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The Impact of Renewable Energy Investment, Eco-Efficiency, Carbon Emission Disclosure, and Profitability on Firm Value

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Abstract

Growing environmental awareness has encouraged investors to consider sustainability alongside financial performance when assessing firm value, particularly in environmentally intensive industries. This study examines the effects of renewable energy investment, eco-efficiency, carbon emission disclosure, and profitability on firm value among companies in the mining and energy subsectors listed on the Indonesia Stock Exchange (IDX). A quantitative descriptive-explanatory design was employed. Secondary data from annual reports, sustainability reports, and financial statements were collected through purposive sampling, yielding 147 observations. Data were analyzed using multiple linear regression in IBM SPSS Statistics. The findings indicate that renewable energy investment has no significant effect on firm value. In contrast, eco-efficiency, carbon emission disclosure, and profitability have positive, significant effects, with profitability contributing the most. These results suggest that environmental management and transparent carbon reporting provide additional value alongside financial performance. The study concludes that companies should strengthen resource efficiency, improve carbon emission disclosure, and maintain profitability to support firm value. Although renewable energy investment shows no significant effect, it remains relevant to long-term sustainability strategies. The findings offer insights for investors and regulators in evaluating and promoting sustainability performance.

Keywords

Carbon Emission Disclosure, Eco-Efficiency, Firm Value, Profitability, Renewable Energy Investment.

1. Introduction

The contemporary business landscape is characterized by rapid change and increasingly intense competition across industries, driven partly by the emergence of new business entities. From an organizational perspective, corporate objectives can generally be divided into short-term and long-term orientations. While short-term objectives emphasize profit generation and asset growth, long-term objectives focus on maximizing firm value. Higher firm value reflects greater shareholder wealth, as investors benefit from both dividend distributions and potential capital gains from their shareholdings (Hasanah, 2023). Beyond indicating financial conditions, firm value also represents investors' perceptions of a company's prospects and growth potential. Therefore, maximizing firm value is an important long-term strategic objective for achieving shareholder prosperity.

Growing environmental awareness and the global sustainability agenda have transformed investment decisions, as investors increasingly consider environmental performance, corporate social responsibility, and transparency alongside financial performance. This shift matters especially for mining companies, whose operations create environmental consequences that require responsible management to maintain investor confidence and firm value. Mining activities, from exploration and extraction to processing and refining, are expected to expand as global energy demand rises. However, increased resource utilization may intensify greenhouse gas emissions and environmental degradation. Therefore, companies need to strengthen environmental management through energy recovery, renewable energy adoption, carbon emission disclosure, and green investment (Aeni & Murwaningsari, 2023; Adrizky et al., 2025). These sustainability practices are increasingly relevant to firm value, as environmental performance and carbon emission disclosure have been associated with firm value, particularly amid resource scarcity (Oktaviani et al., 2026).

This study uses carbon emission disclosure to operationalize corporate sustainability issues. Carbon emission disclosure includes quantitative information on greenhouse gas emissions that contribute to climate change, as well as the measures companies take to control, reduce, and mitigate their CO_2 emissions. It also provides internal and external stakeholders with information about companies' historical carbon footprints and projected future emissions (Velte et al., 2020). Through transparent disclosure, companies can demonstrate environmental accountability and provide stakeholders with relevant information to evaluate their sustainability commitments.

Renewable energy investment represents a tangible corporate commitment to environmental sustainability by reducing dependence on fossil fuels and mitigating carbon emissions. Companies can further strengthen environmental performance through eco-efficiency, which emphasizes optimizing energy and raw material consumption and operational costs while minimizing waste and pollution. This approach enables companies to maximize economic benefits without compromising environmental objectives. Efficient resource utilization can improve productivity, reduce operational expenses, and minimize environmental degradation. Beyond operational benefits, eco-efficiency and carbon emission disclosure demonstrate corporate environmental responsibility and provide investors with relevant information. Previous studies by Hikmah and Akib (2025) and Fitri and Putra (2025) examined the relationship between eco-efficiency and carbon emission disclosure and firm value, while Iislamiyah et al. (2024) also linked disclosure practices to corporate environmental performance and governance characteristics.

