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Sustainability Reporting through Green Accounting: The Moderating Impact of ESG on Energy Firms' Financial Performance

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ABSTRACT

This study examines the effect of green accounting on the financial performance of Indonesian energy firms, with Environmental, Social, and Governance (ESG) implementation as a moderating variable. Using a sample of 18 energy companies listed on the Indonesia Stock Exchange during 2021–2023 (54 firm-year observations), this study applies multiple regression analysis with interaction terms. Financial performance is measured by Return on Assets (ROA), while green accounting is proxied by renewable energy (RE), recycled materials (RM), environmental cost (EC), and emission waste (EW). The results show that emission waste has a positive and significant effect on financial performance ($\beta = 0.416$; $p = 0.001$), whereas EC negatively affects ROA ($\beta = -0.195$; $p = 0.036$). RE and RM do not exhibit significant direct effects. However, ESG implementation plays a critical moderating role. ESG strengthens the relationship between RE and financial performance ($\beta = 0.240$; $p = 0.016$) as well as between RM and financial performance ($\beta = 0.262$; $p = 0.018$). In contrast, ESG intensifies the negative effect of EC ($\beta = -0.185$; $p = 0.048$) and amplifies the positive association between EW and financial performance ($\beta = 0.494$; $p < 0.001$). These findings suggest that green accounting practices alone are insufficient to enhance financial performance; rather, ESG implementation determines whether environmental initiatives are translated into financial value or remain short-term cost burdens.

1. INTRODUCTION

Environmental issues are becoming a global concern due to the impacts of climate change, pollution, and degradation of natural resources [1]. Countries face significant challenges in reducing carbon emissions, maintaining ecosystem sustainability, and ensuring the availability of resources for future generations. Energy, as a key driver of industry, transportation, households, and other sectors, is crucial for economic growth and global competitiveness [2]. However, it is also the main driver of greenhouse gas emissions, accounting for more than 70% of total emissions from fossil fuel combustion. This creates a dilemma for energy companies that must meet demand while reducing environmental impacts. Intensive resource exploitation further contradicts the need for preservation [3]. The energy transition has thus become a priority agenda through the Net Zero Emissions 2060 policy and the Renewable Energy (RE) program. Nevertheless, based on ESDM, RE's share in Indonesia's national energy mix remains only 13.1%, below the 2025 target of 23%. One effort undertaken by various countries to reduce emissions and dependence on fossil fuels is the use of RE. RE is mainly applied in electricity generation, but it can also be harnessed for heating residential and commercial buildings. As technological innovations, renewable biofuels are increasingly used to decarbonize certain transportation sectors. In Indonesia, total energy consumption in 2021 accounted for 13.33%.

In addressing these environmental challenges, companies need a mechanism to integrate environmental factors into their accounting and financial reporting. One emerging approach is green accounting, which focuses on identifying, measuring, and reporting environmental costs (EC) and benefits associated with corporate activities [4]. Green accounting provides quantitative information about how business operations affect natural resources, emissions, and environmental restoration. It enables firms to internalize environmental externalities into their financial systems, promoting transparency and accountability in sustainability-related performance. With green accounting, companies focus not only on financial performance but also consider their environmental impacts, such as carbon emissions, energy consumption, natural resource use, and environmental recovery costs. This can encourage companies in the energy sector and other sectors to innovate, improve energy efficiency, and invest in clean technology.

However, sustainability management today is not limited only to environmental accounting. The global investment community increasingly evaluates corporate sustainability through Environmental, Social, and Governance (ESG) criteria. ESG is a broader framework that assesses how companies integrate ESG practices into their strategic and

operational decisions. Companies that understand the importance of integrating ESG measures into their objectives will be better prepared to face today's global challenges. This raises important questions about the impact of robust ESG practices on an organization's financial results and stakeholder relationships [5].

In this context, green accounting provides measurable data to supports ESG disclosure**,** while ESG serves as a governance framework that interprets and used this data to enhance strategic decision-making and stakeholder trust. Therefore, green accounting and ESG are conceptually distinct but complementary: the former emphasizes environmental measurement and financial recognition, while the latter focuses on corporate governance and sustainability performance evaluation. Companies with high levels of pollution can achieve a balance between financial and environmental performance by disclosing relevant environmental accounting information. This information is based on a carbon strategy, a carbon economy, and a carbon trading framework, all of which are based on a low-carbon development model. This approach not only creates a win-win situation for the company but also enhances its reputation, attracts investors focused on ESG factors, and supports the achievement of the 2060 Net Zero Emissions target [5, 6].

In Indonesia, the relevance of green accounting is reinforced by the fact that RE accounts for only 13.1% of the national energy portfolio. The energy sector faces a dual challenge: meeting rising energy demands while minimizing environmental impacts. By applying green accounting practices, energy companies can systematically record and disclose EC such as RE use, material recycling, emission control, and waste management that reflect their environmental efficiency. Meanwhile, ESG implementation ensures that these environmental disclosures are integrated into broader sustainability governance, thus influencing stakeholder perceptions and investment decisions [7].

Several previous studies provide empirical evidence on the relationship between green accounting and corporate performance. Khan and Gupta [7] found that green accounting positively impacts company performance, but the quality of accounting standards in a country can add complexity and costs. Rahman and Islam [8] found that green accounting improves energy efficiency and environmental performance. Maama and Appiah [9] found that financing sources influence the level of green accounting disclosure, with equity financing increasing disclosure compared to debt financing. Rahaman et al. [10] showed that green accounting disclosure has a positive effect on financial performance, reinforced by green innovation and environmental penalties as moderating variables, while Wang and Xia [11] emphasized the role of green accounting in improving the quality of accounting information, reducing financing constraints, and increasing goodwill.

This study investigates the role of green accounting in enhancing the financial performance of Indonesian energy firms, with ESG implementation as a moderating variable. The selection of the energy sector was not without reason, considering that this industry is a key driver of the economy and also the largest contributor to carbon emissions. Energy companies face dual pressures: meeting increasing national energy needs in line with economic growth while simultaneously reducing the environmental impact of their operations. By implementing green accounting practices, energy companies can be more transparent in reporting EC and impacts, such as carbon emissions, RE use, and environmental mitigation costs. Furthermore, strengthening the implementation of ESG principles can strengthen the relationship between green accounting and financial performance, while also enhancing investor confidence and the company's public reputation. It aims to clarify how environmental accounting mechanisms interact with corporate governance systems to produce financial and reputational value. This conceptual distinction contributes to the literature by strengthening the theoretical differentiation between environmental measurement (green accounting) and governance-based sustainability evaluation (ESG).

