Development of Carbon Emission Disclosure Indicators in Indonesia and Analysis of Determining Factors

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ABSTRACT: The first objective of this research is to develop indicators of carbon emission disclosure in Indonesia, while the second objective is to analyse the determinants of carbon emission disclosure. This research resulted in the development of carbon emission disclosure indicators. The development recommendations were derived from a review of scientific literature. The results of the recommendation are 14 theme indicators as a measure in carbon emissions disclosure and also become dependent variable of this research. Furthermore, this research analyses various determinants that affect carbon emission disclosure. There are four main groups of variables determined in this study, namely financial performance, ownership, committee, and board of directors. The scope of the research is 225 companies sample listed on the Indonesia Stock Exchange. The industry sectors that are the scope of the research are the energy sector, industrial sector, basic material sector, non-cyclical consumer sector, and transportation sector. The method used in this research is a combination of qualitative and quantitative. The development of carbon emission disclosure indicators was examined using qualitative methods through a literature review. While the determinant analysis uses quantitative methods with probability analysis (logistic regression analysis). The results showed that the group of financial performance variables (represented by leverage and market value variables), ownership (represented by International Listing and state ownership variables), committee (represented by environmental committee), and board of directors (represented by Board Diversity) on carbon emission disclosure in Indonesia have significant effects. The development of indicators and the results of this research have supported the Legitimacy theory as a basis that can influence company's carbon emissions disclosure. The novelty of carbon emissions disclosure indicator can be used as a reference for companies and regulators as a basis for complete carbon emissions disclosure.

Keywords: Logistic regression, carbon emission disclosure, indicators.

I. INTRODUCTION

Global climate change is primarily driven by carbon dioxide (CO2) emissions. Asia is the largest carbon emitter, accounting for two-thirds of global carbon emissions. Meanwhile, carbon emissions in developed countries are in structural decline. Research focusing on carbon emissions disclosure in developing countries is still very limited. Developing countries and local communities need financial support to implement various environmental conservation activities. Reducing carbon emissions takes longer for developing countries due to their limitations. Research addressing carbon emissions disclosure for implementation in developing countries is highly urgent [1, 2]. Developing the concept of carbon emissions disclosure is crucial to understanding the influence of diverse determinants in industrialized developing countries like Indonesia.

Corporate carbon emission information is presented in annual reporting as carbon emission disclosures. This disclosure is useful in transmitting carbon emission calculations to stakeholders with different objectives [3]. Stakeholders will exert stronger pressure on companies to disclose carbon emission information in full and access the information easily [4]. Finally, carbon emissions disclosure transforms into a unique communication tool that is

accountable and transparent to the public [5]. Reporting and disclosing carbon emissions will increase decision-making opportunities in climate change mitigation [6].

This research formulates the research objectives as follows: (i) review previous research related to carbon emissions disclosure; (ii) developing carbon emission disclosure indicators; (iii) analyze the determining factors that are thought to influence carbon emissions disclosure. The research began by reviewing various literature studies related to carbon emissions disclosure. The results showed differences and similarities in the indicators used for carbon emissions disclosure (see Table 1). This study sets the recommended carbon emissions disclosure indicator as the dependent variable. The content analysis method was used to collect data on the dependent variable of this research. Content analysis was carried out by examining various company publication reports relevant to the research. A review of the literature reveals 21 articles from 2005 to 2022 that focus on carbon emission disclosure. These findings have been further examined, particularly with regard to the specific disclosure items. The review also indicates that legitimacy theory predominantly explains the determinants of carbon emission disclosure. This study offers recommendations for carbon emission disclosure in developing countries. However, certain items cannot be recommended as they are applicable only in developed countries or under specific national conditions. It is hoped that these recommendations will be implemented in the context of developing countries.

Carbon emissions disclosure will be analyzed through various groups of variables, including financial performance, ownership, committee, and board of directors. Financial performance in this research is represented by capital intensity, profitability, leverage, and market value [5, 7-12]. Another group of variables includes ownership, committee, and board of directors, all of which are part of corporate governance. Corporate governance information is useful for assessing potential climate change risks to stakeholders and forecasting associated opportunities [5, 11, 13]. This means stakeholders need information on the company's policies and procedures for managing a business sensitive to climate change risks [14]. Ownership is represented by three variables: international listing, state ownership, and managerial ownership [3, 8, 11, 15, 16]. The committee is represented by two variables: the environmental committee and the independent audit committee [5, 7, 8, 10]. Meanwhile, board diversity, board meetings, independent directors on the board, and duality represent the board of directors group [5, 8, 9, 11, 13].

II. LITERATURE REVIEW

The topic of climate change, particularly public disclosure, is beginning to influence the development of accounting literature. Research on climate change has started to examine carbon emissions disclosure in relation to environmental and social issues, even discussing potential disclosure indicators [17]. Information asymmetry can be reduced by companies presenting carbon emissions disclosures, making environmental information part of corporate social responsibility. Companies will be compelled to disclose carbon emissions more comprehensively and transparently due to stakeholder pressure [18].

The diversity of contexts for carbon emission disclosure, including differences in research countries and types of company industries, is necessary to build a common foundation applicable to all conditions, especially in developing countries [19]. Table 1 summarizes carbon emissions disclosures from various previous studies that were considered in developing these indicators.

Table 1. Summary of Carbon Emissions Disclosures from Previous Studies

No	Carbon Emissions Disclosure	Reference
1	Carbon disclosure categories in accordance with the Kyoto protocol [This disclosure consists of 5 disclosure items by assigning a weighting score to each disclosure item. The items are generally about the Kyoto Protocol, plans, potential costs, emission reduction costs and information]	[20]
2	Characteristics of corporate climate change strategies [This disclosure consists of 14 items for GHG emission reduction as well as energy efficiency, divided into two main groups operational activities and management activities.]	[2]
3	Climate change governance practices	[21]

