

THE EFFECT OF GREEN ACCOUNTING, MATERIAL FLOW COST ACCOUNTING AND ENVIRONMENTAL DISCLOSURE ON SUSTAINABLE DEVELOPMENT GOALS (SDGS)

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Proses Artikel:

Received 08-18, 2026

Revised 08-29, 2026

Accepted 08-30, 2026

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DOI : 10.30813/jab.v19i2.10449



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Abstract

Background: This study is motivated by the growing attention to the SDGs. The energy sector was selected due to its economic importance and significant environmental impacts, making sustainable accounting practices relevant to achieving the SDGs.

Objective: This study analyzes the effect of green accounting, material flow cost accounting, and environmental disclosure on the Sustainable Development Goals (SDGs) in energy sector companies listed on the Indonesia Stock Exchange during 2021–2025.

Research Methods: Purposive sampling was used, resulting in 9 companies selected for analysis. EViews 13 was used for data processing and hypothesis testing, with panel data regression, simultaneous testing, partial testing, and coefficient of determination as the data analysis techniques. The Random Effect Model was used to examine the effect of green accounting, material flow cost accounting, and environmental disclosure on the Sustainable Development Goals (SDGs).

Research Results: The results show that Green Accounting has a significant negative effect on the Sustainable Development Goals (SDGs), while Environmental Disclosure has a significant positive effect on the SDGs. In contrast, Material Flow Cost Accounting has no significant effect on the SDGs. Simultaneously, Green Accounting, Material Flow Cost Accounting, and Environmental Disclosure have a significant effect on the SDGs. These findings suggest that companies should strengthen the implementation of Green Accounting and Environmental Disclosure to support the achievement of the SDGs.

Originality/Novelty of Research: The novelty of this study lies in the integration of three sustainable accounting approaches Green Accounting, Material Flow Cost Accounting, and environmental disclosure into a single research model to examine their contribution to the achievement of the SDGs within energy sector companies. This integration enables the study to view local practices from two perspectives: internal management through cost and material efficiency, and external transparency through environmental disclosure. Furthermore, the use of data from the 2021–2025 period provides up-to-date empirical evidence regarding sustainable accounting practices in the energy sector.

Keywords: Green Accounting, Material Flow Cost Accounting, Environmental Disclosure, Sustainable Development Goals (SDGs).

Introduction

The Sustainable Development Goals (SDGs) have become a crucial agenda in global development due to their close link to efforts to balance economic, social, and environmental aspects. Indonesia's commitment to achieving the SDGs is reinforced by Presidential Regulation Number 59 of 2017 concerning the Implementation of the Achievement of Sustainable Development Goals. This regulation serves as the legal basis for the implementation, monitoring, evaluation, and reporting of SDG achievements in Indonesia (Presiden RI, 2017). In the corporate context, achieving the SDGs is not solely the government's responsibility, it also requires the involvement of the business sector through operational practices and reporting that support the SDGs.

The energy sector is highly relevant to discussions on Sustainable Development Goals, as its activities are closely linked to natural resource utilization and environmental impacts. The Ministry of Energy and Mineral Resources reported that in 2024, coal continued to dominate Indonesia's primary energy mix with a share of 40.37%, followed by oil (28.82%), natural gas (16.17%), and renewable energy (14.65%). This composition indicates that Indonesia remains heavily reliant on fossil fuels, despite ongoing government efforts to drive a transition toward cleaner and more sustainable energy (Kementerian ESDM, 2025). This situation places significant pressure on companies within the energy sector to manage the environmental impacts of their operations while simultaneously supporting the achievement of the Sustainable Development Goals (SDGs).

Environmental issues in the energy sector are also evident in various conflicts linked to mining activities. One such case involves PT Bukit Asam Tbk. In September 2025, hundreds of residents staged a protest at PT Bukit Asam's headquarters to voice concerns regarding alleged coal waste pollution, land disputes, and the impact on water sources surrounding the mining area. Reports indicate that the community demanded corporate accountability for the alleged contamination of land and rivers, as well as the restoration of affected environments (arahpena.com). This phenomenon demonstrates that corporate activities in the energy sector entail environmental and social consequences that require transparent and responsible management. Consequently, the implementation of green accounting and environmental disclosure has become crucial for companies, serving as a demonstration of their commitment to addressing the environmental impacts of their operations and supporting the achievement of sustainable development goals (Arum & Farida, 2023).

One key element in achieving sustainable development goals is the implementation of accounting practices that prioritize environmental responsibility and the efficient use of resources. Accounting plays a

vital role in supporting the achievement of the Sustainable Development Goals (SDGs) by serving as a means to transparently document, measure, and report a company's economic, social, and environmental performance. Through effective accounting systems, companies can evaluate the extent to which their operational activities impact the environment and society, while simultaneously making more responsible decisions (Kaur et al., 2025).

