Indonesian Journal of Business Analytics (IJBA)
Vol. 6 , No. 3 (June) 2026: 689-704

The Effect of Green Investment and Corporate Social Responsibility (Csr) on Financial Performance With Environmental Performance as a Moderating Variable in Energy Sector Companies on the Idx

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ARTICLEINFO
Keywords: Green Investment, Corporate Social Responsibility, Environmental Performance, Return on Assets, Financial Performance.

Received : 20 April
Revised : 10 May
Accepted: 26 June

ABSTRACT
This study aims to analyze the influence of Green Investment and Corporate Social Responsibility (CSR) on financial performance measured using Return on Assets (ROA) with Environmental Performance as a moderating variable in energy sector companies listed on the Stock Exchange.

The results of the study show that Green Investment does not have a significant effect on ROA, indicating that green investment has not been able to provide a direct impact on the company's financial performance in the short term. Meanwhile, Corporate Social Responsibility (CSR) has a positive and significant effect on ROA, indicating that CSR disclosure can improve the financial performance of energy sector companies. Furthermore, Environmental Performance is unable to moderate the effect of Green Investment on ROA, but it is able to moderate and strengthen the effect of CSR on ROA. Study This provide implications that strategy sustainability company sector energy need emphasizes the quality of CSR implementation and environmental performance as important factors in improving financial performance.

DOI: https://doi.org/10.55927/ijba.v6i3.16525
ISSN: 2808-0718
https://journal.formosapublisher.org/index.php/ijba

INTRODUCTION

Climate change and global pressure to reduce emissions have made sustainability a top priority in international business strategy (Athaya et al., 2025; Rahman, 2024). The energy sector alone accounts for more than 75% of global greenhouse gas emissions (Hanifah & Purbadharmaja, 2025). Global green energy investment reached USD 1.1 trillion in 2022, almost double 2020 levels, reflecting a shift from short-term profit toward long-term sustainability (BloombergNEF, 2022).

Indonesia faces similar demands as part of an increasingly integrated global market. It is one of Southeast Asia's largest energy producers, with coal production reaching 775.2 million tons in 2023, and its heat and power generation sector contributed about 50% of national energy-related CO_2 emissions that year (IEA, 2025). This requires energy companies to strengthen environmental governance and transparency through green investment, social responsibility, and improved environmental performance.

To ensure regulatory compliance and environmental sustainability, the Indonesian government developed PROPER (the Corporate Performance Rating Assessment Program in Environmental Management), published by the Ministry of Environment and Forestry (KLHK). PROPER ranks companies on five color levels—gold, green, blue, red, and black—and evaluated 4,495 companies in the 2023–2024 period alone, making it a credibility indicator recognized by government and investors (Menteri Lingkungan Hidup, 2023).

Companies are also increasingly encouraged to expand green investment, covering energy efficiency, emission reduction, waste management, and renewable energy (Ningsih, 2024; Rita et al., 2025). Indonesian renewable energy investment was projected to reach USD 1.8 billion by 2022, yet several studies find green investment does not always improve short-term financial performance due to high implementation costs and limited market incentives—an inconsistency this study explores further (Tan et al., 2025; Wijayanti & Budi, 2024).

Corporate Social Responsibility (CSR) likewise plays a significant role in sustainability strategy, helping maintain public relations, build reputation, and reduce non-financial risk (Suhairi et al., 2023). More than 90% of large global companies now publish sustainability reports (Purwanto, 2025), and good CSR implementation in the energy sector correlates with improved profitability and investor confidence—though empirical results in Indonesia remain inconsistent due to variation in CSR disclosure quality (Husda et al., 2023; Jung & Yoo, 2023; Ye & Dela, 2023).

These inconsistencies suggest other factors may strengthen or weaken the green investment/CSR–financial performance relationship. Environmental performance is a strong candidate moderator, as it reflects how effectively a company manages its actual environmental impact, turning sustainability

commitments into measurable financial outcomes via investor confidence and public legitimacy (Sari et al., 2024; Tjoa & Patricia, 2022).

Given the energy sector's economic importance, high environmental risk, and the need for stronger empirical evidence, this study examines the effect of green investment and CSR on financial performance, with environmental performance as a moderating variable, using IDX-listed energy companies for 2021–2024—expected to offer both scientific and practical contributions for companies, investors, and policymakers.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Theoretical Review

Green Investment (GI)

Green investment is the allocation of company funds to activities that reduce negative environmental impact, such as energy efficiency, emission control, renewable energy, and eco-friendly waste management (Soraya, 2023), helping companies comply with regulations while enhancing long-term reputation and competitiveness (Ye & Dela, 2023).