Although numerous previous studies have examined the relationship between green accounting and corporate performance, a research gap remains. Most studies, including research on Rahaman et al. [10], Aisbett et al. [12], and Holmes and Yarrow [13], focus on manufacturing, pharmaceutical, or cross-border companies, while studies specifically focusing on energy companies are limited. Second, previous studies have primarily used mediating variables such as green innovation and energy efficiency, while the moderating role of ESG implementation has been underexplored. This is despite ESG being a key indicator that global investors use to assess corporate sustainability and governance. Third, previous studies have generally measured green accounting, whereas this study specifically measures indicators such as RE, recycled materials (RM), EC, and emissions, which are more relevant to the characteristics of energy companies.

Based on these findings, this study offers novelty by examining the effect of green accounting on the financial performance of energy companies, with ESG implementation as a moderating variable. This research is crucial for providing empirical evidence on the extent to which green accounting practices not only improve financial performance but also strengthen a company's sustainability reputation in the eyes of investors and regulators.

2. LITERATURE REVIEW

2.1 Theoretical and conceptual background

Research on green accounting can be explained through a combination of stakeholder theory, legitimacy theory, and the resource-based view (RBV). Stakeholder theory emphasizes that companies are responsible not only to shareholders but also to all stakeholders, such as investors, employees, consumers, the community, and the government [14]. Therefore, companies are required to manage their economic impacts while also considering social and environmental aspects. In this context, green accounting is a crucial tool that provides information on EC and benefits, helping companies create long-term value for stakeholders and reducing information asymmetry [15].

Meanwhile, a middle theory, legitimacy theory, explains that companies strive to maintain their existence by aligning their activities with societal norms, values, and expectations. Environmental reporting through green accounting serves as a legitimizing mechanism that demonstrates corporate commitment to sustainability, helping firms maintain public trust and regulatory compliance [16].

Building on these perspectives, the RBV offers a complementary explanation for the moderating role of ESG.

According to RBV, companies gain a competitive advantage from internal resources that are valuable, rare, inimitable, and non-substitutable. Green accounting creates an internal capability by generating reliable environmental performance data. However, translating this capability into improved financial performance depends on the firm's governance system and strategic orientation. Here, ESG implementation functions as an enabling mechanism that transforms environmental information from green accounting into strategic value creation**.** Strong ESG practices ensure that environmental data are effectively utilized for risk management, innovation, and stakeholder engagement, ultimately amplifying financial performance [15, 16].

2.2 Green accounting

Green accounting, also known as environmental accounting, is an accounting approach that integrates environmental factors into a company's financial reporting. It aims to identify, measure, and disclose EC and benefits arising from corporate operations. Through green accounting, firms internalize environmental externalities by recognizing the financial implications of resource consumption, pollution control, waste management, and environmental restoration [16]. This practice enables companies to evaluate their environmental efficiency, enhance transparency, and demonstrate accountability to stakeholders, in line with stakeholder and legitimacy theories. Furthermore, green accounting serves as a measurement tool that generates quantitative data to support sustainability and ESG disclosures, allowing investors and regulators to assess a company's commitment to sustainable development [16].

In this study, green accounting is operationalized through four measurable indicators that reflect the firm's environmental performance: RE, RM, EC, and emission waste (EW). The use of RE indicates the company's efforts to reduce dependence on fossil fuels and improve long-term energy efficiency, representing proactive investment in sustainable resources [17]. RM reflect the implementation of circular economy principles, emphasizing resource conservation and waste reduction through material reuse. EC capture the firms' financial commitment to preventing and mitigating environmental damage, including expenditures for pollution control, waste treatment, and environmental certification. Lastly, EW measures the company's effectiveness in managing pollutants and minimizing greenhouse gas emissions, serving as a critical indicator of environmental impact management.

These four indicators collectively provide a comprehensive view of environmental performance, covering the entire ecological cycle from input utilization (energy and materials) to environmental outputs (costs and waste). They have been widely adopted in previous studies [18, 19], as reliable proxies for green accounting implementation. Thus, the measurement of green accounting through these indicators captures not only a firm's internal environmental efficiency but also its strategic commitment to sustainable operations and financial value creation.

2.3 Environmental, Social, Governance

ESG is an evaluation framework used to assess how well a company integrates sustainability principles into its business strategy, operations, and corporate governance. ESG comprises three main dimensions: the environmental aspect, which evaluates ecological impacts and resource management efforts; the social aspect, which examines responsibilities toward employees, communities, and customers; and the governance aspect, which assesses oversight structure, transparency, and corporate ethics [10]. Sustainability hinges on the dynamic interaction of environment, economy, and equity [17].

Although ESG and green accounting are often associated because both are oriented toward sustainability, they differ conceptually and functionally. Green accounting is an accounting measurement and reporting system focused on identifying, recording, and reporting the EC and benefits of corporate activities. In other words, green accounting produces quantitative environmental data such as RE use, RM, EC, and emissions or waste management that reflect a company's ecological efficiency. Conversely, ESG functions as a strategic and governance framework that utilizes such information for decision-making, risk management, and enhancing firm value.

In this study, green accounting serves as a measurement system that provides environmental data, while ESG serves as a governance framework that strengthens the link between environmental and financial performance. Companies with high levels of ESG implementation can convert the measurement outcomes of green accounting into value-added sustainability strategies that enhance legitimacy, reputation, and investor trust. Therefore, the fundamental distinction between the two lies in their scope and function: green accounting is operational, focusing on measuring environmental impacts, whereas ESG is strategic, encompassing social and governance dimensions and playing a key role in directing and reinforcing the overall implementation of corporate sustainability practices [18].

Figure 1 illustrates the conceptual framework of this study, which integrates the principles of green accounting and the implementation of ESG in explain their impact on the financial performance of energy firms. The framework highlights how specific dimensions of green accounting serve as measurable indicators of environmental responsibility, while ESG functions as a moderating variable that strengthens the relationship between environmental performance and financial outcomes.

