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Corporate Factors Affecting Carbon Disclosure for SDG 13 in Indonesia

Moch. Yusril Ihza Mahendra[1], Ade Irma Suryani Lating[2], Ratna Anggraini Ariprativi[3], Nufaisa[4]*

[1,2,3,4]Fakultas Ekonomi dan Bisnis Islam, UIN Sunan Ampel Surabaya, Indonesia.

General Background: Climate change, characterised by rising global temperatures, is a critical threat to sustainable development worldwide. **Specific Background:** In line with Sustainable Development Goal (SDG) 13 (Climate Action), disclosure of carbon emissions is increasingly vital. **Knowledge Gap:** Despite the increasing emphasis on ESG reporting, there are still significant gaps in the specificity and consistency of carbon emissions disclosure among Indonesian companies. **Objective:** This study aims to analyse the impact of environmental performance, firm size, and financial distress on carbon emissions disclosure, with corporate governance measured through the proportion of independent commissioners as a moderator variable. **Methods:** Using a quantitative-causal research design, this study utilises secondary data from 47 energy sector companies listed on the Indonesia Stock Exchange between 2021 and 2023, with 141 firm-year observations. Data was analysed using Regression Analysis of Moderation (ARM). **Results:** The findings show that environmental performance and firm size have a positive influence on carbon emissions disclosure, while financial distress has a negative effect. Corporate governance moderates the relationship between environmental performance and disclosure, by weakening the relationship. **Novelty:** This study uniquely integrates the triple bottom line framework with advanced financial ratios and governance factors. **Implications:** The results of this study provide valuable insights for policymakers and investors to improve transparency and accountability in achieving Indonesia's climate commitments.

Keywords: Carbon Emission, Corporate Governance, Environmental Performance, Firm Size, Financial Distress

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*Correspondence:
Ade Irma Suryani Lating
ade.irma@uinsa.ac.id

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INTRODUCTION

Climate change, characterised by long-term weather shifts and rising global temperatures, poses a serious threat to global sustainability. The United Nations (UN) has addressed this issue through the Sustainable Development Goals (SDGs), specifically Goal 13: Climate Action, which aims to reduce carbon emissions and enhance climate resilience. This goal is underpinned by the Paris Agreement, a legally binding international commitment to limit global warming and increase transparency of national carbon emissions data. Currently, Indonesia has entered the Decade of Action to achieve the 2030 Sustainable Development Goals (SDGs). Within the scope of SDG 13, various initiatives have been undertaken, including efforts to raise public awareness through green education, promote maritime environmental strategies, and empower communities to reduce carbon emissions and support government climate policies.

Disclosure of carbon emissions is one aspect of sustainability disclosure according to a commonly used standard in Asia Pacific, the Global Reporting Index (GRI). Studies by (Younis, 2023) show a positive direction between sustainability and firm value, and according to (Afrizal *et al*., 2023) sustainability has a positive influence on investor reactions. In Indonesia, disclosure of carbon emissions is becoming increasingly important, especially in the energy sector, which consistently contributes the highest share of national carbon emissions. According to the Annual Report on SDGs 2023 Implementation by Bappenas and data from EDGAR, the energy sector accounts for a large portion of Indonesia's total emissions. In response, regulatory developments such as Presidential Regulation No. 98/2021, OJK Regulation No. 51/POJK.03/2017, and the recent launch of the BEI Carbon Exchange (2023) aim to encourage transparency and carbon reduction. However, implementation remains limited and inconsistent.

A key practical issue is the reporting gap between general ESG disclosures and specific carbon disclosures. While many companies report on sustainability efforts and ESG targets, they often exclude net-zero targets, emissions strategies, and carbon metrics. Based on our observations of energy sector companies listed on the Indonesia Stock Exchange (IDX) between 2021 and 2023, the proportion of companies reporting full carbon metrics remains below 40%, despite the majority of companies having ESG disclosures. This discrepancy suggests a lack of commitment or ability to align corporate reporting with carbon-focused sustainability goals. Many factors influence carbon emissions disclosure. Many previous studies have found many factors of carbon emission disclosure, and in this study chose factors through the triple bottom line approach as part of the company's efforts to keep legitimising its image or reputation, which also shows that companies in addition providesing profit or profit, also pay attention to aspects of the planet and people (Utami *et al*., 2024; Yuliarini & Inayati, 2022).

