

Influence of Corporate Sustainability Committees, Environmental Performance, and Environmental Costs on Carbon Disclosure in Energy, Mining, and Transportation Companies in Indonesia

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Abstract

Corporate carbon disclosure aims to provide transparency to stakeholders regarding a company's environmental impact. This disclosure can drive emission reductions and enhance sustainability. This study examines the influence of sustainability committees (SCOM), environmental performance (PROPER), and environmental costs (ENCOST) on carbon disclosure (CDIS). Using panel data from annual and sustainability reports of energy, mining, and transportation companies in Indonesia (2019–2023), CDIS is measured with 15 indicators developed by Park et al. The results indicate that SCOM and good PROPER positively affect CDIS practices. Companies with SCOM in their governance structure tend to disclose carbon emissions more transparently. Similarly, firms with high PROPER ratings are more likely to report carbon information to stakeholders. However, ENCOST do not significantly impact CDIS, as some companies do not explicitly report these costs. To strengthen carbon emission management, Indonesia should establish SCOM, enhance the PROPER program with fiscal incentives, and standardize reporting systems; concurrently, regional collaboration through ASEAN and the Belt and Road Initiative (BRI) can support green technology, finance low-carbon projects, and harmonize emission reporting standards, accelerating the nation's transition to a globally competitive and responsible green economy.

Keywords: sustainability committee, environmental performance, environmental cost, carbon emission, carbon disclosure, Indonesia

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1. INTRODUCTION

The 2015 Paris Agreement specifies that the world must limit the rise in world average temperature below 2 degrees Celsius (2°C) from pre-industrial levels and make an effort to limit the rise to 1.5 degrees Celsius (1.5°C) above pre-industrial levels [1]. UN Secretary-General Antonio Guterres, at various world climate meetings, also reminds state leaders always to uphold their 2015 Paris Agreement commitments, including limiting the use of fossil fuels, as an effort to curb the increase in global temperature. By 2035, Asia is expected to become the region with the highest energy consumption in the world, absorbing more than half of total global consumption. This indicates an energy revolution in Asia, marked by a significant surge in energy demand, in contrast to other regions experiencing stagnation or a decline in energy consumption [2].

Meanwhile, the countries comprising ASEAN face an urgent need to enhance environmental sustainability, given their heavy reliance on fossil fuels, which contribute 5.2% to global CO₂ emissions [3]. In fact, according to the World Resource Institute [4], Indonesia is one of the countries that contribute the highest emissions of greenhouse gases in the world. According to the Global Carbon Atlas, in 2021, Indonesia was ranked ninth among the world's largest emitters, behind China, the US, India, Russia, Japan, Iran, Germany and Saudi Arabia. The largest contributors to Indonesia's emissions are the burning of coal, petroleum, and natural gas and cement constructions [5].

The Indonesian government is targeting the achievement of net zero emissions by no later than 2060. To achieve this target, Indonesia should reach peak emissions by 2030 before entering a low-carbon or zero-carbon stage [6]. If the peak of Indonesia's carbon emissions occurs in 2030, it is likely that net zero emissions will be achieved in 2060 [7]. Indonesia is highly committed to handling climate change and controlling emissions, as reflected by the issuance of several supporting regulations, including (1) Presidential Regulation concerning the Implementation of Carbon Pricing to Achieve the Nationally Determined Contribution Targets, (2) Presidential Regulation concerning the Acceleration of Renewable Energy Development to Implement the Energy Transition toward Net Zero Emissions in 2060, and (3) Minister of Environment and Forestry Regulation concerning Indonesian Forestry and Other Land Use (FOLU) Net Sink 2030 for Controlling Climate Change.

Environmental performance, including issues of carbon emissions, in addition to economic and social aspects, is disclosed in sustainability reports. As set out by the Indonesian Financial Services Authority, in running a sustainable business, companies should disclose their economic, social, and environmental performance to the public through sustainability reports [8]. Fulfilling stakeholders' demand for environmental reporting and disclosure will economically benefit these companies as it will protect and improve their reputation, increase their competitive advantage, facilitate environmental performance monitoring and measurement, uncover overlooked environmental risks and opportunities, and ensure their compliance with applicable environmental regulations [9].

According to the Global Reporting Initiative report [10], Indonesia is ranked fourth in ASEAN on climate disclosure, below Thailand, Malaysia, and Singapore. Public companies engaging in the energy, manufacturing, infrastructure, and banking sectors are the most prominent contributors to climate-related disclosure in Indonesia, with energy and mining companies making significant contributions to global carbon emissions [11]. Febriani & Davianti [12] reported that the mining sector dominated carbon emissions disclosure in Indonesia from 2007 to 2016. Others demonstrated that companies operating in high-emissions industrial sectors have higher levels of environmental information disclosure [13,14] and tend to disclose more carbon information [15].

Establishing a SCOM will provide an effective and efficient way to increase the focus of assessments to monitor a company's environmental problems [16]. It constitutes a monitoring

mechanism that allows for the management's better decision-making regarding environmental issues [17]. Companies that have a SCOM tend to exhibit good social and environmental performance [18]. As stated by Dixon-Fowler et al. [19], SCOM contributes to companies' environmental practices. In addition, they play an important role in improving disclosure through integrated reporting [20]. Committees, in line with agency theory, help directors monitor managers' behavior and align stakeholders' and managers' interests [16]. Drawing on this theory, this study examines how the establishment of a sustainability or environmental committee serves as a principal mechanism that ensures sustainability governance is running well [16]. It is expected that the existence of a SCOM will increase the supervision of environmental issues and take the company's environmental performance to a higher level.

