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Analysis Determinants of Carbon Emissions Disclosure in the Energy Sector

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Abstract: Carbon emissions disclosure aims to analyze how companies report carbon emissions transparently. Addressing carbon emissions is an urgent priority that requires swift and decisive action. The energy sector is a major contributor to carbon emissions, and emissions disclosure is voluntary. The novelty of this research is testing the institutional ownership variable. Purposive sampling, secondary data, and quantitative techniques were used in the sample selection process for this research. Descriptive statistics, the normality test, and the multicollinearity test are the methods of analysis employed. The research's goal is to show that, whereas institutional ownership and environmental performance have little bearing on disclosure, leverage and competitiveness levels do. According to the research's findings, firms are encouraged to disclose carbon emissions more publicly due to financial pressures and industry competitiveness, both as a way to be more environmentally responsible and as a tactic to improve their reputation. These findings imply that companies typically disclose carbon emissions in response to external pressures, such as competition and the need to maintain financial stability, rather than because of a commitment to environmental sustainability.

Keywords: Carbon Emissions Disclosure, Leverage, Competition, Environmental Performance, Institutional Ownership

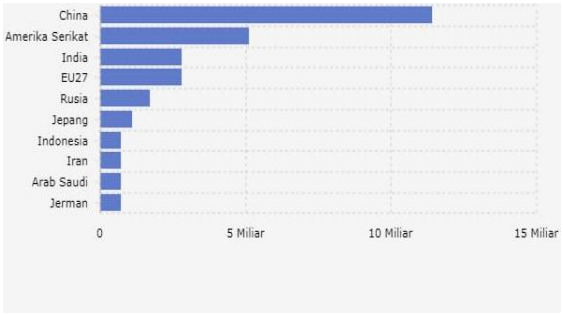
INTRODUCTION

Climate alteration has become a serious focus for many countries worldwide. The increase in global temperature attributed to global warming is considered the main trigger of climate change(Lasmiati et al., 2024). The increase in global temperature is triggered by Carbon Emissions caused by various activities, including fossil fuel combustion, deforestation, and industrial operations.

Forest burning and fossil fuel use limit the environment's capacity to absorb carbon dioxide (CO2), which increases greenhouse gas concentrations. Forest fires cause carbon emissions due to the buildup of CO2 in the atmosphere(Solekhah & Wahyudi, 2022). As a

mitigation measure, many countries are committed to reducing carbon emissions to support *net zero emission* (NZE) in various sectors and achieve a balance of carbon emissions generated and absorbed by the environment.

The energy and transportation sectors are major contributors to carbon emissions Across advanced and emerging nations. By 2022, the top three emitting countries, China, the United States, and India, will contribute more than 53 percent of energy sector pollution. China accounts for 11.4 billion tons of carbon dioxide (CO2) emissions, followed by the United States with 5.1 billion tons of CO2 and India with 2.8 billion tons of CO2.



(Source: Datadoks.id)

Figure 1. The 10 Largest Carbon Emitters in the World (2022)

Carbon emissions in the *Association of Southeast Asian Nations* (ASEAN) are high, accounting for 7.35 percent of global carbon dioxide (C02) emissions of around 1,240.8 million metric tons. The continued industrialization process in Southeast Asia will make Indonesia the largest CO2 emitter by 2022, compared to countries such as Vietnam, Thailand, Malaysia, and the Philippines. This information is taken from Datadoks—Co. ID in 2023.

Indonesia's transportation industry and reliance on coal are the leading causes of the country's carbon emissions, which reached 704.4 million tons of CO2. Other significant contributors include the mining and quarrying sector, which produced 16,144 gigagrams of carbon dioxide (Gg CO2e), water supply and waste management at 3,378 Gg CO2e, and the energy sector, which includes electricity and gas supply at 295,854 Gg CO2e. The transportation sector alone contributed 79,188 Gg CO2e, followed by agriculture, forestry, and fisheries at 6,772 Gg CO2e, and various business sectors that contributed 19,929 Gg CO2e. Reliance on coal as the primary energy source is a significant factor driving Indonesia's increase in carbon emissions. Current data shows that 67% of power generation facilities in Indonesia still rely on coal as an energy source. While the national coal reserves are 24 billion tons, this fossil fuel is still the leading choice to meet domestic electricity demand.

Carbon emissions and climate change are significant challenges that require immediate attention and action. Mitigation efforts such as emission reductions, green investments, and transparency in emissions disclosure are key to achieving environmental sustainability. All parties, including government, industry, and society, must recognize and participate in meeting this challenge to protect our planet for future generations.