Previous research has explored several determinants of corporate environmental disclosure, including environmental performance, firm size, and financial condition. However, the findings across studies are still inconsistent. Some studies confirm a positive relationship between environmental performance and carbon disclosure (Ardillah & Rusli, 2022; Giannarakis *et al*., 2017; Kania Salsabila, 2023; Nurvita & Priambodo, 2022; Suzana *et al*, 2023), while others show no effect or even a negative relationship ((Abdullah *et al*., 2020; Amaliyah & Solikhah, 2019; Angelina & Handoko, 2023; Apriliana, 2019, 2019; Ulfa & Ermaya, 2019). The effect of firm size also varies depending on sectoral exposure, legitimacy threats, and investor pressure (Matsumura *et al*., 2014; Nasih *et al*., 2019). Similarly, the role of financial distress is debated, with some studies suggesting that firms in distress disclose more to regain trust, while others suggest that they withhold information due to resource constraints. (Africano *et al*., 2025; Simamora *et al*., 2022; Ding *et al*., 2023; Allam & Diyanty, 2020; Rahmadhani & Indriyani, 2019; Kartikasary *et al*., 2023)

Corporate governance, as part of the "society" dimension of the triple bottom line, plays a central role in driving corporate strategies on climate change mitigation and adaptation. Corporate governance ensures that companies not only pursue profits but also balance financial and non-financial objectives, including environmentally responsible operations. Previous research shows that effective corporate governance structures support environmental performance and mitigate environmental risks (Biduri *et al*., 2023; Eka *et al*., 2024; Nasih *et al*., 2019). Regarding the disclosure of carbon emissions, the presence of independent commissioners has been shown to affect the level of transparency (Ardillah & Rusli, 2022; Biduri *et al*., 2023; Ummah & Setiawan, 2021). Independent commissioners are seen as able to balance stakeholder interests and strengthen corporate legitimacy, thus acting as a potential moderating variable in environmental reporting (Alin Kristiani *et al*., 2020; Muchlish & Abbas, 2024; Zahri *et al*., 2024).

This topic is motivated by the ongoing environmental crisis due to global warming, caused by excessive carbon emissions that threaten sustainability and hamper activities in various sectors. This poses a serious challenge to the achievement of the 13th Sustainable Development Goal (SDG) by 2030. According to the Annual Report on Sustainable Development Goals 2023 by the Ministry of National Development Planning (Bappenas, 2023), the energy sector is the most significant contributor to carbon emissions in Indonesia. The Emissions Database for Global Atmospheric Research (EDGAR) confirms this by placing the energy sector as the largest emitter, followed by the industrial and raw materials sectors. Based on the environmental context and supporting literature, this study aims to examine the effect of environmental performance, company size, and financial distress on carbon emissions disclosure, with corporate governance as a moderating variable.

This study is based on two main theories: Legitimacy Theory and Agency Theory, which offer complementary explanations for corporate behaviour related to carbon emissions disclosure.

Legitimacy Theory, introduced by (Suchman, 1995), states that organisations seek to operate within the boundaries of societal norms and expectations to gain social acceptance. Carbon emissions disclosure serves as a legitimisation mechanism, especially in environmentally sensitive industries such as energy. Companies that disclose carbon emissions signal accountability and alignment with public concern for

environmental sustainability.

Agency theory, formulated by (Jensen & Meckling, 1976), explains the relationship between principals (shareholders) and agents (management). The separation of ownership and control creates information asymmetry, hence the need for governance mechanisms. Independent commissioners, as part of the corporate governance structure, are expected to reduce agency costs and encourage transparency, including environmental disclosure.

By integrating these theories, we can see how environmental legitimacy, economic pressures, and governance oversight interact in shaping carbon disclosure practices. The Triple Bottom Line (TBL) (Elkington, 1997) approach which includes profit, people, and planet is also applied to classify the main predictors: financial distress (profit), corporate governance (people), and environmental performance (planet).

Effect of Environmental Performance on Carbon Emissions Disclosure

Studies found a positive influence between environmental performance and the level of carbon emissions disclosure, which suggests that companies with better environmental records or performance are more likely to be transparent by reporting their emissions and the steps they take to address them (Ardillah & Rusli, 2022; Kania Salsabila, 2023; Muchlish & Abbas, 2024; Nurvita & Priambodo, 2022; Sari & Paramastri Hayuning Adi, 2023; Suzana *et al*, 2023). If associated with legitimacy theory, research finds that companies that receive environmental performance awards are more likely to disclose their environmental information, thus increasing their legitimacy (Solikhah *et al*., 2020). From the explanation of the research that has been done before, and with reference to the theory used, the first hypothesis is:

H1: Environmental Performance Has a Positive Effect on Carbon Emissions Disclosure

Effect of Company Size on Carbon Emissions Disclosure

Research has shown that large companies are more likely to engage in carbon emissions disclosure (Abdullah *et al*., 2020; Datt *et al*., 2019; Nasih *et al*., 2019), which is potentially a way to manage legitimacy risk and assuage stakeholders' concerns, which means in this case company size has a positive influence on carbon emissions disclosure. This research is in line with and confirmed by (Hapsari & Prasetyo, 2020; Kartikasary *et al*., 2023; Nurvita & Priambodo, 2022; Sari & Paramastri Hayuning Adi, 2023). Supporting studies from (Akhter *et al*., 2023) suggest that larger companies are more likely to engage in legitimacy-seeking behaviours, such as disclosing environmental information, to maintain their legitimacy. Therefore, if associated with the theory used, the second hypothesis is:

