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*CORRESPONDENCE
Alwani,
alwani_22p125@mn.unjani.ac.id

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Determinants of Financial Performance in Indonesia's Renewable Energy Sector: The Interplay of Green Financing, Capital Expenditure, and Leverage

Alwani[1*], Rosmini Ramli[2]

[12] Universitas Jenderal Achmad Yani, Jawa Barat, Indonesia

Abstract

This research investigates how green bonds, green investment, capital expenditure, and leverage influence the financial performance of renewable energy firms listed on the Indonesia Stock Exchange between 2022 and 2024. The study is driven by the escalating challenge of global climate change, where the energy sector remains the largest source of greenhouse gas emissions. This situation has accelerated the transition toward renewable energy, accompanied by a consistent decline in return on assets among renewable energy companies. The novelty of this work lies in its simultaneous examination of four financial and sustainability variables within a single empirical framework applied to Indonesia's renewable energy industry. The sample comprises 21 renewable energy firms selected through purposive sampling based on continuous listing status, availability of complete financial data, and sustainability disclosure during the observation period, observed over a three-year period. A quantitative method was employed, with panel data regression analysis conducted using EViews 13. The results of partial testing reveal that both green bonds and leverage exert a negative impact on financial performance, while green investment and capital expenditure show no significant effect. These findings underscore the short-term financial considerations associated with green financing and capital structure decisions during the energy transition, and offer empirical insights into the short-term financial implications of green financing and capital structure decisions in Indonesia's renewable energy sector.

KEYWORDS
green finance; green bond; green investment; capital expenditure; leverage; financial performance.

Introduction

Climate change is becoming an increasingly urgent global issue as carbon dioxide (CO_2) emissions rise and global average temperatures increase. Global CO_2 emissions in 2024 are projected to reach 41.6 gigatons, while global temperature anomalies have reached 1.54°C above pre-industrial averages (Hausfather & Friedlingstein, 2024; World Meteorological Organization, 2024). According to data from Our World in Data, the energy sector accounts for approximately 73.2% of total global greenhouse gas emissions, making it the largest contributor to climate change (tanahair.net, 2024). This increase in temperature has led to various climate disasters, such as heatwaves, droughts, and extreme rainfall, in multiple regions, including Indonesia. These conditions underscore the importance of accelerating the transition to cleaner, low-carbon energy to mitigate climate change. (See Figure 1).

At the national level, Indonesia faces a significant challenge in achieving its target of a 23% renewable energy mix by 2025. Data from the Kementerian Energi dan Sumber Daya Mineral, (2021) indicate that the national energy mix remains dominated by coal, oil, and natural gas, with renewable energy contributing only 13.29%. This heavy reliance on fossil fuels underscores the need to accelerate investment, strengthen infrastructure, and bolster the role of renewable energy companies, which are entities engaged in the production of clean energy sources such as solar, wind, hydropower, bioenergy, and geothermal energy, in ensuring a stable and sustainable energy supply. With national energy demand continuing to rise, these companies must enhance their operational efficiency, funding structures, and competitiveness to support the energy transition.

In the context of renewable energy development, a company's ability to maintain asset efficiency and achieve profitability is an essential benchmark for investors and regulators in assessing the business's viability and sustainability. ROA reflects how effectively a company utilizes its assets to generate profits and also illustrates operational efficiency, investment management quality, and the accuracy of its funding strategies (Arwani et al., 2024). In the renewable energy industry, which is characterized by high capital requirements and significant operational risks, ROA is a critical evaluation tool for investors and regulators to assess the financial health of companies and the sustainability potential of their businesses. (See Figure 2).

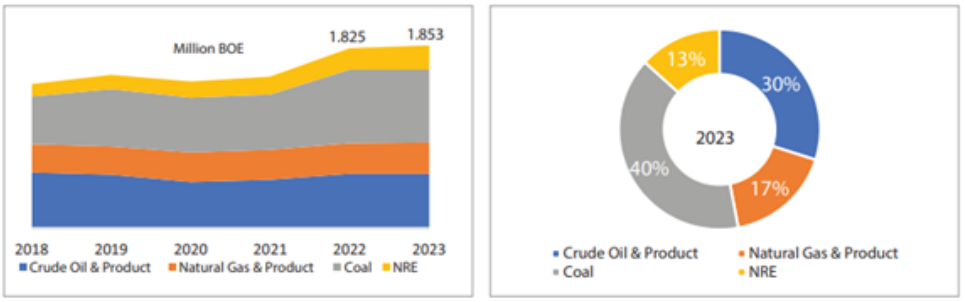

Figure 1. Energy Use in Indonesia
Source: Ministry of Energy and Mineral Resources of the Republic of Indonesia

