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# CARBON EMISSION DISCLOSURE, GREEN ACCOUNTING, GREEN INVESTMENT, AND ECO-EFFICIENCY AS DETERMINANTS OF FIRM VALUE: EVIDENCE FROM INDONESIAN ENERGY COMPANIES

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**Abstract**

This study aims to determine the effect of carbon emission disclosure, green accounting, green investment and eco-efficiency on firm value. The population in this study is the energy sector companies in Indonesia with a total of 19 companies. The sampling technique used in this study is the purposive sampling method and the research sample obtained is 67. The research method is quantitative research. The data analysis technique is Multiple linear regression with data processing using the IBM SPSS 30 program. The results of the study indicate that carbon emission disclosure has a positive effect on firm value, green accounting, green investment and eco-efficiency do not affect firm value.

**Keywords:** Carbon Emission Disclosure, Green Accounting, Green Investment, Eco-Efficiency

## INTRODUCTION

Firm value is a key indicator of a company's ability to maximize shareholder wealth and strengthen investors' confidence in its future prospects. It reflects the market's overall assessment of a firm's performance, growth potential, and long-term sustainability. In this study, firm value is measured using Tobin's Q, as this indicator provides a comprehensive evaluation of the market value of a company's assets relative to their replacement cost. The study focuses on energy sector companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2023 period. The energy sector was selected because it plays a vital role in Indonesia's economic development while simultaneously facing significant challenges arising from the COVID-19 pandemic and the global transition toward a low-carbon economy.

During the observation period, the Tobin's Q values of energy sector companies exhibited considerable fluctuations, with the majority of firms remaining in the undervalued category. This condition indicates that investors perceived differences in firms' financial performance, growth opportunities, and long-term sustainability prospects. The decline in energy demand during the COVID-19 pandemic, driven by restrictions on economic activities, substantially reduced the revenues and stock prices of energy companies (Sipayung, 2023). Consequently, investors became more selective in evaluating companies, paying greater attention not only to their financial performance but also to their environmental and sustainability commitments. Kurnia et al. (2021) further reported that companies providing transparent environmental information tend to receive more favorable market valuations than those with limited sustainability disclosure.

Growing global concern over climate change and Indonesia's commitment to achieving Net Zero Emissions by 2060 have intensified the pressure on energy companies to adopt sustainable business practices alongside maintaining financial performance. As one of the largest contributors to greenhouse gas emissions, the energy sector is expected to play a leading role in supporting environmental sustainability through the implementation of effective environmental management strategies. In this context, carbon emission disclosure, green accounting, green investment, and eco-efficiency have emerged as important corporate sustainability practices that can influence investors' perceptions and ultimately affect firm value.

Carbon emission disclosure serves as a signal of a company's commitment to managing its environmental impacts and reducing greenhouse gas emissions. By voluntarily providing transparent information regarding carbon emissions, companies reduce information asymmetry and enhance stakeholder confidence. Green accounting complements this practice by recognizing, measuring, and reporting environmental costs, thereby improving corporate transparency and accountability in environmental management. At the same time, green investment reflects a company's commitment to allocating resources to environmentally friendly technologies, renewable energy, and sustainable innovation, which can strengthen its long-term competitiveness. Meanwhile, eco-efficiency, proxied in this study by ISO 14001 certification, represents a company's ability to generate greater economic value while minimizing environmental impacts through efficient resource utilization and effective environmental management systems.

Previous studies have generally suggested that these sustainability practices contribute positively to firm value. Hardiyansah et al. (2021) found that carbon emission disclosure positively influences firm value by enhancing corporate legitimacy and investor

confidence. Similarly, Anggita et al. (2022) and Fini and Astuti (2024) reported that the implementation of green accounting improves corporate transparency and strengthens market confidence, ultimately increasing firm value. Furthermore, Zhang (2022) and Wijayanti (2024) demonstrated that green investment enhances firm value by improving operational efficiency, business competitiveness, and long-term sustainability.

Despite these findings, empirical evidence regarding the relationship between sustainability practices and firm value remains inconclusive. Several studies have reported that carbon emission disclosure, green accounting, green investment, and eco-efficiency positively affect firm value (Kurnia et al., 2021; Santoso, 2024; Wijayanti, 2024; Fini & Astuti, 2024). In contrast, other studies have found negative or statistically insignificant relationships (Damas, 2021; Aini, 2023; Triyani, 2022; Kusuma, 2022; Gunawan, 2024). These inconsistent findings suggest the existence of an empirical research gap that requires further investigation.