H2: Company Size Positively Affects Carbon Emissions Disclosure

Effect of Financial Distress on Carbon Emissions Disclosure

Research by (Ding *et al*., 2023) found that the more carbon emissions, the higher the risk of financial distress. This effect is more pronounced in companies with lower operating capabilities (inefficient) and weaker credit financing capabilities. Another study found that emission-intensive industries have a significant positive impact on voluntary disclosure of carbon emissions; the greater the financial distress experienced by a company, the greater the likelihood that the company will disclose carbon emissions as a way to maintain legitimacy in the eyes of stakeholders (Allam & Diyanty, 2020; Rahmadhani & Indriyani, 2019). From the explanation of the research that has been done before, and with reference to the theory used, the third hypothesis is:

H3: Financial Distress Has a Positive Effect on Carbon Emissions Disclosure

The Role of Corporate Governance in the Relationship between Environmental Performance and Carbon Emissions Disclosure

According to Muanifah *et al*. (2023), corporate governance moderates the environmentally concerned industry on the quality of sustainability reports. Existing studies underscore the need for effective corporate governance structures and practices to ensure that companies prioritise environmental performance and transparency in their carbon emissions disclosures. Other studies also confirm the role of corporate governance in moderating the effect of environmental performance on carbon emissions disclosure (Muchlish & Abbas, 2024). This means that corporate governance through agency theory is the first step to maintaining legitimacy by disclosing environmental performance as a form of transparency in emphasising carbon emissions. Therefore, the hypothesis that can be developed is:

H4: Corporate Governance Strengthens the Effect of Environmental Performance on Carbon Emissions Disclosure

The Role of Corporate Governance in the Relationship between Company Size and Carbon Emissions Disclosure

Corporate governance also plays a moderating role in the relationship between environmental performance and market performance (Paleni *et al*., 2014). Other studies also confirm the role of corporate governance in moderating the effect of firm size on carbon emissions disclosure (Zahri *et al*., 2024). Overall, corporate governance plays an important role in shaping the relationship between firm size and carbon emissions disclosure, where larger firms with better corporate governance practices are more likely to disclose carbon emissions information. Therefore, the hypothesis developed is:

H5: Corporate Governance Strengthens the Effect of Company Size on Carbon Emissions Disclosure

The Role of Corporate Governance in the Relationship of Company Size to Carbon Emissions Disclosure

Good corporate governance practices can encourage transparency and disclosure of carbon emissions, regardless of a company's financial health. Financial distress may inhibit these disclosures, but the presence of corporate governance

may increase environmental transparency. This relates to the creation of regulations and corporate strategies to improve environmental accountability and promote sustainable economic growth. Another study also confirmed the role of corporate governance in moderating the effect of financial performance, as measured by earnings growth, on carbon emissions disclosure (Muchlish & Abbas, 2024). Therefore, the hypothesis developed is:

H6: Corporate Governance Strengthens the Effect of Financial Distress on Carbon Emissions Disclosure

METHODS

Type of Research and Types, Sources, and Techniques of Data Collection

This study uses an explanatory causal quantitative design to examine the effect of environmental performance, company size, and financial distress on carbon emissions disclosure, with corporate governance as a moderating variable. A cross-sectional approach was used using secondary data from publicly listed energy sector companies in Indonesia for the years 2021 to 2023. This design is suitable for evaluating relationships and interaction effects between variables at a certain period of time and is often used in environmental accounting research (Sugiyono, 2022).

The secondary data used in this study were collected using documentation techniques in the form of annual reports, sustainability reports, and PROPER rating reports from the selected samples. In conducting this research, the author accessed the Indonesia Stock Exchange website (https://www.idx.co.id/id) provides information on companies listed in the energy sector. The company's official website provides annual report information and sustainability reports, and the Ministry of Environment and Forestry (https://proper.menlhk.go.id) provides environmental performance assessment reports.

Population and Sample

Energy sector public companies on the Indonesia Stock Exchange are the population to be studied in determining the sample using nonprobability sampling, the technique used is purposive sampling (Sugiyono, 2022). Table 1 shows the list of energy sector companies included as research samples based on the purposive sampling criteria.

[Table 1 about here.]

Operational Definition

The Table 2**,** provides definitions for each variable used in the study, including carbon emission disclosure, environmental performance, firm size, financial distress, and the moderating variable of independent commissioners.

[Table 2 about here.]

