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Unveiling Carbon Disclosure: Strategy, Innovation, and Governance

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Abstract

Main Purpose - This study aims to investigate the effect of green innovation, green strategy, and firm governance structure on carbon emission disclosure in the renewable energy sector in Indonesia.

Method - This study uses a quantitative approach by secondary data from the annual reports of renewable energy companies listed on the IDX. The data was selected using purposive sampling and then processed using SPSS 30 to describe the characteristics of the data and assess the influence of the research variables.

Main Findings - The results indicate that firm governance structure does not significantly affect carbon emission disclosure, while green innovation and green strategy positively influence the level of disclosure.

Theory and Practical Implications - The study enhances carbon disclosure theory by demonstrating the role of green strategy and innovation in strengthening environmental transparency and supporting Indonesia's net-zero commitment. Practically, the findings highlight the need for companies to reinforce sustainability strategies and green initiatives to improve disclosure quality.

Novelty – This study contributes to carbon emission disclosure research by focusing on renewable energy companies listed on the Indonesia Stock Exchange during the post-pandemic and regulatory transition period of 2019-2024. This study analysis green innovation, green strategy, and firm governance structure using a CDP-based carbon emission disclosure index adapted to the Indonesian regulatory context, making it relevant for developing countries.

Keywords: Green Innovation, Green Strategy, Corporate Governance, Carbon Emission Disclosure, Renewable Energy

Abstrak

Tujuan Utama *- Penelitian ini bertujuan untuk menyelidiki pengaruh inovasi hijau, strategi hijau, dan struktur tata kelola perusahaan terhadap pengungkapan emisi karbon pada sektor energi terbarukan di Indonesia.*

Metode *- Penelitian ini menggunakan pendekatan kuantitatif dengan menggunakan data sekunder dari laporan tahunan perusahaan energi terbarukan yang terdaftar di BEI. Data ini dipilih melalui teknik purposive sampling dan kemudian diolah menggunakan SPSS 30 untuk menggambarkan karakteristik data dan menilai pegaruh variable penelitian.*

Temuan Utama *- Hasil menunjukkan bahwa struktur tata kelola perusahaan tidak secara signifikan mempengaruhi pengungkapan emisi karbon, sementara inovasi hijau dan strategi hijau secara positif mempengaruhi tingkat pengungkapan.*

Implikasi Teori dan Kebijakan *- Studi ini memperkaya teori pengungkapan karbon dengan menunjukkan peran strategi hijau dan inovasi dalam memperkuat transparansi lingkungan dan mendukung komitmen net-zero Indonesia. Secara praktis, temuan ini menyoroti kebutuhan perusahaan untuk memperkuat strategi keberlanjutan dan inisiatif hijau guna meningkatkan kualitas pengungkapan.*

Kebaruan Penelitian *– Penelitian ini memiliki kebaruan dengan berkontribusi pada penelitian pengungkapan emisi karbon dengan fokus pada perusahaan energi terbarukan yang terdaftar di Bursa Efek Indonesia selama periode pasca-pandemi dan transisi regulasi tahun 2019-2024. Penelitian ini mengalisis inovasi hijau, strategi hijau, dan struktur tata kelola perusahaan menggunakan indeks pengungkapan emisi karbon berbasis CDP yang disesuaikan dengan konteks regulasi Indonesia, sehingga relevan bagi negara-negara berkembang.*

Kata Kunci: *Inovasi Hijau, Strategi Hijau, Tata Kelola Perusahaan, Pengungkapan Emisi Karbon, Energi Terbarukan*

INTRODUCTION

Climate change represents a critical global challenge that threatens environmental stability and long-term economic sustainability through the continuous accumulation of greenhouse gas emissions in the atmosphere. Scientific evidence confirms that anthropogenic activities, particularly the combustion of fossil fuels, have contributed to approximately 90 percent of global warming over the last fifty years, indicating that corporate production and energy consumption patterns play a decisive role in climate deterioration (Nadeau et al., 2022). Increasing international pressure to mitigate climate risks has encouraged governments and corporations to adopt sustainability- oriented policies, including the Nationally Determined Contributions framework under the Paris Agreement, which mandates measurable emission reduction commitments by 2030 (Zhumadilova et al., 2023).