Indonesia's high carbon emissions raise concerns about the future sustainability of the global environment. As a mitigation effort, the Government of Indonesia Regulation No. 98 of 2021 by the Indonesian President regarding policy implementation of Economic Value in Achieving the National Contribution Target and Controlling Greenhouse Gas Emissions has been issued. Carbon emissions reporting is now mandatory in several countries, such the United States, China, Australia, and the UK. However, in Indonesia, it is still voluntary. Voluntary disclosure refers to information companies provide voluntarily without being required by current rules or regulations, so this practice is not yet widespread among companies (Bahriansyah & Lestari Ginting, 2022).

Companies that disclose the level of greenhouse gas (GHG) emissions from their operations are said to engage in carbon emissions disclosure. A company's disclosure policy is critical to maintaining transparency about the environmental impacts of its operations. By making these disclosures, companies can demonstrate their commitment to sustainability and climate change mitigation efforts while meeting Stricter greenhouse gas emission control regulations. The disclosure process also allows companies to identify the primary sources of emissions so they can design reduction strategies, such as switching to renewable energy or improving energy efficiency. Furthermore, transparency regarding carbon emissions can give companies a good reputation among investors and consumers who are increasingly concerned about ecological issues while opening up opportunities for access to green finance and sustainable investments.

The urgency of research on carbon emissions disclosure is becoming more pressing as the global commitment to achieve the *Net Zero Emission* (NZE) target, which the Indonesian government has also proposed, grows. NZE is a target that aims to reduce GHG emissions to net zero by 2060. This initiative is part of international efforts to lower the risks associated with climate shifts and rising temperatures on Earth. Achieving this target will require transparency in corporate disclosure of carbon emissions, as such disclosures can help governments and the private sector monitor progress and formulate more effective policies.

This research addresses several issues: Leverage, Competition, Environmental Performance, and Institutional Ownership. leverage is very important because to secure long-term existence, companies with high debt ratios will continue to publish carbon emissions. This aligns with research conducted Solekhah & Wahyudi (2022) The use of leverage affects entities in disclosing their carbon emissions, but research results show different things by Nofitasari et al. (2024), Claims that carbon emissions remain unaffected by leverage.

Additionally, to leverage, competition is a factor in carbon emissions disclosure, as companies in highly competitive industries often feel the need to increase transparency on environmental issues to create a competitive advantage. This can be done, for example, by attracting environmentally conscious consumers. However, several studies show intense competition can lead to lower disclosure, especially if companies prioritize cost efficiency. This statement matches the research of Kamila et al. (2024); it has been suggested that competition is a significant factor in how companies disclose their carbon emissions; however, in contrast to research by Dewi & Werastuti (2024) which states that no relationship was found with carbon emissions reporting.

Company performance in environmental aspects has a significant influence on carbon emissions reporting. Long-term environmental performance can assist businesses in reducing the impact of global temperature increase and climate change. Ultimately, companies that want to minimize the negative consequences of climate change and global warming can benefit from efficient environmental performance. This research is supported by Melja et al. (2022); it has been suggested that environmental performance is a significant factor in how companies disclose their carbon emissions. However, This finding contradicts the research results by Putri & Dura., (2024), which indicated that disclosure of carbon emissions is not correlated with environmental performance.

Another factor that should be investigated is institutional ownership. Companies are often encouraged to comply with international sustainability reporting requirements, and transparency in carbon emission reporting should be enhanced in compliance with applicable global rules and regulations. This is in line with the analysis of Angelina and Handoko (2023), which indicates that institutional ownership influences the reporting of carbon emissions. But, these findings contradict the research of Wiransyah et al. (2024), which does not find an impact.

Disclosure is a fundamental component of financial reporting that conceptually aims to communicate important information to stakeholders openly and responsibl (Hilmi et al., 2020).

In the technical aspect, disclosure is the last stage in the accounting process, where the processed data is presented in the financial statements. In the environmental context, disclosure of carbon emissions is essential for corporations to demonstrate their commitment to sustainability. By reporting carbon emissions, emission reduction strategies, and other sustainability efforts, companies not only fulfill their reporting obligations but also build public trust, meet regulatory demands, and attract the attention of investors concerned with environmental issues.

This research concentrates on companies within the energy sector, specifically targeting oil, gas, and coal subsectors that were listed on the IDX from 2021 to 2023. What sets this research apart is the inclusion of a new variable, institutional ownership, to examine the company's influence on the effect of characteristics and assess industry type and business size on the reporting of carbon emissions.

