

UDC 332

## RELEVANCE OF VOLUNTARY CARBON DISCLOSURE AND GREEN INNOVATION: THE IMPACT OF RATIFYING PRESIDENTIAL REGULATIONS IN INDONESIA

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### ABSTRACT

The ratification of presidential regulation No. 98 of 2021 is an important step for Indonesia in achieving its NDC (Nationally Determined Contribution) target. This study aims to explore how the impact of these regulations on the relationship between carbon disclosure and green innovation in Indonesian companies. Environmental disclosure, especially carbon disclosure in Indonesia, is still voluntary. The level of adequate disclosure and the ability of companies to mitigate carbon emissions are still controversial. Voluntary environmental disclosure has a greenwashing risk and can mislead stakeholders in making decisions. This study uses the DID method to analyze this phenomenon. The data sample is 510 (company-year). The results of this study found that Indonesian companies have the motivation to mitigate carbon emissions, but there are still limited regulations. This research supports the need for more adequate regulations on carbon emission mitigation and regulations for the protection of stakeholders.

### KEY WORDS

Green innovation, carbon emissions, sustainability, environmental accounting, government policy.

Global warming caused by carbon emissions is an environmental problem that is currently still being faced by the world community and has a major impact on people's quality of life. It is known that during the period 2010 to 2021, global carbon emissions grew by an average of 1.3% annually, had experienced an extreme decline in 2020 due to the Covid-19 pandemic and rose again to reach 36.3 gigatons in 2021 (United Nations Environment Programme, 2021).

To overcome the problem of carbon emissions, various countries that are members of world organizations work together to evaluate and find the best solution. One of them is a group of countries that are members of the G20 (Group of 20). From December 2021 to November 2022, Indonesia will become the G20 presidency, which means Indonesia will play the role of host for the G20 meeting with the theme "recover together, recover stronger". With this theme, Indonesia invites the whole world to work together to achieve a strong and sustainable recovery in all aspects of life, one of which is social and environmental aspects.

Indonesia is one of the largest carbon emitting countries in the world. Indonesia seeks to mitigate carbon emissions by signing the Paris Agreement in 2016 and setting NDC (Nationally Determined Contribution) targets. In 2021, Indonesia passed Presidential Regulation No. 98 regarding the application of carbon economic values to achieve national contribution targets and control of carbon emissions in national development. Indonesia is one of the drivers of market-based carbon emission mitigation globally to achieve a sustainable economy.

Through these regulations it is hoped that all people can mitigate environmental pollution, especially companies. Most of the carbon emissions in Indonesia come from business activities of companies. Thus, companies have a responsibility to mitigate carbon emissions. The relevance of carbon emission disclosures and the company's ability to mitigate carbon emissions has generated controversy. Environmental disclosure, especially carbon emission disclosure in Indonesia is voluntary. There are no specific regulations governing the obligation to disclose the environment in accordance with certain standards.

Companies that are successful in mitigating carbon emissions, may not apply adequate carbon disclosure techniques. Conversely, companies that fail to mitigate carbon emissions, may adopt adequate carbon disclosure techniques as greenwashing measures (Wang & Sarkis, 2017) (Uyar et al., 2020).

Companies with adequate current environmental disclosures should be relevant to the company's accountability and motivation in mitigating environmental pollution (Zhu et al., 2019). Corporate accountability in mitigating environmental pollution can be realized through adequate green innovation practices (Marzucchi & Montresor, 2017).

Green innovation is an innovation concept that produces new products, processes or technologies that are environmentally friendly, use resources efficiently, and reduce negative effects on the environment (Yang et al., 2021). Adequate green innovation provides evidence that companies have a strong motivation to mitigate environmental pollution, especially carbon emissions (Nan et al., 2022) (Hong et al., 2020).