According to Miller & Serafeim [21], companies seeking to strengthen their commitment to sustainability topics typically form a sustainability governance structure by assigning a special director, such as a chief sustainability officer (CSO), or establishing a committee, division, or management-level body in charge of sustainability affairs. Doing so will encourage a greater level of company involvement in CSR activities [22]. Khan et al. [23] holds that the CSO can encourage carbon information disclosure. Acting as a change agent, the CSO can influence the organization in decision-making on matters related to sustainability [21]. Forming such an environmental body as those mentioned above falls on the company to manage environmental and other risks, including threats to reputation and legitimacy from stakeholders [24]. The existence of an environmental committee in the corporate governance structure shows the company's commitment to climate change mitigation [25] and sends signals to stakeholders on the company's concern for environmental issues [26]. Therefore, the existence of this entity in the company predicts the level at which the company engages in carbon emissions disclosure, given its responsibility for providing quality information on carbon emissions [27].

This study examines the role of the SCOM, PROPER, and ENCOST in corporate CDIS practices among energy, mining, and transportation companies in Indonesia. We attempted to fill the gap with respect to the role of the SCOM, PROPER, ENCOST, and their relationship to corporate CDIS practices in Indonesia that have yet to be addressed in previous research. We also address the gap in the use of the carbon disclosure index in research conducted in Indonesia. Typically, studies on CDIS in Indonesia utilize the index or indicators developed by Choi et al. [28]. Meanwhile, we adopt the CDIS indicators from the study by Park et al. [29], which are being used for the first time in the context of research in Indonesia.

Employing a random effects model in panel data analysis, we found that the SCOM and PROPER have a positive effect on corporate CDIS. The SCOM acts as an agent in the corporate governance mechanism by disclosing carbon emissions information to stakeholders as principals, supporting agency theory [30]. In addition, environmental performance interprets the company's legitimacy related to information disclosure to stakeholders, supporting legitimacy theory [31]. This commitment to sustainability is expected to positively influence the company's sustainability performance and disclosure quality [30,32]. Therefore, companies are recommended to increase the role of the SCOM in their corporate governance structure. We also encourage companies in Indonesia to improve their environmental performance by participating in the PROPER rating (Public Disclosure Program for Environmental Compliance). A good PROPER rating indicates that the emissions disclosure aspect is fulfilled in the sustainability report.

This paper is structured into five sections. It presents the research background in section 1 and elaborates on the literature study and hypotheses development in section 2. Section 3 provides an explanation of the design, approach, and methods used in the study, while section 4 reports the analysis results and discussion. Finally, the paper wraps up with conclusions, implications, and suggestions for future studies in section 5.

2. THEORETICAL FRAMEWORK

2.1. Agency theory

According to agency theory, the principal delegates work to the agent, while the agent is expected to maximize the principal utility. It is assumed that the agent will behave opportunistically for his or her own interests. Misalignment of interests creates agency costs that the principal must incur to reduce the impact of the agent's opportunistic behavior [33]. This theory also argues that corporate governance and corporate disclosure are interconnected, in that good corporate governance can strengthen internal control, reduce management's opportunistic behavior, reduce information asymmetry, and improve the quality of information disclosure in corporate reporting. Principal problems can be addressed through monitoring. In this case, the principal will structure the agent monitoring mechanism through a governance structure based on compensation and incentive contracts [33–36].

The issue of information asymmetry has implications for corporate governance and performance reporting [37]. As stated by Jensen & Meckling [34], this issue can be reduced by disclosing complete performance reports. Managers must disclose information about the company's condition to stakeholders as a form of accountability [38]. Therefore, environmental disclosure is also subject to agency problems [39]. In the corporate governance structure, the SCOM carries out the shareholder monitoring mechanism, encouraging managers to increase environmental sustainability information disclosure. Nowadays, how the company contributes to climate change mitigation has become an increasingly interesting issue to shareholders. Thus, in line with agency theory, the integration of climate change into corporate governance becomes a determining factor for effective monitoring in minimizing agency costs and problems between shareholders and management [40].

2.2. Legitimacy theory

An extensive body of accounting literature has been addressing corporate decisions in determining social and environmental disclosure practices. The social agreement between the company and society falls within the scope of legitimacy theory, according to which legitimacy can be beneficial for a company's continued survival [41]. One way to achieve legitimacy is by making social and environmental disclosures. In Dowling & Pfeffer's [41] paper, in which the earliest reference to this theory was made, it is stated that companies must align their behavior with social norms to gain legitimacy from stakeholders, whose expectations regarding the companies' behavior tend to change over time [42]. According to legitimacy theory, corporate disclosure is a company's reaction to environmental pressures (economic, social, and political) and a way to legitimize its existence and behavior [43], leading to a social contract between the company and the society in which it is operating [44].

Legitimacy theory is based on the idea that if a company wants to continue operating well, then it must act within socially acceptable limits. When a legitimacy gap occurs, companies must evaluate their social values and adapt to the values that apply in society [45]. According to Deephouse & Suchman [46], in maintaining its legitimacy, every company faces challenges that come from changes in social values and expectations, political and regulatory pressures, and threats to its reputation. Legitimacy can be derived from conformity to social norms and values, certification, and accreditation. Therefore, environmental performance and environmental cost disclosure are valuable for companies in maintaining their legitimacy.

