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THE INFLUENCE OF GREEN INNOVATION AND ENVIRONMENTAL COST ON ENVIRONMENTAL

DWI JAYANTI
DEPARTMENT OF ACCOUNTING, FACULTY OF ECONOMICS AND BUSINESS JENDERAL ACHMAD YANI UNIVERSITY, CIMAHI, 40531, INDONESIA, EMAIL: dwijayanti@ak.unjani.ac.id

MARLINA
DEPARTMENT OF ACCOUNTING, FACULTY OF ECONOMICS AND BUSINESS JENDERAL ACHMAD YANI UNIVERSITY, CIMAHI, 40531, INDONESIA, EMAIL: marlina@ak.unjani.ac.id

EDDY WINARSO
DEPARTMENT OF ACCOUNTING, FACULTY OF ECONOMICS AND BUSINESS, JENDERAL ACHMAD YANI UNIVERSITY, CIMAHI, 40531, INDONESIA, EMAIL eddywinarso@ak.unjan.ac.id

Abstract
The United Nations Principles of Responsible Investment report presented ESG issues and pushed for their incorporation into sustainable investment practices; these features would be measured by ESG risk ratings. Since then, ESG issues have garnered prominence. Several mining corporations are comparatively high-risk in terms of environmental, social, and governance (ESG) considerations. Examining how environmental expenses and green innovation affect ESG performance is the focus of this study. Environmental cost is determined by the company's actual spending, and green innovation score is used to evaluate green innovation, and ESG risk ratings are used to evaluate ESG performance. Using a purposive selection strategy, a total of 33 firms were chosen to represent the research population. These companies were listed on the IDX from 2021 to 2023. Multiple linear regression is the data analysis approach that was utilized, while SPSS was used for data processing.

Research shows that environmental costs have a minor but considerable effect on ESG performance, green innovation has no effect on ESG performance at all, and both environmental costs and green innovation have a substantial impact on ESG performance when tested together.

Keywords: Green Innovation, Environmental Cost, ESG Performance

INTRODUCTION

Since its debut in the UN Principles of Responsible Investment report—which encourages the integration of ESG components into sustainable investment practices—concern about ESG has risen. The Environmental, Social, and Governance (ESG) framework is a cornerstone for evaluating the efficacy of companies. According to Amalia and Kusuma (2023), it offers a holistic view of corporate social responsibility (CSR) with stakeholders, society, and the environment.

Sustainalytics, Refinitiv Bloomberg, MSCI, and Thomson Reuters are the four most prominent worldwide financial services organizations. Companies that do well on ESG principles are those that care about their shareholders' long-term success, according to an integrated ESG score that these four platforms provide. Environmental, Social, and Governance (ESG) data presents an unrealized opportunity for businesses and investors to maintain a competitive edge (C.-H. Lee et al., 2022). According to Nuraini et al. (2023), ESG is a non-financial measure that shows how a firm is doing in terms of sustainability, social responsibility, and corporate governance.

To evaluate the environmental, social, and governance (ESG) performance of listed firms in Indonesia, the Indonesia Stock Exchange (IDX) collaborated with Morningstar Sustainalytics. Only assessments carried out by the official assessment organization will be shown on IDX. When conducting environmental, social, and governance (ESG) evaluations, Sustainalytics uses the risk decomposition method, which analyzes businesses according to two main criteria: exposure and management. An organization's "exposure" to significant Environmental, Social, and Governance (ESG) hazards influences its overall ESG risk rating.

Management, on the other hand, represents the company's commitment and concrete efforts to address ESG concerns through policies and programs. Based on the ESG score assessment, listed companies are categorized into five risk levels. The Negligible category (score 0-10) includes companies with minimal ESG risk. The Low category (score 10-20) indicates a low level of ESG risk. Companies in the Medium category (score 20-30) face moderate ESG risks. The High category (score 30-40) reflects companies with significant ESG risks. Lastly, the Severe category (score above 40) includes companies exposed to critical ESG risks (Indonesia et al.).

Sustainalytics' ESG measurement approach provides an accurate representation of a company's ESG performance (Xiao et al., 2022). A lower sustainability score indicates a lower ESG risk (Aldieri et al., 2023). Below is the ESG risk rating data for selected mining companies from 2021 to 2023, assessed using Sustainalytics.