This research will explore the relevance of carbon emission disclosure and company motivation to mitigate carbon emissions through the application of green innovation. This study adds the period of ratification of Presidential Regulation No.98 and the Covid-19 period as important parts of this research. Through this research, it can be analyzed how the contribution of government regulations can influence company decision making to mitigate carbon emissions. Then during the Covid-19 pandemic many changes occurred in all aspects of life. This is the first study to explore this issue in Indonesian companies.

## **LITERATURE REVIEW**

Corporate green innovation is a plan used to achieve the company's strategic targets by using new or transformed production techniques, systems, practices and processes to reduce the impact of environmental damage. Fischer & Newell (2008); Marzucchi & Montresor (2017) found that effective environmental policies and regulations can encourage more green innovation in companies. Through analysis of German public survey data, research by Horbach et al., (2012) found that government regulations can encourage ecological innovation in German companies.

Another study by Calel & Dechezlepretre (2016); Zhu et al., (2019) found carbon trading schemes to have a significant impact on low-carbon technology innovation in companies. Another study by Xiang et al., (2020) found environmental disclosure can encourage corporate green innovation in China. Research by Hong et al., (2020) found that disclosure of corporate social responsibility had a significant impact on corporate green innovation in China. The research also succeeded in proving that there is a positive role from environmental regulation by the government.

The relationship between environmental disclosure and green innovation can be explained by stakeholder theory. Donaldson & Preston (1995) explained that stakeholder theory can be seen, presented and used in several different aspects, namely descriptive aspects, instrumental aspects, and normative aspects. In the descriptive aspect, stakeholder theory is used to describe and explain the characteristics or behavior of entities and stakeholders, such as the nature of the company, how managers and stakeholders behave, and how they perceive the behavior and roles of each.

The instrumental aspect, stakeholder theory is used to identify the relationship between management, stakeholders and entity objectives. How should managers act in the interest of the entity to achieve adequate performance and ensure long-term business continuity. Thus, the entity will pay close attention to the people who have an interest in its business.

The normative aspect, stakeholder theory is used to identify the entity's functions based on norms, ethics, and rules. How managers must act and make decisions to achieve goals based on the principles of norms, ethics and rules. Thus, the company will carry out accountability and transparency in environmental aspects to fulfill its responsibilities to stakeholders and the environment. Companies with adequate environmental disclosure should be able to demonstrate that the company is capable of mitigating environmental damage through green innovation.

Research that examines the relationship between environmental disclosure and corporate green innovation is very limited, especially for corporate carbon disclosure. Research using Indonesian company data has also not been found. Thus, this study will analyze the relationship between carbon emissions disclosure and green innovation in Indonesian companies.

## HYPOTHESIS DEVELOPMENT

Referring to stakeholder theory shows that stakeholders have a role in determining the success of the entity in achieving its goals, so that the entity will try to adjust all activities carried out to meet the expectations of its stakeholders (Fontaine et al., 2006). Stakeholder expectations (investors, government and the general public) are also considered not static which in turn requires entities to be more responsive in making decisions. An entity must manage good relations and meet the expectations of its stakeholders to gain support (Taliento et al., 2019) (Miklosik et al., 2021).

In the current era, the focus of stakeholders is not only on the company's ability to achieve financial performance. However, how can companies contribute to mitigating environmental damage and act transparently in providing environmental information (Ionescu et al., 2019) (Liu et al., 2016). The Indonesian government invites all people, especially business entities to contribute to achieving the national NDC target. Companies have a responsibility to mitigate carbon emissions and disclose the necessary information transparently.

Thus, the company will carry out accountability and transparency in environmental aspects, especially carbon information to fulfill its responsibilities to stakeholders and the environment. Companies with adequate environmental disclosure should be able to mitigate environmental damage through green innovation. Green innovation is a plan used to achieve the company's strategic targets by using new or changed techniques, systems, practices and production processes to reduce the impact of environmental damage.

Green innovation is a tool that companies can use to fulfill their responsibilities to stakeholders and the environment (Schiederig, 2011). Environmental disclosure in Indonesia, especially carbon disclosure is still voluntary. It is still controversial whether adequate voluntary disclosure can guarantee that companies are genuinely motivated to engage in green innovation. So it is necessary to do an analysis of this problem. The author also has not found research that investigates this problem in Indonesia.