Beyond environmental sustainability, corporate financial performance remains an important consideration for investors when evaluating firm value. Financial statements reflect a company's financial performance, which investors consider

before making investment decisions (Irman et al., 2022). From a Signaling Theory perspective, improvements in reported financial performance represent positive signals, whereas declining performance may convey negative signals to investors (Marini & Herawaty, 2024). Financial performance can be assessed through financial ratios, with profitability among the most widely used.

Profitability reflects a company's ability to generate earnings from its available resources and indicates its success in generating profits (Irman et al., 2022). It is also important for management in evaluating the effectiveness and efficiency of corporate asset utilization. However, previous empirical findings regarding the effect of profitability on firm value remain inconsistent. Irman et al. (2022), examining mining companies, and Purwanto and Lastanti (2025), examining technology companies, found that profitability positively affects firm value. Conversely, Tsaniatuzaima and Maryanti (2022), investigating food and beverage companies, found no significant effect. These inconsistencies provide an empirical basis for re-examining the relationship between profitability and firm value. Furthermore, renewable energy investment, eco-efficiency implementation, and carbon emission disclosure generally require substantial financial resources. Therefore, companies' ability to finance these sustainability initiatives is closely related to their profitability. Based on this rationale, this study analyzes the effects of renewable energy investment, eco-efficiency, carbon emission disclosure, and profitability on firm value in companies in the mining and energy subsectors listed on the Indonesia Stock Exchange (IDX).

2. Literature Review and Hypothesis Development

2.1. The Effect of Renewable Energy Investment on Firm Value

From the Signaling Theory Perspective, companies' strategic allocation of funds to renewable energy investment can serve as a positive signal to investors regarding their future prospects. Companies investing in renewable energy are perceived as long-term-oriented entities that can adapt to global changes and demonstrate a strong commitment to sustainability. Such investments may strengthen investor confidence by indicating companies' preparedness to address environmental risks and sustainability-related regulatory changes, potentially increasing firm value. Pambudi et al. (2023) supported this argument by demonstrating that renewable energy investment can improve energy efficiency and support long-term corporate sustainability. Similarly, Shabanov et al. (2025) explained that renewable energy utilization can enhance industrial competitiveness through energy efficiency, technological innovation, and corporate value creation. From the Legitimacy Theory perspective by Deegan (2014), companies seek social acceptance through initiatives that support environmental awareness and social values. Renewable energy investment represents a tangible effort to reduce dependence on fossil fuels and minimize the environmental impacts of operational activities.

Renewable energy investment can strengthen reputation by demonstrating commitment to the energy transition and reducing dependence on fossil fuels. Evidence from Indonesian mining companies indicates that renewable energy adoption is positively associated with firm value (Windyasari & Bustaman, 2026). More broadly, sustainable investment improves energy and carbon performance without undermining financial returns, while environmental expenditure may signal long-term risk management to investors (Atif et al., 2023; Purnami & Dewi, 2025). However, valuation effects are not always immediate or significant, particularly when investment remains limited (Safitri et al., 2022). Companies must therefore manage initial costs and implementation carefully to realize long-term benefits.

H1: Renewable energy investment has a positive effect on firm value.

2.2. The Effect of Eco-Efficiency on Firm Value

Eco-efficiency represents a corporate strategy that optimizes resource utilization while minimizing environmental impacts. Under Legitimacy Theory, its implementation demonstrates corporate environmental responsibility and compliance with societal expectations, potentially strengthening stakeholder confidence and firm value. Eco-efficiency also improves operational performance by reducing emissions and optimizing resources (Daud et al., 2023). Previous studies have shown a positive association between eco-efficiency and firm value (Sinkin et al., 2008; Savitri & Nik Abdullah, 2023). From the Signaling Theory perspective, eco-efficiency communicates positive information about managerial quality, operational effectiveness, and long-term sustainability commitment, allowing investors to recognize companies' environmental responsibility and economic prospects (Guenster et al., 2011).

