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Green accounting and firm value: The moderating role of external assurance in Indonesia

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ABSTRACT

This study examines the effect of green accounting on firm value and the moderating role of external assurance in energy sector firms listed on the Indonesia Stock Exchange during 2017–2023. Using a quantitative approach, panel data regression with a Random Effect Model and robust standard errors is applied to 82 firm-year observations after outlier treatment using the Z-score method. Green accounting is measured using GRI-based environmental disclosure, while firm value is proxied by Tobin's Q. The results show that green accounting has a marginally significant negative effect on firm value. However, external assurance significantly strengthens and reverses this relationship, indicating the importance of credibility in sustainability reporting. The findings extend signaling theory by demonstrating that environmental disclosure enhances firm value only when supported by independent verification. This study highlights the contingent role of assurance in shaping market interpretation of sustainability information in emerging markets. The analysis is limited to the energy sector, suggesting avenues for broader future research.

Introduction

In recent years, the growing recognition of environmental challenges, such as climate change and resource depletion, has shifted the focus of businesses towards more sustainable practices. As governments, investors, and society at large increase their expectations for corporate responsibility, businesses worldwide are under pressure to integrate environmental considerations into their operational frameworks (Lako, 2018; Gupta, 2018). These challenges have intensified the demand for greater corporate transparency, particularly concerning environmental impacts. Consequently, sustainability has evolved from being a niche concern to a fundamental aspect of business strategy, influencing corporate decision-making and reporting (Khan & Gupta, 2024).

In Indonesia, the energy sector is both an economic cornerstone and a major contributor to environmental degradation (World Bank, 2023). Energy companies, due to their significant environmental footprint, are under increasing scrutiny from regulators, investors, and the public. As part of the national push for greater corporate transparency, Indonesia has implemented regulatory frameworks, such as POJK No. 51/POJK.03/2017, mandating sustainability reporting for certain industries, particularly in the energy sector. These regulations aim to encourage companies to disclose their environmental practices more systematically and transparently. However, while regulatory measures have encouraged the adoption of green accounting, a gap remains in understanding how these disclosures translate into actual changes in firm value.

Green accounting, which integrates environmental costs and performance into corporate reporting, has been introduced as a means to meet these demands (Lako, 2018; Khan & Gupta, 2024). By disclosing information about their environmental impacts, companies can provide stakeholders with valuable insights into their environmental practices and sustainability efforts. The importance of green accounting is underscored by signaling theory (Spence, 1973; Ross, 1977), which suggests that companies use disclosures, such as those related to environmental performance, to convey signals about their corporate responsibility and long-term sustainability.

Despite its theoretical significance, empirical studies on the relationship between green accounting and firm value present mixed results. Some studies have found a positive impact, suggesting that transparent environmental practices can enhance investor perception and lead to higher firm valuation (Al-Dhaimesh, 2020; Dewi & Narayana, 2020; Lestari & Khomsiyah, 2023; Altarawneh et al., 2025; Anggreni et al., 2025). However, others report that the effect of green accounting on firm value is either insignificant or even negative, suggesting that mere disclosure of environmental information may not be enough to influence market outcomes (Hutabarat,

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2024; Febrianto et al., 2025). This inconsistency points to the need for further exploration of the factors that determine the effectiveness of green accounting in enhancing firm value.

The theoretical foundation of this study is rooted in signaling theory, which posits that firms use their disclosures to signal information to the market, particularly in the presence of information asymmetry (Calvina & Haryanto, 2019; Naibaho & Raudhotuzanah, 2025). In the case of green accounting, credible environmental disclosures are considered signals of a company's commitment to sustainability, potentially increasing its attractiveness to investors. However, the credibility of these signals is crucial, as investors are often skeptical of greenwashing, claims of sustainability that are not backed by substantial evidence. External assurance plays a key role in verifying the reliability of these disclosures and strengthening their impact on firm value (Harymawan et al., 2020).

External assurance, defined as independent verification of sustainability reports by third-party auditors, is believed to enhance the credibility of the disclosed information, addressing concerns about the quality and reliability of sustainability data. External assurance has been shown to mitigate skepticism about greenwashing and build investor confidence (Harymawan et al., 2020; Shellyane & Dharmastuti, 2025). However, studies examining the moderating role of external assurance have yielded conflicting results. Some studies indicate that external assurance strengthens the relationship between green accounting and firm value, while others find no significant impact (Calvina & Haryanto, 2019; Naibaho & Raudhotuzanah, 2025). This inconsistency in the literature suggests the need for more empirical investigation into how external assurance affects the effectiveness of green accounting disclosures, particularly in the context of Indonesia's energy sector.

Given these gaps in the literature, this study seeks to address the following research questions such as does green accounting have an impact on the firm value of companies listed on the Indonesia Stock Exchange (IDX) between 2017 and 2023? and does external assurance moderate the relationship between green accounting and firm value for companies listed on IDX during the same period?

