

# The Effect of Audit Committee Effectiveness, Environmental Performance, and Corporate Disclosure on Carbon Emission Disclosure

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## Abstract

**Purpose:** This inquiry aims to empirically analyze the influence of audit committee effectiveness, environmental performance, and corporate disclosure levels on the intensity of carbon emission reporting. The study focuses on corporate entities within the basic materials sector officially quoted on the Indonesia Stock Exchange throughout the 2020–2024 observation window.

**Research Methodology:** This study employs a quantitative causal-associative design, analyzing 80 observations from 16 basic materials companies selected via purposive sampling on the IDX. Secondary data were aggregated from annual and sustainability reports, corporate websites, *Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan (PROPER)* ratings, and IDX databases. Hypotheses were tested using multiple linear regression and diagnostic assessments via IBM SPSS Statistics.

**Results:** The results of the F-test indicate that audit committee effectiveness, environmental performance, and corporate disclosure simultaneously exert a significant influence on carbon emission transparency. However, the t-test results reveal a divergent pattern: while audit committee effectiveness and corporate disclosure demonstrate a positive and statistically significant impact, environmental performance remains statistically insignificant.

**Conclusions:** Transparency in carbon emissions is more strongly affected by the quality of internal governance and media exposure than by environmental performance achievements.

**Limitations:** Limited access to some historical documents for the period 2020–2024.

**Contributions:** Beyond advancing the scholarly literature on green accounting, these findings offer actionable insights for regulatory bodies and management to improve the quality of carbon-related disclosures.

**Keywords:** *Audit Committee Effectiveness, Corporate Disclosure, Carbon Emission Disclosure, Environmental Performance*

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## 1. Introduction

Climate change and the phenomenon of global warming encourage the business sector to strengthen its environmental responsibility. In this regard, the disclosure of carbon emissions represents a form of corporate accountability, providing a transparent account of the greenhouse gas output inherent in the company's operations ([Wiguna, Stephanus, & Pratama, 2025](#); [Woen & Setijaningsih, 2025](#)). In Indonesia, the commitment toward net zero emissions by 2060, the strengthening of Nationally Determined Contribution (NDC) targets, and the operation of the carbon exchange (IDXCarbon)

reinforce the demand for credible emission reporting ([Andrian, Harahap, & Purnomo, 2025](#); [Wiguna et al., 2025](#)). Given that carbon disclosures are currently voluntary, there is a notable lack of uniformity in the reporting quality and extent among firms within the sector ([Desai, 2022](#); [Sari & Sulfitri, 2023](#)). This condition indicates a phenomenon gap, namely the increasing demand for carbon emission transparency while corporate disclosure practices have not yet been fully consistent and comprehensive ([Doloksaribu, Silkapanis, & Firmansyah, 2024](#)).

Variations in disclosure levels raise scientific questions regarding the factors driving transparency, including the role of corporate governance and internal corporate capabilities ([Sari & Sulfitri, 2023](#)). Carbon emission disclosure serves a strategic function in reducing information asymmetry, maintaining corporate reputation, and signaling readiness to face the low-carbon transition ([Sari & Sulfitri, 2023](#)). Based on stakeholder theory, disclosure is used to meet the information needs of investors, regulators, and the public ([Saputra & Firmansyah, 2024](#)). In accordance with legitimacy theory, organizations utilize information disclosure as a strategic mechanism to align their corporate conduct with societal norms, thereby proactively securing, maintaining, and defending their social license to operate among diverse stakeholders ([Sari & Sulfitri, 2023](#)). Therefore, the effectiveness of internal oversight, such as audit committee effectiveness, environmental performance, and corporate disclosure, is considered important in expanding carbon emission disclosure ([Wiguna et al., 2025](#)).

Audit committee effectiveness is one manifestation of corporate governance implementation that functions to ensure the availability of relevant, transparent, and reliable information for shareholders ([Imelda, Mukhtaruddin, & Kartasari, 2025](#); [Mujiono, Hatta, Fachruzzaman, & Baihaqi, 2021](#)). The audit committee is viewed as a monitoring mechanism that helps improve the quality of corporate information through its supervision of management ([Al-Shaer, Malik, & Zaman, 2022](#); [Mujiono et al., 2021](#)). Empirical studies indicate that audit committee effectiveness positively influences disclosure transparency because it strengthens supervision over environmental reporting ([Angelina & Handoko, 2023](#); [Saputra & Firmansyah, 2024](#)). However, results across studies are not always consistent; some research does not identify a significant impact of audit committee effectiveness on carbon emission disclosure, suggesting variations in how supervisory functions are implemented across companies ([Khoiriyah, Zarefar, Afifah, & Oktari, 2022](#); [Puspita & Tanjung, 2022](#); [Valencia, Nella, & Haryono, 2025](#)). Based on stakeholder theory, an effective audit committee functions as a mechanism that enables companies to fulfill stakeholder information needs through more transparent and accountable carbon emission disclosure ([Putri & Yuliandhari, 2024](#); [Widagdo, Rahanyamtel, & Ika, 2022](#)).

