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Good Corporate Governance's Role in Green Strategy, Innovation, and Carbon Disclosure

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ABSTRACT

This study examines the relationship between carbon emission disclosure and green strategy and green innovation, with Good Corporate Governance (GCG) as a moderating variable. Employing a quantitative approach, the research utilizes secondary data sourced from annual reports and sustainability reports. The population comprises consumer non-cyclical companies listed on the Indonesia Stock Exchange (IDX) during 2021–2023. a total of 44 companies were selected as samples over the three-year period. The findings reveal that both green strategy and green innovation significantly influence carbon emission disclosure, indicating that companies effectively implementing these practices tend to optimize their emission disclosures to enhance their reputation among stakeholders. Furthermore, the association between green strategy and carbon emission disclosure is not moderated by GCG, but it is strongly moderated by the relationship between green innovation and disclosure. This suggests that some consumer non-cyclical companies have yet to fully implement GCG, limiting the support for green strategies to maximize emission disclosure. Optimizing GCG implementation is therefore essential to reinforce both green strategy and green innovation, enabling companies to become more environmentally responsible and reduce operational carbon emissions, ultimately advancing corporate sustainability.

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SARI PATI

Penelitian ini dilakukan untuk menguji pengaruh Green Strategy dan Green Innovation terhadap Pengungkapan Emisi Karbon dengan Good corporate governance sebagai variabel moderasi. Penelitian ini merupakan penelitian kualitatif. Populasi penelitian ini adalah seluruh perusahaan di sektor consumer non-cyclical yang terdaftar di IDX pada tahun 2021-2023 sebanyak 44 sampel perusahaan selama 3 tahun. Hasil penelitian menunjukkan bahwa variabel independen yakni Green Strategy dan Green Innovation berpengaruh signifikan terhadap pengungkapan emisi karbon. Hal ini menunjukkan perusahaan yang berhasil mengimplementasikan green strategy dan green innovation cenderung mengoptimalkan pengungkapan emisi karbon agar memperoleh reputasi yang baik di mata stakeholders. GCG sebagai variabel moderasi mampu memoderasi hubungan Green Innovation terhadap pengungkapan karbon emisi. Namun GCG tidak mampu memoderasi hubungan Green Strategy terhadap pengungkapan karbon emisi. Beberapa perusahaan consumer non-cyclical terbukti belum secara optimal mengimplementasikan GCG sehingga dukungan terhadap green strategy belum mampu mengoptimalkan pengungkapan karbon emisi. Dengan optimalisasi GCG diharapkan mampu mendukung implementasi green strategy dan green innovation agar perusahaan mampu menjadi perusahaan ramah lingkungan dan mengurangi emisi karbon dari kegiatan operasional sehingga dapat mencapai keberlanjutan..

INTRODUCTION

Climate change has consequences that not only threaten the environment but also impact various ecological, socio-political, and socio-economic domains (Albaker et al., 2023). To address climate change issues, several countries signed the *Paris Agreement* in 2015. As a signatory of the Paris Agreement, Indonesia is committed to contributing to global efforts to limit temperature rise. The country has established its *Nationally Determined Contribution* (NDC), which includes an unconditional emissions reduction target of 29% and a conditional target of 41% relative to the projected emissions under the *business-as-usual* (BAU) scenario by 2030 (IMF, 2021).

To achieve these NDC targets, Indonesia mandates publicly listed companies to disclose their *Carbon Emission Disclosure* (CED) in their *Sustainability Reports*. This requirement arises from the rapid industrial growth in Indonesia, which has led to an increase in carbon emissions stemming from corporate operational activities. Companies are no longer solely focused on achieving high profitability; they are also expected to demonstrate environmental responsibility, evidenced through the disclosure of carbon emissions generated by their operations (Rahmanita, 2020). *Carbon Emission Disclosure*, or the reporting of carbon emissions, serves as an accounting-based approach to addressing environmental concerns and broader global issues.

Prior studies have shown that carbon emission disclosure can enhance a company's value(Han et al., 2023; Hardiyansah et al., 2021; Kurnia et al., 2021). These findings indicate that markets respond positively to carbon emission information disclosed by companies as part of their efforts to reduce carbon emissions. Companies are thus expected to take a proactive role in stabilizing climate change and controlling greenhouse gas (GHG) emissions(Andrian & Kevin, 2021).

In the field of accounting, the Indonesian Institute of Accountants (IAI) has established guidelines for corporate environmental disclosure. In December 2024, the *DSK IAI* approved the *Exposure Draft of Sustainability Disclosure Standards*, namely *DE PSPK 1* and *DE PSPK 2*. *DE PSPK 1* covers general provisions for disclosing sustainability-related financial information, including the conceptual framework, general requirements, as well as considerations of uncertainty and errors. Meanwhile, *DE PSPK 2* provides specific guidelines for climate-related disclosures (IAI, 2024).

The implementation of policies regarding sustainability- and climate-related financial disclosures has prompted companies to begin managing carbon emissions resulting from their operational activities. One of the approaches companies adopt to manage their carbon emissions is by formulating environmentally friendly business strategies, commonly referred to as *Green Strategy*. *Green Strategy* comprises a set of policies, actions, and programs designed to minimize adverse environmental impacts while promoting environmentally friendly business practices (Nuraini & Lastanti, 2024). This strategy includes plans that support global sustainable development, with an emphasis on efficient resource management and reducing the carbon footprint associated with corporate waste production (Yuliana & Wedari, 2023).