Research that examines the relationship of environmental disclosure to green innovation is very limited. In addition, no research has been found that focuses on carbon disclosure and green innovation, especially in Indonesia. By doing this research, we can add new literature studies taking into account the period of Covid-19 pandemic and the period of ratification presidential regulation No. 98. The following is the hypothesis that the author proposes:

Hypothesis: Carbon emissions disclosure has a positive and significant effect on green innovation in Indonesian companies.

## METHODS OF RESEARCH

This research will focus on the quality of carbon disclosure. This study will evaluate carbon disclosure based on quantitative and qualitative perspectives using the checklist by Tang et al., (2019) in Table 1.

Then it will be calculated using the following formula:

$$\frac{\text{Score Index fulfilled}}{\text{Total Score Index}} \times 100\%$$

Green innovation in this study will use disclosure indicators developed by Li et al., (2022). Disclosure indicators consist of 18 items in Table 2.

Table 1 – The Checklist of Carbon Emissions Disclosure

No	Evaluation index	Relevant interpretation	Evaluation method and score basis
1	Environmental situation cognition	Enterprises' understanding of the opportunities and challenges brought by climate change	1 point for the opportunity and challenge of the company facing the environmental situation; otherwise 0.
2	Low carbon target planning	Enterprises formulate corresponding energy conservation and emission reduction plans and sustainable development goals	1 point is stated for the target plan; otherwise 0
3	Low-carbon promotion and training	Promote low-carbon and environmental protection, conduct low-carbon education or low-carbon technology training for employees	1 point for the disclosure of training and publicity; otherwise 0
4	Emission reduction incentive mechanism	Whether to adopt incentives for emission reduction	1 point for taking the incentive mechanism for emission reduction; otherwise 0
5	Energy consumption	Energy consumption data	1 point for qualitative description; 2 points for qualitative and quantitative combination
6	Greenhouse gas emission	Greenhouse gas emissions data	1 point for qualitative description; 2 points for qualitative and quantitative combination
7	Action in energy conservation and emission reduction	Description of the adopted low carbon actions or emission reduction measures	2 points for detailed disclosure; 1 point for brief disclosure
8	Investment in energy conservation and emission reduction	Invested capital	1 point for qualitative description; 2 points for qualitative and quantitative combination
9	Low-carbon technology development	Research and development in lowcarbon technologies, subjects and projects	1 point for qualitative description; 2 points for qualitative and quantitative combination
10	Development and utilization of new energy	Development and utilization of clean and renewable energy	1 point for qualitative description; 2 points for qualitative and quantitative combination
11	Improve resource utilization	Description of improving resource utilization	1 point for qualitative description; 2 points for qualitative and quantitative combination
12	Environmental protection department	Whether a specialized department of environmental protection is set up, or one department has the function of supervising the environment	1 point for qualitative description; 2 points for qualitative and quantitative combination
13	Energy conservation effect	Energy conservation effect achieved after implementing measures	1 point for qualitative description; 2 points for qualitative and quantitative combination
14	Emission reduction effect	Emission reduction effect achieved after implementing measures	1 point for qualitative description; 2 points for qualitative and quantitative combination
15	Environmental protection certification	Whether to obtain environmental certification	1 point for environmental certification; otherwise 0
16	Honor rewards	Whether to win the award of energy conservation, emission reduction and environmental protection	1 point for obtaining energy conservation, emission reduction and environmental protection rewards; otherwise 0

Source: Tang et al., 2019.