One method adopted by companies to support sustainable development goals is Green Accounting. Green Accounting is an accounting concept that encompasses the identification, measurement, and management of environmental costs, while also integrating these costs into business decision-making and the provision of information to stakeholders (Yasrawan & Werastuti, 2022). Green Accounting assists companies in calculating costs associated with environmental impacts, such as energy consumption, waste management, and natural resource usage. By measuring and monitoring these factors, companies can identify ways to reduce waste and enhance operational efficiency, ultimately leading to lower operating costs (Setiawati & Sisdianto, 2024). Through the implementation of Green Accounting, companies not only evaluate financial performance but also consider environmental aspects in their decision-making processes, thereby fostering more sustainable business practices (Lako, 2018). The implementation of Green Accounting is considered aligned with the achievement of the Sustainable Development Goals (SDGs) specifically Goal 12 (Responsible Consumption and Production) and Goal 13 (Climate Action) as the method promotes efficient resource use and the management of environmental impacts.

In addition to Green Accounting, Material Flow Cost Accounting (MFCA) is also a significant tool for improving operational efficiency and supporting sustainable development goals. MFCA focuses on mapping material and energy flows to identify sources of waste and hidden costs associated with waste (Jasch, 2009). Through MFCA, companies can formulate strategies to reduce waste, optimize the use of raw materials, and improve energy efficiency, ultimately reducing negative environmental impacts. Therefore, MFCA not only improves a company's economic performance but also contributes to the achievement of the Sustainable Development Goals (SDGs) (Christ & Burritt, 2015). The implementation of MFCA helps improve resource-use efficiency and reduce waste, thereby supporting the achievement of SDGs 9 through increased innovation and production process efficiency, as well as SDGs 13 through the reduction of material and energy waste, which can contribute to lower emissions.

Environmental Disclosure is a crucial element of corporate transparency and accountability to stakeholders. Angela (2021) explain that the increasing need of stakeholders for environmental information makes the quality of environmental disclosure important for assessing a company's environmental performance. Through such disclosures, companies can provide information regarding their environmental

activities and performance, including aspects related to emissions, waste, energy use, and biodiversity conservation. Transparent environmental disclosure in sustainability reports can also help companies strengthen stakeholder trust and provide information that is relevant to investors (Desliniati et al., 2025). Therefore, Environmental Disclosure supports the achievement of SDG 15 (Life on Land) by reflecting companies' efforts to protect terrestrial ecosystems, conserve biodiversity, and minimize environmental impacts resulting from their operational activities.

Although prior research has examined environmental accounting practices, empirical evidence regarding their integration with resource efficiency and environmental transparency remains mixed and yields inconsistent findings. The fundamental limitation of prior research lies in evaluating internal environmental cost management and external transparency separately, without an integrative framework, particularly in high-emission and resource-dependent industries.

Therefore, this study aims to examine the effect of Green Accounting, Material Flow Cost Accounting, and Environmental Disclosure both individually and simultaneously on the achievement of the Sustainable Development Goals (SDGs). By contextualizing this integrative model within energy sector companies listed on the Indonesia Stock Exchange during the recent 2021–2025 period, this research captures up-to-date empirical evidence amidst Indonesia's post-pandemic sustainability regulation shifts and accelerating 2030 SDGs roadmap. Theoretically, this study bridges internal operational control and resource efficiency (Agency Theory) with external reporting transparency (Stakeholder Theory), clarifying how internal cost and material management translate into external SDG performance in an emerging market context.

The implications of this study encompass theoretical, practical, and policy dimensions. Theoretically, this study extends the literature on environmental accounting by demonstrating how internal management controls (Green Accounting and Material Flow Cost Accounting) and external communication (Environmental Disclosure) jointly contribute to corporate SDGs fulfillment under Agency and Stakeholder perspectives. Practically, the findings offer empirical guidance for energy sector management to optimize environmental cost allocations and leverage MFCA data effectively, rather than treating environmental accounting merely as compliance expenses. For policymakers and regulators, these insights highlight the importance of promoting integrated environmental cost management alongside mandatory transparency guidelines to support national SDGs targets in Indonesia.

Literature Review

Stakeholder theory explains that companies are not solely oriented toward the interests of shareholders but must also consider the interests of all stakeholders, including creditors, suppliers, consumers, communities, and governments (Ghozali, 2020). In high-emission and resource-intensive industries such as the energy sector, operational activities inherently generate severe environmental impacts, creating intense pressure from stakeholders for corporate accountability. Within this framework, Environmental Disclosure represents a crucial form of transparency to communicate environmental performance and maintain organizational legitimacy (Husnaini et al., 2023). However, stakeholder theory also recognizes that corporate reporting can range from substantive accountability to symbolic disclosure or greenwashing, where energy firms project an environmentally responsible image as an adaptive strategy to satisfy external expectations without making fundamental operational changes (Ramawi & Mukhtaruddin, 2026). Furthermore, internal accounting practices such as Green Accounting demonstrate environmental responsibility through transparent cost management (Pambudi & Mudji, 2024) while Material Flow Cost Accounting (MFCA) enhances material and energy efficiency to align resource management with stakeholder interests (May et al., 2023). Ultimately, integrating these internal management tools with external transparency enables energy sector companies to address economic, social, and environmental dimensions in supporting the achievement of the Sustainable Development Goals (SDGs) (Yasah et al., 2023).

