

**THE INFLUENCE OF CORPORATE GOVERNANCE AND
COMPENSATION MECHANISMS ON VOLUNTARY CARBON
EMISSION DISCLOSURE IN INDONESIA**

(Undergraduate Thesis)

By

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**ACCOUNTING DEPARTMENT
FACULTY OF ECONOMICS AND BUSINESS
UNIVERSITAS LAMPUNG
BANDAR LAMPUNG
2026**

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Undergraduate Thesis

As One of the Requirements to Achieve the Degree of
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**ACCOUNTING DEPARTMENT
FACULTY OF ECONOMICS AND BUSINESS
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ABSTRACT

THE INFLUENCE OF CORPORATE GOVERNANCE AND COMPENSATION MECHANISMS ON VOLUNTARY CARBON EMISSION DISCLOSURE IN INDONESIA

By

Ravololonirina Natacha

This study examines the influence of corporate governance and compensation mechanisms on voluntary carbon emission disclosure in mining companies listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period. The mining sector is a major contributor to carbon emissions in Indonesia and faces growing pressure to improve environmental transparency, yet voluntary carbon disclosure practices remain inconsistent. Corporate governance is measured by board size and the proportion of independent commissioners, while executive compensation represents the compensation mechanism. Voluntary carbon emission disclosure is measured using an 18-item carbon disclosure index. Using purposive sampling, 53 companies were selected, resulting in 159 firm-year observations. Data from annual and sustainability reports were analyzed using multiple linear regression. The results provide empirical evidence on the role of governance and compensation in influencing voluntary carbon emission disclosure and offer insights to improve environmental reporting practices.

Keywords: corporate governance, board size, independent commissioners, executive compensation, voluntary carbon emission disclosure.

ABSTRAK

PENGARUH CORPORATE GOVERNANCE DAN MEKANISME KOMPENSASI TERHADAP VOLUNTARY CARBON EMISSION DISCLOSURE DI INDONESIA

Oleh

Ravololonirina Natacha

Penelitian ini bertujuan untuk menganalisis pengaruh corporate governance dan mekanisme kompensasi terhadap voluntary carbon emission disclosure pada perusahaan pertambangan yang terdaftar di Bursa Efek Indonesia (BEI) periode 2022–2024. Sektor pertambangan merupakan salah satu penyumbang utama emisi karbon di Indonesia dan menghadapi tekanan untuk meningkatkan transparansi lingkungan, namun praktik pengungkapan emisi karbon secara sukarela masih belum konsisten. Corporate governance diukur melalui ukuran dewan dan proporsi komisaris independen, sedangkan mekanisme kompensasi diproksikan dengan kompensasi eksekutif. Tingkat voluntary carbon emission disclosure diukur menggunakan indeks pengungkapan karbon yang terdiri dari 18 item. Sampel penelitian ditentukan dengan metode purposive sampling dan menghasilkan 53 perusahaan dengan total 159 observasi. Data sekunder diperoleh dari laporan tahunan dan laporan keberlanjutan, kemudian dianalisis menggunakan regresi linier berganda. Hasil penelitian memberikan bukti empiris mengenai pengaruh tata kelola perusahaan dan mekanisme kompensasi terhadap tingkat voluntary carbon emission disclosure serta implikasinya bagi peningkatan praktik pelaporan lingkungan.

Kata-kunci: corporate governance, ukuran dewan, komisaris independen, kompensasi eksekutif, voluntary carbon emission disclosure.

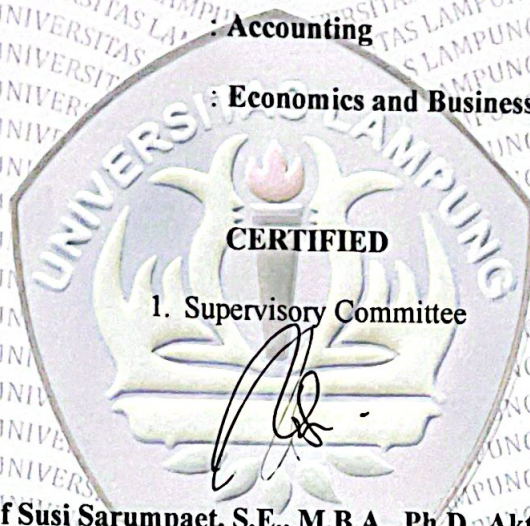
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Hereby declare that my thesis entitled "The Influence of Corporate Governance and Compensation Mechanisms on Voluntary Carbon Emission Disclosure in Indonesia" is entirely the result of my own work.

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BIOGRAPHY



This undergraduate thesis was written by Ravololonirina Natacha, who was born in Ambohimanatrika, Tanjombato, Madagascar, on 13 July. She is the first child of Mr. Rasoloarison Germain and Mrs. Ravololonaina Marie Claire. She has a younger sister, Rahevivololona Nandrianina Larissa, and a younger brother, Rajemison Tambiniaiana Fitiavana.

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With a strong commitment to academic excellence, personal growth, and ethical values, the author aspires to contribute significantly to the field of accounting and to make a positive impact on society in the future.

Motto

“Commit your way to the Lord; trust in Him and He will act.”

« Recommande ton sort à l'Éternel, mets en Lui ta confiance, et Il agira. »

“Ankino amin'i Jehovah ny lalanao, matokia Azy, fa Izy no hanao.”

Psalms 37:5

“Commit to the lord whatever you do, and he will establish your plans”

« Confie au seigneur tout ce que tu fais, et tes projets réussiront »

« Matokisa an'i jehovah dia ataony lavorary izay kasainao »

Proverbs 16:3

“Whatever you do, work at it with all your heart, as working for the Lord, not for human masters.”

« Tout ce que vous faites, faites-le de bon cœur, comme pour le Seigneur et non pour des hommes. »

« Na inona na inona ataonareo, dia ataovy amin'ny fo manontolo tahaka ny ho an'ny Tompo, fa tsy ho an'ny olona. »

Colossians 3:23

DEDICATION

All praise and gratitude be to God, the Almighty, for His endless love, grace, and guidance throughout every step of this journey. Through His strength and mercy, this work has been completed. I also give thanks to His Son, Jesus Christ, whose teachings of love, perseverance, and faith have been a constant source of light and hope in my life.

With a heart full of gratitude, this humble work is dedicated to:

My beloved parents, Rasoloarison Germain and Mrs. Ravololonaina Marie Claire.

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This work is not merely a collection of words and numbers, but a reflection of a journey made possible by many hands that guided, many hearts that encouraged, and countless prayers that sustained the way. Therefore, with the deepest humility and respect, the author wishes to extend sincere gratitude to the following individuals and institutions:

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I. INTRODUCTION

1.1 Background

Climate change has become a critical global concern, driven primarily by the rapid accumulation of greenhouse gas (GHG) emissions that intensify global warming and disrupt environmental stability. Recent assessments highlight that the economic and ecological consequences of climate change continue to escalate, creating severe risks for countries with large extractive industries (Calvin et al., 2023). Indonesia, as one of the world's largest resource rich nations, faces unique challenges in balancing economic growth with environmental responsibility, particularly in the mining sector. Mining activities including coal, nickel, copper, and mineral processing, are among Indonesia's most emission intensive industries, contributing significantly to national GHG outputs (IEA, 2024). As pressure intensifies from global markets, regulators, and investors, the demand for transparent environmental performance has become a central expectation.

The environmental consequences of this development pattern are reflected in Indonesia's emission structure. The *Indonesia Energy Transition Outlook 2024* reports that in 2023 the power generation sector contributed approximately 40% of national carbon dioxide emissions, largely due to the continued reliance on coal-fired power plants. The transportation sector accounted for 27% of emissions, driven by rapid growth in private vehicle ownership, logistics expansion, and limited public transportation systems. Industrial activities, including manufacturing, mining, and mineral processing, contributed 26%, while buildings accounted for the remaining 7% as energy demand increased in both commercial and residential areas (IESR, 2024). These figures demonstrate that Indonesia's emissions are highly concentrated in sectors closely connected to economic growth and industrial expansion.

Energy Sector CO₂ Emissions by Subsector in Indonesia 2023

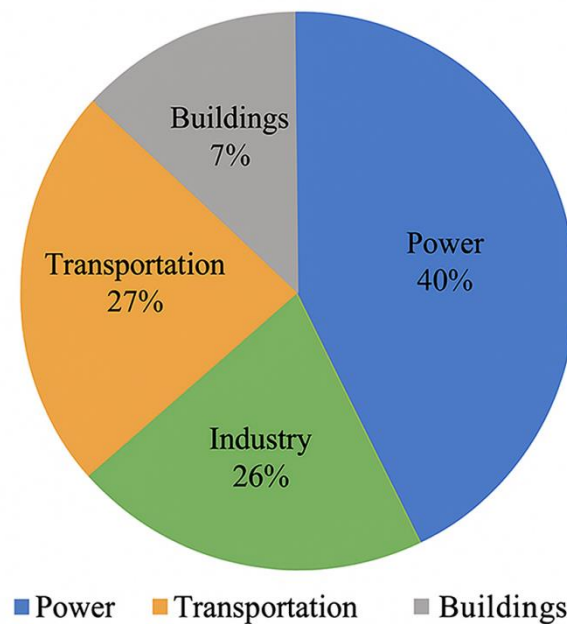


Figure 1.1 Energy Sector CO₂ Emissions by Subsector in Indonesia 2023

Source: Writer's elaboration (2025), adapted from Indonesia Energy Transition Outlook 2024 Institute for Essential Services Reform (IESR, 2024).

This emission profile highlights the strategic importance of emission intensive industries in achieving national climate targets. Mining, manufacturing, and transportation sectors are not only major contributors to greenhouse gas emissions but also highly exposed to global market expectations regarding sustainability performance. International investors, multinational buyers, and financial institutions increasingly require companies to disclose credible environmental information as part of investment and supply chain decisions. As a result, companies operating in these sectors face rising pressure to demonstrate transparent and accountable environmental practices, particularly in relation to carbon emissions and climate risk management.

One mechanism that plays a key role in responding to these expectations is voluntary carbon emission disclosure (VCED). Voluntary carbon

emission disclosure refers to the practice of companies voluntarily information about their greenhouse gas emissions, emission reduction strategies, climate related risks, and long-term decarbonization plans beyond what is legally required. Through such disclosures, firms can reduce information asymmetry between management and stakeholders, enhance credibility, and signal commitment to sustainable business practices. Prior studies have shown that voluntary carbon disclosure is closely associated with internal governance quality and incentive alignment rather than regulatory pressure alone (Bae Choi et al., 2013).

