

The Impact of Green Finance, Green Investment, and Green Innovation on the Financial Performance of Energy-Sector Companies

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Abstract (font type Times New Roman, size 11, space 1, justify, and maximum 250 words)

Purpose: This study aims to examine the effect of green finance, green investment, and green innovation on financial performance, with firm age as a control variable, among energy sector companies listed on the Indonesia Stock Exchange for the period 2020–2024. Financial performance is measured using Return on Assets (ROA).

Design/methodology/approach: The study employs a quantitative approach using secondary data sourced from annual reports, sustainability reports, and corporate financial statements. The sample was selected through purposive sampling, resulting in 19 companies with 95 observations over the five-year observation period. The data were analyzed using panel data regression with the Random Effects (REM) model via EViews 12 software.

Findings: Results show that green finance has a positive and significant effect on financial performance, whereas green investment, green innovation, and firm age do not have a significant effect when considered individually. However, these four variables collectively have a significant effect on financial performance.

Practical implications: The findings indicates that the financial benefits of sustainability strategies are cumulative and only become apparent when various green initiatives are implemented in an integrated manner, rather than separately. This study implies that management at energy companies should prioritize the disclosure and implementation of green finance as the most responsive instrument in the short term, while continuing to develop green investment and green innovation as long-term sustainability strategies.

Originality/value: This study examines the effects of green finance, green investment, and green innovation on financial performance, with firm age as a control variable, in energy sector companies listed on the Indonesia Stock Exchange during the 2020–2024 period.

Paper type: empirical

Keywords: green finance, green investment, green innovation, financial performance, firm age.

1. Introduction

Environmental issues are a major concern in modern business, particularly in the energy sector, which is directly linked to the exploitation of natural resources, the use of fossil fuels, and high carbon emissions. Maharani et al. (2025) emphasizes that this sector accounts for a very large proportion of carbon emissions, so companies in this field are required to integrate sustainability strategies more consistently and comprehensively. Implementing green strategies is not only a matter of complying with environmental requirements, but also has the potential to impact efficiency, reputation, and business sustainability, while pressure on energy companies is growing because this sector carries high environmental risks Hefner et al. (2024). Financial performance, which in this study is proxied by Return on Assets (ROA), reflects a company's ability to leverage its assets to generate profits and serves as an important tool for evaluating management's effectiveness in optimizing internal resources (Ramadhan et al., 2023).

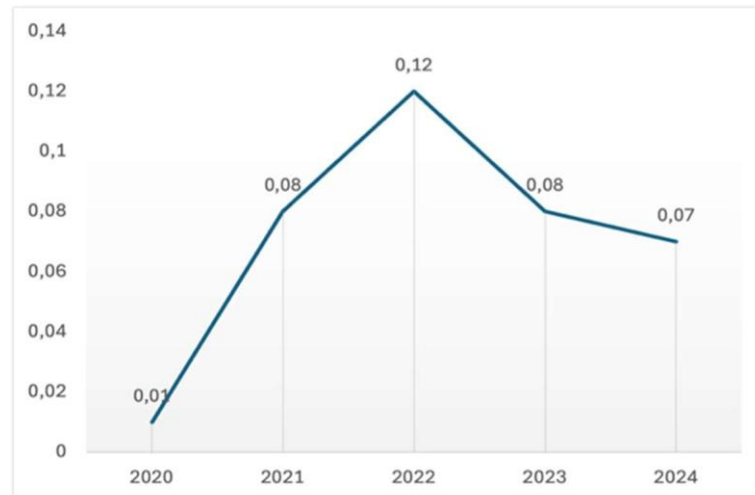


Figure 1. Average Financial Performance (ROA) of Companies in the Energy Sector, 2020–2024
Source(s): Data compiled by the author (2025)

As shown in Figure 1, the average ROA of companies in the energy sector fluctuated throughout the 2020–2024 period. This ratio stood at 0.01 in 2020, rose to 0.08 in 2021, and peaked at 0.12 in 2022. After that, ROA declined consecutively to 0.08 in 2023 and 0.07 in 2024. Pramesti & Yulianti (2025) believes that the use of green finance instruments requires optimal strategic governance so that they can significantly improve a company's profitability and financial performance. Meanwhile, the implementation of green innovation requires substantial investment, technology, and adaptation processes, so its benefits are not always immediately apparent in the short term (Waworuntu & Pratiwi, 2025).

