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Carbon Emission Disclosure, Capital Structure, and Firm Value in Indonesian Energy Sector Companies

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Abstract

This study examines the effect of carbon emission disclosure and capital structure on firm value in energy sector companies listed on the Indonesia Stock Exchange (IDX) during 2022–2025. Carbon emission disclosure is measured using an 18-item index based on the Carbon Disclosure Project, capital structure is proxied by the debt to equity ratio (DER), and firm value is measured by Tobin's Q, with firm size, profitability, and sales growth as control variables. Using purposive sampling, 60 companies (240 firm-year observations) were analyzed with panel data regression in EViews 14. The Chow and Hausman tests selected the fixed effect model, which was estimated using panel EGLS with cross-section weights and White period robust standard errors to address heteroskedasticity. The results show that carbon emission disclosure has no significant effect on firm value, whereas capital structure has a positive and significant effect. Firm size and profitability also have positive and significant effects, while sales growth has no significant effect. These findings suggest that investors in the Indonesian energy sector still rely mainly on financial fundamentals rather than on the breadth of carbon disclosure.

Keywords: Carbon emission disclosure, capital structure, firm value, Tobin's Q, energy sector.

INTRODUCTION

Climate change is one of the most pressing global problems today. The Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change confirms that greenhouse gas (GHG) emissions from fossil fuel use and land-use change have significantly raised the Earth's surface temperature (IPCC, 2021). Through the 2015 Paris Agreement, countries committed to holding the rise in global temperature below 2°C and to pursuing efforts to keep it from exceeding 1.5°C above pre-industrial levels. This

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commitment is translated into emission reduction targets in Nationally Determined Contributions (NDCs), which are updated every five years (Huang et al., 2024). However, actual progress has been disappointing, as global energy-sector emissions rose to around 36 billion tons in 2021 (International Energy Agency, 2022).

Indonesia faces a major challenge in this regard because its energy system still depends on fossil fuels, particularly coal (Lismiyah et al., 2024). Climate Action Tracker (2025) rates Indonesia's climate policies and commitments as "critically insufficient", meaning that they are not yet consistent with the 1.5°C target. Data from the Ministry of Energy and Mineral Resources (MEMR, 2024) show that coal consumption reached 342.67 million BOE in 2024, below crude oil (507.76 million BOE) but far above natural gas (87.73 million BOE). Power plants are the largest coal users, with consumption rising from 121.20 million tons in 2023 to 133.47 million tons in 2024, an increase of about 10.1% (MEMR, 2024). The energy sector is therefore both the main source of emission pressure and the sector most closely scrutinized in decarbonization efforts.

The government has responded to these challenges by targeting an emission reduction of 31.89% through its own efforts, or 43.2% with international support, by 2030 (Santosa, 2025), and net zero emissions (NZE) by 2060 (Resosudarmo et al., 2023). This commitment is reinforced by energy transition financing through the Just Energy Transition Partnership (JETP) worth US$20 billion (Hermawan & Prabhawati, 2024) and by Presidential Regulation Number 98 of 2021 on the Economic Value of Carbon, which paves the way for carbon trading (Sulistiawati & Buana, 2023). Carbon trading and increasingly stringent environmental regulations encourage companies to be more accountable in managing their emissions (Katadata, 2022). Nevertheless, carbon emission disclosure in Indonesia remains voluntary and is not yet widely practiced by companies (Nengzih et al., 2026).

For energy sector companies, these changes cut both ways. Investment in low-carbon technology and in emission measurement and reporting systems adds to costs. Investors may perceive these costs as value-reducing expenditures, as reflected in the negative effect of sustainability disclosure on the firm value of infrastructure companies in Indonesia (Amuktiningsih & Budianto, 2026). However, emission transparency can also provide important information for investors in assessing a company's long-term risk. Firm value, which reflects investors' perceptions of a company's performance and prospects as shown in its share price, is influenced by both financial and non-financial factors (Dang et al., 2020). Carbon emission disclosure (CED) is a non-financial factor that covers information on carbon emissions, energy consumption, governance, and strategies for addressing climate change and reducing emissions (Kurnia et al., 2021). In addition, capital structure, that is, the mix of debt and equity financing, affects a company's

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financial risk, cost of capital, and investors' perceptions of the company (Dang et al., 2020).

Previous studies on these two factors have not reached a uniform conclusion. Carbon emission disclosure has been found to have a positive effect on firm value in South Korea (Lee & Cho, 2021), in Indonesian manufacturing companies (Kurnia et al., 2021), in companies where carbon disclosure mediates the effect of green innovation (Sari et al., 2024), and in non-financial companies in Saudi Arabia (Metwalli, 2026). Similar results were reported by Matsumura et al. (2014), Saka (2014), and Asyifa and Burhany (2022). In contrast, Munir and Pratama (2025) found a negative effect among Southeast Asian companies, while Han et al. (2022) found no significant effect among Taiwanese companies. Putikadea and Siregar (2023) also found no significant direct effect of carbon emission disclosure on the firm value of basic materials companies. Regarding capital structure, a positive effect on firm value was reported by Khasawneh and Staytieh (2017), Khan et al. (2021), and Mahirun et al. (2024), whereas Maneerattanarungrot and Donkwa (2018) and Ferriswara et al. (2022) found no significant effect.

