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Green Accounting, Material Flow Cost Accounting, and the Achievement of Sustainable Development Goals in Indonesian Energy Companies

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ABSTRACT

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Purpose – This study examines the effects of Green Accounting and Material Flow Cost Accounting (MFCA) on the achievement of the Sustainable Development Goals (SDGs) among energy companies listed on the Indonesia Stock Exchange (IDX) between 2020 and 2024. The study used a quantitative methodology with descriptive and verificative analyses. Purposive sampling was used and included 11 energy companies observed over five years, yielding 55 company-year observations. Data were analysed using panel data regression in EViews 12. Based on the Chow, Hausman, and Lagrange Multiplier test results, the Random Effects (RE) Model was selected as the most suitable estimation approach. The results indicate that Green Accounting has a significant negative effect on SDG achievement, whereas MFCA has a positive effect that is only marginally significant ($p = 0.0497$). Both effects are modest, and the model explains only a small share of the variation in SDG achievement. These findings suggest that disclosure alone may not be enough and may need to be paired with operational resource-efficiency measures.

INTRODUCTION

In recent decades, the world has faced increasingly complex challenges in balancing economic growth with environmental conservation. Climate change has become a major concern, marked by rising global temperatures, melting polar ice, rising sea levels, and more frequent natural disasters such as floods, droughts, and wildfires (Suhadi et al., 2023). According to the International Energy Agency (IEA, 2022), the energy sector contributes the most to global greenhouse gas emissions, accounting for more than three-quarters of the total. This makes the transition to a more sustainable energy system a pressing priority. The energy sector is closely linked to natural resource use and land-clearing activities that can damage the environment. Therefore, applying sustainable development principles, which cover financial, social, and environmental aspects, is crucial for energy companies (Wahida & Uyun, 2023).

Through the Sustainable Development Goals (SDGs) agenda, which was adopted by 193 member states in 2015, the United Nations (UN) has established 17 goals and 169 targets for global development through 2030 (Arum & Farida, 2023). According to GoodStats (2025), Indonesia scored 70.22 on the SDG Index, ranking 77th globally and fourth in Southeast Asia.

Although it has shown positive progress, Indonesia has achieved only two of the 17 SDGs, calling for more effective and integrated strategies to accelerate national sustainable development.

Table 1
SDGs Achievement Scores of Energy Sector Companies

No	Code	Company Name	SDG Scores				
			2020	2021	2022	2023	2024
1.	ADRO	PT Alamtri Resources Indonesia Tbk	52.94	52.94	58.82	58.82	76.47
2.	BUMI	PT Bumi Resources Tbk	47.06	58.82	58.82	58.82	64.71
3.	ELSA	PT Elnusa Tbk	82.35	82.35	88.23	82.35	82.35
4.	ENRG	PT Energi Mega Persada Tbk	41.17	88.23	88.23	94.11	76.47
5.	INDY	PT Indika Energy Tbk	70.58	70.58	41.17	70.59	88.24
6.	ITMG	PT Indo Tambangraya Megah Tbk	76.47	64.70	58.82	88.23	64.70
7.	MEDC	PT Medco Energi Internasional Tbk	88.23	41.17	64.70	76.47	82.35
8.	PGAS	PT Perusahaan Gas Negara Tbk	41.17	41.17	35.29	35.29	76.47
9.	PTBA	PT Bukit Asam Tbk	58.82	64.70	41.18	35.29	94.12
10.	PTRO	PT Petrosea Tbk	52.94	47.05	52.94	41.17	35.29
11.	TOBA	PT TBS Energi Utama Tbk	52.94	64.70	70.58	82.35	76.47

Source: Data processed by the authors, 2025

Referring to Table 1, only four of the 11 energy companies (ADRO, BUMI, ELSA, and TOBA) showed a gradual upward trend or remained relatively stable in their SDG scores during the 2020–2024 period. The remaining companies fluctuated, with several notable anomalies. PGAS's score remained at or below 41.17 for four consecutive years before surging sharply to 76.47 in 2024. A similar pattern was observed at PTBA, whose score dropped to 35.29 in 2023 before rising sharply to 94.11 the following year. ENRG, INDY, ITMG, and MEDC also fluctuated, while PTRO showed a general downward trend from 52.94 to 35.29 during the study period. These differences may reflect inconsistent commitment to sustainability, possibly influenced by internal factors such as changes in management strategy and investment allocation, as well as external factors such as government policies and energy market dynamics. It is therefore worth examining the effectiveness and consistency of sustainability strategy implementation in supporting the achievement of the SDGs in the energy sector.