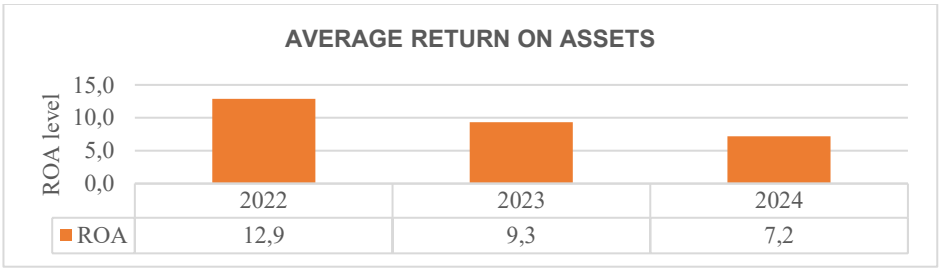

Figure 2. Average ROA of Renewable Energy Companies
Source: IDX (Data processed by author, 2025)

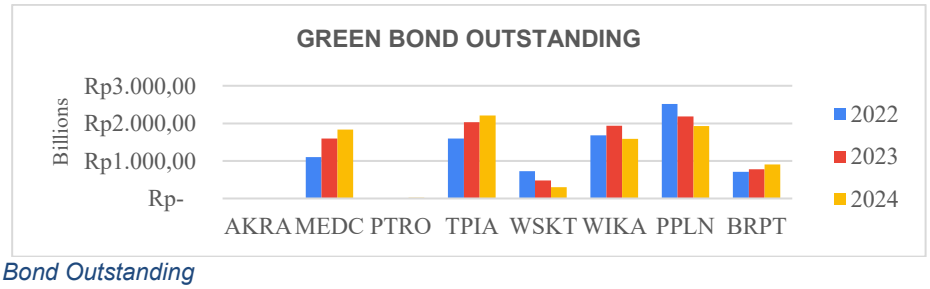

Figure 3. Green Bond Outstanding
Source: IDX (Data processed by author, 2025)

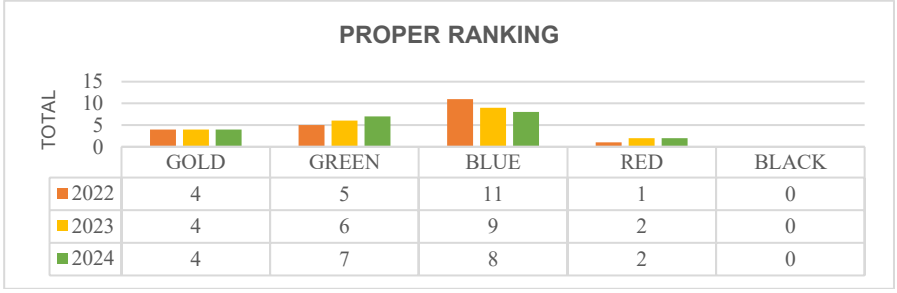

Figure 4. PROPER Ranking of Renewable Energy Companies
Source: Ministry of Environment and Forestry (Data processed by author, 2025)

The return on assets (ROA) of renewable energy companies has experienced a substantial overall decline of 5.67% over the observation period, based on population-level data for renewable energy firms. This pattern indicates increasing financial pressure during the energy transition; however, existing empirical studies in Indonesia largely examine green financing instruments, capital expenditure, or leverage in isolation, providing limited insight into how these factors interact in shaping firm profitability. Consequently, the financial mechanisms underlying the observed deterioration in asset performance remain insufficiently explained, thereby motivating a more integrated empirical investigation into the combined role of sustainability-oriented financing and conventional financial decisions in Indonesia's renewable energy sector.

Sustainable finance is becoming an important consideration due to the growing focus on the financial performance of renewable energy firms in relation to the energy transition. Here, "green finance" is a framework for allocating capital toward sustainable, long-term projects (Rajeshkumar & others, 2021). Businesses may deepen their sustainability efforts and obtain access to capital for renewable energy development via green financing. Therefore, in this study, green finance is represented through green bonds and green investments as two main instruments that reflect the funding strategies and environmentally friendly investment allocations of renewable energy companies.

More and more renewable energy firms are turning to green bonds as a means to finance their long-term projects. An increasingly important component of business sustainability strategy, this sustainable finance tool backs eco-friendly initiatives like energy efficiency upgrades, renewable energy development, and emissions reduction. (See Figure 3).