Furthermore, environmental performance assessed using the *Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan (PROPER)* rating functions as an indicator of external reputation and reflects corporate responsibility in managing ecological impacts ([Sari & Sulfitri, 2023](#)). *PROPER* evaluates compliance and efficiency in resource management, meaning that higher ratings indicate stronger corporate commitment to sustainability ([Sari & Sulfitri, 2023](#)). Based on stakeholder theory, high levels of environmental performance drive companies to expand the scope of their emission data sharing, thereby fulfilling their obligations of accountability to diverse stakeholder groups ([Azzahra, Damayanti, & Dewi, 2025](#); [Sari & Sulfitri, 2023](#)). Congruent with legitimacy and stakeholder theories, empirical evidence suggests a positive correlation between environmental performance and carbon reporting, whereby firms attaining superior *PROPER* ratings demonstrate a greater propensity for comprehensive disclosure regarding their emission strategies and quantitative outcomes ([Sari & Sulfitri, 2023](#)). Nevertheless, research findings vary; in certain sectors, environmental performance has a significant influence, while in others it does not ([Putri & Yuliandhari, 2024](#)). This suggests that external pressure and industry context also determine the extent of disclosure ([Sari & Sulfitri, 2023](#); [Seo, 2021](#)).

In addition, corporate disclosure is an important channel in corporate communication regarding environmental issues ([Fazrin & Basit, 2025](#)). The intensity of corporate disclosure through official news websites, annual reports, and sustainability reports reflects a company's effort to build a reputation and respond to public pressure ([Fazrin & Basit, 2025](#)). Within the framework of stakeholder theory, the

higher the corporate disclosure, the greater the incentive for companies to voluntarily disclose information to maintain public trust ([Sari & Sulfitri, 2023](#)). Previous studies have also shown that corporate disclosure has a positive influence on carbon emission disclosure because it increases corporate visibility while reducing information asymmetry ([Loru, 2023](#); [Nurjanah & Herawaty, 2022](#)). However, several other studies report insignificant results, indicating that media influence strongly depends on sector characteristics and the level of social pressure ([Fazrin & Basit, 2025](#); [Voinea & van Kranenburg, 2017](#)).

In the Indonesian context, research on carbon emission disclosure is increasingly relevant because sustainability regulations remain in a transitional stage, and most practices are still voluntary ([Hermiyetti & Usmar, 2025](#); [Sari & Sulfitri, 2023](#)). Audit committee effectiveness and environmental performance show a positive relationship with the level of information disclosure ([Saputra & Firmansyah, 2024](#); [Sari & Sulfitri, 2023](#); [Wiguna et al., 2025](#)). These three variables conceptually originate from stakeholder theory, explaining how social pressure and external information needs encourage companies to strengthen their carbon emission reporting systems ([Sari & Sulfitri, 2023](#); [Wiguna et al., 2025](#)).

Previous studies provide varied empirical evidence [Angelina and Handoko \(2023\)](#) found that audit committee effectiveness and environmental performance positively influence the level of disclosure. [Puspita and Tanjung \(2022\)](#) found that corporate disclosure plays an important role in expanding carbon emission transparency, [Wiguna et al. \(2025\)](#) emphasize that the combination of governance factors and institutional pressure is a major driver of climate transparency. However, differences in results across studies indicate the existence of a research gap, particularly in the material sector, which produces high emissions and is currently a major focus in the national energy transition ([Sari & Sulfitri, 2023](#); [Wiguna et al., 2025](#)).

Based on these considerations, this study investigates the influence of audit committee effectiveness, environmental performance, and corporate disclosure on carbon emission disclosure. The novelty of this research is reflected in its emphasis on emission-intensive firms within Indonesia's material sector, particularly in a setting where carbon disclosure practices remain largely voluntary. In contrast to prior studies that tend to underemphasize this contextual condition, the present study offers deeper empirical insights into how highly polluting companies respond to environmental transparency demands in the absence of strict regulatory requirements. On a theoretical level, this research advances the integration of stakeholder and legitimacy frameworks within the specialized domain of environmental accounting. Practically, the findings are expected to provide useful guidance for regulators, investors, and corporate management in enhancing governance mechanisms and improving the quality of carbon emission reporting.

## **2. Literature Review and Hypotheses Development**

### **2.1 Literature Review**

#### **2.1.1 Stakeholder Theory**

According to Freeman in [Putri and Yuliandhari \(2024\)](#), this framework is rooted in the principle that businesses are accountable to a wide array of stakeholders rather than just equity holders. Consequently, the interests of society, the public sector, and the press drive companies to enhance their disclosure quality. This heightened transparency is often manifested in more detailed reporting on environmental sustainability and carbon emission mitigation efforts ([Fasya, Susilowati, Septiyanti, & Kusumawardani, 2024](#); [Sari & Sulfitri, 2023](#)). From this perspective, environmental disclosure is viewed as a form of moral accountability and strategic communication by companies toward groups that have an interest in sustainability ([Martins, Gomes, & Branco, 2020](#); [Wiguna et al., 2025](#)). Companies facing high stakeholder pressure, such as those in the energy and materials sectors, tend to have stronger intentions to disclose carbon emissions openly ([Ichsan, Dahlan, & Amrania, 2026](#); [Putri & Yuliandhari, 2024](#)). This theory also explains how variables such as audit committee effectiveness and corporate disclosure can strengthen transparency by expanding communication channels between companies and the public ([Angelina & Handoko, 2023](#); [Putri & Yuliandhari, 2024](#); [Sari & Sulfitri, 2023](#)).