The novelty of this study lies in its exploration of how external assurance impacts the relationship between green accounting and firm value in Indonesia's energy sector. While signaling theory has been applied in other contexts, this study extends it by incorporating the moderating role of external assurance in a developing market like Indonesia. By focusing on the energy sector, where environmental issues are particularly critical, the study provides a unique context for examining the effectiveness of green accounting disclosures and external assurance.

This study makes two primary contributions. As a theoretical contribution, it extends signaling theory by exploring how external assurance enhances the credibility of green accounting disclosures, thereby improving their effectiveness in influencing firm value. And as a practical contribution, for corporate managers, this study offers insights into the importance of external assurance in enhancing the credibility of sustainability reports. For regulators, it underscores the need to consider external assurance as a critical element in sustainability reporting regulations to ensure that environmental disclosures lead to meaningful improvements in firm value.

The sample for this study consists of 13 energy companies listed on the Indonesia Stock Exchange (IDX) between 2017 and 2023. These companies were selected based on their availability of annual and sustainability reports during the study period. The focus on the energy sector is particularly relevant, given its significant environmental impact and the regulatory pressures for sustainability reporting that were implemented during the study period.

Literature Review

Signaling Theory

Signaling theory, proposed by Spence (1973) and later extended by Ross (1977), suggests that companies send signals to external parties to reduce information asymmetry and improve decision-making. In the context of environmental disclosure, companies use green accounting as a signal to the market, indicating their commitment to sustainability and responsible environmental management. According to signaling theory, the effectiveness of these signals depends on their credibility (Xing et al., 2025). If investors perceive the information as unreliable or unverified, the signal loses its value, and the company may not experience the expected increase in firm value (Nguyen, 2025).

External assurance plays a key role in enhancing the credibility of these signals. By verifying the accuracy and reliability of environmental disclosures, external assurance reduces skepticism and increases investor confidence (Harymawan et al., 2020). In this study, signaling theory is applied to examine how green accounting serves as a signal to investors and how external assurance strengthens this signal by providing third-party validation. This theoretical framework is particularly relevant in emerging markets like Indonesia, where regulatory frameworks for sustainability reporting are still developing, and investor perceptions of environmental disclosures may vary (Naibaho & Raudhotuzanah, 2025).

Green Accounting

According to the Ikatan Akuntan Indonesia (IAI), green accounting is an accounting concept that incorporates environmental impacts into corporate financial reporting to integrate environmental responsibility into business

management, ensuring that reports reflect not only financial performance but also environmental effects. Gupta (2018) adds that it includes environmental costs in operational outcomes, enabling more accurate assessment of ecological consequences, while Lako, (2018) frames it as a broader paradigm that extends beyond profit to include social and environmental dimensions (people, planet, profit), thereby enhancing corporate accountability and further view it as a moral and ethical commitment to environmental responsibility and transparent reporting.

Overall, green accounting provides a structured framework for identifying, measuring, and reporting environmental impacts such as emissions, waste, energy use, and resource management, which are disclosed as sustainability information. From a signaling theory perspective, this information acts as a quality signal of environmental commitment, risk management, and long-term sustainability, helping reduce information asymmetry, build investor trust, and potentially enhance firm value.

Firm Value

Firm value is the market value of a company that reflects the price investors are willing to pay for its shares, indicating overall market perception of the firm's performance and future prospects (Setiawanta et al., 2021; Sukmadilaga et al., 2023). It reflects a key objective of firms, as maximizing stakeholder welfare depends on increasing this value, which is typically signaled through higher stock prices. Firm value also serves as an indicator of how well a company is managed and how it is perceived by investors in terms of growth potential. profitability (Kasibi et al., 2023; Yuan et al., 2025). Positive investment signals can improve investor sentiment, drive stock prices, and ultimately enhance firm value (Dewi & Narayana, 2020; Lestari & Khomsiyah, 2023). It is commonly measured using market-based indicators such as Tobin's Q, which compares market value to asset replacement cost to assess market perception of a firm's potential. In addition, effective management of financial and non-financial factors, including CSR and green accounting practices, can shape positive investor perceptions and further increase firm value (Anggreni et al., 2025).

Prior Studies and Research Gap

A number of prior studies have examined the relationship between green accounting and firm value. However, the results have been mixed. For example, Anggreni et al., (2025) found that green accounting has a positive impact on firm value, highlighting its role in improving corporate performance. Similarly, Astuti & Ahmar (2025) showed that green accounting, along with green intellectual capital and green innovation, significantly enhances firm value, with return on assets (ROA) moderating this effect. Dewi & Narayana (2020) also demonstrated that green accounting positively influences firm value, along with profitability and corporate social responsibility. Altarawneh et al., (2025) provided evidence from Jordan that green accounting positively affects firm market value, particularly in manufacturing companies. Lestari & Khomsiyah (2023) further confirmed that the application of green accounting and environmental performance significantly boosts firm value.