Green investment is an important strategy in the energy industry given its relatively high environmental risk; Tan et al. (2025) found that environmentally directed investment can improve environmental performance and indirectly strengthen financial performance.

Measurement GI use Green Investment Disclosure Index , namely:

$$GI = \frac{\text{Amount items disclosure investment}}{\text{green Total items to be disclosed}}$$

A higher GI index reflects a greater company commitment to environmental sustainability.

Corporate Social Responsibility (CSR)

Corporate Social Responsibility (CSR) is a company's commitment to sustainable development through ethical practices toward employees, communities, consumers, and the environment (Sumiyati et al., 2023; Taufiqurrahman & Sitepu, 2020), evolving from pure philanthropy into long-term business strategy (Kludacz-Alessandri & Cygańska, 2021).

Good CSR strengthens corporate legitimacy, builds public trust, reduces business risk, and ultimately improves financial performance (Jung & Yoo, 2023; Putri & Budiantara, 2025).

Measurement CSR in study This use *CSR Disclosure Index* based on GRI (Global Reporting Initiative) guidelines:

$$CSR = \text{Amount items CSR Which disclosed Total GRI standard items}$$

A higher index value indicates better and more transparent CSR practice.

Financial Performance (Y) – Return on Assets (ROA)

Financial performance shows a company's ability to generate profit from its resources (Damayanti et al., 2023; Dewi, 2017); this study measures it using ROA only.

ROA was chosen because it:

1. Reflects the effectiveness of assets in generating profit.
2. Is relevant for the energy industry, which is capital intensive.
3. Is widely used in studies of sustainability-based company performance.

Formula for ROA according to Kasmir (2019):

$$ROA = \frac{\text{Profit Clean}}{\text{Total Asset}} \times 100$$

Interpretation:

- High ROA → the company is efficient and profitable.
- Low ROA → the company is less effective at managing its assets.

Environmental Performance (Z)

Environmental performance (EP) represents a company's success in controlling its environmental impact, assessed in Indonesia via the PROPER system (KLHK).

PROPER assesses companies on regulatory compliance, energy conservation, waste management, and environmental innovation. Its color scale converts to a numerical value:

- Gold = 5
- Green = 4
- Blue = 3
- Red = 2
- Black = 1

$$EP = \text{Skor PROPER Perusahaan yang di terbitkan KLHK}$$

Tjoa & Patricia (2022) found EP has a positive but not strongly significant medium-term effect on financial performance, and can strengthen both the GI→ROA and CSR→ROA relationships—supporting its use as a moderating variable here.

Summary of Section 2.1

These theories together ground the study's conceptual framework, explaining how companies create value through sustainable practices and reinforcing the argument that green investment and CSR positively affect profitability when supported by good environmental performance. This

foundation guides the hypotheses and the analysis of relationships between variables X, Y, and Z for energy sector companies in Indonesia.

METHOD STUDY

Research Design

This research uses an associative quantitative approach to measure the influence of green investment (GI) and CSR on financial performance (ROA), and to test whether environmental performance (EP) moderates that relationship. The research design can be depicted as follows:

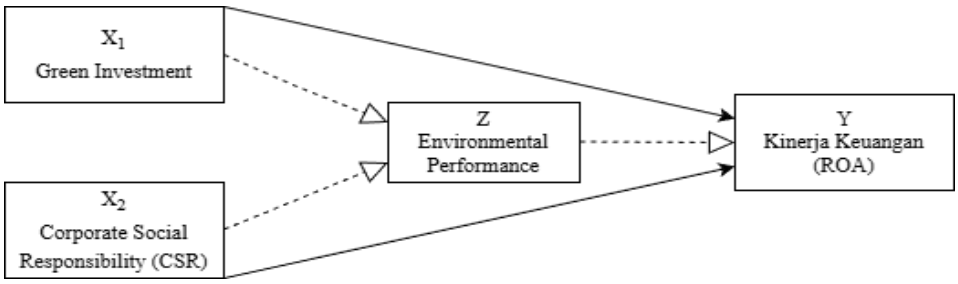


Figure 2: Associative Research Design

RESULTS AND DISCUSSION

Descriptive Statistics

Descriptive statistics summarize the minimum, maximum, mean, and standard deviation of GI, CSR, EP, and ROA, identifying data trends among energy sector companies over 2021–2024 before further testing.