Investors often view companies with effective environmental management more favorably. Valencia and Sri (2022) found that companies implementing eco-efficiency tend to have higher firm value than those that do not. Similarly, Wahyu and Elvina (2024) emphasized that eco-efficiency is an important element of sustainable development because it enables the synergistic balance of economic and environmental dimensions. Nevertheless, Nashrulloh and Achyani (2024) found that the effect of eco-efficiency on firm value is not always consistent. In some cases, investors do not fully perceive eco-efficiency information as significant, resulting in a limited effect on firm value. These inconsistent findings suggest that the effectiveness of eco-efficiency implementation and the quality of environmental information disclosure may play important roles in shaping market responses.

H2: Eco-efficiency has a positive effect on firm value.

2.3. The Effect of Carbon Emission Disclosure on Firm Value

Companies' willingness to communicate the environmental impacts of their operational activities is reflected in their carbon emission disclosure. From the Legitimacy Theory perspective, companies seek social acceptance by demonstrating environmental responsibility through transparent and honest reporting of CO_2 emission statistics. Investors and other stakeholders tend to trust companies that openly disclose their carbon emissions, as this transparency can strengthen corporate reputation. Trimuliani and Febrianto (2023) found that carbon emission disclosure positively affects firm value, indicating that environmental transparency can enhance corporate valuation. Similarly, Blesia et al. (2023) demonstrated a significant positive relationship between carbon emission disclosure and firm value among Indonesian energy companies.

Environmental, Social, and Governance (ESG) considerations have become increasingly important to investors, encouraging positive market responses toward companies with transparent carbon emission reporting. Fanda and Damayanti (2024) found that more transparent carbon emission disclosure can enhance corporate reputation among investors, which may, in turn, increase firm value. Similarly, Velte et al. (2020) found that carbon emission disclosure can increase firm value over time by strengthening stakeholder confidence. Nevertheless, previous studies indicate that carbon emission disclosure does not always produce consistent effects on firm value. These differences may depend on the quality and depth of information communicated to the public. When disclosure is limited or merely formalistic, investors may perceive the information as insufficient to demonstrate a company's genuine commitment to environmental sustainability. Thus, the extent

to which carbon emission disclosure contributes to firm value may depend on the quality and transparency of the information provided.

H3: Carbon emission disclosure has a positive effect on firm value.

2.4. The Effect of Profitability on Firm Value

Profitability reflects a company's ability to generate earnings through the effective management of its resources and assets. From a Signaling Theory perspective, high profitability can send positive signals to investors about a company's financial condition and prospects. Measured using Return on Assets (ROA), profitability indicates a company's effectiveness in generating earnings from its total assets. Higher ROA reflects better earnings-generating capabilities, potentially strengthening investor confidence and increasing firm value (Irman et al., 2022). From an Agency Theory perspective, profitability reflects management's ability to manage corporate resources in shareholders' interests. Effective asset management can increase corporate earnings and provide economic benefits to shareholders. Purwanto and Lastanti (2025) explained that profitability is an important financial performance indicator that can influence firm value. Thus, higher profitability may reflect management's success in operating and creating additional corporate value.

Empirical findings regarding the effect of profitability on firm value remain inconsistent. Irman et al. (2022) found that profitability, measured using ROA, positively affects firm value in the mining sector. Similarly, Purwanto and Lastanti (2025) and Dani et al. (2026) reported a positive effect of profitability on firm value. However, Tsaniatuzaima and Maryanti (2022) found that ROA has no significant effect on firm value. These differences in previous research findings provide a basis for re-examining the effect of profitability on firm value, particularly among companies in the energy and mining sectors.

H4: Profitability has a positive effect on firm value.

