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Carbon disclosure and SDGs performance: adoption of green innovation in Indonesia

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Abstract
This research aims to investigate the effect of Carbon Disclosure (CD) on SDGs Performance and explore the moderating role of Green innovation. The research data was taken from 220 public Mining and Energy companies in Indonesia during the 2017-2021 period. Data processing was carried out using the pooled least squares (PLS) model approach. The results of the study show that Carbon Disclosure (CD) and Green Innovation (GI) can significantly improve SDGs performance. The result of Green Innovation has been shown to significantly strengthen the positive effect of Carbon Disclosure (CD) on SDGs Performance.The implications of this research contribute to the literature related to signaling theory and RBV that the role of CD practices and GI play an important role in sustainability performance (SDGs). Then, companies must actively participate and continue to develop environmental care practices, incorporating issues into the formulation of company strategy through improving environmental performance such as implementing CD practices.
Keywords: Carbon Disclosure (CD), Green innovation, SDGs Performance, Competitive advantage, Indonesia

Abstrak
Penelitian ini bertujuan untuk mengetahui pengaruh Carbon Disclosure (CD) terhadap Kinerja SDGs dan mengeksplorasi peran moderasi dari green innovation. Data penelitian diambil dari 220 perusahaan publik Energi dan Pertambangan di Indonesia selama periode 2017-2021. Data penelitian ini diolah dengan menggunakan pendekatan model Pooled Least Square (PLS). Hasil penelitian menunjukkan bahwa Carbon Disclosure (CD) dan Green Innovation (GI) dapat meningkatkan kinerja SDGs secara signifikan. Kehadiran Green Innovation terbukti secara signifikan memperkuat pengaruh positif Carbon Disclosure (CD) terhadap Kinerja SDGs. Implikasi penelitian ini berkontribusi pada literatur terkait signaling theory dan RBV bahwa peran praktik CD dan GI memegang peranan penting dalam meningkatkan kinerja keberlanjutan (SDGs). Kemudian, perusahaan harus berpartisipasi aktif dan terus mengembangkan praktik peduli lingkungan, memasukkan isu-isu ke dalam perumusan strategi perusahaan melalui peningkatan kinerja lingkungan seperti penerapan praktik CD.
Kata Kunci: Carbon Disclosure (CD), Green innovation, Kinerja SDGs, Keunggulan Kompetitif, Indonesia

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INTRODUCTION

The world is currently in a climate emergency. This is the result of rapid population growth along with increasing economic development and creates serious problems and challenges for policy makers to overcome the problem of carbon emissions (Gills & Morgan, 2020). So, in this case the SDGs play a central role in producing clean and affordable energy to save the planet and take concrete action (Olabi *et al.*, 2022). In addition, companies are an important part of the overall impact of climate change at the national level by reducing carbon emissions from every operational activity (Haney, 2017). In fact, the low-carbon economy has become a trend in global economic development in the issue of corporate sustainability and has become a very important topic in the literature of academic and business world (Yuan & Pan, 2022).

Companies are required to disclose and provide explanations of carbon emissions produced in sustainability reports through Carbon Disclosure (CD). CD is a form of transparency and voluntary accountability by companies to demonstrate their low-carbon economic development to stakeholders and is the basis for the company's existence in realizing sustainable development (Akbar *et al.*, 2021). The benefits of CDs carried out by companies are to increase competitive advantage, improve investors' financial performance and avoid bad effects caused by information asymmetry (Han *et al.*, 2023). Therefore, the existence of CD practices can help internalize externalities to the national government in an effort to achieve SDGs goals, thereby contributing to the implementation of planned commitments to reduce carbon emissions.

Based on signaling theory, it explains that stakeholders use the information contained in sustainability reports in the form of CDs to make business decisions and the information presented by the company as a form of good performance in realizing sustainable development. Previous research related to CD on performance was mostly conducted in developed countries such as the United States, England, Canada, Germany and Australia, showing mixed results. Not limited to the context of developed countries, research on CD on sustainable development performance has begun to emerge in developing countries such as research Hardiyansah, Agustini, & Purnamawati (2021) in Indonesia and Ong *et al.* (2021) in Malaysia with results showing that CD is able to improve sustainable performance. Based on several studies using signaling theory, it was found that disclosure of company CD information is positively and significantly related to performance (Alsaifi, 2021; Datt, Luo, & Tang, 2019; Ong *et al.*, 2021). Meanwhile, based on legitimacy theory using logistic regression analysis, it is revealed that recognition of climate change as a net risk is negatively correlated with sustainability performance (Elijido-Ten, 2017; Liu *et al.*, 2017; Luo & Tang, 2020). Regarding the differences in research results, research regarding CD on sustainable development performance in companies is very interesting to study further.