Previous studies have examined the relationship between Green Accounting, Material Flow Cost Accounting (MFCA), and the SDGs. Adnyana et al. (2024) and Kurniawan and Fitranita (2024) revealed that Green Accounting significantly affects the SDGs. However, Deomega and Sari (2025) and Gresya and Surianti (2024) found the opposite, concluding that Green Accounting does not significantly affect the SDGs. Ningrum (2024) and Selpiyanti and Fakhroni (2020) revealed that MFCA significantly affects the SDGs. However, Arum and Farida (2023) and Kurniawan and Fitranita (2024) discovered the opposite, reporting that MFCA does not affect the SDGs. These inconsistent findings indicate the need for further investigation into the distinct roles of environmental accounting disclosure and resource-oriented cost accounting in corporate sustainability. Building on these gaps, this study examines the relationships between Green Accounting, MFCA, and SDG achievement among energy sector companies listed on the Indonesia Stock Exchange (IDX) between 2020 and 2024. The study also seeks to provide empirical evidence on how environmental accounting practices relate to corporate sustainability outcomes in a sector characterised by substantial environmental impacts and resource-intensive operations.

Theoretically, this study investigates two complementary dimensions of environmental accounting within the framework of legitimacy theory: Green Accounting as an approach to environmental cost recognition and disclosure, and MFCA as an approach to identifying material flows, resource inefficiencies, and associated costs. Examining these dimensions together allows this study to assess whether disclosure-oriented and resource-efficiency-oriented accounting practices show similar relationships with corporate SDG achievement. Practically, the study focuses on Indonesia's energy sector, where environmental impacts, resource use, and sustainability accountability matter most. Using panel data from 11 listed energy companies from 2020 to 2024, the study provides sector-specific evidence to help companies assess the role of environmental accounting in sustainability management. In particular, it clarifies how the relationships of Green Accounting and MFCA with SDG achievement may differ.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Legitimacy Theory

Legitimacy theory, as framed by Suchman (1995), explains that companies must continuously ensure that their operational activities align with the values and norms prevailing in the communities where they operate, given the mutually influential relationship between companies and the surrounding community (Rahmatika et al., 2025). The core of this theory is that an organisation's survival depends heavily on the extent to which its activities align with the value systems prevalent in society (Arum & Farida, 2023).

Sustainable Development Goals

The SDGs are part of a global development initiative that followed the Millennium Development Goals (MDGs), which ran until 2015. Member states of the UN formally adopted the agenda through General Assembly Resolution 70/1, *Transforming Our World: The 2030 Agenda for Sustainable Development*. It sets out 17 goals and 169 targets to be achieved by 2030, balancing economic development, social well-being, and environmental sustainability (United Nations, 2015; Wahyuningsih, 2017).

Green Accounting

Green Accounting is an accounting approach that identifies, organises, allocates, and controls costs related to environmental aspects. In practice, Green Accounting treats environmental cost management and performance reporting as essential elements in

supporting sustainable practices and corporate social responsibility (Nabila & Arinta, 2021). According to legitimacy theory, high Green Accounting disclosure can serve as an effective communication strategy for gaining and maintaining public legitimacy.

H₁: Green Accounting has a significant effect on the achievement of the Sustainable Development Goals among energy companies listed on the Indonesia Stock Exchange.

Material Flow Cost Accounting (MFCA)

MFCA integrates operational and financial information into a single framework. This system comprises three main components: material costs, which refer to the acquisition cost of the actual quantity of materials used in the production process; system costs, which relate to the company's operational activities such as depreciation, transportation, and maintenance; and waste costs, which are expenses arising from production activities that generate waste (Loen, 2018). According to legitimacy theory, companies must demonstrate social responsibility to remain accepted by society. Extensive use of MFCA reflects transparency and efficiency in the use of material and energy resources, which can reduce waste and resource exploitation. This practice may support the achievement of the SDGs and strengthen the company's image as an entity committed to sustainability and social responsibility.