Classical Assumption Test

This test is carried out to see whether the data is normally distributed or not. In this test using the skewness-kurtosis test analysis to determine whether the residuals are normally distributed or not, as reviewed from the p-value. It can fulfil the normality test or be normally distributed if the p-value of the residual variable is above 0.05 or 5%, and vice versa the data is said to be not normally distributed or does not meet the normality test if the p-value shows below the significance value of 0.05 or 5% (Sihombing, 2022).

The multicollinearity test is a test intended to find whether there is a correlation between the independent variables in the regression model. In a good regression model, there is no correlation between each independent variable. To determine the presence or absence of multicollinearity, namely by observing the Variance Inflation Factor (VIF) number. The commonly used cutoff reference in indicating the presence of multicolonierity is a VIF value of less than 10 (Sihombing, 2022). This test is intended to see whether the confounding error in period t with the error in period t-1 (previous) in the linear regression model is correlated or not. To determine the presence of autocorrelation problems, the Durbin-Watson (DW) test is carried out, then the test results are matched with the Durbin-Watson (DW) table. It can be said that there is no autocorrelation if the Durbin-Watson value is between the upper limit values (DU).

The heteroscedasticity test aims to test whether in the regression model there is an inequality of variance from the residuals of one observation to another. A good regression model does not occur heteroscedasticity. The occurrence of heteroscedasticity can be seen from the Breusch-Pagan test, measuring whether the research data shows heteroscedasticity, namely by looking at its significance. P-value is greater than 0.05 (Sihombing, 2022).

RESULTS AND DISCUSSION

Descriptive Statistics

[Table 3 about here.]

In the Table 3, variable Y, namely disclosure of carbon emissions, has an average value of 0.51 with a standard deviation of 0.31, which means that the variation in this variable is very minimal, because the standard deviation value is smaller than the average value.

Classical Assumption Test

[Table 4 about here.]

The test results Table 4 show that the P-value on Prob> Chi2 is 0.0933> 0.05, which means that the residual data is normally distributed and fulfils the normality test.

[Table 5 about here.]

The test results Table 5 show the VIF value is less than <10, which means it fulfils the multicollinearity test.

In addition, from the autocorrelation test results, the DW value is 1.9223. This value is greater than DL (1.6670) and is between DU (1.7835) and 4-DU (2.2165). This means there are no autocorrelation symptoms.

[Table 6 about here.]

The test result, the Table 6 shows the p-value at Prob> chi2 of 0.6799> 0.05 which means it has shown that it has fulfilled the heteroscedasticity test through the *Breusch-Pagan* test.

Hypothesis Result

[Table 7 about here.]

From testing the coefficient of determination in the Table 7, the number 0.54 is obtained in the R-square result. This means that simultaneously, the variables of environmental performance, company size, and financial difficulties significantly represent 54% of carbon emission disclosure in Indonesia. Meanwhile, the other 46% is influenced by other factors or variables.

[Table 8 about here.]

From the test results in Table 8, the first equation can be written as follows.

$$PEK = -4{,}81 + 5{,}15.KL + 5{,}64.UP - 2{,}54.KK + \varepsilon 1 \ldots (\mathbf{1})$$

From the results of the equation, for every 1 rank or score increase in environmental performance, the disclosure of carbon emissions will increase by 5.15 units. For every 1 unit increase in company size, the disclosure of carbon emissions will increase by 5.64 units. In addition, every 1 unit increase in financial distress will decrease carbon emission disclosure by -2.54 units. From this equation, the first and second hypotheses are accepted, while the third hypothesis is rejected.

[Table 9 about here.]

From Table 9 show testing the second and third equations, the equation results can be arranged as follows.

$$PEK = -4{,}49 + 5{,}92.KL + 4{,}67.UP - 2{,}69.KK + 2{,}94.TK + \varepsilon 2 \ldots (\mathbf{2})$$

$$PEK = -1{,}01 + 3{,}76.KL + 1{,}04.UP - 0{,}61.KK + 0{,}04.TK - 2{,}10.KL.TK + 0{,}19.UP.TK - 0{,}20.KK.TK + \varepsilon 3 \ldots \mathbf{(3)}$$

From the third equation above, of the three interactions, only the interaction between environmental performance and independent commissioners is able to show a significance of 0.037 in influencing the disclosure of carbon emissions, although with a negative coefficient. Each one unit increase in the interaction decreases the disclosure of carbon emissions by -2.10. This means that in this interaction, independent commissioners are able to moderate the company's environmental performance with a weakening ability, in other words, it rejects the hypothesis that has been compiled, including the other interactions.

The moderating role of independent commissioners in its interaction with environmental performance is pseudo moderation, because the second and third equations show significance. While the interaction of company size and financial distress has a predictor moderation role, it is only able to act as a predictor or independent variable. In this case, because in the second equation, independent commissioners have a significant effect on the disclosure of carbon emissions, while if the two interact together it does not show significance.