Therefore, this research will try to re-examine the relationship between CD and performance, especially in the SDGs performance in the Indonesian context. Based on data obtained from Climate Watch Data (2020), Indonesia is the fifth largest carbon emitter in 2016 with a total carbon emission of 2,229 MtCO2e. Indonesia also takes part in overcoming issues related to climate change mitigation and adaptation, this is in accordance with the commitments in the Paris Agreement through Law no. 16 of 2016. Therefore, the issue of the negative impact of CD activities carried out by companies is important to research. The disclosure framework in Indonesia is still voluntary and in practice it is rarely carried out by business entities. The strategy that can be carried out must be in the most proactive way in order to achieve sustainable development so as to assist the implementation of the SDGs 2030 target pillars.

Based on the theory of resource based view (RBV) companies that are proactive in utilizing resources can create sustainable competitiveness towards the environment, this will increase the performance of sustainable development (SDGs). The resources provided by the company can be implemented through the application of Green Innovation (GI). GI is an environmentally friendly innovation in the form of green products, green processes, green services, and technology that minimizes greenhouse gases, waste, energy consumption, and maximizes efficiency and effectiveness in achieving corporate sustainability (Tang *et al.*, 2018). Currently, there is very little research on the GI. The importance of GI in companies needs to be considered and investigated further because it plays a role in achieving sustainable performance (Awan, Sroufe, & Kraslawski, 2019). Companies that adopt GIs can help build trust between stakeholders and be sustainable so that they contribute to the achievement of SDGs (Sanchez *et al.*, 2020; Wang & Juo, 2021). GI adoption and sustainable development performance will contribute to promoting cleaner energy and environmentally sustainable approaches to tackling climate change in the SDGs 2030 (Khan, Johl, & Johl, 2021). Then, research Zhang, Qin, & Liu (2020) found that effective and efficient company performance can be achieved by implementing GI. With the application of GI in disclosing CDs to be able to facilitate environmentally friendly innovation, and sustainable development goals can be achieved (Xie, Huo, & Zou 2019). Based on this, identification of GI in viewing CD practices and SDGs performance is important to find out that there are clearer environmental management practices and strategic management.

From the several explanations that have been mentioned, this research is useful for filling gaps in existing research. The gap that exists regarding CD on sustainable development performance is that this research is still carried out in developed countries (Saha *et al.*, 2021; Alsaifi *et al.*, 2021; Chen, Zhang, & Chen, 2021), there are still few who carry out research in developing countries, especially in Indonesia. Furthermore, regarding the role of GI, previous research mostly only focused on innovation in general as a fundamental strategy. So far, no research has been found that looks at the relationship between the GI variable and CD which is expected to have an influence on sustainable development performance. Apart from that, another reason is that studies discussing the relationship between GI, CD and sustainable development performance have never been carried out. Due to the importance of this study, it examines the relationships among these variables in more depth. With the GI adopted, companies can aim to limit resource consumption that impacts the environment, achieving sustainability (Baloch, Danish, & Qiu, 2022). In addition, Wang, Wang, & Chang (2022) found that the implementation of GI can reflect that the company is aware of environmental problems. Then several studies found that GI was positively related to sustainable development performance (SDGs) Carbon disclosure and SDGs Performance (Khan, Johl, & Johl, 2021; Ullah, Khan, & Ahmad, 2022).

Based on signaling theory, companies that disclose additional information about themselves will give their advantage over competitors. Carbon disclosure (CD) is one of the determining indicators for investors in assessing company disclosures regarding climate issues and their efforts to reduce the risks and opportunities for climate impacts that occur (Chen, Zhang, & Chen, 2021). Companies that carry out carbon disclosure activities will provide a signal to attract investors so that they can gain a competitive advantage for the company's sustainability. In addition, companies that increase their quality and scope in disclosing environmental activities can boost their commitment to sustainability performance (Alsaifi, 2021; Datt, Luo, & Tang, 2019). However, in view of legitimacy, it explains that it is in the interests of companies to disclose only because they

want to maximize profits rather than protect the environment so that compliance may be symbolic rather than substantive (Elijido-Ten, 2017; Liu *et al.*, 2017).