Carbon emission disclosure has emerged as an important corporate mechanism for communicating environmental responsibility and demonstrating accountability toward stakeholders through formal reporting practices. Disclosure of carbon-related information allows companies to signal transparency regarding environmental impacts while simultaneously aligning corporate strategies with national and global climate mitigation agendas (Tang & Demeritt, 2018). Indonesia has strengthened its institutional commitment to emission reduction through the ratification of the Kyoto Protocol in 2004 and the implementation of market-based mechanisms such as emissions trading, Joint Implementation, and the Clean Development Mechanisms, which collectively require greater corporate participation in climate governance (Naik et al., 2016). Despite these regulatory commitments, carbon emission disclosure in Indonesia remains largely voluntary, resulting in inconsistent reporting quality and limited comparability across firms.

Empirical evidence shows that the level of carbon emissions disclosure among companies listed on the Indonesia Stock Exchange is still low and uneven across sectors. Darmawan & Firmansyah (2025) reported an average disclosure rate of around 67 percent among mining companies during the 2020-2023 period, while Wahyuningrum et al. (2025) found that disclosure among non-financial companies only increased from 28 percent in 2019 to 36 percent in 2021, indicating partial and voluntary reporting, especially regarding Scope 3 emissions. In line with these findings, (Safutri et al., 2023) documented an average disclosure rate of only 24 percent among Indonesia listed companies, reflecting weak enforcement and high implementation costs. These statistics reveal a significant gap between regulatory expectations and actual corporate carbon disclosure practices.

Green innovation represents a strategic approach through which firms develop environmentally friendly products, processes, and technologies that reduce emission intensity and improve resource efficiency. Companies that invest in green innovation tend to generate measurable environmental outcomes that require disclosure to legitimize innovation effectiveness and justify sustainability-oriented investments to stakeholders (Albaker et al., 2023) Green strategy also complements this process by embedding environmental objectives into long-term corporate planning, operational decision-making, and risk management frameworks, thereby encouraging firms to consistently communicate emission reduction efforts as part of their corporate identity and legitimacy-building process (Yuliana & Wedari, 2023). Firm governance structure further influences disclosure practices by shaping managerial accountability, board oversight, and transparency mechanisms that regulate how environmental information is reported and monitored (Firmansyah & Damayanti, 2021).

Previous empirical studies have produced mixed findings regarding the determinants of carbon emission disclosure, particularly concerning the role of governance mechanisms. Research demonstrates that green innovation and green strategy generally exhibit a positive relationship with carbon disclosure due to their direct linkage with environmental performance and reputational incentives (Maharani & Dewi, 2024). Contrasting evidence suggests that governance structures do not always exert a significant influence on disclosure practices, especially when governance

implementation focuses primarily on financial objectives rather than sustainability oversight (Cai et al., 2023). These inconsistencies indicate the presence of unresolved empirical gaps regarding how strategic, innovative, and governance-related factors interact in shaping disclosure behavior.

The renewable energy sector in Indonesia during the 2019-2024 period presents a particularly relevant research context due to regulatory transformation and external shocks that altered corporate sustainability dynamics. The issuance of Presidential Regulation No. 112 of 2022 and Ministerial Regulation No. 2 of 2024 accelerated the national transition toward clean energy while simultaneously increasing expectations for corporate environmental accountability (Kementerian ESDM, 2022). The COVID-19 pandemic further disrupted investment patterns and operational priorities, creating both constraints and incentives for firms to adopt green innovation and enhance disclosure transparency. Limited empirical research has examined how these regulatory and economic changes affect carbon emission disclosure within renewable energy companies, despite the sector's strategic role in achieving national decarbonization targets.

This study addresses the existing research gap by examining the combined effect of green innovation, green strategy, and firm governance structure on carbon emission disclosure within Indonesia renewable energy companies during a period of regulatory transition and post-pandemic adjustment. Unlike prior studies that predominantly focus on high-polluting sectors or pre-regulatory contexts, this research provides sector-specific and period-sensitive empirical evidence that explains how strategic orientation, innovation capability, and governance mechanisms jointly influence disclosure practices. The findings are expected to contribute theoretically by clarifying the interaction between sustainability strategies and disclosure behaviour while offering practical insights for corporate leaders and policymakers seeking to strengthen environmental transparency and accelerate progress toward national emission reduction targets.

LITERATURE REVIEW

Theoretical Foundation

This study uses legitimacy theory and stakeholder theory as the theoretical foundation to explain corporate carbon emission disclosure. These two theories are considered adequate because carbon emission disclosure represents a corporate response to social expectations and stakeholder demands related to environmental responsibility. The use of two theories provides a focused and relevant framework without adding unnecessary theoretical complexity. Legitimacy theory explains that companies must align their activities with societal norms and values to maintain social acceptance and ensure business continuity. Organizations operate under an implicit social contract that requires responsible behaviour toward social and environmental issues, including climate change (Dowling & Pfeffer, 1975) When environmental issues become a public concern, companies face pressure to demonstrate accountability and compliance with societal expectations.

