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Determinants of Firm Value: An Analysis of Green Accounting and Carbon Emission Disclosure with Firm Size as a Moderating Variable

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Abstract

Climate change and growing demands for environmental transparency have encouraged companies to integrate environmental responsibility into business practices and reporting, yet evidence linking these activities to firm value remains inconsistent. This study examined the associations of green accounting and carbon emission disclosure with firm value and assessed whether firm size moderated these relationships. A quantitative associative design employed secondary data from annual reports, sustainability reports, and financial information for 19 energy-sector companies listed on the Indonesia Stock Exchange during 2020–2024, yielding 95 firm-year observations. Data were analyzed using multiple linear regression and moderated regression analysis. Green accounting was not significantly associated with firm value, whereas carbon emission disclosure showed a positive and significant association in the main analysis. The analysis did not support a moderating role for firm size in either relationship, although firm size exhibited a direct negative association with firm value. These findings indicate the relevance of carbon emission disclosure to firm valuation within the sampled companies, while providing no statistically significant evidence for the proposed green accounting relationship or moderation effects. The study contributes contextual evidence on environmental reporting and firm valuation in Indonesia's energy sector and highlights the importance of clear, measurable, and comparable carbon emission disclosures for corporate management and investors evaluating environmental accountability and investment prospects.

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Keywords: Green Accounting; Carbon Emission Disclosure; Firm Size; Firm Value; Energy Sector

INTRODUCTION

Climate change has become a global concern closely associated with economic activities and corporate operations, particularly in industries that rely heavily on natural resources and energy consumption. Industrial activities contribute to greenhouse gas emissions, prompting governments worldwide to strengthen their commitments to environmental protection (Dwiprigitaningtias et al., 2025). This commitment is reflected in the Paris Agreement, which encourages countries to set emission-reduction targets through their Nationally Determined Contributions (NDCs). In Indonesia, this commitment was reinforced through the ratification of the Paris Agreement under Law No. 16 of 2016 and Presidential Regulation No. 98 of 2021 concerning the Implementation of Carbon Economic Value. These regulatory developments indicate that environmental responsibility has increasingly become an essential component of corporate governance and sustainability reporting.

In the corporate context, financial statements alone cannot provide a comprehensive assessment of a company's condition and prospects because financial information does not fully capture its environmental risks. Investors increasingly require information concerning risk management, sustainability strategies, corporate governance, and carbon emissions to support their investment decisions (Farhan, 2024). Consequently, environmental disclosure has become an important aspect of corporate transparency and accountability. In Indonesia, sustainable finance practices and sustainability reporting are regulated under Financial Services Authority Regulation No. 51/POJK.03/2017, while annual reporting requirements are further addressed in Circular Letter No. 16/SEOJK.04/2021. These regulations encourage companies to move beyond profit-oriented activities by incorporating environmental considerations into their operational and reporting practices.

The energy sector represents a particularly relevant setting for examining these developments. Although it plays a strategic role in economic growth, the sector faces substantial environmental challenges arising from natural resource utilization and potential operational emissions. According to the 2023 Capital Market, Derivatives, and Carbon Exchange Fact Book published by the Financial Services Authority, the energy sector stock

index rose 28.01%, from 2,100.86 at the end of 2023 to 2,689.27 at the end of 2024, while the Composite Stock Price Index declined 2.65%. This development illustrates the distinctive market dynamics of energy companies amid growing expectations for environmental accountability. In this context, green accounting provides a relevant approach by incorporating environmental costs and impacts into corporate management practices (Haerianti et al., 2025). Meanwhile, carbon emissions disclosure communicates information about corporate carbon emissions and the measures taken to manage them (Athaya et al., 2025). Both practices are therefore important to examine, as they may represent corporate environmental responsibility while also providing information that influences investor assessments.