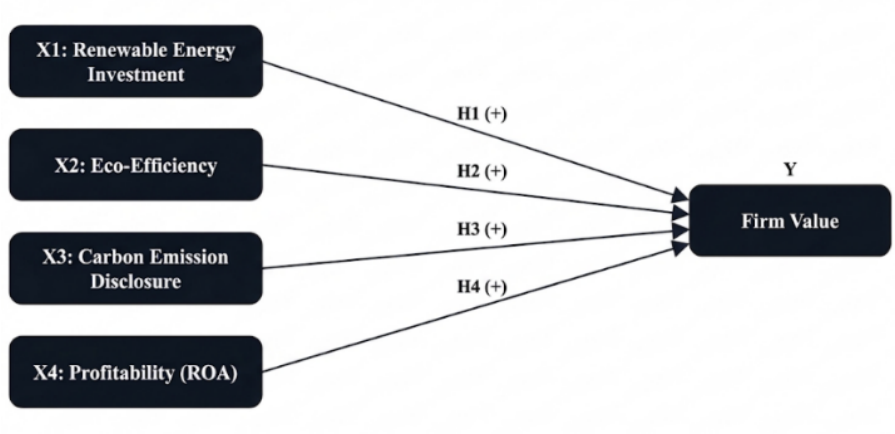


Figure 1. Conceptual Framework

Figure 1 illustrates the conceptual framework of the study, which examines the influence of four independent variables: renewable energy investment (X1), eco-efficiency (X2), carbon emission disclosure (X3), and profitability (ROA) (X4) on firm value (Y). These four variables are hypothesized to have positive relationships with firm value, as indicated by hypotheses H1, H2, H3, and H4. This framework suggests that increased investment in renewable energy, improved eco-efficiency, greater

carbon emission disclosure, and higher profitability are expected to enhance firm value.

3. Methods

This study employed a quantitative approach with a descriptive-explanatory research design to examine the effects of renewable energy investment, eco-efficiency, carbon emission disclosure, and profitability on firm value. The research covered companies in the mining and energy subsectors listed on the IDX during 2021–2025. The population comprised all companies in these subsectors, while the sample was selected using purposive sampling based on the following criteria: companies listed on the IDX during 2021–2025, companies publishing complete annual reports throughout 2021–2025, companies providing sufficient information to measure the research variables, and companies consistently disclosing information on sustainability, renewable energy investment, carbon emission disclosure, and profitability.

The study used secondary data collected from publicly available annual reports, sustainability reports, and financial statements obtained from the IDX website and individual company websites. Firm value was measured using Tobin's Q, calculated as the sum of the market value of equity and total debt divided by total assets (Nuurhasanat & Haq, 2024). Renewable energy investment was measured using the proportion of renewable energy consumption to total energy consumption. Eco-efficiency was assessed using two indicators: the Environmental Performance Rating Program (*Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan*/PROPER) and International Organization for Standardization (ISO) 14001 certification. Each indicator was assigned a score of 1 if the company fulfilled the respective criterion and 0 otherwise, resulting in a combined score ranging from 0 to 2 (Lesmana & Kesaulya, 2022). Carbon emission disclosure was measured using the Carbon Disclosure Index (CDI), based on 18 disclosure items adapted from Bae Choi et al. (2013). Each disclosed item received a score of 1, while undisclosed items received 0. The total disclosure score was divided by the overall number of items. Profitability was measured using Return on Assets (ROA), calculated as net income after tax divided by total assets (Tsaniatuzaima & Maryanti, 2022; Purwanto & Lastanti, 2025).

Data analysis was conducted using IBM SPSS Statistics. Descriptive statistical analysis was initially performed to examine the minimum, maximum, mean, and standard deviation of each variable. Classical assumption tests were subsequently conducted, including multicollinearity, heteroscedasticity, and autocorrelation. Multiple linear regression was employed to examine the relationships between the independent and dependent variables. Hypothesis testing included the coefficient of determination (R^2) to assess the model's explanatory power, the F-test to evaluate the simultaneous effects of the independent variables, and the t-test to examine the partial effect of each independent variable on firm value. All hypothesis tests employed a significance level of 5% (0.05).

4. Results

The analysis was conducted using 147 observations after removing 73 outliers from the initial dataset of 220 observations. Descriptive statistics were used to examine the characteristics of the research variables, followed by classical assumption tests to assess the regression model's suitability. The results confirmed that the model satisfied the assumptions of heteroscedasticity, autocorrelation, and multicollinearity. Furthermore, the regression model demonstrated significant explanatory power.