Meanwhile, Harymawan et al. (2020) and Shellyane & Dharmastuti (2025) highlighted that external assurance strengthens the relationship between Green Accounting practice and financial performance in emerging markets. Similarly, Naibaho & Raudhotuzanah (2025) found that external assurance moderates the relationship between ESG and firm performance, measured by Tobin's Q. In summary, these studies collectively indicate that green accounting and sustainability practices, when coupled with external assurance, have a positive impact on firm value and financial performance. This study aims to fill these gaps by examining the impact of green accounting on firm value in Indonesia's energy sector, with a specific focus on the moderating role of external assurance. The findings will contribute to a better understanding of how green accounting and external assurance can influence investor perceptions and firm valuation, especially in emerging market contexts where environmental disclosure practices are still developing.

Hypothesis Development

Signaling theory posits that firms communicate quality and performance to external parties through credible signals that reduce information asymmetry (Spence, 1973; Ross, 1977). In the domain of environmental performance, green accounting functions as such a signal by disclosing how firms recognize, measure, and report environmental costs and practices (Lako, 2018). When transparently presented, these disclosures indicate a commitment to sustainability and responsible risk management, which should enhance investor confidence and, ultimately, firm value (Nguyen, 2025). Prior studies document that firms revealing environmental costs and sustainability practices are often viewed more favorably because these actions imply long-term responsibility and risk mitigation (Dewi & Narayana, 2020; Anggreni et al., 2025).

However, the empirical evidence is mixed. Some studies find no effect or even a negative association between green accounting and firm value, suggesting that disclosure alone may be insufficient. These inconsistencies imply that the market's response depends not only on the content of the information but also on how credible the information is perceived to be, as well as the industrial context in which it is disclosed (Hutabarat, 2024; Febrianto et al., 2025). This leads to the role of credibility in strengthening environmental signals. Without independent verification, investors

may suspect that environmental disclosures are merely symbolic or represent greenwashing. In this context, external assurance becomes crucial. By validating the reliability of environmental information, external assurance reduces skepticism and enhances the effectiveness of green accounting as a market signal. Empirical evidence shows that externally assured sustainability reports are more trusted by investors and more likely to be associated with higher firm value (Harymawan et al., 2020; Shellyane & Dharmastuti, 2025). Nevertheless, some studies note that assurance may be ineffective when perceived as superficial or lacking rigor (Naibaho & Raudhotuzanah, 2025).

Taken together, these arguments suggest that environmental disclosure and credibility are inseparable in influencing market perception. Green accounting may serve as a signal of sustainability commitment, but its effectiveness depends on whether the information is externally verified. Accordingly, the hypotheses of this study are formulated as follows:

H_1: Green accounting has a positive effect on firm value.

H_2: External assurance strengthens the relationship between green accounting and firm value.

Research Framework

This research framework is based on the perspective of signaling theory, which emphasizes the importance of information disclosure in reducing information asymmetry between companies and stakeholders. It illustrates the relationship between green accounting as the independent variable and firm value as the dependent variable. The implementation of green accounting is viewed as a form of environmental information transparency that can improve investor perception, which is expected to influence the increase in firm value (H1).

Furthermore, External Assurance is positioned as a moderating variable that plays a role in strengthening or weakening the effect of green accounting on firm value (H2), as the presence of assurance is expected to enhance the credibility and reliability of the sustainability information disclosed by the company. In addition, this study includes control variables such as interest rate, leverage, age, size, and exchange rate to control for external factors and company characteristics that could also potentially affect the firm value, allowing for a more accurate analysis of the relationships between the main variables, as illustrated in Figure 1.

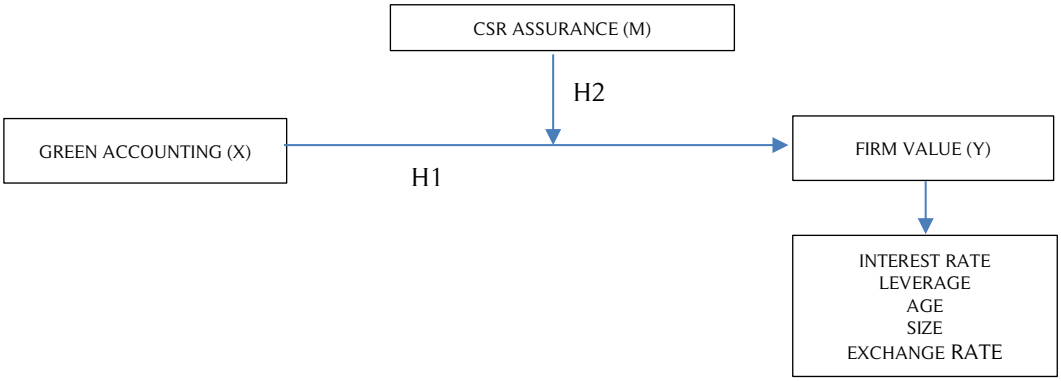

Figure 1. Research Framework

Research Design

This study employs a quantitative research design to analyze the relationship between green accounting, external assurance, and firm value in Indonesia's energy sector. The focus on the energy sector is due to its significant environmental impact and regulatory pressures, which make it an ideal context for investigating the effectiveness of sustainability disclosures and external verification.

The research employs panel data regression analysis, which allows for the examination of data that includes both cross-sectional and time-series components. Panel data is advantageous because it provides insights into changes over time while accounting for individual heterogeneity across firms. This methodology is especially relevant for understanding how the implementation of green accounting and the role of external assurance influence firm value across multiple periods.