	[The disclosure consists of 25 items divided into seven main groups, namely carbon trading, emissions accounting, board oversight, research/development, potential reductions, senior management responsibility and reporting.]	
4	Climate change governance practices [This disclosure consists of 14 items, which are divided into 5 main groups by assigning appropriate weighting scores, namely emissions accounting, public disclosure, board oversight, strategic planning and management execution.]	[22]
5	Voluntary emission disclosure criteria [This disclosure consists of 10 general disclosure items on control, capital expenditure, statement, prevention, conservation, recycling, resource efficiency, anti-waste and, prevent waste.]	[23]
6	Grk disclosure index category [this disclosure consists of 11 disclosures, which are separated into three main groups: Kyoto protocol, GHG emissions, statements, environmental audits, energy, special plans, expenses, carbon allocation and carbon credit sale/purchase].	[24]
7	Carbon footprint disclosure categories [This disclosure consists of 8 disclosure items, namely normative statements, aspirational goals, rewards, internal activities, external activities, helping others, descriptive statements and others, which provide descriptions and examples of the disclosures in question]	[25]
8	ISO 14064-1 requirements for index of GHG disclosure [This disclosure consists of 20 disclosures divided into 2 main groups, GHG inventory description and other issues to be considered, as well as the weighting that has the highest value which is about the description of CO emissions2, GHG uptake, policy/strategy, and GHG info monitoring].	[26]
9	GHG Emissions Disclosure [Disclosures consist of 29 disclosure items divided into six main groups, namely climate change, emissions accounting, energy accounting, emissions reduction, emissions accountability, news type and location.]	[15]
10	Carbon emissions disclosure checklist [This disclosure consists of 18 disclosure items divided into five main groups: emissions reduction, climate change, energy accounting, carbon emissions accountability and emissions accounting.	[27]
11	Climate change disclosure categories [This disclosure consists of 5 general disclosure items, namely risk/opportunity, emissions calculation, verification, performance and governance].	[28]
12	Climate change disclosure coding instrument [This disclosure consists of 25 disclosures divided into three main groups, namely Emission levels, indicators, targets, use of new technologies, certification, waste, renewable energy, alternative transport, employee training, comparisons, partnerships, etc].	[29]
13	Index disclosure categories for climate change [This disclosure consists of 20 general disclosure items, including risks, material impacts, cap-and-trade, Kyoto, impacts, total emissions, total plants and lawsuits].	[30]
14	Content analysis of GHG emissions reporting [This disclosure consists of 18 disclosure items divided into seven main groups, namely accuracy, completeness, consistency, credibility, relevance, timeliness, transparency].	[31]
15	Qualitative and quantitative GHG emissions disclosure [This disclosure consists of 60 disclosure items which are divided into Qualitative Disclosures and quantitative disclosures separately which also separates emission data into scope 1, 2 & 3].	[16]
16	CO2 Emissions Disclosure Index [This disclosure consists of 26 disclosure items, divided into six main groups: strategy, profile, parameters, governance, CO emission initiatives2 and performance indicators].	[3]
17	Disclosure index of corporate governance for climate change [This disclosure comprises 31 disclosure items divided into eight main groups, namely external party relations, emissions accounting, senior management, potential reductions, board oversight, research/development, carbon trading and reporting].	[14]
18	Disclosure research instrument	[32]

	[These disclosures consist of 33 disclosure items that are subdivided into seven main groups, namely policies, governance, finance, risk implications, performance/targets, mitigation and credibility].	
19	Climate change-related disclosure index [These disclosures consist of 22 disclosure items which are subdivided into four main groups, risks, opportunities, emissions accounting, energy accounting, and governance].	[33]
20	GHG emissions disclosure of Chinese energy companies [This disclosure consists of 16 disclosure items which are subdivided into 6 main groups, oversight, risk, emissions reduction, independence, reporting, comparison and external affairs].	[34]
21	GHG Emissions Related Disclosure Index [This disclosure consists of 32 disclosure items divided into two main groups, hard disclosure (governance, credibility & expenses) and soft disclosure (vision, strategy, profile & initiatives)].	[10]

The diversity of carbon emissions disclosure is influenced by many determinants. Carbon emissions disclosure will be analyzed in relation to various factors. Based on previous research, the development of carbon emissions disclosures has been designed to be more practical (see Table 1). The indicator development is described in Table 2 below:

Table 2. Internal and External Indicators of Carbon Emissions Disclosure

No	Theme	Indicators
		Internal
1.	Policy, governance and strategy	Statement of commitment to CEO or board committee engagement
		b. Have an environmental management system
		c. Periodic review
2.	Carbon emissions accountability	Description of carbon emission information
		Have an environmental risk management team
		List of carbon emission inventory facilities
3.	Energy consumption	Amount of energy used
		Use of energy from renewable sources
		Energy efficiency
4.	Calculation of carbon emissions	Determination of base year
		Total carbon emissions in metric tonnes of CO2
		Carbon emission reduction target
5.	Mitigation and adaptation	Energy-saving technology innovation
		Pollution abatement control
6.	Public disclosure	Carbon emission reduction reporting per period
		Reporting on carbon emissions inventory methodology and boundaries
7.	Management activities	Incentivising employees who reduce carbon emissions
		Employee training and development on carbon emission issues
8.	Business operations	Overview of products impacting the environment
		Supply chain overview addresses carbon emissions reduction
		Eksternal
9.	Carbon trading	Determining the economic value of carbon
		Participate in carbon trading schemes
10.	Carbon credits	Allocation of carbon emissions
		Buying/selling carbon credits
11.	Activities with external parties	Cooperation with other organisations on carbon emission reduction
		Promoting environmentally friendly behaviour
		Support the government's ENDC programme
12.	Performance comparison	Comparable carbon emissions reporting.
		Reporting guidelines refer to GRI or ISO 14001/14064
13.	Independent verification	Contact person in charge available
		Verification/assurance/audit by an independent party periodically
14.		Environment-related company certifications

Certifications and awards	Carbon emission reduction certification Award for environmental control and carbon emission reduction

Recent research on carbon emissions disclosures [5, 9, 11, 13, 18, 35] does not provide the necessary index for consideration in this study. Third parties such as Bloomberg and the Carbon Disclosure Project (CDP) supply the data needed by these researchers. The urgency of this research lies in developing indicators of internal and external carbon emissions disclosure as shown in Table 2. These indicators will serve as the basis for the dependent variable through the content analysis method.

Meanwhile, various complex variables in this study are used as independent variables. Financial performance concerning carbon emissions disclosure in this study is represented by capital intensity, profitability, leverage, and Tobin's Q, which are expected to have a positive relationship. Capital intensity is a proxy for the age of the company's equipment. Companies seek to differentiate their corporate image from underperforming companies through carbon emissions disclosure. It provides a positive signal to stakeholders, indicating that the company is updating its equipment to be more environmentally friendly [10]. A positive relationship was found between capital intensity and carbon emissions disclosure in several studies [3, 12, 27, 36, 37]. However, this contradicts other research [8], which found no significant relationship.

Profitability also represents a group of financial performance variables. Companies that can handle external pressures and perform excellently typically have established financial and reliable human resources, enabling them to produce the voluntary reporting needed by stakeholders. Voluntary disclosure of environmental information is more likely to be provided by companies with high profitability, even if the information is not always beneficial to the company [27]. Some studies show a significant relationship with the disclosure of carbon emissions [7, 38, 39]. However, conflicting results are shown by several studies [5, 11, 16] which did not find a significant relationship between the two.

Financial performance can also be represented by the leverage variable. Companies with higher leverage are under greater scrutiny because they have less financial flexibility. As leverage increases, companies face more scrutiny and are more likely to disclose information [40]. Companies with higher levels of debt may be pressured by their creditors to report carbon emissions in their voluntary disclosures. Some studies [7, 9, 10, 12] show a significant relationship between leverage and carbon emissions disclosure. Conversely, other studies show no significant relationship [8, 11, 41].

The next variable describing financial performance in this study is Tobin's Q. A higher Tobin's Q indicates that the company has a higher level of intangibles and/or a higher level of growth prospects. This makes the company more difficult to assess due to the possibility of high information asymmetry. Therefore, companies compensate for information asymmetry through increased disclosure of carbon emissions [40]. This conjecture aligns with previous research [8, 37] which found a significant positive relationship between Tobin's Q and carbon emissions disclosure. However, other studies [12, 36, 40] show conflicting results, finding no significant relationship between Tobin's Q and carbon emissions disclosure.

Another group of variables after financial performance includes ownership, committee, and board of directors, all of which are part of corporate governance. Research focusing on the biggest risks facing the planet argues that stakeholders need corporate governance information to assess the potential risks and opportunities associated with climate change [5, 11, 13]. Stakeholders require knowledge of the policies and procedures that companies have in place to manage aspects of their business related to climate change [14].