Table 1. Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Renewable Energy Investment	147	0.000	5.747	0.218	0.615
Eco-efficiency	147	0.000	2.000	0.762	0.788
Carbon Emission Disclosure	147	0.000	1.000	0.743	0.221
Profitability	147	-0.246	0.593	0.075	0.118
Firm Value	147	0.352	2.239	1.062	0.308
Valid N (listwise)	147	–	–	–	–

Table 1 presents descriptive statistics for the five research variables based on 147 observations. Renewable energy investment ranges from 0.000 to 5.747, with a mean of 0.218 and a standard deviation of 0.615, indicating considerable variation among companies. Eco-efficiency ranges from 0.000 to 2.000, with a mean of 0.762 and a standard deviation of 0.788. Carbon emission disclosure ranges from 0.000 to 1.000, with a mean of 0.743 and a standard deviation of 0.221, indicating that companies disclosed approximately 74.3% of the assessed items on average. Profitability ranges from -0.246 to 0.593, with a mean of 0.075 and a standard deviation of 0.118, indicating an average ROA of 7.5%, although some companies recorded negative profitability. Meanwhile, firm value ranges from 0.352 to 2.239, with a mean of 1.062 and a standard deviation of 0.308. This indicates that the average firm value, measured using Tobin's Q, was slightly above 1. The descriptive statistics demonstrate variation in the five research variables across the 147 observations.

The regression model development process began with an outlier test to identify extreme observations that could affect the accuracy of the regression estimates. Based on the test results, data cleaning was performed by eliminating observations identified as outliers. Of the 220 initial observations, 73 were classified as outliers, leaving 147 observations for the final analysis. The details of the observations identified as outliers are presented in the following Table 2.

Table 2. Outlier Data

No.	Company	Year	Z-Score
1	Baramulti Suksessarana Tbk.	2021	0.07335
2	Baramulti Suksessarana Tbk.	2022	0.11736
3	Baramulti Suksessarana Tbk.	2023	0.03426
4	Baramulti Suksessarana Tbk.	2024	0.03433
5	Baramulti Suksessarana Tbk.	2025	0.08947
6	Buana Lintas Lautan Tbk.	2021	-0.36877
7	Buana Lintas Lautan Tbk.	2022	-0.40538
8	Buana Lintas Lautan Tbk.	2024	-0.61952
9	Bumi Resources Tbk.	2025	0.25163
10	Bayan Resources Tbk.	2021	0.20722
11	Bayan Resources Tbk.	2022	4.28083
12	Bayan Resources Tbk.	2023	4.80348
13	Bayan Resources Tbk.	2024	4.28662
14	Bayan Resources Tbk.	2025	-0.56448
15	Dian Swastatika Sentosa Tbk.	2023	0.78941
16	Dian Swastatika Sentosa Tbk.	2024	0.23739
17	Dian Swastatika Sentosa Tbk.	2025	-0.48456
18	Harum Energy Tbk.	2021	-0.63170
19	Mitrabara Adiperdana Tbk.	2021	-0.06529
20	Mitrabara Adiperdana Tbk.	2022	-0.52257
21	Mitrabara Adiperdana Tbk.	2023	-0.44236
22	Mitrabahtera Segara Sejati Tbk.	2021	-0.63420