Carbon emission disclosure functions as a communication mechanism that allow firms to show commitment to environmental responsibility and sustainability practices (Martins et al., 2020). In the renewable energy sector, disclosure plays an important role in maintaining public trust because companies are expected to support low-carbon development. Stakeholder theory explains that companies are responsible not only to shareholders but also to other stakeholders such as investors, regulators, customers, and local communities whose support influences corporate sustainability (Glambosky et al., 2023) Stakeholders increasingly demand transparency regarding environmental impacts, particularly carbon emissions. Managers respond to these demands by disclosing carbon emission information to reduce information gaps, build trust, and maintain stakeholder support (Tang et al., 2022) Carbon emission disclosure therefore represents a strategic response to stakeholder expectations for transparency and sustainable business conduct.

Green Innovation

Green innovation was chosen because of its major role in improving the company's environmental performance while reducing negative impacts on the environment (Li et al., 2022).According to stakeholder theory, companies that implement green innovation tend to be more proactive in disclosing carbon emissions (Bai & Lyu, 2023).Renewable energy companies focus on green innovation because it can improve the efficiency of clean technologies such as solar panels, energy storage and biomass, which has a direct impact on reducing carbon emissions (Ben Belgacem et al., 2023). This innovation not only improve operational efficiency and reduce costs, but can also make a difference in a competitive market by attracting investors and consumers who are increasingly aware of environmental issues (Zhang et al., 2021). Companies that invest in green innovations have a stronger incentive to demonstrate their carbon disclosures as evidence of their contribution to sustainability amid regulatory pressures related to net-zero emissions targets.

In addition, green-based innovation enhances corporate credibility, improves competitiveness, and promotes positive assessment of Environmental, Social and Leadership (ESG) criteria, which are now a critical component of investment decisions around the world (Zhang & Chen, 2023).Studies show that green innovation has a significant positive effect on carbon emissions, and companies that implement green innovation tend to be more proactive in providing information about their carbon emissions (Albaker et al., 2023). This disclosure is very important because it shows how companies contribute to environmental sustainability.

Green Strategy

Green strategies are chosen because the company is committed to integrating environmental elements thoroughly into its business strategy (Begum et al., 2023). According to legitimacy theory, businesses that implement green strategies tend to more actively disclose their carbon emissions in an effort to gain social recognition and create a more environmentally friendly perception (Bauckloh et al., 2023).All operational processes, from supply chain to distribution, utilize this strategy. In addition, it is critical to spot and manage climate threats such as policy changes, resource shortages and extreme weather. Companies can prepare themselves for increasingly stringent environmental regulations such as Perpres No. 112 of 2022 and Permen ESDM No. 2 of 2024 by implementing green strategies. They can also meet stakeholder expectations about sustainable business practices.

In addition to strengthening social legitimacy, green strategies also offer competitive advantages through access to green financing, improved operational efficiency, and reduced costs. As a result, carbon emissions disclosure is a tangible indicator of green strategy implementation and a means to enhance corporate reputation in the eyes of investors, consumers and regulators. Studies show that companies that implement green strategies are more active in disclosing carbon emissions and have a significant positive impact on this disclosure (Tang et al., 2022).

Firm Governance Structure

Firm governance structures were chosen because they are critical to improving transparency and environmental accountability on issues such as carbon emissions disclosure (Wang et al., 2023). According to agency and legitimacy theories, effective governance-through an active sustainability committee, an active board of directors, and independent directors with environmental expertise-ensures that strategic decisions about renewable energy investments consider long-term opportunities and risks. In this complex and capital-intensive industry, strong governance serves to oversee the integration of sustainability aspects into all business processes, as well as respond to regulatory and social pressures, including compliance with ESG principles and global reporting standards (Ahmad et al., 2023). Good governance structures also strengthen investor and creditor confidence, improve the quality of carbon disclosures, and demonstrate corporate responsibility for sustainability (Wu & Jin, 2022). Although disclosure of carbon emissions indicates concern for the environment, not all companies are willing to provide this information. Therefore, the implementation

of good governance should encourage the disclosure of carbon emissions, as shown by research that found that firm governance can increase disclosure (Guo & Pan, 2022).

HYPOTHESES DEVELOPMENT

The Effect of Green Innovation on Carbon Emission Disclosure

Green innovation refers to the development of environmentally friendly products, processes, or technologies that aim to reduce negative environmental impacts and improve resource efficiency (Guinot et al., 2022).From the perspective of stakeholder theory, companies that invest in green innovation face increasing expectations from stakeholders to demonstrate the environmental outcomes of such investments. Stakeholders, including investors and customers, demand transparent information that reflects a firm's commitment to sustainability and environmental responsibility. Carbon emissions disclosure functions as a communication mechanism through which companies signal the effectiveness of green innovation initiatives and strengthen stakeholder trust (Hong et al., 2020).