The relationship between environmental management and firm value can be understood through legitimacy theory and signaling theory. Legitimacy theory suggests that corporate sustainability depends partly on an organization's ability to maintain social acceptance by aligning its activities with prevailing societal values and expectations (Dowling & Pfeffer, 1975). From this perspective, green accounting and carbon emission disclosure can serve as mechanisms through which companies demonstrate their responsibility for environmental consequences (Muthmainnah et al., 2025). Signaling theory, by contrast, explains how information companies communicate can reduce information asymmetry between management and investors and support investment decisions (Spence, 1973). Accordingly, information concerning environmental expenditure and carbon emission management may serve as signals that investors consider when evaluating corporate prospects and firm value. Nevertheless, market responses to environmental information may vary depending on its credibility and the company's underlying characteristics.

Previous studies have reported inconsistent findings regarding the effects of green accounting and carbon emission disclosure on firm value. Sulistiono & Nur (2024) found that green accounting influenced firm value, although firm size did not strengthen this relationship. In contrast, Kirowati et al. (2026) and Putri & Windiarti (2026) reported that neither green accounting nor carbon emission disclosure significantly affected firm value. Regarding carbon emission disclosure, Kurnia et al. (2021) identified a positive effect on firm value among manufacturing companies in Indonesia, whereas Ananda & Taqwa (2024) found no significant effect. Rahmawati et al. (2025) also reported different findings, identifying a significantly negative relationship between carbon emission disclosure and firm value. Conversely, Ng et al. (2022) found a positive relationship between carbon emission

disclosure and firm value. These contrasting results suggest that environmental information does not necessarily generate consistent responses from capital markets.

Further inconsistencies appear in studies examining energy-sector companies. Yoga P.M. & Rasyid (2026) found that carbon emission disclosure had a significantly positive effect on firm value, while Husein et al. (2026) also reported a positive relationship. In contrast, Audrey & Lestari (2026) identified a significantly negative effect of carbon emission disclosure on firm value measured using Tobin's Q. Previous studies have also adopted different moderating variables when examining these relationships. Kirowati et al. (2026) and Putri and Windiarti (2026) employed profitability as a moderating variable, whereas Yoga P.M. & Rasyid (2026) examined independent commissioners. Meanwhile, Rahmawati, Darmanto, and Setyadi (2025) treated firm size as an independent variable rather than a moderator. These differences indicate that the relationship between environmental disclosure and firm value warrants further investigation using a more specific research model and corporate context.

Based on the preceding discussion, this study identifies two principal research gaps. First, an empirical gap remains because findings on the effects of green accounting and carbon emission disclosure on firm value are inconsistent. Second, a model-related gap exists because previous studies have rarely examined firm size as a moderating variable in both relationships simultaneously. This study's novelty lies in its integrated examination of green accounting and carbon emission disclosure as determinants of firm value, with firm size moderating both relationships simultaneously. The study focuses on energy-sector companies listed on the Indonesia Stock Exchange during 2020–2024, comprising 19 companies and 95 firm-year observations. Drawing on legitimacy theory and signaling theory, this study examines the effects of green accounting and carbon emission disclosure on firm value and investigates whether firm size moderates both relationships. The findings are expected to provide additional empirical evidence for environmental accounting research and offer insights for corporate management and investors in evaluating environmental management practices and corporate disclosure.

METHODS

This study employed a quantitative approach with an associative research design to examine the effects of green accounting and carbon emission disclosure on firm value and

the moderating role of firm size. A quantitative approach was appropriate because the study examined relationships among the research variables using numerical data and statistical analysis. The study used secondary panel data, combining cross-sectional observations across companies with time-series observations over 2020–2024. This design enabled the analysis of differences in corporate characteristics and changes in company conditions throughout the observation period.

The study examined four variables: green accounting (X1) and carbon emission disclosure (X2) as independent variables, firm value (Y) as the dependent variable, and firm size (Z) as the moderating variable. Green accounting was measured using 14 environmental management and responsibility disclosure indicators based on Lako (2011). Carbon emission disclosure was assessed using 18 carbon emission disclosure indicators adapted from Choi et al. (2013). Firm value was measured using Tobin's Q, calculated by comparing the market value of equity plus total liabilities with total assets. Firm size was measured as the natural logarithm of total assets, following Dang et al. (2018). These indicators provided the operational basis for measuring each variable quantitatively.

