theory emphasizes that such firms are more likely to meet stakeholder expectations and sustain long-term relationships.

Studies by Zullaekha & Susanto (2021) and Aulia & Agustina (2015) found that profitability positively affects environmental disclosure. Moreover, Kelly & Henny (2023) and Hanifah & Ismawati (2022) confirmed that profitability enhances the effect of environmental performance on firm value. These findings indicate that profitability acts as an enabling factor, allowing companies to engage in sustainability practices that ultimately contribute to greater investor trust and higher firm valuation.

H4: Profitability Strengthens the Relationship Between Environmental Performance and Firm Value

## **Methods**

This study was conducted on companies listed on the Indonesia Stock Exchange (IDX), specifically within the industrial, manufacturing, and energy sectors, including the energy, basic materials, industrials, consumer non-cyclicals, consumer cyclicals, and healthcare sectors. The selection of these sectors is based on data from the Central Statistics Agency (BPS), which indicates that from 2019 to 2022, companies in these sectors have had the most direct environmental impact and are the largest contributors to carbon emissions compared to other sectors. The research subjects are companies operating in the abovementioned sectors and listed on the IDX from 2021 to 2023. This time frame was chosen to capture the period of significant economic adjustment, encompassing the post-pandemic recovery phase and normalization of business activities. The scope of this study is limited to the variables of carbon emission disclosure and environmental performance as independent variables, firm value as the dependent variable, and profitability as the moderating variable.

The study population includes 466 companies in the industrial, manufacturing, and energy sectors (energy; basic materials; industrials; consumer non-cyclicals; consumer cyclicals; and healthcare) listed on the IDX during 2021–2023. A

sample is a subset of the population that possesses the characteristics of the population (Sugiyono, 2019). The sample in this study consists of 96 companies that fall under the industrial, manufacturing, and energy sectors and meet the defined selection criteria. This study employs purposive sampling, a non-probability sampling technique based on specific criteria. The criteria used for sample selection are as follows:

1. Companies classified under the industrial, manufacturing, and energy sectors, including energy, basic materials, industrials, consumer non-cyclicals, consumer cyclicals, and healthcare;
2. Companies that explicitly or implicitly disclose carbon emissions (at least one item on carbon or GHG-related policies or disclosures);
3. Companies that received PROPER ratings consecutively from 2021 to 2023.

The independent variables in this study are carbon emission disclosure and environmental performance, while the dependent variable is firm value. Profitability serves as the moderating variable. The research begins by identifying relevant phenomena and reviewing prior empirical studies to formulate the hypotheses. Data analysis is conducted using **multiple linear regression** and **Moderated Regression Analysis (MRA)** to evaluate both direct effects and the moderating role of profitability.

## Result and Discussion

### *Moderated Regression Analysis (MRA)*

The Moderated Regression Analysis (MRA) was used to examine the relationship among the variables: Carbon Emission Disclosure (CED) and Environmental Performance (PROPER) as independent variables, Profitability (ROA) as a moderating variable, and Firm Value (measured by Tobin's Q) as the dependent variable.

Table 1. Moderated Regression Analysis

Variable	Coefficient	Std. Error	t	Sig.
(Constant)	1.880883	0.2205669	8.53	0.000
CED	0.6406182	0.0729423	8.78	0.000
PROPER	0.4611226	0.1055362	4.37	0.000
ROA	0.7191131	0.0952653	7.55	0.000
CED × ROA	0.2601613	0.0282594	9.21	0.000
PROPER × ROA	0.2697178	0.0217343	12.41	0.000

Secondary Data, 2025

Regression Model Equation:

$$Y = 1.880883 + 0.6406182(\text{CED}) + 0.4611226(\text{PROPER}) + 0.7191131(\text{ROA}) + 0.2601613(\text{CED} \times \text{ROA}) + 0.2697178(\text{PROPER} \times \text{ROA})$$

All independent variables and interaction terms are statistically significant at the 5% level, indicating their significant influence on firm value. The coefficients can be interpreted as follows:

- Intercept of 1.880883 suggests that when all independent variables are held constant, the average firm value is 1.880883.
- A 1-unit increase in CED increases firm value by 0.6406182, holding other variables constant.
- A 1-unit increase in PROPER increases firm value by 0.4611226.
- A 1-unit increase in ROA increases firm value by 0.7191131.
- The interaction between CED and ROA (0.2601613) positively affects firm value, suggesting that profitability strengthens the effect of carbon emission disclosure.
- Similarly, the interaction term PROPER and ROA (0.2697178) indicates that profitability enhances the impact of environmental performance on firm value.