These inconsistencies leave three research gaps. First, most studies use manufacturing or cross-sector samples, even though the energy sector has higher emissions and faces greater regulatory pressure. Second, carbon emission disclosure and capital structure are generally examined separately, so little evidence tests them within a single model. Third, evidence from a recent period, namely after the carbon economic value policy came into force, remains limited. This study addresses these gaps by jointly examining the effects of carbon emission disclosure and capital structure on firm value in energy sector companies listed on the Indonesia Stock Exchange (IDX) during 2022–2025, with firm size, profitability, and sales growth as control variables. The objective of this study is to provide empirical evidence on the effect of carbon emission disclosure on firm value and the effect of capital structure on firm value in Indonesia's energy sector.

LITERATURE REVIEW

Signaling Theory

Signaling theory originates from Spence's (1973) work on the labor market and was later applied to corporate finance. Its core idea is simple: management knows more about the company's condition than investors do, which creates information asymmetry (Brigham & Houston, 2019). To prevent investors from making wrong decisions, companies need to send credible signals. Voluntary disclosure of non-financial information is expected to serve as good news that increases firm value (Arisanti & Daljono, 2014), because it can reduce information asymmetry and give investors a

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stronger basis for valuation (Nuraini & Purnomo, 2024). Within this framework, firm value is viewed as the outcome of the signaling process, that is, a reflection of how the market evaluates all the information conveyed by the company (Cahyaningtyas et al., 2024).

Trade-Off Theory

Trade-off theory developed from the ideas of Modigliani and Miller (1958) and was formulated by Kraus and Litzenberger (1973). The theory states that companies balance the benefit of the interest tax shield from debt against the costs arising from the risk of financial distress and agency costs. As long as the additional benefit of debt exceeds its cost, debt can increase firm value; beyond the optimal point, additional debt reduces value (Siregar et al., 2021). From a tax perspective, debt generates interest expenses that are deductible from taxable income, thereby reducing the tax payable (Ayatilla & Permatasari, 2024).

Carbon Emission Disclosure, Capital Structure, and Firm Value

Carbon emission disclosure is a company's reporting on the amount of carbon released by its operational activities during a given period (Amira et al., 2024). Its scope covers not only the amount of emissions but also climate change risks and opportunities, emission management strategies, energy use, and emission reduction targets (Choi et al., 2013). This information contains past carbon performance and future prospects, including qualitative perspectives on emission reduction strategies (Pitrakkos & Maroun, 2020). Capital structure is the combination of debt and equity that a company uses to finance its assets and operations (Brigham & Houston, 2019), and in finance research it is commonly measured using leverage ratios such as the debt to equity ratio (DER) (Sudirman et al., 2021). Firm value reflects investors' assessment of a company's performance and prospects as reflected in the market price of its shares (Brigham & Houston, 2019).

Hypothesis Development

Carbon Emission Disclosure and Firm Value

Based on signaling theory, extensive carbon emission disclosure is a positive signal of a company's commitment to sustainability and transparency. This signal can lower perceived risk, increase investor confidence, stimulate demand for the company's shares, and ultimately raise firm value. For other stakeholders, the signal enhances the company's credibility, thereby opening wider access to financing and business support. The direction of this relationship is consistent with the findings of Lee and Cho (2021), Kurnia et al. (2021), Sari et al. (2024), and Metwalli (2026). For basic materials companies on the IDX during 2021–2023, Maushufi and Widoretno (2025) also found that carbon

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emission disclosure has a positive and significant effect on firm value. Therefore, the first hypothesis is formulated as follows:

H_1: Carbon emission disclosure has a positive effect on firm value in energy sector companies in Indonesia.

Capital Structure and Firm Value

Based on trade-off theory, the use of debt at a reasonable level can improve financing efficiency, increase after-tax profit through the tax shield, and signal that the company is able to manage its funding sources. These benefits ultimately increase firm value. This positive relationship was found by Khasawneh and Staytieh (2017), Khan et al. (2021), and Mahirun et al. (2024), who used DER as a proxy for capital structure. Therefore, the second hypothesis is formulated as follows:

H_2: Capital structure has a positive effect on firm value in energy sector companies in Indonesia.

RESEARCH METHOD

Research Design

This study employs a quantitative approach with a causal design. A quantitative approach was chosen because the hypotheses are tested objectively using numerical data and statistical techniques. A causal design was chosen because the study seeks to determine whether changes in one variable cause changes in another (Sekaran & Bougie, 2016), namely the effect of carbon emission disclosure (X_1) and capital structure (X_2) on firm value (Y).