Variable Definitions and Measurements

Independent variable

The independent variable (X) in this study is Green Accounting (GA). In this research, Green Accounting refers to the recognition, measurement, and reporting of environmental costs and impacts (Gupta, 2018; Khan & Gupta, 2024). According to Lako (2018), there is no standardized and established proxy for measuring Green Accounting. However, previous studies have used the Global Reporting Initiative (GRI) Standards as a proxy for measuring

Green Accounting (Ulupui et al., 2020; Astuti & Ahmar, 2025). In this case, the GRI topic standards, previously known as the GRI G4 Specific Standard Disclosure, are used as the measurement reference in this study.

The measurement of Green Accounting with GRI uses a scoring method, assigning a value of 1 for each environmental disclosure made by the company. If each indicator is mentioned in the company's sustainability report, it is given 1 point, and 0 points if the company does not disclose it. The total score is calculated using the following formula:

$$\frac{Number\ of\ item\ Disclosed}{Total\ Item\ of\ GRI}\ x\ 100\%$$

The result is interpreted as the company's level of compliance/transparency in Green Accounting based on GRI standards. The higher the score, the better the company's practices and disclosures in Green Accounting.

Dependent variable

The dependent variable in this study is Firm Value, which refers to the determination of certain measures that can assess the success of a company in generating profits (Sunaryo, 2024). In this study, Firm Value is measured using Tobin's Q, as Tobin's Q provides a more comprehensive view by indicating how the market evaluates the company's potential and future prospects (Anggreni et al., 2025).

$$Tobins'Q = \frac{MVE_{t+1} + DEBT_{t+1}}{TA_{t+1}}$$

Where:
MVE = Share Price x Number of Outstanding Share
DEBT = Company total debt
TA = Total Asset
(Anggreni et al., 2025)

Moderating variable

The moderating variable used in this study is External Assurance, which refers to the disclosure of external assurance in sustainability reporting standards established by the Global Reporting Initiative. This includes GRI indicator 102-56 in the GRI Standards 2016, and indicator GRI 2-5 in the GRI Universal Standards 2021, which emphasize the disclosure of external assurance practices, coverage, and the assurance provider (GRI, 2025).

External assurance is an independent verification process conducted by auditors, consultants, or external experts to assess the reliability and credibility of information in the company's sustainability report. This process aims to enhance transparency, reduce information asymmetry, and build stakeholder trust in the quality of the presented reports (Miralles-Quirós & Miralles-Quirós, 2021). In this study, external assurance is used as both an independent variable and a moderating variable, measured using a dummy variable: it is assigned a value of 1 if the company conducts external assurance on its sustainability report, and 0 if it does not (Harymawan et al., 2020; Naibaho & Raudhotuzanah, 2025).

Control variables

Exchange Rate

The exchange rate is included as a control variable because it significantly impacts firm performance, particularly for companies engaged in international trade. Exchange rate fluctuations affect profitability, cost structures, and market valuation (Setiawanta et al., 2021). This study uses the average exchange rate from Bank Indonesia, which is highly relevant for multinational companies operating both in Indonesia and internationally (Choi & Prasad, 1995; Sutriani, 2014; Glaum et al., 2018).

Interest Rate

Interest rates influence capital costs and investment decisions. Higher interest rates increase borrowing costs, reduce profitability and, consequently, firm value. They also affect the broader economic environment, influencing overall firm performance (Hastuti & Carolina, 2022).

Firm Age

Firm age reflects operational stability and experience. Older firms generally have a stronger market reputation and better access to capital, which can enhance firm value. In contrast, younger firms may face higher market uncertainty (Yuan et al., 2025).

Leverage

Leverage, measured by the Debt-to-Equity Ratio (DER), indicates financial risk. Companies with higher leverage are more exposed to financial risks, which can influence their performance and market value. Leverage also affects a firm's capacity to invest in sustainability practices and external assurance (Kurnia & Zoraya, 2025; Hutabarat, 2024).

Firm Size

Firm size, measured by the natural logarithm of total assets, influences a company's ability to invest in green accounting and external assurance. Larger firms generally have more resources to implement sustainability practices, whereas smaller firms may face more constraints (Mahasari & Rahyuda, 2020; Nguyen, 2025).
These five control variables are crucial for isolating the impact of green accounting and external assurance on firm value. They are particularly relevant in the energy sector, which is shaped by both macroeconomic factors and firm-specific characteristics, as evidenced by previous studies.

Sample Selection

The sample for this study consists of 13 energy companies listed on the Indonesia Stock Exchange (IDX) between 2017 and 2023. These companies were selected based on the availability of both annual reports and sustainability reports during the study period. The energy sector was chosen because of its high environmental impact and the regulatory framework that mandates sustainability reporting (POJK No. 51/POJK.03/2017).

This study limits the data collection period to 2023 due to the availability of relevant data. The data used in this study is complete and well-verified up to 2023. Given that manually searching for data from newer periods may lead to inconsistencies or bias, using readily available data ensures uniformity and reliability. Furthermore, the seven-year observation period, covering data from 2017 to 2023, is sufficiently representative for analyzing the relevant trends and relationships in this study. Therefore, while newer data could provide additional insights, this time frame is deemed adequate to support the findings of this research.