### 2.1.2 Legitimacy Theory

According to Dowling and Pfeffer, as cited in [Putri and Yuliandhari \(2024\)](#), legitimacy theory is based on the idea that a company's survival depends on social acceptance; therefore, companies seek to align their activities and disclosures with prevailing societal values and norms. When a legitimacy gap emerges, firms often utilize carbon emission transparency as a strategic instrument to re-establish institutional credibility and address intensifying demands for ecological accountability ([Sari & Sulfitri, 2023](#)). From this perspective, carbon emission disclosure is viewed as a strategic tool to obtain and maintain legitimacy, particularly in the Indonesian context, where regulatory pressure and stakeholder demands for environmental transparency are increasing ([Wiguna et al., 2025](#)). This theory also explains that audit committee effectiveness can strengthen oversight and improve reporting quality, environmental performance, as reflected by *PROPER*, serves as a signal of corporate compliance with environmental standards, and corporate disclosure increases external pressure, thereby encouraging companies to be more transparent in disclosing carbon emissions ([Putri & Yuliandhari, 2024](#); [Sari & Sulfitri, 2023](#)).

## 2.2 Hypothesis Development

### 2.2.1 The Influence of Audit Committee Effectiveness on Carbon Emission Disclosure

The effectiveness of the audit committee is a core attribute of the internal governance mechanisms designed to regulate corporate conduct that functions to ensure the delivery of relevant and reliable information to shareholders ([Mujiono et al., 2021](#)). Within the framework of stakeholder theory, the effectiveness of the audit committee functions to ensure that companies provide the information needed by stakeholders through more open and reliable carbon emission disclosure, thereby increasing trust and strengthening the company's social legitimacy ([Chariri, Januarti, & Yuyetta, 2018](#); [Putri & Yuliandhari, 2024](#)).

Prior research in the field of carbon disclosure indicates that high-functioning audit committees are instrumental in enhancing corporate transparency. By reinforcing the supervisory role over executive management, these committees facilitate more comprehensive and reliable disclosures of carbon performance ([Angelina & Handoko, 2023](#)). On the other hand, some research findings indicate that the effectiveness of the audit committee does not always have a significant effect on carbon emission disclosure ([Widagdo et al., 2022](#)). This shows that its impact is largely determined by the extent to which the supervisory function is truly carried out optimally within the company ([Puspita & Tanjung, 2022](#)).

*H<sub>1</sub>*: The effectiveness of the audit committee has a positive effect on carbon emission disclosure

### 2.2.2 The Influence of Environmental Performance on Carbon Emission Disclosure

Environmental performance reflects a company's success in managing ecological impacts, including regulatory compliance, waste management, resource efficiency, and conservation ([Sari & Sulfitri, 2023](#)). From the perspective of legitimacy theory, higher *PROPER* ratings function as reputational capital that encourages companies to demonstrate their environmental performance through more comprehensive disclosure, while from a stakeholder theory perspective, such ratings serve as external validation that strengthens stakeholder trust in the reported emission data ([Sari & Sulfitri, 2023](#)).

The *PROPER* initiative, spearheaded by the Ministry of Environment and Forestry, functions as a standardized and impartial metric for evaluating corporate environmental performance within the Indonesian regulatory landscape ([Azzahra et al., 2025](#); [Sari & Sulfitri, 2023](#)). The *PROPER* rating is used as a proxy because it is objective, standardized, and publicly available ([Sari & Sulfitri, 2023](#)). Empirical findings show a positive relationship between environmental performance and the level of carbon emission disclosure ([Sari & Sulfitri, 2023](#)). The *PROPER* program represents a key evaluative mechanism utilized by the Indonesian Ministry of Environment and Forestry to systematically monitor and measure the environmental stewardship of industrial entities. ([Sari & Sulfitri, 2023](#); [Wiguna et al., 2025](#)).

*H<sub>2</sub>*: Environmental performance has a positive effect on carbon emission disclosure

### 2.2.3 The Influence of Corporate Disclosure on Carbon Emission Disclosure

Corporate disclosure represents the level of company information exposure in the public space through official news websites, annual reports, and sustainability reports (Loru, 2023). Media attention can strengthen a reputation or trigger social pressure when there is inconsistency between environmental commitments and actions (Nurjanah & Herawaty, 2022). Elevated levels of corporate transparency exert pressure on firms to communicate their ecological track records more rigorously, thereby safeguarding their institutional reputation and fortifying public confidence (Fazrin & Basit, 2025).