Population, Sample, and Data Sources

The population of this study comprises all 90 energy sector companies listed on the IDX during 2022–2025. The sample was selected using purposive sampling, that is, selection based on specific criteria. This technique was used because the study relies on secondary data, so only companies with adequate data could be analyzed. The sample criteria were: (1) listed (IPO) on the IDX continuously during 2022–2025; (2) published annual reports consecutively during the study period; (3) disclosed carbon emission information in their annual report and/or sustainability report; and (4) had complete data for all research variables. As shown in Table 1, 60 companies met the criteria, yielding 240 firm-year observations (60 companies × 4 years) in a balanced panel.

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Table 1: Sample Selection Criteria

No.	Criteria	Number of Companies
1	Population of energy sector companies listed on the IDX	90
2	Companies newly listed (IPO) after 2021	(20)
3	Companies that did not publish annual reports consecutively during 2022–2025	(3)
4	Companies that did not disclose carbon emission information in their annual report and/or sustainability report	(6)
5	Companies without complete data for the research variables	(1)
Companies meeting the criteria		**60**
Total sample (60 companies × 4 years)		**240**

Source: Data processed from the Indonesia Stock Exchange (2026)

The data are secondary data in the form of annual reports, sustainability reports, financial statements, and share prices of energy sector companies for 2022–2025. All documents were obtained from the official IDX website (www.idx.co.id) and the official websites of the respective companies through observation and documentation techniques. The data were then recorded in a checklist in Microsoft Excel to be classified, calculated, and recapitulated before analysis.

Operational Definitions of Variables

This study has one dependent variable (firm value), two independent variables (carbon emission disclosure and capital structure), and three control variables (firm size, profitability, and sales growth). A summary of the measurements is presented in Table 2, and the rationale for each proxy is explained afterwards.

Table 2: Operational Definitions and Measurement of Variables

Variable	Measurement	Scale
Firm value (TQ)	Tobin's Q = (MVE + DEBT) / TA, where MVE = year-end closing share price × number of common shares outstanding, DEBT = total liabilities, and TA = total assets	Ratio
Carbon emission disclosure (CED)	CED = number of items disclosed / 18 items (score 1 if disclosed, 0 otherwise)	Ratio

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Variable	Measurement	Scale
Capital structure (DER)	Debt to equity ratio = total liabilities / total equity	Ratio
Firm size (FS)	Firm size = Ln (total assets)	Ratio
Profitability (ROA)	Return on assets = net income after tax / total assets	Ratio
Sales growth (SG)	Sales growth = $(Sales_t - Sales_{t-1}) / Sales_{t-1}$	Ratio

Source: Compiled by the authors (2026)

Firm value is measured by Tobin's Q because this ratio compares the market value of the company (the market value of equity plus debt) with the value of its total assets, thereby reflecting the market's assessment of the company's prospects (Rohaeni et al., 2018). A Q value greater than one means that the market values the company more highly than the value of its assets.

Carbon emission disclosure is measured by a CED index based on Carbon Disclosure Project indicators, consisting of 18 items in five categories: climate change risks and opportunities (2 items), GHG emissions (7 items), energy consumption (3 items), emission reduction and costs (4 items), and carbon emission accountability (2 items) (Choi et al., 2013). Each item is scored 1 if disclosed and 0 otherwise, and the scores are summed and divided by 18. This measurement was chosen because it is objective, replicable by other researchers, and suited to the still-voluntary nature of carbon disclosure in Indonesia (Widiawati & Hidayati, 2024).

Capital structure is measured by DER because this ratio directly shows how much financing comes from debt relative to equity, in line with the core concept of capital structure. Firm size is measured by the natural logarithm of total assets so that the very large differences in asset scale across companies become more comparable. Profitability is measured by ROA because it shows the company's ability to generate profit from all of its assets. Growth is measured by sales growth because it directly reflects the development of business activity. The three control variables are included so that the effects of carbon disclosure and capital structure are not confounded with the effects of company size, earning capacity, and growth prospects.

Data Analysis Technique

The data were analyzed using panel data regression in EViews 14. Panel data regression was chosen because the data combine a cross-sectional (between-company) dimension and a time-series (over-time) dimension. This combination provides more observations and allows the researcher to control for unobserved differences in company characteristics (Rahmadeni & Yonesta, 2016). The estimated model is as follows:

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$$TQ_{it} = \alpha + \beta_1 CED_{it} + \beta_2 DER_{it} + \beta_3 FS_{it} + \beta_4 ROA_{it} + \beta_5 SG_{it} + \varepsilon_{it}$$

where TQ is the Tobin's Q of company *i* in year *t* (2022–2025), α is the constant, β_1–β_5 are the regression coefficients, and ε is the error term. The analysis consists of descriptive statistics, selection of the estimation model, classical assumption tests, and hypothesis testing.