To ensure consistency, only firms that consistently published sustainability reports throughout the period were included in the final sample. Companies with missing or inconsistent sustainability disclosures were excluded, as this could lead to unreliable results. After applying the necessary exclusions and data treatment (including Z-Score outlier removal), the final sample consists of 82 firm-year observations, as detailed in Table 1.

Table 1. Sample Selection

Criteria	Firms	Observations
Energy sector firms listed on IDX, 2017-2023	74	518
Firms without consistent sustainability reports during 2017-2023	(61)	(427)
Final sample	13	91
Observations used in regression after outlier treatment	-	82

Source: Processed secondary data

Based on Table 1, it can be seen that this study has a final sample of 13 companies with a total of 82 observations for the period 2017-2023. The sample size represents 17.6% of the total energy sector companies listed on the IDX from 2017 to 2023. Table 2 is the list of sample companies that meet the research criteria.

Table 2. List of Sample Companies

No	Kode	Nama Emiten
1	ABMM	PT. ABM INVESTAMA TBK.
2	ADRO	PT. ADARO ENERGY TBK.
3	AKRA	PT. AKR CORPORINDO TBK.
4	BUMI	PT. BUMI RESOURCES TBK.
5	DEWA	PT. DARMA HENWA TBK.
6	ELSA	PT. ELNUSA TBK.
7	INDY	PT. INDIKA ENERGY TBK.
8	ITMG	PT. INDO TAMBANGRAYA MEGAH TBK.
9	MBSS	PT. MITRABAHTERA SEGARA SEJATI TBK.
10	MEDC	MEDCO ENERGI INTERNASIONAL TBK
11	PGAS	PERUSAHAAN GAS NEGARA (PERSERO) TBK
12	PTBA	PT. BUKIT ASAM TBK.
13	PTRO	PETROSEA TBK

Source: Processed secondary data

Estimation Methodology

The primary estimation method used in this study is panel data regression. Given the nature of the data, the Random Effect Model (REM) is selected as the preferred model, as it is suitable for analyzing data that varies both across firms and over time. The model accounts for both within-firm and between-firm variations.

The following regression models are employed:

Direct-effect Model (Model 1):

$$FV_{it} = \alpha + \beta_1 GA_{it} + \beta_2 Size_{it} + \beta_3 Age_{it} + \beta_4 Leverage_{it} + \beta_5 Interest_t + \beta_6 ExchangeRate_t + \mu_i + \epsilon_{it}$$

This model evaluates the direct effect of green accounting on firm value, excluding the moderating role of external assurance.

Full Model with Moderating Variable (Model 2):

This model includes external assurance as a moderating variable to examine how the relationship between green accounting and firm value changes when external assurance is present:

$$FV_{it} = \alpha + \beta_1 GA_{it} + \beta_2 Assurance_{it} + \beta_3 (GA \times Assurance)_{it} + \beta_4 Size_{it} + \beta_5 Age_{it} + \beta_6 Leverage_{it} + \beta_7 Interest_t + \beta_8 ExchangeRate_t + \mu_i + \epsilon_i$$

Where:

FV_{it}	= *Firm Value* (Nilai Perusahaan) of company i in year t
α	= Constant
β_1-β_8	= Regression coefficients
GA_{it}	= *Green accounting* of company i in year t
$Assurance_{it}$	= *External Assurance* of company i in year t
$(GA \times Assurance)_{it}$	= Interraction variable *GA* and *Assurance* of company i in year t
$Size_{it}$	= Size of company i in year t
Age_{it}	= Age of company i in year t
$Leverage_{it}$	= Ratio of total debt to total equity of company i in year t
$Interest_t$	= Interest in year t
$ExchangeRate_t$	= Exchange Rate in year t

Research Method

This study uses a quantitative design with panel data because the research investigates firm-level observations across multiple years. Panel data are appropriate for capturing both cross-sectional differences between firms and longitudinal variation over time. The population consists of all energy sector firms listed on the Indonesia Stock Exchange during 2017-2023.

Purposive sampling is applied to identify firms that consistently published sustainability reports during the observation period. Firms that did not provide sustainability reporting continuously were excluded because green accounting and assurance data could not be observed consistently. The final sample includes 13 firms with 91 firm-year observations. After outlier treatment using the standardized method (z-score), 82 observations remain for the regression models.

The study relies on secondary data from annual reports, sustainability reports, and supporting macroeconomic information. Green accounting is measured through the proportion of environmental disclosure items reported in accordance with the Global Reporting Initiative. Firm value is measured using Tobin's Q. External assurance is coded 1 when the sustainability report is independently assured and 0 otherwise. Five control variables are included: exchange rate, interest rate, firm age, leverage, and firm size.