Agency theory posits that a conflict of interest inherently exists between agents (management) and principals (shareholders/investors) due to information asymmetry and self-serving motives (Ghozali, 2020). In the energy sector, where operational risks and environmental costs are substantial, management often possesses superior internal information regarding actual environmental liabilities and remediation costs. To address this issue, internal accounting practices such as Green Accounting, Material Flow Cost Accounting (MFCA), and Environmental Disclosure are implemented to reduce information asymmetry and enhance management accountability in supporting the achievement of the Sustainable Development Goals (SDGs). Agency theory further suggests that sustainability reporting can serve as a monitoring mechanism to reduce information asymmetry between management and investors (Natour et al., 2022). However, information asymmetry may also create opportunities for opportunistic managerial behavior, including earnings management or strategic presentation of sustainability information (Al Natour, 2022). Furthermore, Firm Scale represents an important contextual factor because larger firms generally face

greater agency costs and information asymmetry, creating stronger incentives to provide more extensive disclosure to facilitate monitoring and reduce agency problems (Sun et al., 2022).

Hypothesis Development

Green Accounting is an accounting approach that integrates environmental aspects into the measurement and reporting processes of companies, including energy use, emissions, waste management, and resource efficiency (Kurniawan & Fitranita, 2024). The implementation of Green Accounting enables companies to provide more transparent information regarding their environmental performance and responsibilities, thereby enhancing accountability to stakeholders and supporting the achievement of the SDGs. This is supported by Sari et al. (2025), who explain that environmentally oriented accounting practices can serve as a corporate response to stakeholder demands for improved sustainability. Furthermore Kakarika & Yanti (2025) found that Green Accounting has an effect on the Sustainable Development Goals. Based on the foregoing discussion, the research hypothesis is proposed as follows:

H₁: Green Accounting has an effect on the Sustainable Development Goals (SDGs).

Material Flow Cost Accounting helps companies identify material and energy flows, as well as costs arising from waste, thereby improving resource-use efficiency and supporting the achievement of the SDGs, particularly SDGs 7, SDGs 12, and SDGs 13. Based on stakeholder theory, the implementation of MFCA demonstrates corporate responsibility toward stakeholders and the environment, while agency theory emphasizes the importance of efficient and responsible resource management. Anugrah et al. (2024) found that MFCA has an effect on sustainable development goals. Based on the foregoing discussion, the hypothesis is proposed as follows:

H₂: Material Flow Cost Accounting has an effect on the Sustainable Development Goals (SDGs).

Environmental Disclosure represents a form of corporate transparency in communicating information regarding environmental performance and responsibilities to stakeholders. Based on stakeholder theory and agency theory, the disclosure of environmental information can enhance accountability and stakeholder trust while demonstrating the company's commitment to sustainability development goals. Ridwan et al. (2025) found that Environmental Disclosure has an effect on sustainable development goals. Based on the foregoing discussion, the hypothesis is proposed as follows:

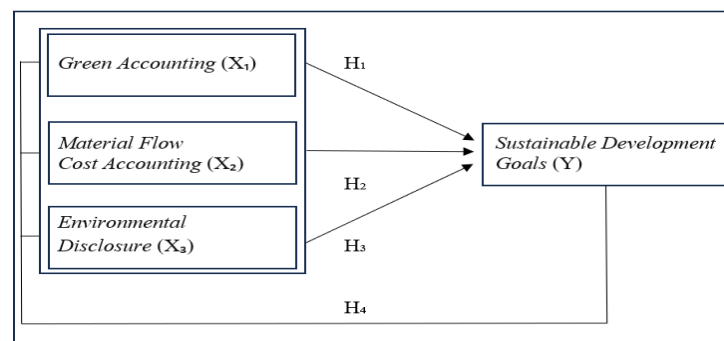
H₃: Environmental Disclosure has an effect on the Sustainable Development Goals (SDGs)

United Nations (2024) states that the Sustainable Development Goals (SDGs) constitute a global development agenda comprising 17 goals aimed at addressing various economic, social, and environmental challenges by 2030. The SDGs emphasize the importance of inclusive and sustainable development through

efforts to eradicate poverty, reduce inequality, protect the environment, and improve societal well-being. One of the ways companies can support the achievement of the SDGs is through the implementation of Green Accounting, an accounting approach that considers environmental costs and impacts in corporate activities. Kurniawan & Fitranita (2024) found that Green Accounting has a positive effect on the SDGs. In addition, Material Flow Cost Accounting is a method that helps companies identify material, energy, and waste-related costs to improve resource-use efficiency (ISO 14051). Putri et al. (2025) found that MFCA has an effect on sustainable development goals. Furthermore, Environmental Disclosure represents a form of corporate transparency in communicating information regarding environmental impacts and management. Such disclosure can enhance corporate accountability and demonstrate a commitment to sustainability. Ridwan et al. (2025) found that Environmental Disclosure has an effect on the Sustainable Development Goals. Based on the foregoing discussion, the implementation of Green Accounting, MFCA, and Environmental Disclosure is considered capable of supporting the achievement of the SDGs through improved resource efficiency, environmental management, and corporate transparency. Therefore, the hypotheses proposed in this study are as follows:

H₄: Green Accounting, Material Flow Cost Accounting, and Environmental Disclosure have an effect on the Sustainable Development Goals (SDGs)

Figure 1. Research Framework



Source: Processed by the author, 2026.

