

THE EFFECT OF GREEN INVESTMENT, FOREIGN INVESTMENT, AND ENERGY CONSUMPTION ON THE PROFITABILITY OF RENEWABLE ENERGY PROJECTS IN INDONESIAN COMPANIES

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Abstract

This study aims to examine and analyze the effect of green investment, foreign investment, and energy consumption on the profitability of renewable energy projects in Indonesian companies. Profitability is measured using Return on Equity (ROE). The population comprises 15 companies engaged in new and renewable energy (NRE) projects in Indonesia. Applying purposive sampling based on the completeness of annual data for the 2020–2024 period yielded seven companies PT Alamtri Resources Indonesia Tbk, PT Arkora Hydro Tbk, PT Kencana Energi Lestari Tbk, PT Medco Energi Internasional Tbk, PT Pertamina Geothermal Energy Tbk, PT Bukit Asam Tbk, and PT TBS Energi Utama Tbk producing 35 panel observations. Secondary data were obtained from company annual reports and sustainability reports and analyzed using panel data regression. The Chow test identified the Common Effect Model (CEM) as the most appropriate estimator, and the model satisfied the classical assumption tests for normality, multicollinearity, heteroscedasticity, and autocorrelation. The partial (t-test) results show that green investment has a positive but statistically insignificant effect on profitability; foreign investment has a negative and significant effect on profitability, indicating that a higher share of foreign ownership tends to be associated with lower profitability; and energy consumption has a positive and significant effect on profitability, indicating that more productive energy use tends to improve earnings performance. Simultaneously (F-test), green investment, foreign investment, and energy consumption jointly and significantly affect profitability, jointly explaining 60.7% of its variance (Adjusted $R^2 = 0.6065$). These findings indicate that sustainability-oriented investment and external financing structures do not uniformly benefit corporate profitability, so companies need to manage green investment, foreign investment, and energy consumption more effectively to strengthen financial performance.

Keywords: energy consumption; foreign investment; green investment; panel data regression; profitability.

INTRODUCTION

As an archipelagic nation, Indonesia holds substantial renewable energy potential solar power in Nusa Tenggara and wind power in Sulawesi among them yet still faces considerable challenges in developing renewable energy projects. According to the Ministry of Energy and Mineral Resources (ESDM, 2023), renewable energy contributed only around 12–13% of national energy production, even as domestic energy consumption continued to rise by 4–5% annually amid urbanization and industrial growth. Globally, the climate change agenda is pushing many countries to shift from fossil fuels toward renewable sources such as solar, wind, hydro, and biomass, with the IEA reporting rapid growth in global installed capacity. In developing countries such as Indonesia, however, this transition remains slow because of financing constraints, limited infrastructure, and technological gaps.

Through the National Energy General Plan (RUEN), the Indonesian government set a target of a 23% renewable energy mix by 2025; by late 2024/early 2025 the realized share remained well below this target. This gap between target and realization can adversely affect project profitability: when renewable energy projects fail to offer attractive returns, investor and developer interest declines, which in turn constrains further investment. An improvement in sector profitability can nonetheless be observed at PT Pertamina Geothermal Energy Tbk (PGEO), whose net profit rose 28.47% in 2023, from US\$127.32 million to US\$163.57 million, while revenue grew from US\$386.07 million to US\$406.29 million evidence that geothermal energy can generate sustainable returns (PT

Pertamina Geothermal Energy Tbk, 2024). Even so, profitability (ROE) among energy-sector companies over 2020–2024 fluctuated year to year: PTBA and ADRO recorded relatively strong performance in certain years, while PGEO improved markedly in 2023, indicating that profitability performance across companies remains uneven and inconsistent over time.

Green investment in Indonesia has grown consistently, from Rp1,269 trillion in 2020 to Rp2,047 trillion in 2024, supported by government policy, the implementation of Indonesia's Sustainable Finance Taxonomy (TKBI) Version 2, and stable macroeconomic conditions, with the sharpest growth (20%) recorded in 2021 following the pandemic (OJK, 2024). Green investment is understood to support renewable energy companies by financing investment, technological innovation, and environmentally friendly infrastructure, while also lowering project risk through government guarantees, blended finance schemes, and risk-mitigation mechanisms such as insurance and long-term contracts. Regarding foreign investment, Tran et al. (2025) find that FDI has a negative and significant effect on renewable energy consumption, since FDI projects tend to prioritize low production costs over the higher upfront cost of renewable energy investment. Overall, prior research shows a clear gap: studies rarely combine green investment, foreign investment (FDI), and energy consumption within a single model of renewable-project profitability in Indonesia, with most studies examining only one or two variables at a time.