This study employs a quantitative design with panel data, which is well-suited for examining firm-level observations across multiple years. Panel data allows us to capture both cross-sectional differences between firms and longitudinal variations over time. The population consists of all energy sector firms listed on the Indonesia Stock Exchange between 2017 and 2023. However, the study period is limited to 2023 due to the availability of relevant data on sustainability reports, which can only be accessed up until that year. This limitation ensures the consistency and validity of the analysis.

Purposive sampling was applied to identify firms that consistently published sustainability reports throughout the observation period. Firms that did not provide continuous sustainability reporting were excluded from the study, as green accounting and assurance data could not be observed consistently. The final sample consists of 13 firms, yielding 91 firm-year observations. After outlier treatment using the standardized method (z-score), 82 observations remain for the regression models.

The study relies on secondary data from annual reports, sustainability reports, and supporting macroeconomic information. Green accounting is measured based on the proportion of environmental disclosure items reported in accordance with the Global Reporting Initiative. Firm value is proxied using Tobin's Q, and

external assurance is coded as 1 when the sustainability report is independently assured and 0 otherwise. Five control variables are included: exchange rate, interest rate, firm age, leverage, and firm size.

Results and Discussion

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std.Dev	Min	Max
FV	82	-0,0881	0,2451	-0,7129	0,4042
GA	82	0,5293	0,2797	0	1
EA	82	0,3956	0,4917	0	1
IR	82	0,0469	0,0079	0,0352	0,0581
ER	82	~0	0,0386	-0,0724	0,0584
Leverage	82	~0	0,9794	-3,0702	3,1294
Size	82	~0	0,0372	-0,0755	0,0618
Age	82	17,46	7,81	6	33

Source: Processed secondary data

As presented in Table 3, descriptive statistics show that the mean green accounting score is 0.5292, indicating that the sampled firms disclosed slightly more than half of the environmental items used in this study. The average value of external assurance is 0.3956, which means that less than half of the sample observations used independent verification. This pattern suggests that while sustainability disclosure has become relatively common among sampled firms, the use of assurance remains selective rather than universal.

The average firm value measure is relatively close to zero after transformation and data treatment, while the control variables reveal meaningful variation across observations. The descriptive results imply that the sampled firms differ not only in environmental reporting practices but also in their internal characteristics and external exposure. Such variation supports the use of multivariate panel regression to isolate the effects of the main variables.

Table 4. Panel Model Selection

Test Type	Statistic (Prob.)	Decision
Chow Test	0.0000	Reject Common Effect Model
Hausman Test	0.9398	Random Effect preferred over Fixed Effect
Lagrange Multiplier	0.0000	Random Effect preferred over Common Effect
Selected Model		Random Effect Model (REM)

Source: Processed secondary data

The model selection procedure indicates that the random effect model is the most appropriate specification for the regression model. Based on the results in Table 4, the Chow test rejects the common effect model, the Hausman test favors the random effect model over the fixed effect model, and the Lagrange Multiplier test supports the random effect specification. Additional diagnostics show that the regression model is statistically acceptable for interpretation.

Table 5. Random Effect Regression Results

Variables	Coefficient	p-value
Constant	0.0273	0.862
Green Accounting (GA)	-0.1532*	0.076
External Assurance (EA)	-0.2650***	0.000
GA × EA	0.2879***	0.001
Exchange Rate (ER)	0.5586	0.408
Interest Rate (IR)	-3.2579	0.191
Leverage	0.0435	0.211
Firm Size	2.2448***	0.007
Firm Age	0.0090	0.205
Observations	82	
Overall R-squared	0.2787	
Prob > Chi^2	0.0000	

Note: * p < 0.10; ** p < 0.05; *** p < 0.01
Source: Processed secondary data

The model selection procedure indicates that the Random Effects Model (REM) is the most appropriate specification for the panel regression. This decision is supported by the Chow test rejecting the common effect model, the Hausman test favoring the random effects over the fixed effects specification, and the Lagrange Multiplier test confirming the presence of panel effects. Considering that panel data commonly suffer from heteroskedasticity and autocorrelation, this study applies clustered Robust Standard Errors to ensure that the estimation results remain consistent and statistically reliable. The regression results reported in Table 5 are estimated using REM in Stata 17 with the command re, vce (cluster id), which clusters standard errors at the firm level. This approach provides more dependable statistical inference by correcting for heteroskedasticity and within-panel serial correlation. A comparison of regression results before and after applying the robust procedure is presented in Appendix, while Table 5 summarizes the REM regression results after the robust adjustment.

Classical Assumption Tests

According to Gujarati & Porter (2009), the GLS approach addresses problems in classical regression models, particularly heteroskedasticity and autocorrelation, by producing more efficient estimators that satisfy the Best Linear Unbiased Estimator (BLUE) properties. In GLS, the variance and covariance structure of the error term are explicitly considered, so issues such as heteroskedasticity and autocorrelation are theoretically accommodated. Therefore, in GLS-based models such as the Random Effect Model, formal testing for these issues is not as essential as in OLS models, although careful interpretation of results remains necessary due to data characteristics. GLS can be viewed as a transformation of OLS that adjusts variables based on the error variance structure to improve efficiency, but it does not fully eliminate all data-related problems. Hence, in this study, despite using a GLS-based Random Effect Model, limited classical assumption testing is still conducted as a precaution, focusing only on multicollinearity to ensure the stability of coefficient estimates.

