Carbon Performance and Carbon Emissions Disclosure: Are They in Sync and Harmony?

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Abstract: *Carbon emission disclosure has emerged as a critical aspect of environmental disclosure in both international and national contexts. This research examines the impact of carbon performance on carbon emission disclosure in the Indonesian energy sector, utilizing data from companies listed on the Indonesian Stock Exchange. The analysis using Ordinary Least Squares (OLS) regression and robustness checks indicates that both direct (Scope 1) and indirect (Scope 2) emissions negatively affect carbon emission disclosure. This research underscores that low direct and indirect emissions motivate companies to enhance transparency in their carbon reporting practices. The research provides empirical evidence from emerging markets, indicating that firms are encouraged to adopt renewable energy solutions to achieve low-carbon performance. Furthermore, this study contributes to the growing body of research on environmental accounting and offers valuable insights for policymakers and carbon emission professionals seeking to enhance corporate sustainability reporting frameworks. Such insights are crucial for promoting greater transparency and accountability in corporate environmental disclosures.*

Keywords: *Carbon emission disclosure; Carbon performance; Coercive institutional isomorphism; Environmental accounting*

1. Introduction

Climate change has emerged as a significant environmental threat to human health and global ecosystem health (Lau, 2022; Simamora et al., 2022). Human activities such as burning fossil fuels and deforestation contribute to elevated greenhouse gas concentrations, primarily carbon dioxide, which accounts for nearly 95% of global warming (Fatima et al., 2024). The Kyoto Protocol and the Paris Agreement aim to limit global temperature increase to below 2°C by encouraging countries to reduce carbon emissions through the adoption of renewable energy sources and low-carbon technologies (He et al., 2021). The energy sector accounts for more than two-thirds of global carbon emissions, underscoring its central role in efforts to combat climate change (Lau, 2022; Simamora et al., 2022). Developing countries face significant challenges in lowering their reliance on fossil fuels due to economic and technological issues (Lau, 2022). The ASEAN region still relies primarily on fossil fuels, and renewable energy sources such as solar and wind have lagged over the past twenty years (Abbas et al., 2023). Indonesia ranks among the top countries worldwide in carbon emissions, primarily driven by the energy, transportation, and industrial sectors, which rely heavily on fossil fuels (Kementerian ESDM, 2019). The energy sector produces

substantial carbon emissions from coal- and petroleum-fueled power generation activities, which still make up the majority of the national energy mix (Rahmatika et al., 2024; Siregar, 2024). The Indonesian government has pledged to cut greenhouse gas emissions by 29% independently and up to 41% with international assistance by 2030, as outlined in the Nationally Determined Contributions (NDC) document aligned with the Paris Agreement (Hastuti et al., 2021; Resosudarmo et al., 2023). However, achieving this target is hindered by a heavy reliance on fossil fuels, which are often considered more cost-effective than renewable energy in the short run (Hastuti et al., 2021).

In Indonesia, carbon emissions disclosures are primarily voluntary, with most driven by large companies listed on the Indonesia Stock Exchange (Ratmono et al., 2021). Most enterprises in the energy sector face comparatively lower regulatory pressures than those in developed nations, which diminishes their motivation to enhance their carbon management practices (Siregar, 2024). Furthermore, despite Indonesia's considerable potential to harness renewable energy sources such as solar, wind, and geothermal, investments in low-carbon technologies remain insufficient to meet the nation's targets for a sustainable energy transition (Resosudarmo et al., 2023). Strong regulations that promote the energy transition and investments in green technologies are crucial to addressing this issue and achieving the net-zero emissions target (Sambodo et al., 2022).

Research on carbon emissions disclosure in Indonesia remains limited, particularly in examining how carbon performance affects corporate transparency. Although governments have set goals to reduce carbon emissions through designated Nationally Determined Contributions (NDCs), implementing regulations often face challenges such as weak enforcement and a lack of incentives for companies to report their carbon emissions (Chithambo et al., 2020; Majid et al., 2023). The existing literature does not explore corporate carbon performance in Indonesia in depth. Although multiple global studies indicate that companies with stronger carbon performance often provide greater carbon disclosures, there is limited empirical evidence specifically within the Indonesian context (Siddique et al., 2021).