The research population comprised energy-sector companies listed on the Indonesia Stock Exchange (IDX) during 2020–2024. The sample was selected through purposive sampling based on the availability of annual reports and/or sustainability reports, financial and stock market information, and sufficient disclosure data for measuring all research variables. Based on these criteria, 19 companies were selected, resulting in 95 firm-year observations over five years. The secondary data were obtained from financial statements, annual reports, sustainability reports, and corporate information published on the official IDX website and individual company websites.

Data were collected through documentation by identifying, examining, and recording relevant information from corporate reports. Green accounting and carbon emission disclosure were measured using content analysis by matching the reported information against predetermined indicators. Each disclosed indicator received a score of 1, whereas an undisclosed indicator received a score of 0. The total score was then divided by the respective number of indicators: 14 for green accounting and 18 for carbon emission disclosure. The study did not use questionnaires or interviews because it relied entirely on documentary sources. Consequently, questionnaire validity and reliability testing was not applicable.

Data analysis used IBM SPSS Statistics through descriptive statistics, classical assumption tests, multiple linear regression, and Moderated Regression Analysis (MRA). Descriptive statistics presented the minimum, maximum, mean, and standard deviation of each variable. Classical assumption testing included the Kolmogorov–Smirnov test and Normal P–P Plot for normality, Tolerance and Variance Inflation Factor (VIF) for multicollinearity, the Glejser test for heteroscedasticity, and the Durbin–Watson statistic for autocorrelation. Multiple linear regression examined the direct effects of the independent variables on firm value, while MRA incorporated interaction terms between firm size and each independent variable. The study tested hypotheses using t-tests, F-tests, and the coefficient of determination (R^2), with a 5% significance level. The observation period covered 2020–2024; however, the original methodology did not report the specific months or the overall duration of data collection and the research process.

RESULTS

Descriptive Statistical Analysis

Descriptive statistics were used to provide an overview of the research data, including the minimum, maximum, mean, and standard deviation. The analysis covered 95 observations of energy-sector companies listed on the Indonesia Stock Exchange during 2020–2024. Table 1 presents the results.

Table 1. Descriptive Statistical Analysis

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Green Accounting (GA)	95	0.357	1.000	0.789	0.152
Carbon Emission Disclosure (CED)	95	0.444	0.944	0.771	0.145
Company Size (SIZE)	95	14.243	18.949	16.778	1.173
Firm Value (Tobin's Q)	95	0.639	4.572	1.229	0.648

Source: Compiled by the researcher (2026)

Table 1. Descriptive Statistical Analysis shows that the green accounting variable has a mean value of 0.789 and a standard deviation of 0.152. RAJA recorded the minimum value of 0.357 in 2020, while ADRO recorded the maximum value of 1.000 in 2024. Carbon emission disclosure has a mean of 0.771 and a standard deviation of 0.145, with a minimum of 0.444 recorded by ELSA in 2020 and a maximum of 0.944 recorded by GEMS in 2024. Company size, measured using the natural logarithm of total assets, has a mean value of 16.778 and a standard deviation of 1.173. KKGI recorded the minimum value of 14.243 in 2020, while ADRO recorded the maximum value of 18.949 in 2022. Meanwhile, firm value, measured using Tobin's Q, has a mean of 1.229 and a standard

deviation of 0.648, with a minimum of 0.639 recorded by HRUM in 2024 and a maximum of 4.572 recorded by GEMS in 2021. Furthermore, 46 out of 95 observations recorded Tobin's Q values above one.

Classical Assumption Tests

We conducted classical assumption tests for two regression models: multiple linear regression (Model 1) and moderated regression analysis (Model 2). The tests included normality, multicollinearity, heteroscedasticity, and autocorrelation.