Discussion

Environmental Performance on Carbon Emission Disclosure

The results of data analysis show significant results with a positive direction of the influence of environmental performance on the disclosure of carbon emissions. The higher the environmental performance obtained from a high PROPER rating, the more companies tend to disclose their carbon emissions by completing the disclosure items in the emissions section of the GRI standard. Companies with strong environmental performance have the confidence to disclose their emissions information, signalling their commitment to sustainability (Clarkson *et al*., 2011; Lahjie *et al*., 2022).Other support the finding of a positive influence between environmental performance and the level of carbon emissions disclosure, suggesting that companies with better environmental records or performance are more likely to be transparent by reporting their emissions and the steps they take to address them (Ardillah & Rusli, 2022; Nurvita & Priambodo, 2022; Kania Salsabila, 2023; Muchlish & Abbas, 2024; Sari & Paramastri Hayuning Adi, 2023; Suzana *et al*., 2023).

From the perspective of legitimacy theory, a study examining the quality of carbon emissions disclosure in companies listed on the Indonesia Stock Exchange found that companies receiving environmental performance awards are more likely to disclose their environmental information, including their carbon emissions, thereby increasing their legitimacy (Solikhah *et al*., 2020). These results are supported and confirmed by observations showing that in 2021 to 2023, 3 out of 5 companies in the energy sector that received a gold PROPER rating tended to disclose all emissions reporting items according to the GRI. This means that improving the quality of reporting by fulfilling all items comparable to good environmental performance with a good rating is also used by companies as an effort to maintain the legitimacy of the company to stakeholders. By providing detailed carbon emission data, companies can demonstrate the results of their environmental responsibility and potentially increase future profits (Adinehzadeh *et al*., 2018; Junjunan *et al*., 2023).

In the context of Indonesia's efforts to achieve SDG 13, the positive influence of environmental performance on carbon emissions disclosure provides important support for climate action targets, especially in the absence of mandatory sustainability reporting regulations. Compliance with existing environmental performance regulations of which carbon emissions reduction is a formal component is a legally recognised fundamental step towards a company's sustainability commitment. By complying with these regulations, companies are required to remain transparent and accountable in reporting their emissions after receiving an environmental rating, thereby increasing their attractiveness to future investors who value strong environmental credentials.

Company Size on Carbon Emissions Disclosure

The results of data analysis show the acceptance of the second hypothesis which states that there is a positive and significant influence of company size on carbon emission disclosure. In other words, the larger the size of the company as seen from its total assets, the more likely the company is to be involved in the disclosure of carbon emissions. It is noted from the observation that 49 out of 67 observation samples with above-average company size values in the energy sector in the observation year showed a tendency to disclose more than half or disclose the entire number of emission items in the GRI standard. This means that large companies are more dominant in disclosing their emissions. This result is in line with the research of Abdullah *et al*. (2020); Datt ;*et al*. (2019) Nasih *et al*. (2019) which also shows that company size has a positive influence on the disclosure of carbon emissions. Other researchers also show positive results (Hapsari & Prasetyo, 2020; Kartikasary *et al*., 2023; Sari & Paramastri Hayuning Adi, 2023).

Legitimacy theory confirms the positive influence of company size on carbon emissions disclosure. Larger companies are more likely to engage in legitimacy-seeking behaviour, such as disclosing environmental information, to maintain their legitimacy (Akhter *et al*., 2023).This effort to maintain legitimacy occurs because large companies with significant assets also receive wider attention from the public and related parties. Companies with large assets also signify the magnitude of the impact of the company's operations. Sustainability performance is something that continues to be considered by the public. Of course, in order to remain legitimate in the future, large companies choose to make frequent sustainability efforts, one of which is by disclosing their carbon emissions. This is done so that the company can maintain its legitimacy, thereby gaining greater benefits such as access to financing and investor attraction.

Companies can enhance their corporate image and market value by combining a large asset base and strong financial performance with strong sustainability outcomes. Increased company value, in turn, will attract additional investment that supports operational expansion while facilitating improved sustainability performance and reporting, particularly, efforts to limit and disclose carbon emissions. This virtuous cycle of investment and transparency directly advances Indonesia's progress towards achieving SDG 13.

Financial Stress on Carbon Emissions Disclosure

A significant negative effect is the result of analysing the effect of financial distress on carbon emissions disclosure. This means that companies that are further away from financial distress tend to disclose more carbon emissions. Conversely, companies with high levels of financial distress tend to refrain from disclosing carbon emissions. This negative effect implies that the ability to disclose carbon emissions is only possessed by companies with stable financial fundamentals or companies with large assets. Research by (Ding *et al*., 2023) also found that the more carbon emissions, the higher the risk of financial distress. This means that by still emitting high carbon emissions, the company is still unable to manage its environmental performance by reducing carbon emissions in environmentally friendly operations. Other research supports the results of this study which show that emission-intensive industries have a significant impact on voluntary disclosure of carbon emissions, while financial distress also has a significant negative impact (Rahmadhani & Indriyani, 2019).