This study addresses that gap by simultaneously examining the effect of green investment, foreign investment, and energy consumption on the profitability of renewable energy projects among Indonesian companies, drawing on the Pollution Halo Hypothesis (Eskeland & Harrison, 2002) and Endogenous Growth Theory (Romer, 1986) as its theoretical foundation.

Based on the discussion above, the following hypotheses are proposed:

H1: Green investment has a positive and significant effect on the profitability of renewable energy projects in Indonesian companies.

H2: Foreign investment has a positive and significant effect on the profitability of renewable energy projects in Indonesian companies.

H3: Energy consumption has a positive and significant effect on the profitability of renewable energy projects in Indonesian companies.

METHOD

Research Design and Data

This study employs a quantitative design using panel data a combination of cross-sectional and time-series data covering the 2020–2024 period. Secondary data were obtained through documentary review of each sampled company's annual reports and sustainability reports, accessed via company websites and the Indonesia Stock Exchange (IDX) website (<https://www.idx.co.id>).

Population and Sample

The population consists of 15 companies engaged in new and renewable energy (NRE) projects in Indonesia, based on data from the Ministry of Energy and Mineral Resources (2023) and IESR (2025). Sampling was conducted using a purposive method, requiring that companies (1) operate in the renewable energy sector during 2020–2024, (2) consistently publish annual and sustainability reports during that period, and (3) have complete data on green investment, foreign investment, energy consumption, and profitability for 2020–2024. Applying these criteria yielded seven companies PT Alamtri Resources Indonesia Tbk (ADRO), PT Arkora Hydro Tbk (ARKO), PT Kencana Energi Lestari Tbk (KEEN), PT Medco Energi Internasional Tbk (MEDC), PT Pertamina Geothermal Energy Tbk (PGEO), PT Bukit Asam Tbk (PTBA), and PT TBS Energi Utama Tbk (TOBA) producing a balanced panel of 35 observations (7 companies × 5 years).

Variable Measurement

Profitability (Y) is measured by Return on Equity (ROE), i.e., net income after tax divided by shareholders' equity, multiplied by 100. Green investment (X1) is measured as the nominal amount of investment allocated by the company to environmentally friendly projects. Foreign investment (X2) is measured through foreign ownership, i.e., the percentage of shares held by foreign investors relative to total shares outstanding. Energy consumption (X3) is measured as the company's total annual energy consumption, converted into gigajoules (GJ). All variables are measured on a ratio scale.

Data Analysis Technique

Data were analyzed using panel data regression comprising three alternative estimators: the Common Effect Model (CEM), the Fixed Effect Model (FEM), and the Random Effect Model (REM). Model selection began with the Chow test (CEM vs. FEM); where the Chow test favors CEM, the Hausman and Lagrange Multiplier tests are not required. Because the selected model (CEM) is estimated via Ordinary Least Squares (OLS), classical assumption tests for normality, multicollinearity, heteroscedasticity, and autocorrelation were performed to ensure the estimator is unbiased and efficient. Hypotheses were tested partially (t-test) and simultaneously (F-test) at $\alpha = 5\%$, and the coefficient of determination (Adjusted R^2) was used to assess the model's explanatory power.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 presents the descriptive statistics for the 35 panel observations. Green investment (GI) shows the widest dispersion, with a mean of 3,476 and a standard deviation of 6,645, reflecting substantial variation in the scale of green-investment allocation among the seven sampled companies; its skewness (3.167) and kurtosis (12.95) indicate a non-normal, right-skewed distribution driven by a small number of companies with unusually large allocations. Foreign investment (IA) averages 27.52% of shares outstanding, ranging from 1.34% to 61.91%, with a Jarque–Bera probability of 0.147, consistent with a normal distribution. Energy consumption (KE) averages 1,054, ranging from 108.0 to 5,336, while profitability (PROFIT), proxied by ROE, averages 14.82% with a standard deviation of 11.99%, ranging from -19.02% to 43.40% reflecting that some sampled companies recorded losses during the observation period.

Table 1. Descriptive Statistics

	GI	IA (%)	KE	PROFIT (%)
Mean	3,476	27.52	1,054	14.82
Median	1,097	25.27	1,320	11.87
Maximum	3,205	61.91	5,336	43.40
Minimum	1,728	1.340	108.0	-19.02
Std. Dev.	6,645	18.75	1,810	11.99
Skewness	3.167	0.763	1.627	0.209
Kurtosis	12.95	2.461	3.969	4.078
Jarque-Bera	203.1	3.823	16.81	1.952
Probability	0.000	0.147	0.000	0.376
Observations	35	35	35	35

Source: processed with EViews 12.