Table 2. Results of Classical Assumption Tests

Test	Indikator	Model 1	Model 2
Normality	Kolmogorov-Smirnov (Sig.)	0.000	0.000
Multicollinearity	Highest VIF	1.704	2.022
Heteroscedasticity	Variables with Sig. <0.05	CED, SIZE	CED, SIZE
Autocorrelation	Durbin-Watson	1.022	1.043

Source: Compiled by the researcher (2026)

Table 2. Results of the Classical Assumption Tests show that the normality test produced significance values of 0.000 for both models, indicating that the residuals were not normally distributed. The multicollinearity test revealed that the highest VIF values were 1.704 for Model 1 and 2.022 for Model 2. Both values were below the 10 threshold, indicating no multicollinearity issues. Furthermore, the Glejser test showed that CED and SIZE had significance values below 0.05 in both models, indicating heteroscedasticity. The autocorrelation test produced Durbin-Watson values of 1.022 for Model 1 and 1.043 for Model 2, suggesting positive autocorrelation.

Multiple Linear Regression Results

Multiple linear regression (Model 1) examined the effects of green accounting and carbon emission disclosure on firm value, with company size as a control variable.

Table 3. Coefficient of Determination Test Results (Model 1)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.3857	0.1488	0.1207	0.6073	1.022

Source: Compiled by the researcher (2026)

Table 3. Coefficient of Determination Test Results (Model 1) show that Model 1 obtained an R value of 0.3857 and an R-squared value of 0.1488. The adjusted R-squared of 0.1207 indicates that green accounting, carbon emission disclosure, and company size explained 12.07% of the variation in firm value. In comparison, other factors outside the research model explained the remaining 87.93%.

Table 4. F-Test Results (ANOVA) for Model 1

Model 1	Sum of Squares	df	Mean Square	F-statistic	Sig.
Regression	5.865	3	1.955	5.301	0.002
Residual	33.557	91	0.369	-	-
Total	39.422	94	-	-	-

Source: Compiled by the researcher (2026)

Table 4. F-Test Results (ANOVA) for Model 1 show that the simultaneous regression test produced an F-statistic of 5.301 with a significance value of 0.002. Since the significance value was below 0.05, green accounting, carbon emission disclosure, and company size were jointly and significantly associated with firm value. Therefore, Model 1 was statistically significant.

Table 5. t-Test Results (Coefficients) for Model 1

Variable	Coefficient (B)	Std. Error	Beta	t-statistic	Sig.
Constant	3.964	0.935	-	4.242	0.000
Green Accounting (GA)	-0.331	0.482	-0.078	-0.687	0.494
Carbon Emission Disclosure (CED)	1.678	0.566	0.375	2.967	0.004
Company Size (SIZE)	-0.225	0.061	-0.407	-3.687	0.000

Source: Compiled by the researcher (2026)

Table 5. t-Test Results (Coefficients) for Model 1 show that green accounting had a regression coefficient of -0.331 with a significance value of 0.494, indicating no statistically significant effect on firm value. In contrast, carbon emission disclosure had a positive coefficient of 1.678 with a significance value of 0.004, indicating a positive and significant effect on firm value. Meanwhile, company size had a negative coefficient of -0.225 with a significance value of 0.000, indicating a negative and significant effect on firm value.

Based on these results, the regression equation for Model 1 is as follows:

$$\text{Tobin's Q} = 3.964 - 0.331\ \text{GA} + 1.678\ \text{CED} - 0.225\ \text{SIZE} + e$$

Moderated Regression Analysis Results (Model 2)

Moderated regression analysis examined the moderating role of company size in the relationship between green accounting, carbon emission disclosure, and firm value. The model included two interaction terms: GA × SIZE and CED × SIZE. Before constructing the interaction terms, all relevant variables were mean-centered.

Table 6. Coefficient of Determination for Model 1 and Model 2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
Model 1	0.3857	0.1488	0.1207	0.6073	1.022
Model 2	0.4152	0.1724	0.1259	0.6054	1.043

Source: Compiled by the researcher (2026)

Table 6. The coefficient of Determination for Model 1 and Model 2 shows that the R-squared value increased from 0.1488 in Model 1 to 0.1724 in Model 2. The adjusted R-squared also increased from 0.1207 to 0.1259. These results indicate improved model explanatory power after including interaction terms, although the increase was relatively small.

Table 7. R Square Change Test Results (Model 2 Compared with Model 1)

R Square Change	F Change	Sig. F Change
0.0237	1.272	0.285

Source: Compiled by the researcher (2026)

Table 7. R-square Change Test Results (Model 2 Compared with Model 1) show that including interaction terms resulted in an R-square change of 0.0237, an F change of 1.272, and a significance value of 0.285. Because the significance value exceeded 0.05, adding interaction terms did not significantly improve the model's ability to explain variation in firm value.