In stakeholder theory, the media acts as a strategic communication bridge between companies and the public (Fazrin & Basit, 2025). Companies with high visibility generally present more comprehensive carbon emission disclosures as an effort to maintain a good reputation (Fazrin & Basit, 2025; S. K. Putri & Arieftiara, 2023). Previous studies show varied findings; in manufacturing companies, corporate disclosure significantly affects the level of disclosure (Loru, 2023), but in the energy and materials sectors, the results are inconsistent (Fazrin & Basit, 2025).

*H<sub>3</sub>*: Corporate disclosure has a positive effect on carbon emission disclosure

## 3. Methodology

### 3.1 Population and Sample

This study applies a quantitative approach with a causal associative design to examine the cause-and-effect relationship between independent variables and the dependent variable, as explained by Sugiyono in (Sari & Sulfitri, 2023). His research uses secondary data obtained from information published through annual reports, sustainability reports, *PROPER* publications from the Ministry of Environment and Forestry, as well as the official websites of companies listed on the Indonesia Stock Exchange (IDX) during the 2020-2024 period. This study focuses on a population consisting of all materials companies with listings on the IDX throughout the 2020–2024 period. The sample was identified through purposive sampling, ensuring that the selected entities aligned with the specific requirements of the research, which is a selection based on certain predetermined criteria, namely:

1. Materials sector companies that were consistently listed on the IDX during the observation period.
2. Publishing complete annual reports and sustainability reports during the 2020–2024 period.
3. Having environmental performance data that can be identified through the *PROPER* rating of the Ministry of Environment and Forestry.

### 3.2 Measurement of Variabels

#### 3.2.1 Carbon Emission Disclosure (*Y*)

Measurement of the dependent variable involves the Carbon Emission Disclosure (CED) adapted from Sari and Sulfitri (2023) and has been widely used in environmental disclosure research in Indonesia (Wiguna et al., 2025). The disclosure index comprises 18 items that address critical dimensions, including climate change policies, greenhouse gas emissions, energy usage, and carbon reduction initiatives. A binary measurement system is utilized to quantify the reporting extent; each disclosure parameter is coded 1 if reported and 0 if not, with the cumulative result derived via the specified equation:

$$CED = \frac{\sum di}{M} \quad (1)$$

Where:

CED : Carbon Emission Disclosure

$\sum di$  : Total number of discloses items

M : Maximum number of items that should be disclosed

#### 3.2.2 Audit Committee Effectiveness (*X<sub>1</sub>*)

According to Hermawan in Mujiono et al. (2021), The efficacy of the audit committee represents a fundamental pillar within the framework of robust corporate governance. The measurement of the audit committee effectiveness score is carried out based on 11 assessment criteria arranged in the form of a checklist, as described by Hermawan in his research Mujiono et al. (2021). These assessment criteria

are designed with reference to the main characteristics that reflect audit committee effectiveness, including aspects of activity, size, and competence. According to Hermawan in [Mujiono et al. \(2021\)](#), the evaluation results are then classified into three categories, namely good with a score of 3, fair with a score of 2, and poor or no information with a score of 1. The maximum total score that can be obtained from these 11 criteria is 33, which reflects the level of audit committee effectiveness in the good category. The following is the formula for measuring audit committee effectiveness:

$$EKA = \frac{\sum EKA \text{ Score}}{\sum \text{Maximum EKA Score}} \quad (2)$$

Where:

- EKA : Audit Committee Effectiveness  
 $\sum$ EKA Score : Calculation of the audit committee effectiveness value based on the 11 predetermined assessment criteria.  
 Maximum EKA Score : The maximum audit committee effectiveness value that can be obtained based on all 11 criteria, which is 33.

### 3.2.3 Environmental performance ( $X_2$ )

The *PROPER* rating is mapped to an ordinal scale with scores assigned as follows: gold = 5, green = 4, blue = 3, red = 2, and black = 1 so that it can be statistically tested and compared across companies and across years ([Sari & Sulfitri, 2023](#)).

### 3.2.4 Corporate Disclosure ( $X_4$ )

The measurement of corporate disclosure is adapted from ([Loru, 2023](#); [Nurjanah & Herawaty, 2022](#)) information was synthesized by examining carbon-related disclosures across three distinct platforms: the corporate website, statutory annual filings, and dedicated sustainability disclosures. Scores are assigned based on the number of channels, where a score of 3 is given if the company discloses carbon emission information in all three channels, namely the website, annual report, and sustainability report. A score of 2 is given if the company uses two channels, while a score of 1 is given if it only uses one channel. It is then calculated as a ratio of the total observed channels, formulated as follows:

$$ME = \frac{\sum \text{Skor CD}}{\sum \text{Skor maksimum CD}} \quad (3)$$

Where:

- ME : Corporate disclosure  
 $\sum$ ME Score : Calculation of the corporate disclosure score based on three channels  
 Maximum ME Score : Maximum corporate disclosure score based on three channels