This research aimed to analyze how transparently businesses report carbon emissions and examine the causes that influence these disclosures and their influence on stakeholders, the environment, and business performance. In addition, the research will identify barriers that companies face in the disclosure process, evaluate the contribution of disclosure to environmental sustainability, and provide policy recommendations that can encourage better disclosure practices. The results of this research are expected to support global efforts in environmental management, increase public awareness, and encourage more responsible investment decisions.

METHOD

This paper implements quantitative techniques and utilizes secondary data to evaluate the influence of leverage, competition, environmental performance, and institutional ownership on carbon emissions reporting.

Business sustainability reports and corporation annual financial reports are the sources. This research looks at companies that work in the energy sector. firms who were listed on the IDX between 2021 and 2023, as long as they regularly released financial and sustainability reports each year. Using particular criteria pertinent to the study's goals, the purposive sampling approach is used to select the sample. This technique is applied to guarantee that the data collected is relevant to the research needs and can provide valid and representative results in analyzing the relationship between the variables studied in data processing using SPSS 25.

The criteria for sample selection in this research consist of:

Table 1. The Criteria for Sample Selection in this Research

	Sample Criteria	Elimination	Sample
1	Corporations within the energy sector are listed on the IDX from 2021-2023.		81
2	Companies in the energy sector regularly prepare and publish annual reports and sustainability reports on the IDX from 2021 to 2023.	(11)	70
3	Companies that explicitly disclose carbon emissions since 2021-2023		70
4	Companies participating in the Corporate Performance Rating Assessment Program (PROPER) conducted under the auspices of the Ministry Environment for the period 2021 to 2023	(43)	27
5	Companies with Institutional Ownership	(2)	25
	Number of companies in the research sample		25
	Total observation data from 2021-2023 (25 x 3)		75

Dependent Variable Measurement

Variable operationalization is important for explaining and measuring the variables or concepts to be studied. This process involves translating more abstract concepts into concrete and measurable indicators.

Dependent Variable

Carbon Emissions Disclosure

$$CED = \frac{\Sigma di}{M} \; x \; 100\%$$

Description:
CED = Carbon Emissions Disclosure
Σdi = Total score one that the company can disclose
M = Total maximum score of the disclosure item

Table 2. Measurement of Independent Variables

Variables	Definition Operational	Variable Measurement	Ratio
Leverage	Company Debt Condition	$DER = \frac{Total\ Liabilitas}{Total\ Ekuitas}$	Ratio
Competition	Competition between companies	$\sum_{i=1}^{n}\left[\frac{Sjt}{St}\right]^2$ Description: Sjt = Sales Value of Company j in year t; St = Total Sales of all energy companies in year t; Sjt/St = Market share of company j in year t	Ratio
Environmental performance	Number of proper awards received by the company	Using a number ratio of 0-5. A low ratio of 0 is not a participant. 1 = Black, 2 = Red, 3 = blue, 4 = Green, and 5 = Gold color. The more intense the color, the greater the company's environmental engagement.	Ordinal
Institutional ownership	the condition of the company's share ownership of specific institutional	KI = $\frac{Institutional\ Share\ Ownership}{shares\ outstanding}$	Ratio

RESULTS AND DISCUSSION

Results

Legitimacy Theory

Social norms and agreements are explained by legitimacy theory to achieve the legality required in an organization. Based on Dowling & Pfeffer (1975), The primary goal of legitimacy theory is to conduct organizational activities in accordance with the societal norms that are in effect. According to Chariri & Ghozali (2007), Asyari & Hernawati (2023), and Melja et al. (2022), The social agreement between an organization and the community in the execution of its operations is intended to secure legitimacy.

Disclosure can provide a positive image of the organization and create a harmonious relationship between the company and society(Angelina & Handoko, 2023). If the company fails to achieve society's expectations in the social contract, the company risks facing social sanctions that can threaten operational sustainability. Thus, legitimacy theory emphasizes managing the interaction between businesses and society to attain long-term sustainability objectives by disclosing carbon emissions. Brown & Deegan (1998) and Chariri & Ghozali (2007) Affirm that the company will persist in ensuring its actions conform to community standards.