Legitimacy theory states that when experiencing financial difficulties, companies may take a safer stance, by minimising disclosures to avoid scrutiny and potential reactions from stakeholders (Kartikasary *et al*., 2023). This dynamic illustrates the critical tension between financial health and environmental accountability, which suggests that companies experiencing economic difficulties may neglect their responsibilities towards transparent environmental reporting to maintain their legitimacy in the eyes of stakeholders so as not to further deteriorate their image. This is evident from the research phenomenon that shows from the total observation sample, 68 samples or less than half of the sample are companies experiencing financial difficulties, and in their disclosures more than half of the samples or 40 samples only complete less than half of the emission indicators in the GRI and even do not complete at all.

From an SDG 13 perspective, financial distress can hinder climate action goals. Economic downturns such as those experienced during the recent pandemic weaken corporate finances and can erode environmental accountability. Therefore, additional mechanisms are needed to mitigate the comprehensive risks that weak economic performance poses to sustainability goals.

The Role of Corporate Governance on Environmental Performance and Carbon Emissions Disclosure

Corporate governance in research proxied by independent commissioners is able to moderate the influence of environmental performance on carbon emission disclosure with a significant negative direction. The greater the number of independent commissioners, the weaker the influence of environmental performance on the disclosure of carbon emissions. The existence of this result is very possible that there is a complex relationship involving governance characteristics on the understanding of sustainability. The results of this study reject the research of (Muchlish & Abbas, 2024) which shows that independent commissioners can moderate with the role of strengthening the influence of environmental performance on disclosure of carbon emissions.

The results of this study indicate that independent commissioners in the manufacturing sector are able to improve environmental performance and disclosure of carbon emissions. In contrast to the results of this study, this study in the energy sector shows the opposite, namely independent commissioners weaken environmental performance in influencing the disclosure of carbon emissions. Research in line with these results by (Wiransyah *et al*., 2024) states that independent commissioners are not always able to provide effective supervision of management performance, especially in environmental matters. In this case, independent commissioners act as parties representing the majority of investors and are only able to provide advice and input for management to manage the environment and its reporting, but do not have the main control in deciding the direction and policies regarding the environment and its reporting. In this context, the energy sector is more directly related to the

exploration of nature from upstream to downstream, which is required to be more compliant with environmental regulations. Time constraints prevent independent commissioners from providing oversight, in contrast to boards of directors who are more involved in decision-making and can understand business performance and potential.

To achieve SDG 13, companies, particularly in the energy sector, should adopt proactive governance policies, including establishing specialised boards or committees that focus on sustainability accountability and transparent performance, including aspects of carbon emissions. Such governance structures should be complemented by a thorough understanding of environmental regulations to ensure effective climate-related decision-making and disclosure.

The Role of Corporate Governance on Firm Size and Carbon Emissions Disclosure

Independent commissioners are unable to moderate or even strengthen the effect of company size on carbon emissions disclosure. This means that in both large and small companies, the presence of independent commissioners does not guarantee the quality of carbon emissions disclosure. This study accepts the results of other studies which provide a statement that independent commissioners are unable to improve the performance and quality of environmental reporting and carbon emissions (Nasih *et al*., 2019; Nurvita & Priambodo, 2022). In this condition, the substantial role of independent commissioners becomes less because they are unable to provide neutral performance by accommodating balanced interests between the company and the company's responsibility to its surroundings.

Independent commissioners often fail to effectively monitor management's performance and transparency, leading to gaps in oversight and differences in interest objectives. These differences stem from conflicting priorities between management, investors and the public. While independent commissioners are expected to act neutrally, such differences can hinder their effectiveness. In the energy sector, especially in large companies, corporate governance cannot be solely assessed based on the presence of independent commissioners, given their limited oversight capacity and limited understanding of the sector's business dynamics. These governance limitations can be addressed through objective oversight and strong internal controls to ensure alignment in management actions, especially with regard to environmental and climate issues. In this regard, decision-making on sustainability and climate action can be better evaluated through the performance of internal management and specialised sustainability committees rather than relying solely on the board. To achieve SDG 13, the role of independent commissioners in overseeing sustainability performance should be strengthened through a clear legal framework and regulatory support.

The Role of Corporate Governance on Financial Distress and Carbon Emissions Disclosure

The results of this study reject the hypothesis formulated, so that independent commissioners are unable to provide a moderating role on financial distress in influencing the disclosure of carbon emissions. Other observations illustrate that as many as 23 companies with an independent commissioner composition below the average, 12 of them experienced financial conditions that were not in difficulty. Of these 12 companies, 8 of them tend to complete more than half of the items. This means that companies that are far from distress are more likely to engage in carbon emissions disclosure regardless of the size of the independent commissioner composition.