Ownership is represented by three variables: international listing, state ownership, and managerial ownership. All three are expected to significantly influence the disclosure of corporate carbon emissions. If a company is successfully listed on the stock exchange of another country, it is likely to provide disclosure of carbon emissions as a form of environmental concern, expected to grant positive legitimacy to investors in other countries. This aligns with previous research [3, 11], which found that international listing has a significant influence on the disclosure of carbon emissions. However, other studies [15] found that this variable does not significantly affect carbon emissions disclosure.

In the ownership variable group, state ownership is considered a strong and influential factor. Research [15] shows that companies with government-owned shares tend to be under pressure to disclose actions addressing climate change. Substantial shareholders tend to provide monitoring that improves governance of climate change

mitigation, especially if there is government ownership. Some studies support the notion that state ownership affects carbon emissions disclosure [15], while other studies contradict this [8].

Similarly, managerial ownership influences corporate carbon emissions disclosure [8, 16]. Managerial ownership encourages information disclosure in the company's voluntary reporting. Management who also own company shares tend to push the company to contribute to corporate sustainability [23], driven by a sense of ownership.

The next group of variables includes the committee, represented by two variables: environmental committee and independent audit committee. Previous research shows that companies with an environmental committee have higher quality carbon emissions disclosures [5, 7, 10, 42]. Companies demonstrating a commitment to carbon emissions issues are more likely to make credible disclosures. Environmental committees actively encourage companies to plan, implement, anticipate, and monitor various climate change mitigations. However, other research [8, 26] shows no significant effect, contradicting this assumption.

Another variable representing the committee variable group is the independent audit committee. The credibility of disclosure in the annual report is high because the information is independently audited by the auditor. This also demonstrates the company's commitment to public accountability. It is expected that the presence of an independent audit committee positively affects the disclosure of carbon emissions, as suggested by previous research [10, 42]. Although some studies [8] contradict this finding.

Another important variable in this study is the board of directors variable group, which includes independent directors on the board, board meetings, board diversity, and duality. Boards with more independent directors are expected to have higher quality carbon emissions disclosures compared to less independent boards [10]. The board of directors plays a key role in environmental performance by disclosing carbon emission strategies [14]. Other research [8, 26] also uses independent directors on the board as a variable affecting carbon emissions disclosure.

Board meetings are another variable thought to influence carbon emissions disclosure [8]. Board meetings that address climate change mitigation can improve the quality of corporate disclosures. Board meetings facilitate the development of policies related to carbon emissions, which can then be included in the company's disclosures [8]. However, some studies [5, 42] contradict this assumption.

Board diversity is another variable in the board of directors group. Diversity, including the presence of women on the board, is an important dimension of board composition that can affect company performance [10]. Companies with diverse boards tend to make more comprehensive disclosures, including information on vision and strategy, environmental profiles, and initiatives related to carbon emissions [10, 43]. This supports the assumption that board diversity influences carbon emissions disclosure [8, 42]. Although some studies [5, 9, 11, 13] present conflicting results.

The duality variable is another aspect of the board of directors. Duality refers to a situation where an individual serves as both a board member and the CEO. This dual role can grant broader authority in decision-making and may encourage better performance in mandatory and voluntary disclosures, providing a positive self-image. It is suspected that duality has a positive relationship with carbon emissions disclosure [10]. Although some research [5, 9] does not support this assumption.

Therefore, based on the above explanation, the research conjecture is in accordance with legitimacy theory and signaling theory. Financial performance (represented by capital intensity, profitability, leverage, and Tobin's Q), ownership (represented by international listing, state ownership, and managerial ownership), committee (represented by the environmental committee and independent audit committee), and board of directors (represented by independent directors, board meetings, board diversity, and duality) positively affect the disclosure of carbon emissions in developing countries.

H1: Financial performance, ownership, committee, and board of directors have a positive effect on carbon emissions disclosure.

III. MATERIAL AND METHOD

1. RESEARCH DESIGN

Based on the research problems and study purpose, the authors have followed a systematic research framework (Figure 1).

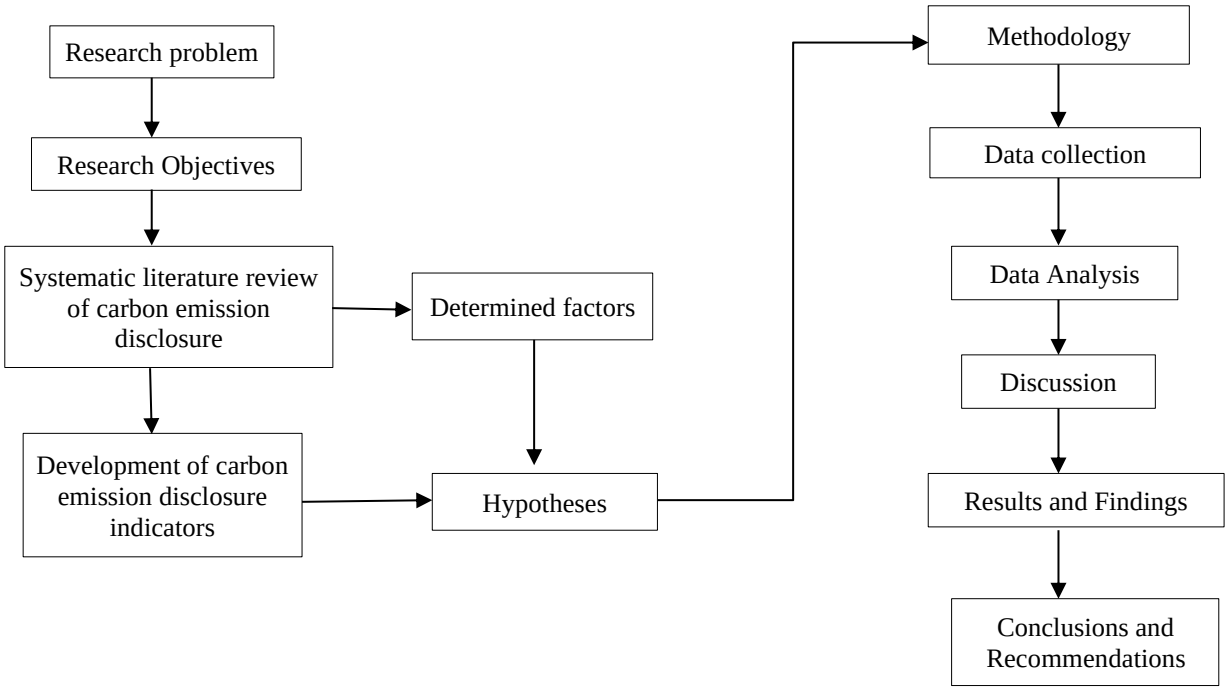

FIGURE 1. Research framework

2. DATA COLLECTION

This research tests the hypothesis of the relationship both partially and simultaneously by limiting the scope to avoid a broader context. The selected sectors are the most dominant companies contributing to national carbon emissions in Indonesia during 2021. This study uses cross-sectional data, consisting of only one observation period. The data source in this study is secondary data from annual reports, sustainability reports, and information obtained from the IDX website and the companies studied. The sector chosen for this study is the one that most significantly contributes to national carbon emissions. According to the IGRK Report, the energy sector contributes the highest carbon emissions, accounting for 56 percent of Indonesia's national carbon emissions. Therefore, the energy sector is selected as the population for the study. The IGRK report categorizes the energy sector to include the energy industry, manufacturing industry, transport, and mining. This categorization forms the research population of 381 companies from the energy sector, industrial sector, basic materials sector, non-cyclical consumer sector, and transportation sector, as obtained from the official website of the Indonesia Stock Exchange (IDX). The total population for this study is 381 companies, based on data recorded on the IDX. A list of the company names included in the study population can be found in Appendix 1.