In addition to the empirical inconsistency, a conceptual gap also exists in the current literature. Most previous studies have examined only one or two sustainability dimensions separately, such as carbon emission disclosure or green accounting. Very few studies have simultaneously integrated carbon emission disclosure, green accounting, green investment, and eco-efficiency into a single analytical framework to examine their combined effects on firm value. However, these four dimensions collectively represent essential components of Environmental, Social, and Governance (ESG) practices and provide a more comprehensive representation of a company's sustainability strategy. Examining these variables simultaneously is expected to offer a broader understanding of how sustainability initiatives create corporate value.

Furthermore, most previous studies have focused on manufacturing companies, general industrial firms, or all companies listed on the Indonesia Stock Exchange. Comparatively, limited attention has been given to the Indonesian energy sector, despite its strategic importance in achieving national decarbonization targets. As the sector most directly affected by environmental regulations and the transition toward clean energy, energy companies provide a particularly relevant context for investigating the relationship between sustainability practices and firm value.

Based on these considerations, this study aims to address both the empirical and conceptual gaps by simultaneously examining the effects of carbon emission disclosure, green accounting, green investment, and eco-efficiency on the firm value of energy sector companies listed on the Indonesia Stock Exchange during the 2020–2023 period. By integrating these four sustainability dimensions into a unified research framework, this study is expected to provide more comprehensive empirical evidence regarding the effectiveness of sustainability practices in enhancing firm value. The findings are anticipated to contribute to the growing body of literature on corporate sustainability and ESG while providing practical insights for corporate managers, investors, and policymakers in supporting the transition toward a low-carbon economy..

## REVIEW OF LITERATURE

### Legitimacy Theory

Legitimacy Theory, proposed by Dowling and Pfeffer (1975), explains that companies must obtain legitimacy from society to ensure that their business operations are accepted and aligned with prevailing social norms and values. According to Titisari (2020),

organizational legitimacy can be maintained through social and environmental responsibility, which reflects a company's commitment to meeting stakeholders' expectations. Accordingly, companies are encouraged to undertake sustainability initiatives that demonstrate accountability and reinforce public trust. In the context of this study, carbon emission disclosure, green investment, and eco-efficiency represent corporate commitments to environmental sustainability. These practices are expected to strengthen stakeholder confidence, enhance corporate legitimacy, and ultimately contribute to improving firm value.

**Signaling Theory**

Signaling Theory, introduced by Spence (1973), explains that organizations convey signals to reduce information asymmetry between management and external stakeholders. These signals provide investors with credible information regarding a company's quality, future prospects, and long-term performance, thereby influencing their investment decisions (Utomo, 2019). Environmental disclosures, including information on sustainability initiatives, serve as positive signals that demonstrate a company's commitment to responsible business practices and sustainable development. By voluntarily disclosing environmental information, companies communicate their ability to manage environmental risks while creating long-term value. Such positive signals enhance investor confidence, attract potential investment, and may ultimately increase firm value.

**Firm Value**

According to Titisari (2020), firm value, often referred to as market value, reflects a company's ability to maximize shareholder wealth through an increase in its stock price. Firm value is considered a key indicator of corporate performance and plays an important role in attracting investors to support the company's long-term growth (Akyunina, 2021). In this study, firm value is measured using Tobin's Q ratio, which was introduced by James Tobin in 1967. According to Hasibuan (2016) and Sitorus (2024), Tobin's Q is calculated by comparing the sum of a company's market value and total debt with its total assets. This ratio provides a comprehensive measure of market valuation by reflecting investors' perceptions of a company's future growth potential and overall performance.

**Carbon Emission Disclosure**

Carbon emission disclosure refers to the process by which companies identify, measure, record, and disclose information regarding the amount of carbon emissions generated from their business activities (Yuliandhari et al., 2023). Such disclosure serves as an important strategy for demonstrating environmental responsibility, improving corporate reputation, and obtaining positive responses from investors and other stakeholders. In this study, the level of carbon emission disclosure is measured using the Carbon Disclosure Project (CDP) checklist developed by Choi et al. (2013). The checklist consists of 18 disclosure items grouped into five categories: climate change, greenhouse gas emissions, energy consumption, greenhouse gas reduction initiatives, and carbon emission accountability. This measurement provides a standardized framework for assessing the extent to which companies disclose information related to their carbon management practices.