Three dimensions of green strategy are in the spotlight in this context. Green finance which focuses on energy efficiency and environmental management has been shown to improve financial performance in a number of studies Li & Lin (2024), although it could potentially become a short-term burden if implementation costs are not effectively controlled Waworuntu & Pratiwi (2025). Green investment that is, the allocation of funds to environmentally friendly projects also has the potential to trigger a positive market response Rosyid & Mulatsih (2024). However, the financial benefits are often not immediate due to the high capital costs in the early stages Novia & Candy (2023). Meanwhile, green innovation has shown the most inconsistent results among the three: some studies report a positive impact on operational efficiency Tuti et al. (2025). Meanwhile, other studies have found that green innovation may actually risk reducing financial performance if companies fail to utilize it effectively (Intari & Khusnah, 2023).

Inconsistent findings across various previous studies indicate a research gap regarding the extent to which green finance, green investment, and green innovation influence financial performance. Wati & Latifah (2024) found that environmental variables and green innovation do not always have a partial effect, but can have an effect when tested simultaneously. Kamaluddin et al. (2025) states that sustainability strategies can improve corporate financial performance when implemented in an integrated manner. Based on this background, this study aims to analyze the impact of green finance, green investment, and green innovation on financial performance with firm age as a control variable among energy sector companies listed on the Indonesia Stock Exchange during the 2020–2024 period (Asyifa & Endri, 2025).

Most previous studies have examined green finance, green investment, and green innovation separately, or have combined at most two of these three dimensions in a single model (see, for example, Pramesti & Yulianti (2025), which examined only green finance and environmental performance; or Rosyid & Mulatsih (2024), which focuses on green investment). Therefore, it remains empirically unknown whether these three dimensions of green strategy reinforce or, conversely, weaken each other's impact on financial performance when tested together in a single model particularly in the energy sector, which faces the highest environmental risk exposure and regulatory pressure compared to other sectors. This study fills that gap by incorporating all three dimensions simultaneously into a single testing

framework, thereby identifying patterns not captured by previous partial studies namely, differences in significance between partial and simultaneous tests.

This study contributes to two aspects. First, theoretically, this study enriches the literature on stakeholder theory, signaling theory, and legitimacy theory by demonstrating that these three theories can adequately explain financial performance only when green strategies are viewed as a unified policy framework, rather than as standalone initiatives. The finding that green finance is partially significant while green investment and green innovation are not yet all four are significant simultaneously provides new empirical evidence for the debate over whether sustainability strategies should be evaluated individually or as an integrated policy portfolio. Second, from a practical perspective, the results of this study are expected to serve as a consideration for management in the energy sector when determining the priorities of sustainability strategies that yield the most responsive financial impact, as well as a basis for investors in assessing the credibility of companies' green initiatives.

2. Literature Review and Hypotheses Development

Theoretical Framework: Stakeholder theory, signaling theory, and legitimacy theory underpin the relationship between sustainability strategies and a company's financial performance. Asyifa & Endri (2025) explained that companies need to conduct business with a focus on sustainability to meet the interests of their stakeholders. From the perspective of signaling theory, green finance, green investment, and green innovation have the potential to serve as positive signals to investors regarding the company's future prospects and its long-term commitment to sustainability. Meanwhile, legitimacy theory explains that green practices can help companies gain social acceptance because their business activities are perceived as being more in line with societal values and expectations (Yulianti & Ramli, 2025).