However, if companies carry out carbon disclosures effectively with the aim of increasing awareness and implementing climate-friendly practices and assessing carbon disclosures as part of their excellence management strategy, they will provide a good evaluation of financial markets (Chen, Zhang, & Chen, 2021). Thus, companies with better environmental performance have incentives to differentiate themselves from competitors which can potentially help companies improve their sustainability performance (Kraus *et al.*, 2020). This is in line with research Qian & Schaltegger (2017) which found that carbon disclosure by companies has a positive effect on changes in performance. Of course, this disclosure makes companies more competitive in the business environment in the face of institutional pressure and can mitigate climate change (Olabi *et al.*, 2022). By making disclosures in this way, the company will gain support from investors who will assist the company in improving sustainable development performance. Therefore, the following hypothesis is proposed:

H$_{1a}$: Carbon disclosure has a positive effect on SDGs performance

Based on the RBV theory, Green innovation (GI) is a resource in the form of innovation consisting of new or modified processes, practices, systems and products that are beneficial to the environment and contribute to environmental sustainability (Lee & Min, 2018). Currently, GI is increasingly emphasized by policy makers and academics in solving environmental problems because it can increase corporate sustainability (Arfi, Hikkerova, & Sahut, 2018). GI can positively affect the performance of companies that are sensitive to the environment (Baloch, Danish, & Qiu, 2022; Wang, Wang, & Chang, 2022; Zhang, Qin, & Liu, 2020).

Moreover, Organizations around the world are adopting GI as an environmental strategy that helps accelerate environmental performance and achieve competitive advantage (Rodriguez *et al.*, 2018; Pakurar *et al.*, 2020). With the adoption of GI it has an influence on the company's economic success and an increase in environmental performance (Abbas & Sagsan, 2019; Asadi *et al.*, 2020). Thus, the adoption of GI can realize sustainable development performance (Meirun *et al.*, 2021). Therefore, the presence of GIs becomes part of important decisions to achieve corporate sustainability. Based on this, GI can be used as a strategy that is proactive, effective and regular in its implementation because it will help companies to achieve sustainable performance. Therefore, the following hypothesis is proposed:

H$_{1b}$: GI has a positive effect on SDGs performance

GI is an important aspect of a company's sustainable performance, and plays a central role in realizing the pillars of sustainable development. Based on the Resource Based View (RBV) theory, GI is part of a company's strategy in achieving sustainable competitive advantage in responding to environmental problems (Siddique *et al.*, 2021). Environmental management strategies and operational practices to handle the company's many stakeholders can lead to increased carbon disclosure in obtaining financial performance and trust, thereby leading to performance in disclosing carbon disclosure (Li *et al.*, 2018). This is in line with research from Wang & Juo (2021) which found that companies that adopt green innovation can reduce carbon emissions and reduce environmental damage. Signaling theory also explains that companies that implement environmental practices such as GI can not only minimize the negative impact of the

business environment, but can increase energy efficiency and carbon reduction (Tao *et al.*, 2021; Umar *et al.*, 2022).

Green innovation practices can bring business models to a higher level of environmental sustainability to promote environmental protection and sustainable development (Song & Yu, 2018). In addition, carbon disclosure activities can signal a company's commitment to protecting the environment and are strategic to improving environmental performance (Zhang, Rong, & Ji, 2019). When the GI is high, Carbon disclosure activities help the company get a favorable view of the stakeholders (Tao *et al.*, 2021). Based on this, companies with a high level of innovation can flexibly adapt to ever-changing markets and maintain stable market competitiveness, so that company performance continues to be improved. GIs can optimize productivity, and generate new market opportunities through continuous product innovation. Therefore, it is necessary to understand the mechanism that links carbon disclosure with SDGs performance. There is the presence of GI which is a reinforcement and an important way for companies to fulfill carbon disclosure and improve sustainable development performance. With various developments in companies, carbon disclosure activities require companies to provide high quality products, services and technology and produce more environmentally friendly products through the application of GI (Li *et al.*, 2018). Therefore, the following hypothesis is proposed:

H_2. The company's Green Innovation strengthens the positive impact of Carbon Disclosure and SDGs Performance