No.	Company	Year	Z-Score
23	Mitrabahtera Segara Sejati Tbk.	2022	-0.69972
24	Mitrabahtera Segara Sejati Tbk.	2023	-0.02288
25	Petrosea Tbk.	2024	-0.05004
26	Petrosea Tbk.	2025	-0.10123
27	Rukun Raharja Tbk.	2022	0.49066
28	Rukun Raharja Tbk.	2023	-0.78409
29	Rukun Raharja Tbk.	2024	-0.76511
30	Rukun Raharja Tbk.	2025	-0.72444
31	Sillo Maritime Perdana Tbk.	2023	-0.42444
32	Sillo Maritime Perdana Tbk.	2024	-0.64341
33	Sillo Maritime Perdana Tbk.	2025	-0.36308
34	Prima Andalan Mandiri Tbk.	2021	-0.46369
35	Prima Andalan Mandiri Tbk.	2022	-0.50001
36	Prima Andalan Mandiri Tbk.	2023	-0.82024
37	Prima Andalan Mandiri Tbk.	2024	-0.72821
38	Vale Indonesia Tbk.	2021	0.09966
39	Vale Indonesia Tbk.	2022	-0.08325
40	Pelat Timah Nusantara Tbk.	2021	0.24670
41	Chandra Asri Pacific Tbk.	2021	-0.57821
42	Chandra Asri Pacific Tbk.	2022	-0.70476
43	Chandra Asri Pacific Tbk.	2023	-0.71467
44	Chandra Asri Pacific Tbk.	2024	-0.88776
45	Chandra Asri Pacific Tbk.	2025	-0.59610
46	Semen Indonesia (Persero) Tbk.	2025	-0.06872
47	Aneka Tambang Tbk.	2021	0.11657
48	Aneka Tambang Tbk.	2022	-0.27291
49	Aneka Tambang Tbk.	2023	-0.45496
50	Aneka Tambang Tbk.	2025	0.17687
51	Merdeka Copper Gold Tbk.	2021	-0.03923
52	Merdeka Copper Gold Tbk.	2022	-0.14845
53	Timah Tbk.	2025	0.13656
54	Archi Indonesia Tbk.	2021	-0.10653
55	Archi Indonesia Tbk.	2022	-0.18607
56	Archi Indonesia Tbk.	2025	0.07561
57	Citra Tubindo Tbk.	2025	0.35512
58	Gunung Raja Paksi Tbk.	2023	-0.10276
59	Gunung Raja Paksi Tbk.	2024	-0.41970
60	Indocement Tunggal Prakarsa Tbk.	2021	-0.25522
61	Semen Baturaja (Persero) Tbk.	2021	0.06066
62	Cemindo Gemilang Tbk.	2021	0.16988
63	Cemindo Gemilang Tbk.	2022	-0.25199
64	Cemindo Gemilang Tbk.	2023	0.02457
65	Cemindo Gemilang Tbk.	2024	-0.47876
66	Cemindo Gemilang Tbk.	2025	0.37488
67	Wijaya Karya Beton Tbk.	2023	-0.05824
68	Waskita Beton Precast Tbk.	2021	0.07481
69	Waskita Beton Precast Tbk.	2022	0.21490
70	Waskita Beton Precast Tbk.	2023	0.07993
71	Waskita Beton Precast Tbk.	2024	-0.04447
72	Waskita Beton Precast Tbk.	2025	0.00492
73	Barito Pacific Tbk.	2025	0.37455

Table 2 shows the outlier detection using Standardized Residuals (Z-scores), which identified 73 observations with extreme values. These observations were subsequently eliminated from the research sample to improve the quality and reliability of the regression analysis. Consequently, the initial dataset of 220

observations was reduced to 147 observations, which were used in the subsequent analysis.

Table 3. Heteroscedasticity Test Results

Variable	B	Std. Error	Beta	t	Sig.
Constant	171160.071	45697.142		3.746	<0.001
Renewable Energy Investment	-0.023	0.020	-0.096	-1.154	0.251
Eco-efficiency	0.018	0.017	0.095	1.081	0.282
Carbon Emission Disclosure	-0.007	0.057	-0.010	-0.126	0.900
Profitability	0.207	0.112	0.162	1.852	0.066

Based on Table 3, the results of the heteroscedasticity test using the Glejser method, the significance values for renewable energy investment, eco-efficiency, carbon emission disclosure, and profitability were 0.251, 0.282, 0.900, and 0.066, respectively. All independent variables had significance values greater than 0.05. Therefore, it can be concluded that the regression model does not exhibit heteroscedasticity, indicating that the model satisfies the classical assumption and is suitable for further analysis.

Table 4. Autocorrelation Test

Test	Value
Durbin-Watson stat (DW)	2.051
dU (n = 147, k = 4)	1.7866
4 - dU	2.2134

The autocorrelation test results in Table 4 show a Durbin-Watson (DW) statistic of 2.051, which falls between the upper bound (dU) of 1.7866 and 4 − dU of 2.2134. This satisfies the condition of $1.7866 < 2.051 < 2.2134$. Accordingly, the regression model is considered free from positive and negative autocorrelation, indicating that the residuals are independent and the autocorrelation assumption is satisfied.