H₂: Material Flow Cost Accounting has a significant effect on the achievement of the Sustainable Development Goals among energy companies listed on the Indonesia Stock Exchange.

RESEARCH METHODOLOGY

This study adopts a quantitative approach using descriptive and verificative analyses. Secondary data were obtained from the IDX and the companies' official websites, specifically annual reports and sustainability reports for the 2020–2024 period. The population consists of 38 energy sector companies listed on the IDX. The sample was selected using purposive (non-probability) sampling. The analysis uses panel data regression, the coefficient of determination, and *t*- and *F*-tests. This study uses three variables: Green Accounting (X1), MFCA (X2), and SDG achievement (Y). Green Accounting refers to the integration of environmental considerations into corporate accounting practices, particularly environmental cost recognition and disclosure. It is measured using environmental accounting information reported in the companies' annual and sustainability reports. MFCA is an environmental management accounting approach that evaluates material costs, operational system costs, and waste-related costs to identify resource inefficiencies. MFCA is assessed using relevant financial and operational information disclosed in corporate reports.

SDG achievement serves as the dependent variable, reflecting the extent to which corporate sustainability activities and disclosures align with the 17 goals of the UN's 2030 Agenda. The variable is measured using SDG-related information disclosed in annual and sustainability reports, which is then expressed as a company-level achievement score. The dataset comprises 11 energy sector companies observed over five consecutive years (2020–2024), giving 55 balanced panel observations. Analyses were conducted in EViews 12. The analytical procedure consisted of several stages. First, descriptive statistics were calculated to summarise the distribution and variability of the research variables. Second, three panel regression specifications were considered: the Common Effects (CE) Model, Fixed Effects (FE) Model, and Random Effects (RE) Model. The Chow test was used to compare CE and FE models, while the Hausman test was employed to evaluate the FE model against the RE model. The Breusch-Pagan Lagrange Multiplier test was subsequently used to compare CE and RE models.

Third, this study conducted diagnostic tests for residual normality, multicollinearity, autocorrelation, and heteroscedasticity. Finally, the selected model was estimated, and the regression coefficients, *t*-statistics, *p*-values, *F*-statistic, and coefficient of determination were interpreted at a 5% significance level.

RESULTS

Descriptive Analysis

Table 2
Results of the Descriptive Analysis

Date: 08/27/25 Time: 04:37
Sample: 2020 2024

	X1	X2	Y
Mean	7.690727	11.95964	0.643969
Median	7.670000	10.12000	0.647000
Maximum	10.67000	34.00000	0.941100
Minimum	1.670000	3.350000	0.352900
Std. Dev.	1.606069	7.831228	0.176100
Skewness	-0.754879	1.171524	-0.084944
Kurtosis	4.825936	3.657359	1.846688
Jarque-Bera	12.86406	13.57124	3.114351
Probability	0.001609	0.001130	0.210730
Sum	422.9900	657.7800	35.41830
Sum Sq. Dev.	139.2908	3311.719	1.674605
Observations	55	55	55

Source: Data processed using EViews 12, 2025

Table 2 summarises the three variables for the 11 energy sector companies listed on the IDX over the 2020–2024 period. The lowest Green Accounting value was 1.67 for PT Indika Energy Tbk, and the highest was 10.67 for PT Perusahaan Gas Negara Tbk in 2024. The mean of 7.69 falls in the upper half of the observed range (1.67–10.67), indicating a relatively high average disclosure level. The standard deviation of 1.61 is smaller than the mean, which suggests the data are fairly homogeneous (coefficient of variation of about 21%). The lowest MFCA value was 3.35 at PT Medco Energi Internasional Tbk in 2021, and the highest was 34.00 at PT Elnusa Tbk in 2022. The mean of 11.96 is closer to the minimum than to the maximum, indicating that the average MFCA implementation remains low. The standard deviation of 7.83 (a coefficient of variation of about 65%) indicates wide dispersion, so the MFCA data are heterogeneous rather than homogeneous. The lowest SDG value was 0.3529 at PT Perusahaan Gas Negara Tbk in 2022 and 2023, at PT Bukit Asam Tbk in 2023, and at PT Petrosea Tbk in 2024, while the highest was 0.9411 at PT Energi Mega Persada Tbk in 2023 and at PT Bukit Asam Tbk in 2024. The mean of 0.644 falls in the middle of the data range, and the standard deviation of 0.176 is small relative to the mean, indicating a symmetrical and fairly homogeneous distribution; the SDG data are therefore reasonably representative.