This research addresses a gap by analyzing how carbon performance influences the disclosure of carbon emissions in Indonesian energy companies. The novelty of the research lies in its approach to measuring carbon performance, which not only considers the total emissions produced by the company specifically, direct emissions (Scope 1) and indirect emissions (Scope 2), but also examines the resilience of each emission type separately. Testing the effects of carbon performance by analyzing scope 1 and scope 2 separately provides a more precise and accurate understanding of how each emission type affects transparency and accountability reporting. Research can provide strategic implications for environmental management and sustainability reporting.

2. Literature Review & Hypotheses development

2.1. Coercive Institutional Isomorphism Theory

Coercive isomorphism is a widely cited concept in institutional theory and in social responsibility research in accounting (Joseph et al., 2019; Sari et al., 2021). Coercive

isomorphism involves the formal and informal pressures that organizations may exert on one another (Martínez-Ferrero & García-Sánchez, 2017). According to Amran & Haniffa (2011), forms of coercive pressure include persuasion or invitation to participate in specific initiatives, political influence, law enforcement, and public pressure. An organization must respond to pressure from stakeholder groups to gain legitimacy to sustain its operations (DiMaggio & Powell, 1983).

2.2. Carbon Emissions Disclosure

Carbon emissions disclosure involves collecting both quantitative and qualitative data on historical emissions as companies assess the risks and opportunities of climate change, including potential financial impacts (Rahmatika et al., 2024). Companies are considered socially irresponsible if they produce high carbon emissions and fail to implement effective reduction policies (Siddique et al., 2021). Providing carbon-related information reduces information asymmetry and enhances company transparency. Carbon emission reporting has become a relatively recent concept within broader environmental disclosure in various international and national contexts over the past few years (Rahmawati et al., 2024).

2.3. Carbon Performance

Carbon performance is a comprehensive management strategy adopted by companies to address climate change risks (Elsayih et al., 2021). Companies that focus on improving carbon performance strengthen relationships with stakeholders (Guenther et al., 2016) and maintain their competitive advantage (Orazalin et al., 2024). Carbon emissions are typically classified into three scopes (Scope 1, 2, and 3) according to their source and ownership. Scope 1 emissions refer to direct emissions resulting from a company's activities, like burning fuel in boilers, furnaces, or company-owned vehicles. Scope 2 emissions are generated indirectly by energy providers through the production of electricity, heat, or steam that organizations purchase. Scope 3 emissions encompass all indirect emissions generated throughout the company's value chain, both upstream and downstream. This includes employee business travel, waste management, third-party logistics transportation, and the use of consumer products.

2.4. Hypotheses

Carbon performance refers to how effectively a company controls its carbon emissions (Guenther et al., 2016). Companies can enhance their carbon performance by using low-emission energy and equipment and by developing low-carbon technologies to meet emissions targets and avoid penalties (Velte, 2021). Strong carbon performance encourages companies to disclose more information about their emissions to stakeholders, thereby enhancing stakeholder support and credibility (Siddique et al., 2021). Companies with stronger carbon performance aim to offer detailed, accurate, and transparent information about their actual conditions. This approach helps them maintain credibility and enhance their sustainability image (Ratmono et al., 2021).