Data shows that outstanding green bonds in Indonesia have continued to increase in recent years. This trend reflects growing investor interest in ESG-based instruments and companies' commitment to financing clean energy projects and other environmental initiatives. Green bonds may boost operational efficiency and business financial performance, according to Siagian et al. (2023), Yuan, (2024), Chatterji, (2024) and Zhou & Cui, (2019), therefore this rise makes sense. The effectiveness of green bonds is greatly influenced by the funding structure and market conditions; however, other studies have shown that they do not always have a significant impact (Hong et al., 2022; Pratami & Yunita, 2025; Yeow & Ng, 2021). This is likely due to factors like high issuance costs or an immature market.

In addition, green investment is also an essential component in strengthening company performance and sustainability. Green investment is understood as a company's effort to allocate resources to improve environmental performance, reduce ecological impacts, and meet and exceed applicable regulatory standards (Huang & Lei, 2021). Han & Yang (2024) also emphasize that renewable energy companies require substantial investments to improve infrastructure and technology, underscoring the importance of green investment in strengthening long-term competitiveness. (See Figure 4).

PROPER ranking data show an increase in the number of renewable energy companies receiving green and gold ratings throughout 2022-2024, indicating the strengthening of green investment implementation through improved energy efficiency, reduced emissions, and better waste management. This condition aligns with the findings of Indriastuti & Chariri, (2021), Lin et al. (2025), and Saenggo & Widoretno, (2024), which indicate that green investment can improve operational efficiency and company reputation, thereby positively impacting financial performance. However, research by Puspitasari & Widoretno (2025) suggests that the economic impact of green investment tends to materialize more slowly, yielding long-term benefits.

Capital spending, with environmental investment and finance, is critical to increasing the ability to produce sustainable energy. New power plants, more efficient technology, and accompanying infrastructure can only be developed with the help of capital expenditures in the renewable energy industry (Han & Yang, 2024). Companies involved in renewable energy face rising capital expenditure needs as the need for expanding clean energy capacity rises (Han & Yang, 2024). The findings of studies like Lanskyaris et al. (2024), Mahendra & Susilowati (2022), and Maulana et al. (2020) indicating capital spending improves financial performance provide credence to this idea. When new assets do not yet provide optimum cash flow, however, advantages are delayed (Lidayat & Adrianto, 2020).

A company's finance structure isn't complete without leverage. While taking on debt may boost a company's investment capacity and return potential, it also comes with more risk in times of high interest rates or unpredictable market circumstances (Istiak & Serletis, 2020). According to Al-Silefanee, (2024), businesses that rely on debt financing are more susceptible to changes in government policies and market volatility. Varieties of research findings: Leverage improves financial performance, according to Fibriyanti (2022) and Mahendra & Susilowati (2022).

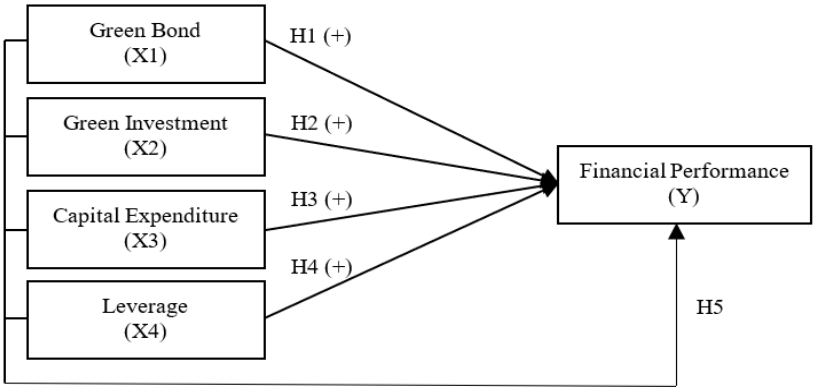

Figure 5. Conceptual Model

while high interest rates have the opposite effect, according to D. H. Hasibuan & Tinambunan, (2024) and Hasti et al. (2022). A company's risk profile and capital structure greatly affect leverage, as shown Lanskyaris et al. (2024) and Lutfiana & Hermanto, (2021), who both found an inconsequential effect.

Despite the growing body of literature on green finance in Indonesia, existing empirical studies largely examine sustainability-oriented financing instruments, capital expenditure, and leverage separately, offering limited insight into how these financial dimensions jointly shape firm performance in the renewable energy sector. This limitation is particularly consequential given the sector's capital-intensive nature and the short-term financial pressures reflected in the observed decline in return on assets. Addressing this gap, the present study empirically investigates the joint effects of green bonds, green investment, capital expenditure, and leverage on the financial performance of renewable energy firms listed on the Indonesia Stock Exchange. By integrating sustainability-related financing and conventional financial decisions within a single analytical framework, this study provides contextual empirical evidence relevant to Indonesia's ongoing energy transition.