Empirical studies support the argument that green innovation encourages higher levels of environmental information disclosure. Firms with stronger green innovation performance tend to disclose more carbon-related information to highlight their environmental achievements and enhance corporate reputation (Hu et al., 2023). These findings indicate that green innovation not only improves environmental performance but also increases incentives for firms to disclose carbon emission information as part of stakeholder-oriented transparency practices.

H1: Green innovation has a positive effect on carbon emission disclosure.

The Effect of Green Strategy on Carbon Emission Disclosure

Green strategy reflects a firm's long-term commitment to integrating environmental considerations into its business operations and strategic decision-making processes (Jirakraisiri et al., 2021).Legitimacy theory explains that companies seek to align their activities with societal norms and environmental expectations in order to maintain social acceptance. The adoption of a green strategy signals corporate commitment to environmental protection and climate change mitigation, which creates pressure to disclose relevant environmental information to the public.

Carbon emission disclosure serves as an important tool for companies to demonstrate conformity with social expectations and strengthen legitimacy. Previous empirical research shows that firms implementing strong green strategies tend to provide more comprehensive carbon emission disclosures as a way to communicate their environmental commitment and enhance transparency (Yuliana & Wedari, 2023).These findings suggest that green strategy increases disclosure incentives as part of legitimacy-seeking behaviour.

H2: Green strategy has a positive effect on carbon emission disclosure.

The Effect of Firm Governance Structure on Carbon Emission Disclosure

Firm governance structure refers to the organizational mechanisms that regulate managerial decision-making and promote transparency in corporate reporting practices, including environmental disclosure (Mousavi et al., 2022). From the perspectives of legitimacy theory and stakeholder theory, effective governance structures support transparency by ensuring that corporate disclosures respond to societal expectations and stakeholder demands for accountability. Governance mechanisms play a role in monitoring sustainability practices and encouraging the disclosure of environmental information that is relevant to stakeholders.

Previous studies indicate that firms with stronger governance structures tend to exhibit higher levels of environmental transparency, including carbon emission disclosure, as governance mechanisms facilitate oversight and improve disclosure quality (He et al., 2021; Li et al., 2021). These findings suggest that firm governance structure contributes to the disclosure of carbon emission information as part of broader efforts to maintain legitimacy and manage stakeholder relationships.

H3: Firm governance structure has positive effect on carbon emission disclosure.

RESEARCH METHOD

This study employs a quantitative research approach based on the positivist paradigm to examine the effect of green innovation, green strategy, and firm governance structure on carbon emission disclosure. The study uses secondary data in the form of panel data, which combine cross-sectional data from multiple firms and time-series data across several observation periods. Panel data are obtained from the annual reports of renewable energy sector companies listed on the Indonesia Stock Exchange (IDX) during the 2019–2024 period, collected from the official IDX website. The population of this study consists of all renewable energy companies listed on the IDX during the observation period. Based on IDX records, the total population includes seven companies operating consistently in the renewable energy sector. From this population, samples are selected using a purposive sampling technique to ensure data relevance and completeness.

The inclusion criteria applied in this study are as follows: (1) the company is classified as a renewable energy company and listed on the IDX during the 2019–2024 period; (2) the company publishes complete annual reports consecutively during the observation period; and (3) the annual reports disclose information related to carbon emissions or environmental performance. The application of these criteria results in 31 firm-year observations, which represent the final sample used for statistical analysis. The panel data structure in this study is processed using SPSS software, which is considered appropriate given the relatively small number of observations and the study's objective to test direct relationships between variables using multiple linear regression analysis.

SPSS is widely applied in accounting and management research for analysing panel datasets with limited observations, conducting descriptive analysis, classical assumption tests, and hypothesis testing without requiring complex econometric estimations. This study does not conduct a robustness test due to methodological considerations related to sample size and research scope. The limited number of firm-year observations restricts the application of alternative estimation techniques or model specifications commonly used in robustness testing. However, to ensure the reliability of the regression results, this study applies classical assumption tests, including tests for normality, multicollinearity, heteroscedasticity, and autocorrelation, which serve as internal validity checks for the regression model.