Table 2 – Indicators of Green Innovation

No	Dimension	Indicators
1	Green Technological Innovation	The production process adopted by company can effectively prevent and abate Pollution The technology adopted by company can effectively reduce energy consumption Company adopts green technology Company uses environmentally friendly waste treatment or recycling process Company applies for green patents which have been or will be granted
2	Green Product Innovation	Company considers reducing pollution and saving energy in its product design All of company's products can pass the green product certification Company attaches importance to investments in green products Company has increased its market share of green products
3	Green Institutional Innovation	Company has promulgated green technology standards Company has improved the transformation rate of green technology achievements Company carries out overall planning to optimize the energy structure Company has implemented total environmental quality management Company focuses on constructing green-related regulations and cultural promotion
4	Green Innovation	Environmental Company is committed to launching green products Company is committed to improving the quality of its green services Company focuses on building green supply chains Company focuses on improving green marketing performance

Source: Li et al. (2022).

Then it will be calculated using the following formula:  $\frac{\text{Items fulfilled}}{\text{Total Items}}$ .

### Sample and Data

The population in this study are companies listed on the Indonesia Stock Exchange, totaling 787 companies (excluding financial companies). Determination of the sample in this study based on certain criteria. Before determining the sample criteria, there are several things that can be explained. First, this research period is from 2017 to 2022 after the Paris agreement was signed by Indonesia in 2016. Second, not all companies have been listed on the Indonesian stock exchange at least from 2017 to 2022. Third, because this research period is from 2017 to 2022, so annual reports and sustainability reports are needed to collect data from 2017 to 2022. Fourth, after observing the population, the authors find that most of the carbon information is explained by companies in sustainability reports. Only a few can be found from other media, such as annual reports and company web pages related to carbon information. Fifth, not all companies have and publish sustainability reports from 2017-2022. So that the determination of the sample was carried out based on the following criteria:

Table 3 – Sample and Data

Criteria	Companies
Companies listed on the Indonesian stock exchange	787 (excluding financial companies)
Companies that do not have a annual report from 2017-2022	(305)
Companies that do not have a sustainability report from 2017-2022	(336)
Companies that do not have a positive profit during the observation period	(61)
Company totals	85
Research Period	2017 to 2022
Total Research Sample	510 (Company-Year)

Source: Data Analyzed (2023).

Based on all these criteria, the sample in this study were 85 companies and 6 years of observation. So the total data in this study is 510 (Company-Year).

### Research Model

This study uses the Difference in Difference (DID) method to evaluate the effect between research variables by adding the period of ratification of Presidential Regulation No.98 and the period of Covid-19. The baseline period for the ratification of Presidential Regulation No.98 is 2022. This period is the period after the ratification of Presidential Regulation No.98. Meanwhile, the baseline period for Covid-19 is 2020. This period is an extreme period during Covid-19.

The baseline period will be compared one by one with the other periods in this study, where in this study the observation period is from 2017 to 2022. Thus it can be seen how the impact of the ratification of Presidential Regulation No. 98 and Covid-19 on the relationship between the variables analyzed.

The DID method is often used to analyze the impact of a policy or treatment, particularly in the social and economic sciences. The DID method calculates the difference in changes in the value of the dependent variable between the treatment group and the control group in a certain time period. Thus it can be seen the impact of a treatment on a dependent variable that is being evaluated. The following is a research model for carbon emission disclosure and green innovation:

$$GIP_{it} = \alpha + \beta_1 \text{PeriodCov}_{it} + \beta_2 \text{GroupCDV}_{it} + \beta_3 \text{PeriodCov}_{it} \times \text{GroupCDV}_{it} + \beta_4 \text{Control Variable}_{it} + \text{Industry} + \varepsilon$$

$$GIP_{it} = \alpha + \beta_1 \text{PeriodReg98}_{it} + \beta_2 \text{GroupCDV}_{it} + \beta_3 \text{PeriodReg98}_{it} \times \text{GroupCDV}_{it} + \beta_4 \text{Control Variable}_{it} + \text{Industry} + \varepsilon$$

Where: CDV - Carbon emission disclosure; GIP - Green innovation; PeriodCov - Covid-19 period (1 for 2020 and 0 for 2017, 2018, 2019, 2021, 2022); Regression analysis was performed per period; PeriodReg98 - Presidential regulation period no.98 (1 for 2022 and 0 for 2017, 2018, 2019, 2020, 2021). Regression analysis was performed per period; GroupCDV - 1 for carbon disclosure values above 50 and 0 for carbon disclosure values

below 50); Control Variable - Size, Leverage, Media exposure, Intensity of capital, Growth of company; Industry - 1 for high carbon emitting industries (utilities, chemicals, construction materials, oil, gas and consumable fuels, metals and mining and transportation); and 0 otherwise.