In practice, however, voluntary carbon emission disclosure among Indonesian mining companies remain highly inconsistent. While a small number of firms provide relatively detailed carbon data, including emission calculations and references to international reporting frameworks, many others disclose only general environmental statements without quantitative information, clear methodologies, or external verification. In several cases, companies emphasize environmental commitment in narrative form without explaining actual emission levels or mitigation actions. This wide variation suggests that VCED has not yet become a consistent strategic practice across the mining sector and remains strongly influenced by internal company conditions (Nilasakti et al., 2024).

The inconsistency of disclosure practices becomes more concerning when viewed alongside Indonesia's evolving sustainability policy framework. In recent years, Indonesia has introduced several initiatives aimed at strengthening climate governance and environmental transparency, including the establishment of IDXCarbon as a carbon trading platform, the issuance of sustainability reporting guidelines by the Financial Services Authority (OJK, 2017), and the reinforcement of national commitments toward net-zero emissions. Regulatory reforms have accelerated with the enactment of the Financial Sector Development and Strengthening Law (Law No. 4 of 2023), which enhances corporate supervision and transparency in sustainable finance. This is

complemented by OJK Regulation No. 18/POJK.03/2023, which replaces the earlier Green Bond regulation (No. 60/POJK.04/2017) and broadens the scope of sustainable securities. In addition, OJK Regulation No. 45/POJK.04/2024 emphasizes stronger board independence, clearer accountability, and improved disclosure quality. Most recently, the launch of the Indonesia Taxonomy for Sustainable Finance (TKBI) Version 2 in 2025 provides a more detailed classification of business activities based on their environmental impact. Despite this increasingly comprehensive regulatory framework, disclosure practices particularly among mining firms remain uneven, indicating that regulatory support alone is insufficient to ensure consistent voluntary climate and environmental disclosure (VCED).

These observations suggest that voluntary carbon emission disclosure cannot be fully explained by regulatory pressure alone, indicating the importance of firm-level internal governance mechanisms. Instead, differences in internal organizational structures and managerial incentives play a decisive role. Some companies appear more prepared to respond to sustainability expectations and disclose environmental information transparently, while others remain reluctant or slow to improve disclosure quality, even though they operate within the same regulatory environment. This phenomenon raises an important question regarding why firms within the same industry demonstrate different levels of transparency in carbon emission reporting.

To explain this variation, this study is grounded in Agency Theory and Legitimacy Theory. Agency Theory explains how conflicts of interest may arise between shareholders and managers when monitoring mechanisms are weak and incentives are misaligned. In such situations, managers may prioritize short-term financial performance over transparency and environmental responsibility, leading to limited voluntary disclosure. Legitimacy Theory complements this perspective by explaining how companies seek to maintain social acceptance by aligning their actions and disclosures with societal expectations. For

emission intensive industries such as mining, environmental disclosure becomes a key tool for maintaining legitimacy in the eyes of stakeholders.

The interaction between Agency Theory and Legitimacy Theory provides a comprehensive explanation of voluntary carbon emission disclosure behavior. Agency Theory emphasizes internal control and incentive alignment, while Legitimacy Theory highlights external social expectations. Together, these theories suggest that meaningful and transparent disclosure is most likely when companies possess strong governance mechanisms that limit managerial discretion and compensation systems that align managerial incentives with long-term sustainability objectives. In contrast, firms with weak governance and misaligned incentives may engage in selective or minimal disclosure to preserve legitimacy without making substantive changes.

Within this situation, it becomes evident that voluntary carbon emission disclosure cannot be fully explained by external factors alone.

Regulations, investor pressure, and sustainability policies establish a common framework for companies, yet they do not guarantee uniform disclosure outcomes. When firms operating in the same industry and under the same regulatory environment show different levels of transparency, the explanation must be sought within the internal structure of the company itself. This condition directs attention to firm level mechanisms that influence how disclosure decisions are made and implemented.

Two internal factors are particularly important in this regard, namely corporate governance and compensation mechanisms. Prior international studies emphasize that these two factors work together in shaping disclosure quality. Governance structures determine how management behavior is monitored, while compensation mechanisms influence managerial priorities and motivation. For example, Park, Lee, and Shin (2023) show that companies with stronger board oversight and

sustainability linked incentives tend to disclose carbon information in a more detailed and consistent manner. Similarly, Bo Bae Choi et al. demonstrate that differences in voluntary carbon emission disclosure can be systematically explained by variations in internal governance mechanisms rather than by regulatory pressure alone.

Corporate governance plays a central role in voluntary disclosure because it defines how much control exists over managerial discretion. In the case of carbon emission disclosure, managers often have flexibility in deciding whether to disclose information, what type of information to disclose, and how detailed that information should be. Strong governance mechanisms can reduce this discretion and encourage managers to provide clearer and more reliable carbon related information. In contrast, weak governance may allow disclosure to remain minimal or symbolic (OECD, 2023).

This study focuses on two corporate governance indicators that are directly linked to monitoring and disclosure processes, namely board size and independent commissioners. These indicators are selected because they represent the main governance bodies responsible for supervising management actions, ensuring accountability, and maintaining the quality of corporate reporting. According to agency theory, effective board structures are essential to reduce information asymmetry and to control managerial discretion, particularly in areas where disclosure is voluntary (Fama & Jensen, 1983).

Board size reflects the board's ability to supervise management and to allocate attention to complex issues such as climate change and carbon emissions. A board with sufficient members may have greater capacity to review management decisions, discuss environmental risks, and support more structured disclosure practices. Board size therefore becomes an important factor in understanding how governance capacity affects voluntary carbon emission disclosure.

Independent commissioners contribute to governance effectiveness by providing objective oversight. As they are not involved in daily management, independent commissioners are expected to offer unbiased judgment and reduce potential conflicts of interest. Their role is particularly important in disclosure decisions, as they can encourage management to provide balanced and transparent information to stakeholders, including information related to carbon emissions and environmental impact.

In addition to governance structures, compensation mechanisms affect how managers respond to sustainability expectations. Compensation systems signal which objectives are valued by the company. When executive compensation focuses mainly on short-term financial performance, managers may give less attention to environmental disclosure.

In this study, the compensation mechanism examined is executive compensation, which refers to the total remuneration received by executive directors or top management, including salaries, bonuses, allowances, and other financial benefits disclosed in the annual report. Executive compensation represents the primary financial incentive provided to top management and may significantly influence managerial decision-making. From an agency theory perspective, executive compensation functions as an incentive alignment mechanism. When remuneration levels are substantial, executives may have stronger incentives to protect corporate reputation, reduce information asymmetry, and enhance transparency, including through more comprehensive voluntary carbon emission disclosure. Therefore, executive compensation is expected to be associated with higher-quality voluntary carbon emission disclosure.

Despite the growing importance of corporate governance and compensation mechanisms in shaping corporate disclosure behavior, empirical evidence regarding how these internal mechanisms influence

voluntary carbon emission disclosure in Indonesia's mining sector remains limited. Most previous studies in Indonesia have concentrated on manufacturing or financial industries, while research specifically focusing on mining companies is still relatively scarce.

This gap is particularly important because the mining sector is one of the largest contributors to national greenhouse gas emissions and is subject to heightened scrutiny from regulators, investors, and international markets concerning environmental accountability. Given the sector's substantial environmental impact and strategic economic role, examining the influence of corporate governance and compensation mechanisms within this context provides valuable insights into the determinants of voluntary carbon emission disclosure in Indonesia.

The relevance of this issue is further strengthened by the 2022–2024 period, during which Indonesia's sustainability landscape has undergone significant changes. The introduction of carbon trading through IDXCarbon, along with stronger ESG requirements from investors and international buyers, has increased expectations for corporate transparency. Although carbon emission disclosure remains largely voluntary, companies are now under greater pressure to demonstrate accountability and readiness to align with global sustainability standards. During this transition period, differences in disclosure practices become more visible and meaningful.

The persistence of uneven disclosure among mining firms during this period suggests that internal governance capacity and incentive alignment play a critical role in determining disclosure quality. Companies with stronger monitoring mechanisms and well-structured compensation mechanisms may be better positioned to respond to these changing expectations. In contrast, firms with weaker governance structures and limited incentive alignment may continue to disclose carbon information in a minimal or symbolic manner, despite facing similar external pressures.

Therefore, this study seeks to examine the influence of corporate governance mechanisms, represented by board size and independent commissioners, as well as compensation mechanisms in the form of executive compensation, on voluntary carbon emission disclosure in Indonesia's mining sector during the 2022–2024 period. By focusing on internal firm-level factors, this research aims to explain why disclosure practices differ among companies operating within the same regulatory and market environment.

The findings of this study are expected to contribute to the literature on sustainability disclosure by providing evidence from a high emission industry in an emerging economy. In practical terms, the results may offer insights for regulators in strengthening governance-based disclosure policies, for investors in assessing environmental transparency, and for mining companies in improving internal structures to support more transparent and accountable carbon emission reporting.

1.2 Problem Statement

Environmental transparency is becoming more important for companies, especially those in high-emission sectors such as mining. In Indonesia, voluntary carbon emission disclosure is still inconsistent, with large differences from one company to another. These differences raise questions about the internal factors that influence disclosure, especially corporate governance and compensation mechanisms.

Corporate governance mechanisms, such as board size and the presence of independent commissioners, are expected to strengthen oversight and encourage transparent reporting. At the same time, compensation mechanisms, particularly executive compensation, may influence managerial decisions related to sustainability and disclosure practices. However, empirical evidence on how specific corporate governance mechanisms and compensation structures affect voluntary carbon emission

disclosure in Indonesia's mining sector is still limited. This gap creates uncertainty regarding the extent to which corporate governance mechanisms and executive compensation function as effective determinants of voluntary carbon emission disclosure in Indonesia's mining sector.

Therefore, this study aims to address the following research questions:

1. How does board size affect voluntary carbon emission disclosure in Indonesian mining companies during 2022–2024?
2. How does the presence of independent commissioners affect voluntary carbon emission disclosure in Indonesian mining companies during 2022–2024?
3. How does executive compensation influence voluntary carbon emission disclosure in Indonesian mining companies during 2022–2024?

