



## The Influence of Green Accounting and Production Costs on Sustainable Development with Supply Chain as a Moderating Variable

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### ABSTRACT

This research examines the effect of green accounting and production costs on sustainable development, with the supply chain serving as a moderating variable, in oil, gas, and coal companies listed on the Indonesia Stock Exchange during the 2021–2024 period. The study adopts a quantitative research design and utilizes secondary data obtained from annual reports and sustainability reports. The sample comprises 50 firms, resulting in 200 firm-year observations. Panel data regression analysis using the Random Effect Model (REM), complemented by Moderated Regression Analysis (MRA), is employed as the analytical technique. The findings indicate that green accounting has a statistically significant impact on sustainable development, whereas production costs do not show a significant effect. Furthermore, the supply chain is found to significantly moderate the relationship between green accounting and sustainable development, but it does not moderate the relationship between production costs and sustainable development. Overall, the results highlight that the attainment of sustainable development is closely linked to the integration of green accounting practices supported by sustainable supply chain management.

## **INTRODUCTION**

In Indonesia, the energy and mining sectors make a significant contribution to national emissions, primarily through the combustion of fossil fuels, methane gas leakage, as well as logistics and transportation activities within the energy supply chain. According to a Reuters report (2025), Indonesia is projected to require substantial investment to reduce emissions from the energy sector and support the transition to clean energy. In the context of the Just Energy Transition Partnership (JETP), it is estimated that approximately USD 31 billion to USD 92 billion will be needed to decarbonize the coal-based energy sector and increase the share of renewable energy in the energy mix. In a report by tanahair.net (2025), climate activists highlighted the outcomes of the United Nations Climate Change Conference (COP30), which were considered insufficiently firm regarding the phase-out of fossil energy. They emphasized that without clear direction and strong domestic policies, Indonesia's commitment to emission reduction and energy transition risks becoming merely a diplomatic formality. The oil and gas industry is one of the strategic sectors that makes a major contribution to the national economy. However, the operational activities of the oil and gas industry also pose significant risks to environmental damage, such as greenhouse gas emissions, soil and water pollution, and the exploitation of non-renewable natural resources.

## **IMPLEMENTATION AND METHODS**

### **Theory of Efficacy**

The Theory of Efficacy, more commonly known as Self-Efficacy Theory, explains the belief of individuals or organizations in their ability to organize, control, and carry out the actions necessary to achieve specific goals (Bandura, 1997).

### **Sustainable Development**

According to May et al. (2023), sustainable development means that development in the present can be achieved without reducing the ability of future generations to meet their own needs. One application of the sustainable development concept by companies is through the implementation of social and environmental responsibility for the activities they have undertaken.

### **Green Accounting**

Green accounting is a concept in which companies prioritize efficiency and effectiveness in the sustainable use of resources within their production processes, thereby aligning corporate development with environmental functions and providing benefits to society (Endiana et al., 2020).

### **Production Costs**

Mulyadi (2019) explains that production costs consist of three main elements: direct raw material costs, direct labor costs, and factory overhead costs. These elements reflect all expenditures that are directly or indirectly related to the production process.