In line with other studies which state that there is no influence of financial conditions and corporate governance in the disclosure of carbon emissions (Hapsari & Prasetyo, 2020; Kartikasary *et al*., 2023; Pratiwi, 2018). These conditions illustrate that financial conditions do not guarantee companies to disclose their carbon emissions performance, as well as the role of corporate governance. So that in its legitimacy, the company can be disrupted because it does not carry out the accountability and transparency that should be fulfilled to the public as an effort to hold the company accountable for its operations. The role of independent commissioners in this context does not provide a substantial function in financial performance and disclosure of carbon emissions. In any financial condition, independent commissioners have less information than management. Therefore, it is more important to understand the condition of the company in order to oversee management performance by emphasising transparency and accountability. This function must be carried out with the effectiveness of internal controls to provide objective oversight, so that there is no bias of interests and information between management and principals. Only then can the target of the 13th Sustainable Development Goal in Indonesia be realised.

CONCLUSION

Based on the results and discussion of the research in the previous chapter, and referring to the formulation of the problem and research objectives in examining the effect of environmental performance, firm size, and financial difficulties on disclosure of carbon emissions, as well as the role of corporate governance as a moderating influence with a study of the energy sector listed on the Indonesia Stock Exchange in 2021-2023, it is concluded as follows; environmental performance has a significant and positive effect on disclosure of carbon emissions, thus the first hypothesis is accepted; firm size has a significant and positive effect on disclosure of carbon emissions, thus the second hypothesis is accepted; financial difficulties have a significant and negative effect on disclosure of carbon emissions, thus the third hypothesis is rejected; corporate governance proxied by independent commissioners is able to moderate by weakening the effect of environmental performance on disclosure of carbon emissions, thus the fourth hypothesis is rejected and is unable to moderate the effect of firm size and financial difficulties on disclosure of carbon emissions, thus the fifth and sixth hypotheses are rejected.

In terms of environmental performance, regional and national environmental performance assessments based on the PROPER law should be integrated into one unified assessment. Regulations on the term limits of independent commissioners should be strengthened and intensive supervision conducted to avoid conflicts of interest. The socialisation of carbon emission

reporting regulations and standards should also be the focus of corporate governance oversight. On the other hand, investors can play an active role in monitoring the company's performance regarding its environmental performance and carbon emissions, so that in making investments they can pay attention to sustainability aspects, one of which is in suppressing carbon emissions. This way, companies can easily carry out and realise carbon emission suppression well with the support of investors. In addition, the complexity of the energy sector is worth noting in assessing corporate governance. Understanding the business sector, regulations, and the existence of specialised committees can be considered in the expansion of the study. Thus, the climate action goals of the Sustainable Development Goals can be achieved in Indonesia.

Thus, this research with legitimacy and agency theories can support efforts to suppress carbon emissions by demanding transparency and accountability of environmental performance and carbon emissions. In addition, the design of other relevant regulations by parties such as the Indonesia Stock Exchange, OJK, and ministries is expected to support the suppression and transparency of carbon emissions, so it is imperative that these regulations are implemented.

Future research should expand beyond basic carbon disclosure indices by integrating textual analysis to assess the quality, tone, and strategic depth of climate-related narratives in sustainability reporting. Cross-sector and cross-country comparisons are also essential to understand how institutional contexts affect disclosure practices. In terms of governance, studies may investigate the role of board climate competency, ESG-driven institutional investor pressure, and how these factors influence the consistency and transparency of emission reporting. Furthermore, there is an urgent need to examine how emerging technologies, such as digital carbon tracking, IoT-based emissions monitoring, and blockchain for ESG reporting, can enhance disclosure accuracy and real-time verification. Researchers are also encouraged to develop transition readiness indexes to assess firms' alignment with net-zero goals and just energy transition pathways. Finally, future studies could explore the interlinkages between SDG 13 and other goals (e.g., SDG 7, SDG 9, SDG 12), as well as the readiness of firms to comply with green taxonomies and carbon-related financial regulations. These directions will not only enrich academic discourse but also provide practical insights for policymakers and businesses navigating the low-carbon economy.