The three theories underlying this study actually predict different rates of impact for each dimension of green strategy, and these differences form the basis for the argument that partial and simultaneous results may differ. From the perspective of signaling theory, a signal will influence market assessments more quickly if the cost of disclosure is relatively low and the information is easily verifiable—conditions that are better suited to green finance, which is generally disclosed in annual reports without requiring major structural changes to a company's operations. Conversely, green investment and green innovation involve substantial capital expenditures and changes in production processes; thus, their financial benefits align more closely with the framework of legitimacy theory—that is, benefits in the form of social acceptance and mitigation of reputational risk that accumulate gradually, rather than instantly Yulianti & Ramli (2025). In other words, the lack of partial significance in this study does not necessarily indicate that green investment and green innovation are ineffective, but rather that the five-year time frame (2020–2024) used in this study may not have been long enough to capture the financial benefits of these two instruments, as was also found by Novia & Candy (2023) dan (Intari & Khusnah, 2023).

Hypothesis Development

H1: Green finance has a positive impact on financial performance (Waworuntu & Pratiwi, 2025).

Green finance refers to financing directed toward environmentally friendly activities and sustainable development. Pramesti & Yulianti (2025) pointed out that green finance can improve financial performance by encouraging companies to direct funding toward activities that support efficiency and sustainability. Li & Lin (2024) confirmed that the allocation of green finance has a positive impact on financial performance because these instruments effectively reinforce investors' expectations regarding the company's future prospects.

H2: Green investment has a positive impact on financial performance (Novia & Candy, 2023).

Green investment is a form of corporate investment in projects that provide environmental benefits and support sustainability. Rahmawati & Hartoko (2025) stated that green investment can improve a company's performance because environmental investments enhance efficiency and reduce ecological risks. Rosyid & Mulatsih (2024) explained that the market may respond positively to information about green investments because it reflects a company's commitment to sustainability.

H3: Green innovation has a positive impact on financial performance (Intari & Khusnah, 2023).

Green innovation refers to innovation aimed at creating products, improving operational management, and updating technological systems in a way that is consistent with the principles of environmental sustainability. Tuti et al. (2025) explained that green innovation has the potential to improve financial

performance if management is able to transform that innovation into optimal operational efficiency. Sukmawati & Effendy (2024) added that green innovation can boost competitiveness because companies become more adaptable to market demands and regulations.

H4: Green finance, green investment, green innovation, and company age simultaneously influence financial performance (Dewi & Arif Noviarkahman Zagladi, 2025).

Company age is used as a control variable because it reflects a company's experience, stability, and ability to cope with business dynamics. Kusnarti & Iswara (2025) emphasized that companies with a longer operational history generally have a more established track record and more mature managerial capabilities. Natalia & Jusuf (2024) added that a company's age is one of the internal attributes that is directly correlated with its financial performance.

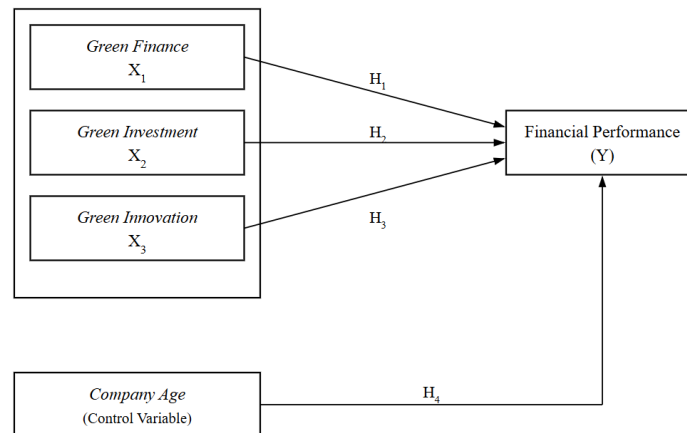


Figure 2. Conceptual Framework of the Study

Source(s): Adapted by the author (2025)

3. Research Method

This study employs a quantitative approach using an explanatory research design. Waruwu et al. (2025) explains that the relationships and correlations among variables in quantitative research are tested through numerical measurements and quantifiable statistical tests. The study population comprises all energy sector companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2024 period. The sample was determined using purposive sampling with the following criteria: (1) listed on the IDX no later than 2020; (2) published annual reports and sustainability reports regularly and continuously throughout the observation period; (3) had PROPER assessment results; and (4) provided complete data on all variables under study. Based on these criteria, a final sample of 19 companies with a total of 95 observations was obtained (Hossan et al., 2023), as summarized in Table 1.