1.3 Objectives of Research

Based on the problem formulation above, this study aims to achieve the following objectives:

1. To analyze the effect of board size on voluntary carbon emission disclosure in Indonesian mining companies during the 2022–2024 period.
2. To analyze the effect of independent commissioners on voluntary carbon emission disclosure in Indonesian mining companies during the 2022–2024 period.
3. To assess the influence of executive compensation on voluntary carbon emission disclosure in Indonesian mining companies during the 2022–2024 period.

1.4 Benefit of Research

1.4.1 Theoretical Contribution

- This study extends the sustainability accounting literature by integrating agency and legitimacy perspectives in explaining voluntary carbon emission disclosure within a high-emission emerging market context, particularly in the mining sector (Nilasakti et al., 2024).
- The study contributes to existing research by clarifying the role of corporate governance mechanisms and compensation mechanisms in shaping voluntary environmental disclosure, helping to address gaps and mixed findings in prior studies related to governance quality and sustainability reporting (Flammer et al., 2019).

1.4.2 Practical Contribution

- This research provides practical insight for mining companies by showing that effective corporate governance structures, such as appropriate board size and independent commissioners, together with executive compensation mechanisms, can support more transparent and credible carbon emission disclosure. Strong internal structures can improve accountability, enhance stakeholder trust, and strengthen corporate reputation in emission intensive industries (Moussa & Elmarzouky, 2024).
- The findings also offer guidance for boards of directors and top management in designing compensation mechanisms that align managerial incentives with sustainability objectives, encouraging managers to integrate environmental responsibility into strategic decision-making and reporting practices (Chakraborty & Dey, 2024).

1.4.3 Policy Contribution

- This study provides evidence-based insights that can support policymakers and regulators, such as the Financial Services Authority (OJK) and the Ministry of Environment and Forestry, in evaluating and strengthening sustainability reporting

frameworks and governance-related regulations in Indonesia (OJK, 2023).

- The results highlight the importance of sustainable corporate governance mechanisms, including board oversight and executive compensation structures, in improving the quality of environmental disclosure. These insights can assist regulators and other stakeholders in promoting more effective governance practices that enhance transparency and accountability in high-emission sectors (Gerwing et al., 2022).

II. LITERATURE REVIEW

2.1. Theoretical Framework

2.1.1 Agency Theory

Agency theory is one of the most widely applied frameworks in accounting, finance, and corporate governance research. The theory was first introduced by Jensen and Meckling (1976), who explained that the relationship between shareholders (as principals) and managers (as agents) is essentially contractual in nature. Shareholders delegate authority to managers to run the company in order to achieve the primary objectives, namely enhancing firm value and generating optimal returns for capital owners.

In practice, however, problems frequently arise that are commonly referred to as agency problems. These issues emerge due to conflicting interests and information asymmetry between principals and agents. Shareholders expect managers to act in ways that maximize their welfare, while managers may pursue personal interests such as obtaining bonuses, perks, or short-term gains. This situation creates the potential for opportunistic behaviour by managers, such as manipulating financial reports, reducing transparency, or making decisions that benefit themselves at the expense of the firm's owners (Sutisna et al., 2024).

Information asymmetry constitutes a critical aspect of agency theory. As the party responsible for managing the firm, managers typically have greater access to internal information compared to shareholders. This results in an information gap, which enables managers to conceal information that may harm the firm's image. Within the scope of this study, one manifestation of information asymmetry is the lack of transparency in disclosing environmental impacts, particularly carbon emissions. Managers may be reluctant to report the magnitude of

emissions generated by the company due to concerns about reputational damage and potential negative effects on market value.

To mitigate agency problems, effective control mechanisms are required. One of the primary mechanisms is corporate governance, which encompasses the presence of independent commissioners, audit committees, ownership structure, and transparency of corporate reporting. Corporate governance serves as a monitoring tool to ensure that management continues to act in alignment with shareholder interests. Furthermore, compensation mechanisms also play a crucial role in aligning the interests of agents and principals. Executive compensation can incentivize managers to make decisions consistent with the firm's long-term objectives, including enhancing the quality of non-financial disclosures such as carbon emissions (Syabina Maharani Zelovena et al., 2023).

Therefore, agency theory provides a strong conceptual foundation for explaining the influence of corporate governance and executive compensation on voluntary carbon emission disclosure. Effective governance mechanisms, such as an appropriate board structure and independent oversight, reduce managerial discretion and information asymmetry between managers and shareholders. At the same time, executive compensation functions as an incentive alignment mechanism that shapes managerial priorities and decision-making. When governance structures are strong and compensation incentives are properly aligned, the likelihood of opportunistic behavior decreases, thereby encouraging greater transparency and more comprehensive reporting of carbon emission information.

2.1.2 Legitimacy Theory

Legitimacy theory is one of the most frequently applied frameworks in the study of social accounting, environmental accounting, and sustainability reporting. This theory is grounded in the notion that corporations do not exist in isolation; rather, they operate within a

complex social environment in which their survival is highly dependent on public acceptance and support. In other words, corporate sustainability is not determined solely by financial performance but also by the extent to which companies can align themselves with societal values, norms, and expectations (Chairunnisa et al., 2025).

Dowling and Pfeffer (1975) explain that legitimacy means a company's actions and values match the values and expectations of society. In other words, people believe the company is doing the right thing. If a company's behavior goes against what society thinks is acceptable for example, by harming the environment or acting unethically people may lose trust in it. This loss of trust can threaten the company's reputation and even its ability to keep operating. Within this framework, corporations are understood to hold a social contract with society. This social contract represents an implicit agreement granting firms the "license to operate," provided that their activities do not conflict with social, environmental, and ethical interests. A breach of this contract for instance, through environmental degradation or failure to meet public expectations may result in society revoking the firm "social license to operate" (Rahman & Asyik, 2021).

With regard to corporate reporting, legitimacy theory provides an explanation for why companies are motivated to disclose non-financial information, particularly that related to social and environmental responsibilities. Chandra & Shauki emphasize that social and environmental disclosures are employed as strategies to maintain or secure legitimacy from society. Such disclosures function as communication tools, through which firms signal that their operations are aligned with prevailing social norms and do not harm public interests. Accordingly, sustainability reporting, including carbon emission disclosure, should not be viewed merely as an administrative obligation but also as a strategic mechanism for legitimacy management (Chandra & Shauki, 2024).

In the context of global environmental concerns, carbon emissions have become a central issue for communities and stakeholders. High levels of carbon emissions from industrial activities, particularly in the mining, energy, and manufacturing sectors, have significant implications for climate change. As a result, society, regulators, and investors are increasingly demanding greater transparency regarding the environmental impacts of corporate activities. To avoid a loss of public trust, firms must provide adequate disclosures on carbon emissions. By doing so, they demonstrate their commitment to sustainable business practices and reinforce their social legitimacy (Santosa, 2024).

Furthermore, legitimacy theory explains the strategic relationship between disclosure practices and corporate image-building. Proactive reporting of carbon emissions can strengthen a company's reputation and enhance its credibility in the eyes of investors and regulators. Conversely, withholding information or providing only minimal disclosure may generate suspicion and weaken legitimacy. At some point, a failure to maintain legitimacy may lead to economic consequences such as declining stock prices, reduced investor interest, and heightened regulatory pressures (Athaya et al., 2025).

In the Indonesian context, the relevance of legitimacy theory is particularly pronounced due to the limited binding regulations on carbon emission disclosure. Most companies in Indonesia still report such information on a voluntary basis, leading to considerable variation in disclosure practices across firms. Legitimacy theory therefore provides insight into why some companies are more proactive than others. Firms with a stronger awareness of the importance of social legitimacy are more likely to disclose carbon emission information transparently in order to sustain public support, comply with regulators, and meet the expectations of international stakeholders (Hadi Supiani Sedar, 2025).

In sum, legitimacy theory serves as an essential conceptual foundation for understanding carbon emission disclosure. From this perspective, disclosure is viewed as a strategic mechanism employed by firms to obtain, maintain, and reinforce social legitimacy. The success of a firm in sustaining legitimacy not only affects its image and reputation but also has long-term implications for business continuity. Within this study, legitimacy theory is applied to explain the motivation of Indonesian firms to voluntarily disclose carbon emissions as both a form of social accountability and a strategy for ensuring business sustainability.

2.2 Research Variables

Research variables are essential elements that constitute the primary focus of a study, as they serve as indicators to be measured, analysed, and interconnected in order to address the research questions. According to Suriani a research variable refers to any entity, object, or attribute determined by the researcher to be studied, from which relevant information can be obtained and conclusions drawn (Suriani et al., 2023).

In this study, the variables employed consist of independent variables and dependent variable.

2.2.1 Independent Variables

Independent variables are factors that influence or are presumed to cause changes in the dependent variable (Anggraeni & Dwiputri, 2022). In this study, two independent variables are examined, namely corporate governance and compensation mechanisms.

1. Corporate Governance

Corporate governance refers to a set of mechanisms, processes, and structures employed to direct and control the company in order to ensure accountability and create value for shareholders and other stakeholders (Triyuwono et al., 2020). In this study, corporate governance is measured using two governance mechanisms that are

commonly applied in environmental disclosure research, namely board size and the proportion of independent commissioners.

a) Board size

Board size refers to the total number of commissioners serving on the board. A larger board is generally expected to provide stronger supervision because it brings more diverse knowledge, experience, and perspectives into decision making. With more members involved in oversight, the board may be better able to discuss complex issues such as environmental risks and carbon emission management. As a result, companies with larger boards are expected to show higher transparency and stronger voluntary carbon emission disclosure.

b) Independent Board of Commissioners

Independent commissioners are board members who have no financial, family, or managerial relationship with the company or controlling shareholders. The proportion of independent commissioners reflects the level of objectivity and independence in board supervision. Independent commissioners are expected to monitor management more effectively and encourage responsible and transparent reporting practices. A higher proportion of independent commissioners can reduce managerial opportunism and support more open disclosure of carbon emission information.

Corporate governance mechanisms through these two indicators are expected to improve transparency and strengthen voluntary carbon emission disclosure (Triyuwono et al., 2020).

2. Compensation Mechanisms

Compensation mechanisms refer to the reward systems provided to management, particularly executive managers, in the form of salaries, bonuses, allowances, and other financial benefits.

Executive compensation represents the total remuneration received by top management and reflects the company's incentive structure. Higher compensation levels may motivate executives to protect corporate reputation and maintain investor confidence, including through more comprehensive voluntary carbon emission disclosure (Paongan et al., 2024).