## 3.3 Research Model and Data Analysis Techniques

Before conducting the main analysis, descriptive statistics are first employed to describe the characteristics of the data for each research variable. This study utilizes panel data consisting of multiple companies observed over the period 2020-2024 and applies a pooled panel regression approach, in which all cross-sectional and time-series observations are combined into a single estimation model. Before proceeding with the regression analysis, the model's validity was verified through a series of classical assumption diagnostics. These included the Kolmogorov-Smirnov test for normality, assessment of Variance Inflation Factor (VIF) and Tolerance to detect multicollinearity, the Glejser test for heteroscedasticity, and the Durbin-Watson statistic to ensure the absence of autocorrelation. After satisfying these assumptions, pooled panel regression analysis is performed to examine the simultaneous and partial effects of the independent variables on carbon emission disclosure. Hypothesis testing is carried out using the F-test, t-test, and coefficient of determination ( $R^2$ ) with a significance level of 5%. The entire data analysis process is conducted using SPSS software. The functional form of the regression model applied in this investigation is expressed as:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (4)$$

Where:

- Y : Carbon Emission Disclosure
- $\alpha$  : Intercept
- $\beta_1, \beta_2, \beta_3$  : Regression coefficients for each independent variable
- $X_1$  : Audit Committee Effectiveness
- $X_2$  : Environmental Performance
- $X_3$  : Corporate disclosure
- $\varepsilon$  : Error term

## 4. Results and Discussions

### 4.1 Description of Research Population and Sample

The target population for this inquiry comprises the entirety of the basic materials sector entities officially listed on the Indonesia Stock Exchange (IDX) throughout the five-year observation period spanning 2020 to 2024. Based on the collected data, the total initial population during the observation period was 114 companies. Upon filtering the population through a non-probability purposive sampling technique, 16 firms successfully satisfied the predetermined prerequisites, forming the empirical basis for this study. With an observation period of five years, the total number of observations generated was 80. The details of the number of samples and total research observations are presented in Table 1 below:

Table 1. Population and sample

Sample Criteria	Total Companies
Initial population of materials sector companies listed on the IDX during the 2020-2024 period	114
Materials sector companies that were not consistently listed on the IDX during the 2020–2024 observation period	(7)
Companies that did not publish annual reports during the 2020–2024 observation period	(29)
Companies that did not publish complete sustainability reports during the 2020–2024 period	(52)
Companies that did not have environmental performance data through the <i>PROPER</i> rating of the Ministry of Environment and Forestry (KLHK) during the 2024–2025 observation year	(10)
Total number of companies that became the sample during the 2020–2024 period	16
Total observations	80

### 4.1 Descriptive Statistics

Descriptive statistical analysis is a method used to explain or describe the characteristics of research data through certain statistical measures, without conducting hypothesis testing or drawing general conclusions. Table 2 presents a comprehensive overview of the descriptive statistics corresponding to the variables analyzed in this study:

Table 2. Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Audit Effectiveness	80	.52	1.00	.8163	.15333
Environmental Performance	80	3.00	5.00	4.0625	.81666
Corporate Disclosure	80	.00	1.00	.6125	.36532
Carbon Emission Disclosure	80	.17	.94	.5604	.19829
Valid N (listwise)	80				

Based on the descriptive statistics of 80 sample companies, the average carbon emission disclosure is 0.5604, which indicates that the level of transparency is in the moderate category. Audit committee effectiveness has an average of 0.8163, indicating that most companies have relatively effective audit committees. Environmental performance (*PROPER*) has an average of 4.0625, showing that companies

generally fall within the green category, approaching gold. Meanwhile, corporate disclosure has an average of 0.6125, indicating that companies have utilized more than half of the media channels in disclosing carbon emission information, although variations still exist among companies.

## 4.2 Classical Assumption Test

### 4.2.1 Normality Test

This test is performed to verify that the residuals (the differences between actual observations and the values predicted by the model) are normally distributed. By assessing the distribution of these error terms, researchers can confirm that the regression model meets the necessary statistical requirements. In a good regression model, residuals are expected to be normally distributed so that the assumptions are fulfilled. The testing criterion is that if the significance value (Sig.) > 0.05, then the residuals are considered to be normally distributed and the assumption is satisfied. In contrast, should the p-value fall below 0.05, it can be inferred that the error terms exhibit a non-normal distribution, thereby violating the normality assumption of the classical linear regression model.

Table 3. Normality test

	<b>Unstandardized Residual</b>
N	79
Asymp. Sig. (2-tailed) <sup>c</sup>	.200 <sup>d</sup>

Empirical evidence from the Kolmogorov-Smirnov diagnostic shows a significance value of 0.200. Given that this figure is greater than the 5% significance threshold, it is evident that the residual terms are normally distributed, thereby validating the model's adherence to the normality assumption."

### 4.2.2 Autocorrelation Test

The autocorrelation test is conducted to determine whether there is a relationship between residuals across different observation periods. This test is generally performed using the Durbin–Watson (DW) statistic. The absence of serial correlation is confirmed if the Durbin-Watson (DW) statistic falls between the upper bound (dU) and the threshold of  $(4 - dU)$ . Adherence to this range signifies that the error terms are independent, thereby satisfying the non-autocorrelation assumption. Conversely, if  $DW < dL$  it indicates the presence of positive autocorrelation, while if  $DW > (4 - dL)$  it indicates negative autocorrelation.