**Green Accounting**

Green accounting is a modern accounting approach that supports environmentally sustainable business practices by identifying, measuring, recognizing, and reporting the environmental impacts arising from corporate activities (Harif, 2024; Mahlomaholo et al., 2024). According to Lako (2011), there is no universally accepted standard governing the measurement, valuation, disclosure, and reporting of green accounting practices.

Nevertheless, effective implementation of green accounting is expected to improve corporate environmental performance and strengthen accountability for environmental management. In this study, green accounting is assessed using the PROPER (Program for Pollution Control, Evaluation, and Rating) environmental performance rating system issued by the Indonesian Ministry of Environment. Under the PROPER system, environmental performance is evaluated using five color-based ratings: gold (score of 5), representing the highest level of environmental performance; green (4); blue (3); red (2); and black (1), representing the poorest environmental performance. The PROPER ratings are published annually, enabling investors and the public to evaluate a company's environmental performance through a transparent and standardized assessment.

**Green Investment**

According to Rizello (2022), green investment refers to corporate investment activities that demonstrate a commitment to preserving natural resources and supporting environmental sustainability. Green investment represents a strategic approach adopted by companies to obtain environmental legitimacy and improve business performance by integrating sustainability considerations into investment decisions (Zhang & Berhe, 2022). Through investments in environmentally friendly technologies, renewable energy, and sustainable projects, companies can reduce environmental risks while creating long-term economic value. The measurement of the green investment variable in this study follows the approaches used by Wijayanti and Yoseph (2024) and Zhang and Berhe (2022). Green investment is measured by comparing the amount of a company's green investment expenditure with its total assets at the end of the fiscal year. This measurement reflects the extent to which companies allocate their resources toward environmentally responsible investments.

**Eco-efficiency**

According to the Organization for Economic Co-operation and Development (OECD) (2008), eco-efficiency refers to the efficient use of ecological and environmental resources to meet human needs while minimizing negative environmental impacts. Eco-efficiency emphasizes the ability of companies to generate greater economic value through more efficient resource utilization and improved environmental management practices. In this study, eco-efficiency is measured by evaluating whether a company has obtained ISO 14001 certification (Yuliandhari et al., 2023). Companies that possess ISO 14001 certification are assigned a value of one (1), while companies without such certification are assigned a value of zero (0). ISO 14001 is an internationally recognized standard that provides guidelines for implementing an environmental management system within organizations. The certification is voluntarily adopted by companies as evidence of their commitment to improving environmental performance and implementing sustainable business practices.

**Research Hypotheses**

Based on the theoretical framework and previous empirical studies, this study develops several hypotheses to examine the effects of carbon emission disclosure, green accounting, green investment, and eco-efficiency on firm value in the energy sector. The proposed hypotheses are formulated as follows:

**H1**: Carbon Emission Disclosure has a positive effect on firm value.

**H2**: Green Accounting has a positive effect on firm value.

**H3**: Green Investment has a positive effect on firm value.

**H4**: Eco-efficiency has a positive effect on firm value.

## RESEARCH METHOD

### Population and Sample

This study focuses on energy sector companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2023 period. The sample was selected using a purposive sampling method, in which sample selection was based on predetermined criteria. Specifically, the sample consisted of energy sector companies listed on the IDX throughout the 2020–2023 period that consistently published annual financial reports and sustainability reports during the same period. These criteria were applied to ensure the availability of relevant and complete data required for the analysis.

**Table 1.**
**Sample Selection Process Using the Purposive Sampling Method**

| No | Selection Criteria | Number |
|---|---|---|
| Energy sector companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2023 period | | 87 |
| 1. | Energy sector companies that **did not provide complete annual reports** during the 2020–2023 period | (21) |
| 2. | Energy sector companies that **did not provide complete sustainability reports** during the 2020–2023 period | (47) |
| Final Sample Size | | 19 |
| Total Observations (19 companies × 4 years) | | 76 |

Source: Author's data processing

### Data Variable

The dependent variable in this study is firm value. Firm value reflects investors' perceptions of the relationship between corporate performance and stock prices. A higher firm value indicates a higher stock price, suggesting that investors perceive the company as having stronger performance and better future prospects. In this study, firm value is measured using Tobin's Q, which is calculated by comparing the market value of equity and the book value of debt to the company's total assets. The market value of equity is determined by multiplying the closing stock price by the number of outstanding shares, while the book value of debt represents the company's total liabilities (Manrique et al., 2017). The independent variables examined in this study consist of carbon emission disclosure, green accounting, green investment, and eco-efficiency. These variables represent corporate sustainability practices that reflect companies' environmental commitments and their potential influence on firm value.