The use of 31 firm-year observations allows for analytical generalization rather than statistical generalization to all industrial sectors. The findings of this study are primarily generalizable to firms operating in the renewable energy sector or sectors with similar regulatory pressure, sustainability orientation, and disclosure characteristics. The logical basis for this generalization lies in the comparable institutional environment, stakeholder expectations, and regulatory frameworks faced by sustainability-oriented industries. Therefore, while the results cannot be generalized to all sectors indiscriminately, they provide relevant insights for industries with similar environmental accountability demands.

Table 1. Operational Definition of Variables

Variable	Definition	Measurement Indicator	Scale
Green Innovation	Corporate activities related to the development of environmentally friendly products, processes, or technologies aimed at reducing environmental impact	Disclosure of green product innovation and green process innovation based on annual reports	Index (0–1)

Green Strategy	Corporate strategic commitment to integrating environmental considerations into business operations and decision-making	Disclosure of environmental strategy indicators related to sustainability policies and emission reduction initiatives	Index (0–1)
Firm Governance Structure	Organizational mechanisms that regulate managerial oversight and transparency in corporate decision-making	Governance index based on compliance with corporate governance principles	Index (0–1)
Carbon Emission Disclosure	The extent to which companies disclose information related to carbon emissions and climate change	Carbon disclosure index based on CDP-related indicators	Index (0-1)

Green Innovation

Innovation in software and hardware related to environmentally friendly products or processes is called green innovation. This includes technologies focused on energy savings, pollution prevention, waste recycling, eco-friendly product design, and corporate environmental management (Zhang et al., 2020). Through the implementation of green innovation, it is expected to reduce pollution, enhance energy productivity, decrease waste, recycle, and also replace limited resources with sustainable resources. In this study, the measurement of green innovation is conducted using 2 main indicators consisting of 8 measurement items (Chen et al., 2006). Each indicator is rated with a score of 0 and 1, where a score of 0 is given if the company does not disclose one of the indicator items, and a score of 1 is given if the company discloses the indicator item. Furthermore, the scores of each indicator are summed to obtain a final result.

Green Strategy

A business approach that considers the environment and is committed to meeting the needs of stakeholders is part of a green strategy (Javeed et al., 2022). Additionally, the implementation of a green strategy has the potential to enhance company value as well as public trust in it (Tan et al., 2022). To reduce carbon emissions, this strategy includes operational management based on annual reports. This is especially applicable to sectors that produce carbon emissions, such as industry and energy. The green strategy of this research is measured using ten indicators categorized into three groups with binary scores (0/1) based on the completeness of disclosure. The results are then summed up for quantitative analysis (Olson, 2008).

Firm Governance Structure

The firm governance structure is a scheme that regulates the rights and responsibilities of management, the board of directors, and shareholders, as well as the strategic decision-making processes to ensure that they operate effectively and transparently in achieving the company's long-term goals (OECD, 2023). This research uses an index created based on the firm governance principles set by the OJK in circular letter number 32 of 2015, which consists of five main dimensions and 25 elements to measure the firm governance structure. Each element is scored 1 if it meets the criteria and 0 if it does not meet the criteria. Furthermore, the average of the elements is calculated to obtain an index value ranging from 0 to 1 (Firmansyah & Damayanti, 2021).

Carbon Emission Disclosure

Companies in Indonesia adhere to the Kyoto Protocol and use CDP indicators adopted through Presidential Regulation Number 71 of 2011 on National Greenhouse Gas Inventory and Law Number 17 of 2004 to disclose their carbon emissions (Yusuf, 2021). Climate change, greenhouse gas emission calculations, energy consumption, costs and greenhouse gas emission reductions, as well as carbon

accountability are five categories of CDP indicators. This study uses carbon emission disclosure as an independent variable with a content analysis method, which involves reading sample company annual reports to assess the level of carbon emission disclosure. Disclosure items are scored 1 if disclosed and 0 if not, with scores summed and compared with the maximum number of items (18), then multiplied by 100% to obtain the disclosure percentage (Bae Choi et al., 2013).

Methods of Data Analysis

This study employs a documentation method with a content analysis technique to measure carbon emission disclosure in company annual reports. Each disclosure item is assigned a score of 1 if the information is disclosed and 0 if it is not disclosed, after which the total score is calculated as a proportion of the maximum number of disclosure items. Data processing includes the selection of annual reports based on predefined criteria, variable measurement, coding, and tabulation using Microsoft Excel for data organization and SPSS version 30 for statistical analysis. SPSS is considered appropriate for this study because the research focuses on examining direct relationships between variables using multiple linear regression with a relatively limited number of panel observations. SPSS provides reliable procedures for descriptive statistical analysis, classical assumption testing, and hypothesis testing, which align with the analytical needs of this research.