The year 2021 was chosen as the basis for the observation year because the Indonesian Financial Services Authority (OJK) issued regulations related to environmental aspects in sustainability reports in 2021. The regulation can be seen in OJK RI Circular Letter No.16/SEOJK.04/2021 concerning the form and content of annual reports of issuers or public companies. The sample in this study was selected using a purposive sampling technique. The total population of companies was subject to several criteria to become a sample in this study. These criteria are shown in Table 3 below:

Table 3. Purposive Sampling Criteria

No	Criteria	Deduction	Total
1	The research population, all companies listed on the IDX in the energy sector, industrial sector, basic materials sector, non-cyclical consumer sector, and transportation sector in 2021.	-	381
2	Companies that published annual reports and sustainability reports in 2021	(156)	225

Source: www.idx.co.id (2022) and official company website

This study uses a number of public companies across Indonesia. Public companies were selected considering that it would facilitate the data collection process needed for the study. The final sample consisted of 225 (see Appendix 2) companies from five different sectors. The results of the purposive sampling data collection technique are detailed as follows:

Table 4. Details of Research Samples by Sector on the IDX

No	Sector	Total	Percentage
1	Energy	47	20,89%
2	Transport & logistics	15	6,67%
3	Basic material	60	26,67%
4	Industry	32	14,22%
5	Non-cyclical consumer	71	31,55%
	Total	225	100 %

Source: Data processed by the author (2023)

The data in Table 4 show that this study is dominated by companies from the non-cyclical consumer sector in Indonesia, comprising 31.55% of the sample. The second largest group is from the basic materials sector, representing 26.67%. The energy sector companies are the third largest group, making up 20.89% of the overall research sample, followed by industrial sector companies at 14.22%. The smallest group in this study is from the transport and logistics sector, which accounts for only 6.67%.

3. RESEARCH DESIGN

Data analysis in this study used two methods: descriptive analysis and quantitative analysis. Descriptive statistical analysis was employed to examine the characteristics of the research variables descriptively. Quantitative analysis used ordinal logistic regression to find the relationship between variables with an ordinal dependent variable.

Content analysis was used to analyze carbon emissions disclosure, with the maximum assessment yielding a total score. Content analysis is a subjective data collection process that examines narratives in printed reports. This may include additional or more extensive disclosures beyond annual reports and sustainability reports, such as those found on company websites [10], [25]. The operational research variables are detailed in Table 5 below:

Table 5. Operational Variables

No	Variables	Operational Definition	Indicators	Scale
		Dependent Variable		
1.	Carbon emission disclosure (CED)	CED is a communication tool for companies to account for the operations of their business activities that produce carbon emissions to stakeholders, in a transparent, accountable manner, in accordance with applicable laws and regulations, so as to have a significant impact on environmental improvement to reduce the risk of climate change through various relevant, effective and efficient initiatives, mitigation and adaptation actions.	Disclosure percentage (total company disclosure divided by total disclosure items) = N/37 Dummy variable, number 2 if the percentage of company disclosure >50% (high disclosure), number 1 if the percentage of company disclosure <50% (low disclosure)	Nominal
		Independent variable Financial performance		
1.	Capital intensity (CI)	CI is capital intensity, a company that has sufficient capital in the form of	Capital expenditure divided by total sales	Ratio

		assets means it has a high level of operations.		
2.	Profitability (ROA)	ROA is the rate of return on a company's assets.	Net income is divided by total assets, the result is then multiplied by 100%	Ratio
3.	Leverage (LEV)	LEV is the level of debt borrowing to increase corporate profits.	Total debt divided by total assets	Ratio
4.	Tobin Q (TOBIN)	TOBIN measures intangibles such as unrecognised goodwill that represent a company's investment environment and future growth opportunities.	Value of shares plus value of preference shares, long-term debt and current liabilities, divided by total assets	Ratio
		Ownership		
5.	International listing (IL)	IL is a company's stock that is legally listed on the IDX and other stock exchanges.	Dummy variable number 1 if the company is listed on the IDX and listed on another country's stock exchange, number 0 if only listed on the IDX	Nominal
6.	State ownership (SO)	SO is the ownership right of a company's shares dominated by the government	Dummy variable, number 1 if share ownership is owned by the government, number 0 if share ownership is owned by the public	Nominal
7.	Managerial ownership (MO)	MO is the right of ownership of a company's shares by the management, either the board of commissioners or the board of directors	Dummy variable, number 1 if the share ownership is owned by the management, number 0 if the share ownership is not owned by the management	Nominal
		Committee		
8.	Environmental committee (EC)	The EC is a committee established by the board of directors and is responsible to the board of directors in assisting the functions and duties of the board of directors. It systematically plans, implements and reviews policies and activities in the environmental sector	Dummy variable, number 1 if the entity has an environmental committee, number 0 if the entity does not have an environmental committee	Nominal
9.	Independent audit committee (IAC)	The IAC is an independent committee formed and responsible to the board of commissioners in providing professional opinions and carrying out the functions assigned by the board of commissioners	Dummy variable, number 1 if the entity has an independent audit committee, number 0 if the entity does not have an independent audit committee	Nominal
		Board of directors		
10.	Independent director on board (IDB)	IDB is a condition when the board of directors is not affiliated with shareholders, and other members of the board of directors /commissioners.	Dummy variable, number 1 if the entity has an independent board of directors, number 0 if the entity does not have an independent board of directors	Nominal
11.	Board meeting (BM)	BM is a meeting attended by the board of directors either in person or virtually.	Dummy variable, number 1 if the entity held a board of directors meeting one or more times, number 0 if the entity did not hold a board of directors meeting	Nominal
12.	Board diversity (BD)	BD is the gender diversity of the board of directors.	Dummy variable, 1 if the entity has a male and female board of directors, 0 if the entity has a	Nominal

			male-only or female-only board of directors.	
13.	Duality (DUAL)	DUAL is when a chief executive officer (CEO) also serves on the board of directors.	Dummy variable, number 1 if the entity has a CEO who concurrently serves on the board of directors, number 0 if the entity does not have a CEO who concurrently serves on the board of directors.	Nominal

Source: Data processed (2022)

The logistic regression analysis is illustrated below:

$$P(Y_i \leq 1|X_i) = C_1 = \frac{\exp(\alpha + \beta 1CI1 + \beta 2ROA2 + \beta 3LEV3 + \beta 4TOBIN4 + \beta 5IL5 + \beta 6SO6 + \beta 7MO7 + \beta 8EC8 + \beta 9IAC9 + \beta 10IDB10 + \beta 11BM11 + \beta 12BD12 + \beta 13DUAL13)}{1 + \exp(\alpha + \beta 1CI1 + \beta 2ROA2 + \beta 3LEV3 + \beta 4TOBIN4 + \beta 5IL5 + \beta 6SO6 + \beta 7MO7 + \beta 8EC8 + \beta 9IAC9 + \beta 10IDB10 + \beta 11BM11 + \beta 12BD12 + \beta 13DUAL13)} \quad (1)$$

Where C1 and C2 are Carbon emission disclosure, α is Constant, CI is Capital intensity, ROA is Profitability, LEV is Leverage, TOBIN is Tobin Q, IL is international listing, SO is State ownership, MO is Managerial ownership, EC is Environmental committee, IAC is independent audit committee, IDB is independent directors on board, BM is Board meeting, BD is Board diversity, and DUAL is Duality.