Table 8. F-Test Results (ANOVA) for Model 2

Model 1	Sum of Squares	df	Mean Square	F-statistic	Sig.
Regression	5.865	3	1.955	5.301	0.002
Residual	33.557	91	0.369	-	-
Total	39.422	94	-	-	-

Source: Compiled by the researcher (2026)

Table 8. F-Test Results (ANOVA) for Model 2 show that Model 2 obtained an F-statistic of 3.709 with a significance value of 0.004. Since the significance value was below 0.05, the independent variables and interaction terms were jointly and significantly associated with firm value. Therefore, Model 2 was statistically significant.

Table 9. t-Test Results (Coefficients) for Model 2

Variable	Coefficient (B)	Std. Error	Beta	t-statistic	Sig.
Constant	1.275	0.069	-	18.410	0.000
Green Accounting (GA)	-0.294	0.498	-0.069	-0.591	0.556
Carbon Emission Disclosure (CED)	1.428	0.614	0.319	2.324	0.022
Company Size (SIZE)	-0.228	0.061	-0.413	-3.720	0.000
GA x SIZE	-0.156	0.391	-0.045	-0.399	0.691
CED x SIZE	-0.504	0.433	-0.138	-1.164	0.248

Source: Compiled by the researcher (2026)

Table 9. t-Test Results (Coefficients) for Model 2 shows that green accounting had a coefficient of -0.294 with a significance value of 0.556, indicating no significant effect on firm value. Meanwhile, carbon emission disclosure had a positive coefficient of 1.428 with a significance value of 0.022, indicating a positive and significant effect on firm value. Company size exhibited a negative coefficient of -0.228 with a significance value of 0.000. For the interaction terms, GA × SIZE had a coefficient of -0.156 and a significance value of 0.691, whereas CED × SIZE had a coefficient of -0.504 and a significance value of 0.248. Neither interaction term demonstrated a statistically significant effect. Therefore, company size did not moderate the effects of green accounting or carbon emission disclosure on firm value.

The resulting regression equation for Model 2 is as follows:

$$\text{Tobin's Q} = 1.275 - 0.294\ GA + 1.428\ CED - 0.228\ SIZE - 0.156\ (GA \times SIZE) - 0.504\ (CED \times SIZE) + e$$

Summary of Hypothesis Testing

Table 10. Summary of Hypothesis Testing Results

Hypothesis	Statement	Coefficient	Sig.	Decision
H1	Green accounting affects firm value	-0.331	0.494	Rejected
H2	Carbon emission disclosure affects firm value	1.678	0.004	Accepted (positive)
H3	Company size moderates the effect of green accounting on firm value	-0.156	0.691	Rejected
H4	Company size moderates the effect of carbon emission disclosure on firm value	-0.504	0.248	Rejected

Source: Compiled by the researcher (2026)

Table 10. Summary of Hypothesis Testing Results shows that only one of the four proposed hypotheses was supported by the empirical results. Carbon emission disclosure had a positive and significant effect on firm value, with a coefficient of 1.678 and a significance value of 0.004. Meanwhile, H1 was rejected because green accounting did not demonstrate a significant effect on firm value. Hypotheses H3 and H4 were also rejected because the interaction terms representing the moderating role of company size did not exhibit statistically significant effects.

Robustness Tests

Robustness tests assessed the consistency of the regression findings, considering violations of classical assumptions and the panel structure of the research data. We employed two estimation approaches: regression with heteroskedasticity-consistent standard errors

(HC3) and the Random Effect Model (REM) with clustered standard errors. The panel model selection process involved the Chow, Lagrange Multiplier, and Hausman tests.

