

Green Innovation, Carbon Emission Disclosure, and Managerial Ownership: A Panel Data Analysis of Firm Value in Indonesia's Basic Materials Sector

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Abstract

Purpose – This research seeks to investigate the influence of green innovation, carbon emissions disclosure, and managerial ownership on the value of companies within the basic materials sector that are listed on the Indonesia Stock Exchange from 2019 to 2023.

Design/Methodology/Approach – This research employs purposive sampling, focusing on primary material companies that are listed in Indonesia as the key criterion. The final sample comprised 7 companies, with a duration of observation spanning 5 years, resulting in a total of 35 data points. This research employs a random effects model of panel data regression analysis to examine the relationship among the research variables.

Findings – The study results obtained from the random effects model indicate that green innovation and managerial ownership do not have a significant impact on the firm's value. On the other hand, revealing carbon emissions positively and significantly influences the firm's value. These findings emphasize the importance of environmental accountability, particularly



through transparent reporting of carbon emissions, as a vital approach to increase company value and foster investor confidence.

Research limitations/Implications – This study is limited to one industry sector only, so the results cannot be generalized to other industry sectors outside the sector. The use of purposive sampling tends to produce a homogeneous sample, which may cause selection bias and affect the external validity of the study.

Keywords: Carbon Emission Disclosure, Firm Value, Green Innovation, Managerial Ownership

Introduction

The fast advancement of the technological scene, especially during the time of Industry 4.0, has increased corporate mindfulness of natural sustainability. Expanding societal weight, administrative requests, and investor intrigue in Environmental, Social, and Governance execution have pushed companies to coordinate green practices into their business practices (Khan et al., 2020). In this setting, Green Innovation and Carbon Emission Disclosure have risen as basic components in upgrading firm value, especially as partners progressively favor naturally sustainable (Dewi & Rahmianingsih, 2020).

Numerous studies have explored the connection between eco-friendly innovation and firm value (Agustia et al., 2019), it was discovered that green innovation positively influences the value of a company (Downar et al., 2021), it was highlighted that carbon disclosure has a direct impact on the evaluation of financial performance. Essentially Yuliandhari et al. (2023) and Rahmanita (2020) uncovered that

carbon emanation revelation contributes significantly to firm value. On the other hand, ponders by Putri Fabiola & Khusnah (2022) and Roza Mulyadi & Maulana (2022) show uncertain or non-significant outcomes, particularly concerning the effect of green development and managerial ownerships on firm performance.

Indonesian context, in which regulatory demands on natural resources are relatively lax, and corporate governance frameworks differ among industries. Also, a few studies centers on the fundamental materials division, which is intrinsically high-impact in terms of environmental degradation and carbon yield. The restricted scope of past thinking about capturing the concurrent impacts of green development, carbon transparency, and possession structure calls for a more integrated investigation.

In light of this gap, the study will explore the effects of Green Innovation, Carbon Emission Disclosure, and Managerial Ownership on firm value in the basic materials sector listed on the

Indonesia Stock Exchange from 2019 to 2023.

In the era of the Industrial Revolution 4.0 and the increasing concern for environmental sustainability, companies are required not only to pursue profits but also to run sustainability-oriented businesses. Companies in the basic materials sector, which fall into the high-profile category due to their capital-intensive industrial activities and large impact on the environment, are in the public and stakeholder spotlight.

Events such as Indonesia's significant carbon emissions worldwide and instances of environmental pollution caused by corporations reveal a shortfall in the adherence to social and ecological responsibility guidelines by businesses. Thus, it is essential to understand how factors like green innovation, carbon emission reporting, and management ownership influence company value, an important measure for attracting investors and ensuring long-term sustainability. This study is important because firms' rising need to declare their environmental obligations helps them to earn social acceptance, the increasing sensitivity of capital markets to corporate sustainability practices, and the need for companies to manage internal ownership structures in line with long-term values and strategies. This research has several aspects of novelty that distinguish it from previous research, namely: The period of the study covers the unique conditions of the post-COVID-19 pandemic, which impacted corporate governance,

sustainability strategies, and market investment patterns and this study strengthens the signaling theory perspective, that environmental information (especially carbon emissions) has strategic value in building investor perceptions of the company.