## RESULTS AND DISCUSSION

The results of the carbon emissions disclosure and green innovation are stated in table 4.

Table 4 – Carbon Emission Disclosure and Green Innovation Period of Ratification Presidential Regulation No.98

Variable	Green Innovation				
	t-value				
	2017	2018	2019	2020	2021
Regulation Period	2.136**	2.218**	2.070**	2.070**	2.451**
Carbon Emission Disclosure (CDV)	3.355**	2.854**	3.111**	3.111**	2.330**
Interaction of Regulation Period and CDV	2.756**	2.387**	2.866**	2.866**	2.715**
Firm Size	1.878	1.901	0.983	0.983	0.834
Firm Leverage	-0.766	-0.976	-1.020	-1.020	-0.743
Media Exposure	-0.804	-1.205	-0.833	-0.833	-1.270
Industry	2.430**	2.550**	2.344**	2.344**	2.128**
Intensity of Capital	2.001**	2.101**	3.203**	3.203**	2.673**
Growth of Company	0.983	0.876	1.002	1.002	0.875

Source: Data Analyzed (2023).

These results show the regulation period, carbon emission disclosure (CDV), interaction of regulation period and CDV, industry, and intensity of capital has a positive effect on green innovation consistently in each period. These results show the ratification of Presidential Regulation No. 98 of 2021 can strengthen the relationship between carbon emission disclosure and green innovation.

The results of the carbon emissions disclosure and green innovation are stated in table 5 below:

Table 5 – Carbon Emission Disclosure and Green Innovation Period of Covid-19

Variable	Green Innovation				
	t-value				
	2017	2018	2019	2021	2022
Covid-19 Period	1.788	1.207	0.952	1.205	0.838
Carbon Emission Disclosure (CDV)	2.811**	2.404**	3.101**	2.860**	2.677**
Interaction of Covid-19 Period and CDV	0.922	1.113	0.895	1.108	0.988
Firm Size	3.121**	2.877**	2.366**	2.677**	3.021**
Firm Leverage	-0.671	-0.873	-1.002	-1.111	-0.875
Media Exposure	0.631	1.062	0.737	1.256	0.765
Industry	2.567**	2.451**	2.883**	2.355**	3.455**
Intensity of Capital	2.125**	2.717**	2.444**	2.661**	2.673**
Growth of Company	1.104	1.885	1.556	0.873	1.223

Source: Data Analyzed (2023).

These results show carbon emission disclosure (CDV), firm size, industry, and intensity of capital has a positive effect on green innovation consistently in each period. These results show that Covid-19 has no impact on the relationship between carbon emission disclosure and green innovation.

The results show that carbon disclosure has a positive impact on green innovation. These results are in accordance with stakeholder theory. Companies that consider stakeholders as an important part of their business, the company will carry out business

activities in accordance with stakeholder expectations. One of these expectations is responsibility in environmental aspects. Companies that prioritize environmental pollution mitigation in their business activities are considered low risk companies. Companies are also considered to have contributed to achieving sustainable development goals.

Referring to the stakeholder theory, it shows that stakeholders have a role in determining the success of a company achieving its goals. Thus, the company will adjust business activities and decision-making those are relevant to stakeholder expectations. Stakeholder expectations are also not static, causing the company to be more responsive in making decisions. An entity must manage good relations with all stakeholders to survive in the long term.

In the current era, the focus of stakeholders is not limited to the company's financial performance. Companies must also contribute to mitigating environmental pollution and be transparent in providing environmental information. The Indonesian government invites all people, especially companies to contribute to achieving the national NDC target.