### Data Analysis Method

This study employs a data analysis technique using multiple linear regression analysis to examine the effects of independent variables on the dependent variable. Before conducting the main analysis, several preliminary tests are performed, including descriptive statistical analysis and classical assumption tests to ensure that the regression model meets the required statistical criteria.

The multiple linear regression model used in this study is formulated as follows:

$Y = \alpha + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + €$

Detail :

FV = Firm Value

A = Constant

$\beta_1, \beta_2, \beta_3, \beta_4$ = Regression coefficients
X1 = Carbon emission disclosure
X2 = Green Accounting
X3 = Green investment
X4 = Eco-efficiency
$\varepsilon$ = Error term

The multiple linear regression analysis in this study was conducted through several stages. The analysis process includes descriptive statistical analysis, classical assumption tests, heteroscedasticity test, multicollinearity test, autocorrelation test, and hypothesis testing. These preliminary tests were performed to ensure that the regression model met the required statistical assumptions before examining the relationships between the independent variables and the dependent variable. The hypothesis testing was then conducted to determine the significance and direction of the effects of carbon emission disclosure, green accounting, green investment, and eco-efficiency on firm value.

## RESULTS AND DISCUSSION

### Descriptive Statistics

**Table 2.**
**Statistics Descriptive Data**

| Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| CED | 67 | 0,05560 | 0,94440 | 0,6940239 | 0,18835826 |
| Green Accounting | 67 | 0,00 | 5,00 | 2,4776 | 2,04019 |
| Green Investment | 67 | 0,00001 | 0,09261 | 0,0082131 | 0,01965754 |
| Eco-Effciency | 67 | 0,00 | 1,00 | 0,9851 | 0,12217 |
| Firm Value | 67 | 0,05060 | 0,96190 | 0,4883403 | 0,21349998 |
| Valid N (listwise) | 67 | | | | |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025

### Kolmogorov-Smirnov Test Results

**Table 3.**
**Kolmogrov-Smirnov Results Test**

| One-Sample Kolmogorov-Smirnov Test | | |
|---|---|---|
| | | Unstandardized Residual |
| N | | 67 |
| Normal Parameters[a,b] | Mean | 0,0000000 |
| | Std. Deviation | 0,19111646 |
| Most Extreme Differences | Absolute | 0,060 |
| | Positive | 0,060 |

| | | | |
|---|---|---|---|
| | Negative | | -0,054 |
| Test Statistic | | | 0,060 |
| Asymp. Sig. (2-tailed)[c] | | | .200[d] |
| Monte Carlo Sig. (2-tailed)[e] | Sig. | | 0,793 |
| | 99% Confidence Interval | Lower Bound | 0,782 |
| | | Upper Bound | 0,803 |
| a. Test distribution is Normal. | | | |
| b. Calculated from data. | | | |
| c. Lilliefors Significance Correction. | | | |
| d. This is a lower bound of the true significance. | | | |
| e. Lilliefors' method based on 10000 Monte Carlo samples with starting seed 2000000. | | | |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025

Based on Table 3, the total number of sample observations after the outlier treatment was reduced to 67 observations. The results of the Kolmogorov-Smirnov normality test show an Asymp. Sig. (2-tailed) value of 0.200. These results indicate that the data are normally distributed, as the significance value exceeds the threshold of 0.05.

**Multicollinearity Test**

The multicollinearity test is conducted to examine the correlation among independent variables within the regression model. Multicollinearity occurs when independent variables have a high correlation with each other, which may affect the accuracy of regression coefficient estimates. In this study, multicollinearity is identified based on the Variance Inflation Factor (VIF) and tolerance values. A regression model is considered free from multicollinearity problems if the VIF value is less than 10 and the tolerance value is greater than 0.10. The results of the multicollinearity test are presented as follows.