Table 1. ESG Risk Rating Data on Mining Companies Listed on the Indonesia Stock Exchange (IDX) 2021-2023

No	Company name	ESG Risk Rating			
		2021	2022	2023	Note
1.	PT. Timah, Tbk	60.1	53.00	45.1	*Severe*
2.	PT. Mega Energy Persada Tbk	46.9	42.2	46.9	*Severe*
3.	PT. Medco Energi Internasional, Tbk	46.9	42.2	46.9	*Severe*

The ESG risk ratings of various Indonesian mining companies fluctuated annually from 2021 to 2023, as shown in Table 1. However, when looking at the data, it is clear that the average company posed a severe risk, with ratings above 40. Overcoming this should naturally be a priority for everyone involved. In light of the aforementioned occurrences, studies examining the impact of green innovation and environmental costs on ESG performance are necessary.

LITERATURE REVIEW

Legitimacy Theory

Since firms are an integral part of society, legitimacy theory argues that businesses should be mindful of societal norms and strive to comply with them to enhance the legitimacy of their business (Rais and Usman, 2020). The community environment can provide an assessment of the activities carried out by a company, so these activities must align with community expectations (Cota-Montes, 2022). Legitimacy theory provides the view that the relationship between organizations and society is related to the expectations of the reality of social life (Rais & Usman, 2020).

Green Innovation

According to Lestari and Sunyoto (2023), green innovation is defined as follows: "Green Innovation is an innovation that is implemented to provide results in the form of reducing environmental impacts."

Green innovation is a strategy designed to help companies achieve their strategic objectives by implementing new methods, systems, practices, and production processes or by making transformations aimed at minimizing the negative impact of environmental degradation and damage (Dewi & Rahmianingsih, 2020).

Green Innovation indicators are as follows:

1. Production processes use new technologies to reduce energy, water, and waste.
2. Products use a small amount of non-hazardous and environmentally friendly materials.
3. The production process can be recycled

(Data Source: Muwaffaq Helmi & Erna Widiastuty 2023)

Environmental Cost

Environmental costs refer to expenses incurred by companies for managing the environment as a consequence of their routine operational activities (Meiyana & Aisyah, 2019). According to Jihan and Murwaningsari (2023), environmental costs are defined as follows:

"Environmental costs include internal and external costs in managing the consequences of the company's operational activities to demonstrate responsibility in complying with applicable regulations and optimizing resources, and can affect sustainable development and sustainability reports with company performance because environmental costs include costs used by the company in carrying out corporate social responsibility."

Based on research (Dewata et al., 2018), environmental costs are measured by comparing the costs incurred by the company for environmental development programs with net profit.

Environmental, Social, and Governance (ESG) Performance

All things considered, ESG stands on three legs: governance, social responsibility, and the environment. Environmental performance reflects the extent to which a firm has attempted to reduce the negative environmental impacts caused by its activities, as measured by the environmental pillar's emphasis on resource consumption, emissions, and innovation (Fuadah et al., 2023; LC Lee et al., 2023). The social pillar addresses corporate behavior concerning social issues, covering aspects such as labor practices, product responsibility, community engagement, and human rights (Souza & Oliveira, 2023). Meanwhile, the governance pillar pertains to a company's internal structure and corporate behavior, including management, investor relations, and Corporate Social Responsibility (CSR) strategies, highlighting the rights and responsibilities within the governance framework (Wahdan et al., 2023).

State of The Art

Environmental, Social, and Governance (ESG) management and green innovation have the same goals and drivers, including stakeholder pressure for ESG activities and CSR (Chen & Jin, 2023). An organization's ESG performance—an all-encompassing evaluation of its sustainability based on environmental effect, social responsibility, and governance practices—is greatly improved by green innovation. While environmental, social,

and governance (ESG) performance assesses a firm's comprehensive sustainability, green innovation is the visible result of these endeavors and is in line with ESG's fundamental principles (Wu & Li, 2023). While Xua et al. (2022) discovered that green innovation favorably affects ESG performance, Zheng et al. (2022) revealed that it may greatly improve ESG ratings.