Selection of the Estimation Model

There are three panel data model approaches. The Common Effect Model (CEM) pools all data and assumes the same intercept and slope for all companies. The Fixed Effect Model (FEM) allows intercepts to differ across companies and captures these differences using dummy variables. The Random Effect Model (REM) treats differences between companies as a random error component (Rahmadeni & Yonesta, 2016). The model was selected in stages. The Chow test compares CEM with FEM; if the probability is < 0.05, FEM is selected. The Hausman test compares FEM with REM; if the probability is < 0.05, FEM is selected because the company effects are correlated with the independent variables, which makes REM biased. The Lagrange Multiplier (LM) test compares CEM with REM and is procedurally required only if the Chow test selects CEM. In this study, the LM test is still reported as supporting evidence.

Classical Assumption Tests

Because the selected model is the Fixed Effect Model, the classical assumption tests were limited to multicollinearity and heteroskedasticity. Multicollinearity was examined through the correlation matrix of the independent variables, and correlations below 0.80 indicate no serious multicollinearity. Heteroskedasticity was tested using the Glejser test; if the probability is greater than 0.05, the error variance is considered constant (homoskedastic) and the model passes the heteroskedasticity test.

Hypothesis Testing

The t-test examines the partial effect of each independent variable; an effect is declared significant if the probability is < 0.05 and the sign of the coefficient is consistent with the hypothesis. The F-test examines the overall fit of the model, and the coefficient of determination (R^2) shows how much of the variation in firm value can be explained by the model (Ghozali, 2021).

RESULTS AND DISCUSSION

Descriptive Statistics

Descriptive statistics provide an initial overview of the characteristics of the data before further testing. Table 3 presents a summary of the 240 observations.

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Table 3: Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Median	Std. Dev.
Tobin's Q (TQ)	240	−1.1599	2.6817	0.3371	0.1203	0.6830
CED	240	0.0000	1.0000	0.5780	0.6111	0.2806
DER	240	−9.0007	30.2554	1.3672	0.8651	2.8724
FS (Ln assets)	240	25.9835	32.7557	29.1783	29.0252	1.6869
ROA	240	−0.6173	0.6163	0.0708	0.0505	0.1381
SG	240	−0.9999	2.3615	0.0854	0.0371	0.3044

Source: Data processed with EViews 14 (2026)

Firm value (Tobin's Q) has a mean of 0.3371 and a median of 0.1203, with a standard deviation of 0.6830. A mean higher than the median indicates that a small number of companies have market valuations far above those of the others. Carbon emission disclosure (CED) has a mean of 0.5780, meaning that the sample companies disclose on average about 58% of the 18 items, or roughly 10 items. The maximum value of 1.0000 indicates that some companies disclose all items, while the minimum value of 0.0000 indicates that some firm-year observations do not disclose a single item. The level of disclosure is thus fairly high but uneven.

Capital structure (DER) has a mean of 1.3672 and a median of 0.8651. This means that for a typical company, total liabilities are still below total equity, while the mean is pushed up by a small number of companies with very large debt (maximum 30.2554). The minimum DER is negative (−9.0007), indicating observations with negative equity or a capital deficiency. Firm size (FS) is relatively uniform, with a standard deviation of 1.6869. Profitability (ROA) averages 7.08% and ranges from −61.73% to 61.63%, while sales growth (SG) averages 8.54% with a very wide range (−99.99% to 236.15%). The wide ranges of these two variables reflect the nature of the energy sector, which is sensitive to commodity price cycles.

Panel Data Model Selection

The first stage is to determine the most appropriate estimation model. The results of the three tests are presented in Table 4.

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Table 4: Model Selection Test Results

Test	Statistic	Probability	Decision
Chow (cross-section F)	12.4842 (df 59; 175)	0.0000	FEM preferred over CEM
Chow (cross-section chi-square)	396.0914 (df 59)	0.0000	FEM preferred over CEM
Hausman (cross-section random)	21.0536 (df 5)	0.0008	FEM preferred over REM
LM Breusch-Pagan (cross-section)	175.8151	0.0000	REM preferred over CEM

Source: Data processed with EViews 14 (2026)

The Chow test yields a probability of 0.0000 (< 0.05) for both the F and chi-square statistics, so FEM is more appropriate than CEM. This means that each company has its own unobserved characteristics, such as management culture, type of business, and access to financing, that should not be ignored.

The Hausman test yields a probability of 0.0008 (< 0.05), so FEM is more appropriate than REM. This result means that the company-specific effects are correlated with the independent variables, making the REM estimator inconsistent. The coefficient comparison shows that the largest difference lies in firm size (probability 0.0000), which is reasonable because asset scale is inherent to each company. The LM test serves only as supporting evidence. Because both the Chow and Hausman tests select FEM, the final model used is the Fixed Effect Model.

Classical Assumption Test Results

Multicollinearity Test

Table 5 shows the correlations among the independent variables. The highest correlation is between CED and firm size (0.5959), and all other pairs are below 0.35. Because all correlations are below the 0.80 threshold, there is no multicollinearity problem. The positive correlation between CED and firm size is also reasonable, as larger companies generally have more resources and face greater public pressure to report their emissions. This moderate correlation makes the inclusion of firm size as a control variable important.