#### *Coefficient of Determination ( $R^2$ )*

Table 2. Coefficient of Determination

R Square	Adjusted R Square
0.6162	0.6094

Secondary Data, 2025

The adjusted  $R^2$  value of 0.6094 indicates that 60.94% of the variation in firm value is explained by the model, including CED, PROPER, ROA, and their respective interaction terms. The remaining 39.06% is attributed to other variables not included in this model.

#### *Simultaneous F-Test*

Table 3. F-Test Result

F-statistic	Prob (F-statistic)
90.57	0.0000

Secondary Data, 2025

The significance value ( $p = 0.0000$ ) is less than  $\alpha = 0.05$ , indicating that the model is statistically fit. All independent variables and interaction terms jointly have a significant effect on firm value in industrial, manufacturing, and energy companies from 2021 to 2023.

*Hypothesis Testing (t-Test)*

Table 4. Partial t-Test Results

Variable	Coefficient	t-value	p-value	Conclusion
CED	0.6406182	8.78	0.000	Positive and significant
PROPER	0.4611226	4.37	0.000	Positive and significant
ROA	0.7191131	7.55	0.000	Positive and significant
CED × ROA	0.2601613	9.21	0.000	Positive and significant
PROPER × ROA	0.2697178	12.41	0.000	Positive and significant

Secondary Data, 2025

*Carbon Emission Disclosure on Firm Value*

The t-test results in Table 4 show that the regression coefficient for Carbon Emission Disclosure (CED) is 0.6406182, with a significance level of 0.000, which is below the 0.05 threshold, and a positive t-value of 8.78. These results indicate that carbon emission disclosure has a positive and significant effect on firm value among the companies studied from 2021 to 2023.

Companies with strong governance and transparent carbon emission disclosure tend to increase their firm value. The growing awareness among Indonesian investors regarding environmental issues has led to greater interest in investing in companies that are environmentally responsible (Kurnia et al., 2020).

According to **legitimacy theory**, implementing carbon emission disclosure helps create a positive image for the company. This theory suggests that companies respond to societal expectations by aligning their business behavior with environmental concerns. Transparent disclosure of carbon emissions fosters public trust and sends a signal to the market that the company has the internal capacity to manage its environmental impact (Alfayerds & Setiawan, 2021). As a result, investors perceive the company as low-risk with lower equity costs, which can drive up stock prices and enhance firm value (Fitriana et al., 2024).

Carbon emission disclosure also helps companies avoid implicit or explicit sanctions that may otherwise increase costs and reduce investor confidence (Kurnia et al., 2020). These findings are consistent with those of Sari & Budiasih (2022), Kurnia et al. (2020), and Zuhrufiyah & Anggraeni (2019), who found a positive relationship between carbon emission disclosure and firm value, particularly among companies in the Southeast Asian Carbon Disclosure Project. Additional support comes from Soleha & Isnalita (2022), Ezra & Santoso (2024), and Ramdani & Nugraha (2024), who also confirmed the positive influence of carbon emission disclosure on firm value.

*The Effect of Environmental Performance on Firm Value*

The t-test results in Table 4 also show that the regression coefficient for Environmental Performance (PROPER) is 0.4611226, with a significance level of

0.000 (less than 0.05) and a positive t-value of 4.37. This suggests that environmental performance has a positive and significant effect on firm value for the observed companies during the 2021–2023 period.

Environmental performance reflects a company's management system in addressing environmental issues. It generally refers to the extent of environmental impact caused by business activities and how effectively the company manages waste and environmental risks (Sapulette & Limba, 2021). Low levels of environmental damage indicate good environmental performance, while high levels of negative impact reflect poor environmental performance (Angelina & Nursasi, 2021).

According to **stakeholder theory**, environmental performance disclosure serves as a communication tool to show stakeholders that the company is committed to environmental responsibility. It also demonstrates that the company prioritizes not only its operations but also the resulting environmental impacts (Apriyanti et al., 2023). High-quality environmental performance disclosures enhance the reputation among stakeholders and investors, boost investor interest, increase share prices, and ultimately lead to shareholder prosperity and higher firm value (Khanifah et al., 2020).

These findings align with those of Pasau & Khomsiyah (2023), Sapulette & Limba (2021), and Wardani & Sa'adah (2020), who observed a positive effect of environmental performance on firm value. Other supporting studies by Asrizon et al. (2021), Utomo et al. (2020), and Khanifah et al. (2020) found similar results, showing that companies successful in mitigating environmental damage enjoy higher valuations compared to less environmentally responsible firms.