Environmental costs reflect a company's commitment to environmental responsibility, signifying its accountability in preserving the environment and contributing to social well-being. Investment in environmental costs can lead to improved environmental performance because companies that spend more money on environmentally friendly technologies or sustainable business practices can reduce pollutant emissions and waste. (Rahayudi & Apriwandi, 2023).

Method, Data, and Analysis

This study adopts a quantitative research approach, utilizing both descriptive and verification methods. Two hundred and twenty-eight mining businesses that were listed on the Indonesia Stock Exchange (IDX) between 2021 and 2023 make up the study population. The study's sample size is 33 businesses, obtained using a purposive sampling method.

For data analysis, descriptive statistics are used to present an overview of demographic variables. Additionally, multiple linear regression analysis is applied to examine the relationships between variables.

RESULTS

Green Innovation

The following presents data on green innovation among mining companies listed on the Indonesia Stock Exchange (IDX) for the 2021-2023 period.

Table 2. Green Innovation Data on Mining Companies Listed on the IDX for the 2021-2023 Period

			Year		
No	**Code**	**Company Name**	**2021**	**2022**	**2023**
1	ADARO	PT. Adaro Energy Indonesia, Tbk	0.75	0.75	0.75
2	ANTM	PT. Aneka Mining. Tbk	1.00	1.00	1.00
3	ENRG	PT. Energi Mega persada. Tbk	0.75	0.75	0.75
4	HRUM	PT. Harum Energy. Tbk	0.75	0.75	0.75
5	INCO	PT. Vale Indonesia. Tbk	0.75	0.75	0.75
6	INDY	PT. Indika Energy. Tbk	0.75	0.75	0.75
7	ITMG	PT. Indo Tambangraya Megah. Tbk	1.00	1.00	1.00
8	MDKA	PT. Merdeka Copper Gold. Tbk	0.75	0.75	0.75
9	MEDC	PT. Medco Energy International, Tbk		1.00	1.00	1.00
10	PTBA	PT. Bukit Asam. Tbk		1.00	1.00	1.00
11	TINS	PT. Timah. Tbk	0.75	0.75	0.75

Table 2 illustrates the condition of green innovation in mining sector companies listed on the Indonesia Stock Exchange (IDX) for the 2021-2023 period. In 2021, 2022, and 2023, out of 33 mining company samples, 21 companies had a score of 0.75, while 12 companies had a score of 1. This means that, on average, mining companies have disclosed 3 of the 4 green innovation indicators. Where on average, companies have disclosed indicators (G1), namely the production process uses new technology to reduce energy, water, and waste, (G2) products use fewer substances that do not cause hazardous pollution (environmentally friendly), and (G4) companies have used components or production materials that can be recycled or reconditioned. Meanwhile, 1 indicator that is still slightly disclosed is indicator (G2), namely, products use fewer substances that do not cause pollution or are hazardous (environmentally friendly materials)

From the foregoing, it is clear that, for the years 2021–2023, green innovation is doing quite well among mining sector businesses listed on the Indonesia Stock Exchange (IDX).

Environmental Cost

The following is a breakdown of the environmental costs incurred by mining firms trading on the IDX from 2021 to 2023

Table 3. Environmental Cost Data on Mining Companies Listed on the IDX for the 2021-2023 Period

No	Code	Company Name	Year		
			2021	2022	2023
1	ADRO	Adaro Energy Indonesia Tbk.	352.136.838.990	481.654.398.950	645.173.183.818
2	ANTM	Aneka Tambang Tbk.	102.080.540.000	142.926.400.000	152.120.000.000
3	ENRG	Energi Mega Persada Tbk.	5.634.314.416	11.202.218.141	11.047.059.352
4	HRUM	Harum Energy Tbk.	34.674.342.857	36.398.816.667	12.921.833.333
5	INCO	Vale Indonesia Tbk.	304.685.764.374	312.953.991.426	1.038.123.337.072
6	INDY	Indika Energy Tbk.	453.061.860.000	155.862.660.000	251.742.730.000
7	ITMG	Indo Tambangraya Megah Tbk.	148.055.760.000	604.682.040.000	1.127.192.032.000
8	MDKA	Merdeka Copper Gold Tbk.	101.150.585.714	99.808.156.250	121.037.676.923
9	MEDC	Medco Energi Internasional Tbk.	441.285.714	1.349.953.125	722.892.308
10	PTBA	Bukit Asam Tbk.	124.960.000.000	173.228.000.000	253.759.000.000
11	TINS	Timah Tbk.	54.550.515.600	55.429.165.658	29.200.000.000
		annual avarage	147.898.299.279	183.642.421.324	328.530.885.891
		avarage		220.023.868.831	