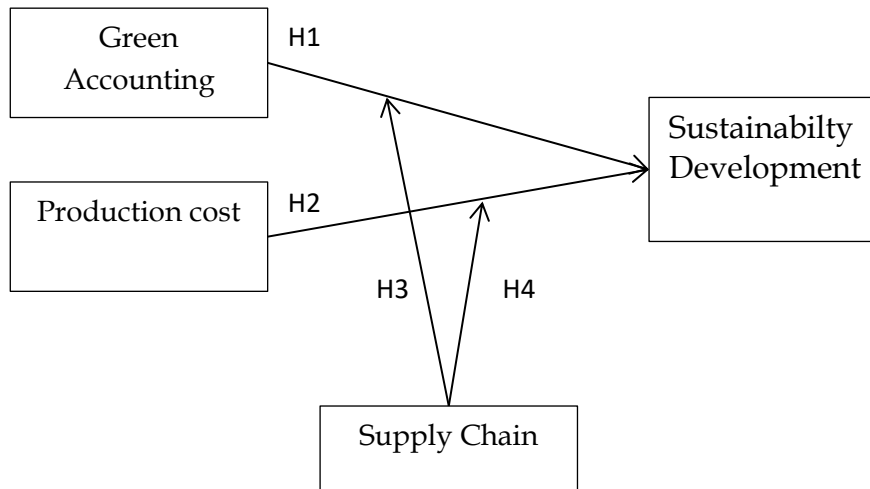
### Supply Chain

The supply chain is a concept aimed at reducing a company’s operational costs through the optimization of material distribution from suppliers, material flows within the production process, and the distribution of products to consumers (Widiyanto, 2012).

### Oil, Gas, and Coal Sector Companies

According to the International Energy Agency (2022), oil, gas, and coal companies are business entities that produce and supply fossil fuel-based energy, which has historically been the world’s primary energy source but is also the largest contributor to global greenhouse gas emissions.

### Conceptual Framework



## RESULTS AND DISCUSSION

### Descriptive Statistical Test

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 Sample: 1 200

	X1	X2	Z	Y
Mean	0.545000	6.72E+10	-4.14E+14	4.63E+14
Median	1.000000	5.36E+08	-3.60E+14	6.07E+12
Maximum	1.000000	9.70E+11	-1.55E+11	7.33E+15
Minimum	0.000000	1160280.	-9.97E+14	-1.41E+15
Std. Dev.	0.499220	1.51E+11	2.91E+14	1.44E+15
Skewness	-0.180733	2.757159	-0.501720	3.483658
Kurtosis	1.032665	11.63033	2.053187	14.88542
Jarque-Bera Probability	33.34222	874.0865	15.86120	1581.723
	0.000000	0.000000	0.000360	0.000000
Sum	109.0000	1.34E+13	-8.27E+16	9.27E+16
Sum Sq. Dev.	49.59500	4.56E+24	1.68E+31	4.11E+32
Observations	200	200	200	200

The Sustainable Development variable has a mean value of 4.63E+14, with a standard deviation of 1.44E+15, indicating substantial variability across observations. Its maximum value reaches 7.33E+15, while the minimum value is -1.41E+15. The Green Accounting variable records an average value of 0.5450, equivalent to 54.50%, with a standard deviation of 0.4992. This variable ranges

from a minimum of 0.0000 to a maximum of 1.0000. The Production Cost variable exhibits a mean of 6.72E+10 and a standard deviation of 1.51E+11, with observed values spanning from a minimum of 1,160,280 to a maximum of 9.70E+11. Meanwhile, the Supply Chain variable shows an average value of -4.14E+14, accompanied by a standard deviation of 2.91E+14. The maximum observed value is -1.55E+11, whereas the minimum value reaches -9.97E+14, reflecting considerable dispersion within the data.

**Regression Model Testing**

No	Test Type	Objective	Results	Selected Model
1	Uji Chow	Compare Common Effect vs Fixed Effect	Prob = 0.0000 < 0.05	Fixed Effect Model (FEM)
2	Uji Hausman	Compare Fixed Effect vs Random Effect	Prob = 0.6958 > 0.05	Random Effect Model (REM)
3	Uji Lagrange Multiplier (LM)	Compare Common Effect vs Random Effect	Prob = 0.0000 < 0.05	Random Effect Model (REM)

**Assumption Test Source: Data Processed by the Author Classic**

**Normality Test**

Based on the histogram of the normality test, the Jarque–Bera probability value is lower than the 0.05 significance level (0.0000 < 0.05), indicating that the data are not normally distributed. However, as emphasized by Gujarati (2012), the assumption of normality is not a prerequisite for obtaining a Best Linear Unbiased Estimator (BLUE), and several econometric perspectives do not strictly require this condition to be satisfied. Furthermore, Santosa and Hidayat (2015) argue that normality testing is particularly relevant for small samples, generally those consisting of fewer than 50 or even fewer than 30 observations. In contrast, for studies employing large datasets, the normality assumption may be reasonably relaxed and the test may be disregarded.