To further support environmentally friendly business practices, companies also develop various innovations aimed at reducing their carbon footprint and fostering green business models. The term *Green Innovation* has emerged to represent initiatives that create environmentally friendly businesses and enhance corporate value while generating positive impacts on both the environment and society (Sun et al., 2021). *Green Innovation* refers to the introduction of new or significantly improved products, processes, organizational

changes, or marketing solutions that reduce the consumption of natural resources, lower the release of harmful substances throughout the product life cycle, and improve working conditions for employees (Thomas et al., 2021).

The successful implementation of *green strategy* and *green innovation* requires a strong corporate commitment to environmental and social responsibility. Hence, the integrity of the corporate governance system plays a critical role in supporting these initiatives. Akhter et al. (2023) highlight that *Good Corporate Governance* (GCG) is crucial, as companies that effectively implement GCG principles tend to demonstrate greater accountability in reporting their environmental impacts. Strong corporate governance practices not only facilitate the adoption of green strategies and innovations but also enhance corporate reputation and public trust, thereby increasing the firm's overall value.

This study focuses on Carbon Emission Disclosure (CED) influenced by green strategy and green innovation, with Good Corporate Governance (GCG) serving as a moderating variable. This research differs from prior studies, which primarily explored the relationship between green strategy and green innovation and firm value (Han et al., 2023; Hardiyansah et al., 2021; Rahmanita, 2020; Tonay & Murwaningsari, 2022). Moreover, the use of GCG as a moderating variable remains relatively underexplored, making it an interesting avenue for further investigation to determine whether it can strengthen or weaken the relationship between *green strategy*, *green innovation*, and *carbon emission disclosure*.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Stakeholder Theory

Stakeholder Theory, introduced by Freeman (1984), emphasizes the critical concept that a company is viewed as a network of interactions among various stakeholders that shape its organizational structure. According to *Stakeholder Theory*, external stakeholder groups—such as governments, creditors, consumers, and the broader community—exert strong influence on companies through social pressures or public policies (Yuliana & Wedari, 2023). Information disclosure serves as a medium of communication between a company and its stakeholders, as corporate management possesses more comprehensive knowledge about business operations than external stakeholders (Kurnia et al., 2021). *Sustainability reporting* thus becomes an essential tool for presenting information regarding a company's economic, social, and environmental performance. It enhances transparency and informs stakeholders about the impacts generated by the company's activities.

Carbon Emission Disclosure

Carbon Emission Disclosure (CED) refers to the process by which companies report the amount of greenhouse gas emissions generated from their operations. Detailed disclosures include direct emissions, indirect emissions related to purchased energy, and other indirect emissions associated with the company's operations but originating from sources not owned or controlled by the company (Bolton & Kacperczyk, 2021). CED serves as a mechanism to account for environmental issues and other topics of global concern(Andrian & Kevin, 2021). Global climate change is driving greater transparency in emissions reporting, which in turn assists stakeholders—including investors and consumers—in making more sustainable decisions (Kurnia et al., 2021). This study measures CED using the disclosure index developed by the Carbon Disclosure Project (CDP). The CDP is a global non-profit organization that operates the world's only independent environmental disclosure system for companies, capital markets, cities, states, and regions to manage their environmental impacts (Bae Choi et al., 2013).

Green Strategy

Green strategy is defined as an action plan implemented by companies to manage resources sustainably (Yuliana & Wedari, 2023). The adoption of green strategy is grounded in the concept of the *green economy* as outlined by the United Nations Environment Programme (UNEP) in 2011, which envisions an economy that improves human well-being and social equity while significantly reducing environmental risks and ecological degradation. Green strategy represents an approach adopted by companies to integrate environmentally friendly practices into their operations and business strategies. It involves managing business operations to minimize carbon emissions, utilizing carbon emission disclosure reports presented within sustainability reports.

Green innovation

Green innovation has become an increasingly important concept within the context of sustainable development, as its primary objective is to reduce negative environmental impacts while enhancing corporate efficiency and competitiveness (Cahyaningtyas et al., 2022). According to Singh et al., (2022), *green innovation* encompasses both process and product innovations achieved through improvements in manufacturing processes and product design. The goals of green innovation are to reduce pollution, conserve energy, minimize waste, and mitigate the adverse environmental impacts of corporate activities.

Good Corporate Governance

The concept of Good Corporate Governance (GCG) refers to mechanisms for controlling operational activities effectively and in accordance with corporate procedures (Wisnu Mawardi, 2020). According to Cadbury (1992), GCG is a system by which companies are directed and controlled, with the board of directors responsible for its implementation. Shareholders play a role in appointing directors and auditors and ensuring that an appropriate governance structure is in place. The implementation and management of GCG emphasize the importance of shareholders' rights to obtain accurate, reliable, and timely information. Good corporate governance promotes better disclosure of corporate social responsibility, including carbon emission disclosure, which in turn can influence the company's value in the eyes of stakeholders (Blesia et al., 2023). Transparent and clear disclosure of carbon emissions is an integral part of corporate social responsibility and aligns with the principles of GCG. Through such efforts, companies not only contribute to sustainable growth but also actively participate in combating climate change.