Sustainability Theory

It was the Brundtland Report (1987) that first proposed the idea of sustainable development, which is where Sustainability Theory gets its start. It stresses the need of conducting economic operations in a manner that does not jeopardize future generations' capacity to fulfill their own needs. This idea emphasizes the significance of balancing economic, social, and environmental aspects within the setting of corporations to guarantee their long-term existence. Green finance instruments and ecologically responsible investments are examples of sustainability methods that companies may use to show their dedication to sustainable practices. Sustainable measures that boost operational efficiency, reputation, and environmental results may have a positive effect on financial success, according to (Elkington, 1997).

Stakeholder Theory

Freeman first proposed Stakeholder Theory in 1984. According to it, businesses have a duty to care for everyone who has a stake in how they run their business, including workers, residents, regulators, customers, and investors. The capacity of management to satisfy the expectations of stakeholders is a key factor in a company's performance, according to this thesis (Freeman, 1984). Issuers of green bonds and investors in green projects often seek to appease environmental-related stakeholder concerns (Flammer, 2021). In this way, a company's efforts to satisfy its stakeholders' expectations may lead to better financial results in the long run by gaining their confidence and support.

Legitimacy Theory

Companies try to gain social legitimacy by conforming their actions to accepted societal norms and values, according to Dowling and Pfeffer's 1975 Legitimacy Theory. Organizations, according to this view, will do what society deems "appropriate" if they want to keep running (Dowling & Pfeffer, 1975). An attempt to obtain public legitimacy may be observed in the issue of green bonds, the creation of sustainability reports, and the acquisition of PROPER ratings by renewable energy businesses. Organizations may boost their reputations and operational stability, which in turn improves their financial performance, with higher legitimacy.

Growth of Firm Theory

The Growth of the Firm Theory was proposed by Penrose (1959), explaining that firm growth is influenced by internal capabilities for utilizing resources, innovation, and market opportunities. This theory states that company expansion is typically characterized by increases in assets, investment, and capital expenditure (Penrose, 1959). In this study, this theory is relevant because capital expenditure reflects a company's growth strategy through capacity expansion and investment projects. The company's competitiveness and financial performance in the long run are anticipated to be enhanced by increasing capital expenditure.

Trade-Off Theory

According to Kraus and Litzenberger's (1973) Trade-Off Theory, businesses should optimize their capital structure by weighing the tax benefits of debt against the costs of financial crisis that they anticipate. The use of debt provides tax savings but also poses the risk of bankruptcy if used excessively (Kraus & Litzenberger, 1973). In the context of research, leverage reflects the extent to which companies use debt as a source of funding. This theory suggests that if the leverage ratio is at the optimal level, financial performance can improve. However, excessive leverage actually suppresses performance due to increased financial costs.

Financial Performance

A company's financial performance is an indicator of how well it uses its resources to make money. A popular metric for evaluating a company's financial health is its return on assets (ROA), which measures the efficiency with which a business generates profits in relation to the value of its total assets (Brigham & Houston, 2021). According to Afriani & Susyani, (2024) return on assets (ROA) is a key metric for investors to consider when evaluating a company's financial health and operational effectiveness. In order to determine how green bonds, green investments, capital expenditures, and leverage affect the bottom line of corporations, this research uses return on assets (ROA) as its dependent variable. ROA is measured as net income divided by total assets, using data obtained from audited annual financial statements.

Green Finance

The term "green finance" refers to a system of financing that prioritizes projects that help the environment, reduce carbon emissions, and promote sustainable development, with a focus on renewable energy (Yang, 2023). Selvakumar & Manjunath, (2025) state that the financial system may play a role in green finance by providing sources and mobilizing funds to encourage enterprises to include environmental issues in their financial decision-making and business strategy. Green financing plays a significant role in the renewable energy industry by helping to meet the rising expense of meeting the rising demand for sustainability and the advancement of low-carbon technology. Here, green bonds and investments stand in for environmentally friendly financing.

Renewable energy, energy efficiency, and waste management are some of the ecologically friendly efforts that may be funded by green bonds, which are debt-based financial instruments issued by organizations or businesses (Ullah & others, 2025). A company's stance on sustainability and ethical business practices may be

inferred from the issuing of green bonds, according to Ye & Dela, (2023). Nevertheless, there may be extra expenses that affect short-term financial performance due to compliance and verification charges. According to this research, renewable energy firms' bottom lines might be affected by green bonds, a measure of green finance. In this study, green bonds are measured using a dummy variable, where a value of 1 indicates that a firm issued green bonds during the observation period, and 0 otherwise.