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Table 5: Correlation Matrix of Independent Variables

	CED	DER	FS	ROA	SG
CED	1.0000	−0.0097	0.5959	0.2062	−0.0850
DER	−0.0097	1.0000	0.0752	−0.1650	0.1099
FS	0.5959	0.0752	1.0000	0.3394	0.0293
ROA	0.2062	−0.1650	0.3394	1.0000	0.1880
SG	−0.0850	0.1099	0.0293	0.1880	1.0000

Source: Data processed with EViews 14 (2026)

Heteroskedasticity Test

Heteroskedasticity is a condition in which the spread of prediction errors in a regression model is not the same across observations. This condition needs to be tested so that the results of the analysis, particularly the t-test, are reliable. Based on Table 6, the probability values of the Glejser test are 0.7533, 0.7478, and 0.8559, all of which are greater than 0.05. This indicates that the regression model does not suffer from heteroskedasticity.

Table 6: Heteroskedasticity Test Results (Glejser)

Statistic	Value	Probability	Decision
F-statistic	0.5303	0.7533	Homoskedastic
Obs*R-squared	2.6889	0.7478	Homoskedastic
Scaled explained SS	1.9512	0.8559	Homoskedastic

Source: Data processed with EViews 14 (2026)

Fixed Effect Model Estimation and Hypothesis Testing

Because indications of heteroskedasticity remained in the model, the final Fixed Effect Model was estimated with cross-section weights. The estimation results are presented in Table 7.

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Table 7: Fixed Effect Model Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Decision
Constant (C)	−9.1659	3.2988	−2.7785	0.0073	
CED	−0.0177	0.0907	−0.1952	0.8459	H_1 Rejected
DER	0.0051	0.0010	5.0366	0.0000	H_2 Accepted
FS	0.3251	0.1131	2.8739	0.0056	Accepted
ROA	0.2673	0.1327	2.0140	0.0486	Accepted
SG	0.0013	0.0694	0.0194	0.9846	Rejected
R^2 = 0.9706; Adjusted R^2 = 0.9598; F-statistic = 90.2030 (Prob. 0.0000)					

Source: Data processed with EViews 14 (2026); dependent variable: Tobin's Q; N = 240

F-test and coefficient of determination (R^2). The F-statistic of 90.2030 with a probability of 0.0000 (< 0.05) indicates that all independent and control variables jointly have a significant effect on firm value, so the model is feasible. An R^2 of 0.9706 and an adjusted R^2 of 0.9598 mean that the model explains approximately 96–97% of the variation in firm value. Such a high value is common in FEM because the company-specific intercepts (60 intercepts) also explain variation between companies. Therefore, the pure contribution of the research variables should not be read from R^2 alone, but from the significance and magnitude of each variable's coefficient.

t-test. At the 5% significance level, carbon emission disclosure (CED) has a coefficient of −0.0177 with a probability of 0.8459, so it has no significant effect. Capital structure (DER) has a coefficient of 0.0051 with a probability of 0.0000, so it has a positive effect. Among the control variables, firm size (coefficient 0.3251; probability 0.0056) and profitability (coefficient 0.2673; probability 0.0486) have positive effects, whereas sales growth (coefficient 0.0013; probability 0.9846) has no effect. Thus, H_1 is rejected and H_2 is accepted.

DISCUSSION

The Effect of Carbon Emission Disclosure on Firm Value

The results show that carbon emission disclosure has no significant effect on the firm value of energy sector companies in Indonesia, so H_1 is rejected. Signaling theory predicts that extensive disclosure will be read as good news, but the 2022–2025 data do not show a response of firm value to that signal. There are several plausible explanations, which should be understood as interpretations rather than the results of direct testing.

First, an effective signal must be able to distinguish good companies from less good ones (Spence, 1973). The mean CED of 0.5780 and median of 0.6111 indicate that most sample companies already disclose more than half of the items. When many

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companies disclose similar information, disclosure no longer functions as a differentiator, and investors find no reason to value one company more highly than another. This is reinforced by the nature of the sample, which includes only companies that already disclose carbon information (criterion 3), so the difference between disclosers and non-disclosers is not captured.

Second, the CED index measures the presence or absence of information items, not their quality. A company that merely mentions a general commitment receives the same score as one that reports third-party-verified emissions, even though investors place more trust in carbon information that is accurate, comparable, and verified (Pitrakkos & Maroun, 2020). Moreover, the FEM estimation uses only within-company changes in CED from year to year. If each company's disclosure pattern remained relatively stable over the four years, the within-company variation available to explain changes in firm value would be small. This conjecture requires further testing because within-company variation data are not presented in this study.