In this study, compensation mechanisms focus specifically on executive compensation as a governance mechanism that may influence managerial behavior. Under agency theory, compensation structures serve as incentive and monitoring tools intended to align the interests of managers with those of shareholders. Higher levels of executive compensation may encourage managers to enhance corporate performance and reputation, including through greater transparency in voluntary carbon emission disclosure.

2.2.2 Dependent Variable

The dependent variable is the variable that is influenced or affected by the independent variables in a research model. It represents the outcome or phenomenon that the study seeks to explain.

In this study, the dependent variable is Carbon Emission Disclosure. Carbon emission disclosure is defined as the communication of information by companies regarding the amount of carbon emissions produced, emission control policies, and climate change mitigation strategies. In Indonesia, such disclosure remains voluntary, leading to considerable variation across companies. The level of disclosure is typically measured using a disclosure index developed based on guidelines such as the Global Reporting Initiative (GRI) or other relevant frameworks (Widiawati & Hidayati, 2024).

2.2 Previous Research

Several studies have been carried out to examine the relationship between corporate governance, compensation mechanisms, and voluntary disclosure of environmental or carbon information. Previous research helps provide a clearer understanding of how governance structures and incentive systems influence companies' decisions to report carbon emissions. These studies also show that good governance practices and fair compensation mechanisms can encourage managers to be more transparent in environmental reporting. Reviewing earlier findings is important to identify consistent results, differences, and research gaps that this study aims to address. The summary of previous research related to this topic is presented in the following table.

Table 2.1 Previous Research

No	Writer & Year	Title	Results/Findings
1	Park, J., Lee, J., & Shin, J. (2023).	Corporate governance, compensation mechanisms, and voluntary disclosure of carbon emissions: Evidence from Korea.	Board independence and performance-based compensation significantly voluntary carbon emission.
2	Zhu, C., Liu, X., Chen, D., & Yue, Y. (2024)	Executive compensation and corporate sustainability: Evidence from ESG ratings (Heliyon)	Found that ESG sensitive compensation structures correlate positively with ESG ratings; firms with stronger governance show stronger effects.
3	Chakraborty, R., & Dey, S. K. (2024)	The effects of corporate governance mechanisms on voluntary corporate carbon disclosures:	Board diversity and independence positively affect the extent of carbon

		Evidence from the emerging economy (Journal of Economic and Administrative Sciences)	disclosure in emerging markets.
4	Jeffrey Wilson, Jędrzej George Frynas. (2024)	Corporate Governance Mechanisms and Carbon Disclosure: A Review and Synthesis of 62 Empirical Studies	Strong corporate governance (independent board, audit committee, gender diversity) significantly increases carbon emission disclosure.
5	Jiang Y, Fan H, Zhu Y, Xu J (2023)	Carbon disclosure: A legitimizing tool or a governance tool? Evidence from listed US companies	Firms often use carbon disclosure for legitimacy purposes, but in low-carbon sectors, it functions as an effective governance tool enhancing transparency.
6	Haque, F., & Ntim, C. (2020).	Executive Compensation, Sustainable Compensation Policy, Carbon Performance and Market Value.	Linking executive pay to sustainability goals improves carbon performance and firm value.
7	Zhang, M., [et al.] (2020).	The Role of Corporate Governance in Voluntary Carbon Disclosure: New	Board diversity and industry experience (board capital) increase voluntary

		Insights from Board Capital and CEO Celebrity.	carbon disclosure, while CEO celebrity weakens this positive effect.
8	Oyewo, B. (2023).	Corporate Governance and Carbon Emissions Performance: International Evidence on Curvilinear Relationships.	Board diversity, ESG committees, and ESG-linked pay lower emissions; governance–emission relationship is curvilinear.
9	He, Y. & Song, W. (2022)	Analysis of the Impact of Carbon Trading Policies on Carbon Emission and Carbon Emission Efficiency. Sustainability, 14(16), 10216.	Carbon trading policies reduce emissions and improve carbon efficiency, with stronger dynamic and synergistic effects over time.
10	Lee Jaehong (2021)	CEO Overconfidence and Voluntary Disclosure of Greenhouse Gas Emissions: With a Focus on the Role of Corporate Governance (Sustainability)	CEO overconfidence reduces voluntary GHG disclosure; strong corporate governance mitigates this negative effect.
11	Bel-Oms, I., & Segarra-Moliner, J. R. (2022)	How Do Remuneration Committees Affect Corporate Social Responsibility Disclosure? Empirical	Active remuneration committees are positively associated with CSR and ESG

		Evidence from an International Perspective (Sustainability)	disclosure quality globally.
12	Wahyuningrum, I. F. S. (2025)	Driving Climate Change Disclosure and Advancing SDGs: Evidence from Indonesia (Journal of Risk & Financial Management)	Corporate governance positively affects carbon emission disclosure and carbon performance among Indonesian firms.

Source: Writer (2025)

2.3 Hypothesis Development:

2.3.1 Board Size and Voluntary Carbon Emission Disclosure

Board size reflects the total number of commissioners responsible for supervising and monitoring managerial activities within a company. The board of commissioners plays a crucial governance role in ensuring that management decisions align with shareholder interests and broader stakeholder expectations. In the context of environmental accountability, the board's supervisory function becomes increasingly important, particularly for companies operating in environmentally sensitive industries such as mining.

From the perspective of agency theory, conflicts of interest may arise between managers (agents) and shareholders (principals), particularly when managers prioritize personal objectives over long-term corporate value (Jensen et al., 1976). An effective board serves as a monitoring mechanism that mitigates agency problems by overseeing managerial behavior and enhancing transparency. A larger board may strengthen monitoring effectiveness by providing greater diversity in

expertise, professional backgrounds, and perspectives. This diversity can enhance the board's capacity to evaluate complex environmental risks and sustainability disclosures, including carbon emission reporting.

Furthermore, a larger board may improve decision-making quality through broader discussion and more comprehensive oversight. In environmentally sensitive sectors such as mining, carbon emission disclosure is increasingly scrutinized by regulators, investors, and the public. A board with sufficient size and expertise is more likely to recognize the strategic importance of transparent environmental disclosure as part of corporate risk management and sustainability strategy.

From the standpoint of legitimacy theory, organizations continuously seek to align their operations with societal norms and expectations in order to maintain legitimacy (Suchman, 1995). In recent years, environmental responsibility and climate-related transparency have become central societal concerns. Companies in the mining industry face heightened environmental pressure due to their significant environmental impact. Therefore, boards with stronger governance capacity may encourage voluntary carbon emission disclosure as a strategic response to maintain social acceptance, corporate reputation, and stakeholder trust.

Empirical evidence supports this theoretical argument. Park et al. (2023) find that board characteristics positively influence carbon disclosure transparency. Similarly, Chakraborty and Dey (2024) demonstrate that stronger board structures, including board independence and diversity, enhance environmental reporting quality. These findings suggest that board effectiveness, including board size, contributes positively to voluntary carbon emission disclosure.

Based on the theoretical and empirical explanation above, the first hypothesis is formulated as follows:

H1: Board size has a positive effect on voluntary carbon emission disclosure.

2.3.2 Independent Commissioners and Voluntary Carbon Emission Disclosure

Independent commissioners are board members who do not have financial, managerial, or familial relationships with the company, thereby ensuring objectivity and impartial oversight. Their independence enhances the credibility of corporate governance and strengthens the board's monitoring function.

According to agency theory, independent oversight mechanisms reduce conflicts of interest between management and shareholders by limiting opportunistic behavior and improving transparency (Jensen & Meckling, 1976). Independent commissioners are less likely to be influenced by management and are therefore more capable of demanding accountability and comprehensive disclosure practices. In the context of environmental issues, independent commissioners may push management to adopt higher standards of environmental transparency, including voluntary carbon emission disclosure.

In addition, independent commissioners often represent broader stakeholder interests beyond shareholders, including environmental and social concerns. Given the increasing global emphasis on sustainability and climate-related reporting, independent commissioners may advocate for enhanced disclosure practices to mitigate environmental risk and reduce reputational damage.

From a legitimacy theory perspective, independent commissioners play a critical role in ensuring that companies align their reporting practices with societal expectations (Suchman, 1995). Mining companies, in particular, are subject to intense public scrutiny regarding their environmental impact. Voluntary carbon emission disclosure may serve as a mechanism to demonstrate accountability,

transparency, and commitment to environmental sustainability. Independent commissioners, through their monitoring and advisory roles, may encourage management to disclose carbon emission information to maintain corporate legitimacy.

Prior studies finding support this relationship. Park et al. (2023) report that board independence significantly improves carbon disclosure quality. Similarly, Chakraborty and Dey (2024) find that greater board independence is associated with more extensive environmental reporting practices. These findings indicate that independent commissioners contribute positively to voluntary environmental disclosure.

Therefore, the second hypothesis is proposed as follows:

H2: Independent commissioners have a positive effect on voluntary carbon emission disclosure.

2.3.3 Executive Compensation and Voluntary Carbon Emission Disclosure

Executive Compensation (EC) refers to the total remuneration received by executive directors or top management within a fiscal year. Compensation mechanisms play a central role in aligning managerial incentives with corporate objectives.

Under agency theory, incentive-based compensation schemes reduce agency conflicts by aligning the interests of managers with those of shareholders (Jensen & Meckling, 1976). When compensation is tied to performance outcomes, managers are motivated to enhance firm value and long-term sustainability. In the modern corporate environment, firm value is increasingly influenced by non-financial factors, including environmental performance and sustainability reputation.

Voluntary carbon emission disclosure can serve as a strategic tool for enhancing corporate transparency, strengthening investor confidence,

and improving corporate reputation. Managers whose compensation depends on overall corporate performance may be incentivized to adopt broader disclosure practices in order to signal environmental responsibility and attract environmentally conscious investors.

From the perspective of legitimacy theory, transparent environmental reporting helps companies maintain social acceptance and reduce legitimacy gaps (Suchman, 1995). When executive compensation structures reward long-term performance, managers may prioritize sustainability strategies, including carbon emission disclosure, to safeguard the company's public image and stakeholder trust.

Empirical research supports this argument. Luo et al. (2022) find that incentive structures are positively associated with environmental disclosure quality. Likewise, Zhu et al. (2024) report that performance-related incentives encourage broader sustainability reporting practices. These findings suggest that executive compensation can stimulate voluntary environmental transparency.