IV. DATA ANALYSIS

1. DESCRIPTIVE ANALYSIS

Descriptive statistical analysis provides an overview of the characteristics of the data used in the study. The results of this analysis show the average (mean), minimum, and maximum values. Table 6 presents a statistical description of the 225 research samples. The CI (Capital Intensity) variable has a minimum value of 0, with 115 companies (51% of the sample) not making any capital expenditures in 2021. The remaining 110 companies (49%) did make capital expenditures in 2021. Many companies cited the national economic conditions caused by the Covid-19 pandemic as the reason for delaying capital expenditures. Instead, existing funds were prioritized for urgent matters, such as paying Fixed Operating Costs, which had to be incurred even when operations were halted. The maximum value of the CI variable is 3.19, belonging to PT Harapan Duta Pertiwi Tbk. The average (mean) value of the CI variable is 0.73, with a standard deviation of 0.28.

Table 6. Descriptive Statistical Analysis Test Results

Variables	Minimum	Maximum	Mean
CI	0,00	3,19	0,07
ROA	0,00	52,02	6,71
LEV	0,00	1,85	0,49
TOBIN	0,02	9,28	0,80
IL	0,00	1,00	0,23
SO	0,00	1,00	0,06
MO	0,00	1,00	0,71
EC	0,00	1,00	0,09
IAC	0,00	1,00	0,85
IDB	0,00	1,00	0,37
BM	0,00	1,00	0,96
BD	0,00	1,00	0,45
DUAL	0,00	1,00	0,08
CED	1,00	2,00	1,11
	N 225		

Source: Data processed by the author (2023)

The next variable is ROA (Return on Assets), which has a minimum value of 0, encompassing 41 companies (18.22% of the sample). This indicates that these companies had poor current asset conditions or likely experienced losses in 2021. Many transportation service companies faced lockdowns and operational restrictions both nationally and internationally due to the Covid-19 outbreak. The highest ROA value was achieved by PT Bayan Resources Tbk. at 52.02% in 2021. Despite widespread operational challenges, some sectors, like mining, continued operations by adhering to safety protocols. For instance, PT Bayan Resources Tbk. managed to maintain operations with minimal human labor. The mean ROA value for 2021 is 6.71, with a standard deviation of 8.63, indicating significant variability in profitability among companies.

The LEV (Leverage) variable, also part of financial performance, shows PT Exploitasi Energi Indonesia Tbk. with a minimum value of 0 (specifically, 0.002). The maximum LEV value is held by PT Garuda Indonesia (Persero) Tbk. at 1.85. This suggests that PT Exploitasi Energi Indonesia Tbk. primarily finances its assets with its own capital rather than debt. In contrast, PT Garuda Indonesia (Persero) Tbk., despite being among the top 10 companies by asset value, has the highest LEV value, indicating significant losses in 2021, with total debt exceeding total assets. The mean LEV value is 0.49, with a standard deviation of 0.30.

The TOBIN variable shows that PT Indo Pureco Pratama Tbk. has the lowest value at 0.02, indicating that the company's market value is lower than its book value. Conversely, PT Wilton Makmur Indonesia Tbk. has the highest TOBIN value at 9.28, meaning the market values the company much higher than its book value. PT Kokoh Inti Arebama Tbk. has a TOBIN value of 1, indicating parity between its market and book values. Forty-two companies have a TOBIN value exceeding 1, predominantly large companies. The TOBIN variable has a mean value of 0.80 and a standard deviation of 0.76.

The next variable is the IL variable which is a dummy variable. The IL variable has a minimum value of 0 in 173 companies or 76.89% of the research sample companies listed on the IDX only. While the maximum value of 1 consists of 52 companies or 23.11 listed also on the stock exchanges of other countries. This is possible for companies that have active subsidiaries outside Indonesia. While the mean value is 0.23 with the possibility of deviating data (standard deviation) of 0.42.

The SO variable has a minimum value of 0 with a total of 212 companies or equal to 94.22% public share ownership, while the maximum value is 1 consisting of 13 companies or 5.78% of the company sample owned by the government. The results of this study are mostly depictions of public companies, because the sample of companies in the study is predominantly non-governmental. The SO variable has a mean value of 0.06, this is due to the gap in variation between companies with public or government ownership. The standard deviation value reaches 0.23, which means that the data deviation is still relatively small.

The third ownership group variable is the MO variable. This variable has a minimum value of 0 in 65 sample companies, or 28.89% of share ownership is not owned by management. The maximum value of the MO variable is 1 owned by 160 companies or 71.11% of the company's share ownership is owned by management. The mean value of the MO variable is 0.71 with a standard deviation of 0.45.

The next group variable is committee, one of which is the EC variable. The EC variable has a minimum value of 0 in 204 companies or around 90.67% of the company sample does not have an environmental committee. While the remaining 21 companies or 9.33% are companies that have environmental committees. Most of these companies come from the energy sector and the non-cyclical consumer sector. The average value (mean) of the EC variable is 0.09, with a standard deviation of 0.29 possible data deviation.

In addition to the EC variable, there is also the IAC variable which belongs to the committee variable group. The IAC variable has a minimum value of 0 with a total of 33 companies that do not disclose the independence of the audit committee transparently. The remaining 192 companies disclose their independent audit committee clearly in the annual report. The IAC variable has a mean value of 0.85 with a data deviation of 0.36.

The next variable is the IDB variable, which is classified in the board of directors variable group. The IDB variable has a minimum value of 0 which consists of 141 companies or 62.67% of companies that do not have an independent board of directors. While the maximum value of 1 IDB variable is a company that has an entire independent board of directors, with a total of 84 companies or equivalent to 37.33%. The IDB variable has an average value of 0.37 with a data deviation of 0.48.

The BM variable has a minimum value of 0 in only 10 companies or equivalent to 4.44% The company does not clearly explain the board of directors how many times the Board of Directors meets. The maximum value of 1 BM variable as many as 215 companies or 95.56% clearly explained that the board of directors held a joint meeting. The mean value of this variable is 0.96 with a possible data deviation value of 0.21.

The next variable is the BD variable which has a minimum value of 0 in 124 companies equivalent to 55.11% of companies have a male board of directors only. While 101 companies or equivalent to 44.89% of companies classified in the maximum value of 1 have fulfilled gender diversity, where the board of directors consists of men and women. The BD variable has a mean value of 0.45 with a standard deviation value of 0.50.

The last independent variable in this study is the DUAL variable. This variable consists of a minimum value of 0 in 207 sample companies or 92% of companies that do not have a CEO who doubles as a board of directors. While the maximum value of the DUAL variable is 1, where 18 companies or 8% of the sample only have a CEO who doubles as a board of directors. The average value of the DUAL variable is 0.08 while the possible value of the data deviation is 0.27.

The dependent variable, CED (Carbon Emission Disclosure), has a minimum value of 1 for companies in the low disclosure category, comprising 200 companies (88.89%). Twenty-five companies (11.11%) fall into the high disclosure category with a maximum value of 2. The CED variable has a mean value of 1.11 and a standard deviation of 0.32.

2. LOGISTIC REGRESSION ANALYSIS

Logistic regression analysis is a multivariate technique used when the dependent variable is a qualitative variable with ordinal (binary) categories. The goal is to determine the probability of making a qualitative decision based on the dependent variable. This stage of the analysis examines the influence of financial performance, ownership, committee, and board of directors on the disclosure of carbon emissions in Indonesia.