Hypothesis Development

The Effect of Green Strategy on Carbon Emission Disclosure

Green strategy reflects a company's contribution to environmental sustainability efforts aimed at reducing carbon emissions, thereby supporting broader climate change mitigation initiatives (Yuliana & Wedari, 2023). Companies that are transparent about their carbon emissions and incorporate *green strategy* into their operations tend to foster greater public trust. This is consistent with *Stakeholder Theory*, which suggests that companies can gain stakeholder support by providing transparent information about corporate performance, including carbon emission disclosure (Ramadhani & Astuti, 2023).

Several studies have examined the role of *green strategy* in reducing carbon emissions and promoting environmental sustainability (Kurnia et al., 2021; Linda & Shanti, 2022; Ramadhani & Astuti, 2023; Yuliana & Wedari, 2023). However, some research indicates that *green strategy* does not significantly influence carbon emission disclosure (Nuraini & Lastanti, 2024), suggesting that further investigation is needed to understand its impact in

the Indonesian context. Based on this rationale, the following hypothesis is proposed:

H1: *Green strategy* influences *carbon emission disclosure*.

The Effect of Green Innovation on Carbon Emission Disclosure

Green innovation represents a form of innovation aimed at reducing the environmental impact of products and industrial processes (Albaker et al., 2023). Innovation is essential for the development of technologies that can mitigate the negative environmental consequences of economic growth. Implementing *green innovation* can drive industrial progress and transformation, thereby contributing to carbon emission reduction goals.

From a Stakeholder Theory perspective, the positive relationship between green innovation and carbon emission reduction can be explained by the importance of considering the diverse interests and demands of stakeholders. Through innovations aimed at lowering carbon emissions, companies can enhance their reputation and credibility. Moreover, green innovation supports the adoption of sustainable initiatives and technologies (Handoyo et al., 2024).

Studies conducted by Sun et al., (2021), Rahelliamelinda & Handoko (2024), and Ruan et al., (2024) demonstrate that the implementation of green innovation can lead to greater transparency in disclosing carbon emissions, thereby enhancing corporate credibility among stakeholders. However, research by Li et al., (2023) suggests that green innovation does not significantly impact carbon emission disclosure. Nonetheless, companies that invest in green innovation are generally more likely to provide comprehensive information related to carbon emissions. Based on this evidence, the following hypothesis is proposed:

H2: *Green innovation* influences *carbon emission disclosure*.

Good Corporate Governance as a Moderator of the Relationship between Green Strategy and Carbon Emission Disclosure

Good Corporate Governance (GCG) serves to maintain the relationship between decision-makers and those who oversee their actions (Blesia et al., 2023). Through the principles of GCG, companies are expected to openly disclose information regarding their carbon emissions, enabling stakeholders to better understand the environmental impact of corporate operations. This is consistent with *Stakeholder Theory*, which posits that all stakeholders have the right to access information about corporate activities that concern them (Firmansyah et al., 2021). To date, research that employs GCG as a moderating variable in the relationship between *green strategy* and *carbon emission disclosure* remains limited. However, a study conducted by Jaenudin et al., (2024) found that GCG does not significantly moderate this relationship. In the present study, GCG is expected to play a pivotal role in reducing carbon emissions and promoting transparency within the *sustainability report*. By adopting sound governance practices, companies are anticipated to be better positioned to develop and implement *green strategies* aimed at reducing carbon emissions and supporting long-term sustainability. Based on this rationale, the following hypothesis is proposed:

H3: *Good Corporate Governance* (GCG) moderates the relationship between *green strategy* and *carbon emission disclosure*.

Good Corporate Governance as a Moderator of the Relationship between Green Innovation and Carbon Emission Disclosure

According to the *Stakeholder Theory* framework, voluntary disclosure serves as a means to enhance and support effective and ethical ways of managing organizational issues in diverse environmental contexts. Companies with robust governance structures are better equipped to mitigate pressure from investors concerned about corporate activities by transparently disclosing their social responsibility efforts, including those related

to carbon emissions (Hapsari & Prasetyo, 2020). Effective corporate governance promotes transparency and encourages continuous innovation aimed at reducing carbon emissions.

Studies by Andrian & Kevin, (2021), Blesia et al., (2023), and Witri Astiti & Wirama, (2020) indicate that GCG can contribute to reducing carbon emissions and enhancing transparency within *sustainability reports*. While the role of GCG in moderating the relationship between *green innovation* and *carbon emission disclosure* has not been extensively explored, it is anticipated that strong governance practices can enhance a company's capacity to innovate in reducing carbon emissions from its operations. Such efforts support corporate reporting on carbon emissions as a form of transparency and accountability to stakeholders, reinforcing the company's commitment to sustainability. Based on this rationale, the following hypothesis is proposed:

H4: *Good Corporate Governance* (GCG) moderates the relationship between *green innovation* and *carbon emission disclosure*.

Conceptual Framework

Based on the hypotheses outlined, the conceptual framework applied in this study is illustrated in Figure 1.