Higher executive compensation may increase managerial incentives to safeguard corporate reputation and sustain long-term firm value, potentially encouraging more comprehensive voluntary carbon emission disclosure. Based on this reasoning, the third hypothesis is formulated as follows:

H3: Executive compensation has a positive effect on voluntary carbon emission disclosure

2.3.4 The Simultaneous Effect of Board Size, Independent Commissioners, and Executive Compensation on Voluntary Carbon Emission Disclosure

Board size, independent commissioners, and executive compensation represent governance and incentive mechanisms that function to reduce agency conflicts and improve corporate transparency. According to agency theory, monitoring mechanisms (board size and

independent commissioners) combined with incentive alignment mechanisms (executive compensation) reduce managerial opportunism and encourage accountability (Jensen & Meckling, 1976).

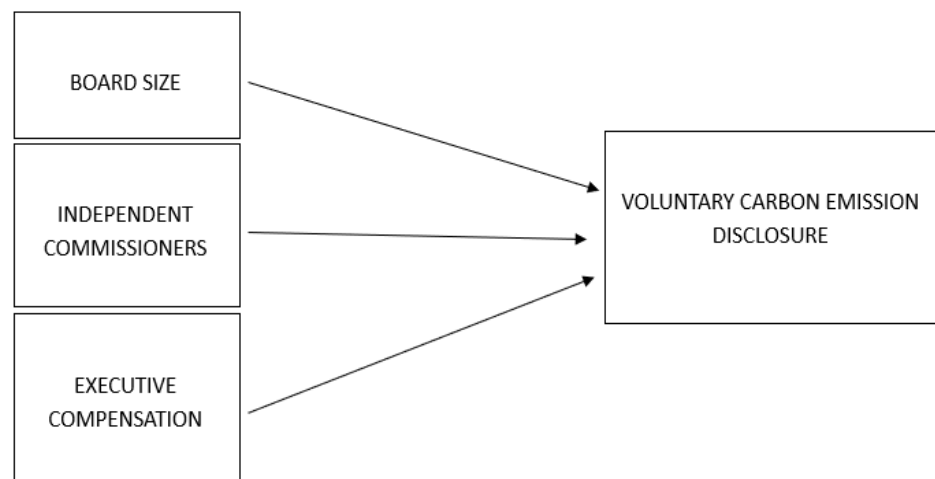
From the perspective of legitimacy theory, companies with stronger governance and incentive structures are more likely to disclose environmental information in order to maintain social acceptance and corporate reputation (Suchman, 1995).

When these mechanisms operate effectively and simultaneously, they are expected to strengthen corporate transparency, including voluntary carbon emission disclosure.

Therefore, the fourth hypothesis is formulated as follows:

H4: Board size, independent commissioners, and executive compensation simultaneously have a positive effect on voluntary carbon emission disclosure.

The research framework of this study is presented below and illustrated in Figure 2.1



Source: Writer elaboration (2025).

Figure 2.1 Thinking Framework

III. RESEARCH METHODOLOGY

3.1 Type of Research

This study employs a quantitative research design with both descriptive and associative approaches. The quantitative approach is selected because the primary aim of this research is to examine the effect among variables using numerical data derived from corporate reports. The descriptive approach is used to provide an overview of the current condition of voluntary carbon emission disclosure among Indonesian mining companies during the 2022–2024 period, while the associative approach is applied to test the relationship and influence between the independent variables namely board size, independent commissioners, and executive compensation, and the dependent variable, voluntary carbon emission disclosure. Thus, this study not only describes the phenomenon of carbon emission disclosure but also tests the interrelationships among the variables formulated in the hypotheses.

3.2 Population and Sample

The population in this study consists of all mining companies listed on the Indonesia Stock Exchange (IDX) during the observation period of 2022-2024. The selection of this population is based on the consideration that publicly listed companies are required to publish annual reports and sustainability reports, ensuring that information related to board size, independent commissioners, executive compensation, and carbon emission disclosure can be obtained consistently and verified.

The sample was determined using a purposive sampling technique, which is a method of selecting samples based on specific criteria aligned with the objectives of the study (Ulva Putri Ramadani et al., 2025). The criteria applied in this research are as follows:

1. Companies must be continuously listed on the Indonesia Stock Exchange during the 2022-2024 period.
2. Companies must publish complete annual reports and/or sustainability reports during the research period.
3. Companies must provide data regarding board size and the proportion of independent commissioners in their corporate governance disclosures.
4. Companies must disclose information related to executive compensation or executive remuneration in their annual reports.
5. Companies must disclose information related to environmental issues, particularly carbon emissions, either explicitly or implicitly in their annual or sustainability reports.

Based on the application of these criteria, this study obtained 53 companies as the final research sample. All of these companies operate within Indonesia's mining sector, recognized as one of the largest contributors to national carbon emissions.

Table 3.1 Sample Selection Based on Criteria

NO	Criteria	Total
1	Mining companies listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period	63
2	Companies that were not continuously listed during the 2022–2024 period	7
3	Companies that experienced mergers during the observation period	1
4	Companies for which annual or sustainability reports were inaccessible during the research period	1

5	Companies that did not provide complete data regarding board size, proportion of independent commissioners, executive compensation, and carbon emission disclosure	1
Final Sample		53
Years of observation		3
Total Research Observations		159

Based on Table 3.1, the mining companies that became the population in this study amounted to 63 companies listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period. From this population, 53 companies met the sample criteria using the purposive sampling method. It can be explained by the following calculation: $53 \text{ (companies)} \times 3 \text{ (annual reports for the period 2022–2024)} = 159 \text{ observations}$. The 53 companies that fulfilled all the predetermined criteria are further presented in Table 3.2

Table 2.2 Research Sample

Coal Production		
No	Company Name	Stock Code
1	PT. Adaro Energy Tbk /Alamtri Resources Indonesia Tbk	AADI
2	PT. Akbar Indo Makmur Stimec Tbk	AIMS
3	PT. Atlas Resources Tbk	ARII
4	PT. Baramulti Suksessarana Tbk	BSSR
5	PT. Bumi Resources Tbk	BUMI
6	PT. Bayan Resources Tbk	BYAN
7	PT. Dian Swastatika Sentosa Tbk	DSSA
8	PT. Golden Energy Mines Tbk	GEMS
9	PT. Harum Energy Tbk	HRUM
10	PT. Indika Energy Tbk	INDY
11	PT. Indo Tambangraya Megah Tbk	ITMG

12	PT. Resource Alam Indonesia Tbk	KKGI
13	PT. Mitrabara Adiperdana Tbk	MBAP
14	PT. Bukit Asam Tbk	PTBA
15	PT. Golden Eagle Energy Tbk	SMMT
16	PT. TBS Energi Utama Tbk	TOBA
17	PT. Pelayaran Nasional Bina Buana Raya Tbk	BBRM
18	PT. Batulicin Nusantara Maritim Tbk	BESS
19	PT. Capitol Nusantara Indonesia Tbk	CANI
20	PT. Alfa Energi Investama Tbk	INDI
21	PT. Mitrahahtera Segara Sejati Tbk	MBSS
22	PT. Pelita Samudera Shipping Tbk	PSSI
23	PT. Indo Straits Tbk	PTIS
24	PT. Rig Tenders Indonesia Tbk	RIGS
25	PT. Sumber Global Energy Tbk	SGER
26	PT. Transcoal Pacific Tbk	TCPI
27	PT. Dana Brata Luhur Tbk	TEBE
28	PT. Trans Power Marine Tbk	TPMA
29	PT. Black Diamond Resources Tbk	COAL
Oil & Gas Production & Refinery		
No	Company Name	Stock Code
1	PT. Astrindo Nusantara Infrastruktur Tbk	BIPI
2	PT. Energi Mega Persada Tbk	ENRG
3	PT. Medco Energi Internasional Tbk	MEDC
4	PT. Mitra Investindo Tbk	MITI
5	PT. Super Energy Tbk	SURE
Gold		
No	Company Name	Stock Code
1	PT Merdeka Copper Gold Tbk	MDKA
2	PT J Resources Asia Pasifik Tbk	PSAB
3	PT Wilton Makmur Indonesia Tbk	SQMI
Iron & Steel		

No	Company Name	Stock Code
1	PT Saranacentral Bajatama Tbk	BAJA
2	PT Beton Jaya Manunggal Tbk	BTON
3	PT Citra Tubindo Tbk	CTBN
4	PT Gunawan Dianjaya Steel Tbk	GDST
5	PT Gunung Raja Paksi Tbk	GGRP
6	PT HK Metals Utama Tbk	HKMU
7	PT Steel Pipe Industry of Indonesia Tbk	ISST
8	PT Krakatau Steel (Persero) Tbk	KRAS
9	PT Lionmesh Prima Tbk	LMSH
10	PT Optima Prima Metal Sinergi Tbk	OPMS
Diversified Metals & Minerals		
No	Company Name	Stock Code
1	PT. Aneka Tambang Tbk	ANTM
2	PT. Bumi Resources Minerals Tbk	BRMS
3	PT. Central Omega Resources Tbk	DKFT
4	PT. Ifishdeco Tbk	IFSH
5	PT. Vale Indonesia Tbk	INCO
Copper		
No	Company Name	Stock Code
1	PT. Tembaga Mulia Semanan Tbk	TBMS

3.3 Operational Definition of Variables

The operational definition of variables refers to the elaboration of research concepts into measurable empirical indicators. By providing operational definitions, each research variable can be measured clearly and systematically, while minimizing potential misunderstandings in the data analysis process. In this study employs two types of variables: independent variables (X) and dependent variables (Y).

The independent variables in this study are board size, the proportion of independent commissioners, and executive compensation. Corporate

governance in this research is proxied by board size and the proportion of independent commissioners, as these variables reflect the structure and independence of the board in carrying out monitoring and supervisory functions. Board size refers to the total number of members serving on the board of commissioners within a company, while the proportion of independent commissioners represents the percentage of independent members compared to the total board composition. (Defina & Kuswanto, 2025). Meanwhile, executive compensation is used to represent the compensation mechanism, which refers to incentives or rewards provided to management based on the achievement of specific performance targets. These independent variables are examined to analyze their effect on voluntary carbon emission disclosure as the dependent variable (Ruslaini et al., 2024).

The dependent variable in this study is carbon emission disclosure. This variable is measured based on the level and quality of carbon emission disclosure presented by companies in their annual reports and sustainability reports (Dozan Alfayerds & Angelina Setiawan, Mia, 2021). The assessment is conducted using a disclosure index developed from international guidelines such as the Carbon Disclosure Project (CDP) and the Global Reporting Initiative (GRI), adapted to the Indonesian context.