Research Methods

This study employs a quantitative method with an associative approach to examine the effects of Green Accounting, Material Flow Cost Accounting (MFCA), and Environmental Disclosure on the Sustainable Development Goals (SDGs). The data used are secondary data obtained from the annual reports

and sustainability reports of companies accessed through the official website of the Indonesia Stock Exchange (IDX) and the respective companies' websites. The population consists of energy sector companies listed on the Indonesia Stock Exchange during the 2021–2025 period. The sampling technique used was purposive sampling based on the following criteria: (1) listed on the IDX, (2) published annual reports consecutively, (3) published sustainability reports consecutively, (4) reported positive profits, and (5) provided the data required for the study. Based on these criteria, nine companies met the requirements, resulting in a total of 45 observations over the research period.

Table 1. Operational Definitions

Variable	Operational Definitions	Indicator
Sustainable Development Goals (SDGs) (Y)	The level of a company's sustainable development achievement, reflecting a balance among economic, social, environmental, and technological aspects.	$\text{SDGs} = \text{Economic} + \text{Social} + \text{Environmental} + \text{Technology}$ Description: Economic = Sales, net profit, and investment Social = CSR costs and salary expenses Environmental = Waste and environmental management costs and utility costs Technology = Development and training costs After summing all the values, a natural logarithm (LN) transformation is performed using the Excel formula =LN(total value).
Source: (Andini et al., 2025)		
Green Accounting (X1)	An accounting approach that integrates environmental aspects into a company's activities and measurement processes, particularly through the recognition of environmental management costs.	$\text{GA} = \text{Environmental Management Cost} / \text{Net Profit}$ Environmental Management Costs = Costs for waste management, energy efficiency, conservation, and emission monitoring. Net Profit = Revenue remaining after deducting all expenses. Source: (Santoso & Handoko, 2023)

Variable	Operational Definitions	Indicator
Material Flow Cost Accounting (X2)	An environmental management accounting method that identifies material, energy, and cost flows to assess resource-use efficiency and identify waste in the production process.	MFCA = Total Output Produced/Total Cost Total Output Produced : Material Costs = Costs of materials or raw materials. Energy Costs = Utility costs related to energy use. System Costs = Labor, depreciation, transportation, and maintenance costs. Source: (Santi et al., 2022)
Environmental Disclosure (X3)	The disclosure of information regarding a company's environmental activities, performance, and responsibilities in its corporate reports.	ED = Total environmental disclosure score of the company / Number of environmental disclosure categories Environmental Disclosure is measured using 31 indicators based on GRI Standards 301–306 and 308. Each disclosed item is scored and summed to obtain the Environmental Disclosure value. Source: (Wiranty & Kartikasari, 2018)

This study employs descriptive statistical analysis and panel data regression to examine the effects of Green Accounting, Material Flow Cost Accounting, and Environmental Disclosure on the Sustainable Development Goals (SDGs). Based on the test results, the Random Effect Model (REM) was selected as the appropriate model for this study. Subsequently, classical assumption tests were conducted, followed by hypothesis testing using the t-test, F-test, and coefficient of determination (R^2), with EViews 13 used for data analysis.

Results and Discussion

Table 2. Descriptive Statistics

	SDGs	GA	MFCA	ED
Mean	31.28109	0.086946	0.488255	0.744803
Median	31.35244	0.011791	0.410914	0.806452
Maximum	32.71253	0.860923	0.918933	1.000000
Minimum	28.81339	0.000776	0.127271	0.096774
Std. Dev.	0.702951	0.193271	0.263751	0.216374

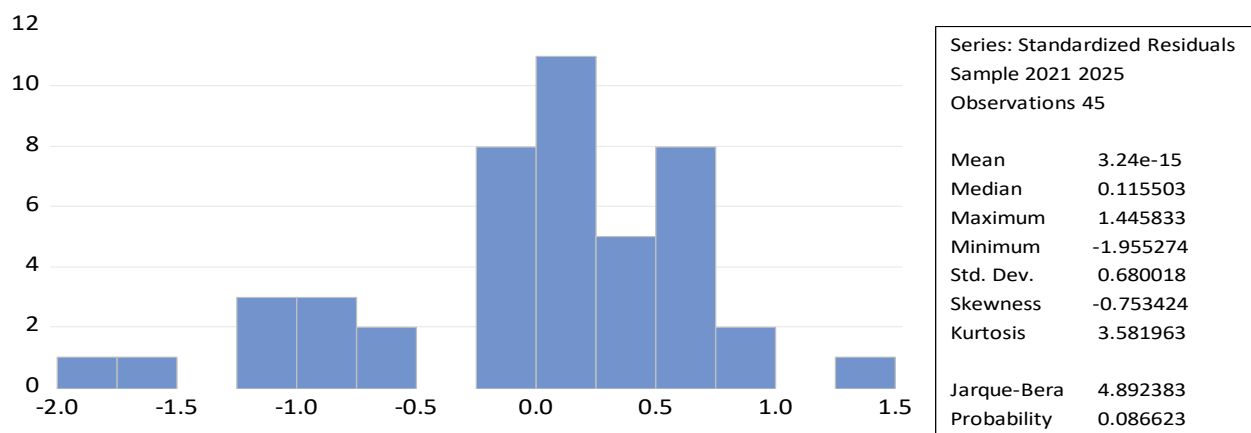
	SDGs	GA	MFCA	ED
Observations	45	45	45	45