METHOD

This type of research uses quantitative methods and is analyzed descriptively (Sugiyono, 2015). The population of this study was taken based on data from the Indonesian Stock Exchange by taking Indonesian Energy and Mining public companies during the 2017-2021 period. Energy and mining companies were chosen as research objects because these companies have a big impact on the environment which gives rise to negative sentiment from the activities they carry out. Another thing is that energy and mining companies are also major contributors to environmental problems such as climate change, waste, resource depletion,nature, water and air pollution. The mining industry is the largest contributor to emissions carbon in developing countries, including Indonesia (Nasih *et al.*, 2019; Anshari & Isnalita, 2020). A total of 44 companies were obtained from this database and adjustments were then made according to purposive sampling criteria. The total number of samples used in this research for energy and mining companies was 220 observations using a balanced panel approach. The data used in this research is secondary data. Data on carbon disclosure, green innovation and SDGs performance are obtained from text data in the sustainability reporting and annual reports. Data related to control variables were obtained from the Thomson Reuters Eikon database.

Research Model

The regression model in this research is used to see the effects of companies providing signals in the form of company information to companies (Signalling), utilizing resources (Resource Based View), through carbon disclosure from companies related to activities carried out, Green innovation, and sustainable development performance. This research will relate these variables which are formulated as follows:

Model 1 The Effect of Carbon Disclosure and Green Innovation on SDGs Performance

$$SDGs_{i,t}=\alpha+\beta1\ CD_{i,t}+\beta2\ GI_{i,t}+\beta3\ size_{i,t}+\beta4\ leverage_{i,t}+\beta5\ ROA_{i,t}+\beta6AGE_{i,t}+\varepsilon_{i,t} \quad \text{.....(1)}$$

Model 2 The Moderating Effect of Green Innovation on Carbon Disclosure and SDGs Performance

$$SDGs_{i,t}=\alpha+\beta1\ GI^{*}CD_{i,t}+\beta2\ size_{i,t}+\beta3\ leverage_{i,t}+\beta4\ ROA_{i,t}+\beta5AGE_{i,t}+\varepsilon_{i,t} \quad \text{.....(2)}$$

Information:
SDGs = Performance SDGs
CD = Carbon Disclosure
GI = Green innovation
Size = Company Size
Lev = Leverage
ROA = Return On Assets
AGE = Company Age

Table 1. Operationalization and Measurement of Research Variables

Variable	Operationalization	Data source
Dependent Variable		
SDGs Performance	Content analysis by giving a score of 1 if the company discloses the SDGs goals and 0 if it does not	Thomson Reuters (Xie, Huo, & Zou, 2019)
Independent Variable		
Carbon Disclosure (CD)	Content analysis by giving a score to each disclosure item (Carbon Emissin Disclosure Checklist) with a dichotomous scale. The maximum score is 18, while the minimum score is 0. Each item is worth 1 so that if the company fully discloses the items in its report, the company's score is 18	Annual Report and Sustainability Reporting (Qian & Schaltegger, 2017).
Moderating variable		
Green innovation (GI)	Content analysis by giving a value of 1 if the component is disclosed and 0 if it is not disclosed. Then divide the number of items disclosed from a maximum of 9 evaluation items from the ASSET4 database	Annual Report and Sustainability Report (Khan, Johl, & Johl, 2021)
Control Variable		
Size	Natural logarithm of the company's total assets	Data Streams (Xie, Huo, & Zou, 2019)
Leverage	Total debt divided by total assets	Data Streams (Siddique *et al.*, 2021)
ROA *(Return On Asset)*	Total net profit divided by total assets	Data Streams Datt, Luo, & Tang (2019)
AGE	Ln (Age of Company) is established	Company Website (Siddique *et al.*, 2021; Saha *et al.*, 2021)

Data analysis method

This research uses regression analysis which first carries out descriptive statistical tests and then carries out classical assumptions consisting of normality tests, multicollinearity tests and heteroscedasticity tests to test the quality of the data. And after that, hypothesis testing was carried out using the data analysis method using the common effects model (Pooled Least Square (PLS)). The analysis in this study was carried out using the STATA statistical program package. The alpha values or significant levels set are 1%, 5% and 10%.

RESULT AND DISCUSSION

The population of this study was taken based on data from the Indonesia Stock Exchange by taking Indonesian Public Mining and Energy companies during the 2017-2021 period. A total of 44 companies were obtained from the database and then adjustments were made according to the criteria specified in Chapter 3. The total sample used in this study for energy and mining companies was 220 observations using a balanced panel approach.