To further clarify the measurement indicators, the operational definitions of the research variables are summarized in Table 3.3 below.

Table 3.3 The Operational definitions of the research variables

Variable	Definition	Indicators	Scale
Corporate Governance - Board size (X1) - Proportion of independent	Mechanisms of corporate control and supervision that ensure managerial accountability and transparency.	- Board size - Proportion of independent commissioners	Ratio

commissioners (X2)			
Compensation Mechanisms -Executive compensation (X3)	The system of providing incentives and compensation to managers/executives that influence decisions related to environmental transparency.	- Executive compensation	Ratio
Carbon Emission Disclosure (Y)	The extent of corporate transparency regarding generated carbon emissions and mitigation efforts.	- Carbon emission disclosure index (CDP/GRI) - Quality of sustainability reporting - Completeness of carbon emission information	Index Score (0-1)

Source: Writer (2025)

3.3.1 Corporate Governance

In this study, corporate governance is proxied by board size and the proportion of independent commissioners. These variables are used to reflect the effectiveness of the board of commissioners in performing supervisory and monitoring functions.

1. Board Size (X1)

Represents the number of board of commissioners' members in a company.

$$\text{Board Size} = \text{Total number of commissioners}$$

A larger board size may enhance supervisory effectiveness by providing diverse expertise, broader perspectives, and more comprehensive oversight of management decisions. However, its

effectiveness also depends on coordination and communication among board members.

2. Proportion of Independent Commissioners (X2)

The proportion of independent commissioners represents the percentage of independent members compared to the total number of commissioners.

Proportion of Independent Commissioners

$$= \frac{\text{Number of independent commissioners}}{\text{Total number of commissioners}} \times 100$$

A higher proportion of independent commissioners indicates stronger board independence. Independent commissioners are not involved in daily management activities, enabling them to provide objective supervision, minimize conflicts of interest, and promote transparency and accountability in corporate reporting, including voluntary carbon emission disclosure.

3.3.2 Compensation Mechanisms

1. Executive compensation (X3)

Executive Compensation refers to the total remuneration received by executive directors or top management in a company within a fiscal year. Executive compensation reflects the financial incentives provided to management and may influence managerial decisions, including environmental disclosure practices.

In this study, executive compensation is measured using the total annual compensation received by executive directors as disclosed in the company's annual report.

The variable is calculated as:

$$\text{Executive compensation (EC)} = \text{Total Executive Compensation}$$

EC = Executive compensation of firm i in year t

Total Executive Compensation includes salaries, allowances, bonuses, incentives, and other monetary benefits received by executives.

The amount is measured in Indonesian Rupiah (IDR).

A higher percentage indicates a stronger alignment between managerial incentives and company performance, which may encourage management to improve transparency and sustainability-related reporting, including voluntary carbon emission disclosure.

3.3.3 Carbon Emission Disclosure (Y)

The dependent variable in this study is Carbon Emission Disclosure (CED), which reflects the extent to which mining companies voluntarily disclose information related to carbon emissions and climate-related activities in their annual reports and/or sustainability reports.

The measurement of Carbon Emission Disclosure follows the disclosure index developed by Bo Bae Choi et al. (2013), which has been widely applied in prior studies on environmental and carbon reporting. This index consists of 18 disclosure items, grouped into five major categories: climate change risks and opportunities, greenhouse gas (GHG) emissions, energy consumption, GHG reduction and cost, and carbon emission accountability.

Each disclosure item is assessed using a binary scoring method, where:

- A score of 1 is assigned if the item is disclosed in the company's annual or sustainability report.
- A score of 0 is assigned if the item is not disclosed.

The detailed checklist used in this study is presented in table 3.4

Table 3.4 Carbon Emission Disclosure Index (CEDI)

Climate Change: risks and opportunities	CC1- Assessment/description of the risks (regulatory, physical or general) relating to climate change and actions taken or to be taken to manage the risks
	CC2- Assessment/description of current (and future) financial implications, business implications and opportunities of climate change
GHG Emission	GHG1- Description of the methodology used to calculate GHG emissions (e.g. GHG protocol or ISO)
	GHG2- Existence external verification of quantity of GHG emission- if so by whom and on what basis
	GHG3- Total GHG Emissions – metric tonnes CO ₂ -e emitted
	GHG4- Disclosure of scopes 1 and 2, or scope direct GHG emissions
	GHG5- Disclosure of GHG emissions by sources (e.g. coal, electricity, etc.)
	GHG6- Disclosure of GHG emissions by facility or segment level
	GHG7- Comparison of GHG emissions with previous years
Energy Consumption	EC1- Total energy consumed (e.g. tera-joules or peta joules)
	EC2- Quantification of energy used from renewable sources
	EC3- Disclosure by type, facility or segment
GHG Reduction and Cost	RC1- Detail of plans or strategies to reduce GHG emissions
	RC-2- Specification of GHG emissions reduction target level and target year

	RC3- Emissions reductions and associated costs or savings
	RC4- Cost of future emissions factored into capital expenditure planning
Carbon Emission Accountability	AEC1- Indication of which board committee (or other executive body) has overall responsibility for actions related to climate change
	AEC2- Description of the mechanism by which the board (or other executive body) reviews the company's progress regarding climate change

Source : (Bae Choi et al., 2013).

Each disclosure item presented in the company's annual report and/or sustainability report is assigned a score of 1 if the item is disclosed and 0 if the item is not disclosed.

The Carbon Emission Disclosure Index (CEDI) for each firm is calculated using the following formula:

$$CEDI = \frac{\text{Number of disclosed items}}{18}$$

The CEDI score ranges from 0 to 1, where a higher value indicates a greater extent of voluntary carbon emission disclosure.

A higher Carbon Emission Disclosure Index (CEDI) score indicates a greater level of transparency, completeness, and accountability in a company's carbon emission reporting practices.

A higher Carbon Emission Disclosure Index (CEDI) score reflects a broader level of transparency and completeness in reporting carbon-related information, including emissions data, mitigation strategies, environmental targets, and climate-related risks. Accordingly, firms with higher CEDI scores demonstrate a higher level of disclosure regarding carbon emission reporting practices.

Carbon Emission Disclosure in this study refers to the extent to which companies voluntarily report information related to greenhouse gas

emissions, energy usage, climate change risks, and environmental management strategies in their annual or sustainability reports. This variable is measured using the Carbon Emission Disclosure Index (CEDI) developed by Bae Choi et al. (2013). This index is chosen because it provides a clear and specific framework that focuses directly on carbon-related disclosure rather than general environmental reporting. Compared to broader sustainability measurement tools, the CEDI allows a more precise evaluation of how companies communicate their efforts to manage carbon emissions. In addition, the index uses a simple binary scoring method, where a score of one is given if an item is disclosed and zero if it is not, which helps ensure objective and consistent measurement across companies and research periods.

The use of the CEDI is also considered highly appropriate in the Indonesian context, where carbon emission disclosure is still largely voluntary and reporting practices are not yet fully standardized. Companies often disclose environmental information in different formats and levels of detail, making it difficult to measure transparency using general sustainability indicators. Therefore, a carbon specific index such as the CEDI provides a more structured and reliable approach for assessing disclosure practices. This measurement is particularly relevant for mining companies, which are categorized as high emission industries and face increasing pressure from stakeholders to improve environmental transparency. For these reasons, the Carbon Emission Disclosure Index by Bae Choi et al. (2013) is considered the most suitable tool to capture voluntary carbon disclosure practices in this study.

3.4 Type of Data

The type of data used in this study is secondary data. Secondary data refers to information obtained indirectly, typically through documents that have already been published or republished by other parties. In this research, the secondary data are collected from corporate annual reports and sustainability

reports, which are accessed through the official website of the Indonesia Stock Exchange (IDX) www.idx.co.id as well as the official websites of the respective companies.

The research period spans from 2022 to 2024, allowing the data collection to cover three years of observation. This period was chosen based on the growing importance of sustainability issues and environmental responsibility in recent years, which have received increasing attention from regulators, investors, and the broader public. Furthermore, the selected timeframe is expected to provide a more representative picture of the consistency of carbon emission disclosure practices in the mining sector, one of the largest contributors to emissions in Indonesia.

Additional data are obtained from relevant literature, including books, scholarly journals, previous research articles, as well as regulations and guidelines related to carbon emission reporting. These references are utilized to strengthen the theoretical foundation, clarify the research variables, and compare the findings with prior studies. Accordingly, the combination of company secondary data and supporting literature provides comprehensive and reliable for the analysis conducted in this study.

3.5 Data Collecting Technique

The data collection techniques employed in this study consist of documentation, library research, and internet research. The documentation method is carried out by collecting and reviewing annual reports and sustainability reports of mining companies for the 2022–2024 period. These documents are analysed to obtain quantitative data related to the research variables.

Library research is conducted by reviewing relevant theoretical literature, academic journals, prior research, and regulatory frameworks concerning corporate governance, compensation mechanisms, and carbon emission disclosure. This approach is intended to strengthen the theoretical foundation

of the study and support the formulation of hypotheses. Additionally, internet research is utilized to obtain supporting information, including regulatory developments and sustainability reporting guidelines relevant to carbon disclosure practices.

3.6 Data Analysis Technique

This study employs panel data regression analysis to examine the influence of corporate governance and compensation mechanisms on voluntary carbon emission disclosure (CED). Panel data regression is selected because the dataset combines cross-sectional data and time-series data. The cross-sectional data consist of 53 mining companies, while the time-series data cover a three-year observation period from 2022 to 2024. Thus, the total number of observations analyzed in this study amounts to 159 firm-year observations.

Panel data regression is considered the most appropriate analytical method for this research for several reasons. First, it allows the researcher to control for unobservable firm-specific characteristics that may influence voluntary carbon emission disclosure but are not directly included in the regression model. These characteristics may include internal corporate culture, management style, or long-term company policies. Second, panel data analysis captures variations both across companies and over time, which increases the efficiency and accuracy of the estimation results. By combining cross-sectional and time-series dimensions, panel data regression reduces omitted variable bias and produces more reliable conclusions.

All statistical analyses in this study, including descriptive analysis, panel data model selection, classical assumption testing, and hypothesis testing, are conducted using EViews software to ensure systematic and accurate data processing.