Literature Review & Hypothesis

Signaling Theory by Connelly et al. (2011) proposes that organizations employ voluntary disclosures and deliberate actions to diminish information gaps and convey trustworthy signals to outside parties, particularly investors. Green innovation and transparent environmental reporting serve as positive signals indicating long-term value creation and risk management (Connelly et al., 2011).

Green innovation, carbon emission disclosure, and managerial ownership are forms of strategic signals that can influence market perceptions of the company. The company's value reflects how the market reacts to these signals, which is measured through market indicators such as stock price and market capitalization. Therefore, signaling theory serves as the conceptual framework for the connection between the variables in this study, elucidating how the information communicated by companies can affect the economic choices of investors and ultimately shape the market value of the company.

Legitimacy Theory Burlea & Popa (2013), posits that organizations seek societal approval

to ensure survival. Disclosing carbon emissions and adopting eco-friendly innovations are strategies to maintain legitimacy, especially in environmentally sensitive industries.

The aim of revealing greenhouse gas emissions is to generate additional benefits and guarantee the ongoing operation of the company. Legitimacy theory inspires businesses to freely reveal details on their social and environmental responsibilities. According to this hypothesis, companies show their social responsibility activities to obtain financial stability over time and to gain legitimacy from the communities they serve. There are social ties that connect companies with society. To gain legitimacy from society, companies must follow the norms and standards accepted by the group. One method to earn respect from society is to establish an environmentally friendly and sustainable atmosphere. Organizations that effectively achieve this will gain greater respect from the community.

Stakeholder Theory (Schaltegger et al., 2019) asserts that firms must address the expectations of all stakeholders, not just shareholders. This includes integrating sustainability into corporate governance and aligning managerial interests with stakeholder values to drive firm performance. Stakeholder theory is a concept that shows companies must serve all stakeholders-including shareholders, creditors, customers, suppliers, governmental agencies, society,

analysts, and others-and not just their own interests. All stakeholders are entitled to access information regarding company activities that may affect their decision-making, including details related to environmental responsibility (Halkos & Nomikos, 2021). Therefore, the presence of a company is significantly affected by the assistance received from its stakeholders. The company's approach to maintaining positive relationships with stakeholders involves consistently participating in socially responsible initiatives. One illustration of how the corporation is committed to environmental sustainability and the bigger community is the carbon emissions management strategy. By paying attention to carbon emissions, a company has implemented stakeholder theory.

Research Gap

Although previous research has examined the separate effects of green innovation, carbon disclosure, and ownership structure on firm value, limited research has investigated their simultaneous influence, particularly in high-impact sectors such as basic materials. Moreover, empirical studies in emerging markets like Indonesia remain sparse, despite the country's rising environmental challenges and regulatory developments (Xie et al., 2022). Using panel data from the Indonesia Stock Exchange, this study aims to close this gap by looking at how environmental and governance variables combined influence corporate value.

Framework

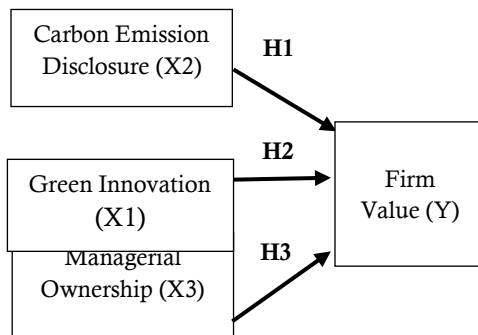


Figure 1
Research Framework

Hypothesis Development

Green Innovation and Firm Value

Environmental progress enhances operational efficiency and reduces long-term ecological risks. Previous studies suggest that companies involved in green innovation can enhance their brand image and attract environmentally conscious investors, potentially increasing the firm's value (Ramli et al., 2023). The company's reputation may reflect its future potential, but it also serves as a standard for investors when considering investments in the firm. Nonetheless, while performing their business activities, companies often face conflicts regarding environmental issues. Companies are not only obligated by stakeholders to generate the highest possible profit, but they must also pay attention to environmental concerns. Eco-friendly progress can be considered one of the strategies that companies may employ to compete effectively while enhancing their environmental performance to increase overall