Legitimacy theory also argues that companies should prioritize their social and environmental obligations to various stakeholders to enhance and build their environmental legitimacy [47]. As a

result, companies will pay more attention to activities related to environmental responsibility [48]. These activities include the establishment of an environmental committee, carbon strategy, and environmental management system in the company [49]. Companies convince stakeholders that their actions are in line with their expectations to maintain the social contract and gain legitimacy [24]. Thus, climate disclosure and climate governance can be considered important tools that can enhance corporate legitimacy [47].

2.3. Sustainability committee and carbon disclosure

To improve CDIS performance, companies must form an environmental or SCOM in their organizational governance structure [50]. The SCOM is part of the companies' governance structure, like the audit committee. The SCOM is responsible for sustainability strategy, sustainability performance, improving stakeholder relationships, and improving the quality of sustainability reports [20,51]. The board's expertise regarding sustainability in modern sustainable management systems is applied institutionally through the establishment of an environmental committee, CSR committee, or CSO, with a role in managing environmental-related issues [52]. A CSO is a senior executive within the top management team who is explicitly responsible for environmental issues in the company [20,50]. The main task of a CSO is to improve the work environment, enhance the supply chain security procedures, and encourage the creation of products and services that are friendly to environmental and social issues [20,53]. A CSO may have varying authority for each organization [21].

The SCOM in a corporate governance structure sends a signal to all stakeholders that the company is concerned about all environmental issues [26]. The company forms a special committee to manage environmental problems with respect to risks, opportunities, and strategies, as well as to demonstrate a commitment to stakeholders [54]. The SCOM is established for the purpose of planning, implementing, and reviewing policies related to sustainability issues systematically. SCOM, including CSOs, environmental committees, ESG committees, CSR committees, and other similar committees, has an important role in minimizing the level of risk that triggers global warming [55]. These committees share the same role as the audit committee in ensuring adequate disclosure in the company's financial reports [56]. These SCOM represent the board's views on social and environmental responsibility and communicate with external stakeholders, particularly regarding carbon emissions reporting [57]. In conclusion, assigning an environmental committee or person in charge is one of the main corporate governance mechanisms in managing environmental responsibility. Therefore, we propose the following hypothesis:

- H1: SCOM positively affects CDIS.

2.4. Environmental performance and carbon disclosure

To achieve legitimacy from various external parties, a company needs to disclose important information needed by stakeholders [38], including information on environmental performance. Companies with good environmental performance are more likely to make voluntary disclosures of such information. Various studies have also addressed the importance of environmental performance disclosure [58]. For instance, Dawkins & Fraas [58] highlighted the positive relationship between environmental performance and climate change disclosure. Meanwhile, Li et al. [59] discovered that environmental legitimacy directly influences the possibility of carbon disclosure, suggesting that companies should improve their external environmental legitimacy mechanisms to increase carbon information disclosure. In their research, Ahmadi & Bouri [60] also found that environmental disclosure has a positive association with environmental performance. Likewise,

Giannarakis et al. [31], Anwar et al. [61], and J. H. Lee & Cho [62] stated that companies with better environmental performance tend to disclose more carbon information than companies with low environmental performance. They also pointed out that CDIS level is an indication of consistent environmental performance.

Environmental performance variables have been used by various studies in Indonesia as determinants of corporate CDIS [63]. Currently, environmental performance measurement in Indonesia is based on the PROPER rankings published annually by the Indonesian government through the Ministry of Environment and Forestry. In addition to PROPER, several other environmental award indices in Indonesia are also used, including ISRA (Indonesian Sustainability Reporting Award), SRI-KEHATI (Sustainable and Responsible Investment), and ICA (Indonesian CSR Awards). Research has revealed that environmental performance interpretation with PROPER can improve environmental and carbon emissions disclosures [27, 64, 65]. Thus, the hypothesis below is proposed:

- H2: PROPER positively affects CDIS.

2.5. Environmental cost and carbon disclosure

Companies must demonstrate accountability and transparency to stakeholders regarding sustainability activities. One way of doing so is by disclosing ENCOST in sustainability reports. ENCOST includes management and supervision costs to finance various environmental management initiatives and efforts, such as reforestation, rehabilitation of former mining land, water, air, and soil quality management, biodiversity management, waste management, river watershed rehabilitation, and other related activities. Disclosure of ENCOST is aimed at ensuring that the company is running its business operations responsibly. The fact that the company allocates funds for environmental management shows that the company has consistent environmental awareness, leading to public trust in its corporate responsibility in social and environmental aspects [66].

ENCOST are an investment in a company's long-term sustainability, because funds spent at present can increase the company's legitimacy [67]. Sustainability reports serve as media for companies to disclose information related to sustainability activities in environmental, social, and governance aspects. ENCOST are an indicator of disclosure in the environmental aspect which can be used to derive legitimacy from stakeholders. This legitimacy is expected to reduce negative stakeholder perceptions on corporate activities that impact the environment, thereby increasing the company's reputation in the eyes of society. Thus, high social or environmental costs as a manifestation of corporate commitment go hand in hand with increased quality of disclosure in sustainability reports [30, 68]. Therefore, the hypothesis below is proposed:

- H3: ENCOST positively affects CDIS.

Figure 1 illustrates the conceptual framework in this study, explaining the relationship between the main variables—SCOM, PROPER, ENCOST, and CDIS. This research also involved several control variables, namely firm size, firm age, auditor, profitability, leverage, environmental certification, and sustainability report.