The software is widely applied in accounting and management studies for handling quantitative data derived from content analysis and secondary sources, ensuring consistency, accuracy, and replicability of the results. Data analysis is conducted descriptively to summarize the characteristics of the data and inferentially to test the relationships between variables. Classical assumption tests, including normality, multicollinearity, heteroscedasticity, and autocorrelation tests, are performed to ensure the validity of the multiple linear regression model. Hypothesis testing involves the F-test to assess model feasibility, the t-test to examine the partial effects of independent variables on the dependent variable, and the coefficient of determination (R^2) to evaluate the explanatory power of the model. Multiple linear regression analysis is employed to test the research hypotheses.

$$CED = \alpha + \beta1\ GI + \beta2\ GS + \beta3\ FGS + e \quad \text{.....(1)}$$

Information:

CED	= Carbon Emission Disclosure
α	= Constant
β1 – β3	= Regression Coefficient
GI	= Green Innovation
GS	= Green Startegy
FGS	= Firm Governance Structure
e	= Error

RESULTS

The results of the data analysis show that the implementation of green innovation in companies is at a moderate to high level. The implementation of green strategies also appears to be evenly distributed among the companies studied. The firm governance structure shows a higher level of consistency and stability compared to other variables, reflecting fairly strong internal oversight. On the other hand, the level of carbon emissions disclosure shows differences between cases, although in general it is in the moderate category. These findings illustrate the characteristics of the data analysed in this study.

Table 2. Descriptive Statistics

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Green Innovation	31	.38	1.00	.7137	.20462
Green Strategy	31	.60	1.00	.8774	.09560
Firm Governance Structure	31	.88	1.00	.9316	.05184
Carbon Emission Disclosure	31	.11	.83	.4319	.18632
Valid N (listwise)	31				

Source: Data processed with SPSS 30, 2025

The results of the classical assumption test show that the regression model used meets all the requirements needed to proceed with further analysis. Examination of the residual pattern shows that the data has the appropriate characteristics and does not show any significant discrepancies. Evaluation of the relationship between independent variables shows no signs of excessive correlation, so that each variable can function independently in the model. In addition, the examination of residual variance consistency shows that the model does not face problems of irregularity in distribution of values. The test of the relationship between residuals also shows no tendency for repeated correlations that could interfere with the reliability of the model. Overall, the results of this classical assumption test confirm that the regression model used meets all the assumptions required for further analysis.

The results of the analysis show that green innovation, green strategy, and firm governance structure have conceptual relevance in explaining companies tendency to disclose carbon emission information. The research findings indicate that the implementation of green innovation and green strategy are important factors in encouraging companies to increase transparency regarding their environmental performance. Both of these reflect a company's attitude of caring about sustainability, which ultimately strengthens the company's commitment to communicating information about the impact of their activities on the environment.

Conversely, firm governance structures do not contribute significantly to the level of carbon emissions disclosure. This shows that formal governance mechanisms have not been sufficiently successful in encouraging companies to increase their environmental responsibility. Therefore, it can be concluded that strategic and innovative factors have a greater influence on carbon emissions disclosure practices that structural aspects of governance. The results of this study indicate that companies need to strengthen their commitment to sustainability through innovation and environmentally friendly strategies in order to improve the quality of environmental information provided to stakeholders.

Table 3. Hypothesis Test Result

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	-.616	.537		-1.146	.262
	Green Innovation	.457	.155	.502	2.943	.007
	Green Strategy	.764	.268	.392	2.849	.008
	Firm Governance Structure	.055	.574	.015	.096	.924
	N			31		
	Adjusted R^2			0.520		
	F-stat			11.838		
	F sig			<.001		

Source: Data processed with SPSS 30, 2025

DISCUSSION

The Effect of Green Innovation on Carbon Emission Disclosure

The results indicate that green innovation has a positive effect on carbon emission disclosure, which implies that firms developing environmentally oriented products or processes tend to provide more extensive carbon-related information in their reporting. This relationship suggests a practical mechanism in which innovation activities generate measurable environmental outputs and managerial incentives to communicate such outcomes in order to strengthen credibility in the eyes of external parties. Stakeholder theory supports this result because investors, customers, and other market actors increasingly evaluate firms based on visible sustainability performance, which motivates companies to disclose carbon information as a signal of responsible innovation and to reduce stakeholder uncertainty about environmental impacts (Hong et al., 2020). The finding also aligns with evidence that innovation supports firm adaptation to environmental policy pressures and encourages transparent reporting as part of strategic positioning (Colombelli et al., 2020).