Table 4. Autocorrelation test

<b>Model</b>	<b>R</b>	<b>R Square</b>	<b>Adjusted R Square</b>	<b>Std. Error of the Estimate</b>	<b>Durbin-Watson</b>
1	.782 <sup>a</sup>	.611	.595	.10994	1.929

Based on the results in Table 4 of the autocorrelation test, the Durbin–Watson value obtained is 1.929, which falls within the criteria of  $dU < DW < 4 - dU$ . The findings indicate that the model is free from autocorrelation issues, validating the structural integrity of the regression analysis. Since neither positive nor negative autocorrelation is detected, the suitability of the regression for hypothesis testing.

### 4.2.3 Multicollinearity Test

The multicollinearity test is conducted to determine whether the independent variables are highly correlated with one another. A good regression model should not have excessively strong relationships among the independent variables. The requirements are that the Tolerance value must be > 0.10 and the Variance Inflation Factor (VIF) value must be < 10. If both requirements are met, then multicollinearity does not occur.

Table 5. Multicollinearity test

<b>Model</b>	<b>Unstandardized Coefficients</b>		<b>Standardized Coefficients</b>	<b>Collinearity Statistics</b>	
	<b>B</b>	<b>Std. Error</b>	<b>Beta</b>	<b>Tolerance</b>	<b>VIF</b>

1	Constant	-.092	.086			
	Audit Effectiveness	.520	.113	.360	.867	1.154
	Environmental Performance	.016	.016	.075	.972	1.029
	Corporate Disclosure	.295	.042	.559	.845	1.184

Table 5 shows empirical evidence from the multicollinearity diagnostic reveals that all predictor variables exhibit Tolerance values exceeding 0.10 and VIF scores below the threshold of 10. These metrics confirm the absence of severe inter-variable correlation, thereby validating the model's structural integrity and its suitability for further regression analysis.

#### 4.2.4 Heteroscedasticity Test

The objective of the heteroscedasticity diagnostic is to evaluate whether the variance of the stochastic components is constant. In high-quality empirical modeling, the residuals must exhibit homoscedasticity. If the significance (Sig.) level surpasses 0.05, the model is deemed devoid of heteroscedasticity; conversely, a result under 0.05 suggests that the assumption of variance constancy has been violated.

Table 6. Heteroscedasticity test

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error	Beta			
1	Constant	.110	.054		2.047	.044
	Audit Effectiveness	-.087	.071	-.151	-1.227	.224
	Environmental Performance	.004	.010	.051	.439	.662
	Corporate Disclosure	.009	.026	.042	.336	.738

Table 6 shows the results of the heteroscedasticity test; all independent variables have significance values  $> 0.05$ . These findings confirm that the empirical model is devoid of heteroscedasticity, thereby satisfying the homoscedasticity requirement wherein the residual variance remains uniform across all observations.

### 4.3 Hypothesis Testing

#### 4.3.1 F-Test

To ensure the reliability of a regression model, a heteroscedasticity test is conducted to verify if residual variance is constant. Ideally, the model should exhibit homoscedasticity rather than heteroscedasticity. If the resulting p-value is greater than 0.05, the model is deemed compliant with the constant variance assumption. However, a significance level below 0.05 indicates that heteroscedasticity has occurred, which may affect the model's validity.

Table 7. F-Test

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	1.404	3	.468	38.713	.000 <sup>b</sup>
	Residual	.894	74	.012		
	Total	2.298	77			

According to the ANOVA (F-test) results presented in Table 7, the model yielded an F-statistic of 38.713 with a p-value of 0.000 ( $p < 0.05$ ). Given that the significance level falls below the established alpha ( $\alpha = 0.05$ ), the regression model is considered simultaneously significant. This indicates that audit

committee effectiveness, environmental performance, and corporate disclosure collectively influence carbon emission disclosure. Consequently, the model is statistically robust and suitable for subsequent partial hypothesis testing via the t-test.

#### 4.3.2 Coefficient of Determination Test

The  $R^2$  and Adjusted  $R^2$  tests serve as a measure of the model's predictive strength, evaluating the degree to which the collective independent variables elucidate the variability in the outcome variable. The assessment criterion is that the Adjusted R Square value lies within the range of  $0 \leq \text{Adjusted R Square} \leq 1$ . A value nearing 1 signifies a robust contribution from the independent variables in elucidating the dependent variable. In contrast, as the value moves toward 0, the model's capacity to account for the variance in the dependent variable is deemed minimal or restricted.