#### *Moderating Variable Classification*

According to the interaction model:

$$Y = \beta_1 X_1 + \beta_2 Z + \beta_3 (X_1 \times Z)$$

The classification of moderation types is as follows:

Table 5. Moderating Variable Classification

No.	Moderation Type	Coefficient Pattern
1	Pure Moderator	$\beta_2$ non-significant, $\beta_3$ significant
2	Quasi Moderator	$\beta_2$ significant, $\beta_3$ significant
3	Homologiser	$\beta_2$ non-significant, $\beta_3$ non-significant
4	Predictor Moderator	$\beta_2$ significant, $\beta_3$ non-significant

Secondary Data, 2025

#### *Profitability in Moderating the Effect of Carbon Emission Disclosure on Firm Value*

The significance of ROA ( $\beta_2$ ) and the interaction term CED×ROA ( $\beta_3$ ) are both < 0.05, classifying this as a quasi-moderation. This implies that profitability

strengthens the positive effect of carbon emission disclosure on firm value. The results of the moderated regression analysis show that both carbon emission disclosure and its interaction with profitability have significant and positive effects on firm value. This indicates a synergistic relationship where profitability strengthens the positive effect of carbon emission disclosure. Companies with high profitability are more capable of disclosing carbon emissions transparently.

According to legitimacy theory, increased profitability enhances the legitimacy of a company because it demonstrates financial capacity to invest in environmental initiatives, including carbon disclosure. On the other hand, companies with lower profitability may prioritize short-term operational needs and lack the resources or motivation to disclose environmental information.

These findings are supported by Zulkifli (2025), who confirmed that profitability moderates the relationship between carbon emission disclosure and firm value. When companies demonstrate high profitability, they are more likely to engage in sustainability disclosures, which in turn enhances firm value.

#### *Role of Profitability in Moderating the Effect of Environmental Performance on Firm Value*

Similarly, the significance values for ROA and  $PROPER \times ROA$  are both  $< 0.05$ , indicating a quasi-moderator role. This shows that profitability enhances the positive effect of environmental performance on firm value. The results also show that the interaction between environmental performance and profitability is positive and significant, indicating that profitability strengthens the effect of environmental performance on firm value. Higher profitability encourages more comprehensive disclosure and better environmental practices, which positively impact firm value.

Environmental performance often involves significant costs, such as waste treatment and compliance expenditures, which may reduce available operational funds. High-profit companies are better equipped to manage these costs and implement sustainability strategies without compromising financial performance. Based on stakeholder theory, high profitability serves as a signal to stakeholders that the company can maintain strong environmental performance. Profitability allows firms to absorb the costs of environmental initiatives and meet stakeholder expectations.

These findings are in line with studies by Zullaekha & Susanto (2021) and Aulia & Agustina (2015), who found that profitability influences environmental disclosure. Kelly & Henny (2023) and Hanifah & Ismawati (2022) further confirmed that profitability enhances the role of environmental performance in increasing firm value.

## **Conclusion**

1. **Carbon emission disclosure has a positive and significant effect on firm value.** This finding indicates that more comprehensive and detailed carbon

emission disclosures enhance a company's public image, thereby increasing investor confidence, which ultimately leads to higher firm value.

2. **Environmental performance has a positive and significant effect on firm value.** This suggests that strong environmental performance signals to stakeholders that the company is committed to environmental responsibility, which in turn boosts investor trust and contributes to an increase in firm value.
3. **Profitability acts as a moderating variable that strengthens the positive effect of carbon emission disclosure on firm value.** Companies with high profitability are more capable of maintaining transparency in carbon emission disclosures, which enhances investor confidence and positively influences firm value.
4. **Profitability also moderates and strengthens the positive relationship between environmental performance and firm value.** High profitability serves as a signal to stakeholders that the company has the financial capacity to achieve optimal environmental performance, thus further increasing firm value.

### *Managerial Implication*

This study provides empirical evidence supporting legitimacy theory and stakeholder theory by demonstrating that carbon emission disclosure and environmental performance positively influence firm value, helping companies maintain legitimacy and meet stakeholder expectations. It also highlights the role of profitability in strengthening these relationships, enriching the theoretical framework and expanding the literature on corporate social responsibility (CSR) and firm value. Practically, the findings offer valuable insights for corporate managers to enhance transparency in environmental disclosures, as these efforts improve investor trust and firm value while supporting long-term business sustainability. Additionally, investors can use these results as a reference when assessing companies' environmental commitments and potential long-term risks.

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