Table 1. Descriptive Statistics Test Results

	Y_ROA	X1_GI	X2_CSR	M_EP
Mean	0.176402	0.914583	0.786813	4.025000
Median	0.128750	0.916667	0.780220	4,000,000
Maximum	0.634274	1,000,000	0.868132	5,000,000
Minimum	- 0.010647	0.833333	0.703297	3,000,000
Std. Dev.	0.162266	0.069305	0.044710	0.576795
Skewness	1.084932	0.046215	0.122328	0.003552
Kurtosis	3.488495	1.484295	2.021006	3.076604
Jarque- Bera	8.244897	3.843175	1.697144	0.009864
Probability	0.016205	0.146374	0.428026	0.995080
Sum	7.056062	36.58333	31.47253	161,0000
Sum Sq. Dev.	1.026885	0.187326	0.077962	12.97500
Observations	40	40	40	40

Source: Attachment Eviews Output

The ROA variable has an average of 0.1764, a maximum of 0.6343, and a minimum of -0.0106. The positive average indicates that energy sector companies

generally generate profit from their assets, though some show relatively low performance in certain periods.

GI has an average of 0.9146 with a relatively small standard deviation, indicating high and fairly homogeneous green investment disclosure—reflecting a fairly strong sector-wide commitment to environmentally friendly investment.

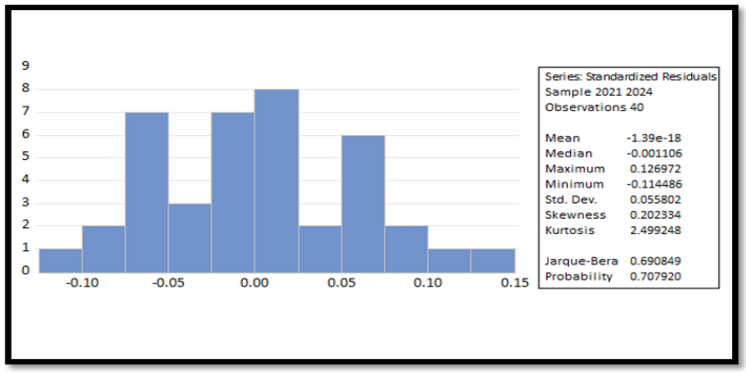
CSR has an average of 0.7868, reflecting fairly good GRI-aligned disclosure. EP, measured by PROPER score, averages 4.025, indicating most companies fall within the blue-to-green rank and meet applicable environmental requirements.

Classical Assumption Tests

Classical assumption tests ensure the panel data regression model satisfies the BLUE (Best Linear Unbiased Estimator) assumptions, so estimates are unbiased and accurately interpretable.

Normality Test

A normality test checks whether residual data are normally distributed (Khotimah et al., 2024)—an important assumption for unbiased, validly interpretable estimates.



Normality was tested using the Jarque-Bera test on the regression residuals via EViews; a probability value above 0.05 indicates normally distributed residuals.

The test produced a probability value above 0.05, so residuals are normally distributed, satisfying the normality assumption and confirming the model is suitable for further analysis.

This also indicates that data deviations are not extreme and that the regression estimates reliably explain the relationships among GI, CSR, EP, and ROA.

Multicollinearity Test

The multicollinearity test checks for strong linear relationships among independent variables; high multicollinearity destabilizes coefficients and complicates interpretation (Hendrianto et al., 2023).

Table 2. Multicollinearity Test Results
Variance Inflation Factors
Date: 02/03/26 Time: 20:47 Sample: 1 40
Included observations: 40

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.113343	417.4850	NA
X1_GI	0.063590	197.0179	1.096916
X2_CSR	0.182897	418.3696	1.313023
M_EP	0.001116	67.95819	1.333975

Source: Attachment Eviews Output

This test examined the Centered VIF of GI, CSR, and EP, where a value below 10 indicates no multicollinearity. All independent variables show Centered VIF below 10, indicating no strong linear relationship among them. Thus, the model is free of multicollinearity, allowing all independent variables to be used together For analyze its influence to performance finance (ROA) energy sector companies.