Table 7. Results of parameter estimates and Wald test

Variables	Estimate	Wald	Sig.
CED	5,23	4,72	0,03
CI	1,62	0,22	0,64
ROA	0,07	1,98	0,16
LEV	-8,03	3,82	0,05
TOBIN	8,59	5,38	0,02
IL	2,35	11,46	0,00
SO	4,01	9,92	0,00
MO	0,88	1,45	0,23
EC	3,03	12,44	0,00
IAC	1,30	1,12	0,30
IDB	-1,52	2,99	0,08
BM	21,24	0,00	0,00
BD	-1,72	6,71	0,01
DUAL	-0,43	0,12	0,74

Source: Data processed by the author (2023)

The initial stage in ordinal logistic regression analysis involves examining the parameter estimates output in Table 7, leading to the formulation of the initial Ordinal Logistic Regression model:

$$P(Y_i \leq 1|X_i) = C_1 = \frac{\begin{matrix}\exp(5{,}23 + 1{,}62CI + 0{,}07ROA - 8{,}03LEV + 8{,}59TOBIN \\ +2{,}35IL(0) + 4{,}01SO(0) + 0{,}88MO(0) + 3{,}03EC(0) \\ +1{,}30IAC(0) - 1{,}52IDB(0) + 21{,}24BM(0) - 1{,}72BD(0) \\ -0{,}43DUAL(0))\end{matrix}}{\begin{matrix}1 + \exp(5{,}23 + 1{,}62CI + 0{,}07ROA - 8{,}03LEV + 8{,}59TOBIN \\ +2{,}35IL(0) + 4{,}01SO(0) + 0{,}88MO(0) + 3{,}03EC(0) + 1{,}30IAC(0) \\ \pm 1{,}52IDB(0) + 21{,}24BM(0) - 1{,}72BD(0) - 0{,}43DUAL(0))\end{matrix}} \quad (2)$$

Table 8. Output results of model fitting information

Model	-2 Log Lokelihood	Sig.
Intercept Only	156,97	
Final	80,54	0,00

Source: Data processed by the author (2023)

The -2 Log Likelihood test based on Table 8 output model fitting information shows the Sig value. 0.000 <0.05 so it can be concluded that together (simultaneously) the independent variables affect the model. The -2-log likelihood value of 80.538 < 259.914 chi square table value, this means that the model before entering the independent variable has met the test requirements.

This test stage, pay attention again to the output parameter estimates, where the output results between variables are shown from the sig. value which is compared to 0.05. The wald test summary results in table 9 show the sig. value of each variable. Table 4.12 shows that the initial regression model of this study found that the variables CI, ROA, MO, IAC, BM, DUAL had no significant effect on CED (Disclosure of Carbon Emissions). While other variables such as TOBIN, IL, SO, EC and BD found significant effect on CED with 5% significance level. In addition, the variables LEV and ID have a significant effect on CED with a significance level of 10%.

Table 9. Wald test output results

Variables	Output Sig. against 0,05/0,10	Summary
CI	0,64 > 0,05	No significant effect
ROA	0,16 > 0,05	No significant effect
LEV	0,05 > 0,10*	Significant effect
TOBIN	0,02 < 0,05	Significant effect
IL	0,00 < 0,05	Significant effect
SO	0,00 < 0,05	Significant effect
MO	0,23 > 0,05	No significant effect
EC	0,00 < 0,05	Significant effect
IAC	0,29 > 0,05	No significant effect
IDB	0,08 > 0,10*	Significant effect
BM	0,99 > 0,05	No significant effect
BD	0,01 < 0,05	Significant effect
DUAL	0,74 > 0,05	No significant effect

* The significance level used is 10%

Source: Data processed by the author (2023)

The next stage of designing the estimated model is to re-conduct ordinal logistic regression analysis by removing variables that do not have a significant effect. The first step is to form the second modelling by looking at the results of the parameter estimates output.

Table 10. Results of parameter estimates and the second Wald test

Variables	Estimate	Wald	Sig.
CED	3,17	5,78	0,01
LEV	-8,40	4,84	0,03
TOBIN	8,42	5,95	0,02
IL	1,78	9,37	0,00
SO	2,79	7,51	0,00
EC	2,62	14,02	0,00
IDB	-0,81	1,46	0,23
BD	-1,60	6,84	0,01

Source: Data processed by the author (2023)

Next, look back at the results of the -2 Log Likelihood Test and Wald test in table 11 Sig Output. Wald Test results in table 12.

Table 11. Output results of the second model fitting information

Model	-2 Log Lokelihood	Sig.
Intercept Only	156,97	
Final	91,25	0,00

Source: Data processed by the author (2023)

Table 12. Output results of the second wald test

Variables	Output Sig. against 0,05	Summary
LEV	0,01 < 0,05	Significant effect
TOBIN	0,02 < 0,05	Significant effect
IL	0,00 < 0,05	Significant effect
SO	0,00 < 0,05	Significant effect
EC	0,00 < 0,05	Significant effect
IDB	0,23 > 0,05	No significant effect
BD	0,01 < 0,05	Significant effect

Source: Data processed by the author (2023)

Based on the Sig. value in Table 11, it can be said that together the independent variables affect the dependent variable. However, partially in the output of Table 12, only the independent variables (LEV, TOBIN, IL, SO, EC and BD) affect the dependent variable. While the independent variable IDB has no significant effect on the CED variable. Because the output results still find modelling results that have no significant effect, the next stage will be tested again by eliminating the IDB variable in the final modelling.

The next estimation model is an ordinal logistic regression analysis by removing variables that do not have a significant effect. The step begins with forming the third modelling by looking at the results of the parameter estimates output. Based on the output of the second Parameter Estimates in Table 13, the third stage Ordinal Logistic Regression model (Final Model) is obtained as follows:

$$P(Y_i \leq 1|X_i) = C_2 = \frac{\exp\left(2{,}91 - 9{,}08LEV + 8{,}90TOBIN + 1{,}73IL(0) + 2{,}25SO(0) + 2{,}35EC(0) - 1{,}57BD(0)\right)}{1 + \exp\left(2{,}91 - 9{,}08LEV + 8{,}90TOBIN + 1{,}73IL(0) + 2{,}25SO(0) + 2{,}35EC(0) - 1{,}57BD(0)\right)} \quad (3)$$

The calculation of odds ratio value is only used for independent dummy variables that are significant in the model, meaning that the final model output can be done. Based on table 13 of the final model estimate output, the odds ratio value of IL variable is exp (1.73) = 5.61. This means that there is an increase of 5.61 times the company discloses carbon emissions for companies listed on the Stock Exchange of Other Countries. The output results obtained the odds ratio value of the SO variable of exp (2.25) = 9.48. This means that there is an increase of 9.48 times the company discloses carbon emissions for companies owned by the Government. And the output results obtained the odds ratio value of the EC variable of exp (2.35) = 10.49. This means that there is an increase of 10.49 times the company discloses carbon emissions for companies that have an Environmental Committee. Finally, the output results obtained the value of the odds ratio of the BD variable of -1.57 can still get the value of exp (1.57) = 4.82 by utilising the palindromic invariance property, but has a different direction of interpretation. This means that there is an increase of 4.82 times for companies to disclose carbon emissions for companies that have a male- only or female-only Board of Directors.