Table 8. Coefficient of determination test

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate	Durbin-Watson
1	.782 <sup>a</sup>	.611	.595	.10994	1.929

According to the coefficient of determination results presented in Table 8, the Adjusted  $R^2$  value is 0.595. Based on the coefficient of determination, 59.5% of the fluctuations in carbon emission reporting can be attributed to the combined influence of audit committee oversight, environmental outcomes, and existing disclosure frameworks. The remaining portion is likely influenced by factors outside the scope of this model. Meanwhile, the remaining 40.5% is influenced by other factors outside the research model that are not included in the analysis. Thus, the regression model used has a fairly strong explanatory ability in explaining variations in carbon emission disclosure.

#### 4.3.3 T-Test

To evaluate the specific contribution of each predictor, a t-test is performed. The decision rule stipulates that if the p-value is less than 0.05, the independent variable is deemed to have a significant effect on the outcome, leading to the validation of the corresponding hypothesis. Conversely, if the significance value  $> 0.05$ , then the variable does not have a significant effect and the hypothesis is rejected.

Table 9. t-Test

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.092	.086		-1.079	.284
	Audit Effectiveness	.520	.113	.360	4.615	.000
	Environmental Perfomance	.016	.016	.075	1.018	.312
	Corporate Disclosure	.295	.042	.559	7.081	.000

This research utilizes multiple linear regression analysis as the primary econometric tool to evaluate the impact of the explanatory variables on carbon emission disclosure. The mathematical specification of the regression model is formulated as follows:

$$Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon \quad (5)$$

$$Y = -0,092 + 0.520X_1 + 0.016X_2 + 0.295X_3$$

Based on the results of the t test in Table 9, hypothesis testing is conducted to determine the effect of each independent variable on carbon emission disclosure partially:

1. The results of the first hypothesis test show that audit committee effectiveness has a regression coefficient value of 0.520 with a significance level of  $0.000 < 0.05$ . Given that the p-value falls below the 0.05 threshold and the regression coefficient is positive, it can be inferred that audit committee effectiveness exerts a significant positive influence on carbon emission disclosure. This suggests that enhanced oversight mechanisms directly correlate with higher levels of environmental transparency. This means that the more effective the audit committee, the higher the level of corporate carbon emission disclosure. Therefore, the first hypothesis is accepted.
2. The evaluation of the second hypothesis produced a regression coefficient of 0.016 for environmental performance, accompanied by a p-value of 0.312. Given that this significance level surpasses the 0.05 alpha threshold, the findings suggest that environmental performance does not exert a statistically meaningful influence on the extent of carbon emission disclosure. Despite the positive direction of the coefficient, the absence of statistical significance necessitates the rejection of the second hypothesis.
3. Empirical evidence from the third hypothesis test indicates that corporate disclosure possesses a regression coefficient of 0.295 with a p-value of 0.000, well below the 0.05 threshold. This statistically significant positive result establishes that comprehensive disclosure practices act as a primary catalyst for carbon emission transparency, suggesting that the utilization of diverse communication channels inherently broadens the scope of environmental reporting.

#### **4.4 Discussion**

##### **4.4.1 Audit Committee Effectiveness and Carbon Emission Disclosure.**

The empirical findings substantiate the first hypothesis, revealing that audit committee effectiveness exerts a favorable influence on carbon emission disclosure. This suggests that the robust oversight provided by a competent audit committee serves as a vital mechanism for improving environmental transparency within the organization. These results suggest that enhanced oversight by the audit committee directly correlates with more comprehensive carbon reporting. This finding aligns with stakeholder theory, which posits that organizations must secure legitimacy and public confidence by disseminating relevant and dependable information ([Mujiono et al., 2021](#); [Putri & Yuliandhari, 2024](#)). Organizations are obligated to address the informational requirements of their stakeholders via robust governance frameworks. ([Putri & Yuliandhari, 2024](#)). Specifically, a high-functioning audit committee reinforces management oversight and elevates reporting standards, thereby fostering transparency in environmental disclosures. Such transparency serves as a dual manifestation of both moral and strategic accountability to the general public ([Mujiono et al., 2021](#)).

Consistent with prior research, these results affirm that audit committee effectiveness significantly enhances carbon emission disclosure ([Angelina & Handoko, 2023](#); [Saputra & Firmansyah, 2024](#)). The findings suggest that when internal oversight mechanisms operate optimally, they compel organizations to expand the scope and quality of their environmental reporting. Consequently, a high-functioning audit committee ensures that the disclosure process remains accountable, transparent, and strictly adherent to the tenets of robust corporate governance ([Mohammed, 2022](#)). Thus, audit committee effectiveness not only strengthens the monitoring function over management but also becomes a driving factor in increasing the transparency of corporate carbon emission disclosure.