Source: Data processed using EViews 13.

Based on the descriptive statistical analysis presented in the table, the SDGs variable has a minimum value of 28.81339, a maximum value of 32.71253, a mean of 31.28109, and a standard deviation of 0.702951, indicating that the data are relatively homogeneous. The Green Accounting (GA) variable has a minimum value of 0.000776, a maximum value of 0.860923, a mean of 0.086946, and a standard deviation of 0.193271, indicating relatively high data variation. The Material Flow Cost Accounting (MFCA) variable has a minimum value of 0.127271, a maximum value of 0.918933, a mean of 0.488255, and a standard deviation of 0.263751, indicating relatively low data dispersion. Meanwhile, the Environmental Disclosure (ED) variable has a minimum value of 0.096774, a maximum value of 1.000000, a mean of 0.744803, and a standard deviation of 0.216374, indicating relatively low variation and a tendency toward uniformity. Overall, the SDGs, MFCA, and ED variables exhibit relatively low data dispersion, whereas GA shows greater variation across companies during the 2021–2025 period.

Based on the results of the panel data regression model selection, this study determines the Random Effect Model (REM) as the most appropriate estimation model. The selection of the REM was based on the results of the Chow test, Hausman test, and Lagrange Multiplier (LM) test. Therefore, the analysis of the effects of Green Accounting, Material Flow Cost Accounting, and Environmental Disclosure on the Sustainable Development Goals (SDGs) was conducted using the Random Effect Model (REM) approach.

Table 3. Normality Test



Source: Data processed using EViews 13.

Based on the results of the normality test, the probability value was 0.086623. Since this value is greater than 0.05, it can be concluded that the residuals in the regression model are normally distributed.

The multicollinearity test aims to determine whether there is a correlation among the independent variables in the regression model. A good regression model should not exhibit correlation among the independent variables (Caraka, 2017).

Table 4. Multicollinearity Test

	GA	MFCA	ED
GA	1.000000	-0.008186	0.263057
MFCA	-0.008186	1.000000	-0.288820
ED	0.263057	-0.288820	1.000000

Source: Data processed using EViews 13.

Based on the results of the multicollinearity test, the correlation values among the independent variables are below 0.90, namely -0.008186 between Green Accounting and Material Flow Cost Accounting, 0.263057 between Green Accounting and Environmental Disclosure, and -0.288820 between Material Flow Cost Accounting and Environmental Disclosure. Therefore, it can be concluded that there are no indications of multicollinearity among the independent variables.

The heteroscedasticity test aims to determine whether there is any inequality in the variance of residuals across observations. A good regression model should be free from heteroscedasticity (Caraka, 2017).

Table 5. Heteroskedasticity Test : Glejser

F-statistic	1.543091	Prob. F(3,41)	0.2178
Obs*R-squared	4.565430	Prob. Chi-Square(3)	0.2065
Scaled explained SS	4.026785	Prob. Chi-Square(3)	0.2586

Source: Data processed using EViews 13.

Based on the results of the Glejser test, all independent variables have significance values greater than 0.05. Therefore, it can be concluded that the regression model does not exhibit heteroscedasticity, indicating that the homoscedasticity assumption is satisfied.

The autocorrelation test aims to determine whether there is a correlation between the residuals in a given period and those in the previous period. A good regression model should be free from autocorrelation (Caraka, 2017).

Table 6. Autocorrelation Test

Weighted Statistics			
R-squared	0.202889	Mean dependent var	7.189674
Adjusted R-squared	0.144564	S.D. dependent var	0.401519
S.E. of regression	0.371364	Sum squared resid	5.654372
F-statistic	3.478586	Durbin-Watson stat	1.748093
Prob(F-statistic)	0.024338		

Source: Data processed using EViews 13.

Based on the table, the Durbin–Watson value is 1.748093. According to the criterion proposed by Nachrowi and Usman (2002) in Chairani et al. (2023), a Durbin–Watson value between -2 and $+2$ indicates the absence of autocorrelation. Since the obtained value falls within this range ($-2 < 1.748093 < +2$), it can be concluded that there is no positive or negative autocorrelation in this study, and the regression model is free from autocorrelation.

The t-test is used to determine the partial effect of each independent variable on the dependent variable.