Listed on the Indonesia Stock Exchange (IDX) for the years 2021–2023, Table 3 shows the environmental cost circumstances of mining industry businesses. With an increase to IDR 183,642,421,324 in 2022 and a further significant increase to IDR 328,530,885,891 in 2023, the average environmental costs incurred by companies increased from IDR 147,898,299,279 in 2021. The total amount spent on environmental impacts was an average of 220,023,868,831 IDR.

The average environmental investment funds issued by companies are used for environmental management as a form of commitment to climate change mitigation, reclamation mitigation, and revegetation. As well as innovations for energy efficiency, emissions, water, waste, and biodiversity, including research funding, and several collaborations in the environmental field and environmental monitoring.

From what we can see, the mining industry businesses listed on the Indonesia Stock Exchange (IDX) have kept up a respectable environmental cost profile from 2021 to 2023.

Environmental, Social, and Governance (ESG) Performance

The following is Environmental Cost data for mining companies listed on the Indonesia Stock Exchange (IDX) for the 2021-2023 period.

Table 4. ESG Risk Rating Data on Mining Companies Listed on the IDX for the 2021-2023 Period

				Year		
No	**Code**	**Company Name**		**2021**	**2022**	**2023**
1	ADARO	PT. Adaro Energy Indonesia, Tbk	39.8	39.7	42.8	
2	ANTM	PT. Aneka Mining. Tbk		45.8	39.9	42.1
3	ENRG	PT. Energi Mega persada. Tbk		46.9	42.2	46.9
4	HRUM	PT. Harum Energy. Tbk	44.7	45.7	44.0	
5	INCO	PT. Vale Indonesia. Tbk		62.0	37.1	34.4
6	INDY	PT. Indika Energy. Tbk		34.5	34.9	35.8
7	ITMG	PT. Indo Tambangraya Megah. Tbk		36.9	35.5	44.7
8	MDKA	PT. Merdeka Copper Gold. Tbk	52.8	45.8	32.0	
9	MEDC	PT. Medco Energy International, Tbk			46.9	42.2 46.9
10	PTBA	PT. Bukit Asam. Tbk			36.0	32.5 33.6
11	TINS	PT. Timah. Tbk		60.1	53.0	45.1
Annual average				46.04	40.77	40.75
Average					42.52	

Table 4 illustrates the ESG risk rating conditions of mining sector companies listed on the Indonesia Stock Exchange (IDX) for the 2021-2023 period. if seen in the table above, the ESG risk rating figures fluctuate every year. In 2021, the average ESG risk rating had a score of 46.04 (severe category), then in 2022 and 2023, the average ESG risk rating had a score of 40.77 and 40.75 in the very high-risk category (severe category). The overall average has an ESG risk rating with a score of 45.52 in the very high-risk category (severe category). If seen, there is a decrease in the average ESG risk rating each year, but the decrease that occurs is not significant and is still in the very high-risk category. This shows an increase in compliance with ESG standards; companies,

on average, have made efforts to reduce environmental impacts, increase transparency, and improve corporate governance.

In light of the above, it is reasonable to assume that the environmental, social, and governance (ESG) performance conditions of mining sector businesses listed on the Indonesia Stock Exchange (IDX) were not good from 2021 to 2023.