Normality Test

A summary of the test results for the model is presented in Table 6. From the calculation results, the significance value is 0.9403 > 0.05, so H_0 is accepted. This indicates that the residuals are normally distributed.

Table 6. Residual Normality Test Results

Model	Hypothesis	Prob > Chi²	Status
Panel Data Model	—	0.9403	Normal

Source: Processed secondary data, 2026

Multicollinearity Test

The multicollinearity test is conducted to ensure that there is no very strong relationship or perfect linear relationship among the independent variables. The test is performed by comparing the correlation values obtained from the panel regression calculation. If the VIF value < 10, then multicollinearity does not occur. A summary of the test results is presented in Table 7.

Table 7. Multicollinearity Test Results

Model	Hypothesis	Mean VIF	Status
Panel Data Model	—	3.10	Passed (No Multicollinearity)

Source: Processed secondary data, 2026

Hypothesis Testing

Simultaneous test (Wald Chi-Square)

This test examines whether the overall model is fit and whether all independent and moderating variables jointly affect Firm Value. In the Random Effect Model, this is assessed using the Wald Chi-Square statistic. As shown in Table 5 the Prob > chi² value is 0.0000 (< 0.05), indicating that the model is statistically fit to predict Firm Value.

Partial test (z-test)

The partial test evaluates the individual effect of each variable on Firm Value using the P>|z| value at a 10 % significance level. The empirical outcomes of this analysis are summarized in Table 8.

Table 8. Partial (z-test) Results

Hypothesis	Variable Tested	Prob (P>|z|)	Coefficient	Interpretation	Conclusion
H1	Green Accounting → Firm Value	0.076	-0.1532	Marginally significant at 10%; the negative coefficient indicates that greater green accounting disclosure is associated with a decrease in firm value	Rejected
H2	(Green Accounting × External Assurance) → Firm Value	0.001	0.2879	Significant moderating effect; external assurance strengthens the relationship between green accounting and firm value	Accepted

Source: Processed secondary data, 2026

Coefficient of Determination (R^2)

The coefficient of determination measures the model's explanatory power. In the Random Effect panel regression, the overall R-squared is used. The result shows an overall R^2 of 0.2787, indicating that, with External Assurance as a moderating variable, the model explains 27.87% of the variation in Firm Value, while 72.13% is explained by factors outside the model.

Robustness Check

Robustness Check Using Propensity Score Matching (PSM)

To mitigate potential selection bias arising from observable firm characteristics, this study conducts a robustness check using Propensity Score Matching (PSM). External assurance (EA) is defined as the treatment variable, while firm size, firm age, leverage, interest rate (IR), and exchange rate (ER) are included as covariates in the estimation of the propensity score. The matching procedure employs nearest-neighbor matching based on a logit specification. The covariate balance assessment indicates a notable improvement after matching, as empirically demonstrated in Table 9. The mean bias decreases substantially from 54.5% in the unmatched sample to 15.3% in the matched sample. In addition, the covariate balance test becomes statistically insignificant ($p = 0.761$), suggesting that treated and control firms are more comparable in terms of observable characteristics within the common support region.

Table 9. Covariate Balance Before and After Matching

Indicator	Unmatched	Matched
Mean Bias	54.5%	15.3%
p-value (covariate balance test)	0.000	0.761
ATT of EA on FV	0.112	-0.008 (not significant)
Sample status	Full sample	Common support subsample

Source: Processed secondary data, 2026

Following the matching procedure, the analysis is re-estimated on the common support subsample using a Random Effects model with clustered standard errors. The results remain qualitatively consistent with the baseline findings reported in Table 10. Specifically, external assurance (EA) continues to exhibit a statistically significant negative association with firm value, while the interaction term between green accounting and external assurance (GA×EA) remains positive and statistically significant. These findings suggest that the main empirical results are not primarily driven by observable differences in firm characteristics and are robust to potential selection bias concerns addressed through PSM. Overall, the PSM results provide additional support for the stability of the baseline findings, reinforcing the credibility of the estimated relationships in the main analysis.

Table 10. Random Effects Results After Matching

Variable	Coefficient	Significance
GA	-0.153	*
EA	-0.265	***
GA × EA	0.288	***
Control variables	Included	
Standard errors	Clustered	Yes

Source: Processed secondary data, 2026

The propensity scores matching results confirm that the baseline findings are robust to potential selection bias based on observable firm characteristics. This strengthens the internal validity of the empirical results and supports the conclusion that the observed relationships are not driven by systematic differences between treated and control firms in the pre-matching sample.

Discussion

The effect of green accounting on firm value

The empirical results show that Green Accounting affects Firm Value at the 10% significance level with a negative coefficient. Although marginally significant, this finding is theoretically meaningful because it reveals how investors in the energy sector interpret environmental disclosure when it is presented without independent verification. Rather than perceiving green accounting as a value-enhancing signal, the market appears to interpret it cautiously, associating it with potential cost burdens, compliance expenses, or even symbolic reporting practices that do not necessarily reflect substantive environmental performance.