Third, the effect of carbon disclosure may work in two directions that cancel each other out. On the one hand, transparency reduces uncertainty and risk. On the other hand, disclosure may reveal high emissions and potential future compliance costs, leading investors to view it as an additional risk (Munir & Pratama, 2025). The slightly negative coefficient in this study (−0.0177), although not significant, is consistent with this possibility. Fourth, carbon trading and emission reporting obligations in Indonesia are still relatively new, so investors may not yet incorporate carbon information into share valuation in the way they assess earnings and debt. Disclosure is seen more as compliance with regulatory and stakeholder demands than as information that changes cash flow prospects.

This finding is consistent with Han et al. (2022), who also found no significant effect of carbon disclosure on firm value in Taiwan. However, it differs from Lee and Cho (2021), Kurnia et al. (2021), Sari et al. (2024), and Metwalli (2026), who reported a positive effect. These differences may stem from differences in sector (manufacturing versus energy), country, observation period, and model, including the use of company fixed effects in this study, which control more strictly for unobserved company characteristics.

The Effect of Capital Structure on Firm Value

Capital structure has a positive effect on firm value, so H_2 is accepted. This result is consistent with trade-off theory: at a still-reasonable level of debt, the benefits of debt in the form of tax savings and funding for expansion outweigh the costs of financial distress. The data support this interpretation. The median DER of the sample is only 0.8651, meaning that for a typical company debt is still smaller than equity, so most companies are likely still below the optimal point. The capital-intensive nature of the

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energy sector, such as mining, shipping fleets, and infrastructure, also makes debt an important source of financing for investments that the market values positively. This finding is in line with Khasawneh and Staytieh (2017), Khan et al. (2021), and Mahirun et al. (2024), but differs from Maneerattanarungrot and Donkwa (2018) and Ferriswara et al. (2022), who found no significant effect.

The magnitude of the effect should be interpreted with caution. The DER coefficient is only 0.0051, so an increase in DER is associated with an increase in firm value that is statistically significant but economically small. There are also two methodological notes. First, Tobin's Q and DER both contain total liabilities, so part of the positive relationship may be mechanical rather than purely an investor response. Second, the model is linear, whereas trade-off theory implies a curvilinear relationship with an optimal point, so this study cannot yet determine the optimal debt threshold.

Furthermore, firm size has a positive effect (coefficient 0.3251). Larger companies generally have broader access to financing, more diversified business risk, and better disclosure (Brigham & Houston, 2019), so the market values them more highly. In the FEM context, this result means that companies whose assets grow from year to year tend to experience an increase in valuation. Profitability also has a positive effect (coefficient 0.2673; probability 0.0486). Higher earnings are a strong financial signal of a company's ability to create value, although a probability close to 0.05 indicates that this conclusion is less robust than that for the other variables. Sales growth has no effect (probability 0.9846). In the energy sector, sales are strongly influenced by commodity prices and demand cycles, so they change rapidly and do not always reflect long-term prospects, as shown by the very wide range of SG. Investors appear to value a company's ability to convert sales into profit more than sales growth itself.

CONCLUSION

This study examined the effect of carbon emission disclosure and capital structure on firm value in 60 energy sector companies listed on the IDX during 2022–2025 (240 observations) using the Fixed Effect Model. First, carbon emission disclosure has no significant effect on firm value, so H_1 is rejected; carbon disclosure does not yet function as a signal that differentiates companies in the eyes of investors. Second, capital structure has a positive effect, so H_2 is accepted; at a still-reasonable level of debt, debt financing is associated with higher firm value, although the size of the effect is small. Firm size and profitability have positive effects, whereas sales growth has no effect. The model explains 97.06% of the variation in firm value.

In terms of implications, energy sector companies cannot rely merely on increasing the number of carbon disclosure items. To become a credible signal, disclosure needs to be strengthened through third-party verification, measurable emission reduction targets,

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and data that are comparable across years. Companies also need to keep their debt within safe limits. For investors, these results indicate that financial fundamentals remain the main basis of valuation in this sector. For regulators, standardizing emission reporting can help make carbon information more meaningful to the market.

This study has several limitations. The sample covers only companies that already disclose carbon information over a four-year period; the CED index is binary and therefore does not assess disclosure quality; and Tobin's Q and DER both contain total liabilities. Future studies could extend the period and sample, assess disclosure quality, test a non-linear relationship between DER and firm value, use other firm value proxies such as price to book value, and add moderating variables such as corporate governance.

REFERENCES

Amira, M. P., Nur, H., Ermaya, L., & Miftah, M. (2024). Faktor-faktor yang mempengaruhi carbon emission disclosure [Factors affecting carbon emission disclosure]. *Indonesian Journal of Auditing and Accounting, 1*(2), 21–41.

Amuktiningsih, F., & Budianto, R. (2026). The effect of sustainability disclosure and corporate governance on firm value: Evidence from Indonesia's infrastructure sector. *Majapahit Journal of Islamic Finance and Management, 6*(2), 2083–2102.

Arisanti, L. A., & Daljono. (2014). Pengaruh tingkat pengungkapan sukarela terhadap nilai perusahaan [The effect of the level of voluntary disclosure on firm value]. *Diponegoro Journal of Accounting, 3*, 1–8.