Hypothesis Test Results

A normal distribution is shown by the results of this investigation. Using multivariate linear regression analysis, we looked at how different factors affected the outcome. The table below displays the results of the regression:

Table 5. Multiple Linear Regression Test Results

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	7,174	2,217		3,236	0,003					
	GI	-1,881	1,253	-0,237	-1,501	0,144	-0,187	-0,264	-0,235	0,989	1,011
	EC	-0,223	0,073	-0,480	-3,042	0,005	-0,455	-0,486	-0,477	0,989	1,011

a. Dependent Variable: ESG

The green innovation variable has a t-value of -1.501, which is less than 0.334 (t-value < t-table), and a significance value of 0.144, which is higher than 0.05, according to Table 5. With H_0 accepted and H_a rejected, it follows that green innovation and ESG performance are not significantly related. A significant level of 0.005 (less than 0.05) is associated with the environmental cost variable, while its t-value of -3.042 (higher than 0.334; t-value > t-table) further supports this conclusion. A substantial negative association between environmental expenses and ESG performance is shown by a coefficient value of -0.223, which leads to the rejection of H_0 and the acceptance of H_a.

whether you want to know whether all of the independent factors significantly affect the dependent variable, you may use the F-statistical test. The table below displays the results of the regression.

Table 6. Multiple Linear Regression Test Results

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7,919	2	3,959	5,338	.010[b]
	Residual	22,251	30	0,742		
	Total	30,169	32			

a. Dependent Variable: ESG

b. Predictors: (Constant), EC, GI

All of the independent variables had F-count values of 5.338, as shown in Table 6, which is higher than the F-table value of 1.692. Furthermore, the p-value is less than 0.05 at 0.01. Therefore, Ha is rejected and H0 is accepted. What this means is that environmental expenses and green innovation both play a big role in determining ESG success.

DISCUSSION

The Influence of Green Innovation on ESG Performance

When viewed from the average condition of the green innovation score obtained, it shows a value that is still quite good, there are company efforts made every year to reduce the risk of environmental damage, but the efforts made by the company have not been able to fully reduce the assessment on the ESG risk rating to change to a high category or other lower ones, still in a high-risk condition. This may happen; there are still many mining companies that use hazardous substances/materials and are still considered to cause pollution (not environmentally friendly). This is shown from the 33 companies studied, 27 companies have not met the G2 criteria, namely, companies are considered to still use hazardous/non-environmentally friendly substances.

In addition, the ESG risk rating assessment is not only assessed from the component of how the company can manage its environmental risks well, but also how the company manages risks related to social factors and corporate governance is an important assessment.

The Influence of Environmental Cost on ESG Performance

The average condition of environmental costs in mining companies shows a good value. It can be seen that the value of funds invested by mining companies has an increasing trend every year, meaning that the company has made efforts to increase environmental investment funds to manage its environment better. A company's care for the environment is shown via environmental expenses.

By incurring environmental expenditures, a business shows that it cares about environmental preservation and community well-being. Investment in environmental costs can lead to improved environmental performance because companies that spend more money on environmentally friendly technology or sustainable business practices can reduce pollutant and waste emissions (Rahayudi & Apriwandi, 2023).

In this study, a negative coefficient value was produced on environmental costs, which means that when environmental costs increase, ESG performance decreases. This happens because ESG performance is measured using ESG risk rating, where the lower the ESG risk rating, the lower the risk condition (good), so that when environmental costs increase, it tends to decrease the ESG risk rating value and vice versa. This study's findings corroborate those of Dewata et al. (2018), who found that ESG performance is negatively influenced by environmental expenses.

The Influence of Green Innovation and Environmental Cost on ESG Performance

Green innovation and environmental expenses are usually looking favorable for IDX-listed mining businesses from 2021 to 2023. Collectively, these factors contribute to achieving the ESG risk rating obtained. The coefficient of determination is 26.2%, indicating that green innovation and environmental costs influence ESG performance by 26.2%, while the remaining 73.8% is affected by other factors, potentially including other ESG components such as social factors and corporate governance.

CONCLUSIONS

Based on the research findings, green innovation is in a fairly good state, environmental costs are in good condition, but ESG performance in mining companies listed on the Indonesia Stock Exchange (IDX) for the 2021–2023 period is in poor condition.

Partially, green innovation does not impact ESG performance, whereas environmental costs have a significant negative effect on ESG performance. However, when considered simultaneously, green innovation and environmental costs have a significant influence on ESG performance in mining sector companies listed on the IDX during the 2021–2023 period.

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