3. MATERIAL AND METHODS

3.1. Data and sample

The data in this research included energy, mining, and transportation companies in the Indonesian Capital Market from 2019 to 2023, comprising a total of 92 companies with 460 observation

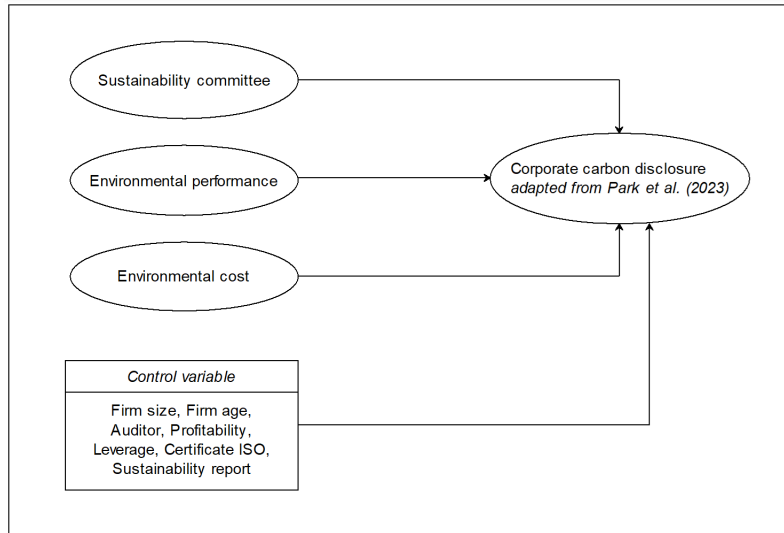


Figure 1: Conceptual framework of the empirical research

data. Energy, mining, and transportation companies were selected on the grounds that they are significant contributors to the increase in global carbon emissions [11]. The primary data we used in this research were obtained from sustainability reports and annual reports from stock exchange databases and firms’ websites. The sample was obtained using the purposive sampling technique according to the following criteria (Table 1).

Table 1: Sampling criteria

No.	Sampling Criteria	Firms
1	Energy, mining, and transportation companies listed on the Indonesia Stock Exchange (IDX)	106
2	Firms excluded from the sample (firms that were delisted or suspended or firms lacking annual reports and sustainability reports)	(14)
3	Firms included in the sample	92
4	Total sample over a period of five years	460

3.2. Corporate carbon disclosure

We adapted disclosure items from the climate change disclosure index of Park et al. [29] as a basis for measuring the level of carbon emissions disclosure, involving different weighting of the scores. In assessing disclosure, Park et al. [29] use two criteria: high-quality disclosure and low-quality disclosure. However, in our study, each disclosure item was assessed using a score of 1 if the item was available and a score of 0 if the opposite was true, as opposed to using the criteria above. In total, this study assessed 15 items of disclosure, as detailed in Table 2.

3.3. Data analysis and variable definition

To investigate the influence of the independent variables on the dependent variable, we used panel data with the random effects model (REM). The control variables used included firm size, firm age, auditor, profitability, leverage, environmental certificate, and sustainability report. Then,

Table 2: Climate change disclosure index

No.	Disclosure Items	Score
1	Board-level oversight of climate-related issues	1
2	Incentives of climate-related issues such as the attainment of targets	1
3	Processes for identifying, assessing, and managing risk and opportunities of climate-related issues	1
4	Inherent climate-related risks with the potential to have an impact on business	1
5	Inherent climate-related opportunities with the potential to have an impact on business	1
6	Climate-related issues integrated into business objectives and strategy	1
7	Active emission target for the reporting year	1
8	Other key climate-related targets	1
9	Active emission reduction initiatives for the reporting year such as the planning and/or implementation phases	1
10	Standard, protocol or methodology used to collect emission data	1
11	Gross global Scope 1 and/or Scope 2 emissions in metric tons CO2e	1
12	Gross global Scope 3 emissions in metric tons CO2e	1
13	Emission intensities such as emission in metric tons CO2e per unit revenue (efficiency)	1
14	Energy-related activities	1
15	Energy consumption total (excluding feedstock) in MWh	1

to estimate the model parameters on panel data, we tested endogeneity using the Generalized Method of Moment (GMM). Lastly, we also used OLS and Tobit regression as alternative tests to measure the consistency of the dependent variable indicators with limited disclosure value. The analysis tool was EViews version 12. Below is the regression model equation used in our research:

$$\begin{aligned}
 \text{CDI}_t = & \alpha_0 + \beta_1\text{SCOM}_t + \beta_2\text{PROPER}_t + \beta_3\text{ENCOST}_t + \beta_4\text{SIZE}_t + \beta_5\text{AGE}_t \\
 & + \beta_6\text{AUD}_t + \beta_7\text{ROA}_t + \beta_8\text{LEV}_t + \beta_9\text{ISO}_t + \beta_{10}\text{SR}_t + \varepsilon_t
 \end{aligned}
 \tag{1}$$

where CDIS is corporate carbon disclosure, SCOM is sustainability committee, PROPER is environmental performance, ENCOST is environmental cost, SIZE is firm size, AGE is firm age, AUD is big four auditor, ROA is profitability, LEV is leverage, ISO is the ISO:14001 certificate, and SR is sustainability report. The definitions and measurements of the independent variables are explained in Table 3.