**Table 4.**
**Multicollinearity Test Data**

| **Coefficients[a]** | | | |
|---|---|---|---|
| | | CollinearitysStatistics | |
| Model | | Tolerance | VIF |
| 1 | (Constant) | | |
| | CED | 0,734 | 1,363 |
| | Green Accounting | 0,715 | 1,399 |
| | Green Investment | 0,922 | 1,085 |
| | Eco-Effciency | 0,996 | 1,004 |
| a. Dependent Variable: Firm Value | | | |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025

Based on Table 4, it can be concluded that the VIF values of all independent variables are below 10, namely Carbon Emission Disclosure (CED) of 1.363, Green Accounting of 1.399, Green Investment of 1.085, and Eco-efficiency of 1.004. These results indicate that there is no multicollinearity among the independent variables. Furthermore, the tolerance values for each variable are above 0.10, namely CED of 0.734, Green Accounting of 0.715, Green Investment of 0.922, and Eco-efficiency of 0.996. Therefore, the regression model does not exhibit multicollinearity problems, indicating that there are no significant correlations among the independent variables included in the model.

**Heteroscedasticity Test**

The heteroscedasticity test is conducted to determine whether there is a difference in variance among observations within the regression model (Ghozali, 2018). In this study, the heteroscedasticity test was performed using the Glejser test. The decision criterion is that if the significance value is less than 0.05, the independent variable is considered to have a significant effect on the dependent variable, indicating the presence of heteroscedasticity. Conversely, a significance value greater than 0.05 indicates that the regression model does not suffer from heteroscedasticity problems. The results of the heteroscedasticity test are presented as follows.

**Table 5.**
**Heteroscedasticity Test Data**

| Coefficients[a] | | | |
|---|---|---|---|
| Model | | Sig.(2 tailed) | Result |
| 1 | (Constant) | 0,326 | |
| | CED | 0,006 | Heteroscedasticity occurs |
| | Green Accounting | 0,830 | No heteroscedasticity occurs |
| | Green Investment | 0,051 | No heteroscedasticity occurs |
| | Eco-Effciency | 0,776 | No heteroscedasticity occurs |
| | | | |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025

Based on Table 5, it can be concluded that the significance values of Green Accounting, Green Investment, and Eco-efficiency are 0.830, 0.051, and 0.776, respectively. Since these values are greater than 0.05, these variables do not indicate the presence of heteroscedasticity. However, the Carbon Emission Disclosure (CED) variable has a significance value of 0.006, which is below 0.05, indicating the presence of heteroscedasticity in the regression model.

**Table 6.**
**Heteroscedasticity Glejser Test Data**

| Coefficients[a] | | | |
|---|---|---|---|
| Model | | Sig.(2 tailed) | Result |
| 1 | (Constant) | 0,858 | |
| | CED | 0,548 | No heteroscedasticity occurs |

| | | |
|---|---|---|
| Green Accounting | 0,537 | No heteroscedasticity occurs |
| Green Investment | 0,858 | No heteroscedasticity occurs |
| Eco-Effciency | 0,224 | No heteroscedasticity occurs |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025
Therefore, an improvement procedure was conducted by applying the Glejser test to address the heteroscedasticity issue. The results of the Glejser test are presented as follows:
After conducting the improvement procedure using the Glejser test, the results indicate that the regression model does not exhibit heteroscedasticity, as all significance values (Sig. (2-tailed)) are greater than 0.05.

**Autocorrelation Test**

The autocorrelation test aims to examine whether there is a linear relationship between error terms in a sequence of observations arranged chronologically based on time (time-series data). To detect the presence of autocorrelation in the research model, the Durbin-Watson test is applied. The obtained Durbin-Watson value is then compared with the critical value from the Durbin-Watson table at a significance level of $\alpha = 5\%$. The comparison results are used to determine the presence or absence of autocorrelation, with the following criteria:

1. If the Durbin-Watson (DW) value is less than -2, it indicates the presence of positive autocorrelation.
2. If the Durbin-Watson (DW) value is between -2 and +2, it indicates that there is no autocorrelation.
3. If the Durbin-Watson (DW) value is greater than +2, it indicates the presence of negative autocorrelation.

**Table 7.**
**Durbin Watson Test Data**

| Model Summary[b] | | | | | |
|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
| 1 | .446[a] | 0,199 | 0,147 | 0,19718516 | 0,802 |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025Based on Table 7, the obtained Durbin-Watson value is 0.802. This value falls within the range of -2 to +2, indicating that the multiple linear regression model used in this study does not exhibit any autocorrelation problems.