3.6.1 Descriptive Statistical Analysis

Descriptive statistical analysis is conducted to provide an overview of the characteristics of the research variables. This analysis describes the

distribution of data through statistical measures such as mean, median, maximum value, minimum value, and standard deviation. The purpose of descriptive statistics is to present a general picture of the level of voluntary carbon emission disclosure (CED), corporate governance variables, and compensation mechanisms among mining companies during the observation period. By presenting these statistics, the researcher is able to understand the overall pattern and variability of the data before proceeding to further inferential analysis.

3.6.2 Panel Data Regression Model Selection

After conducting descriptive statistical analysis, the next step is to determine the most appropriate panel data regression model. In panel data estimation, three alternative approaches can be used, namely the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Selecting the correct model is crucial to ensure that the regression results are consistent, efficient, and unbiased.

According to Widarjono (2009), the selection of panel data estimation techniques can be determined through three statistical tests: the Chow Test, the Hausman Test, and the Lagrange Multiplier (LM) Test. These tests are conducted sequentially to identify the most suitable estimation model.

1. Chow Test

The Chow Test is conducted to determine whether the Common Effect Model (CEM) or the Fixed Effect Model (FEM) is more appropriate. This test examines whether there are significant differences in intercepts across cross-sectional units, indicating the presence of individual firm effects.

The hypotheses for the Chow Test are formulated as follows:

H_0 : The Common Effect Model (CEM) is appropriate.

H_1 : The Fixed Effect Model (FEM) is appropriate.

The decision is based on the probability value of the Cross-section F-statistic. If the probability value is less than the significance level of 0.05, H_0 is rejected, indicating that the Fixed Effect Model (FEM) is more appropriate. However, if the probability value is greater than 0.05, H_0 is accepted, meaning that the Common Effect Model (CEM) is sufficient.

2. Hausman Test

The Hausman Test is conducted to determine whether the Fixed Effect Model (FEM) or the Random Effect Model (REM) should be used. This test evaluates whether the individual effects are correlated with the independent variables.

The hypotheses for the Hausman Test are:

H_0 : The Random Effect Model (REM) is appropriate.

H_1 : The Fixed Effect Model (FEM) is appropriate.

The decision is based on the probability value of the Chi-square statistic. If the probability value is less than 0.05, H_0 is rejected, indicating that the Fixed Effect Model (FEM) should be selected. Conversely, if the probability value is greater than 0.05, H_0 is accepted, meaning that the Random Effect Model (REM) is more suitable.

3. Lagrange Multiplier (LM) Test

The Lagrange Multiplier (LM) Test is used to determine whether the Random Effect Model (REM) is more appropriate than the

Common Effect Model (CEM). This test identifies whether random effects exist across cross-sectional units.

The hypotheses for the LM Test are:

H_0 : The Common Effect Model (CEM) is appropriate (no random effect).

H_1 : The Random Effect Model (REM) is appropriate.

The decision is based on the probability value of the Breusch-Pagan LM statistic. If the probability value is less than 0.05, H_0 is rejected, indicating that the Random Effect Model (REM) is preferred. However, if the probability value is greater than 0.05, H_0 is accepted, meaning that the Common Effect Model (CEM) remains appropriate.

Through these three tests, the most appropriate panel data regression model is determined before proceeding to classical assumption testing and hypothesis testing. This process ensures that the regression results accurately reflect the influence of corporate governance and compensation mechanisms on voluntary carbon emission disclosure (CED).

3.6.3 Classical Assumption Tests

After determining the most appropriate panel data model through the Chow Test, Hausman Test, and Lagrange Multiplier (LM) Test, the next step is conducting classical assumption tests. These tests are performed to ensure that the regression model meets the basic assumptions required to produce reliable and unbiased estimators. By fulfilling these assumptions, the results of hypothesis testing become more valid and trustworthy.

The classical assumption tests in this study are conducted according to the selected panel data regression model. In general, the tests include the normality test, multicollinearity test, heteroskedasticity test, and autocorrelation test. These tests are used to evaluate the quality of the regression model and to ensure that the data are suitable for further regression analysis. Each test is explained as follows:

1. Normality Test

The normality test is conducted to examine whether the residuals of the regression model are normally distributed. Although normality is not a strict requirement in panel data estimation, testing normality supports the validity of statistical inference, particularly in hypothesis testing using t-statistics and F-statistics.

Generally, normality testing can be conducted using the Jarque-Bera test in EViews. The decision criteria are as follows:

- If the probability value (Prob.) > 0.05 , the residuals are normally distributed.
- If the probability value (Prob.) < 0.05 , the residuals are not normally distributed.

2. Multicollinearity Test

The multicollinearity test is conducted to determine whether there is a high correlation among independent variables. A good regression model should not contain strong correlations between independent variables, because multicollinearity can distort coefficient estimates and reduce the reliability of the model.

Generally, multicollinearity can be detected using the correlation matrix. The decision criteria are as follows:

- If the correlation value between independent variables is less than 0.90, multicollinearity is not considered problematic.

- If the correlation value exceeds 0.90, multicollinearity may exist.

3. Heteroskedasticity Test

The heteroscedasticity test aims to examine whether the variance of residuals is constant across observations. A good regression model should have homoscedastic

residuals, meaning the variance of errors remains constant.

Generally, heteroskedasticity can be tested using the Glejser test in EViews. The decision criteria are as follows:

- If the probability value (Prob.) > 0.05 , heteroskedasticity does not occur.
- If the probability value (Prob.) < 0.05 , heteroskedasticity occurs.

4. Autocorrelation Test

The autocorrelation test is conducted to determine whether there is a correlation between residuals across different time periods in the regression model. Autocorrelation usually occurs in data that contain a time-series element, where the error term in one period may be related to the error term in another period. Since this study uses panel data with a time dimension, testing for autocorrelation is important to ensure that the residuals are independent and that the regression model produces reliable estimation results.

Generally, autocorrelation can be tested using the Durbin-Watson (DW) statistic or other relevant tests available in EViews. The Durbin-Watson value is used to indicate whether autocorrelation exists in the regression model. The decision criteria are as follows:

- A DW value close to 2 indicates no autocorrelation.

- A DW value significantly below 2 indicates positive autocorrelation.
- A DW value significantly above 2 indicates negative autocorrelation.

3.6.4 Panel Data Regression Analysis

After the regression model passes the classical assumption tests, panel data regression analysis is conducted to examine the effect of independent variables on the dependent variable.

The regression model used in this study is formulated as follows

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$$

Description:

Y = Voluntary Carbon Emission Disclosure (CED)

α = Regression constant

β_1 – β_4 = Regression coefficients of each independent variable

X_1 = Board Size

X_2 = Proportion of Independent Commissioners

X_3 = Executive Compensation

e = Error term

3.6.5 Hypothesis Testing

Hypothesis testing is a fundamental component in panel data regression analysis. It is to determine whether the independent variables significantly influence the dependent variable and to draw conclusions regarding the proposed research hypotheses. In panel data regression, hypothesis testing is performed based on the selected estimation model (Common Effect Model, Fixed Effect Model, or Random Effect Model) determined in the previous stage.

In this study, hypothesis testing is carried out using three statistical approaches: the t-test (partial significance test), the F-test (simultaneous significance test), and the coefficient of determination (R^2). The level of significance applied in this research is 5% ($\alpha = 0.05$).

1. t-Test (Partial Significance Test)

The t-test is used to examine the partial effect of each independent variable on the dependent variable, namely Carbon Emission Disclosure (CED). This test aims to determine whether each independent variable individually has a significant influence on the dependent variable while other independent variables are held constant. In panel data regression analysis, the t-test is important because it helps identify which variables contribute significantly to explaining variations in Carbon Emission Disclosure.

The t-test evaluates whether each regression coefficient (β) is statistically different from zero. A significant coefficient indicates that the corresponding independent variable has a meaningful effect on the dependent variable. Conversely, an insignificant coefficient indicates that the variable does not have a statistically significant effect on Carbon Emission Disclosure.

The hypotheses for each variable are formulated as follows:

Board Size (BS)

$H_{01}: \beta_1 = 0 \rightarrow$ Board Size does not significantly affect Carbon Emission Disclosure.

$H_{a1}: \beta_1 \neq 0 \rightarrow$ Board Size significantly affects Carbon Emission Disclosure.

Proportion of Independent Commissioners (IC)

$H_{02}: \beta_2 = 0 \rightarrow$ The proportion of Independent Commissioners does not significantly affect Carbon Emission Disclosure.

$H_{a2}: \beta_2 \neq 0 \rightarrow$ The proportion of Independent Commissioners significantly affects Carbon Emission Disclosure.

Executive Compensation (EC)

$H_{03}: \beta_3 = 0 \rightarrow$ Executive Compensation does not significantly affect Carbon Emission Disclosure.

$H_{a3}: \beta_3 \neq 0 \rightarrow$ Executive Compensation significantly affects Carbon Emission Disclosure.

2. F-Test (Simultaneous Significance Test)

The F-test is conducted to determine whether all independent variables simultaneously influence the dependent variable. This test is used to evaluate the overall significance and feasibility of the regression model in explaining variations in Carbon Emission Disclosure (CED). In other words, the F-test examines whether the independent variables, when considered together, have a significant effect on the dependent variable.

In panel data regression analysis, the F-test is important because it indicates whether the regression model is appropriate for explaining the relationship between the independent variables and the dependent variable. A significant F-test result suggests that the regression model has explanatory power and can be used for further interpretation and analysis.

The hypotheses are formulated as follows:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$$

(All independent variables jointly do not significantly affect Carbon Emission Disclosure)

H_a : At least one $\beta \neq 0$

(At least one independent variable jointly significantly affects Carbon Emission Disclosure)

Decision criteria:

- If the probability value of the F-statistic < 0.05 , H_0 is rejected, meaning that the independent variables collectively have a significant effect on CED.
- If the probability value of the F-statistic > 0.05 , H_0 is not rejected, meaning that the independent variables do not simultaneously affect CED.

3. Coefficient of Determination (R^2)

The coefficient of determination (R^2) is used to measure the extent to which variations in the dependent variable can be explained by the independent variables included in the regression model. The R^2 value ranges from 0 to 1. A value closer to 1 indicates that the independent variables have strong explanatory power in explaining variations in Carbon Emission Disclosure. Conversely, a value closer to 0 indicates that the independent variables explain only a limited proportion of the variation in the dependent variable.

In panel data regression analysis, the Adjusted R^2 is generally considered a more accurate measure of model fit because it adjusts for the number of independent variables included in the regression model. Therefore, Adjusted R^2 is commonly used to evaluate the explanatory power of the model.