According to the coercive isomorphism approach, governments and society often pressure companies to meet stricter environmental standards, particularly with respect to

carbon emissions. This pressure can motivate companies to adopt practices that focus on managing carbon emissions and enhancing the quality and quantity of their disclosures. Previous studies indicate that poor carbon performance is associated with reduced carbon emission disclosure (Siddique et al., 2021). Companies with stronger carbon performance are motivated to inform stakeholders about their environmental strategies through carbon emissions disclosures. (Ratmono et al., 2021). This research, drawing on existing literature, suggests the following hypothesis:

H_1. *Carbon performance directly negatively affects carbon emission disclosure.*

H_2. *Carbon performance indirectly negatively affects carbon emission disclosure.*

3. Method

3.1. Research Design

This research employs a quantitative approach with an explanatory method to clarify the cause-and-effect relationship between independent and dependent variables. It investigates how a company's carbon performance affects the disclosure of carbon emissions among energy sector companies in Indonesia. This research uses a population of energy-sector companies listed on the Indonesia Stock Exchange (IDX) from 2020 to 2023. The energy sector in Indonesia is a primary focus for reducing carbon emissions because it accounts for a substantial share of national emissions, largely due to its dependence on fossil fuels such as coal and oil (Hastuti et al., 2021). Although the sector faces challenges, including limited infrastructure and suboptimal policies, its potential for transformation is enormous, driven by disruptive technologies such as renewable energy, smart grids, and energy efficiency (Resosudarmo et al., 2023). In addition, this sector plays a strategic role in supporting economic growth while achieving emission-reduction targets under international commitments, such as the Nationally Determined Contributions (NDCs) under the Paris Agreement (Hastuti et al., 2021; Resosudarmo et al., 2023).

Table 1. Sample Determination

Criterion	Total
Companies operating in the energy industry and listed as public companies on the Indonesia Stock Exchange (IDX) from 2020 to 2023	87
Companies that do not submit annual reports and/or sustainability reports on the IDX website or the website of each company	(17)
Companies that submit annual reports and/or sustainability reports on the IDX website or the website of each company	70
Observation period (4 years)	
Number of observations	280
Number of observations with incomplete data	(9)
Final observations	271

Source*: Data processed (2025)*

Data sources include audited annual reports, financial statements, and corporate sustainability reports. All of these reports are used as research populations. The sample selection process employs purposive sampling, which allows researchers to select participants based on specific characteristics.

3.2. Variable Measurement

Carbon emissions disclosure encompasses qualitative and quantitative reports on past and forthcoming actions to manage climate change risks and opportunities, as well as GHG emissions (Bedi & Singh, 2024). It also includes measures to reduce carbon emissions to meet stakeholders' needs. Carbon emission disclosure was measured using the Carbon Disclosure Project (CDP) indicator developed by Choi et al. (2013). Carbon performance is the effectiveness with which an organization or system manages and reduces its carbon emissions across operations and supply chains (Bui et al., 2022). Carbon performance is measured by emission intensity (metric tons of carbon emissions) (Bui et al., 2022; Bui, Houqe, et al., 2020; Elsayih et al., 2021). This study also tested whether our results were the same if using carbon performance (CP_{C1} and CP_{C2}) by separating alternative carbon performance proxies as developed (Bui et al., 2020; Datt et al., 2019). This proxy uses the natural logarithm of the sum of total CO2 emissions from scope one (CPC1) and scope two (CPC2) activities. The research used negative marks on this measure to facilitate interpretation and comparison with other studies (Guenther et al., 2016). Therefore, a high level of carbon performance is achieved when CO2 emissions are low.

3.2.1. Control Variable

Control variables are included in the research model to control for the influence of factors not the primary focus of the study that may affect the dependent variables. The study also considered three company-specific control variables: leverage, financial performance, and company size. Leverage is calculated as the ratio of total debt to total assets, also known as the debt-to-total-assets ratio (DAR) (Abbas et al., 2023; Krismiaji et al., 2025; Kusharyanti et al., 2024), with previous research showing a positive correlation between leverage and carbon emission disclosure (Rahmawati et al., 2024). This leverage is included because of increased social responsibility disclosures among companies facing financial challenges.