Verificative Analysis

Selecting a Regression Estimation Method for Panel Data

a. Chow Test

Table 3
Chow Test

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.624360	(10,42)	0.0141
Cross-section Chi-square	26.697775	10	0.0029

Source: Data processed using EViews 12, 2025

In Table 3, the cross-sectional chi-square value has a *p*-value of 0.0029, which is below 0.05. The result indicates that the FE model is preferred to the CE model.

b. Hausman Test

Table 4
Hausman Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.356258	2	0.8368

Source: Data processed using EViews 12, 2025

Table 4 shows that the cross-section RE test has a *p*-value of 0.8368, which is above 0.05. The result indicates that the RE model is preferred to the FE model.

c. Lagrange Multiplier Test

Table 5
Lagrange Multiplier Test

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	5.498774 (0.0190)	0.074610 (0.7847)	5.573384 (0.0182)

Source: Data processed using EViews 12, 2025

Referring to Table 5, which shows a Breusch-Pagan *p*-value of 0.0190 (below 0.05), the RE model is preferred to the CE model. After conducting model selection tests using the Chow, Hausman, and Lagrange Multiplier tests, the appropriate model is the RE model because it was favoured by two of the three tests (Hausman and Lagrange Multiplier). Table 6 presents the results.

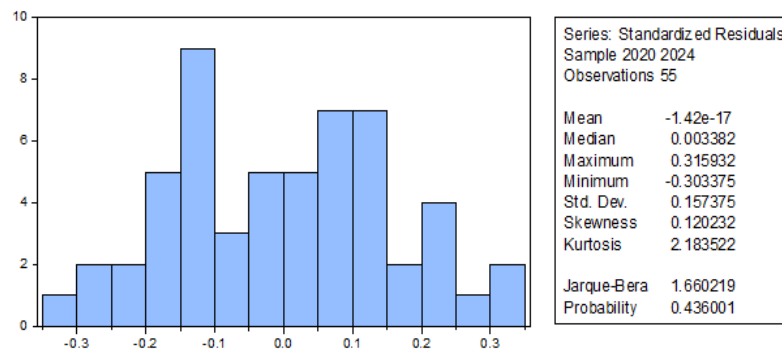
Table 6

Summary of Model Selection Tests

No	Test	Function	Result	Selected Model
1.	Chow Test	Choosing between FE Model and CE Model	FE Model	RE Model
2.	Hausman Test	Choosing between FE Model and RE Model	RE Model	
3.	Lagrange Multiplier Test	Choosing between CE Model and RE Model	RE Model	

Source: Data processed using EViews 12, 2025

Normality Test



Source: Data processed using EViews 12, 2025

Figure 1

Results of the Normality Test

Referring to Figure 1, the Jarque-Bera (JB) statistic is 1.660219, with a p -value of 0.436001, which is above 0.05. These results indicate that the residuals of the selected model are normally distributed, so the normality assumption is satisfied.

Multicollinearity Test

Table 7

Results of the Multicollinearity Test

Variance Inflation Factors

Date: 08/27/25 Time: 04:59

Sample: 1 55

Included observations: 55

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.009115	19.52639	NA
X1	0.000116	1.381361	1.031136
X2	7.62E-06	3.247367	1.031136

Source: Data processed using EViews 12, 2025

Table 7 shows that Green Accounting and MFCA both have a centred variance inflation factor (VIF) of 1.031136, well below the common threshold of 10. These results indicate no strong correlation between the independent variables, so the model is free from multicollinearity.