Companies have a responsibility to mitigate carbon emissions and are able to disclose the necessary information. Thus, the company will carry out accountability and transparency of carbon emissions to fulfill its responsibilities to stakeholders and the environment. Companies with adequate environmental disclosure should be able to mitigate environmental pollution through green innovation. Green innovation is a plan to achieve the company's strategic targets by using new or modified techniques, systems, practices and production processes to reduce the impact of environmental pollution.

Green innovation is a tool used by companies to fulfill their responsibilities to stakeholders and the environment. Empirical results show that Indonesian companies with adequate carbon information disclosure techniques this year have a strong motivation to mitigate carbon emissions through green innovation in the following year. This shows that most Indonesian companies have the awareness to contribute to achieving Indonesia's NDC targets. The company's awareness must be supported by adequate standards and regulations by the Indonesian government. So that Indonesia's NDC target will be achieved.

The results of this study are relevant to research by Xiang et al., (2020) found that environmental disclosure can encourage green innovation in Chinese companies. Research by Hong et al., (2020) found that CSR disclosure has a positive effect on green innovation in Chinese companies. All of these studies at the same time prove the positive impact of government regulations in relation to environmental disclosure and green innovation.

The results of this study also show that the ratification of Presidential Regulation No. 98 can strengthen the relationship between carbon disclosure and green innovation. This finding also proves that Indonesian companies consider government regulations in carrying out their business activities. The government has the power to intervene in companies in making decisions. Thus, it is necessary to have adequate regulations and standards related to environmental pollution mitigation.

This finding at the same time proves that Indonesian companies actually have the motivation to mitigate carbon emissions, however, the current standards and regulations in Indonesia are inadequate. Further regulations are needed to ensure companies can mitigate carbon emissions to achieve Indonesia's NDC target.

Meanwhile, Covid-19 has no impact on the relationship between carbon disclosure and green innovation. These findings prove that the Covid-19 pandemic has not changed the company's perspective on carbon disclosure and carbon emission mitigation through green innovation. The company will make decisions that are relevant to government standards and regulations.

## **CONCLUSION**

This study found that carbon disclosure has a positive effect on green innovation. Indonesian companies with adequate carbon disclosure techniques this year have a great opportunity to mitigate carbon emissions through green innovation in the following year. This study also proves that most Indonesian companies have the motivation to contribute to

achieving Indonesia's NDC targets. This motivation needs to be supported by adequate government standards and regulations. This study supports the need for further and adequate regulations related to environmental pollution mitigation. Thus, Indonesia can achieve its target of reducing greenhouse gas emissions by 29% and 41% with international support by 2030.