Heteroscedasticity Test

The heteroscedasticity test checks for unequal residual variance; if present, error variance is non-constant, making estimates less efficient and accurate (Martaningtyas et al., 2024).

Table 3. Heteroscedasticity Test Results
Heteroskedasticity Test: Glejser Null hypothesis: Homoscedasticity

F- statistic	0.997364	Prob. F(3,36)	0.4052
Obs*R-squared	3.069434	Prob. Chi-Square(3)	0.3810
Scaled explained SS	1.937994	Prob. Chi- Square(3)	0.5854

Source: Attachment Eviews Output

This was tested using the Glejser test; a probability value above 0.05 for each variable indicates no heteroscedasticity.

All independent variables show probability values above 0.05, indicating homogeneous error variance.

Thus, the model is free of heteroscedasticity and suitable for further regression analysis.

Autocorrelation Test

The autocorrelation test checks for correlation between residuals across periods (Madany et al., 2022; Wibowo, 2025), which can reduce coefficient efficiency and estimate accuracy if unaddressed.

Table 4. Autocorrelation Test Results

Breusch-Godfrey Serial Correlation LM Test:

Null hypothesis: No serial correlation at up to 2 lags

F- statistic	0.487989	Prob. F(2.34)	0.6181
Obs*R-squared	1.116169	Prob. Chi-Square(2)	0.5723

Test Equation:

Dependent Variable: RESID Method: Least Squares

Date: 02/03/26 Time: 20:47 Sample: 1 40

Included observations: 40

Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t- Statistic	Prob.
C	- 0.087129	0.368094	- 0.236703	0.8143
X1_GI	0.016369	0.258259	0.063382	0.9498
X2_CSR	0.105966	0.464258	0.228248	0.8208
M_EP	- 0.002734	0.034443	- 0.079373	0.9372
RESID(- 1)	- 0.059258	0.173861	- 0.340833	0.7353
RESID(- 2)	0.158576	0.182865	0.867172	0.3919
R-squared	0.027904	Mean dependent var		4.31E- 16
Adjusted R-squared	- 0.115051	Elementary School dependent var		0.100121
SE of regression	0.105724	Akaike information criteria		- 1.518487
Sum squared resid	0.380038	Black criterion		- 1.265155
Log likelihood	36.36974	Hannan-Quinn criter.		- 1.426890
F- statistic	0.195196	Durbin-Watson stat		1.999289
Prob(F-statistic)	0.962252			

Source: Attachment Eviews Output

This was tested using the Breusch–Godfrey Serial Correlation LM test; a probability value above 0.05 indicates no autocorrelation.

The result was 0.5723, above 0.05, indicating no correlation between residuals across periods. The autocorrelation assumption is thus satisfied, and the estimates can be used for further analysis.

Panel Regression Model Selection

The panel data regression model was selected among Pooled Least Squares (PLS), Fixed Effect Model (FEM), and Random Effect Model (REM) to best capture the influence of GI, CSR, and EP on financial performance.

Model selection used the Chow Test, Hausman Test, and Lagrange Multiplier Test (LM Test), as described in the Method section.

Chow Test

The Chow test compares PLS and FEM; a probability value below 0.05 favors FEM.

Table 5. Chow Test Results

Redundant Fixed Effects Tests Equation: EQ1_FEM Test cross-section fixed effects			
Effects Test	Statistics	df	Prob.
Cross-section F	6.657777	(9.27)	0.0001
Cross-section Chi- square	46.766049	9	0.0000

Source: Attachment Eviews Output

The Chow Test produced a probability value of 0.0001, below 0.05, so the analysis proceeds using FEM.

Hausman Test

The Hausman test compares FEM and REM; a probability value below 0.05 favors FEM.

Table 6. Hausman Test Results

Correlated Random Effects - Hausman Test Equation: EQ2_REM

Test cross-section random effects

Test Summary	Chi- Sq. Statistics	df	Prob.
ross-section random	8.440773	3	0.0377

Source: Attachment Eviews Output

The Hausman test produced a probability value of 0.0377, below 0.05, confirming FEM is more appropriate than REM.

Lagrange Multiplier Test (LM Test)

The LM Test compares PLS and REM; since the Chow and Hausman tests already favor FEM, its results here only reinforce the analysis.