Table 11. Results of Panel Data Model Selection

Test	Model 1	Model 2
Chow Test	F = 6.835; Sig. = 0.000	F = 6.665; Sig. = 0.000
Lagrange Multiplier Test	52.370; Sig. = 0.000	50.623; Sig. = 0.000
Hausman Test	0.852; Sig. = 0.837	1.334; Sig. = 0.931
Selected Model	REM	REM

Source: Compiled by the researcher (2026)

Table 11. Results of the Panel Data Model Selection show that the Chow and Lagrange Multiplier tests produced significance values of 0.000 for both models, indicating that the common effect approach was not the most appropriate specification for the research data. Furthermore, the Hausman test produced significance values of 0.837 for Model 1 and 0.931 for Model 2. Since both values exceeded 0.05, the Random Effect Model (REM) was selected as the appropriate panel data estimation approach.

Table 12. Comparison of Regression Estimation Results

Parameter	Ordinary Regression (Coefficient/Sig.)	Robust SE HC3 (Coefficient/Sig.)	REM with Clustered SE (Coefficient/Sig.)
Model 1: GA	-0,331 / 0,494	-0,331 / 0,377	-0,283 / 0,600
Model 1: CED	1,678 / 0,004	1,678 / 0,003	1,299 / 0,076
Model 1: SIZE	-0,225 / 0,000	-0,225 / 0,000	-0,183 / 0,007
Model 2: GA × SIZE	-0,156 / 0,691	-0,156 / 0,440	-0,368 / 0,288
Model 2: CED × SIZE	-0,504 / 0,248	-0,504 / 0,041	-0,247 / 0,490

Source: Compiled by the researcher (2026)

Table 12. Comparison of Regression Estimation Results shows variations in the statistical significance of several variables across the estimation approaches. The results for green accounting consistently indicate no significant effect across all three approaches, whereas company size consistently exhibits a negative and significant effect on firm value. The positive effect of carbon emission disclosure is statistically significant under ordinary regression and robust SE HC3, with significance values of 0.004 and 0.003, respectively. However, under REM, its significance value increases to 0.076, indicating that the effect is no longer significant at the 5% level. Meanwhile, the CED × SIZE interaction is not significant under ordinary regression and REM, but becomes significant under robust SE HC3, with a significance value of 0.041. These findings indicate that the conclusions regarding H2 and H4 are sensitive to the estimation approach employed.

DISCUSSION

The findings indicate that green accounting has no statistically significant effect on the firm value of energy-sector companies listed on the Indonesia Stock Exchange during 2020–2024, as reflected by a significance value of 0.494. Therefore, the first hypothesis (H1) is not supported. This result suggests that the disclosure of information concerning environmental management and corporate environmental responsibility does not necessarily constitute a primary consideration for investors when assessing a company's market value. In this study, green accounting was measured using a disclosure index comprising 14 indicators, with a score of 1 assigned to disclosed information and 0 to information not disclosed, following Lako (2011). The insignificant result should consequently be interpreted in light of the characteristics of this measurement. The index captures the extent of environmental information a company discloses. However, it does not directly measure environmental expenditure, investment, or the effectiveness of environmental management practices. The mean green accounting index of 0.789, accompanied by a standard deviation of 0.152, also indicates that disclosure levels among the sampled companies were relatively high, with limited variation. This condition may reduce the index's ability to distinguish firms by market valuation. When most companies disclose environmental information at similar levels, investors may receive insufficient differentiating information to assign substantially different market assessments. Furthermore, the presence of environmental information in corporate reports does not necessarily demonstrate superior environmental performance. Investors may place greater emphasis on substantive aspects, including actual environmental expenditure, the effectiveness of operational impact controls, and measurable environmental management outcomes, which the disclosure index used in this study does not fully capture.

From the perspective of legitimacy theory, this finding can be understood as environmental disclosure being one means by which companies seek to maintain social acceptance of their operational activities (Dowling & Pfeffer, 1975). In the energy sector, green accounting disclosure may form part of a company's response to environmental and social expectations. Nevertheless, fulfilling legitimacy expectations does not automatically translate into higher market value. Investors may regard such disclosures primarily as evidence of transparency and compliance with stakeholder expectations rather than as new information that directly changes their assessment of a company's economic prospects. This result is consistent with Kirowati et al. (2026) and Putri and Windiarti (2026), who also reported no significant effect of green accounting on firm value. However, it differs from

Sulistiono and Nur (2024), who identified an effect of green accounting on firm value among mining companies. These differences may reflect variations in research objects, observation periods, and firm-value proxies. Sulistiono and Nur (2024), for instance, examined mining companies and employed the price-to-book value ratio (PBV). In contrast, the present study focuses on energy-sector companies during 2020–2024. It uses Tobin's Q. Such contextual differences indicate that the relationship between environmental disclosure and firm value may not be uniform across sectors and measurement approaches.