## REFERENCES

1. Calel, R., & Dechezlepretre, A. (2016). Environmental policy and directed technological change: evidence from the European carbon market. *Review of Economics and Statistics*, 98(1), 173–191. <https://doi.org/10.1162/REST>.
2. Donaldson, T., & Preston, L. E. (1995). The Stakeholder Theory of The Corporation: Concepts, Evidence, and Implications. *Academy of Management Review*, 20(1), 65–91. <http://www.jstor.org/stable/258887>.
3. Fischer, C., & Newell, R. G. (2008). Environmental and technology policies for climate mitigation. *Journal of Environmental Economics and Management*, 55(2008), 142–162. <https://doi.org/10.1016/j.jeem.2007.11.001>.
4. Fontaine, C., Haarman, A., & Schmid, S. (2006). The Stakeholder Theory. *Management*, 1(December), 37–44. <https://doi.org/10.1057/9780230524224>.
5. Hong, M., Drakeford, B., & Zhang, K. (2020). The impact of mandatory CSR disclosure on green innovation: evidence from China. *Green Finance*, 2(3), 302–322. <https://doi.org/10.3934/gf.2020017>.
6. Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of Eco-innovations by Type of Environmental Impact: The Role of Regulatory Push/Pull, Technology Push and Market Pull. *SSRN Electronic Journal*, 11. <https://doi.org/10.2139/ssrn.1805765>.
7. Ionescu, G. H., Firoiu, D., Pirvu, R., & Vilag, R. D. (2019). The impact of ESG factors on market value of companies from travel and tourism industry. *Technological and Economic Development of Economy*, 25(5), 820–849. <https://doi.org/10.3846/tede.2019.10294>.
8. Li, S., Li, X., Zhao, Q., Zhang, J., & Xue, H. (2022). An Analysis of the Dimensional Constructs of Green Innovation in Manufacturing Enterprises: Scale Development and Empirical Testing. *Sustainability (Switzerland)*, 14(24). <https://doi.org/10.3390/su142416919>.
9. Liu, Y. S., Zhou, X., & Yang, J. H. (2016). Corporate Carbon Emissions and Financial Performance: Does Carbon Disclosure Mediate the Relationship in the UK? Discussion Paper, ICM-2016–0, 1–35. <https://doi.org/10.2139/ssrn.2941123>
10. Marzucchi, A., & Montresor, S. (2017). Forms of knowledge and eco-innovation modes : Evidence from Spanish manufacturing firms. *Ecological Economics*, 131(2017), 208–221. <https://doi.org/10.1016/j.ecolecon.2016.08.032>.
11. Miklosik, A., Starchon, P., & Hitka, M. (2021). Environmental sustainability disclosures in annual reports of ASX Industrials List companies. *Environment, Development and Sustainability*, 23(11), 16227–16245. <https://doi.org/10.1007/s10668-021-01338-8>.
12. Nan, S., Wang, Z., Wang, J., & Wu, J. (2022). Investigating the Role of Green Innovation in Economic Growth and Carbon Emissions Nexus for China: New Evidence Based on the PSTR Model. *Sustainability (Switzerland)*, 14(24). <https://doi.org/10.3390/su142416369>.
13. Schiederig, T. (2011). What is Green Innovation ? – A quantitative literature review Frank Tietze Cornelius Herstatt The XXII ISPIM Conference 2011. ISPIM Conference 2011, January 2011, 1–18.
14. Taliento, M., Favino, C., & Netti, A. (2019). Impact of environmental, social, and governance information on economic performance: Evidence of a corporate “sustainability advantage” from Europe. *Sustainability (Switzerland)*, 11(6). <https://doi.org/10.3390/su11061738>.
15. Tang, Y., Shen, Y., Yang, Q., & Zhao, Z. (2019). Evaluation and Effect of Carbon Disclosure Quality in China: Based on the Perspective of Investor Protection. *Emerging Markets Finance and Trade*, 57(9), 1–16.



<https://doi.org/10.1080/1540496X.2019.1680539>.

16. United Nations Environment Programme. (2021). Emissions Gap Report 2021.
17. Uyar, A., Karaman, A. S., & Kilic, M. (2020). Is corporate social responsibility reporting a tool of signaling or greenwashing? Evidence from the worldwide logistics sector. *Journal of Cleaner Production*, 253, 119997. <https://doi.org/10.1016/j.jclepro.2020.119997>.
18. Wang, Z., & Sarkis, J. (2017). Corporate social responsibility governance, outcomes, and financial performance. *Journal of Cleaner Production*, 162, 1607–1616. <https://doi.org/10.1016/j.jclepro.2017.06.142>.
19. Xiang, X., Liu, C., Yang, M., & Zhao, X. (2020). Confession or justification: The effects of environmental disclosure on corporate green innovation in China. *Corporate Social Responsibility and Environmental Management*, 27(6), 2735–2750. <https://doi.org/10.1002/csr.1998>.
20. Yang, Y., Wen, J., & Li, Y. (2021). The impact of environmental information disclosure on the cost of debt: evidence from China. *Research Square*, 1–20.
21. Zhu, J., Fan, Y., Deng, X., & Xue, L. (2019). Low-carbon innovation induced by emissions trading in China. *Nature Communications*, 10(1), 1–8. <https://doi.org/10.1038/s41467-019-12213-6>.