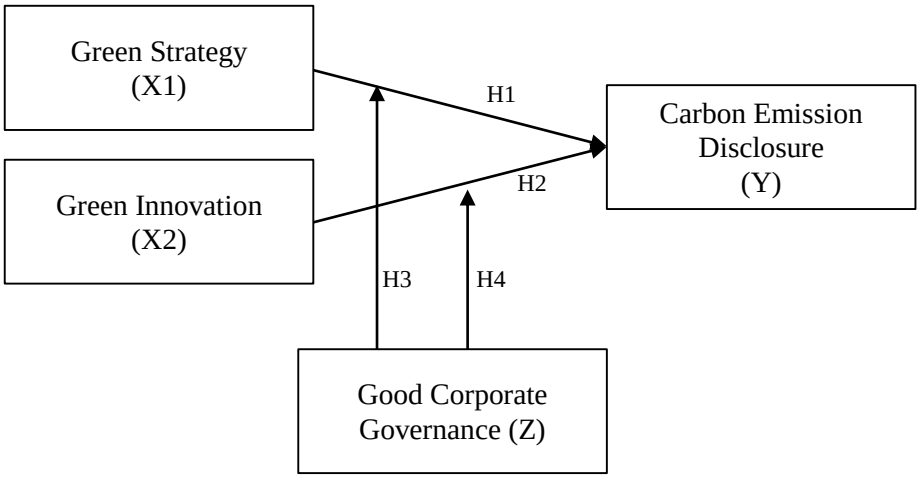

Figure 1. Conceptual Framework

Source: Author (2025)

RESEARCH METHODOLOGY

This study employs a quantitative research approach, utilizing secondary data sourced from *Annual Reports* and *Sustainability Reports* published by companies in the **Consumer Non-Cyclicals** sector listed on the **Indonesia Stock Exchange (IDX)** during the period 2021–2023. The sample was selected using a *purposive sampling* method based on predetermined criteria to ensure that the selected sample adequately represents the target population (Haryati et al., 2023). Out of a total population of **130 Consumer Non-Cyclicals companies** listed on the IDX between 2021 and 2023, a final sample of **44 companies** was selected and observed over a three-year period, yielding a total of **132 firm-year observations**. This study employs regression panel data and moderated regression analysis using **STATA** software as a statistical tool to analyze the relationships between the variables under investigation and to test the corresponding hypotheses. The operational definitions and measurement of each variable are presented in Table 1.

Tabel 1. Variables and Measurements

Variable	Measurement Indicator	Measurement Formula	Data Source
Carbon Emission Disclosure (Dependent Variable)	There are 18 disclosure items altogether throughout the index's five climate change and carbon emissions-related categories (Bae Choi et al., 2013).	CED = (∑di / M) × 100% where: CED = Carbon Emission Disclosure ∑di = Total score obtained by the company M = Maximum number of disclosure items (18 items)	Sustainability Report
Green Strategy (Independent Variable)	Indicators are based on the environmental indicators in the Global Reporting Initiative (GRI) standards: GRI 302, 303, 304, 306, and 307 (Nuraini & Lastanti, 2024).	IGS = (Number of disclosed items by the company / Total number of items) × 100%	Annual Report and Sustainability Report
Green Innovation (Independent Variable)	The Green Innovation indicator is divided into two components: green process innovation and green product innovation (Xie et al., 2019).	GI = (Total score of company items / Total possible item score) × 100%	Annual Report and Sustainability Report
Good Corporate Governance (Moderating Variable)	GCG is measured using an index consisting of five key dimensions of corporate governance based on the principles outlined in the Circular Letter of the Financial Services Authority No. 32/SEOJK.04/2015 (Firmansyah et al., 2021)	GCG = (Number of implemented GCG items / Total possible GCG items) × 100%	Annual Report

Source: Author (2025)

Panel Data Regression Model

This study employs a panel data regression model with the following regression equation:

$$CED = \alpha + \beta 1\, GS + \beta 2\, GI + \beta 1(GS * GCG) + \beta 2(GI * GCG) + e$$

Explanation:

CED = Carbon Emission Disclosure
α = Constant
β1, β2 = Regression coefficients
GS = Green Strategy
GI = Green Innovation
GCG = Good Corporate Governance
e = Error term

Data Analysis Procedure

The analysis begins with descriptive statistics to provide an overview of the characteristics of the secondary data set used in this study. Next, the selection of the most appropriate panel regression model is conducted through several statistical tests. The Chow test is performed to determine whether the Fixed Effects Model (FEM) is preferable over the Common Effects Model (CEM). The Hausman test is used to decide between the Fixed Effects Model and the Random Effects Model (REM). The Lagrange Multiplier (LM) test is conducted to choose between the Random Effects Model and the Common Effects Model. The decision on the most suitable panel data regression model is based on the p-value criteria obtained from these tests.