company value. Alongside functioning as a means for achieving sustainable performance, green development can also act as a means for marketing activities that effectively contribute to a continuous increase in market share (Küçükoğlu & Pinar, 2015). Development can create value for both startup and existing businesses. (Zahra & Wright, 2016). Consequently, firms that integrate environmentally friendly innovations into their operations will improve their attractiveness to investors, which may cause a rise in the company's worth.

H1: Green Innovation has a significant effect on Firm Value.

Carbon Emission Disclosure and Firm Value

Transparent carbon reporting demonstrates environmental responsibility, reduces information gaps, and improves investor perception of the company. As noted by Downar et al. (2021), companies disclosing their carbon emissions enjoy greater valuations in capital markets. According to stakeholder theory, the increasing disclosure of carbon emissions reflects the company's transparency on environmental issues, hence sending good messages to stakeholders. This can enhance trust and favorable views of the company's environmental and social efforts, positively influencing the company's value. Therefore, the organization's endeavors to be more transparent regarding carbon emissions can significantly contribute to enhancing the company's value and reputation among stakeholders.

Enhancing the company's value will concurrently boost the prosperity of its stakeholders (Flammer, 2021). Investors in Indonesia are becoming more attracted to firms that show commitment to environmental responsibility, especially considering the potential effects of climate change (Xie et al., 2022).

H2: Carbon Emission Disclosure has a significant effect on Firm Value.

Managerial Ownership and Firm Value

Managerial ownership links the interests of shareholders and management, which may help lessen conflicts that arise between them (Jensen and Meckling, 1976). Nevertheless, practical evidence continues to be inconsistent. While some research (Waheed & Malik, 2019) points out a positive relationship, other studies argue that the effect is shaped by the particular context of the company and its governance structure. Managed companies uphold robust corporate values. The way investors view a company's quality and performance is called its corporate image. When assessed impartially, it can be stated that the company has achieved favorable outcomes, which influence its quality and worth. Management's ownership therefore affects the company's valuation. The results of prior research by Djanor & Erawati (2022) show that managerial ownership improves a company's

value. The portion of shares that directors own or control can influence the policies of the company. It can be determined that as managers have a larger ownership stake, they will engage more actively in addressing the needs of shareholders, which may enhance the value of the firm.

H3: Managerial Ownership has a significant effect on Firm Value.

Research Method

This research is quantitative and utilizes an associative approach, investigating the statistical means of causal relationship and the connections among variables. Literature research and documentation were employed to implement data-sifting techniques. The financial reports and sustainability reports of basic material companies from 2019-2023 are the focus of the research. These reports are available on the respective company websites at www.idx.co.id. Purposive sampling is a sampling method. Descriptive statistics, classical assumptions, panel data regression analysis, model adequacy evaluation, coefficient of determination, and hypothesis testing using t-tests are some of the data analysis methods that can be utilized with EViews 12 tools. The following criteria were used in the purposive sampling methodology for this study:

Table 1
Population and Sample

Description	Amount
Firms in the basic materials industry were traded on the Indonesia Stock Exchange (IDX) between 2019 and 2023.	103
Firms in the basic materials sector did not publish annual reports consistently from 2019 to 2023.	(4)
Firms within the basic materials industry did not publish sustainability reports between 2019 and 2023.	(85)
Firms in the basic materials industry do not have detailed information about research variables.	(7)
Quantity of company samples (i)	7
Timeframes for observation (t)	5
Concluding Remarks (i*t)	35

Source: EViews 12 Output (Processed by Researchers, 2025)