Table 3: Variables and measurements

Variable	Symbol	Measurement
Carbon disclosure	CDIS	CD = (Total score of disclosure) / (Maximum score of disclosure)
Sustainability committee	SCOM	A dummy variable coded 1 if the firm has a sustainability committee (chief sustainability officer, sustainability or environmental committee/department/division, or sustainability team) and 0 if otherwise.
Environmental performance	PROPER	The PROPER rating obtained by the company, with the following details: 5 = golden rating (very good), 4 = green rating (very good), 3 = blue rating (good), 2 = red rating (bad), 1 = black rating (very bad), and 0 = non-participation.
Environmental cost	ENCOST	A dummy variable coded 1 if environmental costs are disclosed in the sustainability report and 0 if otherwise.
Firms size	SIZE	Natural logarithm of total assets of the firm.
Firms age	AGE	Number of years, counted since first listed on the stock exchange.
Firms audit	AUD	A dummy variable coded 1 if the company has been audited by either of the big 4 accounting firms (Deloitte, PwC, EY, KPMG) and 0 if otherwise.
Profitability	ROA	Proportion of net income to total assets.
Leverage	LEV	Proportion of total debt to total assets.
Environmental certificate	ISO	A dummy variable coded 1 if the company holds an ISO:14001 certificate and 0 if otherwise.
Sustainability report	SR	A dummy variable coded 1 if the SR has been assessed by an external assurance institution, and 0 otherwise.

4. RESULTS

4.1. Descriptive statistics

Table 4 presents the descriptive statistics (i.e., minimum value, median, maximum value, mean, and standard deviation) for all the variables tested, including control variables. For corporate CDIS, the mean and standard deviation values are 0.244 and 0.317, the minimum value is 0.000, the median is 0.075, and the maximum value is 1.000. The mean value of 0.244 shows that the average CDIS score for all companies is 24.4%. The mean value for SCOM is 0.348, meaning that 34.8% of companies have a SCOM. The mean value for PROPER is 1.304, meaning that, based on the Indonesian government's PROPER rating (5 = very good, 4 = very good, 3 = good, 2 = bad, 1 = very bad, 0 = non-participation), the average PROPER of the research sample is low. Meanwhile, ENCCOST has a mean value of 0.454, meaning that 45.4% of companies disclose ENCCOST through sustainability reports.

Table 4: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Med	Max
CDIS	0.244	0.317	0.000	0.075	1.000
SCOM	0.348	0.477	0.000	0.000	1.000
PROPER	1.304	1.757	0.000	0.000	5.000
ENCCOST	0.454	0.498	0.000	0.000	1.000
SIZE	18.782	1.933	12.074	18.667	23.102
AGE	11.935	9.093	1.000	10.000	33.000
AUD	0.283	0.451	0.000	0.000	1.000
ROA	-0.001	0.636	-9.390	0.032	2.072
LEV	0.486	0.404	0.002	0.444	4.040
ISO	0.489	0.500	0.000	0.000	1.000
SR	0.654	0.476	0.000	1.000	1.000
Obs.	460	460	460	460	460

4.2. Correlation coefficients

Table 5 shows the correlation between corporate CDIS, SCOM, PROPER, ENCCOST, and control variables. The table reports that SCOM, PROPER, ENCCOST, firm size, firm age, firm audit, return on asset, leverage, ISO certification, and sustainability report have a positive correlation with corporate CDIS. Meanwhile, based on the correlation matrix in Table 5, the correlation coefficients for all variables are below ± 0.8 , which indicates that multicollinearity might not be a problem in the study [69].

Table 5: Correlation matrix

No.	1	2	3	4	5	6	7	8	9	10	11	
1	CDIS	1.000										
2	SCOM	0.548	1.000									
3	PROPER	0.527	0.616	1.000								
4	ENCCOST	0.539	0.598	0.587	1.000							
5	SIZE	0.550	0.462	0.510	0.414	1.000						
6	AGE	0.265	0.192	0.295	0.193	0.280	1.000					
7	AUD	0.394	0.271	0.391	0.309	0.559	0.212	1.000				
8	ROA	0.079	0.076	0.106	0.099	0.073	-0.058	0.064	1.000			
9	LEV	0.018	0.020	-0.011	-0.006	0.146	0.140	-0.039	-0.201	1.000		
10	ISO	0.542	0.353	0.464	0.417	0.550	0.235	0.457	0.111	0.001	1.000	
11	SR	0.485	0.511	0.357	0.553	0.295	0.153	0.202	0.054	-0.004	0.272	1.000

4.3. Regression analysis results

4.3.1 Selection of panel data regression model

To determine the regression model for panel data, the Chow test, Hausman test, and Lagrange Multiplier test (LM test) must be used. First, the Chow test is used to determine which model is better between CEM or FEM. Then, the Hausman test is used to select which model is better between REM or FEM. Meanwhile, the LM test is used to determine whether to choose REM or CEM.

Table 6 displays the Chow test, Hausman test, and LM test results. Based on the Chow test results, the prob. cross-section chi-square value is 0.0000 (< 0.05), so the model chosen is FEM. Then, based on the Hausman test results, the prob. cross-section random effects value is 0.0000 (< 0.05), so the model chosen is FEM. Furthermore, the LM test yields a prob. Breusch-Pagan value of 0.0000 (< 0.05), so the best estimation model chosen for this research is REM.

Table 6: Selection of panel data regression model

Test	Chow Test	Hausman Test	LM Test
Cross-section F	0.0000		
Cross-section chi-square	(0.0000)		
Cross-section random		46.8913 (0.0000)	
Breusch-Pagan			117.3837 (0.0000)

Table 7 shows the conclusions from the Chow test, Hausman test, and LM test results. Based on the results of the three tests, the panel data regression model to be used for testing hypotheses and regression equations is the REM.