Descriptive statistics

Descriptive statistics are data presented in simple form. Meanwhile, analysis of descriptive statistics will present an overall picture of the variables in the form of number of observations, average value, standard deviation, minimum value and maximum value so that the existing data can be more easily understood and can provide a deeper understanding of the existing data. Descriptive statistics are depicted in Table 2.

Table 2. Descriptive Statistics

Variable	N	Mean	Std.Deviation	Min	Max
CD	220	0,456	0,132	0,17	0,75
GI	220	0,619	0,128	0,3	0,9
SDGs	220	8,323	1,637	7,56	12,51
SIZE	220	10,275	1,277	9,65	13,46
Leverage (LEV)	220	0,448	0,554	0,01	2,5
ROA	220	0,122	0,325	-0,58	1,3
AGE	220	3,205	0,744	0,69	4,88

Information :
CD as the number of items disclosed in the company's carbon divided by the total number of items = 12 (maximum score) in year t, GI as the number disclosed in the GI indicator evaluated from ASSET4 to determine the level of green innovation intensity Number of items = 10 (maximum score) in year t, SDGs performance: Number of SDGs Disclosures made by the company, SIZE: Natural Logarithm of Total Assets in year t, LEV: Ratio of Total Debt divided by Total Assets in year t, ROA: Ratio of net profit divided by total assets in year t, AGE: logarithm age of the company since its founding.

In this research, we can see the descriptive statistical results of SDGs performance which have an average value of 8.323 with a minimum value of 7.56 and a maximum value of 12.51 and a standard deviation of 1.637. In a period of 5 years, disclosure of responsible activities in Carbon disclosure (CD) has an average value of 0.456, which means that 45.6% of responsible disclosure in carbon has been achieved, the minimum value is 0.17 and the maximum value is 0.75 and the standard deviation of 0.132. Then GI is an environmentally friendly technique and process through the disclosure of indicators from ASSET4 and the annual report which has an average value of 0.619,

which means 61.9% of the disclosure indicators have been achieved, the minimum value is 0.3 and the maximum value is 0.9 and a standard deviation of 0.128.

Control variables are used in this research to define conditions rather than samples, the aim is that the model to be tested tends to be better at predicting the relationship between the independent variable and the dependent variable (Siddique *et al.*, 2021). This research also uses several control variables in the form of Size, Leverage, ROA, AGE, Size (company size) with measurement of the natural logarithm of the company's total assets. From table 2 it can be seen that the average total assets of the company is 10.275. Then leverage in the form of the company's debt ratio in the current year. In the table, the average leverage value is 0.448, which means that the company is financed by debt whose value is 44.8 percent of total assets. Next is Return on Assets (ROA), with the results in the table of the average value of the company's profitability level being 12.2 percent, which means that the sample company has the ability to generate profits from each asset it owns on average of 12.2%. Standard deviation of 0.325. Then AGE which is the natural logarithm of the age from when the company was founded. AGE has an average of 3.205, a standard deviation of 0.744, a minimum value of 0.69.

Table 3. Regression Test Results (Hypothesis 1a and 1b)

Research Model

$$SDGsit = \beta 0 + \beta 1CDit + \beta 2GIit + \beta 3SIZEit + \beta 4LEVit + \beta 5ROAit + \beta 6AGEit + eit$$

Variable	Expected	Coefficient	Probability
CD	+	1.249567	0.043**
GI	+	1.972361	0.012**
Size	+	0.0162934	0.651
Lev	+	0.0821376	0.553
ROA	+	1.3329861	0.000 ***
AGE	+	-0.0897452	0.574
Constant		6.29378	0.000 ***
N		220	
Adj.R^2		0.1965(19.65%)	
Prob > F		0.0000	

Information :

CD as the number of items disclosed in the company's carbon divided by the total number of items = 12 (maximum score) in year t, GI as the number disclosed in the GI indicator evaluated from ASSET4 to determine the level of green innovation intensity Number of items = 10 (maximum score) in year t, SDGs performance: Number of SDGs Disclosures made by the company, SIZE: Natural Logarithm of Total Assets in year t, LEV: Ratio of Total Debt divided by Total Assets in year t, ROA: Ratio of net profit divided by total assets in year t, AGE: logarithm age of the company since its founding.