In contrast to green accounting, the main regression results demonstrate that carbon emission disclosure has a positive and statistically significant effect on firm value, with a coefficient of 1.678 and a significance value of 0.004. This finding supports the second hypothesis (H2). It indicates that broader disclosure of carbon-related information is associated with higher firm value, as measured by Tobin's Q. Carbon emission disclosure was assessed using 18 indicators based on Choi et al. (2013), covering information on carbon emissions, their measurement, and corporate efforts to manage and reduce emissions. The findings therefore suggest that transparency concerning carbon-related issues is relevant to market valuation in the energy sector. This relationship can be interpreted through signaling theory, which views corporate information as a means of reducing uncertainty and communicating a company's condition and prospects to investors (Spence, 1973). Carbon emissions disclosure may signal that management recognizes environmental risks and is working to address them over the long term. This information is particularly relevant to energy-sector companies because their operations are closely tied to emissions and environmental impacts. More comprehensive disclosure may enable investors to assess whether management acknowledges and responds to these risks. Nevertheless, disclosure should not be equated with successful emission reduction. The findings are more appropriately interpreted as evidence of an association between carbon transparency and market valuation, rather than confirmation that companies with more extensive disclosures necessarily achieve better carbon performance.

The result supports the findings of Kurnia et al. (2021), Ng et al. (2022), Yoga P.M. & Rasyid (2026), and Husein et al. (2026), who reported positive relationships between carbon emission disclosure and firm value. However, this differs from Ananda and Taqwa (2024), Kirowati et al. (2026), and Putri and Windiarti (2026), who found no significant effect. It also contrasts with Rahmawati et al. (2025) and Audrey and Lestari (2026), who reported negative effects. These inconsistent findings reinforce an empirical gap in research on carbon

emission disclosure. Differences in research objects, observation periods, and measurement characteristics provide important context when comparing how capital markets respond to carbon-related information. Despite the positive result, it requires cautious interpretation because the sensitivity test using the Random Effect Model (REM) produced a significance value of 0.076, which is not significant at the 5% level. This difference indicates that the evidence concerning the effect of carbon emission disclosure is not entirely stable across the estimation approaches employed. Therefore, the main regression results support H2, but the sensitivity analysis qualifies the strength of this conclusion.

The moderation analysis further shows that firm size does not moderate the relationship between green accounting and firm value, with an interaction significance value of 0.691. Accordingly, the third hypothesis (H3) is not supported. This finding indicates that company size, measured as the natural logarithm of total assets following Dang et al. (2018), does not alter the relationship between green accounting disclosure and firm value. Larger firms do not automatically receive a stronger market response to their environmental disclosures than smaller firms. This result is consistent with Sulistiono and Nur (2024), who found that firm size did not strengthen the effect of green accounting on firm value. The present study extends that evidence to energy-sector companies observed during 2020–2024, using Tobin's Q as the firm-value proxy. The interaction between carbon emission disclosure and firm size also does not show a statistically significant moderating effect, with a significance value of 0.248. Thus, the fourth hypothesis (H4) is not supported. The negative interaction coefficient of -0.504 suggests that firm size tends to weaken the positive relationship between carbon emission disclosure and firm value. However, because this coefficient is not significant at the 5% level, the tendency cannot be interpreted as a statistically established effect. The H4 result differs from Ericho & Amin (2024), who found that firm size moderated the relationship between carbon emission disclosure and firm value. This difference suggests that the moderating role of firm size may depend on sample characteristics and research context. Taken together, the H3 and H4 results indicate that firm size has not been demonstrated to significantly alter the relationships between the two forms of environmental disclosure and firm value.