Table 7: Model Conclusion

Method	Test	Results
Chow test	CEM vs FEM	FEM
Hausman test	REM vs FEM	FEM
Lagrange multiplier test	REM vs CEM	REM

4.4. Regression results

Table 8 shows the results of panel data regression analysis using the REM method. First, the regression results show that the p-value (prob) for SCOM is significant at the 1% level ($0.000 < 0.01$). The p-value (prob) for PROPER is also significant at the 1% level ($0.0014 < 0.01$). However, the p-value (prob) for ENCOST is not significant. Based on these results, hypotheses 1 and 2 are accepted and hypothesis 3 is rejected. The R-squared value of 0.557 indicates that the independent variables are able to explain the estimation model in this research at 55.7%, while the remaining 44.3% is explained by other variables outside the research model. Furthermore, the prob (F-statistic) value of 0.000 shows that the independent variables simultaneously influence the dependent variable, or the model used in this research is quite good. Firm size, ISO, and sustainability report are control variables with significant effects.

Table 8: Regression results of random effect models

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.9559	0.1524	-6.2690	0.0000
SCOM	0.1602	0.0224	7.1449	***0.0000
PROPER	0.0243	0.0075	3.2231	0.0014
ENCOST	0.0132	0.0224	0.5912	0.5546
SIZE	0.0531	0.0087	6.1001	***0.0000
AGE	0.0014	0.0015	0.9872	0.3241
AUD	-0.0148	0.0335	-0.4415	0.6590
ROA	-0.0045	0.0124	-0.3671	0.7137
LEV	-0.0334	0.0234	-1.4243	0.1550
ISO	0.0977	0.0265	3.6826	***0.0003
SR	0.0967	0.0183	5.2746	***0.0000
R-squared	0.5575			
F-statistic	56.5831			
Prob(F-statistic)	0.0000			

Notes: Level of significance at 0.1*, 0.05**, 0.01***

4.5. Robustness test

4.5.1 Endogeneity – fixed effect and system GMM

In conducting robustness analysis, we used alternative estimation techniques for endogeneity problems. These problems occur due to omitted variable bias or reverse causality, in which case these variables are connected to the independent and dependent variables. To eliminate endogeneity problems, the fixed effects model is used as a solution to overcome omitted variable bias. Meanwhile, the Generalized Method of Moments or GMM model developed by Blundell & Bond [70] is used to overcome reverse causality, and/or to eliminate endogeneity and time-invariant fixed effects problems that can influence the dependent variable.

Our study controlled the possibility of reverse causality using the system GMM method. The analysis of the GMM system model yielded the same results, showing that the effect of SCOM on CDIS is positive and significant. Therefore, the analysis results in this study are considered to be robust in controlling endogeneity. The analysis results of the fixed effects model and GMM system are provided in Table 9. Based on these results, it is likely that the existence of a SCOM plays a role in increasing corporate CDIS. Meanwhile, PROPER shows a negative correlation with the level of corporate CDIS.

Table 9: Regression results of fixed effect and GMM models

Variables	Fixed Effect		System GMM	
	Coefficient	P-value	Coefficient	P-value
Lag CCD_{t-1}			0.077	0.848
SCOM	0.160	***0.000	0.098	*0.036
PROPER	-0.005	*0.052	-0.066	**0.028
ENCOST	0.024	0.323	0.042	0.248
SIZE	0.047	**0.015	0.063	*0.072
AGE	0.021	***0.009	0.043	0.131
AUD	0.000	0.997	-0.084	0.433
ROA	-0.000	0.980	0.006	0.281
LEV	-0.038	0.176	-0.014	0.617
ISO	0.070	*0.074	0.067	0.324
SR	0.068	***0.001	0.094	**0.026
Number of obs	460		460	
R-squared	0.855			
F-statistic	21.025			
Prob(F-statistic)	0.000			
Sargan test			0.761	
AR (1) test			0.889	
AR (2) test			0.997	

Notes: Level of significance at 0.1*, 0.05**, 0.01***

4.5.2 Additional test – OLS and Tobit regression

Table 10 presents the results of the regression analysis, which was conducted to estimate the effect of SCOM and PROPER on CDIS. Then, we used OLS models to ensure that there was no omitted variable bias. We also used Tobit regression analysis to validate our regression estimates because our dependent variable's CDIS score is truncated to a low value of zero. The results of our analysis show that SCOM and ENCOST disclosure positively and significantly influence corporate CDIS at the 1% level (0.01). This significant relationship indicates that companies that have a SCOM and good PROPER ratings will increase their corporate CDIS.

As the CDIS scores range from 0 to 15, the dependent variable CDIS is both left-censored and right-censored. This shows that the use of OLS regression may provide inconsistent estimation results. Meanwhile, Tobit regression produces a model that can predict the results of the dependent variable CDIS within a predetermined range. Table 10 shows that testing using the Tobit model has results that are qualitatively the same as those yielded from testing using the OLS model.

Table 10: Regression results of OLS and Tobit models

Variables	OLS		Tobit	
	Coefficient	P-value	Coefficient	P-value
SCOM	0.144	***0.000	0.114	***0.000
PROPER	0.059	***0.000	0.060	***0.000
ENCOST	-0.021	0.387	-0.006	0.826
SIZE	0.040	***0.000	0.061	***0.000
AGE	0.000	0.716	-0.000	0.810
AUD	-0.020	0.394	-0.030	0.294
ROA	-0.007	0.576	-0.007	0.680
LEV	-0.018	0.419	-0.000	0.992
ISO	0.101	***0.000	0.103	***0.000
SR	0.109	***0.000	0.328	***0.000
Number of obs	460		460	
R-squared	0.673			
F-statistic	92.563			
Prob(F-statistic)	0.000			
Log-likelihood			-1.045	
Left censored obs			136	
Uncensored obs			324	

Notes: Level of significance at 0.1*, 0.05**, 0.01***

5. DISCUSSION

As shown in Table 8, SCOM has a positive coefficient value (0.160), which means that it has a positive influence on CDIS. This finding supports hypothesis 1 (H1), indicating that the existence of a SCOM in a company has an important role in increasing CDIS in annual reports and sustainability reports. It has been proven that the existence of a SCOM in the corporate governance structure can improve the quality of CDIS.