Table 1. Sample Selection Criteria

Criteria	Total
Energy sector companies listed on the IDX	91
Companies that were not yet listed by 2020 at the latest	(25)
Companies that did not submit complete reports and variable data	(47)
Research sample size	19
Total observations for 2020–2024	95

Source(s): Data compiled by the author (2025)

This study uses secondary data collected from annual reports, sustainability reports, and financial statements accessed through the official portal of the Indonesia Stock Exchange and the official websites of the respective issuers. Martins et al. (2018) states that secondary data consists of information that has been previously published and can be reprocessed to address the research question. In this analytical model, financial performance proxied by ROA serves as the dependent variable, while

green finance, green investment, and green innovation serve as independent variables, with firm age as a control variable. The operational definitions of the variables are presented in Table 2.

Table 2. Operational Definitions of Variables

Variables	Indicators	Scale
Financial Performance (Y)	ROA = net income / total assets $\times$ 100%	Ratio
Green Finance (X1)	1 = discloses green finance; 0 = does not disclose	Nominal
Green Investment (X2)	PROPER Rating: gold = 5, green = 4, blue = 3, red = 2, black = 1	Ordinal
Green Innovation (X3)	1 = discloses green innovation; 0 = does not disclose	Nominal
Company Age (AGE)	Year of study – year of IPO	Ratio

Source: Pramesti & Yulianti (2025), adapted by the author

The data were analyzed using panel data regression techniques with the help of EViews 12 software. Asyifa & Endri (2025) explains that panel data modeling integrates the characteristics of time-series and cross-sectional data, thereby capturing variations across time periods as well as across firms. The analysis begins with descriptive statistics, followed by the estimation of three models—the Common Effects Model (CEM), the Fixed Effects Model (FEM), and the Random Effects Model (REM)—which are then selected using the Chow test, the Hausman test, and the Lagrange Multiplier test to determine the best model. The final stage involves hypothesis testing using the (partial) t-test, the (simultaneous) F-test, and the coefficient of determination analysis by Rosyid & Mulatsih (2024). The regression model used is formulated as follows:

$$ROA = \alpha + \beta_1 GF + \beta_2 GI + \beta_3 GIN + \beta_4 AGE + \varepsilon$$

Notes: ROA = financial performance; GF = green finance; GI = green investment; GIN = green innovation; AGE = firm age; α = constant; β = regression coefficient; ε = error term. In the EViews 12 output tables (Tables 3, 6, and 9), these three independent variables are displayed in order using the software's standard notation: X1 = green finance (GF), X2 = green investment (GI), and X3 = green innovation (GIN).

4. Result and Discussion

Descriptive Statistics

Table 3. Descriptive Statistics Results

	Y	X1	X2	X3	AGE
Mean	0,073053	0,568000	3,842105	0,608000	17,95789
Median	0,050000	0,600000	4,000000	0,670000	16,00000
Maximum	0,450000	0,900000	5,000000	0,830000	34,00000
Minimum	-0,100000	0,300000	2,000000	0,080000	3,000000
Std. Dev.	0,087203	0,131453	0,719275	0,146154	7,629612
Skewness	1,251509	0,155294	0,069262	-0,663461	0,466031
Kurtosis	5,893371	2,655298	2,297183	3,408813	2,385007
Jarque-Bera	57,93690	0,852166	2,031180	7,631064	4,935875
Probability	0,000000	0,653062	0,362189	0,022026	0,084759
Sum	6,940000	53,96000	365,0000	57,76000	1706,000
Sum Sq. Dev.	0,714815	1,624320	48,63158	2,007920	5471,832
Observations	95	95	95	95	95

Source: Output EViews 12

Based on Table 3, the average ROA of 0.073053 indicates that the energy sector companies included in the study generally posted positive financial performance, although there were still some companies with negative profits (as indicated by the minimum value of -0.100000). Maharani & Ekdajaja (2023) explains that financial performance reflects a company's ability to generate profits and optimize the use of its assets. The average green finance score of 0.568000 and the average green innovation score of 0.608000 indicate that the level of sustainability disclosure among companies in the

energy sector remains in the “moderate” category. Meanwhile, the average value for green investment of 3.842105—which is close to the “green” category on the PROPER rating scale—indicates that the majority of companies have implemented relatively adequate environmental governance practices (Rahmawati & Hartoko, 2025).