**Classical Assumption Test Results**

The classical assumption tests are conducted to minimize potential bias in decision-making and to avoid model specification errors in the regression analysis. In this study, the classical assumption tests include the normality test, multicollinearity test, autocorrelation test, and heteroscedasticity test. These tests are performed to ensure that the regression model meets the required statistical assumptions and produces reliable estimation results.

**Table 8.**
**Multiple Linear Regression Test Data**

| Coefficients[a] |
|---|

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 0,216 | 0,219 | | 0,989 | 0,326 |
| | CED | 0,432 | 0,150 | 0,381 | 2,869 | 0,006 |
| | Green Accounting | 0,003 | 0,014 | 0,029 | 0,216 | 0,830 |
| | Green Investment | 2,561 | 1,286 | 0,236 | 1,991 | 0,051 |
| | Eco-Efficiency | -0,057 | 0,199 | -0,033 | -0,286 | 0,776 |
| a. Dependent Variable: Firm Value | | | | | | |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025

**Multiple Linear Regression Analysis**

Based on the output presented in Table 9, the regression model obtained in this study is formulated as follows:

FV = $\boldsymbol{a}$0 + β1 CED + β2 Green Accounting + β3 green investment + β4 eco-efficiency+ ε

FV = 0,216 + 0,432 + 0,003 + 2,561 -0,057 + ε

The regression equation can be interpreted as follows:

Constant (α) = 0.216 The constant value of 0.216 indicates that if carbon emission disclosure (CED), green accounting, green investment, and eco-efficiency are assumed to have no effect on firm value, the expected firm value would be 0.216.

β1 (CED) = 0.432 The regression coefficient of CED is 0.432, indicating that a one-unit increase in carbon emission disclosure is associated with an increase in firm value of 0.432 units, assuming other variables remain constant.

β2 (Green Accounting) = 0.003 The regression coefficient of green accounting is 0.003, indicating that a one-unit increase in green accounting is associated with an increase in firm value of 0.003 units, assuming other variables remain constant.

β3 (Green Investment) = 2.561 The regression coefficient of green investment is 2.561, indicating that a one-unit increase in green investment is associated with an increase in firm value of 2.561 units, assuming other variables remain constant.

β4 (Eco-efficiency) = -0.057 The regression coefficient of eco-efficiency is -0.057, indicating that a one-unit increase in eco-efficiency is associated with a decrease in firm value of 0.057 units, assuming other variables remain constant.

**F-Test**

The F-test is conducted to determine whether all independent variables included in the regression model simultaneously influence the dependent variable. The F-test evaluates the overall significance of the regression model by examining the joint effect of carbon

emission disclosure, green accounting, green investment, and eco-efficiency on firm value. The results of the F-test are presented as follows:

**Table 9.**
**F Test Data**

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
| 1 | Regression | 0,598 | 4 | 0,149 | 3,843 | .007[b] |
| | Residual | 2,411 | 62 | 0,039 | | |
| | Total | 3,008 | 66 | | | |
| a. Dependent Variable: Firm Value | | | | | | |
| b. Predictors: (Constant), Eco-Efficiency, CED, Green Investment, Green Accounting | | | | | | |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025

Based on the table above, the F-test results show that the calculated F-value is 3.843 with a significance probability value of 0.007. Therefore, it can be concluded that the independent variables simultaneously have a significant effect on the dependent variable, as the significance value is lower than 0.05 (0.007 < 0.05). These results indicate that the regression model is statistically significant and that carbon emission disclosure, green accounting, green investment, and eco-efficiency collectively influence firm value.

**Coefficient of Determination Test**

The coefficient of determination test is conducted to measure the ability of the regression model to explain variations in the dependent variable. This test indicates the extent to which the independent variables can explain changes in firm value. The results of the coefficient of determination test are presented in the following table:

**Table 10.**
**R2 Test Data**

| Model Summary | | |
|---|---|---|
| Model | R Square | Adjusted R Square |
| 1 | 0,199 | 0,147 |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025

The coefficient of determination ($R^2$) value can be observed in the Adjusted R Square column, which shows a value of 0.147 or 14.7%. This value indicates the extent to which the independent variables explain the variation in the dependent variable. Therefore, the results suggest that the independent variables in this study simultaneously explain 14.7% of the variation in firm value, while the remaining 85.3% is explained by other factors outside the variables included in this research model.