Firm value, as reflected in stock prices influenced by the balance of supply and demand from investors in the financial market, reflects how well a company is performing. Evident in how the public sees the value of the business, this assessment reflects the market's view of its success. Both investors' and the general public's views and ideas about a company's value may be influenced by the link between stock prices and a company's major value (Imawan & Triyonowati, 2021). This study uses the PBV ratio, which measures market price against Book Value (PBV), as the primary indicator for assessing the firm.

$$PBV = \frac{\text{price per share}}{\text{book value per share}}$$

The evaluation of green innovation in this research employs various metrics, which include the following (Agustia et al., 2019):

1. The manufacturing method incorporates modern technology to

minimize energy, water usage, and waste production.

2. The products utilize fewer materials that are non-polluting or harmful (eco-friendly materials).
3. Environmentally responsible packaging is used for products (such as paper and plastic).
4. The materials or components involved in the production can be recycled or refurbished.

Each of these metrics is assigned a value of 1 if the business or organization engages in practices that align with these metrics, and a value of 0 if it does not. The total score for all indicators is then used to divide the sum of the values obtained from each sample for the metrics.

$$GI = \frac{\text{number of green innovations disclosed}}{\text{total score of all indicators}}$$

Two methods exist to assess carbon emissions disclosure: by looking at the carbon emissions disclosure index included in the company's annual report or via a sustainability report, usually published independently. This

carbon emissions disclosure index consists of five categories totaling 18 items (Choi et al., 2021). To determine the Carbon Emission Disclosure score, the following steps are taken: 1) Assign a value to each disclosure item. 2) Each entry in the checklist is given a score of 1, meaning if the company includes all items in the provided information, the maximum score for the company's disclosure is 18.

$$CED = \frac{\text{sum of scores}}{\text{total maximum score}}$$

Managerial Ownership refers to the portion of common stock possessed by the organization's management, board members, and executives. The leaders of the company are well aware of its true situation, which motivates them as shareholders to perform more effectively, leveraging their status as both owners and managers. The level of managerial ownership is assessed by contrasting the shares owned by management with the total shares that are available. The computation for managerial ownership can be obtained using (Dewi & Sanica, 2017):

$$KM = \frac{\text{number of shares owned by the manager}}{\text{number of shares outstanding}}$$

Results and Discussion

Summary Statistics

Table 2 shows the summary statistics of the information. Standard deviation indicates the spread of data above the mean. A higher standard deviation suggests that the data points are more concentrated around the mean. Quality data is characterized by a low standard deviation and an indicative mean. This combination suggests that the data is fairly uniform, making the mean a reliable measure for the overall dataset.

Table 2
Descriptive Statistics

	Y	X1	X2	X3
Mean	1.238	0.916	0.734	0.776
Median	1.127	0.866	0.830	0.709
Max	2.830	1.000	0.940	1.105
Min	0.509	0.866	0.170	0.707
Std.Dev	0.510	0.066	0.245	0.137
Obs	35	35	35	35

Source: EViews 12 Output (Processed by Researchers, 2025)

Model Estimation of Panel Data Regression

The Chow Test, the Hausman Test, and the Lagrange Multiplier Test are employed to choose a panel data regression model. The model selection results are presented in Table 3.

Table 3
Model Estimation of Panel Data Regression Test

Model Testing	Model Option	Results	Conclusion Of The Right Model
Chow Test (prob cross-section F)	CEM vs FEM	0.0000	Fixed Effect Model (FEM)
Hausman Test (prob cross-section random)	FEM vs REM	0.1816	Random Effect Model (REM)
Lagrange Multiplier (prob breusch pagan both)	CEM vs REM	0.0000	Random Effect Model (REM)

Source: EViews 12 Output (Processed by Researchers, 2025)

The outcomes of the Chow test show that the cross-section F probability value is 0.0000 is lower than the significance level of 0.05, indicating that the fixed effects model is an appropriate choice compared to CEM and FEM. The findings from the Hausman test indicate a random cross-section probability of zero. Since 0.1816 it has been greater than 0.05, the random effects model serves as an effective estimation model between the fixed effects model and the random effects model. Additionally, the Lagrange Multiplier Test is performed, revealing that the

probability results of Breusch-Pagan are both 0.0000.