Once the appropriate regression model has been selected, classical assumption tests are conducted to validate the suitability of the data for panel regression analysis. These tests include Multicollinearity test, Heteroscedasticity test, Autocorrelation test. Following the validation stage, hypothesis testing is performed using the selected panel regression model. The coefficient of determination (R^2) test is used to assess the model's explanatory power regarding the variation in the dependent variable (CED). Additionally, the following significance tests are conducted such as F-test (simultaneous significance test) to examine whether all independent variables jointly influence the dependent variable and t-test (partial significance test) to evaluate the individual contribution of each independent variable to the dependent variable. All data analyses in this study are performed using STATA statistical software.

RESULT AND DISCUSSION

Descriptive Statistics

The descriptive statistical analysis conducted in this study aims to provide an overview of the maximum value, minimum value, mean, and standard deviation of the dependent and independent variables. Table 2 are the descriptive statistics results for the variables: Carbon Emission Disclosure, Green Strategy, Green Innovation, and Good Corporate Governance.

Tabel 2. Descriptive Statistics

Variabel	Obs	Mean	Std Deviasi	Min	Max
CED	132	0,6734007	0,179139	0,1111111	0,944444
GS	132	0,6511164	0,164956	0,2631579	1
GI	132	0,6174242	0,1308348	0,25	1
GCG	132	0,9175758	0,0897505	0,48	1

Source: Stata v.17 Output (2025)

The number of observations (Obs) in the table indicates the sample size used in this study, which is 132. The dependent variable, Carbon Emission Disclosure (CED), has a mean of 0.6734 and a standard deviation of 0.1791, indicating a moderate spread of the variable Y values. The minimum value of 0.1111 and maximum value of 0.9444 demonstrate a relatively wide range in the level of this dependent variable among the entities. The independent variable Green Strategy (GS) has a mean of 0.6511 with a standard deviation of 0.1650, showing moderate variability across observations. The minimum value of 0.2632 and maximum of 1.0000 reflect some uniformity in the implementation of Green Strategy among the companies.

Green Innovation (GI) shows a mean value of 0.6174 and a standard deviation of 0.1308, indicating relatively low variation among observations. This suggests that several companies

have demonstrated consistent efforts in implementing Green Innovation. The values of this independent variable range from 0.25 to 1.00, implying that most entities scored relatively high on Green Innovation. The variable Good Corporate Governance (GCG) exhibits a very high mean of 0.9176 with a standard deviation of 0.0898, indicating that most entities have GCG scores close to the maximum. The minimum value of 0.48 and maximum of 1.00 indicate that the values tend to cluster at a high level.

Model Fit Test

In this phase, tests are conducted to identify the most appropriate model for this study. The three model options considered are the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Panel data regression will be performed to determine the best-fitting model for this research. The regression results are in Table 3.

Table 3. Results of Panel Data Regression Model Fit Test

No	Test	Probability	Selected Model
1	*Chow test*	Prob > 0.05	CEM
		0.000 < 0.05	**FEM**
2	*Hausman test*	Prob > 0.05	REM
		0.000 < 0.05	**FEM**
3	*Lagrange Multiplier test*	Prob < 0.05	REM
		1.000 > 0.05	**CEM**

Source: Stata v.17 Output (2025)

Based on Table 3, the model selection process begins with the Chow Test, which aims to choose the most appropriate model between the Fixed Effect Model (FEM) and the Common Effect Model (CEM) in panel data analysis. The Chow Test results indicate a Prob > F value of 0.0000, which is less than 0.05. Therefore, the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted, suggesting that the Fixed Effect Model (FEM) is the preferred model according to the Chow Test.

Following the Chow Test, since the Fixed Effect Model was identified as appropriate, the next step is to conduct the Hausman Test to determine the best model between Fixed Effect and Random Effect. The Hausman Test compares the estimates of the Fixed Effect and Random Effect models. The test results show a Prob > Chi2 value of 0.000, which is less than 0.05. Thus, the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted, indicating that the Fixed Effect Model is preferred.

Next, the Lagrange Multiplier Test results show a Breusch-Pagan probability value of 1.0000, which is greater than 0.05. This suggests that the null hypothesis (H0) is accepted and the alternative hypothesis (H1) is rejected, indicating that the Common Effect Model is the best fit. However, since the Chow Test previously indicated that the Common Effect Model is not suitable, it can be concluded that the Fixed Effect Model (FEM) is the most appropriate model for this study.

Multicollinearity Test

According to Ghozali (2021, pp. 157), the multicollinearity test aims to assess the presence of relationships among independent variables in the regression model. Multicollinearity can be detected by examining the Tolerance value or the Variance Inflation Factor (VIF). If the Tolerance value is ≤

0.10 and the VIF is ≥ 10, it indicates the presence of multicollinearity. Conversely, if the Tolerance value is ≥ 0.10 and the VIF is ≤ 10, there is no indication of multicollinearity. The results of the multicollinearity test are in Table 5.

Tabel 5. Result of Multicollinearity Test

Variabel	VIF	1/VIF
GS	1,09	0,914468
GI	1,09	0,914793
GCG	1,01	0,994101
Mean VIF	1,06	

Source: Stata v.17 Output (2025)

Based on Table 5, the variable Green Strategy has a tolerance value of 0.914468 > 0.10 and a VIF value of 1.09 < 10. The variable Green Innovation has a tolerance value of 0.914793 > 0.10 and a VIF value of 1.09 < 10. The variable Good Corporate Governance has a tolerance value of 0.994101 and a VIF value of 1.01. These results indicate that all variables have tolerance values ≥ 0.10 and VIF values ≤ 10, thus it can be concluded that there is no multicollinearity problem in the regression model. Therefore, the regression model is structurally stable and suitable for further analysis without concerns of distortion caused by linear relationships among independent variables.