Autocorrelation Test

Table 8
Results of the Autocorrelation Test

R-squared	0.164822	Mean dependent var	0.358553
Adjusted R-squared	0.132699	S.D. dependent var	0.147791
S.E. of regression	0.137636	Sum squared resid	0.985074
F-statistic	5.131072	Durbin-Watson stat	1.836559
Prob(F-statistic)	0.009253		

Source: Data processed using EViews 12, 2025

Table 8 shows a Durbin-Watson (DW) statistic of 1.836559, which is compared with the upper critical value (dU). At a 5% significance level ($\alpha = 0.05$), with $n = 55$ observations and $k = 2$ independent variables, the tabulated dU is 1.6406. Because $dU (1.6406) < DW (1.836559) < 4 - dU (2.3594)$, the selected model shows no evidence of first-order autocorrelation.

Heteroscedasticity Test

Table 9
Results of the Heteroscedasticity Test

Heteroskedasticity Test: Glejser

F-statistic	2.802616	Prob. F(2,52)	0.0698
Obs*R-squared	5.351732	Prob. Chi-Square(2)	0.0688
Scaled explained SS	3.880745	Prob. Chi-Square(2)	0.1437

Source: Data processed using EViews 12, 2025

Table 9 shows that the Glejser test returns an F -statistic p -value of 0.0698, which is above the 5% significance level ($\alpha = 0.05$). The null hypothesis of homoscedasticity is therefore not rejected, and there is no evidence of heteroscedasticity.

Results of the Panel Data Regression Analysis

Table 10
Results of the Regression Panel Data Analysis

Dependent Variable: ABS(Y)
Method: Panel EGLS (Cross-section random effects)
Date: 08/27/25 Time: 04:57
Sample: 2020 2024
Periods included: 5
Cross-sections included: 11
Total panel (balanced) observations: 55
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.727907	0.104910	6.938362	0.0000
X1	-0.023141	0.010838	-2.135157	0.0375
X2	0.007867	0.003916	2.009215	0.0497
Effects Specification				
		S.D.	Rho	
Cross-section random		0.093316	0.3080	
Idiosyncratic random		0.139865	0.6920	
Weighted Statistics				
R-squared	0.164822	Mean dependent var	0.358553	
Adjusted R-squared	0.132699	S.D. dependent var	0.147791	
S.E. of regression	0.137636	Sum squared resid	0.985074	
F-statistic	5.131072	Durbin-Watson stat	1.836559	
Prob(F-statistic)	0.009253			

Source: Data processed using EViews 12, 2025

Based on Table 10, the panel data regression equation is as follows:

$$Y = 0.727907 - 0.023141X_1 + 0.007867X_2 + \varepsilon$$

1. The constant of 0.727907 is positive. If Green Accounting and MFCA were both zero, the predicted SDG score would equal this constant. This is only a mathematical baseline, because zero lies outside the observed range of both variables (minimums of 1.67 and 3.35).
2. The coefficient for Green Accounting is -0.023141 . This negative sign means that a one-unit increase in Green Accounting is associated with a 0.023141 decrease in the SDG score, holding MFCA constant. Conversely, a one-unit decrease is associated with a 0.023141 increase.
3. The coefficient for MFCA is 0.007867. This positive sign means that a one-unit increase in MFCA is associated with a 0.007867 increase in the SDG score, holding Green Accounting constant. Conversely, a one-unit decrease is associated with a 0.007867 decrease.

The error term (ε) captures the effect of factors other than Green Accounting and MFCA that affect SDG achievement but are not included in the model.

The F -statistic of 5.131072 ($p = 0.009253$) shows that Green Accounting and MFCA are jointly significant at the 5% level.