Carbon Emission Disclosure

Carbon emissions are one of the issues that contribute to climate change globally. Therefore, many countries are implementing *Net Zero Emission* (NZE) to mitigate environmental impacts. With this, companies are expected to disclose carbon emissions that aim to help the country. The emergence of carbon emissions increases the need for businesses to be transparent in the entire industrial framework(Machfoedz, 1996). However, few companies voluntarily publish their carbon emissions(Hilmi et al., 2020). In addition,

enterprise developing countries lack financial resources, which hinders the ability to convey information like that in developed countries(Nofitasari et al., 2024). Companies must disclose carbon emissions as part of their duties and demonstrate their social responsibility in annual reports (M. A. Putri & Dura, 2024)

Leverage

Leverage can be seen when a business entity can fulfill its long-term debt obligations. This statement is consistent with corporate legitimacy, which states that a company must comply with local standards because it significantly influences society (Brown & Deegan, 1998). The more assets a corporation has in the form of debt, the greater the ratio. Businesses with large debt loads will be more cautious regarding disclosure and carbon emissions deductions, including some aspects of carbon emissions mitigation plans(Claudia & Halik, 2024). Corporations will require stakeholders to disclose carbon emissions, which are now optional, and ensure long-term sustainability (Ambarwati, 2022). This aligns with research by Wiratno & Muaziz (2020) and Indah Sukmawati & Deliza Henny (2024), said, leverage affects the disclosure of carbon emissions.

H_1: Leverage influences the disclosure of carbon emissions.

Competition

Competition can improve the sales performance of companies aiming to make a profit. Some theories suggest that sellers can maintain product quality if the price received is high, regardless of the level of competition. 0Competition in the industry shows how challenging it is for each company to compete in capturing market share and attracting consumer attention (Nawawi, 2012). Disclosing carbon emissions can be a competition between companies aiming to create good views from the community and become a company's obligation to the environment related to legitimacy theory. This data supports findings that have been reported in previous studies by Kamila et al. (2024), Pranasyahputra et al. (2020), and Irwhantoko and Basuki (2016). Competition exerts a beneficial influence.

H_2: Competition influences carbon emissions disclosure.

Environmental Performance

Firms with excellent environmental performance relationships increase transparency in delivering financial and non-financial information, including information on carbon emissions. This will cause the company to be expected to get more attention related to the community's social norms and values, making it easier for them to participate in government programs(Melja et al., 2022). Environmentally conscious businesses will be more likely to provide information to build strong ties with stakeholders(Murniati & Sovita, 2021)(Angelina & Handoko, 2023) in line with the legitimacy of a theoretical framework that clarifies the social contract. This aligns with findings from Melja et al. (2022) and Nofitasari et al. (2024)'s research, said environmental performance positively impacts carbon emissions transparency.

H_3: Environmental performance positively impacts carbon emissions transparency.

Institutional Ownership

Institutional ownership refers to ownership carried out collectively by institutions that have a significant role in implementing company activities. As the amount of institutional ownership increases, so does the right of institutional investors to disclose the organization's reported carbon output(Angelina & Handoko, 2023). This is same with Angelina and Handoko (2023) and Almuaromah and Wahyono (2022)'s research, said institutional ownership significantly impacts carbon emissions reporting.

H_4: Institutional ownership has a significant impact on carbon emissions reporting.

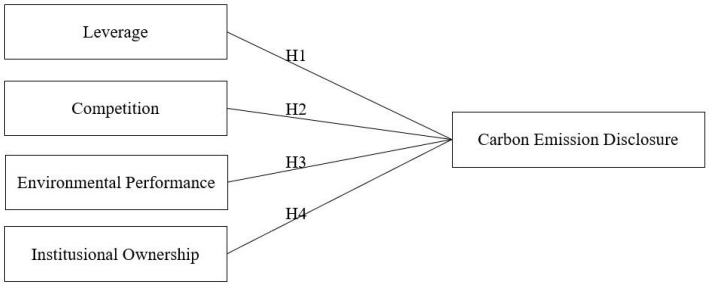


Figure 2. Conceptual Framework

Table 3. Descriptive Test Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Leverage	75	.0461	6.7595	1.159081	1.3031462
Competition	75	.000	.420	.04000	.060474
Environmental Performance	75	2	5	3.53	.827
Institutional Ownership	75	.0153	9.6429	.887044	1.0474053
CED	75	.0556	.7222	.475556	.1852142
Valid N (Listwise)	75				

The analysis results are shown in Table 3, using the natural logarithm (LN) measurement. Leverage using the DER measurement, as shown in Table 3, can be described as the lowest value of 0.0461 and a max of 6.7595. So, the company has had a high level of debt for three consecutive years, and the average is 1.159081, with a standard deviation of 1.3031462, so the sample data shows a significant spread. The average value exceeds the standard deviation. The distribution of data presented in this table suggests a rise in the company's sales and the presence of competition among firms, with the range of data spanning from 0.000 at the lowest to 0.420 at the highest.