Heteroscedasticity Test

Ghozali (2021, pp. 178) states that the purpose of the heteroscedasticity test is to evaluate whether there is inconsistent variance in the residuals across observations within a regression model. If the residual variance remains stable from one observation to another, this condition is called homoscedasticity. Conversely, if the variance fluctuates, it is called heteroscedasticity. This study employs White's test, and the results are in Table 6.

Table 6. Results of Heteroscedasticity Test

White's Test	Sig
Prob > chi2	0,1224

Source: Stata v.17 Output (2025)

Based on Table 6, the White's test results show a probability value of 0.1224. Since this probability is greater than 0.05, it can be concluded that there is no indication of heteroscedasticity in the regression model. Thus, the model meets the assumption of homoscedasticity, meaning the error variance is constant and the regression model can be validly interpreted.

Autocorrelation Test

The autocorrelation test is used to assess whether there is correlation between the error terms at time t and the error terms at time t-1 in the regression model. This issue arises because residuals (errors) are not independent across observations, which often occurs in time series data. This study tests for autocorrelation using the Durbin-Watson test (Table 7), which compares the test statistic with the predetermined significance level (Gujarati, 2015, pp. 118-120).

Table 7. Results of Autocorrelation Test

Durbin-Watson	Sig
du	2,488062

Sumber: Stata v.17 output (2025)

Table 7 presents the results of the autocorrelation test using the Durbin–Watson test, with a value of 2.4. This value lies above the upper bound (du ≈ 1.75) and below 4 – du (≈ 2.25), indicating that there is no autocorrelation present in the regression model. Therefore, the model meets the assumption of residuals being free from autocorrelation.

Hypothesis Testing

Hypothesis testing was conducted using the Fixed Effect Model (FEM), which was selected based on the results of the Chow test, Hausman test, and Lagrange Multiplier test. The hypothesis testing consists of two stages: the first stage involves testing the panel data regression, followed by the second stage which tests the Moderated Regression Analysis (MRA).

a. **Panel Data Regression Testing**

The results of the panel data regression testing are in Table 8:

Table 8. Results of Panel Data Regression Testing

Variable	Regression Model			
	Fixed Effect Model			
	Coefficients	**Std. Err.**	**t**	**P>[t]**
Cons	-0,1689444	0,154184	-1,10	0,275
GS	0,4966208	0,0849817	5,84	0,000
GI	0,389553	0,101912	3,82	0,000
GCG	0,3034819	0,1430891	2,12	0,036

Source: Stata v.17 output (2025)

Based on the test results using the Fixed Effect Model, the regression equation is:

$$\boldsymbol{CED = -0,1689444 + 0,4966208\ GS + 0,389553\ GI + 0,3034819\ GCG + e}$$

From the regression equation above, it can be interpreted that the constant coefficient (α) of -0.1689444 means that if the independent variables Green Strategy (GS), Green Innovation (GI), and Good Corporate Governance (GCG) are all zero, the value of Carbon Emission Disclosure (CED) would be -0.1689444. However, since this constant is not statistically significant (p = 0.275), its contribution to the model is considered economically and statistically insignificant. The variable Green Strategy (X1) has a positive regression coefficient of 0.4966208, indicating that for each one-unit increase in GS, assuming other variables remain constant, CED will increase by 0.4966208. Therefore, GS has a positive relationship with CED. The coefficient for Green Innovation (X2) is positive at 0.389553, which means that every one-unit increase in GI, holding other variables constant, increases CED by 0.389553, indicating a positive relationship between GI and CED. The variable Good Corporate Governance (Z) has a positive

coefficient of 0.3034819, meaning that a one-unit increase in GCG, assuming other variables remain constant, increases CED by 0.3034819. Hence, GCG has a positive relationship with CED.

b. **Moderated Regression Analysis (MRA)**

The results of the regression test including the moderating variable are in Table 9.

Table 9. Results of Moderated Regression Analysis (MRA)

Variable	Moderated Regression Analysis Model			
	Fixed Effect Model			
	Coefficients	**Std. Err.**	**t**	**P>[t]**
Cons	1,171189	0,9132674	1,28	0,202
GS	-0,0900387	0,9253907	-0,10	0,923
GI	0,378132	0,1026729	3,68	0,000
GS*GCG	-0,3214927	0,9482886	-0,34	0,735
GI*GCG	0,5723003	0,2873663	1,99	0,049

Source: Stata v.17 output (2025)

Based on the MRA test, the regression equation is:

$$CED = 1{,}171189 - 0{,}0900387\ GS + 0{,}378132\ GI\ - 0{,}3214927\ \text{GS} * GCG + 0{,}5723003\ \text{GI} * \text{GCG} + e$$

From this regression equation, the constant coefficient (α) of 1.171189 means that if the independent variables Green Strategy, Green Innovation, and the moderating effect of Good Corporate Governance all equal zero, the predicted value of CED is 1.171189. However, this constant is not statistically significant (p = 0.275), so its contribution is not meaningful economically or statistically. Green Strategy (X1) has a negative regression coefficient of -0.0900387, indicating that an increase of one unit in GS, assuming other variables remain constant, leads to a decrease in CED by 0.0900387. Thus, GS has a negative relationship with CED in the presence of the moderator.