Coefficient of Determination Analysis

Table 11
Results of the Coefficient of Determination Analysis: Green Accounting

R-squared	0.102528	Mean dependent var	0.643969
Adjusted R-squared	0.085595	S.D. dependent var	0.176100
S.E. of regression	0.168395	Akaike info criterion	-0.689325
Sum squared resid	1.502910	Schwarz criterion	-0.616332
Log likelihood	20.95645	Hannan-Quinn criter.	-0.661098
F-statistic	6.054788	Durbin-Watson stat	1.245211
Prob(F-statistic)	0.017161		

Source: Data processed using EViews 12, 2025

Table 11 reports an adjusted R^2 of 0.085595 for Green Accounting. This means that Green Accounting alone explains about 8.6% of the variation in SDG achievement, while the remaining 91.4% (100% – 8.6%) is attributable to factors outside the model.

Table 12
Results of the Coefficient of Determination Analysis: Material Flow Cost Accounting

R-squared	0.135047	Mean dependent var	0.643969
Adjusted R-squared	0.118727	S.D. dependent var	0.176100
S.E. of regression	0.165316	Akaike info criterion	-0.726232
Sum squared resid	1.448454	Schwarz criterion	-0.653238
Log likelihood	21.97138	Hannan-Quinn criter.	-0.698005
F-statistic	8.275010	Durbin-Watson stat	1.313442
Prob(F-statistic)	0.005779		

Source: Data processed using EViews 12, 2025

Table 12 reports an adjusted R^2 of 0.118727 for MFCA. This means that MFCA alone explains about 11.9% of the variation in SDG achievement, while the remaining 88.1% (100% – 11.9%) is attributable to factors outside the model.

Explanatory Power of the Regression Models

The relatively low adjusted coefficients of determination indicate that the explanatory power of the independent variables is limited. The separate regression specifications produced adjusted R^2 values of 0.085595 for Green Accounting and 0.118727 for MFCA, indicating that each variable individually explains only a limited proportion of the variation in SDG achievement. By contrast, the combined RE model reported an adjusted R^2 of 0.132699, suggesting that Green Accounting and MFCA jointly account for approximately 13.27% of the variation in SDG achievement after adjustment for the number of predictors.

These findings suggest that corporate SDG achievement is a multidimensional outcome that cannot be adequately explained by environmental accounting indicators alone. Other potentially relevant factors include corporate governance, environmental performance, sustainability investment, organisational characteristics, and external economic or regulatory conditions. Although these factors were not included in the present model, they may contribute to differences in sustainability outcomes across companies and periods.

The statistically significant coefficients should therefore be interpreted in light of the model's limited explanatory power. The findings provide evidence of associations between the selected accounting variables and SDG achievement. However, they do not imply that Green Accounting and MFCA are the principal determinants of corporate sustainability outcomes.

DISCUSSION

The Relationship between Green Accounting and the Sustainable Development Goals

The t -test for Green Accounting yields a negative t -statistic of -2.135157 with a p -value of 0.0375. Because the absolute t -statistic (2.135157) exceeds the critical t -value (2.00665 at $\alpha = 0.05$ with 52 degrees of freedom) and the p -value is below 0.05, H_0 is rejected, and H_1 is accepted. This means that Green Accounting has a significant effect on SDG achievement. This result aligns with Adnyana et al. (2024) and Kurniawan and Fitranita (2024), who found a significant effect, but differs from Deomega and Sari (2025) and Gresya and Surianti (2024), who found none. The consistency concerns only statistical significance; the negative sign is discussed below.

The negative coefficient ($\beta = -0.023141$) requires a more nuanced interpretation than the assumption that greater environmental accounting disclosure necessarily corresponds to stronger sustainability outcomes. In Indonesia's energy sector, companies engage in activities characterised by substantial resource consumption, environmental exposure, and sustainability-related stakeholder expectations. Under these conditions, more extensive environmental accounting disclosure may reflect increased recognition of environmental costs, risks, and obligations rather than immediate improvements in sustainability performance.

From the perspective of legitimacy theory, companies facing greater environmental scrutiny may strengthen their environmental reporting to demonstrate accountability and maintain stakeholder acceptance. However, the disclosure of environmental information and the achievement of measurable sustainability outcomes are conceptually distinct. The negative coefficient may therefore reflect a gap between the extent of environmental accounting practices captured by the research indicator and the SDG outcomes reported during the observation period. This interpretation remains tentative without additional evidence on

environmental performance, operational changes, and the timing of sustainability investments. Reverse causality is another possibility: firms with weaker sustainability performance may disclose more to protect their legitimacy. The current design cannot distinguish between these explanations.