Panel Data Regression Model Selection

Table 4. Testing Results for Model Selection

Testing	Probability Value	Decision
Chow Test	0,0000	FEM
Hausman Test	0,1518	REM
Lagrange Multiplier Test	0,0000	REM
Selected Model	—	Random Effect Model (REM)

Sumber: Output EViews 12

Based on the Chow test, the Hausman test, and the Lagrange Multiplier test, the estimation model selected for this study is the Random Effects Model (REM). Rosyid & Mulatsih (2024) explains that selecting the appropriate model in panel data regression is absolutely necessary to ensure that the resulting estimates are consistent with the characteristics of the data distribution. The REM model was chosen because it better explains the variation across firms and across periods compared to other models; therefore, all subsequent hypothesis tests are based on this model (Asyifa & Endri, 2025).

Test of Classical Assumptions

Table 5. Normality Test Results

Jarque-Bera	Probability	Description
0,411507	0,814034	Normal

Source: Output EViews 12

The results of the normality test show a Jarque-Bera value of 0.411507 with a probability of 0.814034. Since this probability value exceeds the threshold of 0.05, the model residuals are considered to be normally distributed. Ghazali (2018) emphasizes that the normality assumption must be met to ensure that the regression model’s residuals are normally distributed, so that the model can be used in the next stage of analysis.

Table 6. Multicollinearity Test Results

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0,002547	37,26866	NA
X1	0,006932	34,45771	1,734245
X2	0,000183	40,00329	1,374262
X3	0,006073	34,70689	1,880339
AGE	1,26E-06	7,006765	1,061810

Source: Output EViews 12

The results of the multicollinearity test show that the VIF values for all variables are below 10 (the highest Centered VIF value is 1.88 for variable X3), indicating that there is no strong correlation among the independent variables. Ghazali (2018) explains that the absence of multicollinearity is an important prerequisite for ensuring that estimates of the effects of each predictor on the dependent variable are unbiased; therefore, the variables green finance, green investment, green innovation, and firm age are appropriate for use together in a single model (Rosyid & Mulatsih, 2024).

Table 7. Heteroscedasticity Test Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,053492	0,032291	1,656557	0,1011
X1	-0,006044	0,053272	-0,113458	0,9099
X2	0,007942	0,008667	0,916381	0,3619
X3	0,004806	0,049860	0,096397	0,9234

AGE	-0,001350	0,000718	-1,880235	0,0633
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Source: Output EViews 12

The results of the heteroscedasticity test show that the p-values for all variables are above 0.05; therefore, the model is deemed free of heteroscedasticity. Dea Larasati & Betharia (2024) explains that the homogeneity of residual variances is important for ensuring the reliability and objectivity of the estimation results, making this model suitable for use in hypothesis testing (Ghozali, 2018).

Tabel 8. Autocorrelation Test Results

Description	Value
Durbin-Watson stat	2,079475

Source: Output EViews 12

The estimation results show a Durbin-Watson value of 2.079475, which is close to the theoretical value of 2, confirming that there is no autocorrelation among the residuals. Ghozali (2018) explains that an autocorrelation test is necessary to ensure there is no correlation between the current period's residuals and those of the previous period. Since all classical assumption tests have been met, this regression model is deemed suitable for testing the research hypotheses (Pramesti & Yulianti, 2025).