Investing in ways that help the environment, such as making buildings more energy efficient, reducing emissions, and better managing trash, is known as "green investment" (Paramita & Ali, 2023). The PROPER grading system, which is overseen by the Ministry of Environment and Forestry, is often used to operationalize green investment in the Indonesian environment. The PROPER rating captures a firm's level of compliance with environmental regulations as well as the effectiveness of its environmental management initiatives (Yulianti & Ramli, 2025). An increase in green investment is expected to enhance corporate reputation and legitimacy, which in turn may contribute to improved financial performance. In this study, green investment is measured using the PROPER rating, coded numerically as Black = 1, Red = 2, Blue = 3, Green = 4, and Gold = 5, and treated as a numerical proxy to capture relative differences in environmental investment intensity.

Capital Expenditure

Capital expenditure (CAPEX) is spending used to acquire or improve long-term fixed assets such as equipment, facilities, or technology (Ona Delang & Rotua Sitorus, 2024). Particularly in the renewable energy industry, where substantial expenditures are necessary for project development, CAPEX is a crucial metric for a company's expansion plan. Typically, capital expenditure increases are made to improve efficiency or increase production capacity, with the hope of better financial results down the road. In this study, capital expenditure is measured as the natural logarithm of total capital expenditure, as reported in the audited financial statements, to reduce scale differences and potential heteroscedasticity.

Leverage

A company's leverage indicates how much of its capital structure is based on loan financing. F. U. Hasibuan & Ramadhan, (2025) Define the DAR as the ratio of total liabilities to total assets. This ratio is a commonly used indicator of leverage. Higher leverage levels indicate increased reliance on external funding sources, which may elevate financial risk and exert downward pressure on firm performance (Sutrisno, 2017). Nonetheless, when managed effectively, leverage can provide fiscal benefits, such as tax shields, and support greater operational liquidity through enhanced working capital availability. Leverage in this study is measured using the Debt to Asset Ratio (DAR), calculated as total liabilities divided by total assets, based on audited annual financial statements.

The Impact of Green Bonds on Financial Performance

Sending a favorable message to stakeholders about the company's strong environmental orientation, the issuing of green bonds indicates a commitment to finance sustainable initiatives. An improvement in financing efficiency and profitability may be possible as a result of this move, according to Stakeholder Theory, as it may boost investor trust, improve the company's image, and decrease risk and capital costs. The study by Yuan (2024) demonstrates that green bonds have the potential to boost profitability by improving the efficiency of financing. By lowering capital expenditures, green bonds boost financial performance, according to Zhou & Cui (2019). Furthermore, green bonds enhance ROA, particularly in environmentally intensive industries, according to Siagian & others, (2023).

H1: Green Bonds have a positive effect on Financial Performance

The Effect of Green Investment on Financial Performance

Green investment is when a business puts money into environmental management initiatives that help the environment, boost energy efficiency, and make the firm seem good. Based on Legitimacy Theory, companies that invest in sustainability gain stronger social legitimacy, thereby increasing public trust and attracting investor interest. Indriastuti & Chariri (2021) found that green investment positively affects ROA by increasing operational efficiency. Lin et al. (2025) also showed that environmental investment increases profitability by reducing risk and strengthening competitiveness. Research by Fachrozi et al. (2024) and Yulianti & Ramli (2025) supports the notion that green investment strengthens financial performance by improving reputation and access to funding.

H2: Green Investment has a positive effect on Financial Performance

The Effect of Capital Expenditure on Financial Performance

Capital expenditure (capex) is used to finance fixed assets that expand production capacity and improve operational efficiency. Based on Growth of Firm Theory, an increase in capex reflects a company's growth strategy and increases the potential for future revenue growth. Research by Mahendra & Susilowati, (2022) shows that capex has a positive effect on profitability by strengthening the development of productive assets. Lanskyaris et al., (2024) also found that capex can improve financial performance through increased asset utilization. The findings of Abdullah et al., (2022) and Juwita & Hasbi (2024) support that capex supports long-term growth and profitability.

H3: Capital Expenditure affects Financial Performance

The Effect of Leverage on Financial Performance

Leverage reflects the use of debt in a company's capital structure and can increase funding efficiency through tax shield benefits. Based on Trade-Off Theory, optimal debt use can increase net income and strengthen ROA, mainly when borrowed funds are used to finance productive assets that generate returns above the cost of debt. Research by Mahendra & Susilowati (2022) shows that leverage has a positive effect on profitability when managed at a reasonable level. Fibriyanti (2022) and Maulana et al. (2020) also found that leverage can improve financial performance when used productively and within risk limits.