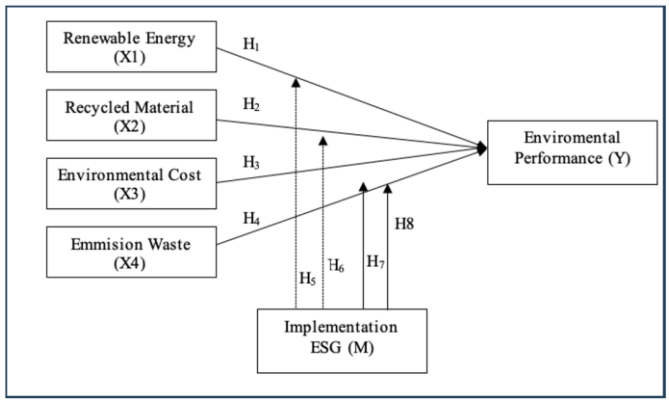

Figure 1. Conceptual framework
Source: Author's own work

2.4 The effect of renewable energy on financial performance

RE is a crucial component of green accounting practices because it reflects a company's commitment to environmental

sustainability and impacts its financial results [19]. RE, such as solar, wind, hydro, and biofuels, helps reduce dependence on fossil fuels and greenhouse gas emissions. Within the green accounting framework, disclosure of RE use measures the extent to which a company integrates environmental considerations into its operations and reporting [20]. From a financial perspective, using RE can improve company performance through several mechanisms. First, RE can lower long-term operating costs by reducing dependence on volatile fossil fuel markets, thereby increasing cost efficiency and profitability [21]. Second, adopting RE strengthens a company's reputation and legitimacy in the eyes of stakeholders, particularly investors focused on ESG criteria. Third, compliance with environmental regulations through RE can minimize the risk of sanctions and open opportunities to obtain government incentives or subsidies.

Several studies, including those by Wahyuni et al. [19], show that implementing RE positively impacts financial performance. Companies that disclose RE initiatives as part of their green accounting practices tend to be perceived as more transparent, accountable, and resilient, thus attracting investment and increasing Return on Assets (ROA). Therefore, RE contributes to environmental sustainability and supports financial sustainability by efficiently utilizing company assets to generate long-term economic benefits.

H_1: *RE has a positive impact on financial performance.*

2.5 The effect of recycled material on financial performance

RM are derived from the recycling process, either from production waste or unused products, reused as production inputs. Using RM is part of implementing green accounting, which focuses on resource efficiency and environmental sustainability. Recycled waste, in the Environmental Accounting Guidelines, is defined as waste that is reused or recycled and recovered [22].

By utilizing RM, companies can reduce waste in the environment, prevent the exploitation of new natural resources, and lower the generally fluctuating and expensive cost of purchasing raw materials. This helps companies contribute to environmental sustainability and supports the development of more efficient, sustainable production processes [23].

Using RM can provide significant added value from a financial performance perspective. Savings on raw material costs directly increase company profitability, while a positive image as an environmentally friendly company encourages increased consumer trust and market loyalty. Research by Wahyuni et al. [19] also shows that RM positively impact financial performance. This support ultimately leads to increased company value and long-term business sustainability. Quantitatively, this impact can be reflected in improvements in economic performance indicators such as ROA, driven by increased net profit in line with cost efficiency and strengthened market competitiveness.

H_2: *RM has a positive impact on improving financial performance.*

2.6 The effect of environmental cost on financial performance

EC are a key component of green accounting, reflecting a company's commitment to managing the environmental impacts arising from its operations. These costs include all expenditures allocated to pollution prevention, waste control, environmental restoration, and compliance with environmental regulations. The disclosure of EC information not only serves as an internal control tool but also provides stakeholders with transparency into the company's environmental responsibility [18]. Accordingly, EC are an important indicator of the extent to which a company integrates sustainability into its business strategy and financial performance [24].

From the perspective of stakeholder theory, companies are required not only to focus on profit maximization but also to be accountable for the social and environmental impacts of their operations. Several empirical studies indicate that the allocation of EC positively affects financial performance. Wahyuni et al. [19] suggested that EC allocation reflects a company's commitment to responsible environmental management, which enhances corporate credibility and stakeholder trust. Andi Yuliana [25] found that investments in environmental conservation activities embedded in EC allocation can improve firm profitability and overall financial performance.

Although several empirical studies suggest that EC allocation can positively influence financial performance by enhancing corporate credibility and stakeholder trust, EC may also impose financial burdens on firms. The allocation of substantial funds to environmental management increases operational expenses and reduces net income, particularly when the economic benefits of these investments are not realized immediately. Consequently, higher EC can exert pressure on profitability and weaken financial performance in the short term. This indicates that, despite their importance for sustainability and stakeholder legitimacy, EC may negatively affect a company's financial performance.

H_3: *EC has a negative impact on improving financial performance.*

2.7 The effect of emmision waste on financial performance

EW refers to exhaust gases or carbon emissions released into the air due to a company's production and operational activities [26]. High, uncontrolled emissions can exacerbate air pollution, accelerate climate change, and put regulators and the public under pressure. Therefore, within a green accounting framework, emissions disclosure and management are essential metrics for assessing the extent to which a company integrates sustainability aspects into its business strategy [27].

EW in this study is measured as the proportion of waste disposed of through landfilling relative to total waste generated by a company. A higher EW ratio indicates greater reliance on landfill disposal, reflecting lower efficiency in waste management efficiency and weaker implementation of environmentally responsible practices. From a stakeholder theory perspective, companies are expected to manage waste responsibly in order to meet stakeholder expectations for environmental sustainability. Excessive reliance on landfilling may increase environmental risks, regulatory pressure, and negative public perception, thereby adversely affecting corporate reputation and financial performance.

Furthermore, legitimacy theory suggests that firms seek to operate within socially accepted environmental norms. High levels of landfill disposal may signal non-compliance with sustainability expectations, thereby threatening corporate legitimacy and increasing potential costs related to regulation,

remediation, and social pressure. In addition, from the RBV, heavy reliance on landfilling reflects inefficient resource use, as waste that could be recycled or reused is disposed of, leading to higher operational costs and lost economic value. Therefore, higher EW is expected to reduce profitability and weaken financial performance.

H4: *EW has a negative impact on improving financial performance.*

2.8 The effect of renewable energy on financial performance moderated by ESG implementation

The adoption of RE can positively impact a company's financial performance. However, this relationship is not isolated; sustainability governance factors can influence it. In this context, ESG factors act as moderators, strengthening or weakening the influence of RE use on financial performance. Companies with strong ESG implementation tend to be better able to optimize the benefits of RE because their governance systems, social strategies, and environmental concerns are aligned with sustainability goals.