Table 7. T-test (Partial)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	30.66382	0.507063	60.47344	0.0000
GA	-0.940979	0.459955	-2.045806	0.0472
MFCA	0.081838	0.710450	0.115192	0.9089
ED	0.884958	0.338818	2.611900	0.0125

Source: Data processed using EViews 13.

Based on the results of the t-test, the Green Accounting variable has a probability value of 0.0472, which is less than 0.05, indicating that it has a partial effect on the Sustainable Development Goals (SDGs). The Material Flow Cost Accounting variable has a probability value of 0.9089, which is greater than 0.05, indicating that it does not have a partial effect on the SDGs. Meanwhile, the Environmental Disclosure

variable has a probability value of 0.0125, which is less than 0.05, indicating that it has a partial effect on the SDGs.

The F-test, also known as the simultaneous test, aims to determine the joint effect of all independent variables and to assess whether the regression model is statistically significant.

Table 8. F-test (Simultaneous)

F-statistic	3.478586
Prob(F-statistic)	0.024338

Source: Data processed using EViews 13.

Based on the results of the F-test presented in the table, the probability value is 0.024338, which is less than 0.05. Therefore, it can be concluded that Green Accounting, Material Flow Cost Accounting, and Environmental Disclosure simultaneously have a significant effect on the Sustainable Development Goals (SDGs). The coefficient of determination (R^2) aims to measure the extent to which the independent variables can explain the dependent variable.

Table 9. Coefficient of Determination (R^2)

Weighted Statistics	
R-squared	0.202889
Adjusted R-squared	0.144564

Source: Data processed using EViews 13.

Based on the regression results, the Adjusted R-squared value of 0.144564 indicates that Green Accounting, Material Flow Cost Accounting, and Environmental Disclosure explain 14.4% of the variation in the Sustainable Development Goals (SDGs), while the remaining 85.6% is explained by other factors beyond the scope of this study.

Discussion

The Effect of Green Accounting on the Sustainable Development Goals (SDGs)

The first hypothesis states that Green Accounting has an effect on the Sustainable Development Goals (SDGs). The test results show a t-statistic of -2.045806 and a probability value of 0.0472 < 0.05, indicating that Green Accounting has a significant effect on the SDGs, thus, H_1 is accepted. The negative regression coefficient indicates that the effect of Green Accounting on the SDGs is negative. Therefore, the

significance of the effect forms the basis for accepting H_1 , while the negative direction is an empirical result indicated by the regression coefficient.

Green Accounting integrates environmental aspects into accounting practices by providing information on a company's activities, costs, and environmental impacts. In the context of sustainability accounting, this information can be used to understand the relationship between company activities, sustainability, and stakeholder interests. Based on Stakeholder Theory, companies consider not only the interests of shareholders but also the interests of various stakeholders affected by the company's activities. Hörisch et al. (2020) explain that Stakeholder Theory can be used in the development of sustainability accounting by considering sustainability topics and stakeholders relevant to an organization. Therefore, the implementation of Green Accounting can be a form of providing environmental information as part of a company's accountability to stakeholders. However, providing information and recognizing environmental costs does not in itself indicate improved SDGs achievement, as achieving sustainability encompasses a broader range of aspects (Hörisch et al., 2020).

From the perspective of Agency Theory, differences in interests between management and shareholders may influence managerial decisions regarding the allocation of corporate resources, including resources related to environmental activities. In this context, Green Accounting can provide information on environmental costs and activities that supports management accountability and allows shareholders to assess the company's responsibility toward environmental aspects (Okoli et al., 2021). Therefore, the significant negative effect found in this study indicates that the environmental costs reflected in Green Accounting have not been accompanied by an increase in SDGs achievement during the observation period. This result does not imply that Green Accounting is inherently detrimental to SDGs, but rather indicates that, within the observed energy-sector companies and period, higher Green Accounting values were associated with lower SDGs achievement.

The finding is consistent with Adnyana et al. (2024) who found that Green Accounting has a significant effect on the SDGs, although the direction of the relationship differs from the findings of this study. Furthermore, Rahmatika et al. (2025) found that Green Accounting has no significant effect on SDGs disclosure. These differences indicate that the relationship between Green Accounting and SDGs may vary across research settings, including differences in research objects, measurement methods, observation periods, and company characteristics. Therefore, in energy-sector companies during the 2021–2025 period, the significant negative effect found in this study indicates that higher environmental costs reflected in Green Accounting have not been accompanied by a corresponding increase in SDGs achievement.

The Effect of Material Flow Cost Accounting on the Sustainable Development Goals (SDGs)

The second hypothesis states that Material Flow Cost Accounting (MFCA) has an effect on the Sustainable Development Goals (SDGs). The test results show a probability value of $0.9089 > 0.05$, indicates that MFCA has no effect on the SDGs; therefore, H_2 is rejected. This finding indicates that the implementation of MFCA in energy-sector companies during the 2021–2025 period has not demonstrated a significant relationship with SDGs achievement.