Asyifa, D. A., & Burhany, D. I. (2022). Carbon emission disclosure and environmental performance effect on firm value. *International Journal of Arts and Social Science, 5*(7), 193–203.

Ayatilla, N., & Permatasari, I. K. (2024). How profitability, thin capitalization, and company size affect tax avoidance. *Jurnal Bisnis Mahasiswa, 4*(4), 518–530. https://doi.org/10.60036/jbm.v4i4.art6

Brigham, E. F., & Houston, J. F. (2019). *Fundamentals of financial management*. Cengage Learning.

Cahyaningtyas, S. R., Muhsyaf, S. A., & Husnaini, W. (2024). Environmental, social, and governance (ESG) disclosure and company performance: Empirical evidence in Indonesian banking. *23*(62), 134–154.

Choi, B. B., Lee, D., & Psaros, J. (2013). An analysis of Australian company carbon emission disclosures. *Pacific Accounting Review, 25*(1).

Climate Action Tracker. (2025). *Indonesia overall rating: Critically insufficient*. https://climateactiontracker.org/countries/indonesia/

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Dang, H. N., Thu, T., Nguyen, C., & Tran, D. M. (2020). The impact of earnings quality on firm value: The case of Vietnam. *Journal of Asian Finance, Economics and Business, 7*(3), 63–72. https://doi.org/10.13106/jafeb.2020.vol7.no3.63

Ferriswara, D., Sayidah, N., & Buniarto, E. A. (2022). Do corporate governance, capital structure predict financial performance and firm value? (Empirical study of Jakarta Islamic Index). *Cogent Business & Management, 9*(1). https://doi.org/10.1080/23311975.2022.2147123

Ghozali, I. (2021). *Aplikasi analisis multivariate dengan program IBM SPSS 25* [Application of multivariate analysis with the IBM SPSS 25 program]. Badan Penerbit Universitas Diponegoro.

Han, Y., Huang, H., Liu, W., & Hsu, Y. (2022). Firm-value effects of carbon emissions and carbon disclosures: Evidence from Taiwan.

Hermawan, L. T., & Prabhawati, A. (2024). Implementasi Just Energy Transition Partnership Indonesia menuju Net Zero Emissions tahun 2060 [Implementation of Indonesia's Just Energy Transition Partnership towards net zero emissions by 2060]. *Jurnal Energi Baru & Terbarukan, 5*, 28–38. https://doi.org/10.14710/jebt.2024.24161

Huang, Z., Huang, Y., & Zhang, S. (2024). The possibility and improvement directions of achieving the Paris Agreement goals from the perspective of climate policy. *Sustainability*, 1–19.

International Energy Agency. (2022). *Global energy review: CO_2 emissions in 2021*. IEA Publications. https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021

IPCC. (2021). *Climate change 2021: The physical science basis. Working Group I contribution to the Sixth Assessment Report*. https://www.ipcc.ch/assessment-report/ar6/

Katadata. (2022). *Indonesia carbon trading handbook*.

Khan, A., Qureshi, M. A., & Davidsen, P. I. (2021). A system dynamics model of capital structure policy for firm value maximization. *Systems Research and Behavioral Science*, 503–516. https://doi.org/10.1002/sres.2693

Khasawneh, A. Y., & Staytieh, K. S. (2017). Impact of foreign ownership on capital structure and firm value in emerging market: Case of Amman Stock Exchange listed firms. *Afro-Asian Journal of Finance and Accounting, 7*(1), 35–64.

Kraus, A., & Litzenberger, R. H. (1973). A state-preference model of optimal financial leverage. *The Journal of Finance, 28*, 911–922.

Kurnia, P., Putra, A. A., & Nur, D. P. E. (2021). Carbon emission disclosure and firm value: A study of manufacturing firms in Indonesia and Australia. *International*

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Journal of Energy Economics and Policy, 1–6. https://doi.org/10.32479/ijeep.10730

Lee, J.-H., & Cho, J.-H. (2021). Firm-value effects of carbon emissions and carbon disclosures: Evidence from Korea.

Lismiyah, E., Taher, A. R., Gunarto, T., & Aida, N. (2024). The causality between energy consumption and carbon emission in Indonesia. *Jurnal Riset Ilmu Ekonomi*.

Mahirun, M., Ayuningrum, A. P., Kushermanto, A., Rahayu, T., Jannati, A., & Ardiyani, K. (2024). The effect of capital structure on firm value of LQ45 index listed in Indonesia Stock Exchange. *25*(202), 310–320. https://doi.org/10.47750/QAS/25.202.33

Maneerattanarungrot, C., & Donkwa, K. (2018). Capital structure affecting firm value. *ABAC Journal, 38*(2), 133–146.