Previous research supports this view. According to Kumari et al. [28], using RE contributes to sustainable development by increasing efficiency and creating economic value for the company. Rounaghi [29] also emphasized that green accounting and environmental practices are closely related to increased profitability and sustainability indicators. Furthermore, a study by Wahyuni et al. [19] found that implementing environmentally friendly practices in the mining and energy sectors improved environmental performance, ultimately positively impacting financial performance. Therefore, it can be concluded that the combination of RE utilization and ESG implementation provides synergy in driving better economic performance.

H5. *ESG implementation strengthens the influence of RE on a company's financial performance.*

2.9 The effect of recycled material on financial performance moderated by ESG implementation

The use of RM not only reduces waste but also lowers production costs by reusing materials that still have value. However, this effect is not absolute, as it depends heavily on how companies integrate sustainability into their governance systems. In this context, implementing ESG practices serves as a moderating variable, strengthening the relationship between the use of RM and improved financial performance. Companies with high ESG levels tend to reap greater benefits because the use of RM is seen not only in cost-efficient but also in enhancing reputation, investor confidence, and compliance with environmental regulations.

Several studies support this view. Rosaline and Wuryani [30] found that implementing green accounting, including the use of RM, contributes to improved company economic performance. Similarly, Wahyuni et al. [19] stated that implementing environmentally friendly practices positively impacts the performance of mining and energy companies in Indonesia. Furthermore, Latifah and Soewarno [31] emphasized that environmental accounting and waste management strategies, including material reuse, are crucial factors in maintaining the sustainability of MSME businesses. Therefore, the synergy between using RM and implementing ESG significantly contributes to achieving sustainable corporate financial performance.

H6: *ESG implementation strengthens the influence of material recycling on corporate financial performance.*

2.10 The effect of environmental cost on financial performance moderated by ESG implementation

EC reflect a company's commitment to environmental responsibility, including waste management, investments in environmentally friendly technology, and the restoration of damaged ecosystems. In the short term, ecological costs are often viewed as an additional burden that can reduce profits. However, in the long term, these cost allocations can improve financial performance by helping companies comply with regulations, reduce the risk of fines, minimize potential pollution-related losses, and enhance their image and reputation among stakeholders. The role of ESG as a moderating variable is crucial. Companies with strong ESG implementation can transform EC from mere expenses into strategic investments that increase efficiency, innovation, and competitiveness, thus strengthening their impact on financial performance.

Research by Dita and Ervina [32] also found that EC significantly influence the financial performance of mining companies in Indonesia. Rounaghi [29] added that recognizing and reporting EC can identify sustainability indicators and provide stakeholders with a more realistic economic picture. Thus, when supported by effective ESG implementation, EC expenditure can be a long-term investment strategy that drives improved corporate financial performance.

H7: *ESG implementation strengthens the influence of EC on corporate financial performance.*

2.11 The effect of emmision waste on financial performance moderated byESG implementation

Emissions waste, including greenhouse gases, air pollutants, and other hazardous waste, reflect the effectiveness of a company's environmental management practices [33]. High levels of EW indicate poor environmental control, which can increase environmental risks, regulatory pressure, and compliance costs. From the perspective of stakeholder theory, companies that fail to manage waste emissions adequately may experience declining stakeholder trust and legitimacy, leading to reputational damage and reduced market confidence. These conditions can ultimately weaken operational efficiency and negatively affect financial performance. Therefore, higher emissions are expected to reduce a company's financial performance [26].

The role of ESG factors is essential in shaping the relationship between emissions and financial performance. Strong ESG implementation can mitigate the negative impact of EW by enhancing transparency, improving governance quality, and encouraging responsible environmental practices. Companies with strong ESG performance are perceived as more accountable and sustainability-oriented, which helps reduce reputational risk, regulatory sanctions, and financial uncertainty. Conversely, weak ESG practices may intensify the adverse effects of high EW on financial performance. Thus, ESG functions as a moderating mechanism that influences the extent to which emissions affect a company's financial performance.

H8: *ESG implementation weakens the negative effect of waste emissions on corporate financial performance.*

3. RESEARCH METHOD

This study used a quantitative approach to analyze a specific population and sample. The collected data are processed using statistical techniques to describe data characteristics and to test the proposed research hypotheses. This study used secondary data obtained from Sustainability Reports and Annual Reports of energy companies listed on the Indonesia Stock Exchange (IDX), as well as from the companies' official websites. Data collection is conducted using a documentation method by gathering relevant documents from various information sources. The data analysis technique in this study utilizes IBM SPSS software version 26.

3.1 Population and sample

The population in this study is 91 energy companies listed on the IDX. The sampling technique used purposive sampling to select samples based on specific criteria: 1. Energy companies listed on the IDX 2. Companies disclosing sustainability reports and have complete data required for the study, and 3. Companies have an ESG score for the 2021-2023 period. Table 1 presents the sample selection process for the 91 energy companies listed on the IDX. 67 companies were excluded from the sample because they did not disclose sustainability reports or complete data, and 6 companies did not have an ESG score for the 2021-2023 period. Therefore, the sample size was 18 companies per year, for a total of 54 research samples.

Table 1. Process of sample selection

No.	Criteria	Not According to Criteria	Total
1	Energy companies listed on the Indonesia Stock Exchange (IDX) during the research year.		91
2	Companies that disclose sustainability reports and have complete data	(67)	24
3	Companies that have an ESG score	(6)	18
	The sample number that meets the criteria		18
	Years of study		3 years
	Total number of sample observations		**54**

Source: Author's own work
Note: ESG is Environmental, Social, Governance.

3.2 Definition of variable

3.2.1 Dependent variable

The dependent variable in this study uses financial performance. Financial performance describes a company's financial condition during a specific period, including its ability to raise funds and allocate capital in accordance with Financial Accounting Standards (FASB), Generally Accepted Accounting Principles (GAAP), and other applicable regulations.

In this study, profitability ratios serve as a measure of financial performance, with the indicator used being ROA. ROA is a profitability ratio that measures a company's ability to generate net income from its total assets. This ratio illustrates the extent to which a company's assets are optimally utilized to generate profits. The higher the ROA, the better the company's performance, indicating that its assets contribute significantly to net income [34]. Consistent with research by Riadi and Aqshal [35], financial performance in this study is viewed from a management perspective, as reflected in ROA. This indicator demonstrates an entity's ability to generate net income before tax compared to its total assets.