MFCA is a management accounting method that provides information on material flows and associated costs within production processes. The information generated through MFCA can help identify material losses and provide a basis for evaluating resource use. Kokubu et al. (2023) found that MFCA has the potential to contribute to multiple SDGs and can integrate SDGs into actual management decision-making. From the perspective of Stakeholder Theory, the information generated through MFCA regarding material use and losses is relevant to sustainability topics that may concern stakeholders. Meanwhile, from the perspective of Agency Theory, information regarding material flows and associated costs can support accountability in managerial decisions concerning the use of corporate resources. Therefore, MFCA provides information that is relevant to sustainability considerations and managerial accountability, although such information does not necessarily result in a significant improvement in SDGs achievement.

The insignificant effect found in this study indicates that the information generated through MFCA has not translated into a measurable improvement in SDGs achievement during the observation period. Although Kokubu et al. (2023) that MFCA can potentially contribute to multiple SDGs and support the integration of SDGs into management decision-making, the findings of this study indicate that such potential has not resulted in a significant relationship with SDGs achievement in the observed energy-sector companies. This condition suggests that the identification of material flows and associated costs through MFCA alone may not be sufficient to influence broader SDGs outcomes, particularly when the information generated is not fully reflected in sustainability-related decisions and practices.

The finding of this study is consistent with Kakarika & Yanti (2025), who found that MFCA had no significant effect on sustainable development. However, this finding differs from Putri et al. (2024) who found that MFCA had a significant effect on sustainable development. The findings of Kokubu et al. (2023) also demonstrate the potential contribution of MFCA to multiple SDGs through its integration into management decision-making, although their study emphasizes the potential and mechanism through which MFCA can contribute to SDGs rather than testing the same statistical relationship examined in this study. The differences among these findings may be related to differences in research objects, observation periods, measurement methods, and the extent to which MFCA information is integrated into sustainability-oriented

decision-making. Therefore, the insignificant effect found in this study indicates that MFCA has not yet made a measurable contribution to SDGs achievement in energy-sector companies during the 2021–2025 period.

The Effect of Environmental Disclosure on the Sustainable Development Goals (SDGs)

The third hypothesis states that Environmental Disclosure has an effect on the Sustainable Development Goals (SDGs). The test results show a t-statistic value of 2.611900 and a probability value of $0.0125 < 0.05$, indicating that Environmental Disclosure has a effect on the SDGs, therefore, H_3 is accepted. The positive regression coefficient indicates that the effect of Environmental Disclosure on the SDGs is in a positive direction. Thus, the significance of the effect is the basis for accepting H_3 , while the positive direction represents the empirical result indicated by the regression coefficient.

Environmental Disclosure provides information regarding a company's environmental activities and environmental performance to external stakeholders. From the perspective of Stakeholder Theory, companies are expected to respond to the interests and information needs of stakeholders affected by their activities. Zarzycka & Krasodomska (2021) found that stakeholders interested in environmental issues play an important role in corporate decisions regarding the disclosure of environmental key performance indicators. This indicates that environmental disclosure can be used by companies to communicate information concerning their environmental performance to stakeholders. Therefore, greater Environmental Disclosure can provide stakeholders with more information to assess the company's environmental activities and responsibilities.

From the perspective of Agency Theory, Environmental Disclosure can serve as a mechanism for providing external parties with information about corporate activities and managerial actions. Sun et al. (2022) explain that sustainability reporting can be related to Agency Theory through information asymmetry between management and external parties, while disclosure can support greater transparency and accountability. In this context, Environmental Disclosure provides additional information regarding the company's environmental activities that may assist external parties in evaluating management's actions. The significant positive effect found in this study indicates that greater Environmental Disclosure is associated with higher SDGs achievement during the observation period. This result suggests that environmental information disclosed by energy-sector companies is associated with broader sustainability outcomes reflected in SDGs achievement.

This finding is consistent with Agustin & Trisnawati (2025), who found that Environmental Disclosure has an effect on Sustainable Development, but differs from Anugrah et al. (2024), who found

that Environmental Disclosure has no effect on the SDGs. In energy sector companies, environmental disclosure is particularly important because their operational activities tend to have substantial environmental impacts. Therefore, the better the quality and extent of environmental disclosure provided by a company, the greater its potential contribution to the achievement of the SDGs, particularly when the disclosed information is supported by tangible and consistent environmental management practices.

The Effects of Green Accounting, Material Flow Cost Accounting, and Environmental Disclosure on the Sustainable Development Goals (SDGs)

The fourth hypothesis states that Green Accounting, Material Flow Cost Accounting (MFCA), and Environmental Disclosure simultaneously has an effect on the Sustainable Development Goals (SDGs). The F-test results show a probability value of $0.024338 < 0.05$, indicating that the three variables jointly have a significant effect on the SDGs, therefore, the fourth hypothesis is accepted. These results indicate that the combination of these three variables significantly influences SDG achievement in energy sector companies. Thus, Green Accounting, MFCA, and Environmental Disclosure collectively contribute to explaining SDG achievement during the study period.