H4: Leverage has a positive effect on Financial Performance

Based on the description provided, the following conceptual model illustrates the relationship between the study's variables. (See Figure 5).

Methods

This study employs a quantitative research design to examine the effects of green bonds, green investment, capital expenditure, and leverage on the financial performance of renewable energy companies. Secondary data were obtained from audited annual financial statements, sustainability reports, annual reports, and PROPER ratings of firms listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period. The sample was selected using purposive sampling based on the following criteria: firms classified as renewable energy companies and continuously listed on the IDX throughout the observation period, availability of complete annual financial statements, and disclosure of sustainability or environmental performance information required for the analysis. Firms with incomplete financial or sustainability data were excluded from the sample. Based on this screening process, 21 renewable energy companies were included in the final dataset. When processing the data, EViews 13 was used, which includes features like descriptive statistics, model selection procedures, regression estimation, testing of classical assumptions, hypothesis testing with t and F statistics, and evaluation of the coefficient of determination to evaluate explanatory power.

Result and Discussion

Descriptive Statistical Analysis

An initial synopsis of the study variables is provided in the descriptive statistics section. In order to make interpretation and evaluation easier, this method is used to reduce the amount of data for each variable. The report includes important statistical indicators such as the median, minimum, and maximum values. The descriptive statistics of the study variables are presented as follows.

The results of descriptive statistical tests, as shown in Table 1, indicate that all research variables exhibit heterogeneous data characteristics, as reflected in relatively large standard deviation values relative to their means. The mean value of green bonds (GB) of 0.32 indicates that approximately 32% of firm-year observations involved green bond issuance during the study period, suggesting that the adoption of this instrument remains limited among renewable energy firms. The average green investment (GI) score of 3.58 reflects moderate to relatively strong environmental performance based on the PROPER rating system. The mean value of capital expenditure.

Table 1. Descriptive Analysis Results

	GB	GI	CAPEX	DAR	ROA
Mean	0.32	3.58	26.47	47.00	13.72
Median	0	3	27.66	48.50	8.23
Maximum	1	5	31.84	90.00	52.05
Minimum	0	2	15.59	2.26	-0.22
Std. Dev	0.47	0.91	3.79	23.73	13.86

Table 2. Results of Regression Model Selection Test for Panel Data

Test	P-Value	Conclusion
Chow	0.0000 < 0.05	FEM
Hausman	0.3004 > 0.05	REM
Lagrange Multiplier	0.0061 < 0.05	REM

Table 3. Multicollinearity Test Results

Variable	Centered VIF
GB	1.327844
GI	1.176271
CAPEX	1.354362
DAR	1.146376

Table 4. Regression Results with Random Effect Model (REM)

Variable	Coefficient	t-Statistic	P-Value	Decision
C	16.99212	1.247002	0.2177	
GB	-10.84178	-2.227673	0.0300	H1 Accepted
GI	-1.579556	-0.623595	0.5355	H0 Accepted
CAPEX	0.544867	1.043341	0.3014	H0 Accepted
DAR	-0.183065	-2.122187	0.0383	H4 Accepted

(CAPEX) of 26.47 indicates notable variation in investment intensity across firms, while the average debt-to-asset ratio (DAR) of 47.00 suggests that nearly half of total assets are financed through liabilities. Meanwhile, the mean return on assets (ROA) of 13.72 reflects moderate profitability across the sample. This condition indicates significant differences among renewable energy companies in their funding structures, investment levels, capital expenditures, and financial performance during the observation period. The heterogeneity of the data reflects variations in business strategies and operational efficiency across companies, thereby supporting the use of panel data regression analysis to capture differences in company characteristics and changes in performance over time.

Selection of Panel Data Regression Model

For the purpose of selecting the best method of estimate, we ran experiments using panel data models. The fixed effect model was better than the common effect model, according to the Chow test, which produced a probability value below 0.05. The random effect model was better, however, since the probability value from the Hausman test was more than 0.05. The Lagrange Multiplier test, which also supported the random effect specification, further supported this finding. In order to handle any problems with heteroscedasticity and autocorrelation, the random effect model was chosen and evaluated using GLS Kroy & Desmiza, (2025). (See Table 2).