This positive association is consistent with prior studies showing that firms with stronger green innovation tend to expand environmental information disclosure to strengthen legitimacy and stakeholder trust (Hu et al., 2023). Empirical work also shows that environmental-oriented innovation can enhance firm value and reputation, which increases incentives to communicate innovation outcomes through disclosure mechanisms (Bai & Lyu, 2023). The practical implication for companies is that green innovation should be managed not only as an operational improvement program but also as a measurable sustainability portfolio that can be communicated consistently in annual reporting through quantified emission indicators and innovation outcomes, because disclosure can reinforce stakeholder confidence and reduce skepticism regarding "symbolic" sustainability claims.

The theoretical implication indicates that the result supports stakeholder theory because disclosure functions as a response to stakeholder expectations for transparency regarding environmental impacts and innovation effectiveness. A company that invests in innovation but fails to disclose carbon information risks weakening stakeholder trust and reducing the perceived credibility of its green initiatives, particularly in sectors where sustainability claims represent an important strategic identity.

The Effect of Green Strategy on Carbon Emission Disclosure

The study finds that green strategy has a positive and significant effect on carbon emission disclosure, indicating that firms with stronger environmental strategic orientation tend to report carbon-related information more comprehensively. This result implies that strategic commitment drives systematic reporting behaviour because a green strategy requires formal planning, target setting, and monitoring mechanisms that naturally produce disclosure-ready information. Legitimacy theory supports this finding because companies operating under high societal expectations regarding environmental responsibility use disclosure to demonstrate alignment with social norms, regulatory direction, and public expectations related to climate action (Tang et al., 2022). The result indicates that carbon emission disclosure functions as a legitimacy-maintenance instrument that allows firms to demonstrate that environmental commitments are implemented through concrete actions and measurable outcomes.

This evidence aligns with prior research documenting that environmentally oriented strategies increase transparency and encourage broader carbon disclosure as part of a structured sustainability approach (Bazhair et al., 2022). Evidence from cross-country work also supports the argument that green strategy strengthens carbon emission disclosure as firms attempt to communicate strategic alignment with climate mitigation expectations and improve stakeholder confidence (Afni et al., 2018). The practical implication suggests that companies should translate green strategy into operational disclosure architecture by establishing internal emission data governance, setting clear disclosure boundaries for Scope-related reporting where feasible, and integrating carbon

information into performance measurement systems, because strategic statements without consistent disclosure can weaken legitimacy and trigger stakeholder doubt regarding implementation quality.

The theoretical implication indicates that the finding supports legitimacy theory because firms appear to use disclosure to demonstrate conformity with societal expectations and regulatory directions. The result also remains consistent with stakeholder theory because disclosure supports stakeholder evaluation of whether strategic commitments translate into credible environmental performance.

The Effect of Firm Governance Structure on Carbon Emission Disclosure

The results show that firm governance structure does not significantly influence carbon emission disclosure, which means that the presence or configuration of governance mechanisms does not automatically translate into higher disclosure levels in the sampled renewable energy firms during 2019–2024. This result suggests that governance arrangements may operate as formal compliance structures rather than as active drivers of sustainability transparency, particularly when environmental reporting is not treated as a core monitoring priority. From the combined lens of legitimacy and stakeholder theory, this finding indicates that governance mechanisms may fail to convert societal expectations and stakeholder demands into stronger disclosure practices when boards and committees prioritize short-term financial performance, operational continuity, or regulatory compliance that does not explicitly enforce carbon disclosure depth.

This non-significant result can be interpreted as consistent with evidence showing that some governance attributes do not necessarily increase carbon disclosure, particularly in contexts where governance effectiveness is symbolic or where sustainability oversight is not embedded in board agendas (De Villiers & Dimes, 2021). Evidence from Indonesian-listed firms also shows that governance-related factors such as board composition and foreign influence can matter in some settings, yet disclosure remains uneven across companies, indicating that governance effects can be contingent on specific board capabilities and incentives rather than structure alone (Wahyuningrum et al., 2025). Empirical findings also show mixed outcomes regarding audit committee and governance effects, with some studies finding no significant relationship between board/audit committee characteristics and carbon emission disclosure, which supports the possibility that governance mechanisms do not consistently translate into carbon transparency across settings (Ratmono et al., 2022).

At the same time, the result contradicts studies reporting positive governance effects, including evidence that audit committee expertise and activity can improve carbon disclosure quality in certain institutional contexts and findings that governance mechanisms can be associated with stronger carbon emission disclosure in Indonesian settings under specific conditions (Widagdo et al., 2022). These inconsistencies suggest that governance influence may depend on board competence in sustainability matters, the intensity of external scrutiny, and whether disclosure expectations are reinforced by investors and regulators. The practical implication indicates that firms should not treat governance as a structural checklist, because stronger disclosure requires functional governance practices such as sustainability-focused oversight mandates, board-level climate competence, and audit committee routines that explicitly review carbon data reliability and reporting completeness.