**t-Test**

The t-test is conducted to examine and determine the partial effect of each independent variable on the dependent variable. This test aims to identify whether each

independent variable individually has a significant influence on firm value. The results of the t-test are presented as follows:

**Table 11.**
**t Test Data**

| Coefficients[a] | | | | | | |
|---|---|---|---|---|---|---|
| | | Unstandardized Coefficients | | Standardized Coefficients | | |
| Model | | B | Std. Error | Beta | T | Sig. |
| 1 | (Constant) | 0,216 | 0,219 | | 0,989 | 0,326 |
| | CED | 0,432 | 0,150 | 0,381 | 2,869 | 0,006 |
| | Green Accounting | 0,003 | 0,014 | 0,029 | 0,216 | 0,830 |
| | Green Investment | 2,561 | 1,286 | 0,236 | 1,991 | 0,051 |
| | Eco-Efficiency | -0,057 | 0,199 | -0,033 | -0,286 | 0,776 |
| a. Dependent Variable: Firm Value | | | | | | |

Source: Author's processing of data output from IBM SPSS Statistics 30 (Free Trial), 2025

**Hypothesis Testing Results**

**Table 12.**
**Hypothesis Results Data**

| Hypothesis | Statement | Coefficient (B) | t-value | Sig. | Decision |
|---|---|---|---|---|---|
| **H1** | Carbon Emission Disclosure has a positive effect on Firm Value. | 0.432 | 2.869 | 0.006 | **Accepted** |
| **H2** | Green Accounting has a positive effect on Firm Value. | 0.003 | 0.216 | 0.830 | **Rejected** |
| **H3** | Green Investment has a positive effect on Firm Value. | 2.561 | 1.991 | 0.051 | **Rejected** |
| **H4** | Eco-Efficiency has a positive effect on Firm Value. | –0.057 | –0.286 | 0.776 | **Rejected** |

Source: Author's processing of data

**Discussion**

This study examines the effects of carbon emission disclosure, green accounting, green investment, and eco-efficiency as independent variables on firm value.

**The Effect of Carbon Emission Disclosure on Firm Value**

The results of this study indicate that carbon emission disclosure has a significant positive effect on firm value, with a significance value of 0.006. This finding suggests that a higher level of carbon emission disclosure is associated with an increase in firm value. In the context of the Indonesian energy industry, this relationship can be explained by the fact that the energy sector is a high carbon-intensive industry, making it subject to greater pressure compared to other sectors regarding climate change issues. Energy companies, particularly

those engaged in coal mining, oil and gas, and fossil fuel-based power generation, have become primary targets of government policies related to emission reduction and energy transition. Consequently, information regarding carbon emission management has become an important indicator in assessing corporate sustainability performance. Furthermore, the investment structure of the energy industry is characterized as capital intensive, requiring substantial long-term financing from investors and creditors. Under these conditions, transparency regarding environmental risk management becomes increasingly important because investors not only consider potential returns but also evaluate regulatory risks that may affect future corporate cash flows. Carbon emission disclosure provides a signal that companies have identified environmental risks and developed mitigation strategies in response to policies such as carbon taxation and Indonesia's Net Zero Emission target. Therefore, such information can reduce investors' perceived risk, enhance market confidence, and ultimately contribute to increased firm value Moreover, developments in the Indonesian capital market indicate growing attention toward Environmental, Social, and Governance (ESG) aspects. Although many domestic investors still emphasize financial performance, institutional investors and foreign investors have increasingly incorporated sustainability information into their investment decision-making processes. Therefore, energy companies that provide more comprehensive carbon emission disclosures tend to receive positive market responses because they are perceived as being better prepared to face regulatory changes and global market demands. This result is consistent with the studies conducted by Kurnia (2021) and Yuliandhari (2023), which found that carbon emission disclosure has a positive effect on firm value. This finding also supports Signaling Theory, which explains that carbon emission disclosure serves as a positive signal regarding corporate governance quality and the company's ability to manage environmental risks.