Matsumura, E. M., Prakash, R., & Vera-Muñoz, S. C. (2014). Firm-value effects of carbon emissions and carbon disclosures. *The Accounting Review, 89*(2), 695–724. https://doi.org/10.2308/accr-50629

Maushufi, N. N., & Widoretno, A. A. (2025). Enhancing corporate value through sustainability: The role of carbon emission disclosure, green accounting, and environmental performance in the basic materials sector. *AKUNESA: Jurnal Akuntansi Unesa, 14*(1), 54–64.

Metwalli, M. Z. (2026). Statistical analysis to measure the relation between carbon emission disclosure and firm value in Saudi listed firms. *Journal of Statistics Applications & Probability, 15*(3), 505–518.

Ministry of Energy and Mineral Resources. (2024). *Handbook of energy & economic statistics of Indonesia 2024*.

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review, 48*(3), 261–297.

Munir, A. R., & Pratama, A. (2025). Emission performance, environmental disclosure, and firm value: Evidence from Southeast Asia.

Nengzih, N., Oktris, L., Mappanyuki, R., Djuitaningsih, T., Saat, M. M., & Ahmad, Z. (2026). Determinants of voluntary carbon emission disclosure: An empirical investigation on manufacturing. *AKRUAL: Jurnal Akuntansi, 17*(2), 388–397. https://doi.org/10.26740/jaj.v17n2.p.388-397

Nuraini, E., & Purnomo, L. I. (2024). Pengaruh asimetri informasi, manajemen laba, dan pengungkapan modal intelektual terhadap biaya ekuitas [The effect of information asymmetry, earnings management, and intellectual capital disclosure on the cost of equity]. *Jurnal Ilmiah Ekonomi dan Manajemen, 2*(1), 99–112.

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Pitrakkos, P., & Maroun, W. (2020). Evaluating the quality of carbon disclosures. *Sustainability Accounting, Management and Policy Journal, 11*(3), 553–589. https://doi.org/10.1108/SAMPJ-03-2018-0081

Putikadea, I., & Siregar, C. S. (2023). Does disclosure of carbon emission able to attract investors? *AKRUAL: Jurnal Akuntansi, 15*(1), 39–52.

Rahmadeni, & Yonesta, E. (2016). Analisis regresi data panel pada pemodelan produksi panen kelapa sawit di kebun sawit plasma Kampung Buatan Baru [Panel data regression analysis in modeling oil palm harvest production in the Kampung Buatan Baru plasma plantation]. *Jurnal Sains Matematika dan Statistika, 2*(1).

Resosudarmo, B. P., Rezki, J. F., & Effendi, Y. (2023). Prospects of energy transition in Indonesia. *Bulletin of Indonesian Economic Studies, 59*, 149–177. https://doi.org/10.1080/00074918.2023.2238336

Rohaeni, N., Hidayat, S., & Fatimah, I. (2018). Nilai perusahaan manufaktur di Bursa Efek Indonesia ditinjau dari perspektif kebijakan deviden dan kebijakan hutang [The value of manufacturing companies on the Indonesia Stock Exchange from the perspective of dividend policy and debt policy]. *Jurnal Bisnis Teori dan Implementasi, 9*(2), 1–6.

Saka, C. (2014). Disclosure effects, carbon emissions and corporate value. *Sustainability Accounting, Management and Policy Journal, 5*(1), 22–45. https://doi.org/10.1108/SAMPJ-09-2012-0030

Santosa, J. (2025). Carbon capture in Indonesia's energy sector: A least-cost optimization approach. *Sustainability*, 1–25.

Sari, P. A., Purwanti, Muh, R., & Hidayat, I. (2024). Achievement of carbon emission disclosure as a mediator between factors increasing firm value: Eco-efficiency and green innovation. *International Journal of Energy Economics and Policy*. https://doi.org/10.32479/ijeep.16949

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill-building approach* (8th ed.). John Wiley & Sons.

Siregar, B. G., Salman, M., & Lubis, A. (2021). Optimalisasi struktur modal dengan trade off theory pada bank umum syariah [Optimizing capital structure using trade-off theory in Islamic commercial banks]. *Jurnal Penelitian Ekonomi Akuntansi, 8*, 264–278.

Spence, M. (1973). Job market signaling. *The Quarterly Journal of Economics, 87*(3), 355–374.

Sudirman, M. A., Sandi, A. I., & Lamappapoleonro, U. (2021). Pengaruh struktur modal dan pertumbuhan perusahaan [The effect of capital structure and company growth]. *Jurnal Ilmiah METANSI "Manajemen dan Akuntansi", 4*, 51–60.

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Sulistiawati, L. Y., & Buana, L. (2023). Legal analysis of the carbon pricing regulation in Indonesia. *Journal of Central Banking Law and Institution, 2*(1), 179–198.

Widiawati, P., & Hidayati, C. (2024). Pengungkapan emisi karbon: Studi pada perusahaan manufaktur di Indonesia [Carbon emission disclosure: A study of manufacturing companies in Indonesia]. *Jurnal Masharif Al-Syariah: Jurnal Ekonomi dan Perbankan Syariah, 9*(204), 2186–2206.

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