Financial performance is calculated using the return on assets (ROA) ratio (Hapsari et al., 2025; Surianti et al., 2025), with previous research showing a positive correlation between financial performance and carbon emission disclosure (Al-Mari & Mardini, 2024; Majid et al., 2023; Song et al., 2024; Wahyuningrum et al., 2024). The financial performance of high-performing companies is motivated to maintain strong environmental practices and raise awareness of carbon emissions (Al-Mari & Mardini, 2024). Company size is quantified through the natural logarithm of total assets as of the year-end (Abbas et al., 2023), with previous research showing a positive correlation between company size and carbon emission disclosures (Chithambo et al., 2022; Handono et al., 2025; Setiany et al., 2022; Song et al., 2024), quality of sustainability reports (Nugrahani et al., 2023). The company's size was included because Purnamasari & Fauziah (2022) observed that it reflects a strong management commitment to increasing potential investors' confidence.

4. Result and Discussion

4.1. Descriptive Statistics

Descriptive statistics are used in this study to describe the characteristics of the data collected without the intention of making further generalizations or statistical inferences. This analysis includes the calculation of the mean, standard deviation, maximum, and minimum for each variable. Table 2 presents an overview of the distribution and variation of the data, with the number of observations (n) ranging from 271 to 271 for each variable. The carbon emission disclosure variable ranges from 0.000 to 0.667, with a mean of 0.305 and a standard deviation of 0.190, indicating consistent values. The carbon performance variable has a mean value, whereas the medians for CPC1 and CPC2 are considerably negative, indicating that the energy sector makes a relatively large contribution to carbon emissions. A minimum value of -17.279 and a maximum of 0 suggest very extreme conditions. Based on the data, many companies have not yet submitted their total carbon emissions.

Table 2. Descriptive Statistics

Description	CED	CP_{C1}	CP_{C2}	LEV	ROA	SIZE
Mean	0.305	-6.490	-3.111	0.545	0.048	28.791
Median	0.389	-8.875	0.000	0.505	0.046	28.677
Maximum	0.667	0.000	2.659	2.566	0.616	32.708
Minimum	0.000	-17.279	-13.254	0.002	-3.540	22.081
Std. Dev.	0.190	6.089	4.259	0.387	0.268	1.821
Skewness	-0.283	-0.007	-0.773	2.533	-8.724	-0.128
Kurtosis	1.726	1.237	1.895	11.787	118.789	3.134
Jarque-Bera	21.932	35.080	40.799	1161.693	154826.9	0.951
Probability	0.001	0.000	0.000	0.000	0.000	0.621
Sum	82.718	-1758.892	-843.186	147.842	13.242	780.239
Sum Sq. Dev.	9.791	10010.830	4898.123	40.521	19.520	8.960
Observations	271	271	271	271	271	271

Source: Secondary Data (2025)

Descriptive statistics of the research sample showed that the average leverage ratio (LEV) was 0.545, indicating that energy sector companies in Indonesia, on average, use a funding structure with a moderate level of debt. The average financial performance (ROA), which is 0.048, indicates that assets are used effectively to generate profits. However, there are still significant variations to be aware of. Meanwhile, the average company size (SIZE), measured using the natural logarithm of total assets, is 28,791. This indicates that most companies have comparable business scales, providing an important basis for performance analysis and sector development strategies.

4.2. Correlation Analysis

Correlation analysis is a statistical method used to measure the strength and direction of the relationship between two variables. Correlation does not imply causation, but only shows a tendency for variables to change together. Table 3 shows that financial performance and company size are positively correlated, whereas leverage and carbon performance are negatively correlated with carbon disclosure.