Table 7. LM Test Results

Lagrange Multiplier Tests for Random Effects Null hypothesis: No effects

Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Cross-section	Test Hypothesis Time	Both
Breusch-Pagan	8.670803	0.576672	9.247475
	(0.0032)	(0.4476)	(0.0024)
Honda	2.944623	- 0.759390	1.545193
	(0.0016)	(0.7762)	(0.0611)
King- Wu	2.944623	- 0.759390	0.814661
	(0.0016)	(0.7762)	(0.2076)

Standardized Honda	3.360697	- 0.475058	- 1.081136
	(0.0004)	(0.6826)	(0.8602)
Standardized King- Wu	3.360697	- 0.475058	- 1.607348
	(0.0004)	(0.6826)	(0.9460)
Gourieroux, et al.	--	--	8.670803
			(0.0049)

Source: Attachment Eviews Output

LM Test results favor REM over PLS, but since the Hausman Test favors FEM, this study retains FEM as its panel data regression model.

Analysis Regression Panel Data

Panel data regression analysis examines the influence of GI and CSR on financial performance and the moderating role of EP, using the Fixed Effects **Model (FEM) selected above.**

Two models were estimated: a basic regression model (without moderation) and a moderated regression model using the interaction term technique.

Base Regression Model (Without Moderation)

The basic regression model tests the direct effect of GI and CSR on ROA, formulated as follows:

$$ROA_{it} = \alpha + \beta_1 GI_{it} + \beta_2 CSR_{it} + \varepsilon_{it}$$

Table 8. Base Regression Model Results
Dependent Variable: Y_ROA Method: Panel Least Squares Date: 02/03/26
Time: 20:42 Sample: 2021 2024
Periods included: 4
Cross-sections included: 10
Total panel (balanced) observations: 40

Variable	Coefficient	Std. Error	t- Statistic	Prob.
C	- 0.971623	0.338779	- 2.868018	0.0078
X1_GI	0.300156	0.221191	1.357001	0.1856
X2_CSR	1.110183	0.350529	3.167168	0.0037

Effects Specification
Cross-section fixed (dummy variables)

R-squared	0.840264	Mean dependent var	0.176402
Adjusted R-squared	0.777511	Elementary School dependent var	0.162266
SE of regression	0.076539	Akaike information criteria	- 2.058706
Sum squared resid	0.164030	Black criterion	- 1.552042
Log likelihood	53.17412	Hannan-Quinn criter.	- 1.875512

F- statistic 13.38995 Durbin-Watson stat 2.477244
Prob(F-statistic) 0.000000

Source: Attachment Eviews Output

The FEM estimation shows GI has a regression coefficient of 0.3002 with a probability value of 0.1856—above 0.05, so green investment has no significant effect on ROA.

CSR has a regression coefficient of 1.1102 with a probability value of 0.0037—below 0.05—indicating a positive, significant effect on ROA: higher CSR disclosure corresponds to better financial performance.

Moderated Regression Model

The moderated regression model tests whether environmental performance strengthens or weakens the GI/CSR–ROA relationship using the interaction term technique, formulated as follows:

$$ROA_{it} = \alpha + \beta_1 GI_{it} + \beta_2 CSR_{it} + \beta_3 EP_{it} + \beta_4 (GI \times EP)_{it} + \beta_5 (CSR \times EP)_{it} + \varepsilon_{it}$$

Table 9. Moderated Regression Model Results
Dependent Variable: Y_ROA Method: Panel Least Squares Date: 02/03/26 Time: 20:42 Sample: 2021 2024
Periods included: 4
Cross-sections included: 10
Total panel (balanced) observations: 40

Variable	Coefficient	Std. Error	t-Statistics	Prob.
C	4.150224	1.162922	3.568789	0.0015
X1_GI	0.981587	1.276165	0.769170	0.4490
X2_CSR	- 6.651430	1.814899	- 3.664903	0.0012
M_EP	- 1.145213	0.278990	- 4.104850	0.0004
X1Z	- 0.195039	0.330752	- 0.589683	0.5607
X2Z	1.790388	0.445471	4.019093	0.0005

Effects Specification
Cross-section fixed (dummy variables)

R-squared	0.938457	Mean dependent var	0.176402
Adjusted R-squared	0.903993	Elementary School dependent var	0.162266
SE of regression	0.050278	Akaike information criteria	- 2.862489
Sum squared resid	0.063198	Black criterion	- 2.229159
Log likelihood	72.24977	Hannan-Quinn criter.	- 2.633497
F- statistic	27.22992	Durbin-Watson stat	2.503510
Prob(F-statistic)	0.000000		

Source: Attachment Eviews Output

Environmental Performance (EP) significantly influences ROA. The GI × EP interaction has a coefficient of -0.1950 with a probability value of 0.5607—above 0.05—so EP does not moderate the effect of green investment on ROA.