Table 13. Results of parameter estimates and Wald test of the final model

Variables	Estimate	Wald	Sig.
CED	2,91	5,31	0,02
LEV	-9,08	5,50	0,02
TOBIN	8,90	6,44	0,01

IL	1,73	9,25	0,00
SO	2,25	6,66	0,01
EC	2,35	13,21	0,00
BD	-1,57	6,74	0,00

Source: Data processed by the author (2023)

Next, look back at the results of the -2 Log Likelihood Test and Wald test in table 14 Sig Output. and table 15 results of the third stage Wald Test.

Table 14. Final model fitting information output results

Model	-2 Log Lokelihood	Sig.
Intercept Only	156,97	
Final	92,82	0,00

Source: Data processed by the author (2023)

Table 15. Wald test results of the final model

Variables	Output Sig. against 0,05	Summary
LEV	0,02 < 0,05	Significant effect
TOBIN	0,01 < 0,05	Significant effect
IL	0,00 < 0,05	Significant effect
SO	0,01 < 0,05	Significant effect
EC	0,00 < 0,05	Significant effect
BD	0,00 < 0,05	Significant effect

Source: Data processed by the author (2023)

Based on the Sig. value in Table 14, it can be said that together the independent variables (LEV, TOBIN, IL, SO, EC and BD) affect the dependent variable. Partially in the output Table 15, all independent variables (LEV, TOBIN, IL, SO, EC and BD) partially affect the dependent variable. Thus, this research has found the best final model.

Table 16. Output results of goodness-of-fit

	Chi-Square	Sig.
Pearson	135,54	1,00
Deviance	92,82	1,00

Source: Data processed by the author (2023)

The next test is the goodness-of-fit test seen in Table 16. This test is used to determine how well the model is formed using the size of the coefficient of determination of the independent variable. Based on the Pearson value, the Chi-Square value is 135.54 with Sig.1> 0.05. Thus, it can be said that the model formed is suitable between the initial and final models, and in accordance with the research observation data.

Table 17. Output results of pseudo r-square

Cox and Snell	0,25
Nagelkerke	0,50
McFadden	0,41

Source: Data processed by the author (2023)

The magnitude of the coefficient of determination of the model in Table 17 can focus on the output results showing the Nagelkerke value of 0.50, indicating that this ordinal logistic regression model is able to explain about 50% of the variation in the observed ordinal dependent variable. This means that 50% of the variation in the dependent variable can be explained by the combination of independent variables in the final model of this study.

3. DISCUSSION

Financial performance in this study is represented by the variables CI (capital intensity), ROA (profitability), LEV (leverage), and TOBIN (Tobin's Q). Of the four variables, two of them, namely the CI and ROA variables, showed no partial influence on the disclosure of carbon emissions. This is in line with several studies, that the CI variable has no effect on the disclosure of carbon emissions [8]. A company that has sufficient capital in the form of assets means that it has a high level of operations. The increase in business activities should be directly proportional to the carbon emissions disclosed from the company's operations. In fact, the sample of companies, all of which are from Indonesia, shows the opposite of the theory. That high company operations do not show high disclosure of carbon emissions also in the research sample of developing countries. This could be due to the fact that in the year of the study, these companies did not have the obligation to calculate and report their carbon emissions in their annual reports or sustainability reports.

ROA variable which represents financial performance also has no effect on carbon emission disclosure, the same thing is also experienced by several previous studies [8, 15, 36, 44, 45]. Companies with high profitability should disclose more complete and more information, signalling that the company will resolve various issues including environmental issues more quickly [27]. This opinion does not apply to the condition of companies in developing countries that do not have mandatory rules in reporting carbon emissions. So that companies that have a high level of profitability prioritise other interests that are considered more important, rather than reporting carbon emissions.

In contrast, the LEV variable which represents financial performance has a negative influence on carbon emissions disclosure which is in line with several previous studies [7, 8]. Transparent and credible disclosure of carbon emissions is intended to reduce information uncertainty, thereby reducing the cost of renegotiating and monitoring the debt structure, debtholders may get a lower interest rate for corporate loans [7]. The results of the analysis show that there is an influence of the level of corporate borrowing on the reporting of carbon emissions disclosure, especially companies in developing countries such as Indonesia. Lenders pay attention to environmental issues, as well as the payment track record of the borrower. Issues such as carbon emission disclosure are important for banks or lenders as a consideration in company assessment. Based on the estimated value of LEV in table 13, carbon emission disclosure increases 9.08 times more if the company has a decreasing leverage ratio. This result also supports signalling theory [1] that the level of debt can indicate high or low disclosure of carbon emissions.

The partial test result of TOBIN variable which represents financial performance also has a significant positive influence on carbon emission disclosure. Based on the estimated TOBIN value in table 13, the disclosure of carbon emissions increases 8.9 times more if the company has a high TOBIN Q ratio value. The results of this study support other research [8] that if the intangible value of the company is higher, it will encourage wider disclosure of carbon emissions. Tobin Q results are also often used as the value of a company. This contradicts the results of other research [45] which found that Tobin Q has no influence on the disclosure of corporate carbon emissions.

Furthermore, the ownership variable groups are IL (international listing), SO (state ownership) and MO (managerial ownership). The results of the ordinal logistic regression analysis test show that the IL and SO variables have a significant influence on the disclosure of carbon emissions. This supports the findings of previous studies. Research in line with the IL variable [3, 11] agrees that rapid growth in a country and its movement towards internationalisation attracts substantial foreign investment into the country. Therefore, many companies on a particular stock exchange are also listed on foreign stock exchanges [15]. Multinational companies face higher pressure from domestic and global communities, and have a social contract not only with their home country but also with foreign countries. Companies listed on foreign stock exchanges can disclose more information, one of which is information related to carbon emissions that can attract world attention [3]. The results of the analysis show an increase of 5.61 times more disclosure of carbon emissions for companies that are also listed on the stock exchange of other countries. It is undeniable that the attention of potential foreign investors will certainly urge management to disclose important corporate issues, especially the disclosure of carbon emissions.

Another variable that also represents ownership that has a significant effect on the disclosure of carbon emissions is the SO variable. This is in line with other research [15] that have same result. The SO variable is considered a strong and influential stakeholder, state-owned companies are expected to have a higher commitment to fulfilling social and political agendas compared to public companies [8]. The results of the analysis show that companies owned by the government have an increase of 9.48 times in disclosing carbon emissions. These companies are therefore required to engage in socially responsible activities even if the issue is not yet mandatory. Government-

owned companies also face a higher level of public pressure and expectations, unwittingly becoming role models for other companies. Following public expectations to achieve legitimacy, these companies report a significant amount of corporate social information, including disclosure of carbon emissions. These results support the use of legitimacy theory [45] as a linking variable to carbon emissions disclosure.

Different results are shown by the MO variable which has no significant effect on the disclosure of carbon emissions. This is contrary to previous research [8]. Managerial ownership is more likely to integrate climate change issues into the company's business strategy and maintain long-term commitments effectively across all business operations. Directors with a higher proportion of shareholding in the company are more likely to influence strategic decisions, including environmental and climate change issues [16]. However, the results of the analysis show a new thing that is different from various previous studies, that managerial ownership does not affect the disclosure of carbon emissions, especially in developing country companies such as in Indonesia.