Multiple Linear Regression Equations and Hypothesis Testing

Based on the estimates from the Random Effects Model, the following regression equations were obtained:

$$\text{ROA} = -0,034407 + 0,148989\text{GF} + 0,013638\text{GI} + 0,033026\text{GIN} - 0,002764\text{AGE} + \varepsilon$$

The coefficients for green finance, green investment, and green innovation indicate a positive relationship with financial performance, while firm age indicates a negative relationship. Pramesti & Yulianti (2025) explains that the regression coefficient describes the direction of the predictor's effect on the dependent variable; however, conclusions regarding hypotheses still depend on the significance values of each variable, so partial testing is conducted using the t-test (Rosyid & Mulatsih, 2024).

Table 9. Results of the t-Test (Partial)

Variables	Coefficient	t-Statistic	Prob.	Desc.
C	-0,034407	-0,665931	0,5072	—
Green Finance (X1)	0,148989	2,061371	0,0422	Sig.
Green Investment (X2)	0,013638	0,844365	0,4007	TS
Green Innovation (X3)	0,033026	0,456665	0,6490	TS
Company Age (AGE)	-0,002764	-1,519724	0,1321	TS

Source: Output EViews 12. Sig. = significant; TS = not significant ($\alpha = 0.05$)

The Effect of Green Finance on Financial Performance. The results of the t-test show that the green finance variable has a p-value of 0.0422 (< 0.05), which means that green finance has a positive and significant effect on financial performance. Thus, H1 is accepted. This finding is consistent with Pramesti & Yulianti (2025) which states that green finance governance contributes to cost efficiency and business sustainability. It also confirms Li & Lin (2024) that green finance schemes can increase profitability by strengthening market confidence. These findings support signaling theory, according to which green finance disclosures send a positive signal to the market regarding a company's long-term commitment to sustainability (Yulianti & Ramli, 2025).

The Effect of Green Investment on Financial Performance. The green investment variable recorded a probability value of 0.4007 (> 0.05), indicating that green investment does not have a significant effect on financial performance. Thus, H2 is rejected. This finding differs from the theoretical argument Rahmawati & Hartoko (2025) which states that environmentally-based spending can boost profitability, but in line with Novia & Candy (2023) which explains that green investments often do not yield immediate results due to high capital costs in the early stages. The energy sector companies in this study appear not to have reaped direct financial benefits from green investments (Rosyid & Mulatsih, 2024).

The Effect of Green Innovation on Financial Performance. The green innovation variable yielded a probability value of 0.6490 (> 0.05), indicating that there is no significant effect on financial performance. Therefore, H3 is rejected. Tuti et al. (2025) explains that environmentally friendly innovations can increase profits if they are able to generate concrete operational cost efficiencies. The results of this study reinforce the findings Intari & Khusnah (2023) that green innovations risk failing to improve profitability if their utilization is not yet optimal, given that the high costs of research, technology adoption, and the period of structural adjustment hinder short-term financial benefits (Sumayyah et al., 2025).

The Effect of Firm Age on Financial Performance. The firm age variable has a p-value of 0.1321 (> 0.05), indicating that the length of a firm's operations does not have a significant effect on financial performance. Although Kusumowati & Tere (2025) While it is often argued that a company's age reflects its experience and business stability, the results of this study indicate that the length of time a company has been in operation does not necessarily guarantee increased profitability. Financial performance is largely determined by the effectiveness of strategy, the efficiency of asset management, and the company's ability to adapt to industry changes (Natalia & Jusuf, 2024).

Simultaneous Test and Coefficient of Determination

Table 10. F-Test Results and Coefficient of Determination

Description	Value
R-squared	0,151796
Adjusted R-squared	0,114098
F-statistic	4,026637
Prob(F-statistic)	0,004746

Source: Output EViews 12

The Prob(F-statistic) value of 0.004746 (< 0.05) indicates that green finance, green investment, green innovation, and firm age simultaneously have a significant effect on financial performance. Thus, H4 is accepted. This finding is consistent with Wati & Latifah (2024) which explains that environmental variables and green innovation can influence financial performance when tested together, and Kamaluddin et al. (2025) which confirms that an integrated sustainability strategy can improve corporate financial performance. These results indicate that the financial performance of companies in the energy sector is not determined by a single variable, but rather by a simultaneous combination of environmentally friendly policies and the company's internal attributes (Asyifa & Endri, 2025).