Table 3. Correlation Analysis

Variable	CED	CP_{C1}	CP_{C2}	LEV	ROA	SIZE
CED	1.000					
CP_{C1}	-0.759	1.000				
CP_{C2}	0.607	0.614	1.000			
LEV	-0.277	0.194	0.117	1.000		
ROA	0.280	-0.222	-0.169	-0.212	1.000	
SIZE	0.707	-0.688	-0.629	-0.082	0.380	1.000

Source: Secondary Data (2025)

4.3. Hypothesis Testing

Hypothesis testing is a statistical method used to assess whether there is enough evidence to reject or accept the characteristics of a given sample. According to Table 4, the results of the CP_{C1} and CP_{C2} regressions are shown in CED. Table 4 shows that CP_{C1} and CP_{C2} have an adverse effect (as proxied by the company's carbon intensity) on carbon disclosure ($p<0.05$), indicating that with excessive GHG emissions, there will be less transparent disclosure of carbon emissions. This supported the hypotheses (H_1) and (H_2) that better carbon performance is associated with less carbon disclosure. These results show that companies with low carbon intensity are better equipped to handle regulatory pressures and are more proactive in carbon emissions disclosures. Energy sector companies with better carbon performance are more likely to disclose their emissions to meet stakeholder expectations and reduce reputational risks (Siddique et al., 2021).

Table 4. Hypothesis Test Results

Variable	Predictions	Coefficient	Std. Error	t-Statistic	Prob.	Result
C		-0.702	0.158	-4.427	0.000**	
CP_{C1}	-	-0.013	0.001	-8.358	0.000**	H_1: Supported
CP_{C2}	-	-0.005	0.002	-2.568	0.010*	H_2: Supported
LEV	-	0.007	0.027	0.288	0.773	
ROA	+	0.000032	0.000	5.622	0.000**	
SIZE		-0.073629	0.018	-4.066	0.000**	
Adj. R-squared		0.665				
F-statistic		108.594				
Prob (F-statistic)		0.000**				
Observation		271				

Description: **$p< 1\%$; *$p< 5\%$

This disclosure serves as evidence of the company's compliance with applicable regulations in Indonesia. The Government of Indonesia has implemented various policies to reduce emissions from companies. Policies such as Presidential Decree No. 61/2011 on the National Action Plan for Reducing Greenhouse Gas Emissions and Presidential Decree No. 71/2011 on the Greenhouse Gas Inventory in Indonesia, or PROPER by the Ministry of Environment and Forestry, create formal pressure for companies to report carbon emissions. Complexity and differences in environmental and regulatory policies affect how organizations adopt environmental management and governance practices, thereby influencing companies' overall performance (Andreou & Kellard, 2021; Gaganis et al., 2021; Orazalin et al., 2024).

These results are consistent with a coercive isomorphism, which posits that companies adjust their reporting practices to meet government expectations. Companies with low carbon intensity have adopted more environmentally friendly technologies or practices, such as using renewable energy or energy efficiency (Velte, 2021). Low-carbon companies are more confident in meeting compliance because their performance demonstrates optimal environmental efficiency (Ratmono et al., 2021). The results of this study are consistent with previous findings (Guenther et al., 2016; Siddique et al., 2021). Carbon performance gives companies the confidence to disclose carbon emissions data transparently and reflects a commitment to sustainability. In contrast, companies that emit excessive greenhouse gases will experience unfavorable market valuations (Orazalin et al., 2024).

5. Limitations & Suggestions

This study examines the influence of carbon performance on carbon emission disclosure among energy-sector companies in Indonesia. The analysis results indicated that carbon performance, measured by carbon intensity, negatively affected the disclosure of carbon emissions, supporting H1 and H2. Companies with low carbon intensity are more actively disclosing carbon emissions, reflecting regulatory compliance and commitment to sustainability. Technological advances can improve energy efficiency and the deployment of renewable energy technologies, thereby reducing low-carbon emissions. Renewable energy technologies have higher per-unit initial capital costs than investments in conventional energy infrastructure. However, rapid technological advances and high demand for renewable energy have gradually made renewable energy compete with fossil fuels. This research has limitations. This research was conducted only in the energy industry, which accounts for the largest share of carbon emissions. It would be better if further research examined sectors other than energy that affect carbon emissions to develop a different perspective. Further research can use the more intensive transportation, materials, and utilities sectors in producing carbon emission disclosures (Ulupui et al., 2020).

Acknowledgement

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