Table 5. Multicollinearity Test

Variable	Tolerance	VIF
Renewable Energy Investment	0.986	1.014
Eco-efficiency	0.880	1.137
Carbon Emission Disclosure	0.983	1.017
Profitability	0.884	1.131

Based on Table 5, all independent variables have tolerance values greater than 0.10 and VIF values lower than 10. This indicates no high correlations among the independent variables in the regression model. Therefore, it can be concluded that the regression model does not exhibit multicollinearity and satisfies one of the classical assumptions.

Table 6. Coefficient of Determination

Model	Results
R	0.615
R-Square	0.378
Adjusted R-Square	0.361

Based on Table 6, the adjusted R-square is 0.361, or 36.1%. This indicates that the independent variables, consisting of renewable energy investment, eco-efficiency, carbon emission disclosure, and profitability, explain 36.1% of the variation in firm value. The remaining 63.9% is explained by variables outside the research model.

Thus, the independent variables explain 36.1% of the variation in the dependent variable.

Table 7. F Test

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	5.226E+12	4	1.307E+12	21.580	<0.001
Residual	8.597E+12	142	60545295886	-	-
Total	1.382E+13	146	-	-	-

Based on the F-test results in Table 7, the calculated F-value is 21.580, with a significance value below 0.001, which is below 0.05. This indicates that renewable energy investment, eco-efficiency, carbon emission disclosure, and profitability simultaneously have a significant effect on firm value. Therefore, it can be concluded that the regression model used in this study is suitable for explaining the relationship between the independent and dependent variables.

Table 8. Hypothesis Testing

Variable	B	Std. Error	Beta	t	Sig.
Constant	753747.653	75236.907	-	10.018	<0.001
Renewable Energy Investment	-0.053	0.033	-0.105	-1.583	0.116
Eco-efficiency	0.065	0.028	0.167	2.360	0.020
Carbon Emission Disclosure	0.200	0.093	0.143	2.147	0.034
Profitability	1.622	0.184	0.620	8.815	<0.001

Table 8 presents the results of hypothesis testing using multiple linear regression. The results indicate that renewable energy investment has a negative but statistically insignificant effect on firm value, with a regression coefficient of -0.053 and a significance value of 0.116, which is greater than 0.05. Therefore, the first hypothesis is not supported. In contrast, eco-efficiency has a positive and significant effect on firm value, with a regression coefficient of 0.065 and a significance value of 0.020, which is below 0.05. Thus, the second hypothesis is supported. These findings indicate that improvements in eco-efficiency are associated with higher firm value, whereas renewable energy investment has not demonstrated a significant relationship with firm value.

Furthermore, carbon emission disclosure has a positive and significant effect on firm value, with a regression coefficient of 0.200 and a significance value of 0.034, which is below 0.05. Therefore, the third hypothesis is supported. Profitability also has a positive and significant effect on firm value, with a regression coefficient of 1.622 and a significance value below 0.001. This result supports the fourth hypothesis. Among the four independent variables, profitability has the strongest standardized regression coefficient (Beta = 0.620), indicating the greatest relative contribution to explaining variation in firm value. The findings suggest that eco-efficiency, carbon emission disclosure, and profitability significantly determine firm value in this study.

5. Discussion

Renewable energy investment does not significantly affect firm value; therefore, the first hypothesis is rejected. Although renewable energy adoption signals environmental responsibility and long-term sustainability, these benefits may not immediately influence investor assessments. Investors tend to prioritize short-term financial performance, while renewable energy investment requires substantial initial expenditures for technology, infrastructure, and operational adjustments. Consequently, the market may not immediately recognize its potential value. This finding does not fully support Signaling Theory or Legitimacy Theory, as renewable

energy investment has not been perceived as an influential signal or a direct determinant of corporate legitimacy. It differs from Pambudi et al. (2023), who reported positive contributions of renewable energy investment or adoption to firm value. These differences may reflect initial costs, delayed economic benefits, and variations in adoption across companies in the energy and basic materials sectors. However, the finding aligns with Martí-Ballester (2017), who found no significant effect of renewable energy use on corporate financial performance. Thus, renewable energy investment remains strategically important for sustainability, although its financial benefits may not be immediately reflected in firm value.