ROA	Return on Assets	$ROA = \frac{Net\ Income}{Total\ Asset}$

3.2.2 Independent variable

The independent variable in this study is green accounting, divided into RE, RM, EW, and EC. RE is defined as using environmentally friendly sources, such as solar, wind, water, and biomass, reflecting a company's commitment to reducing its dependence on fossil fuels and carbon emissions. RM are the reuse of used materials or production waste in the production process, demonstrating a company's efforts to increase resource efficiency while reducing waste [34]. Furthermore, EW is understood as the company's operational waste, whether in the form of gas, liquid, or solid, that has the potential to pollute the environment. This variable therefore, illustrates the extent to which the company controls and reduces pollutants in accordance with environmental standards. Meanwhile, EC are defined as all expenses allocated by the company for activities related to environmental conservation, such as pollution prevention, waste treatment, and energy conservation, reflecting the company's concern for sustainability through investment in environmental aspects.

RE	Renewable Energy	$RE = \frac{Total\ Renewable\ Energy}{Total\ Energy\ Consumption}$
RM	Recycled Material	$RM = \frac{Total\ Volume\ Recycled\ Material}{Total\ Waste\ Material}$
EC	Environmental Cost	$EC = \frac{Environmental\ Cost}{Total\ Cost}$
EW	Emission Waste	$EW = \frac{Land\ Filling}{Total\ Waste}$

3.2.3 Moderating variable

The moderating variable in this study is ESG. ESG is a framework for assessing company performance across three main dimensions: environmental, social, and corporate governance. This variable is a moderator because ESG practices are believed to strengthen or weaken the relationship between the independent variables and a company's financial performance. In this study, ESG is measured using an ESG score that reflects the extent to which a company implements ESG practices. The ESG score was obtained from Bloomberg data and cross-referenced with the ESG score available on the IDX.

ESG	Implementasi ESG	$ESG\ Score$

Based on the ESG score assessment, listed companies are classified into one of five categories presented in Table 2.

Table 2. ESG score assessment

Risk Score	Category	Description
0-10	Negligible	Considered to have negligible ESG risk
10-20	Low	Considered to have low ESG risk
20-30	Medium	Considered to have moderate ESG risk
30-40	High	Considered to have high ESG risk
> 40	Severe	Considered to have severe ESG risk

Source: Indonesia Stock Exchange (IDX)
Note: ESG is Environmental, Social, Governance

3.3 Model testing

Hypothesis 1 through 8 were tested using multiple regression analysis. The research model used is presented below.

$$ROA = \alpha + \beta_1 RE_{it} + \beta_2 RM_{it} + \beta_3 EC_{it} + \beta_4 EW_{it} + \beta_5 RE_{it} * ESG_{it} + \beta_6 RM_{it} * ESG_{it} + \beta_7 EC_{it} * ESG_{it} + \beta_8 EW_{it} * ESG_{it} + \varepsilon_i$$

ROA represents a financial performance measured by ROA; α represents a constant; β represents the regression coefficient. *RE* represents a renewable energy; *RM* represents a recycled material; *EC* represents environmental cost; *EW* represents emission waste; *ESG* represents the implementation ESG and $\mathcal{E}$ is an error.

4. RESULTS

4.1 Descriptive statistics analysis

Descriptive statistical analysis is presented to provide an overview of the characteristics of the research data. Descriptive statistics include the number of samples, minimum, maximum, average, and standard deviation values of each research variable. The results of this analysis provide information on the distribution of the data and the trend of each variable, so they can be used as a basis for understanding the relationships between variables in the next stage of analysis.

Based on the descriptive statistical analysis, this study uses 54 observations for each variable. The ROA variable has a minimum value of 0.01 and a maximum value of 0.54, with a mean of 0.192 and a standard deviation of 0.157. This indicates that company profitability varies considerably among the sampled firms. The RE variable shows a minimum value of 0.00 and a maximum value of 0.69, with an average of 0.240 and a standard deviation of 0.214, suggesting that the utilization of RE is still relatively low on average, although some companies have implemented it at a high level. Furthermore, the RM variable has a minimum value of 0.00 and a maximum value of 0.59, with a mean of 0.308 and a standard deviation of 0.169. This implies that, on average, companies use RM at a level of 30.8%, with a moderate variation across firms. The EC variable records a minimum value of 0.01 and a maximum value of 0.68, with an average of 0.105 and a standard deviation of 0.178, indicating that EC incurred by companies are generally low, although there are notable differences among companies.

Meanwhile, the EW variable has a minimum value of 0.001 and a maximum value of 0.65, with a mean of 0.144 and a standard deviation of 0.186. This result shows that waste emissions tend to be relatively low on average, but with substantial variability between firms. Lastly, the ESG variable has a minimum score of 32.99 and a maximum score of 76.32, with an average value of 51.23 and a standard deviation of 12.40, indicating moderate ESG performance with a fairly wide distribution across the observed companies (Table 3).

Table 3. Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ROA	54	0.01	0.54	0.192	0.157
RE	54	0.00	0.69	0.240	0.214
RM	54	0.00	0.59	0.308	0.169
EC	54	0.01	0.68	0.105	0.178
EW	54	0.001	0.65	0.144	0.186
ESG	54	32.99	76.32	51.23	12.40

Notes: ROA is Financial Performance; RE is Renewable Energy; RM is Recycled Material; EC is Environmental Cost; EW is Emmision Waste; ESG is Environmental, Social, Governance.

4.2 Classical assumption test

4.2.1 Normality test result

The normality test is conducted to examine whether the data or residuals in the research model are normally distributed.

Table 4 presents the results of the One-Sample Kolmogorov-Smirnov test used to assess the normality of the data. The test yielded a significance value (Asymp. Sig. 2-tailed) of .200, which is greater than the significance level of .05. This indicates that there is no significant difference between the data distribution and the normal distribution. Therefore, the residual data are normally distributed**.** The normality of residuals suggests that the regression model satisfies one of the key classical assumption tests, thereby validating its use for further statistical analysis.

Table 4. One-Sample Kolmogorov-Smirnov test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		54
Normal Parameters[a,b]	Mean	.000
	Std. Deviation	.097
Most Extreme Differences	Absolute	.103
	Positive	.103
	Negative	-.044
Test Statistic		.104
Asymp. Sig. (2-tailed)		.200[c,d]

4.2.2 Multicollinearity test result

The multicollinearity test is used to determine the presence of high correlations among independent variables in the regression model, which may affect the reliability of the regression results.