These findings support the findings of Liao et al. [56], according to whom the tendency of companies to disclose information on greenhouse gas emissions will be high when they have an environmental committee or SCOM within their structure. Our findings are also in line with those of Fu et al. [22] and Chairina & Tjahjadi [30], which state that the existence of sustainability officers encourages companies to disclose more environmental and social responsibility information. These findings are also in line with the study by Latif et al. [71], which states that the presence of a sustainability committee within the internal governance mechanism contributes to improving the quality of corporate sustainability disclosure. Our findings also reinforce the results of Cosma et al. [72] study, which states that the presence of an environmental or CSR committee dedicated to

sustainability issues serves as a differentiator in corporate transparency, particularly in climate change disclosure. These findings also support the research of Jannah & Narsa [27] conducted in the Indonesian plantation industry, where they found a positive relationship between the presence of an environmental committee and the level of carbon emission disclosure. In general, these findings also support agency theory.

However, these findings are at odds with those of previous studies by Chairina & Tjahjadi [30], Fitriasari [54], Peters et al. [57], and Velte [73], who found no relationship between the environmental committee, SCOM, or chief sustainability committee and the level of corporate disclosure, whether it be in the aspect of the environment, CSR, sustainability, or carbon emissions. The differences between our findings and those of the aforementioned studies can be explained as follows. First, the findings of Chairina & Tjahjadi [30] indicate that the presence of the SCOM has yet to demonstrate a significant impact on the quality of sustainability reports and integrated reporting. Their study suggests that the environmental committee (or SCOM) does not influence environmental performance, as its role is not carried out effectively and tends to be symbolic rather than a form of substantive legitimacy. Second, Fitriasari [54] found no significant relationship between the presence of a chief sustainability officer (CSO) or environmental committee (EC) and corporate environmental disclosure. This may be due to the roles of CSOs and ECs not being prominently performed, with a focus more on addressing environmentally damaging activities rather than enhancing corporate social responsibility initiatives.

Next, the fundamental difference between our study and Velte [73] research lies in the dependent variable used. Our study measures the level of CDIS reported in the annual report and sustainability report, whereas Velte [73] research specifically assesses the quality of integrated reporting. Nevertheless, our findings remain relevant to the ongoing discussion on future regulations regarding corporate governance and sustainability reporting, particularly in relation to other sustainable corporate governance attributes, such as the SCOM. Finally, the difference between our study and that of Peters et al. [57] lies in the data testing period used. Peters et al. [57] conducted their analysis over two observation periods. In the first test, they found no relationship between the appointment of a CSO and improved sustainability performance in companies with initially poor performance. Meanwhile, the second test showed that companies with relatively better sustainability performance prior to the CSO appointment began to experience significant improvements in performance after three years.

Table 8 also shows that PROPER has a positive coefficient value (0.024) and a significant p-value (0.000), suggesting that it has a positive effect on CDIS. This finding supports hypothesis 2 (H2). This positive relationship strengthens the research findings of Jannah & Narsa [27], Giannarakis et al. [31], Lee & Cho [62], Meiryani et al. [64], Krisnawanto & Solikhah [74], Kiswanto et al. [75], and Wahyuningrum et al. [76]. Companies with good environmental performance tend to voluntarily disclose their carbon emissions information [62], confirming that the level of corporate CDIS is one of the positive indicators of environmental performance [31]. Other findings show that environmental performance, measured using the PROPER rating, moderates the relationship of not only liquidity, profitability, leverage, and growth [77] but also market value to carbon emissions disclosure [78].

These findings also support previous studies that have found a positive relationship between environmental performance and environmental disclosure [79], as well as between environmental performance and carbon emission disclosure [58]. The study by Meiryani et al. [64] concludes that the notion stating environmental performance has a significant impact on carbon emission disclosure is valid. Companies that are actively involved in managing their environmental performance are more likely to meet stakeholders' needs for transparent and reliable environmental information disclosure. This conclusion is also consistent with [80] the view that environmental disclosure

requirements can serve as a motivator for businesses to revise their managerial procedures to become more effective and productive. In general, these findings support legitimacy theory.

However, this study provides different results from those of previous studies conducted by Abdullah et al. [65], who found that PROPER has a negative effect on corporate CDIS. They found that, when environmental performance is low, the company will disclose more positive information to gain stakeholder trust. Stanny & Ely [38] even observed that companies will disclose more carbon information if they are continuously monitored. The main difference between our study and the research by Abdullah et al. [65] lies in the sample selection. Abdullah et al. [65] focused their research on companies listed on the Jakarta Islamic Index (JII). They found that the PROPER rating negatively affects carbon emission disclosure. This is due to the regulatory differences faced by companies in the Islamic index compared to conventional companies. Consequently, companies operating under Sharia principles tend to increase their CDIS when their environmental performance is poor, as an effort to maintain investor confidence. These findings are consistent with previous studies by Stanny & Ely [38] and Stanny [81], which indicate that companies tend to enhance their disclosure levels when under stricter oversight. On the other hand, studies conducted by Rahmawati et al. [77], and Andriadi et al. [82] found no evidence that environmental performance influences CDIS practices. Their findings suggest that environmental performance has not yet been able to effectively drive CDIS, particularly in companies with weak financial performance.