The distribution of the sample data is elevated, Showing an average score of 0.04000 and a standard deviation of 0.060474. The data distribution in this table, which uses the PROPER measurement to measure environmental performance, shows that specific organizations have received a gold medal or scored 5, indicating they are environmentally conscious. The smallest value is 2, and the most significant value is 5. The relatively homogeneous nature of the sample is reflected in the mean score of 3.53 and a standard deviation of 0.827. Presented in the table below is the institutional ownership of the sample data mix, which is quite large, with the least data distribution of 0.0153, the highest value of 9.6429, the mean value of 0.887044, and the Variability value of 1.0474053. These values indicate investment growth. The last variable, carbon emissions information disclosed in sustainability and annual reports, averaging 0.475556 and a standard deviation of 0.1852142, is evident from the data with a higher level of variability within the sample range.

Table 4. Normality Test

		Unstandardized Residuals
N		69
Normal Parameters[b]	Mean	.0000000
	Std.Deviation	.14657017
Most Extreme Differences	Absolute	.054
	Positive	.054
	Negative	-.050
Test Statistic		.054
Asymp. Sig. (2-tailed		.200[c,d]

Table 4 shows a significance value of 0.200 obtained from the normality test. Since the significance value is > the designated limit, the data can be considered to follow a normal distribution. The value exceeds the 0.05 threshold.

Table 5. Multicollinearity Test

Collinearity Tolerance	Statistic VIF
.936	1.068
.643	1.554
.642	1.558
.911	1.097

The relationship or correlation in the independent variables is tested using the multicollinearity test. Referring to the aforementioned table, it is in the Collinearity Tolerance and VIF Statistic columns. Since all independent variables exhibit VIF values below 0.10, the corresponding Tolerance values confirm that each variable meets the minimum threshold of 0.1, indicating no multicollinearity concerns. Thus, the conclusion implies that the variables are free from multicollinearity because the predictor variables do not show a high correlation.

Table 6. Heteroscedasticity Test

Variables	Sig
Leverage	0.485
Competition	0.926
Environmental Performance	0.871
Institutional Ownership	0.824

As shown in Table 6, the variables have significance values ≥ 0.05. Thus, the findings indicate the absence of heteroskedasticity in the model.

Table 7. Autocorrelation Test

Model Summary

Model	Adjusted R Square	Std. Error of The Estimate	Durbin-Watson
T	.246	.15108	2.018

With four independent variables (k) and 75 samples, the Durbin Watson (DW) value is 2.018, according to the test findings shown in Table 7. Autocorrelation symptoms can be identified through the DW Test. The DW statistic is interpreted as valid when it resides in the interval DU < DW < (4 - DU); with a DW value of 2.018, which is in the range between DU 1.7390 and 4-DU 2.2610, there are no autocorrelation symptoms in this model, as the DW value falls within the acceptable range. Therefore, the findings of this evaluation are valid and should not be ignored. Thus, it can be concluded that there is no autocorrelation, so this decision is not rejected (Ghozali, 2018).

Table 8. Regression Analysis

Variables	Coefficient	Statistics t	Significant
Constant	1.557	-1.662	.110
Leverage	.046	2.970	.004
Competition	.669	3.368	.001
Environmental Performance	.045	-.219	.828
Institutional Ownership	.513	.852	.397
F (statistic)	6.532		
R^2	.290		

H1 can be accepted because it is proven from the test results in Table 8 that leverage significantly increases information about carbon emissions. The t-statistic, with a value of 2.970 and a significance of 0.004 (less than 0.05), as well as a coefficient of 0.046, provide evidence for this, which has a value of 2.970, with sig: 0.004 (<0.05) along with a coefficient

of 0.046. The coefficient value is 0.669, t-statistic is 3.368, and sig. 0.001 (<0.05). In addition, this indicates that competition exerts a statistically significant and positive impact on carbon emissions transparency, which supports the applicability of H2. Owing to the unavailability of a strong correlation between environmental performance and carbon emissions disclosure, H3 is rejected. The coefficient generated in the analysis is 0.045, while the significance value is 0.828. surpassing the 0.05 benchmark and a t-statistic of -0.219. In addition, H4 is not supported, as there is no institutional ownership of the disclosure of carbon emissions. The results show a coefficient of 0.513, accompanied by a t-statistic of 0.852 and a p-value of 0.397, which exceeds the 0.05 level and therefore indicates insignificance.