##### **4.4.2 Environmental Performance and Carbon Emissions Disclosure.**

Empirical findings indicate that environmental performance displays a positive directional relationship with carbon emission disclosure; however, this association fails to reach the threshold of statistical significance. This suggests that while better environmental records may trend toward higher disclosure, the impact is not statistically robust in this sample. Consequently, the second hypothesis is rejected, suggesting that enhancements in environmental performance do not automatically translate into more extensive carbon reporting. This finding implies that attaining a favorable *PROPER* rating does not inherently guarantee broader disclosure. Within the framework of stakeholder theory, however, environmental performance ought to function as a vital channel for moral communication between a corporation and its constituents ([Sari & Sulfitri, 2023](#)). However, in this study, carbon emission disclosure remains voluntary, so companies that obtain high environmental ratings are not automatically encouraged to present emission information more broadly and in greater depth. From the perspective of

legitimacy theory, this finding indicates that companies may focus more on maintaining legitimacy through symbolic compliance, such as achieving high *PROPER* ratings, rather than through substantive transparency in carbon emission disclosure ([Sari & Sulfitri, 2023](#)). As a result, legitimacy is maintained through compliance signals rather than expanded disclosure practices.

These findings indicate that the achievement of good environmental performance focuses more on regulatory compliance aspects rather than carbon reporting transparency strategies ([Liu, Zhou, Yang, Hoepner, & Kakabadse, 2023](#)). In other words, companies can obtain high *PROPER* ratings without having to expand detailed carbon emission disclosures in public reports. The findings of this research diverge from previous studies, which suggest that environmental performance exerts a positive and significant influence on carbon emission disclosure ([Sari & Sulfitri, 2023](#)), but are consistent with studies that find that the influence of environmental performance on disclosure is not always consistent and highly depends on the sectoral context and external pressures faced by companies ([Fazrin & Basit, 2025](#)).

#### 4.4.3 Corporate Disclosure and Carbon Emission Disclosure

According to the statistical findings, corporate disclosure positively influences carbon emission disclosure, indicating that the third hypothesis is supported. This suggests that the more extensively a company uses communication channels such as websites, annual reports, and sustainability reports, the greater the level of carbon emission disclosure it provides. Under the lens of stakeholder theory, the media functions as a vital intermediary connecting corporations with the general public; consequently, a robust corporate disclosure strategy incentivizes firms to exhibit greater environmental transparency as a tactical move aimed at safeguarding organizational reputation and fortifying stakeholder confidence ([Sari & Sulfitri, 2023](#)).

Empirical evidence indicates that as a firm's public profile becomes more prominent, the societal pressure to report environmental data intensifies. Consequently, companies with greater visibility are incentivized to adopt more comprehensive disclosure practices to maintain their social license to operate. Companies that actively utilize various media channels tend to be more responsive to public and regulatory expectations regarding sustainability issues ([Rahmansyah, Mulyany, & Geumpana, 2023](#)). The results of this study are consistent with previous studies, which found that corporate disclosure has a positive effect on carbon emission disclosure [Loru \(2023\)](#); [Nurjanah and Herawaty \(2022\)](#), and strengthen the argument that external pressure through media becomes one of the important determinants in increasing the transparency of corporate carbon reporting ([Fidiana, 2024](#)).

## 5. Conclusions

### 5.1 Conclusions

This study aims to investigate the impact of audit committee effectiveness, environmental performance, and corporate disclosure on the extent of carbon emission disclosure among materials sector companies listed on the Indonesia Stock Exchange over the 2020–2024 period. The statistical analysis reveals that the independent variables, when evaluated simultaneously, have a meaningful and significant effect on the extent of carbon emission disclosure. This suggests that the variables work together in a complementary manner to influence the level of disclosure. Partially, audit committee effectiveness and corporate disclosure show a positive and significant influence, indicating that the more effective the supervisory function of the audit committee and the wider the utilization of media channels by companies, the higher the level of carbon emission transparency disclosed. In contrast, environmental performance measured through the *PROPER* rating does not show a significant influence, although descriptively, the average company has relatively good environmental performance. These findings indicate that carbon emission disclosure in the materials sector still tends to be voluntary and is more influenced by internal governance commitment and external communication strategies than by environmental performance achievements, so that carbon emission transparency in this study reflects the quality of supervision and company visibility in the public sphere rather than merely environmental performance ratings.

## 5.2 Research Limitations

This study has several limitations related to technical constraints and the data collection process. First, this study relies heavily on secondary data obtained from annual reports, sustainability reports, and official company publications through their respective websites. In practice, not all companies present information consistently and in a structured manner each year, so researchers need to conduct manual searches, which potentially create limitations in data completeness. Second, there are constraints in document accessibility, such as reports that are no longer available on company websites or changes in website displays that hinder the process of collecting historical data for the 2020–2024 period.

## 5.3 Suggestions and Directions for Future Research

Future researchers are advised to expand the scope of research by adding other industrial sectors and extending the observation period so that the results obtained have stronger generalization power and are able to capture regulatory dynamics and developments in sustainability reporting practices in Indonesia. In addition, further studies are suggested to include additional variables that may influence carbon emission disclosure, such as corporate financial characteristics, stakeholder pressure, ownership structure, and regulatory aspects, so that the developed research model becomes broader and more comprehensive.

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## Author Contributions

The conceptualization and methodology were developed by MMGS, who also conducted the data collection, analytical processing, and primary drafting. IOW served in a supervisory capacity, offering methodological expertise and refining the manuscript. The final manuscript has been vetted and authorized by both contributors.

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