The findings suggest that Green Accounting should not be evaluated solely through the extent of reporting or environmental cost recognition. For energy companies, its practical relevance depends on whether accounting information supports environmental risk management, pollution reduction, resource efficiency, and measurable sustainability improvements. The results therefore add to the legitimacy theory literature by showing that environmental accountability and reported SDG achievement do not necessarily move in the same direction within the same reporting period.

The Impact of Material Flow Cost Accounting on the Sustainable Development Goals

The t -statistic for MFCA is 2.009215, with a p -value of 0.0497. Because the t -statistic exceeds the critical value of 2.00665 and the p -value is below 0.05, the study rejects H_0 at the 5% level, although the margin is very narrow. Hence, the effect is only marginally significant. This suggests that MFCA significantly affects SDG achievement. These findings align with Ningrum (2024) and Selpiyanti and Fakhroni (2020), who found that MFCA affects the SDGs. However, they contradict Arum and Farida (2023) and Kurniawan and Fitranita (2024), who concluded that MFCA does not affect the SDGs. Unlike the negative coefficient for Green Accounting, the positive coefficient for MFCA ($\beta = 0.007867$) suggests that the MFCA indicator is positively associated with the sustainability outcomes measured in the study. MFCA is conceptually relevant to energy companies because their operations involve substantial material inputs, energy consumption, production processes, and potential resource losses.

By identifying the costs of material flows and inefficiencies, MFCA can provide management with information on resource utilisation and environmental cost control. In energy-related operations, such information may support decisions concerning material losses, energy efficiency, waste management, and operational improvements. These are possible routes, but the study did not test any of them. Legitimacy theory offers a second way to read this result. Firms can seek acceptance by reporting on their responsibility, but they can also seek it by showing that they handle materials and energy carefully. MFCA belongs to the second group because it puts a cost on material loss and waste. The positive coefficient fits that view, but the evidence is thin. The p -value is 0.0497, and the study has no operational data showing that MFCA changed how materials were used. The result should be tested again with efficiency indicators such as material loss or energy intensity.

CONCLUSION

This study examined whether Green Accounting and MFCA relate to SDG achievement among 11 energy companies listed on the IDX between 2020 and 2024. For Green Accounting, the answer is yes, but the sign is negative. Companies that reported more environmental accounting information tended to have lower SDG scores ($\beta = -0.023141$, $p = 0.0375$). The data do not show why. Heavier reporting by firms under scrutiny and reverse causality are both possible. In theoretical terms, disclosure that serves legitimacy and performance that serves the SDGs need not move together. MFCA has the opposite sign ($\beta = 0.007867$), but the relationship is small and only just significant ($p = 0.0497$). It should not be treated as firm support for MFCA. However, it is consistent with the idea that tracking material losses and waste costs helps firms manage resources more carefully. For managers, the findings suggest linking environmental

reporting to operational targets and using MFCA to locate material and energy losses. For regulators and investors, SDG scores built from disclosures should be read together with data on actual environmental performance. For researchers, the low explanatory power and the borderline MFCA result call for replication with more firms, more years, and additional controls.

This study has several methodological limitations. First, the sample comprises only 11 energy sector companies listed on the IDX over the 2020–2024 period, which limits the generalisability of the findings to other industries and institutional contexts. Second, the combined model's low adjusted R^2 (0.1327) indicates that the selected variables explain only a small share of variation in corporate SDG achievement. Third, the study relies on secondary information obtained from corporate annual reports and sustainability reports, making the analysis dependent on the availability, consistency, and quality of publicly disclosed information. Fourth, the observational research design identifies statistical associations but does not establish causal relationships. Finally, the MFCA effect is only marginally significant ($p = 0.0497$), and the disclosure-based scores involve some coding subjectivity. Future studies could add more years, other sectors, and other countries; include governance and environmental performance measures; and use lagged disclosure to address reverse causality.

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