The committee variable group is represented by the EC (environmental committee) and IAC (independent audit committee) variables. The results of ordinal logistic regression show that companies that have an environmental committee have an increase of 10.49 times in disclosing carbon emissions. This means that the EC variable has a significant effect on the disclosure of carbon emissions, this is in line with previous research [5, 7, 10, 42]. Based on the estimated EC value in table 13, the disclosure of carbon emissions increases 10.49 times more if the company has an environmental committee. The existence of an environmental committee indicates that the company has incorporated its climate change policy into business operations and continues to adapt to changing sustainability requirements [46]. The board of directors or senior managers in the environmental committee will reconfigure existing capabilities and structures, initiate and manage carbon emission mitigation actions, and prioritise resources to achieve reduction targets and monitor carbon emission reduction performance. In addition, the environmental committee will engage stakeholders to participate in sustainability activities for the good of the company and its image. This result also supports signalling theory [1] that environmental committees can indicate high or low disclosure of carbon emissions.

In contrast to the IAC variable which represents the committee found the results have no significant effect on the disclosure of carbon emissions, this is in line with previous research [8]. Companies are expected to voluntarily disclose information related to carbon emissions by involving independent third parties to verify the information [7], verification and assurance of carbon emission information from independent parties to increase credibility and validity in carbon emission disclosure [46]. The presence of an independent audit committee in the independent variable of this study, however, did not affect the disclosure of carbon emissions of companies in Indonesia. Given the weak awareness of environmental issues in developing countries, companies that even have an authorised party to verify this, have not been able to encourage voluntary disclosure of carbon emissions. Different results may be found if the carbon emission disclosure condition is mandatory.

Furthermore, the board of directors variable group, which is represented by the variables IDB (independent directors on board), BM (board meeting), BD (board diversity) and DUAL (duality). The results of ordinal logistic regression analysis show that the variables IDB, BM, and DUAL have no significant effect on the disclosure of carbon emissions. The lack of effect of IDB variable on carbon emission disclosure is not in line with previous research [8]. Not yet found research that has the results of the IDB variable does not affect the disclosure of carbon emissions, the results of this study will add to the variation of the results of the IDB variable. Independent directors will take a broader view and oppose the narrow definition of corporate performance that focuses primarily on financial measures and benefits. Independent directors tend to have a long-term perspective and tend to pursue sustainable development [42]. Unfortunately, the results of this study cannot support this opinion. In fact, developing country companies in Indonesia, despite having independent boards of directors, do not encourage company management to pay attention to environmental issues such as disclosure of carbon emissions. This may be due to the fact that there are many other things that are more important than disclosing carbon emissions more transparently

The BM variable representing the board of directors also has analytical results that have no effect on the disclosure of carbon emissions. This supports previous research that has the same results [42]. The board of directors meeting is expected to produce policies related to carbon emission processing to be reported in the company's carbon emission disclosure [8]. In fact, as analysed for companies in developing countries such as Indonesia, board meetings are not a guarantee that management will consider disclosing carbon emissions in the company's annual

reporting. As there is no obligation to report in Indonesia, it will not be a prioritised topic to be reported in corporate disclosures.

The DUAL variable representing the board of directors has the same result as the previous variable, where this variable does not have a significant influence on the disclosure of carbon emissions, same result with other research [42]. A board of directors that also serves as CEO will encourage management to disclose carbon emissions in its annual report [10]. In fact, companies in developing countries such as Indonesia, a CEO who doubles as a board of directors does not necessarily become concerned with disclosing carbon emissions, this is possible because the party already has priorities in mandatory disclosure rather than having to focus on voluntary disclosure.

In contrast, the BD variable has a significant effect on carbon emission disclosure. Companies that have a male-only or female-only board of directors will increase the disclosure of carbon emissions by 4.82 times. This is in line with previous research [8, 42]. And strengthens the BD variable as a variable that consistently affects the disclosure of carbon emissions. Women are generally more concerned than men about environmental issues and also tend to take action to reduce perceived environmental risks [8]. The composition of directors with only female or only male gender is more likely to disclose carbon emissions, this is due to the similarity of gender that makes the board of directors more comfortable to determine what is an important concern for the company.

Simultaneously, all independent variables have a significant effect on carbon emission disclosure. The results of the ordinal logistic regression test show that 50% of the variation in carbon emission disclosure variables can be explained by a combination of financial performance variables (represented by leverage and Tobin Q), ownership (represented by international listing and government ownership), committee (represented by environmental committee), and board of directors (represented by board diversity) together before adding control variables in the modelling. The remaining 50% is explained by variations in other independent variables that are most likely not included in the research observations.

V. CONCLUSION

Transparent and credible disclosure of carbon emissions is intended to reduce information uncertainty, as a consideration in company valuation for stakeholders, especially lenders, potential investors and domestic and foreign investors. Multinational companies are shown to disclose more information related to carbon emissions than companies that are only listed on one stock exchange. This also applies to state-owned companies, which also disclose more carbon emission disclosures than privately-owned companies. State-owned companies have a higher commitment to fulfil the achievement of carbon emission reduction in accordance with the vision and mission of the country's goal towards net zero carbon.

The presence of an environmental committee also encourages more disclosure of carbon emissions for companies, as environmental committees are formed by companies to focus on setting, implementing and reporting on carbon emissions. In addition, companies with male-only or female-only boards of directors increase carbon emissions disclosure. The equal gender composition makes the board of directors more likely to determine important matters such as carbon emissions.

As a global concern, carbon emissions disclosure should be high on the disclosure agenda of businessoperations. The results of the development of carbon emission disclosure indicators can provide implications or benefits for companies in developing countries if they are able to be implemented properly and optimally. The disclosure of carbon emissions will be considered by the management in developing countries when publishing the company's Annual Report and Sustainability Report. It will be easier for management to decide which key information should be disclosed to stakeholders regarding the company's carbon emissions disclosure.

The findings are also valuable for regulators and policymakers in developing countries in terms of designing better climate policies and regulations in the future, so that companies will publish carbon emissions information in a more transparent, credible and easily comparable manner. The development of carbon emissions disclosure in developing countries will provide research opportunities for researchers, lecturers and other experts to analyse corporate carbon emissions disclosure. In fact, this information will be useful when they independently assist companies in developing countries in the process of producing carbon emissions disclosure reports. Companies should report the amount of carbon emissions they produce. Moreover, dominant companies have independent auditors who actually know how to disclose carbon emissions in the annual report. For management, this research

can be taken into consideration when publishing annual reports and corporate sustainability reports, by paying attention to carbon emission disclosure items.

For regulators, it can consider ideas for the design of climate policies and regulations related to carbon emissions. For researchers, lecturers, and other experts, the development of carbon emission disclosure will provide future research opportunities and be useful when assisting the process of making carbon emission disclosure reports for companies independently. Disclosure of carbon emissions will be easier to do if the government actively supervises and follows up on the disclosure of carbon emissions of every listed company in Indonesia. In 2021, the government of indonesia has started to encourage company management to conduct carbon trading in the capital market. The carbon market is growing rapidly, the geographical green area in Indonesia allows many companies to reserve carbon or even buy and sell carbon inventories on the carbon exchange. In addition, the government has also encouraged to report carbon emission information in each publication report.

This study has limitations using only one year of data, namely 2021. Where the government in the observation year has not actively called on companies in Indonesia to report disclosure of carbon emissions. In addition, the research data does not use all sectors listed on the IDX. Future research can expand the range of sectors and years of observation that are the object of research. For example, by using all sectors on the IDX, or by comparing companies in other developing countries. Future research can also use various other variables that have not been included in the research observation variables, for example the variable quantity of carbon emissions, greenwashing practices, and other variables.

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Author contribution

All authors made an equal contribution to the development and planning of the study.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability Statement

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