Classical Assumption Test

Multicollinearity Test

If there is a high degree of correlation between the regression model's independent variables, the multicollinearity test will reveal it. The Variance Inflation Factor (VIF) is a popular tool for this kind of assessment; if the VIF value is less than 10, it means that the model is robust to multicollinearity. (See Table 3).

The VIF was used to evaluate the presence of multicollinearity. The lack of multicollinearity and the robustness of the regression model were confirmed by all independent variables reporting VIF values below the threshold of 10.

Hypothesis Testing

According to the results of the model selection process, the REM best describes the data in this investigation. The regression equation is as follows: (See Table 4).

ROA = 16.99212 - 10.84178*GB - 1.579556*GI + 0.544867*CAPEX - 0.183065*DAR

Partial Test (T-test)

A p-value of 0.0300 reflects the negative impact of green bond issuance on the financial performance of renewable energy enterprises, according to the partial test findings. This result suggests that green bond use often lowers the efficiency of short-term asset profits for corporations. During the same time, there is no statistically significant relationship between green investment and financial success (p-value = 0.5355), indicating that the environmental investment's financial advantages were not immediately apparent. For the same reason that investments in renewable energy often take some time to pay off in the best possible way, capital expenditures do not significantly impact financial performance (p-value = 0.3014). On the other side, research shows that leverage hurts financial performance (p-value = 0.0383), which means that having a lot of debt may make a business more financially burdened and less efficient at making money.

Simultaneous Test (F-test).

The simultaneous test yields an F-statistic of 2.960115 with a probability value of 0.027551, which is lower than the 0.05 significance level. This result leads to the rejection of the null hypothesis and indicates that green bonds, green investments, capital expenditures, and leverage jointly have a statistically significant association with financial performance. (see Table 5).

Determination Coefficient Test

Adjusted R-squared = 0.117301; this result is derived from the coefficient of determination analysis. The whole variance in financial performance may be explained by green bonds, green investments, capital expenditures, and leverage, which adds up to 11.73%. At the same time, extraneous variables account for the other 88.27% of the variance that was not included in this study. The relatively low explanatory power of the model may be influenced by the absence of firm-specific control variables and the short observation period, and therefore the results should be interpreted with caution. (See Table 6).

The Effect of Green Bonds on Financial Performance.

According to the theory, green bonds may boost a company's bottom line. The study's findings, however, reveal that green bonds have a negative impact on ROA. This finding is contrary to the proposed hypothesis, which expected a positive relationship between green bonds and financial performance. These results show that green bonds may put a temporary financial strain on businesses, even when they are issued to fund eco-friendly initiatives. The increased expenses associated with compliance, verification, and certification for green bonds may contribute to this outcome. A lower return on assets may result from these expenditures cutting down net income. A company's issue of green bonds should be seen as a commitment to sustainability, according to Stakeholder Theory. Investors may conclude that the company's reputational advantages are not yet sufficient to justify the expenses in the near term.

Green bonds may impair profitability owing to high implementation costs, as shown in this research and in Yuan (2024). While green bonds do have a good effect in the long run, financial may decline during the initial stages of issuance, according to Zhou & Cui (2019). Furthermore,

Table 5. Simultaneous Test Results (F Test)

F-statistic	2.960115
Prob (F-statistic)	0.027551

the renewable energy industry is one with significant environmental compliance costs; Siagian et al. (2023) discovered that green bonds have the tendency to reduce ROA in this sector.

On the other hand, research that found green bonds to boost financial performance contradicts these results. This disparity may occur because it takes a number of years for green initiatives to pay off. Given that this study focuses on a short observation period (2022–2024), the estimated effects primarily capture short-term financial responses. Therefore, this study's findings suggest that short-term green bond issuance can lower an organization's return on assets.

The Effect of Green Investment on Financial Performance

Theoretically, green investment may boost bottom line results. But green investment has little effect on ROA, according to the research. The financial advantages of investing in environmental programs like waste management, energy efficiency, or pollution reduction often do not appear for quite some time, even if these initiatives seek to enhance operational performance. While green investment may improve a company's social legitimacy and public perception, the reputational gains may take time to materialize in the form of increased profits, according to Legitimacy Theory. Companies also have to pay a lot up front, which means their net earnings won't go up for a while.

Research by Indriastuti & Chariri (2021) and Lin et al. (2025) supports these results, which indicate that the profitability-boosting impact of environmental investment is only apparent after the program has been functioning at its best. Fachrozi et al., (2024) and Yulianti & Ramli (2025) both found that green investment, when coupled with strategic integration and long-term operational efficiency, enhances financial performance.