Based on Table 5, the multicollinearity test results, all independent variables show tolerance values greater than 0.10 and Variance Inflation Factor (VIF) values below 10. These results indicate that there is no high correlation among the independent variables in the regression model. Therefore, it can be concluded that the model is free from multicollinearity problems, and each independent variable can be used reliably to explain the dependent variable.

Table 5. Multicollinearity test

Coefficients[a]			
Model		Collinearity Statistics	
		Tolerance	VIF
1	RE	.927	1.079
	RM	.845	1.184
	EC	.985	1.015
	EW	.605	1.653
	ESG	.686	1.457
a. Dependent Variable: ROA			

4.2.3 Autocorrelation test result

The autocorrelation test examines whether residuals across observations in the regression model are correlated. This study uses the Durbin–Watson (DW) statistic to detect autocorrelation. A regression model is considered free from autocorrelation if the DW value lies between 1.5 and 2.5, indicating that the residuals are independent across observations.

Based on Table 6, the DW (d) value is 1.483. This value is compared with the DW critical values at the 5% significance level using the formula (k′; N). The value of k represents the number of independent variables, which is 3, while N represents the sample size of 54. Therefore, (k′; N) = (4; 54). The value (4; 54) is then referred to the DW distribution table at the 5% significance level, as shown in the following Figure 2.

Table 6. Durbin-Watson test

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin-Watson
1	.786[a]	.617	.578	.1025	1.483

a. Predictors: (Constant), Skor ESG, RM, EC, RE, EW
b. Dependent Variable: ROA

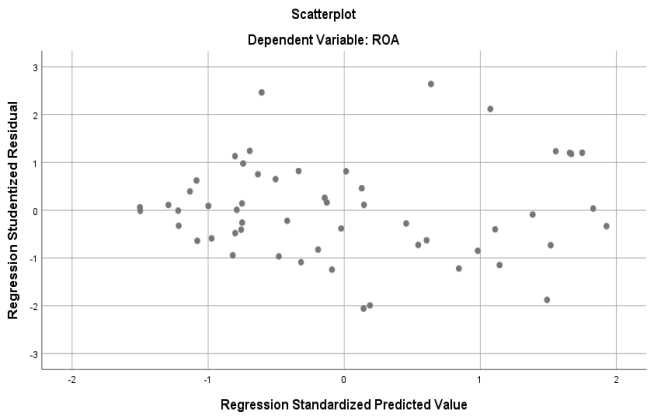

Figure 2. Heteroscedasticity test result

In Figure 2, with (k′; N) = (4; 54), the lower bound (dL) is 1.406 and the upper bound (dU) is 1.723, while the DW (d) value of the regression model is 1.483. This indicates that the DW value lies between dL and dU (1.406 < 1.483 < 1.723). According to the decision rule of the DW test, when the value of d lies between dL and dU or between (4 − dU) and (4 − dL), the test result is inconclusive. Therefore, it can be stated that there is no autocorrelation in the regression model.

4.2.5 Heteroscedasticity test result

The heteroscedasticity test in this study is conducted using a scatterplot of standardized residuals against predicted values. This method is used to examine whether the residuals exhibit a certain pattern. If the data points are randomly distributed and do not form a clear pattern, it indicates that the regression model is free from heteroscedasticity.

Based on the heteroscedasticity test results, the data points are randomly distributed with no clear pattern. The points do not show a tendency to cluster above or below the zero line. This indicates that the data do not exhibit any symptoms of heteroscedasticity.

4.3 Multiple regression analysis

The use of multiple regression in testing hypotheses 1 through 8 aims to determine the extent to which sustainable practices, as measured by environmental indicators, can impact a company's financial performance. The regression test results provide information on the direction of the relationship (positive or negative), the level of significance, and the magnitude of each independent variable's influence on the dependent variable. Table 7 presents the results of the hypothesis tests (H1, H2, H3, H4, H5, H6, H7, and H8).

Table 7. Multiple regression analysis

Coefficients	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	Std Error	Beta	T	Sig.
(Constant)	-.93	.073		-1.27	.210
RE	.132	.057	.213	2.295	.226
RM	.198	.088	.219	2.260	.228
EC	-.376	.174	-.195	-2.16	.036
EW	.281	.078	.416	3.620	.001
ESG	.003	.001	.246	2.282	.027
RE*ESG	.003	.001	.240	2.487	.016
RM*ESG	.004	.002	.262	2.458	.018
EC*ESG	-.006	.003	-.185	-2.02	.048
EW*ESG	.005	.001	.494	4.376	.000

Dependent variable: ROA.

The first hypothesis test, the effect of RE on financial performance, was insignificant (Sig value = 0.226 > 0.05), indicating that H1 was rejected. The second hypothesis test, the effect of RM on financial performance, was also insignificant (Sig value = 0.228 > 0.05), indicating that H2 was rejected. The third hypothesis test, the effect of EC on financial performance, was significant with a negative direction (Sig value = 0.036 < 0.05; β = −0.195), indicating that H3 was accepted. The fourth hypothesis test shows that waste emissions (EW) have a significant positive effect on financial performance (Sig value = 0.001 < 0.05; β = 0.416), indicating that H4 is rejected.

Furthermore, H5 is accepted. The fifth hypothesis test shows that the effect of RE on financial performance moderated by ESG (RE*ESG) is positive and significant (Sig value = 0.016 < 0.05; β = 0.240), indicating that H5 is accepted. The sixth hypothesis test demonstrates that the effect of RM on financial performance moderated by ESG (RM*ESG) is also positive and significant (Sig value = 0.018 < 0.05; β = 0.262), indicating that H6 is accepted. The seventh hypothesis test shows that the effect of EC on financial performance moderated by ESG (EC*ESG) is significant with a negative effect (Sig value = 0.048 < 0.05; β = −0.185), indicating that H7 is accepted. Finally, the eighth hypothesis test indicates that the effect of waste emissions on financial performance moderated by ESG (EW*ESG) has a significant positive effect (Sig value = 0.000 < 0.05; β = 0.494), indicating that H8 is rejected (Table 8).