Discussion

Leverage Effect on Carbon Emission Disclosure

DER represents the metric used. According to this research, leverage can significantly increase the disclosure of carbon emissions. As supported by Solekhah & Wahyudi (2022), Kamila et al. (2024), and Mujiani et al. (2019)'s research, companies that have more leverage are often more vulnerable to pressure from creditors, investors, and authorities to comply with sustainability standards. Companies have the opportunity to demonstrate their commitment to sustainability and gain social legitimacy through carbon emissions disclosure practices, which in turn can strengthen corporate reputation and reduce potential financial risks. According to legitimacy theory, companies want to gain legitimacy by complying with social norms around environmental issues, such as disclosing carbon emissions. However, in contrast, research by Septriyawati and Anisah (2019) states that leverage does not influence reporting carbon emissions.

The Impact of Competition on the Disclosure of Carbon Emissions

The research discovered that carbon emission disclosure is influenced by competition. This aligns with the conclusions drawn by Kamila et al. (2024). Pranasyahputra et al. (2020), Companies' competition in business influences the transparency of carbon emissions disclosed since businesses aim to protect their good name and the level of trust held by stakeholders, such as investors and customers who are becoming more aware of environmental issues. Firms tend to reveal their carbon emissions openly as a strategy to strengthen their reputation and gain a competitive edge, differentiate themselves from competitors, and meet consumer demands, and this is to avoid corporate risk in society by complying with regulations; however, in contrast to research by Dewi & Werastuti (2024), which states that competition does not affect.

The Impact of Environmental Performance on the Disclosure of Carbon Emissions

H3 is not supported, implying that environmental performance has no notable result in reporting carbon output. This outcome remains consistent with earlier studies by Putri & Dura (2024), Florencia et al. (2021), and Sekarini & Setiadi (2022) because regulatory limitations make companies not required to report carbon emissions despite having good environmental performance. Companies tend to consider more reputational strategies, whereas companies with poor environmental performance are more active in disclosing carbon emissions to improve their image. In addition, Businesses that concentrate on environmental priorities such as waste reduction and efficient energy use may not place high importance on reporting carbon emissions. Different reporting guidelines also influence how transparently companies disclose their carbon emissions. However, this contradicts with Melja et al. (2022) and Nofitasari et al. (2024)'s research, said environmental performance has a positive influence.

The Impact of Institutional Ownership on the Disclosure of Carbon Emissions

H4 is rejected; this suggests that institutional ownership has no substantial notable correlation to carbon emissions disclosure. These results same with Wiransyah et al. (2024), Mustar et al. (2020), N. A. Putri et al. (2022), and Rosita et al. (2021)'s research because institutional investors because institutional investors often prioritize financial performance and profitability over environmental factors. In addition, institutional investors also do not always force businesses to disclose carbon emissions because they do not have a deep concern for sustainability issues, so they do not always pressure companies to disclose carbon emissions. The lack of regulations requiring emissions disclosure also makes companies feel no obligation to disclose despite having institutional investors. However, this differs from Angelina & Handoko (2023), which state that institutional ownership contributes positively.

This section must answer the problems or research hypotheses that have been formulated previously.

CONCLUSION

This research examines how leverage, competition, environmental performance, and institutional ownership influence carbon emission disclosure among energy firms listed on the IDX from 2021 to 2023. The outcomes reveal that leverage and competition significantly influence carbon emission disclosures, whereas environmental performance and institutional ownership do not demonstrate a notable impact. According to the results, companies should enhance the transparency of their carbon emission disclosures as part of their environmental accountability while also leveraging it as a strategic response to financial pressure and competitive dynamics within the industry.

However, the impact of environmental performance and institutional ownership shows that carbon emissions disclosure practices in Indonesia are still voluntary and not a top priority for most companies. Therefore, stricter regulations and stakeholder encouragement are needed to improve carbon emissions transparency.

This research only focuses on one sector, the energy sector, so the sample that meets the criteria is limited. The relatively short period of this research, from 2021 to 2023, may result in results that do not reflect broader policy changes or global sustainability trends. Thus, for future studies, it would be beneficial to expand the scope to other sectors and longer timeframes and to include additional factors like company size and green investments, which also impact the disclosure of carbon emissions.

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