The combination of these three variables reflects the existence of internal management mechanisms and external transparency that are jointly related to SDGs achievement. Green Accounting functions to identify and record the allocation of environmental costs through financial accounting, which is then clarified by MFCA at the micro-operational level by tracking raw material flows and separating product costs from waste costs (Christ & Burritt, 2015). This internal recording process prevents manipulation or perceived efficiencies at the management level. Furthermore, internal physical and cost efficiency data is published through Environmental Disclosure to provide a valid signal and reduce information asymmetry for the public (Song et al., 2017).

From a Stakeholder Theory perspective, providing information on environmental activities and performance is a company's response to stakeholders' information needs. Stakeholders have a vested interest in the environmental impacts arising from company activities, particularly in energy sector companies whose operations are related to resource use and environmental impacts. Zarzycka & Krasodomska (2021) that stakeholder attention to environmental issues plays a role in company decisions regarding the disclosure of environmental performance indicators. Therefore, the information generated and conveyed through these three variables can serve as a basis for stakeholders in assessing a company's environmental activities and responsibilities.

From an Agency Theory perspective, this mechanism relates to the need to reduce information asymmetry between management as the agent and external parties as the principal. Information on environmental costs, material use, and environmental performance can assist external parties in assessing management actions and decisions. Green Accounting and MFCA generate internal information regarding costs and resource use, while Environmental Disclosure provides this information to external parties. Sun et al. (2022) explain that sustainability reporting can be linked to information asymmetry between management and external parties and plays a role in supporting corporate transparency and accountability. Simultaneous test results indicate that when Green Accounting, MFCA, and Environmental Disclosure are considered together, all three have a significant impact on the SDGs. This finding suggests that SDGs achievement is related to various aspects of a company's environmental practices, reflected in environmental cost management, material efficiency, and environmental information transparency. Although partial test results may indicate different levels of significance for each variable, the F-test results indicate that all three variables collectively have a significant impact on the SDGs. Thus, H₄ is accepted, providing empirical evidence of a joint effect of Green Accounting, MFCA, and Environmental Disclosure on SDGs achievement in energy sector companies.

Conclusion

Based on the research findings, it can be concluded that Green Accounting, Material Flow Cost Accounting (MFCA), and Environmental Disclosure provide different empirical results in explaining the achievement of the Sustainable Development Goals (SDGs) in energy sector companies in Indonesia during the 2021–2025 period. Green Accounting has a significant negative effect on SDGs, indicating that higher environmental management costs do not necessarily correspond to higher SDG achievement during the observation period. Environmental Disclosure has a significant positive effect on SDGs, indicating that broader environmental information disclosure is associated with higher SDG achievement. Meanwhile, MFCA does not have a significant effect on SDGs, indicating that information related to material, energy, and waste management has not demonstrated a significant relationship with SDG achievement. Simultaneously, Green Accounting, MFCA, and Environmental Disclosure have a significant effect on SDGs, indicating that the three variables collectively have a significant relationship with SDG achievement when considered together in the research model.

This study contributes to the environmental accounting literature by examining Green Accounting, MFCA, and Environmental Disclosure simultaneously in Indonesian energy sector companies during the

2021–2025 period. The study addresses the research gap concerning the limited empirical evidence that combines these three environmental-related variables within the context of the Indonesian energy sector. The findings provide more recent empirical evidence regarding the relationship between environmental accounting practices, material flow management, environmental disclosure, and SDGs. The different results obtained from the partial tests further indicate that the effects of environmental-related practices on SDGs are not uniform across variables, while the significant simultaneous result demonstrates the relevance of considering the three variables collectively within the research model.

The findings have implications for companies, regulators, and researchers. For companies, the results highlight the importance of strengthening the substantive implementation and utilization of environmental accounting and material flow information in operational and sustainability-related decision-making, while maintaining transparent environmental disclosure. For regulators and policymakers, the findings can be considered in strengthening regulations, supervision, and mechanisms that encourage corporate environmental accountability and the quality of environmental information. For researchers and academics, this study provides a basis for further research by extending the observation period, examining other sectors with significant environmental impacts, and developing more comprehensive measures of SDG achievement. Future research may also examine additional factors that could explain differences in the relationship between environmental practices and SDGs.

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Author Contributions

Dinda Anggraeni: conceptualization, methodology, data collection, data processing, statistical analysis, investigation, drafting and writing the initial manuscript, and manuscript revision. Reni Astuti: supervision and academic guidance throughout the research and manuscript preparation process. Both authors have read and approved the final version of this manuscript.

Conflict of Interest

The authors declare that there are no financial, personal, or professional conflicts of interest that could unduly influence or bias the content, results, or conclusions of this research.

Research Funding

This research did not receive any specific grants or funding from any funding agencies in the public, commercial, or non-profit sectors.

Declaration of Generative AI Use

Generative AI tools were used during the preparation of this manuscript to assist with language editing, grammar checking, and improving sentence clarity. The use of these tools was limited to supporting the presentation and readability of the manuscript and was not used to generate research data or research findings. The suggestions provided by the tools were reviewed and revised by the authors, and the final manuscript was reviewed and approved by the authors