*** significant at level α = 1% (0.01)

** significant at level α = 5% (0.05)

* significant at level α = 10% (0.1)

Result and Discussion

The Effect of Carbon Disclosure and Green Innovation on SDGs Performance

Based on table 2, it can be seen that the CD variable has a significant positive effect on company value with a regression coefficient of 1.249567 with a p-stat value of 0.043 (below 10%). This means that companies that have high disclosure of CD activities will improve sustainable development (SDGs) performance. Based on this analysis, hypothesis 1a in this study was supported. GI has a positive and significant effect on sustainable development performance (SDGs) with a regression coefficient of 1.972361

with a p-stat value of 0.012 (below 5%). This means that companies that have high levels of innovation disclosure in the form of GI will improve sustainable development performance. Based on this analysis, hypothesis 1b in this study was supported.

Carbon Disclosure and SDGs Performance

The results of this research contrary to research conducted by Anshari & Isnalita (2020) which shows that companies do not disclose information materially enough to easily see the amount of consumption and emissions produced by the company. But, the results of this study are in line with research Alsaifi (2021) and Datt, Luo, & Tang (2019) that companies that improve their quality and scope in disclosing environmental activities can encourage their commitment to sustainability performance. CD is interpreted positively as providing a signal to attract investors so they can gain a competitive advantage for the sustainability of the company. The decision is related to their superiority management strategy so that it will have a good impact on financial markets (Chen, Zhang, & Chen, 2021). This will create added value for the company so that investors provide more value in accordance with the potential economic, social and environmental benefits in the future. From this research we can also see that Energy and Mining companies in Indonesia are concerned and serious about implementing CD activities that are well managed by them in practice and making CD a form of competitive advantage in the market (Qian & Schaltegger, 2017). In the end, CD is used as a form of strategy that leads to operational efficiency. Of course, this disclosure makes companies more competitive in the business environment in the face of institutional pressure and can mitigate climate change (Olabi *et al.*, 2022).

Green Innovation and SDGs Performance

The results of this study are in line with research conducted Baloch, Danish, & Qiu (2022), Wang, Wang, & Chang (2022), and Zhang, Qin, & Liu (2020) that the implementation of GI by companies can improve performance continuously. Another thing is because the GI applied by the company aims to increase productivity which can effectively improve significant performance. This research is in accordance with the RBV theory which states that companies have deemed it necessary to apply one of the resources in the form of innovation consisting of modified processes, techniques, systems and products that are beneficial to the environment in increasing the value of competitive advantage in the market (Xie, Huo, & Zou, 2019). Then the intense consumer attention to the company's environmental behavior became an impetus for top management to integrate GI into the company's business strategy (Rodriguez *et al.*, 2018; Pakurar *et al.*, 2020). This will strengthen the company's position in line with customer expectations and demands for environmentally friendly products to achieve sustainable development. Therefore, the existence of GI creates hope on their part that the company will develop sustainable business strategies and improve performance (Abbas & Sagsan, 2019; Asadi *et al.*, 2020).

Table 4. Regression Test Results (Hypothesis 2)

Research Model

$$SDGsit = \beta 0 + \beta 1GI^{*}CDit + \beta 2SIZEit + \beta 3LEVit + \beta 4ROAit + \beta 5AGEit + eit$$

Variable	Expected	Coefficient	Probability
GI*CD	+	1.126964	0.037**
Size	+	0.0478121	0.512
Lev	+	0.0652177	0.433
ROA	+	1.0262113	0.000 ***
AGE	+	-0.0637149	0.219
Constant		3.27416	0.000 ***

N	220
Adj.R^2	0.2219(22.19%)
Prob > F	0.0000

Information :
CD as the number of items disclosed in the company's carbon divided by the total number of items = 12 (maximum score) in year t, GI as the number disclosed in the GI indicator evaluated from ASSET4 to determine the level of green innovation intensity Number of items = 10 (maximum score) in year t, SDGs performance: Number of SDGs Disclosures made by the company, SIZE: Natural Logarithm of Total Assets in year t, LEV: Ratio of Total Debt divided by Total Assets in year t, ROA: Ratio of net profit divided by total assets in year t, AGE: logarithm age of the company since its founding.
***significant at level α = 1% (0.01)
**significant at level α = 5% (0.05)
*significant at level α = 10% (0.1)

Results and Discussion The Moderation Effect of Green Innovation on Carbon Disclosure and SDGs Performance

In testing hypothesis 2, the role of the GI moderating variable on the effect of CD on SDGs performance. The results of the data analysis show that companies that have a high GI can strengthen the relationship between CD and SDGs performance. This can be seen in the GICD variable which has a positive coefficient of 1.126964 with a p-stat value of 0.037 (below 5%). This means that the existence of GI as a moderator is able to strengthen a significant relationship with CD on SDGs performance. Based on this analysis, hypothesis 2 in this study is supported.