From a signalling theory perspective, this result indicates that environmental disclosure alone does not automatically function as a credible signal. Signals that originate solely from internal corporate reporting are susceptible to scepticism, especially in environmentally sensitive industries such as energy, where stakeholders are highly aware of the gap between symbolic disclosure and actual environmental practices. This finding aligns with prior evidence from Fahad & Busru (2020) and Hutabarat (2024), which document that unverified sustainability disclosures may fail to enhance, and may even reduce, firm value due to concerns about credibility and greenwashing. Thus, while the market has begun to pay attention to sustainability disclosure, the response remains fragile. Green accounting, in this context, has not yet achieved the status of value-relevant information because investors question the reliability of self-declared environmental performance.

The moderating effect of external assurance on the relationship between green accounting and firm value

A more substantial finding emerges from the interaction between Green Accounting and External Assurance. The results indicate that External Assurance significantly strengthens and reverses the direction of the relationship between Green Accounting and Firm Value, with the interaction term significant at the 1% level. This reversal is not only statistically strong but also substantively important.

This finding suggests that external assurance transforms environmental disclosure into credible market information. When sustainability reports are independently verified, investors no longer interpret green accounting as a cost signal or potential greenwashing practice. Instead, it becomes a trustworthy indicator of genuine environmental commitment. This evidence is consistent with studies by Harymawan et al. (2020) and Shellyane & Dharmastuti (2025), which show that assurance increases investor confidence and enhances the valuation relevance of sustainability reporting.

Referring to the framework of Sharma et al., (1981), the significant interaction confirms that External Assurance operates as a quasi-moderator that changes the form of the relationship between Green Accounting and Firm Value. This means that the effect of green accounting is inherently contingent upon the presence of a credibility mechanism. In addition, following the argument of Busenbark et al., (2021) regarding Robustness of Inference to Replacement (RIR), the strong 1% significance of the interaction term indicates that the moderating conclusion is methodologically more stable than the direct effect of Green Accounting alone. Importantly, the rejection of H1 alongside the acceptance of H2 does not weaken the research model. Instead, it strengthens the theoretical contribution by demonstrating that the value relevance of green accounting is conditional rather than universal.

The findings show that sustainability information in the energy sector is primarily interpreted based on credibility. Green Accounting alone does not increase firm value due to concerns over the reliability of self-reported disclosures, but it becomes value-relevant when supported by External Assurance. This suggests that the key determinant is not the extent of disclosure, but its credibility. The study extends signalling theory by showing that signal effectiveness depends on both what is disclosed and who verifies it. External Assurance therefore strengthens credibility and influences whether Green Accounting is viewed as a cost or a signal of sustainable performance. Overall, the relationship between Green Accounting and Firm Value is contingent on the presence of credible external verification.

Implications

The findings carry several implications. For corporate managers, the results indicate that sustainability disclosure should be supported by governance mechanisms that enhance credibility. Firms in environmentally sensitive industries may not obtain valuation benefits simply by increasing the volume of disclosure. What matters is whether investors view the disclosure as reliable and relevant to actual corporate conduct.

For regulators, the results support efforts to strengthen sustainability reporting quality and to encourage greater transparency regarding assurance scope, assurance provider, and reporting criteria. More consistent reporting and assurance practices could reduce information asymmetry and improve market discipline. For investors, the results suggest that sustainability reports should be assessed together with the existence of independent verification rather than being read as stand-alone claims.

Conclusion

This study shows that green accounting, by itself, does not enhance firm value among Indonesian energy firms. Its direct effect is negative and relatively weak, suggesting that environmental disclosure without credible verification may be interpreted by investors as an additional cost or a potential indication of greenwashing. In the absence of credibility support, green accounting fails to operate as an effective market signal.

The central finding is that external assurance functions as a quasi-moderator that significantly strengthens the relationship between green accounting and firm value. Independent verification transforms environmental disclosure into value-relevant information, indicating that the effectiveness of sustainability reporting is inherently dependent on credibility. This result reinforces signaling theory by demonstrating that assurance serves as a mechanism that enhances the credibility of corporate signals. From a practical perspective, managers should not rely solely on the extent of disclosure but should integrate assurance mechanisms to improve the quality and credibility of sustainability information. Regulators may also consider encouraging assurance practices to strengthen the reliability of sustainability reporting in capital markets.

This study has several limitations that should be considered when interpreting the findings. The analysis is situated within energy sector firms that consistently publish sustainability reports, where environmental disclosure forms a visible part of corporate communication with investors. The study relies on disclosure-based measures of green accounting because such information is directly observable and evaluated by the market. External assurance is examined in terms of its presence as an institutional credibility mechanism rather than variations in its scope or quality, and the panel regression model is designed to capture contemporaneous relationships during the observation period.

Future research can extend this framework by exploring differences in assurance quality and standards, employing alternative proxies for environmental performance, or applying the model across different industries and institutional contexts. Additional governance variables and alternative research designs may also be incorporated to deepen understanding of how sustainability reporting is interpreted in capital markets.

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