Finally, Table 8 shows that ENCOST has a positive coefficient value (0.013), which means that it has a positive relationship with CDIS. However, the p-value for this variable is not significant, leading to the rejection of hypothesis 3 (H3). This finding is inconsistent with the research results of Chairina & Tjahjadi [30], who stated that social costs and ENCOST are forms of sustainability commitment that improve the quality of sustainability reports. Chairina & Tjahjadi [30] refer to previous research which states that the greater the social costs incurred as a form of corporate commitment, the higher the quality of the company's sustainability reporting [68].

The difference in our research findings lies in the method used to measure environmental costs (sustainability commitment). Chairina & Tjahjadi [30] employed a broader measurement scope, namely social costs, which include total expenditures for: (1) environmental costs, (2) carbon emission reduction costs, (3) CSR costs, (4) education and training costs, and (5) research and development (R&D) costs. In contrast, our study specifically measures sustainability commitment based on the total environmental cost expenditures that are reported in detail in the company's sustainability report. Therefore, the scope of our research regarding sustainability commitment is limited solely to the environmental cost component. Furthermore, the companies in our sample tend to have limited disclosure of environmental cost information in their sustainability reports. Therefore, our study did not find a significant effect of ENCOST disclosure on CDIS in companies within the energy, mining, and transportation sectors.

6. CONCLUSION AND RECOMMENDATIONS

This study found that SCOM and PROPER positively influence corporate CDIS, while ENCOST has no effect. The presence of a SCOM in the corporate governance structure has a positive role in improving environmental disclosure practices, including the disclosure of carbon emissions information. This study also provides valuable insights into how the presence of a SCOM within the board's internal mechanism contributes to improving the quality of corporate sustainability disclosure. In addition, companies with good environmental performance, as indicated by the PROPER ratings, are more likely to disclose their carbon emissions information in sustainability reports. The findings in this study support agency theory and legitimacy theory. We also

conducted endogeneity testing using the GMM model, in addition to Tobit regression analysis. The GMM and Tobit test results are consistent with the results of our primary test, confirming the positive effect of SCOM, and ENCOST on corporate CDIS.

These findings suggest that, from the perspective of agency theory, the presence of a SCOM can enhance oversight functions and encourage management to be more transparent in disclosing carbon emissions. Meanwhile, based on legitimacy theory, companies with good environmental performance tend to increase disclosure as a form of social responsibility and an effort to gain public legitimacy. However, a different result is shown by the ENCOST variable, which, although a form of sustainability commitment, has not been able to significantly drive disclosure practices. This indicates that environmental expenditures are not yet perceived as a sufficiently strong legitimacy tool in the context of carbon emission disclosure in Indonesia.

We recognize several limitations to this study. Firstly, our sample only encompasses energy, mining, and transportation firms listed on the Indonesia Stock Exchange. Further research is encouraged to expand observations into other industries. Secondly, our measurement of the dependent variable only used the index developed by Park et al. [29]. Therefore, we recommend that future researchers use the carbon emissions disclosure indices developed by other authors or develop their own. Finally, we recommend that companies improve the quality of their carbon emissions disclosure by appointing people responsible for environmental and sustainability aspects, such as chief sustainability officers, or establishing bodies with such responsibilities, such as SCOM or environmental committees, and maintaining good environmental performance (e.g., achieving PROPER ratings).

The Indonesian government needs to encourage the establishment of sustainability committees through regulations that mandate transparent carbon emission reporting. The PROPER program should also be strengthened and integrated with fiscal incentives to enhance corporate environmental performance and disclosure. On the other hand, the effectiveness of environmental costs in promoting emission disclosure remains limited, highlighting the need for a more standardized and supervised reporting system. Furthermore, regional cooperation—both within ASEAN and with China through the Belt and Road Initiative (BRI)—can be leveraged to obtain support in green technology, financing for low-carbon projects, and the harmonization of emission reporting standards. Such collaboration has the potential to accelerate Indonesia's transition toward a green economy that is not only globally competitive but also more accountable in addressing the climate crisis. These recommendations aim to strengthen transparency, accountability, and regional synergy in carbon emission management.

The Green BRI holds strategic significance for Indonesia, particularly in advancing sustainable infrastructure development, achieving national climate targets, and strengthening environmental governance [83]. This initiative can be optimized in the development of the energy, mining, and transportation sectors, aligning with Indonesia's green transition agenda. In the energy and mining sectors, the Green BRI contributes to shifting investments from fossil fuels, such as coal, towards renewable energy sources, and facilitates the transfer of environmentally friendly technologies through green financing schemes [84,85]. An example of this implementation is the construction of the Cirata Floating Solar Power Plant (PLTS) in Purwakarta, West Java, which is one of the largest floating solar power plants in Southeast Asia [86]. In the transportation sector, the Green BRI has the potential to strengthen the transformation of the national transportation system towards lower-emission and integrated modes. The Jakarta–Bandung High-Speed Railway (KCIC) project, one of the Indonesian National Strategic Projects (PSN), a collaboration between Indonesia and China, exemplifies this initiative by enhancing mobility efficiency and contributing to carbon emission reductions in the transportation sector [87].

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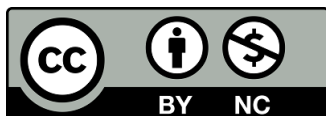
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