The Moderation Effect of Green Innovation on Carbon Disclosure and SDGs Performance

The research results show that GI is used as a special tool to achieve sustainable development and strengthen the link between CD practices and SDGs performance. These results are explained by the fact that the intensity in the form of innovation is a key factor determining the company's strategy because it has a better effect on its market share (Ullah, Khan, & Ahmad, 2022). The results of this study are in line with research Li *et al.* (2018) which states that in a dynamic and changing environment, the presence of innovation is highly related to company competitiveness so that GI is considered more broadly as one of the most important sources of sustainable competitive advantage in the environment (Siddique *et al.*, 2021). Supports the theory of Resource Based View (RBV) view and is in accordance with previous research by Song & Yu (2018) which shows that market resource intensity in the form of committed GI implementation can amplify the impact of a company's sustainability performance and promote environmental protection. In particular, stronger GI intensity may influence the effect of CD on SDGs performance. A possible explanation is that a company's implementation of GI can result in better levels of profitability. In fact, this suggests that the efforts of higher GIs coupled with committed market resources do create the impression that a company's GI efforts are well received by the market. Therefore, the presence of GI can be a reinforcement and an important way for companies to fulfill CD in improving Sustainability performance (Wang & Juo, 2021) with various developments, CD activities also require providing tools in the form of high quality environmentally friendly products and services through the application of GI. The implications of this research are that companies should improve GI practices because it can bring business models to a higher level of environmental sustainability to promote environmental protection and sustainable development. Apart from that, the government must also strengthen regulations regarding green resource-

based innovation for companies by offering incentives and rewards so that the implementation of GI in each company can be carried out effectively.

Control Variable

The control variable in this study, SIZE shows positive and insignificant results, which indicates that the bigger a company is, it does not affect SDGs performance. Likewise, the leverage control variable also shows that the results have a positive and insignificant effect. This indicates that there is an assumption that high debt within the company will provide a positive level of information in achieving sustainable development performance. Then, the ROA control variable shows significant positive results which indicate that the higher the profitability of a company, the higher SDGs performance. Company age (AGE) in this study was found to be negatively and insignificantly related to SDGs performance.

CONCLUSION

Research findings prove that Energy and Mining Company CD in Indonesian countries make a significant contribution to SDGs performance. The same results were also shown by GI to have a significant positive effect on SDGs performance. The results of subsequent research show that GI can play a role in moderating the relationship between CD and SDGs performance, where the presence of GIs strengthens the positive influence of CD on SDGs performance. As an investment that can become a competitive advantage. However, more is needed to understand this. This research provides implications for contributions to add to the literature review related to signaling theory and RBV that the role of CD and GI practices plays an important role in sustainability performance (SDGs). In addition, the government in Indonesia must strengthen enforcement of regulations regarding companies' obligations to carry out environmentally based activities by offering incentives and rewards, so that they can carry out programs effectively. Companies must actively participate and continue to develop green practices, incorporate environmental issues into the formulation of corporate strategy through improving environmental performance such as implementing CD practices, implementing GI in protecting the environment to build an environmentally based image and corporate reputation, in achieving promotion of financial performance and competitive advantage. Companies must be aware of the important role of GI for CD in creating a proactive strategy as a competitive advantage for the company, bearing in mind that the application of GI in Energy and Mining companies in Indonesia is significant in improving SDGs performance.

This research found several limitations that might be useful and useful for future research, including that this research only uses secondary data where the level of company disclosure is not necessarily the same (identical) as existing practices within the company. Future research can use more primary data (eg interviews, questionnaires, observations). This research has not included corporate governance issues. Further research could include corporate governance issues, because previous literature has stated the importance of corporate governance in the context of assessing company value. In this research, the number of observations analyzed is still relatively limited, namely from Energy and Mining companies listed on the stock exchange in Indonesia. Further research should expand the scope of industry as an observation sample. In this research, the use of keywords for the search process and performance scoring process for CD, GI practices may contain an element of subjectivity in the assessment. Future research may require a double check to carefully identify the item in question. The measurement of

each variable in previous research, namely CD and GI, is still not conclusive. Further research can be carried out using other alternative measurements.

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