Green Innovation (X2) has a positive coefficient of 0.378132, meaning that an increase of one unit in GI, holding other variables constant, increases CED by 0.378132. This shows a positive relationship between GI and CED. The moderating variable Good Corporate Governance (Z) moderates the relationship between Green Strategy (GS) and CED, with a negative coefficient of -0.3214927. This means that for every one-unit increase in GCG, assuming other variables constant, the effect of GS on CED decreases by 0.3214927, indicating that GCG weakens the relationship between GS and CED. Conversely, GCG moderates the relationship between Green Innovation (GI) and CED with a positive coefficient of 0.5723003. This indicates that for every one-unit increase in GCG, the effect of GI on CED increases by 0.5723003, showing that GCG strengthens the relationship between GI and CED.

Coefficient of Determination Test

The R-Squared value consists of three main components: within, between, and overall. The within component

measures how well the model explains variation within each group for each variable, while the between component measures how well the model explains variation across groups for each variable. Table 10 are the results of the coefficient of determination test.

Table 10. Results of the Coefficient of Determination Test

	R-squared
Within	0,3598
Beetween	0,9947
Overall	0,3902

Source: Stata v.17 output (2025)

Table 10 shows the results of the moderated panel regression test (MRA). Based on the Table 10, the within R-squared value is 0.3598, indicating that 35.98% of the variation in Carbon Emission Disclosure (CED) over time within each individual can be explained by the independent variables and the moderation interaction in the model. The between R-squared value is 0.9947, which shows that 99.47% of the variation in CED over time between groups is explained by the independent variables and moderation interaction in the model. The overall R-squared value is 0.3902, meaning that 39.02% of the total variation in CED over time at both individual and group levels can be explained by the independent variables and moderation interaction in the model.

F- Statistic Test

The F-statistic test is used to evaluate the overall effect of the independent variables—Green Strategy and Green Innovation—on the dependent variable Carbon Emission Disclosure, including the moderating variable Good Corporate Governance, simultaneously. The results of the F-test are in Table 11.

Table 11. Results of the F-Statistic Test

Effect Tes	**Prob**
F	13,94
Prob > F	0,0000

Source: Stata v.17 output (2025)

The results indicate a Prob > F value of 0.0000, which is less than 0.05. This implies that Green Strategy and Green Innovation, along with the moderation by Good Corporate Governance, have a statistically significant joint effect on Carbon Emission Disclosure.

Partial t-Test

The t-statistic test is used to assess the individual effect of each independent variable on the dependent variable. An effect is considered significant if the p-value is less than 0.05. The results of the partial t-test are presented in Table 12:

Table 12. Results of the Partial t-Test

Variable	Regression Model				
	Fixed Effect Model				
	Coefficients	**Std. Err.**	**t**	**P>[t]**	**Result**
Cons	-0,1689444	0,154184	-1,10	0,275	
GS	0,4966208	0,0849817	5,84	0,000	Accepted
GI	0,389553	0,101912	3,82	0,000	Accepted

Source: Stata v.17 output (2025)

Table 13. Results of the Partial t-Test

Variable	Moderated Regression Analysis Model				
	Fixed Effect Model				
	Coefficients	**Std. Err.**	**t**	**P>[t]**	**Result**
Cons	1,171189	0,9132674	1,28	0,202	
GS*GCG	-0,3214927	0,9482886	-0,34	0,735	Rejected
GI*GCG	0,5723003	0,2873663	1,99	0,049	Accepted

Source: Stata v.17 output (2025)

Based on Tables 12 and 13, the conclusions are:

1. Green Strategy (GS) has a p-value of 0.000 and a t-statistic of 5.84. Since $p < 0.05$, hypothesis H1 is accepted, indicating that Green Strategy has a significant partial effect on Carbon Emission Disclosure.
2. Green Innovation (GI) has a p-value of 0.000 and a t-statistic of 3.82. Since $p < 0.05$, hypothesis H2 is accepted, indicating that Green Innovation significantly affects Carbon Emission Disclosure.
3. The interaction of Green Strategy moderated by Good Corporate Governance (GS*GCG) has a p-value of 0.735 and a t-statistic of -0.34. Since $p > 0.05$, hypothesis H3 is rejected, indicating that Good Corporate Governance does not significantly moderate the effect of Green Strategy on Carbon Emission Disclosure.
4. The interaction of Green Innovation moderated by Good Corporate Governance (GI*GCG) has a p-value of 0.049 and a t-statistic of 1.99. Since $p < 0.05$, hypothesis H4 is accepted, indicating that Good Corporate Governance significantly moderates the effect of Green Innovation on Carbon Emission Disclosure.