In contrast, eco-efficiency positively affects firm value, supporting the second hypothesis. It reflects a company's ability to create economic value while maintaining environmental responsibility through resource optimization, reduced waste, lower operating costs, and minimized environmental impacts. In this study, eco-efficiency is measured using PROPER indicators and ISO 14001 certification. This finding supports Legitimacy Theory because environmentally responsible business practices help companies gain stakeholder recognition, strengthen their reputation, and maintain social legitimacy. It also supports Signaling Theory because effective environmental management signals a commitment to sustainability and potential long-term economic benefits to investors. This finding is consistent with Oktaviani and Al Ghozi (2025), who explained that the effect of eco-efficiency depends on how the market communicates and receives environmental information. However, it differs from Yuliandhari et al. (2023), who found no effect of eco-efficiency on firm value. Such differences may arise from variations in industry sectors, research periods, and measurement indicators.

Carbon emission disclosure also positively affects firm value, supporting the third hypothesis. It demonstrates corporate transparency regarding operational environmental impacts, including emission volumes and sources, reduction strategies, sustainability targets, and policies for anticipating climate change risks. Comprehensive disclosure strengthens corporate accountability. This finding supports Signaling Theory because environmental transparency reduces information asymmetry and provides investors with a stronger basis for evaluating corporate prospects. It also supports Legitimacy Theory, as transparent carbon reporting helps companies gain social acceptance, maintain their reputation, and strengthen social legitimacy amid growing environmental awareness. This result is consistent with Kurnia et al. (2021) and Hardianti and Mulyani (2023), who linked carbon emission disclosure to transparency, investor confidence, and competitive advantage. However, this differs from Oktaviani and Al Ghozi (2025). This difference may relate to disclosure quality, as information presented merely as a formality without concrete emission management strategies may not generate positive investor responses.

Profitability positively affects firm value, supporting the fourth hypothesis. Measured using ROA, profitability reflects a company's ability to generate profits from its assets. Higher profitability indicates more productive asset management and strengthens investor confidence in future earnings and cash flows. This finding supports Signaling Theory because reported profits provide positive information about financial conditions and management effectiveness. It also supports Agency Theory, as shareholders can use profitability to evaluate management's effectiveness in managing resources for their benefit. Unlike sustainability signals, whose benefits may take longer to materialize, profitability provides more direct and measurable information. It also reflects a company's capacity to finance renewable energy investment, eco-efficiency, and carbon emission disclosure. The finding is consistent with Irman et al. (2022), but differs from Tsaniatuzaima and Maryanti (2022), who found no effect of ROA on firm value in food and beverage companies. These differences may reflect industry characteristics, research periods, market conditions,

and investor assessments of earnings sustainability. Profitability is the strongest determinant of firm value, while eco-efficiency and carbon emission disclosure remain significant after profitability is controlled for, indicating that sustainability practices provide additional value beyond financial performance.

6. Conclusion

This study finds that renewable energy investment does not significantly affect firm value, whereas eco-efficiency, carbon emission disclosure, and profitability have positive effects. Profitability is the most dominant factor, while eco-efficiency and carbon emission disclosure remain relevant beyond financial performance. These findings highlight the importance of considering financial and sustainability aspects when assessing corporate value. The results contribute to sustainability accounting literature by demonstrating the relevance of environmental management and transparency alongside profitability. Companies should improve resource efficiency, disclose carbon emissions transparently, and maintain profitability. Although renewable energy investment has not shown a significant effect on firm value in this study, it remains relevant to long-term sustainability strategies. Investors may consider environmental performance and disclosure as complementary information, while regulators can encourage consistent and transparent sustainability reporting.

This study is limited to companies in the energy and mining sectors listed on the IDX during 2021–2025. Specific data requirements and outlier exclusions also reduced the sample size. Moreover, the model excludes other potential determinants of firm value, and measures profitability only by Return on Assets. The analysis also relies on company disclosures, whose completeness may vary. Future research could expand the sample to other industry sectors and extend the observation period to capture the long-term effects of sustainability initiatives, particularly renewable energy investment. Further studies could incorporate variables such as leverage, firm size, corporate governance, Corporate Social Responsibility (CSR), ESG disclosure, and green innovation. They could also use other profitability measures, such as Return on Equity and Net Profit Margin, and examine profitability as a moderating variable in the relationship between sustainability factors and firm value.

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