V. CONCLUSION, IMPLICATIONS, AND RECOMMENDATIONS

5.1 Conclusion

This study aims to examine the effect of Board Size (BS), Independent Commissioners (IC), and Executive Compensation (EC) on Carbon Emission Disclosure (CED) among mining companies listed in Indonesia during the 2022–2024 observation period. The analysis was conducted using panel data regression with the Common Effect Model (CEM) as the selected regression model. Based on the results of data analysis, hypothesis testing, and comprehensive discussion presented in the previous chapter, several important conclusions can be drawn.

1. Board Size is proven to have a positive and statistically significant effect on Carbon Emission Disclosure. This finding indicates that companies with a larger number of board members tend to disclose more carbon emission information. A larger board may provide stronger monitoring capacity, broader perspectives, and more diverse expertise in supervising management decisions, including decisions related to environmental reporting and sustainability practices. The existence of more board members may also increase discussion and attention toward environmental issues, particularly in industries with high environmental impact such as mining. This result suggests that board structure plays an important role in encouraging environmental transparency and strengthening corporate accountability toward stakeholders.
2. Second, Independent Commissioners are found to have no significant effect on Carbon Emission Disclosure. This finding indicates that the proportion of independent commissioners alone is not sufficient to influence the level of environmental disclosure among the observed companies. Although independent commissioners are theoretically expected to strengthen supervision and improve transparency, their presence may still be more formal than substantive in practice. The result

suggests that governance effectiveness depends not only on the existence of independent commissioners, but also on their competence, expertise, active involvement, and commitment to sustainability-related issues. Therefore, the role of independent commissioners in encouraging environmental transparency may still require further strengthening within Indonesian corporate governance practices.

3. Executive Compensation has a positive and statistically significant effect on Carbon Emission Disclosure. This result demonstrates that higher executive compensation is associated with higher levels of environmental disclosure. Executive compensation may function as an incentive mechanism that encourages management to support long-term corporate objectives, including sustainability and environmental transparency. Executives receiving higher compensation may become more motivated to maintain company reputation, improve accountability, and respond to increasing stakeholder expectations regarding environmental responsibility. This finding indicates that compensation systems can influence managerial behavior and strategic corporate decisions related to sustainability reporting.
4. Board Size, Independent Commissioners, and Executive Compensation simultaneously have a significant effect on Carbon Emission Disclosure. This finding indicates that governance mechanisms and managerial incentives collectively influence environmental disclosure practices among mining companies in Indonesia. The significance of the overall regression model demonstrates that Carbon Emission Disclosure is not determined by a single governance factor alone, but rather by the interaction between monitoring mechanisms, governance structures, and executive incentives operating within the company.

Overall, this study provides empirical evidence that corporate governance mechanisms and managerial incentives play important roles in influencing Carbon Emission Disclosure practices in Indonesia. The findings highlight that environmental transparency is closely related to the effectiveness of

internal governance structures and strategic managerial behavior. Companies with stronger governance systems and more effective incentive mechanisms are more likely to demonstrate greater accountability through broader environmental disclosure practices.

5.2 Research Implications

The findings of this study provide theoretical, practical, and policy implications that strengthen the overall contribution of this research.

1. Theoretical Implications: From a theoretical perspective, this study reinforces and extends both Agency Theory and Legitimacy Theory in the context of Carbon Emission Disclosure practices among mining companies in Indonesia. The positive effect of Board Size confirms that stronger governance monitoring mechanisms play an important role in influencing corporate transparency. A larger board structure may increase supervisory effectiveness because a greater number of members can provide broader perspectives, more diverse expertise, and stronger discussion regarding strategic decisions, including environmental issues and sustainability initiatives. This finding supports Agency Theory by suggesting that governance structures may reduce information asymmetry between management and stakeholders through stronger monitoring and oversight functions.

In addition, the positive effect of Executive Compensation further strengthens Agency Theory by demonstrating that incentive alignment plays a crucial role in influencing managerial behavior. When executive compensation systems are properly structured and aligned with long-term organizational objectives, they may encourage executives to adopt sustainability commitments and improve environmental transparency practices. This finding supports the argument that governance mechanisms function not only as monitoring tools but also as strategic instruments that shape managerial decisions and organizational direction. Furthermore, the non-significant role of Independent Commissioners contributes to the corporate governance and sustainability literature by

helping explain inconsistencies in previous studies. The findings suggest that governance effectiveness depends more on functional quality than formal structural compliance. The presence of independent commissioners alone may not be sufficient to improve Carbon Emission Disclosure if they are not actively involved in sustainability-related oversight or do not possess adequate expertise regarding environmental governance issues. This finding contributes to sustainability accounting literature by emphasizing that formal governance structures alone do not automatically guarantee stronger environmental disclosure outcomes. In addition, the findings provide support for Legitimacy Theory by demonstrating that Carbon Emission Disclosure functions as a corporate strategy to maintain legitimacy and stakeholder trust. Companies operating in environmentally sensitive industries face increasing public concern and stakeholder pressure regarding environmental responsibility and sustainability performance. Governance mechanisms and managerial incentives therefore function as important internal drivers that enable companies to respond to stakeholder expectations through transparent environmental reporting practices.

2. Practical Implications: From a practical standpoint, this study provides several direct implementation implications for companies, particularly mining companies and other industries with high environmental impact. Based on the findings of this study, companies may improve Carbon Emission Disclosure practices by strengthening governance effectiveness, increasing board involvement in sustainability oversight, improving the practical role of independent commissioners, and integrating sustainability indicators into executive compensation systems. These actions may help companies strengthen environmental transparency, improve accountability, and support long-term corporate sustainability objectives.

First, the positive relationship between Board Size and Carbon Emission Disclosure suggests that companies may directly strengthen board

participation in sustainability governance and environmental oversight activities. Companies may implement this by establishing sustainability committees within board structures, conducting regular environmental performance evaluations, and appointing board members who possess expertise related to environmental management, climate issues, or ESG implementation. Increasing board involvement in sustainability discussions may improve strategic decision-making and strengthen the quality of environmental disclosure practices.

Second, although Independent Commissioners are expected to strengthen monitoring and accountability functions, their non-significant effect indicates that companies should improve their practical and substantive role rather than simply fulfilling regulatory requirements. Companies may directly implement this by involving independent commissioners in sustainability reporting evaluations, environmental risk assessments, and climate-related strategic discussions. In addition, companies may provide sustainability governance training programs and ESG-related education to strengthen commissioner effectiveness in supervising environmental accountability.

Third, the positive influence of Executive Compensation highlights the importance of aligning managerial incentives with sustainability objectives. Companies may directly implement this finding by integrating environmental performance indicators into executive remuneration systems. Such indicators may include carbon emission reduction achievements, environmental compliance targets, sustainability reporting quality, ESG performance indicators, and environmental risk management performance. Linking executive compensation with sustainability outcomes may encourage stronger managerial commitment toward environmental responsibility while improving transparency, accountability, and long-term corporate reputation.

3. Policy Implications: This study also provides evidence-based and directly applicable implications for policymakers and regulators,

including the Financial Services Authority (OJK), Indonesia Stock Exchange (IDX), and environmental authorities in Indonesia.

The findings demonstrate that governance mechanisms significantly influence Carbon Emission Disclosure practices among companies.

Therefore, regulators may directly strengthen governance-related regulations by encouraging greater board involvement in environmental oversight and sustainability reporting activities. This may be implemented through policies requiring companies to establish sustainability committees, strengthen board responsibility regarding environmental reporting, and improve governance monitoring related to sustainability performance.

Furthermore, the insignificant effect of Independent Commissioners suggests that regulators should focus not only on structural requirements regarding board composition but also on improving governance quality and sustainability competencies. Policymakers may directly implement this through sustainability governance training initiatives, environmental education programs, and ESG competency development for commissioners and board members.

In addition, the positive role of Executive Compensation indicates that policymakers may encourage companies to adopt sustainability-based remuneration frameworks. Regulatory guidelines may integrate environmental performance indicators into executive evaluation systems to strengthen managerial commitment toward sustainability objectives. Stronger environmental disclosure standards and governance regulations may ultimately improve transparency, strengthen corporate accountability, and support Indonesia's long-term environmental sustainability goals.

5.3 Limitations

Although this study has been carefully designed and executed, several limitations should be acknowledged:

1. **Institutional Context Limitation:** This study focuses on companies operating within the Indonesian corporate governance system, which applies a two-tier board structure separating supervisory and managerial functions. Therefore, the findings reflect the characteristics of this governance framework and may produce different results in countries applying a one-tier board system.
2. **Methodological Scope:** The study employs a quantitative panel data approach using the Fixed Effect Model to examine the relationship between governance mechanisms and voluntary carbon emission disclosure. While this method provides strong statistical evidence, it does not capture qualitative aspects such as internal board dynamics, strategic discussions, or managerial motivations that may influence disclosure decisions.
3. **Disclosure Measurement Approach:** Voluntary carbon emission disclosure in this study is measured using an index-based content analysis derived from publicly available reports. Although this method enables systematic comparison across firms, it may not fully reflect the depth, quality, or strategic intention behind the disclosed information.
4. **Observation Period Constraint:** The analysis is limited to the selected research period. Changes in regulatory developments, sustainability standards, or corporate environmental awareness outside the observed timeframe are not captured in this study.

These limitations do not diminish the validity of the findings but provide boundaries for interpretation and open opportunities for further refinement in future research.

5.4 Recommendations

Based on the limitations described above, several recommendations for future research can be proposed:

1. **Comparative Governance System Studies:** Future research is encouraged to conduct comparative studies between countries applying two-tier and one-tier board systems. Such comparison may provide broader insight into how

different governance structures influence voluntary carbon emission disclosure and whether governance effectiveness varies across institutional contexts.

2. **Integration of Qualitative Approaches:** Further studies may combine quantitative analysis with qualitative methods, such as interviews, case studies, or in-depth corporate document analysis. This approach would provide deeper understanding of internal governance dynamics, managerial considerations, and strategic motivations behind environmental disclosure decisions.
3. **Development of More Comprehensive Disclosure Measurement:** Future researchers may refine the measurement of voluntary carbon emission disclosure by incorporating qualitative scoring criteria or weighting mechanisms that better capture the depth, credibility, and strategic orientation of disclosed information.
4. **Extension of Observation Period:** Subsequent research is recommended to extend the observation period and include more recent data. A longer timeframe may provide stronger evidence regarding the consistency and sustainability of governance effects on environmental transparency.

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