Discussion

The Effect of Green Strategy on Carbon Emission Disclosure

Based on the statistical test results, the Green Strategy variable has a significant effect on carbon emission disclosure, thus the first hypothesis (H1) is accepted. Green strategy is a strategic approach adopted by consumer non-cyclical companies to reduce carbon emissions as part of their sustainability commitment. Companies strive to improve energy efficiency, manage waste responsibly, and utilize natural resources more responsibly to optimize their carbon emission disclosures.

These findings are consistent with studies by Kurnia et al., (2021), Linda & Shanti, (2022), Ramadhani & Astuti (2023) and Yuliana & Wedari (2023) which show that green strategy positively influences carbon emission disclosure. According to stakeholder theory, companies implementing green

strategies tend to be more attentive to the interests of stakeholders, including the community and the environment. The consumer non-cyclical sector is particularly pressured to demonstrate environmental commitment as a form of accountability and transparency to sustain their existence in the industry.

Global awareness of climate change during the 2021-2023 observation period further motivates companies to actively reduce carbon emissions. For instance, PT Dharma Satya Nusantara Tbk has implemented various green initiatives such as using Bio-CNG as fuel for transportation trucks through converters, utilizing renewable energy via solar panels, and converting waste into energy. This indicates that sustainability investments not only focus on financial gains but also reflect corporate social and environmental responsibility.

The Effect of Green Innovation on Carbon Emission Disclosure

The statistical test results also show that Green Innovation significantly influences carbon emission disclosure in consumer non-cyclical companies. Firms that continuously innovate in waste management, energy reduction, and responsible resource utilization tend to disclose higher levels of carbon emissions. This demonstrates a firm commitment to sustainability implementation and recognition from stakeholders.

Aligned with stakeholder theory, companies adopting green innovation practices aim to meet stakeholder expectations and enhance their public reputation. This finding corroborates studies by Andrian & Kevin, (2021), Handoyo et al (2024), and Li et al., (2023), which reveal that green innovation can enhance corporate transparency and accountability in environmental impact reporting, including carbon emissions. For example, Unilever Indonesia Tbk has demonstrated its commitment to green innovation through managing plastic waste by innovating and redesigning product packaging to be more environmentally friendly. This effort is part of the company's commitment to carbon emission reduction and environmental sustainability.

The Moderating Role of Good Corporate Governance in the Relationship Between Green Strategy and Carbon Emission Disclosure

The results indicate that Good Corporate Governance (GCG) does not significantly moderate the relationship between green strategy and carbon emission disclosure in consumer non-cyclical companies. In other words, companies with good governance practices do not necessarily strengthen the impact of green strategy on carbon emission disclosure. This finding aligns with the study by Jaenudin et al., (2024), which suggests that while GCG is expected to reduce internal conflicts and support green strategy implementation, suboptimal application of GCG can limit this support. The average carbon emission disclosure in this sector varies, with some companies practicing good governance but not consistently disclosing carbon emissions transparently. Hence, a strong commitment across all organizational levels is essential to implement GCG optimally to support green strategies that enhance carbon emission disclosure.

The Moderating Role of Good Corporate Governance in the Relationship Between Green Innovation and Carbon Emission Disclosure

Conversely, the findings show that Good Corporate Governance (GCG) significantly moderates the relationship between green innovation and carbon emission disclosure. This suggests that companies with strong governance structures can better support management in innovating waste management, wisely utilizing natural resources, and building a reputation as environmentally friendly operations. Good corporate

governance is reflected in transparent reporting practices, including carbon emission disclosures, which enhance corporate reputation and public trust. Companies committed to optimal GCG implementation can reinforce green innovation efforts and maximize carbon emission disclosure as part of their sustainable development responsibilities.

CONCLUSION, IMPLICATIONS, AND SUGGESTION

This study aims to examine the influence of Green Strategy and Green Innovation on carbon emission disclosure, with Good Corporate Governance (GCG) as a moderating variable. The research focuses on consumer non-cyclical companies listed on the Indonesia Stock Exchange (IDX) during 2021–2023. The results indicate that both Green Strategy and Green Innovation significantly affect carbon emission disclosure. Companies that adopt strategic approaches to managing production waste, reducing energy consumption, and responsibly utilizing natural resources tend to optimize their carbon emission disclosures in sustainability reports. Similarly, companies that innovate to become environmentally friendly and sustainable also enhance their carbon emission disclosures. These efforts contribute positively to the company's reputation among the public, consistent with stakeholder theory, which states that companies committed to positive environmental practices receive stronger stakeholder support.

The study also finds that GCG does not moderate the relationship between Green Strategy and Carbon Emission Disclosure. This is attributed to the suboptimal implementation of GCG in many consumer non-cyclical companies, resulting in limited management support for green strategies and less effective carbon emission disclosure. In contrast, GCG plays a significant moderating role between Green Innovation and Carbon Emission Disclosure. This suggests that green innovation efforts receive better support under Strong corporate governance, thereby optimizing carbon emission disclosure.

This study is limited to consumer non-cyclical companies, so future research should extend to other business sectors. Additionally, carbon emission disclosure often involves subjective assessments influenced by internal company policies and management decisions, which may lead to variations in the detail and accuracy of the information disclosed. Future studies could expand independent variables beyond those used here and explore other measurement indicators to determine the most suitable ones for assessing similar variables.

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