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***Table 1** / Characteristics of Research Samples*

CRITERIA	TOTAL
Energy sector on the Indonesia Stock Exchange	87
Energy sector not is reports for the period 2021-2023 consecutively	(16)
Energy sector companies that did not issue sustainability reports for the period 2021-2023 consecutively	(24)
Total Company Sampels	47
Observation Periods	3
TOTAL	**141**

Source: Researcher Processed Data, 2024

***Table 2** / Operational Definition of Variables*

VARIABELS	OPERATIONAL DEFINITION	REFERENCES
Carbon Emissions Disclosure (Y)	$PEK = \frac{\Sigma xi}{\Sigma Ni} \; x \; 100\%$ Descriptions: xi = total company score Ni = total maximum score	(Amaliyah & Solikhah, 2019; Kartikasary *et al*., 2023; Nasih *et al*., 2019)
Environmental Performance (X1)	PROPER Assessment, the score criteria are as follows: score 5 for gold rating; score 4 for green rating; score 3 for blue rating; score 2 for red rating; and score 1 for black rating.	(Ardillah & Rusli, 2022)
Firm size (X2)	$UP = Ln\ (Total\ aset)$ Description: Ln = natural logarithm	(Hapsari & Prasetyo, 2020; Kartikasary *et al*., 2023; Nasih *et al*., 2019; N. Sari & Paramastri Hayuning Adi, 2023)
Finansial Distress (X3)	$KK = 1{,}03X1 + 3{,}07X2 + 0{,}66X3 + 0{,}4X4$ Descriptions: X1 = Working Capital/Total Asset X2 = Net Profit Before Interest Taxes/Total Assets X3 = Net Profit Before Taxes/Current liabilities X4 = Sales/Total assetss	(Gupita *et al*., 2020; Melina & Susetyo, 2021; Mulyani *et al*., 2018)
Corporate Governance (Z)	Measured based on the percentage of the composition of independent commissioners from the total board of commissioners obtained in the company's annual report.	(Ardillah & Rusli, 2022; Ummah & Setiawan, 2021)

Source: Researcher Processed Data, 2024

***Table 3** / Descriptive Statistics*

Var.	Obs.	Mean	Std. Dev.	Min	Max
Y	141	0.51	0.31	0.00	1.00
X1	141	1.72	1.99	0.00	5.00
X2	141	29.51	1.62	24.89	32.76
X3	141	1.36	1.61	-4.17	6.72
Z	141	0.45	0.13	0.25	0.80

Source: STATA 17 Processed Data, 2024

***Table 4** / Normality Test Result*

Var.	Obs.	Pr(Skew.)	Pr(Kurt.)	Adj Chi2 (2)	Prob > Chi2
e (res)	141	0.0305	0.9907	4.74	0.0933

Source: STATA 17 Processed Data, 2024

***Table 5** / Multicolinierity Test Result*

Variable	VIF.	1/VIF
X1	2.32	0.430604
X2	1.91	0.524224
X3	1.31	0.763291
Z	1.12	0.888966
Mean VIF	**1.67**	

Source: STATA 17 Processed Data, 2024

Table 6 / *Heterokedasiticity Test Result*

Breusch–Pagan/Cook–Weisberg test for heteroskedasticity

Assumption: Normal error terms

Variable: Fitted values of Y

H0: Constant variance

Chi2(1) = 0.17

Prob > chi2 = 0.6799

Source: STATA 17 Processed Data, 2024

***Table 7** / Coefficient of Determination Test Result*

F(3,137)	=	53.59
Prob > F	**=**	0.000
R-Squared	=	0.54
Adj R-Squared	=	0.53

Source: STATA 17 Processed Data, 2024

***Table 8** / Partial Significant Test*

Y	Coeff	Std. Err.	t	P > |t|
X1	0.0704	0.0137	5.15	0.000
X2	0.0859	0.0152	5.64	0.000
X3	-0.0339	0.0133	-2.54	0.012
Cons	-2.1038	0.4370	-4.81	0.000

Source: STATA 17 Processed Data, 2024

***Table 9** / Moderated Regeression Analysis Result*

No Interaction Variable				
Y	***Coeff***	***Std. Err.***	***t***	***P > |t|***
X1	*0.0825*	*0.0139*	*5.92*	*0.000*
X2	*0.0724*	*0.0155*	*4.67*	*0.000*
X3	*-0.0349*	*0.0129*	*-2.69*	*0.008*
Z	*0.4478*	*0.1521*	*2.94*	*0.004*
Cons	*-1.9271*	*0.4295*	*-4.49*	*0.000*
Interaction Variable				
Y	***Coeff***	***Std. Err.***	***t***	***P > |t|***
X1	*0.1736*	*0.0462*	*3.76*	*0.000*
X2	*0.0539*	*0.0517*	*1.04*	*0.298*
X3	*-0.0291*	*0.0480*	*-0.61*	*0.544*
Z	*0.1214*	*3.0946*	*0.04*	*0.969*
X1Z	*-0.1933*	*0.0919*	*-2.10*	*0.037*
X2Z	*0.0200*	*0.1055*	*0.19*	*0.850*
X3Z	*-0.0204*	*0.1042*	*-0.20*	*0.845*
Cons	*-1.5118*	*1.4946*	*-1.01*	*0.314*

Source: STATA 17 Processed Data, 2024