In contrast, the CSR × EP interaction has a coefficient of 1.7904 with a probability value of 0.0005—below 0.05—indicating EP does moderate and strengthen the effect of CSR on ROA.

DISCUSSION OF RESEARCH RESULTS

Influence of Green Investment on Financial Performance (ROA)

Green investment is widely viewed as a sustainability strategy with potential economic benefits through improved energy efficiency, reduced environmental impact, and enhanced corporate image, though it often requires large upfront costs and time before financial benefits materialize (Tan et al., 2025; Wijayanti & Budi, 2024).

Consistent with this, the test results show green investment has no significant impact on ROA, indicating its allocation has not yet translated into higher profitability during the observation period.

This is consistent with the long-term nature of green investment: energy companies tend to focus such spending on regulatory compliance and operational standards, whose economic benefits are not felt in the short term. Green investment is therefore better viewed as a sustainability commitment than as a near-term profitability driver within this study's timeframe.

Influence of Corporate Social Responsibility on Financial Performance (ROA)

CSR is widely seen as a strategy for building positive community relationships, reputation, and social legitimacy—especially important in the energy sector given its significant social and environmental impact (Jung & Yoo, 2023; Kludacz-Alessandri & Cygańska, 2021).

The analysis confirms CSR has a positive, significant effect on ROA: companies disclosing CSR more broadly tend to perform better financially.

CSR appears to function as a positive signal to investors and stakeholders—companies seen as more responsible and better able to manage social risk earn greater trust, which ultimately improves financial performance.

Role of Environmental Performance in Moderating the Influence of Green Investment on ROA

Environmental performance is often used as an indicator of how well a company manages its environmental impact, with good EP assumed to support better optimization of sustainability strategies such as green investment (Sari et al., 2024; Tjoa & Patricia, 2022).

However, the results show EP does not strengthen the green investment–ROA relationship, suggesting good environmental performance alone is insufficient to accelerate green investment's financial impact.

This likely reflects the long timeframe needed for green investment to pay off: even with a good PROPER rating, its financial benefit may not yet be directly visible within the research period, so EP has not played an optimal moderating role here.

Role of Environmental Performance in Moderating the Influence of CSR on ROA

CSR implementation has a stronger impact when paired with good environmental performance, which reflects genuine sustainability commitment and increases CSR credibility (Sari et al., 2024; Tjoa & Patricia, 2022).

The analysis confirms EP strengthens the CSR–ROA relationship: companies that both actively implement CSR and maintain good environmental performance tend to gain greater financial benefit.

CSR backed by strong environmental performance is not merely symbolic but reflects genuine sustainability commitment, increasing investor and public confidence and positively impacting financial performance.

CONCLUSION

This study analyzes the influence of Green Investment and CSR on financial performance (ROA), with Environmental Performance as a moderating variable, in energy sector companies listed on the IDX for 2021–2024.

Based on the FEM panel data regression analysis and partial (t-test) hypothesis testing, the following conclusions are drawn:

1. Green investment does not significantly impact financial performance (ROA), indicating that energy sector companies' green investments have not yet directly improved profitability in the short term. Such investment tends to be long-term with significant upfront costs, so its economic benefits are not yet fully reflected in financial performance.
2. Corporate Social Responsibility (CSR) has a positive and significant impact on financial performance (ROA). Companies with higher CSR disclosure tend to perform better financially, as CSR improves reputation, investor confidence, and social legitimacy.
3. Environmental Performance is unable to moderate the influence of Green Investment on financial performance (ROA), indicating that good environmental performance is not strong enough to strengthen this relationship for energy sector companies.
4. Environmental Performance is able to moderate and strengthen the influence of CSR on financial performance (ROA), showing that CSR's effect is stronger when supported by good environmental performance, as reflected in a high PROPER ranking.

Overall, CSR and environmental performance play an important role in improving energy sector financial performance, while green investment serves a more strategic, long-term sustainability role whose financial benefits are not yet directly visible within the research period.

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