Table 8. Hypotheses results

Items	Hypotheses	Result
H1	RE has a positive impact on financial performance	R
H2	RM has a positive impact on improving financial performance	R
H3	EC has a negative impact on improving financial performance	+ accepted
H4	EW has a negative impact on improving financial performance.	R
H5	ESG implementation strengthens the influence of RE on a company's financial performance.	+ accepted
H6	ESG implementation strengthens the influence of material recycling on corporate financial performance.	+ accepted
H7	ESG implementation strengthens the influence of EC on corporate financial performance.	+ accepted
H8	ESG implementation weakens the influence of waste emissions on corporate financial performance.	R

Notes: R represents rejected, + represents a positive effect

4.4 Coefficient of determination test

Based on Table 9, the Adjusted R-Square value is 0.578 or 57.8%. This indicates that the variables ESG Score, RM, EC, RE, and EW collectively explain 57.8% of the variation in ROA. Meanwhile, the remaining 42.2% is likely influenced by other factors not included in this research model.

Table 9. Hypotheses results

Model Summary[b]					
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin-Watson
1	.786[a]	.617	.578	.10250	1.483

a. Predictors: (Constant), Skor ESG, RE, RM, EC.
b. Dependent Variable: ROA

5. DISCUSSION

5.1 The impact of renewable energy on financial performance

Based on the test results, RE had no impact on financial performance (β = 0.132; Sig = 0.226). This finding contradicts that of Wahyuni et al. [19], who found that RE initiatives positively contribute to economic outcomes by enhancing efficiency and reducing long-term operational costs. The inconsistency may stem from differences in implementation scale, industry characteristics, or the time horizon required for RE investments to yield measurable financial benefits. In many cases, adopting RE involves high upfront costs, while the financial advantages often materialise only in the long run.

From a stakeholder theory perspective, the insignificant effect of RE on financial performance suggests that RE adoption is primarily driven by external stakeholder pressure rather than immediate economic motives. Companies may adopt RE to respond to expectations from regulators, investors, and society, even when short-term financial returns are limited. In line with legitimacy theory, RE initiatives function more as legitimacy-seeking mechanisms aimed at aligning corporate activities with societal norms regarding environmental responsibility. The benefits derived from such initiatives are indirect and long-term, often manifested through enhanced corporate reputation and reduced legitimacy risk, rather than immediate improvements in financial performance. From the RBV, RE investments have not yet become valuable, rare, and inimitable resources that generate competitive advantage. High upfront investment costs and long payback periods may prevent RE adoption from translating into superior financial performance within the observed time horizon. Differences in measurement approaches and observation periods compared to prior studies may therefore explain the inconsistent findings.

5.2 The impact of recycled material on financial performance

Based on the test results, RM had no impact on financial performance (β = 0.198; Sig = 0.228). This finding aligns with [30], who found that RM did not affect financial performance. From a stakeholder theory perspective, the insignificant effect of RM usage on financial performance indicates that firms adopt RM primarily to respond to stakeholder expectations rather than to achieve immediate financial gains. Stakeholders such as regulators, customers, and investors increasingly demand environmentally responsible practices, and firms may comply with these expectations even when the short-term economic benefits are uncertain or limited.

In line with legitimacy theory, the use of RM serves as a legitimacy-maintenance strategy, aligning corporate operations with societal norms on waste reduction and circular-economy principles. The benefits of such practices tend to be indirect and long-term, manifested through enhanced corporate reputation, improved public perception, and reduced environmental compliance risks. However, these benefits may not be immediately reflected in accounting-based financial performance measures within the observed time horizon.

From the RBV RM usage has not yet evolved into a valuable, rare, and inimitable resource capable of generating competitive advantage. Firms may face higher processing costs, quality inconsistencies, and limited availability of recycled inputs, which can offset potential cost savings. Moreover, without firm-specific capabilities such as advanced recycling technology, supply chain integration, and process innovation, the adoption of RM remains insufficient to produce measurable improvements in financial performance. Differences in measurement approaches, industry context, and observation periods compared to prior studies may therefore explain the lack of a significant relationship.

5.3 The impact of environmental cost on financial performance

Based on the test results, EC has a significant negative effect on financial performance (β = −0.195; Sig = 0.036). This finding indicates that higher environmental expenditures are associated with lower short-term financial performance, reflecting the cost burden imposed on firms.

From a stakeholder theory perspective, the negative relationship suggests that firms incur EC primarily to fulfil stakeholder expectations and regulatory requirements rather than to generate immediate economic returns. Compliance with environmental standards often requires substantial

financial outlays, and while stakeholders value such commitments, the associated costs may reduce short-term profitability.

In line with legitimacy theory, EC can be interpreted as expenditures aimed at maintaining organizational legitimacy by aligning corporate activities with societal norms and environmental regulations. These costs function as a form of legitimacy investment, where firms prioritize social acceptance and regulatory compliance over short-term financial performance. As a result, the benefits of legitimacy, such as enhanced reputation and reduced social or regulatory risk, are indirect and long-term, and may not be immediately reflected in accounting-based financial indicators.

From the RBV, EC do not necessarily constitute strategic resources capable of generating competitive advantage unless they are accompanied by firm-specific capabilities. When environmental spending is reactive, compliance-driven, or inefficient, it represents a cost rather than a value-creating investment. Without innovation, eco-efficiency, or process optimization, EC are unlikely to be transformed into valuable, rare, and inimitable resources, thereby negatively impacting financial performance. Differences in cost structure, industry characteristics, and time horizon may further explain the observed negative effect.

5.4 The impact of emissions waste on financial performance

Hypothesis 4 posited that emissions waste has a negative effect on financial performance. However, the empirical results indicate that EW has a positive and significant effect on financial performance ($\beta = 0.416$; Sig = 0.001). This finding suggests that higher levels of EW are associated with better financial performance, leading to the rejection of H4.

Conceptually, this result can be explained in terms of a short-term trade-off. In practice, landfill-based waste management is often the most cost-effective and operationally efficient option compared to recycling, advanced waste treatment, or the adoption of environmentally friendly technologies. By relying on landfill disposal, companies can reduce short-term operational costs, thereby increasing profits and improving financial performance indicators. As a result, higher levels of emissions waste may be positively associated with financial performance.

Furthermore, this positive relationship can also be explained through the RBV, in which firms prioritize cost efficiency and resource optimization to enhance financial performance. In this context, expenditures on more sustainable waste management practices may be perceived as additional costs that do not generate immediate economic benefits. Consequently, firms that have not yet made substantial investments in sustainable waste management tend to exhibit better short-term financial performance.