Model Selection Test

Table 2 summarizes the results of the Chow test, used to choose between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). The cross-section fixed-effects statistic yields a chi-square of 10.84 (6 d.f., $p = 0.093 > 0.05$), so H_0 is not rejected and the Common Effect Model (CEM) is selected as the most appropriate estimator for this study; the Hausman and Lagrange Multiplier tests are therefore not required.

Table 2. Summary of the Chow Test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	1.513	(6,25)	0.215
Cross-section Chi-square	10.84	6	0.093

Source: processed with EViews 12.

Classical Assumption Tests

Because CEM is estimated using Ordinary Least Squares, the model was further checked against the classical assumptions. The Jarque–Bera normality test yields a probability of 0.299 (> 0.05), indicating normally distributed residuals. Pairwise correlations among the independent variables (GI, IA, KE) all fall below 0.80 (ranging from -0.209 to 0.637), indicating the model is free of multicollinearity. The Glejser heteroscedasticity test shows that all

independent variables have probabilities above 0.05, indicating homoscedastic residuals. The Durbin–Watson statistic of 1.983 falls between dU (1.6528) and 4–dU (2.3472), indicating the model is free of positive or negative autocorrelation.

Common Effect Model (CEM) Estimation

Table 3. Common Effect Model (CEM) Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C (Constant)	15.87	5.982	2.654	0.012
Green Investment (GI)	2.412	3.075	0.785	0.438
Foreign Investment (IA)	-0.285	0.092	-3.079	0.004
Energy Consumption (KE)	0.000	0.000	3.062	0.004

R-squared = 0.641228; *Adjusted R-squared* = 0.606508; *F-statistic* = 18.46862; *Prob(F-statistic)* = 0.000000.

Source: processed with EViews 12.

The resulting regression model is: $ROE = 15.87 + 2.412 GI - 0.285 IA + 0.000 KE + \varepsilon$. The constant of 15.87 indicates the estimated level of profitability when green investment, foreign investment, and energy consumption are held at zero, *ceteris paribus*. The green investment coefficient (2.412, positive) indicates that, holding foreign investment and energy consumption constant, a one-unit increase in green investment is associated with a 2.412-unit increase in estimated profitability. The foreign investment coefficient (−0.285, negative) indicates that a one-unit increase in foreign ownership is associated with a 0.285-unit decrease in estimated profitability, holding the other variables constant. The energy consumption coefficient, though numerically close to zero at this scale, is positive and indicates that higher energy consumption is associated with higher profitability, holding the other variables constant.

Hypothesis Testing

Partial (t-test) results, evaluated at $df = n - k = 35 - 4 = 31$ and $\alpha = 5\%$ ($t\text{-table} = 2.0395$), are as follows. Green investment has a t-statistic of 0.7850 ($p = 0.4384 > 0.05$); because $|t\text{-statistic}| < t\text{-table}$ and $p > 0.05$, green investment has a positive but statistically insignificant effect on profitability, so H1 is rejected. Foreign investment has a t-statistic of −3.0799 ($p = 0.0043 < 0.05$); because $|t\text{-statistic}| > t\text{-table}$ and $p < 0.05$, foreign investment has a significant effect on profitability — however, the direction is negative rather than the hypothesized positive, so H2, as stated, is rejected. Energy consumption has a t-statistic of 3.0625 ($p = 0.0045 < 0.05$); because $t\text{-statistic} > t\text{-table}$ and $p < 0.05$, energy consumption has a positive and significant effect on profitability, so H3 is accepted.

Simultaneously (F-test), the F-statistic of 18.4686 exceeds the F-table value of 2.9113 ($df_1 = 3$, $df_2 = 31$), with $Prob(F\text{-statistic}) = 0.000000$ far below 0.05. Green investment, foreign investment, and energy consumption therefore jointly and significantly affect the profitability of renewable energy projects among the sampled Indonesian companies.

Table 4. Summary of Hypothesis Testing

Hypothesis	Path	Hypothesized	Result	Decision
H1	Green Investment → Profitability	Positive, significant	Positive, not significant ($t=0.785$; $p=0.438$)	Rejected
H2	Foreign Investment → Profitability	Positive, significant	Negative, significant ($t=-3.080$; $p=0.004$)	Rejected
H3	Energy Consumption → Profitability	Positive, significant	Positive, significant ($t=3.063$; $p=0.004$)	Accepted

Coefficient of Determination

The CEM estimation produces an Adjusted R^2 of 0.606508, indicating that green investment, foreign investment, and energy consumption jointly explain 60.7% of the variation in the profitability of renewable energy projects across the seven sampled companies, while the remaining 39.3% is explained by factors outside the model, *ceteris paribus*.