Classical Assumptions

In this research, the test for normality is not conducted as the assumption of normality is not essential for the Best Linear Unbiased Estimator. The results of the classical assumption tests indicate that the data does not exhibit autocorrelation, heteroscedasticity, or multicollinearity. This indicates that the model derived from the random effects methodology can serve as the foundation for testing hypotheses.

Table 4
Classical Assumption Test

Test	Result	Conclusion
Autocorrelation Test ($-2 < DW < 2$)	1.052	Free from autocorrelation problem
Multicollinearity test (correlation < 0.85)	0.206 0.474 0.055	There is no multicollinearity
Heteroskedasticity <i>Breusch-Pagan-Godfrey</i> Test(Prob. Chi-square > 0.05)	0.211	Free from heteroscedasticity problem

Source: EViews 12 Output (Processed by Researchers, 2025)

Panel Data Regression Analysis

The random effect model output is shown in Table 5. The regression model formed is:

$$Y = -0.099968 - 1.018839X1 + 2.033114X2 + 1.003770X3 + e$$

The equation model above can be explained that the constant value of -0.099968 means that without Green Innovation (X1), Carbon Emission Disclosure (X2), Managerial Ownership (X3), the Company Value (Y) variable will decrease by 0.099968.

The coefficient for the Green Innovation variable (X1) is -1.018839, meaning that if the value of other variables is considered constant and the Green Innovation variable

increases by 1 unit, the Company Value variable (Y) will decrease by 1.018839.

The coefficient value of the Carbon Emission Disclosure variable (X2) is 2.033114. If the value of other variables is constant and the Carbon emission Disclosure variable increases by 1 unit, the Company Value variable (Y) will increase by 2.033114.

The coefficient value of the Managerial Ownership variable (X3) is 1.003770. If the value of other variables is constant and the Managerial Ownership variable has increased by 1 unit, then the Company Value variable (Y) will increase by 1.003770.

Table 5
Random Effect Model

Variable	Coefficient	Prob.
C	-0.099968	0.9464
X1	-1.018839	0.3432
X2	2.033114	0.0009
X3	1.003770	0.5065

Source: EViews 12 Output
(Processed by Researchers, 2025)

Table 5 displays the outcomes of the research hypothesis assessment:

The likelihood of the green innovation (X1) is 0.3432 > 0.05, indicating that green innovation does not influence firm value, thus H1 is unsupported.

The likelihood of Carbon Emission Disclosure (X2) being 0.0009, which is less than 0.05, indicates that Carbon Emission Disclosure influences firm

value; therefore, H2 is accepted. P-value of Managerial Ownership (X3) is 0.5065 > 0.05, indicating that Managerial Ownership does not influence firm value, hence H3 is unsupported.

Goodness of Fit & Coefficient Determination

Table 6
Goodness of Fit test

Adjusted R-squared	0.2617
F-statistic	5.0178
Prob(F-statistic)	0.0059

Source: EVIEWS 12 Output
Processed By Researchers (2025)

Table 6 displays an Adjusted R-squared number of 0.26, or 26%. With the other 74% being influenced by other factors not covered in this research model, this suggests that the independent variable used in this study has a 26% influence on the dependent variable. The F-test output shows an F probability value of $0.0059 < 0.05$, meaning that the regression model used in this study is feasible as a predictive tool.

Discussion

The test findings indicate that Green Innovation does not have a notable impact on firm value (t-statistic value = -0.962662 , $p = 0.3432 > 0.05$). This indicates that businesses have not leveraged green innovation to draw in investors. The adoption of green innovation serves primarily as regulatory compliance and involves substantial expenses, limiting its capacity to deliver considerable added value to the business.