The theoretical implication indicates that the result does not fully support the expectation that governance structure automatically strengthens legitimacy- or stakeholder-driven transparency, because structural governance elements alone may be insufficient to operationalize societal and stakeholder pressure into meaningful carbon reporting outcomes. The finding suggests that legitimacy and stakeholder responsiveness can remain driven by strategy and innovation signals rather than by governance structure unless governance becomes substantively oriented toward sustainability oversight.

CONCLUSION

The main goal of this study is to find out what factors make companies disclose their carbon emissions. Specifically, we looked at green innovation, green strategy, and firm governance structure in renewable energy companies in Indonesia. Based on the results, we draw three main conclusions. First, green innovation has a positive effect on carbon emission disclosure. This means that when companies invest in new green technologies or products, they are more willing to report their carbon emissions. They do this to show stakeholders that their innovation is real and successful. This supports stakeholder theory, where companies try to satisfy the information needs of their stakeholders. Second, green strategy also has a positive effect on carbon emission disclosure. Companies with a clear plan to protect the environment tend to be more transparent. They use disclosure to prove that they are following social norms and regulations. T

his finding supports legitimacy theory, which states that companies report good news to get acceptance (legitimacy) from society. Third, firm governance structure does not have a strong effect on carbon emission disclosure. This suggests that having a board of directors or audit committee does not automatically make a company more open about its emissions. It is possible that the governance in these companies focuses more on financial profit than on environmental issues. This challenges agency theory in this specific context, showing that internal supervision alone may not be enough to drive environmental transparency.

SUGGESTION

Practical Suggestion

Based on the research findings, several practical recommendations are proposed for specific stakeholders. For renewable energy companies, green innovation and green strategy should be integrated into carbon emission disclosure through concrete managerial actions. Companies are advised to establish internal carbon data management systems that systematically record innovation outcomes, emission reduction activities, and energy efficiency improvements so that disclosure is based on measurable indicators rather than narrative statements. Firms should assign dedicated sustainability or ESG units responsible for collecting, verifying, and reporting carbon-related information in annual reports to ensure consistency and accuracy. This approach enables companies to transform green innovation and strategic commitments into transparent disclosure practices that strengthen stakeholder trust and corporate legitimacy.

For corporate boards and top management, the findings indicate the need to incorporate carbon disclosure as part of strategic performance evaluation rather than treating it as a compliance formality. Boards are encouraged to include carbon emission disclosure indicators in strategic review meetings, link disclosure quality with sustainability performance targets, and require periodic reporting on emission-related risks and mitigation outcomes. This recommendation is based on the study's result showing that governance structure alone does not automatically increase disclosure, which implies that governance must function substantively rather than structurally to improve transparency.

For policymakers and regulators, the study suggests strengthening carbon disclosure regulations by issuing more detailed disclosure guidelines for renewable energy companies, particularly regarding minimum disclosure items, reporting consistency, and verification mechanisms. Regulators may also consider introducing sector-specific disclosure benchmarks and incentives for firms that provide comprehensive and reliable carbon information. Such regulatory refinement can enhance comparability across firms and encourage companies to move beyond symbolic disclosure toward substantive environmental accountability.

Theoretical Suggestion

For future research, scholars are encouraged to extend the findings of this study by examining mediating or moderating variables that were not included due to data and methodological constraints. Variables such as environmental performance, external stakeholder pressure, or organizational sustainability culture are theoretically relevant because they may explain how and under what conditions green innovation and green strategy influence carbon emission disclosure. These variables were not tested in this study because of the limited availability of standardized data and the relatively small sample size, which restricts the statistical power required for mediation or moderation analysis.

Future studies may also employ qualitative approaches, such as in-depth interviews with sustainability managers or board members, to explore internal decision-making processes behind carbon disclosure practices. This approach can complement quantitative findings by providing contextual insights that cannot be captured through secondary data alone. In addition, researchers are encouraged to use larger samples or cross-sector comparative designs to improve statistical generalizability and examine whether the relationships identified in this study hold in sectors with different regulatory pressures and emission profiles.

This study does not claim to fully resolve the issue of carbon emission disclosure but contributes empirical evidence that clarifies the strategic and innovation-related drivers of disclosure within the renewable energy sector. The findings provide a foundation for subsequent research to refine theoretical models of carbon disclosure and to test more complex relationships under broader empirical settings.

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