In the main regression model, firm size also has a negative and statistically significant effect on firm value, with a coefficient of -0.225 and a significance value of 0.000. This result indicates that an increase in market value relative to the assets held does not necessarily accompany an increase in company size. The finding is consistent with Rahmawati et al.

(2025), who also reported a negative effect of firm size on firm value in the energy sector. One relevant consideration is the use of Tobin's Q as the firm-value proxy, which compares the market value of equity plus total liabilities with total assets. Because total assets are in the denominator, firms with larger asset bases may show lower Tobin's Q values when their market value and liabilities do not increase proportionately. Accordingly, interpret the negative relationship in light of the proxy's mathematical characteristics, rather than as direct evidence that larger firms perform less effectively.

Theoretically, this study provides evidence that legitimacy theory and signaling theory explain different aspects of market responses to environmental disclosure. The insignificant green accounting result suggests that disclosure intended to maintain social legitimacy does not necessarily change market valuation. Conversely, the positive effect of carbon emission disclosure in the main regression indicates that carbon-related information may function as a relevant signal for investors. However, the sensitivity analysis shows that this relationship is not entirely consistent. The study also contributes empirical evidence by examining firm size as a moderator of both relationships simultaneously within the energy sector. In practical terms, the findings may encourage energy-sector management to move beyond treating environmental management as a matter of fulfilling disclosure indicators. Companies should emphasize the substance of their environmental information, the measurability of their performance, and the clarity of their emission-control initiatives so that sustainability reports provide more meaningful information to stakeholders. For investors, the results highlight the importance of assessing environmental disclosures alongside corporate performance and financial conditions, rather than relying exclusively on the extent of disclosure when making investment decisions. For regulators and policymakers, the findings may provide a basis for encouraging environmental reporting that is more measurable and comparable across companies.

Interpreting these findings should account for several limitations. First, the assumptions of normality, homoscedasticity, and non-autocorrelation were not fully satisfied, so caution is needed when interpreting the estimated relationships. The difference in the significance of carbon emission disclosure between the main regression and REM also indicates that the H2 conclusion is sensitive to the estimation approach. Second, the adjusted R-squared value of 0.1207 indicates that the model has limited explanatory power in accounting for variations in firm value. Other factors outside the model may therefore be associated with firm valuation. Third, the sample comprises only 19 energy-sector companies

over five years, resulting in 95 firm-year observations. Consequently, generalize the findings to other sectors with caution. Fourth, we measured green accounting and carbon emission disclosure through content analysis using dichotomous scores. This approach captures whether information is disclosed but does not assess its depth, quality, or accuracy. In addition, consider the calculation characteristics of Tobin's Q when interpreting the effect of firm size. Future studies may therefore consider alternative firm-value proxies, more comprehensive measures of disclosure quality, broader samples, and estimation approaches that better accommodate panel data structure.

CONCLUSION

This study examined the effects of green accounting and carbon emission disclosure on firm value and tested firm size as a moderator in Indonesian listed energy companies during 2020–2024. The sample included 19 listed companies and 95 firm-year observations. Green accounting had no significant effect on firm value, indicating that extensive environmental accounting disclosure does not necessarily lead to higher market valuation. Carbon emission disclosure had a positive and significant effect in the main analysis, suggesting that carbon transparency may provide investor-relevant information. This finding was not consistent with the random-effects panel estimation and warrants cautious interpretation. Firm size did not moderate either relationship, although it had a significant negative direct effect on firm value.

The findings show that the relationship between environmental disclosure and firm value varies according to the type of information disclosed and is not demonstrably strengthened by firm size. Theoretically, this study adds empirical evidence to environmental accounting research by indicating that market responses to environmental disclosure are not uniform. Practically, the results emphasize the value of clear, measurable, and comparable carbon information. Energy companies should improve disclosure of emission levels, measurement methods, and reduction targets. Investors should assess this information alongside financial indicators.

Future research should broaden the sample across industries and periods, apply panel-data procedures consistently, and include relevant control variables. Researchers could assess disclosure quality and depth rather than its mere presence, use alternative firm-value

measures, and examine lagged effects. These improvements may clarify how environmental accountability relates to firm value.

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