The adjusted R-squared value of 0.114098 indicates that the independent variables in the model account for 11.41% of the variation in financial performance, while the remaining 88.59% is explained by other factors outside the model. Dea Larasati & Betharia (2024) explains that financial performance is also influenced by capital structure, liquidity, company size, operational efficiency, and macroeconomic conditions. In the energy sector specifically, fluctuations in global commodity prices, regulatory interventions, leverage levels, and market volatility are key determinants that need to be considered in future research in order to develop a more comprehensive model (Maharani et al., 2025).

Limitations of the Study

This study should be interpreted with three main limitations in mind. First, the adjusted R-squared value of 11.41% is relatively low, even though the model remains statistically significant (F-statistic probability 0.004746); therefore, this model is best understood as a test of whether green strategies influence financial performance, rather than as a comprehensive predictive model; the financial performance of companies in the energy sector is also influenced by exogenous factors such as global commodity prices and national energy policies, which are not accounted for in this model Dea Larasati & Betharia (2024). Second, the measurement of green finance and green innovation uses dummy variables (1 = disclosed, 0 = not disclosed), which capture the presence or absence of disclosure but do not capture the intensity or quality of its implementation; therefore, the non-significant results

for green innovation should be interpreted with consideration of this instrument's limitations, rather than solely as evidence of the absence of a substantive effect. Third, the five-year observation period (2020–2024) overlaps with the post-pandemic economic recovery, which may increase the volatility of financial performance and obscure the structural, long-term effects of green strategies; therefore, the generalizability of these findings should be limited to the context of energy sector companies listed on the IDX during the same observation period.

5. Conclusion

This study found that green finance has a positive and significant impact on the financial performance of energy sector companies listed on the Indonesia Stock Exchange during the 2020–2024 period. These findings confirm that effective disclosure and implementation of green finance can serve as a strategic pillar for energy companies to maintain both profitability and long-term business sustainability. (Li & Lin, 2024).

Conversely, green investment, green innovation, and firm age were not found to have a significant impact on financial performance. This is consistent with the characteristics of these two variables, which require substantial upfront costs and only yield financial benefits in the long term. Intari & Khusnah (2023). Meanwhile, a company's age does not always determine its profitability, as financial performance is influenced more by the effectiveness of its strategies and the efficiency of its asset management (Natalia & Jusuf, 2024).

Nevertheless, the four variables green finance, green investment, green innovation, and firm age were found to have a significant impact on financial performance when tested simultaneously. These findings confirm that the benefits of sustainability strategies are cumulative and complementary Wati & Latifah (2024). Therefore, companies in the energy sector need to manage their green strategies in an integrated manner so that they are not merely a form of formal compliance, but also have a tangible impact on improving financial performance.

Acknowledgement

For companies in the energy sector, it is recommended to enhance the implementation and disclosure of green finance, as it has been shown to have a positive and significant impact on financial performance. Companies also need to evaluate the effectiveness of green investment and green innovation so that their benefits are more evident in operational efficiency and long-term profitability. For investors, green strategies can be one factor to consider in investment decisions, but they should be assessed based on the effectiveness of their implementation, not solely on the level of disclosure.

For future research, it is recommended to integrate additional determinants such as company size, leverage, liquidity, capital structure, operational efficiency, environmental performance, good corporate governance (GCG), and fluctuations in energy commodity prices, given that corporate profitability is dynamic and influenced by various internal and external factors. Dea Larasati & Betharia (2024). Future research could also expand the scope of the analysis to other industrial sectors or use alternative financial performance proxies, such as ROE, NPM, or Tobin's Q, to draw more comprehensive conclusions regarding the impact of sustainability strategies on financial performance U. J. Maharani et al. (2025). In light of the limitations of the measurement instruments described earlier, future research is also advised to use more granular measures of green finance and green innovation—such as disclosure intensity scores or composite indices—rather than binary dummy variables, in order to more accurately capture variations in the quality of implementation across firms. Extending the observation period beyond the post-pandemic recovery phase is also recommended to test whether the patterns of partial significance found in this study are temporary or structural.

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