The findings indicated that Carbon Emission Disclosure has a notable positive impact on firm value (t-statistic = 3.654241 , $p = 0.0009$). The announcement of carbon emissions by businesses is viewed as a favorable indication by investors. It showcases the firm's openness and

commitment to environmental sustainability, thereby boosting investor trust and engagement.

The Managerial Ownership variable does not have a significant impact on firm value (t-statistic = 0.672124 , $p = 0.5065 > 0.05$). This indicates that managerial ownership of shares does not directly enhance the value of the firm. This might be because managers must still take into account the interests of other shareholders and cannot act independently.

Conclusion and Recommendation

Conclusion

The findings of this research show that green innovation does not significantly influence firm value. This indicates that companies in Indonesia's basic material sector view green innovation primarily to follow laws and regulations, rather than as a significant criterion for investor evaluation. In addition, the application of Green Innovation between companies still varies and requires different resources and competencies, so the impact on company value is not so significant. Implementing Green Innovation is also not an easy task, because it requires considerable costs to achieve it.

The findings of this research suggest that carbon emission disclosure significantly impacts firm value. carbon emission disclosure is a process carried out by companies to record, recognize, disclose, and measure the amount of carbon emissions produced. For companies

with a high industrial profile, one way to get a positive response and image from the market is to carry out carbon emission disclosure. By being transparent about environmental impacts, investors will view it as a favorable indication of the company's sustainability, prompting them to show greater interest in investing. carbon emission disclosure can also be an indicator that the company has fulfilled its environmental responsibilities. In addition, this disclosure can create added value and provide a competitive advantage for the company.

The results of this study indicate that managerial ownership does not influence firm value. The basic material sector companies in this study have a proportion of managerial ownership of only a small portion of the total shares, so the managers' incentives to act in line with the interests of shareholders are not strong enough to increase firm value. In a sufficiently efficient market, information about the ownership structure may have been anticipated by investors and reflected in the stock price. Therefore, changes on managerial ownership structures do not provide new signals that have a major impact on firm value. In companies within the basic materials sector that maintain effective information disclosure and oversight systems, the potential agency problem between owners and managers is reduced. Consequently, managerial ownership becomes a less significant determinant of the firm's value.

Recommendation

This research reinforces stakeholder theory, signaling theory, and legitimacy theory, particularly regarding the impact of environmental disclosure on firm value. The findings indicate that carbon emission disclosure significantly influences firm value, providing evidence that the market (investors) reacts favorably to environmental disclosure, thus highlighting the importance of environmental transparency in a company's market value.

For corporate management, the findings of this research highlight the significance of carbon emission reporting as a tactic to enhance company value, particularly in the basic materials industry, which is susceptible to environmental challenges.

This research offers investors an empirical foundation that environmental disclosure serves as a crucial sign in evaluating the company's future potential.

For regulators, these findings may serve as a factor to promote compulsory regulations concerning the disclosure of carbon emissions in a more uniform and clear way.

The research focuses solely on one industry sector, which restricts the applicability of the results since the traits of this sector differ from those in finance, technology, or real estate. Employing purposive sampling often results in a homogeneous and non-random sample, potentially causing selection bias and impacting the study's external validity.

Green innovation and carbon emission disclosure are evaluated

through the content of annual reports, relying on the existence of information (disclosure checklist). This approach overlooks the depth or quality of information, potentially rendering the measurement less responsive to significant differences among companies. The managerial ownership variable is determined solely by the percentage of shares held by management, thereby omitting elements of professional management, board composition, or leadership that might offer deeper insights into its impact on firm value.

Future studies can investigate how environmental performance, environmental management accounting, or good corporate governance serve as moderators or mediator variables in the relationship between green innovation and firm value. This is crucial as green innovation might not have a direct effect, but it enhances environmental performance.

The study could be extended to other sectors such as energy, manufacturing, or finance, to see if similar results occur outside the basic materials sector. Additionally, take into account cross-country comparisons when examining emerging and developed markets.

Future research could use the carbon disclosure project index as an alternative or complement to measure carbon emissions disclosure more objectively and globally.

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