5.5 The impact of ESG implementation strengthens the influence of renewable energy on a company's financial performance

Based on the results, ESG implementation does not significantly affect the relationship between RE and financial performance. This indicates that, although ESG practices are increasingly recognised as essential for long-term sustainability, their role in amplifying the financial benefits of RE adoption is not evident in this study. One possible explanation is that RE projects often involve substantial upfront costs and long payback periods, which may overshadow the potential positive signalling effect of ESG initiatives. In addition, ESG implementation may not yet be fully integrated into the company's core strategies or may be perceived more as compliance-oriented, thereby failing to enhance the financial outcomes from RE investments.

From the stakeholder theory perspective, stakeholders may expect companies to adopt RE and ESG practices. However, suppose these practices are not effectively communicated or translated into tangible efficiency gains. In that case, stakeholders may not reward them with improved trust, investment, or loyalty, limiting their impact on financial performance. Similarly, legitimacy theory suggests that companies pursue ESG and RE to maintain legitimacy in the eyes of society. However, if these actions are viewed as symbolic rather than substantive, they may not significantly strengthen financial benefits. Therefore, the findings suggest that while ESG implementation and RE adoption are critical for sustainability and legitimacy, their combined effect may not automatically translate into measurable improvements in financial performance unless they are strategically integrated and yield operational or reputational advantages that stakeholders can recognise.

5.6 The impact of ESG implementation strengthens the influence of recycled material on a company's financial performance

The empirical results demonstrate that ESG implementation positively and significantly moderates the relationship between RM and financial performance ($\beta = 0.262$; Sig = 0.018), indicating that H6 is accepted. This finding suggests that using RM alone may not immediately enhance financial performance; however, when supported by strong ESG implementation, RM practices are more likely to generate financial benefits. ESG strengthens the effectiveness of recycled-material initiatives by embedding them within a structured sustainability strategy and credible governance framework.

From the perspectives of stakeholder and legitimacy theories, strong ESG implementation enhances stakeholder confidence in firms that utilize RM by signaling transparency, environmental responsibility, and long-term sustainability commitment. Companies with high ESG performance are perceived as more accountable and compliant with environmental norms, which improves corporate reputation, investor trust, and market acceptance. Moreover, from a RBV, ESG functions as an organizational capability that enables firms to transform RM into a strategic resource through efficiency gains, cost optimization, and innovation. Consequently, ESG amplifies the positive impact of RM utilization on financial performance.

5.7 The impact of ESG implementation strengthens the influence of environmental cost on a company's financial performance

The empirical results show that ESG implementation significantly moderates the relationship between EC and financial performance with a negative effect ($\beta = -0.185$; Sig = 0.048), indicating that H7 is accepted. This finding suggests that stronger ESG implementation intensifies the negative impact of EC on financial performance. In firms with high

ESG commitment, environmental expenditures tend to be more comprehensive and systematic, leading to higher short-term cost burdens that may reduce profitability and weaken financial performance.

From the perspectives of stakeholder and legitimacy theories, companies with strong ESG implementation face greater pressure to comply with environmental standards and to meet stakeholder expectations regarding environmental responsibility. As a result, these firms allocate more resources to environmental management, pollution control, and regulatory compliance, which increases operational expenses. Although such expenditures enhance environmental accountability and long-term sustainability, they may not generate immediate economic returns. Consequently, ESG strengthens the negative relationship between EC and financial performance, reflecting a short-term trade-off between financial outcomes and environmental responsibility.

5.8 The impact of ESG implementation weakens the influence of emmision waste on a company's financial performance

The empirical results show that ESG implementation significantly moderates the relationship between emissions waste and financial performance with a positive effect (β = 0.494; Sig = 0.000). This finding indicates that ESG strengthens the positive relationship between EW and financial performance, leading to the rejection of H8. The positive moderating effect of ESG on the relationship between EW and financial performance does not imply that higher EW inherently reflects better environmental performance. Rather, this finding can be explained by ESG's role as a governance and transparency mechanism.

In this study, emissions waste are measured as the proportion of waste disposed of through landfilling relative to total waste, which reflects a firm's waste management strategy rather than absolute pollution levels. Firms with strong ESG implementation tend to manage landfill disposal within a controlled, compliant, and well-documented framework, thereby reducing regulatory, legal, and reputational risks. From a RBV, ESG functions as an organizational capability that enables firms to balance cost efficiency and environmental responsibility by selecting waste management methods that minimize operational costs while maintaining compliance and accountability.

Moreover, from a stakeholder perspective, transparent ESG disclosure reduces information asymmetry, enabling stakeholders to evaluate how waste is managed rather than solely the volume of waste. As a result, firms with strong ESG performance can translate cost-efficient waste management practices into improved financial performance, even when EW levels remain relatively high.

6. CONCLUSION

This study examines the relationship between green accounting practices and the financial performance of energy companies in Indonesia, with ESG implementation acting as a moderating variable. These findings show that RE, RM, and EC are not significantly associated with financial performance, suggesting that these sustainability initiatives may not yet be fully reflected in firms' short-term financial outcomes or may still be in the early stages of strategic integration. In contrast, EW has a significant positive associated with financial performance, which may reflect short-term operational or cost-related dynamics rather than a direct improvement in sustainability outcomes.

Importantly, the results highlight the role of ESG implementation in shaping these relationships. ESG appears to strengthen the association between RE, RM, and financial performance, while also intensifying the negative association of EC. These patterns suggest that ESG may influence how environmental initiatives translate into financial outcomes, though these relationships should be interpreted with caution.

Despite its contributions, this study has several limitations that also offer opportunities for improvement. The analysis is limited to energy companies listed on the IDX over a relatively short observation period, which may restrict the generalizability of the findings across industries and time horizons. In addition, financial performance is measured solely using ROA, which may not fully capture market-based performance or long-term firm value. The measurement of EW focuses on the proportion of waste disposed of through landfilling rather than absolute pollution intensity, while the use of aggregated ESG scores may obscure the distinct roles of ESG dimensions. Therefore, future studies are encouraged to broaden the sample scope, apply multiple financial performance indicators, and disaggregate ESG components to enhance analytical depth.

Future research should further investigate the long-term financial implications of sustainability initiatives by employing longitudinal or panel data approaches that capture delayed economic benefits. Expanding the scope of analysis across different industries and countries would also provide valuable insights into how institutional environments and regulatory frameworks influence green accounting practices. Moreover, integrating external factors such as environmental regulations, carbon pricing mechanisms, and energy transition policies would provide a more comprehensive understanding of how green accounting and ESG governance jointly shape corporate financial performance.

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