Nonetheless, research has shown that green investments may enhance profits, so our findings go counter to that. The inconsistency with those findings may be explained by the short-term scope of this study (2022–2024), during which the financial returns of green investment are unlikely to be fully realized. Consequently, green investment did not demonstrate a direct impact on ROA during the very short study period.

The Effect of Capital Expenditure on Financial Performance.

According to the hypothesis, investing in physical assets (capex) may boost a company's bottom line. The data, however, demonstrates that capex has little bearing on ROA. Capital expenditures are usually used to renew business assets and boost production capacity. Investment in fixed assets is a key factor in generating

Table 6. Determination Coefficient Test Results

Adjusted R-squared	0.117301

growth over the long run, according to the Growth of Firms Theory. Capital expenditures (capex) sometimes take a long time to pay for itself, and in the beginning they only boost overall assets without boosting profitability. Because of this, ROA is likely to remain mostly unchanged or undergo very small fluctuations.

These findings corroborate those of Mahendra & Susilowati (2022), who found that capital expenditures (capex) only pay off after assets start making money. The same holds true for the findings of Lanskyaris et al. (2024): capex boosts profitability, but only after the long-term advantages have materialized. Investment in capital expenditures has a delayed and indirect impact on financial performance, as shown in studies by Abdullah et al. (2022) and Juwita & Hasbi, (2024).

Contrarily, prior research has shown that capital expenditures (capex) boost profitability, particularly in sectors where assets are replaced at a high rate. This discrepancy may reflect the capital-intensive characteristics of the renewable energy sector and the relatively short time horizon of the present study, which limits the ability to observe the long-term benefits of capital investment. Over the course of the research, capital expenditures had no discernible impact on return on assets (ROA).

The Effect of Leverage on Financial Performance

According to the hypothesis, financial results may be enhanced by the use of leverage. Nevertheless, the research indicated that leverage had a detrimental effect on ROA. This result is opposite to the hypothesized direction. A company's leverage indicates how much debt it requires to fund its day-to-day operations. If you handle debt responsibly, you may save money on taxes (a tax shield), according to Trade-Off Theory. On the other hand, interest costs rise in tandem with debt levels, which reduces net income. Due to the high startup costs associated with renewable energy projects, companies using high levels of leverage may find it more difficult to turn their overall assets into a profit (Hasti et al., 2022).

Mahendra & Susilowati (2022) also discovered that leverage decreases profitability above an appropriate level, therefore our findings are in line with theirs. Excessive leverage reduces financial efficiency, which in turn lowers ROA (Fibriyanti, 2022; Maulana et al., 2020).

Conversely, these results differ from studies that state that leverage can increase profitability when used to finance productive projects. The divergence from those findings may be attributed to the short-term focus of this study and the long-term nature of debt-financed renewable energy projects, whose financial benefits may not yet be observable. Hence, the benefits are not yet visible in the short term. Thus, leverage negatively affected ROA during the study period.

Conclusion

This study examined the impact of green bonds, green investment, capital expenditure, and leverage on the financial performance of renewable energy firms listed on the Indonesia Stock Exchange during 2022–2024. Green investment and capital expenditure did not exhibit a significant effect during the observed period, while green bonds and leverage were found to have a negative association with return on assets. These results indicate that green financing instruments and capital structure decisions may exert short-term pressure on the financial performance of renewable energy firms. This study contributes by providing integrated empirical evidence on the joint role of green bonds, green investment, capital expenditure, and leverage within the context of Indonesia's renewable energy sector. The findings suggest the need for a more selective approach to financing and capital structure decisions during the energy transition.

While this research contributes to the existing empirical literature, it is subject to several limitations. The explanatory power of the model remains relatively low, as reflected by the Adjusted R^2 value, indicating that a substantial portion of the variation in financial performance is influenced by factors not captured in the current model. In addition, the relatively short observation period may limit the ability to observe the longer-term financial effects of green investment and capital expenditure. Future research is therefore encouraged to extend the observation period, incorporate alternative performance measures, and refine model specifications to provide a more comprehensive understanding of the relationship between green finance and financial performance.

Author contributions

This statement is intended to provide clarity and transparency regarding each party's contributions to the research process and manuscript preparation. All stages of the research, from problem formulation and theoretical foundation development to data collection, statistical analysis, and manuscript writing and refinement, were carried out independently by the lead author. Throughout the entire process, Dr Rosmini Ramli, S.E., M.M., as the supervisor, provided scientific direction, methodological guidance, substantive input, and academic evaluation to ensure the quality and accuracy of the analysis. The combination of these contributions enabled this research to be completed successfully and in accordance with applicable academic standards.

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