**The Effect of Green Accounting on Firm Value**

The results of this study indicate that green accounting does not have a significant effect on firm value, with a significance value of 0.830. Therefore, the second hypothesis is rejected. The insignificant effect can be explained by the characteristics of the Indonesian energy industry, which is still in a transition phase toward sustainable business practices. Most energy companies implement green accounting primarily as a form of compliance with government regulations and sustainability reporting requirements, rather than as a strategic initiative that directly improves operational efficiency or profitability. Consequently, the information provided through green accounting has not yet been able to reflect economic value creation that can be immediately recognized by investors. Furthermore, the cost structure of energy companies is largely dominated by investments in fixed assets, exploration activities, production processes, and energy infrastructure development. Environmental costs recorded through green accounting practices remain relatively small compared to the total investment value of companies, resulting in limited material effects on financial performance and firm valuation. Investors tend to place greater emphasis on a company's ability to generate profits, maintain cash flow stability, and sustain production performance rather than the amount of resources allocated to environmental activities.

**The Effect of Green Investment on Firm Value**

The results of this study indicate that green investment does not have a significant effect on firm value, with a significance value of 0.051. Although this value is close to the significance threshold, the results indicate that green investment has not yet been able to directly increase firm value. In the Indonesian energy industry, green investment is generally

realized through the development of renewable energy projects, low-carbon technology adoption, energy efficiency improvements, and emission reduction initiatives. These activities require substantial financial investment with relatively long payback periods. The capital-intensive characteristics of the energy industry cause the economic benefits of green investment to be realized over a longer period, meaning that these benefits may not yet be reflected in stock prices during the research period. Furthermore, energy companies in Indonesia still generate most of their revenue from fossil fuel-based businesses. Consequently, the contribution of green investment to total company revenue remains relatively limited. Investors tend to focus more on the performance of the company's core business activities rather than investments whose financial benefits are expected to be realized in the long term. The characteristics of the Indonesian capital market also contribute to this result. Although ESG-based investment trends continue to develop, many investors remain focused on short-term financial returns. Green investment is often perceived as an expenditure that may reduce current-period profits, resulting in limited market appreciation for such investments. This condition indicates the existence of a time lag between the implementation of green investment and the recognition of its economic benefits by the market. This result is consistent with the studies conducted by Putri (2023), Aini (2023), and Triyani (2022), which found that green investment does not have a significant effect on firm value.

**The Effect of Eco-efficiency on Firm Value**

The results of this study indicate that the eco-efficiency variable has a significance value of 0.776. Since this value is greater than the predetermined significance level of 0.05, eco-efficiency does not have a significant effect on firm value. Therefore, the fourth hypothesis is rejected. The insignificant effect of eco-efficiency, which is measured based on the ownership of ISO 14001 certification, indicates that investors do not yet perceive this certification as a factor that directly increases the economic value of a company. ISO 14001 primarily reflects compliance with environmental management systems rather than the achievement of measurable financial performance or actual environmental improvements. Furthermore, the characteristics of energy sector companies, which generally have implemented environmental management standards, make ISO 14001 certification a relatively common practice. As a result, the certification no longer provides a strong competitive advantage or a significant signal to investors. Consequently, ownership of ISO 14001 certification has not been able to enhance firm value during the research period. This result is consistent with the study conducted by Damas (2021), which found that eco-efficiency has a negative effect on firm value.

## CONCLUSION

The results of this study provide empirical support for Legitimacy Theory, suggesting that carbon emission disclosure serves as an important mechanism through which companies gain legitimacy from stakeholders. By transparently communicating their environmental performance, companies are better able to demonstrate accountability and strengthen stakeholders' trust, which in turn contributes to higher firm value. Conversely, the insignificant effects of green accounting, green investment, and eco-efficiency indicate that not all sustainability practices are immediately recognized by the market as value-enhancing activities. These practices may require a longer period to generate tangible financial benefits or may not yet be sufficiently reflected in investors' decision-making processes. From a

managerial perspective, energy sector companies should consistently improve the quality, transparency, and credibility of their carbon emission disclosures to strengthen stakeholder confidence and enhance market valuation. In addition, the implementation of green accounting, green investment, and eco-efficiency should be integrated into the company's overall business strategy rather than being treated merely as compliance initiatives. Such integration is expected to generate measurable economic benefits that can be recognized and appreciated by investors over the long term. From a policy perspective, the government and regulatory authorities should strengthen sustainability reporting standards, particularly those related to carbon emission disclosure. More standardized, comparable, and reliable sustainability reporting will improve the quality of information available to investors, reduce information asymmetry, and support more informed investment decisions. Ultimately, stronger reporting standards can encourage greater corporate transparency and accelerate the transition toward a more sustainable and low-carbon economy.

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