The Effect of Green Investment on Profitability

Green investment is found to have a positive but statistically insignificant effect on profitability, indicating that increases in green investment tend to be accompanied by higher profitability, but the relationship is not strong enough to be statistically confirmed. This result is consistent with Rahmawati and Hartoko (2025) and Tomczak et al. (2021), who likewise find that green investment does not significantly affect profitability.

The positive direction is consistent with the expectation that investment in environmentally friendly technology, energy efficiency, and waste management can improve operational efficiency and corporate reputation. The lack of statistical significance, however, is consistent with Endogenous Growth Theory (Romer, 1986), which frames investment in knowledge and technology as generating returns over the long run rather than immediately: the benefits of green investment are typically realized gradually, so they may not yet be fully reflected in earnings within the observation period.

This pattern is illustrated by PT Pertamina Geothermal Energy Tbk (PGE), which continued to expand its geothermal investment even as its net profit declined slightly, from US\$163.57 million in 2023 to US\$160.30 million in 2024 — evidence that the economic benefits of green investment are not always immediately reflected in profit within the same period, but instead require time to materialize through efficiency gains and capacity development.

The Effect of Foreign Investment on Profitability

Foreign investment is found to have a negative and significant effect on profitability, indicating that an increase in foreign ownership tends to be accompanied by a decline in profitability. This can occur because funds from foreign investors are more often allocated to business expansion, infrastructure development, or technology adoption that requires substantial upfront cost before generating returns. The presence of foreign investors can also raise operating and monitoring costs and increase demands for stronger corporate governance, which may compress short-run profitability.

This finding is consistent with Gande (2021) and Kartika et al. (2024), who find that foreign ownership negatively affects ROE, and can be explained through Technology Spillover Theory, under which foreign investment brings new technology, knowledge, and management practices that require an adaptation process — during which companies continue to incur adjustment and development costs before the economic benefits of foreign investment are fully realized, so ROE can decline even as foreign ownership increases.

PT Vale Indonesia Tbk, which has substantial foreign ownership, illustrates this pattern: its large-scale investment in nickel mining and processing requires considerable cost and operational adjustment before the benefits of the investment and technology applied are realized, so the presence of foreign investors does not always translate immediately into higher profitability — supporting this study's finding that foreign investment has a negative and significant effect on ROE.

The Effect of Energy Consumption on Profitability

Energy consumption is found to have a positive and significant effect on profitability: the higher a company's energy consumption, the higher its profitability tends to be. This occurs because energy is a key input supporting production and operational activity; higher energy consumption reflects a higher level of operational activity, which increases production capacity and sales, ultimately contributing to higher profit.

This finding is consistent with Salehi et al. (2025) and Handayani et al. (2026), who find that clean energy consumption positively and significantly affects profitability as measured by ROE, and with Energy Demand Theory, which holds that energy is a critical input supporting production and operational activity — the greater a company's energy consumption, the greater its operational activity, so production capacity and sales can increase, which in turn contributes to higher profitability. Efficient energy use can improve operational efficiency, productivity, and a company's ability to generate profit from its own capital.

This is illustrated by PT Arkora Hydro Tbk (ARKO), which continues to develop hydroelectric power generation as a renewable energy source. Its use of hydro energy in operational activity supports more sustainable electricity production, helping improve operational efficiency and financial performance — consistent with this study's finding that energy consumption has a positive and significant effect on ROE.

CONCLUSION

Based on the panel data analysis of seven Indonesian renewable-energy companies over 2020–2024, this study concludes the following: (1) green investment has a positive but statistically insignificant effect on profitability, indicating that greater allocation to environmentally friendly investment has not yet directly translated into higher profitability, as its economic benefits tend to accrue over the long run; (2) foreign investment has a negative and significant effect on profitability, indicating that an increase in foreign ownership tends to be accompanied by a

decline in the company's ability to generate returns on its own capital; and (3) energy consumption has a positive and significant effect on profitability, indicating that more productive energy use supports operational activity and strengthens companies' ability to generate profit. Simultaneously, the three variables significantly affect profitability, jointly explaining 60.7% of its variance.

These findings suggest that sustainability-oriented investment and external financing structures do not uniformly benefit corporate profitability. Companies are encouraged to manage green investment, foreign investment, and energy consumption more effectively — for instance, by pairing green investment with a clear medium-term efficiency roadmap, structuring foreign-investment partnerships to shorten the adaptation period, and directing energy use toward higher-value productive activity — in order to strengthen financial performance over time. This study has several limitations: it considers only three independent variables (green investment, foreign investment, and energy consumption); the sample is limited to seven companies because of incomplete data disclosure among other population members during the observation period; and the literature specifically linking these variables to the profitability of renewable energy projects remains limited. Future research is encouraged to extend the observation period, incorporate additional explanatory variables, expand the company sample as more complete data become available, and consider alternative profitability measures such as ROA or net profit margin.

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