**Multicollinearity Test**

The independent variables in this study consist of Green Accounting ( $X_1$ ) and Production Costs ( $X_2$ ), with Supply Chain ( $Z$ ) serving as a moderating variable for Sustainable Development ( $Y$ ). Based on the results generated using EViews 13, the correlation coefficient between Green Accounting and Production Costs is 0.108288, while the correlation between Green Accounting and Supply Chain is 0.159992. In addition, the correlation between Production Costs and Supply Chain is -0.064948. Since all correlation coefficients among the independent variables are below the threshold of 0.80, the results indicate the absence of strong linear relationships, suggesting that multicollinearity is not a concern in this model.

### Heteroscedasticity Test

F-statistic	1.707309	Prob. F(3,196)	0.1668
Obs*R-squared	5.093355	Prob. Chi-Square(3)	0.1651
Scaled explained SS	32.05210	Prob. Chi-Square(3)	0.0000

**Source: Secondary data processed through Eviews 13, 2025**

Based on the results of the heteroscedasticity test, it can be seen that there is no heteroscedasticity problem. This is because the probability value is greater than 0.05.

### Autocorrelation test

F-statistic	56.84505	Prob. F(2,194)	0.0000
Obs*R-squared	73.89909	Prob. Chi-Square(2)	0.0000

**Source: Secondary data processed using Eviews 13, 2025**

The results show that the chi-square probability value is 0.0000, which is less than 0.05. This indicates that the regression model used has an autocorrelation problem.

### Panel Data Regression Analysis

#### Constant (C)

The sample in this study consists of 50 energy sector companies listed with the Financial Services Authority during the 2021–2024 period, with a total of 200 observations. The variables included are Green Accounting (X1), Production Costs (X2), Supply Chain (Z) as a moderating variable, and Sustainable Development (Y) as the dependent variable.

#### Sustainable Development Variable (Y)

The average value of the Sustainable Development variable is 4.63E+14, indicating that, in general, energy sector companies have a relatively high level of sustainability performance.

#### Green Accounting Variable (X1)

The average value of Green Accounting is 0.5450 or 54.5%, indicating that more than half of the sampled companies have implemented green accounting practices.

#### Production Cost Variable (X2)

The average value of Production Costs is 6.72E+10, reflecting the substantial production costs incurred by energy sector companies in their operational activities.

#### Supply Chain Variable (Z)

The average value of the Supply Chain variable is -4.14E+14, indicating that, in general, the supply chain performance of energy sector companies is still facing various challenges.

### **Coefficient of Determination Analysis**

Based on the estimation results obtained from the Random Effects Model (REM) without incorporating the moderating variable, the R-squared value is approximately 0.0029. This indicates that Green Accounting and Production Costs collectively account for only about 0.29% of the variation in Sustainable Development, while the remaining 99.71% is attributable to other factors not included in the research model.

Hypothesis Testing

#### **t-Test (Partial Test)**

The Green Accounting variable yields a regression coefficient of 4.23E+13 with an associated probability value of 0.0451, which is below the 0.05 significance level. This result indicates that Green Accounting exerts a positive and statistically significant influence on Sustainable Development.

#### **F-Test (Simultaneous Test)**

The test results show that the Prob(F-statistic) value is 0.944919, which exceeds the 0.05 significance level. This indicates that, when considered jointly, Green Accounting and Production Costs do not have a statistically significant effect on Sustainable Development.

#### **Moderated Regression Analysis (MRA)**

The Moderated Regression Analysis (MRA) results indicate that the interaction term between Green Accounting and Supply Chain ( $X_1 \times Z$ ) has a positive coefficient and is statistically significant at a level below 0.05. This finding suggests that the Supply Chain variable effectively moderates the relationship between Green Accounting and Sustainable Development. In contrast, the interaction term between Production Costs and Supply Chain ( $X_2 \times Z$ ) exhibits a probability value greater than 0.05, indicating that Supply Chain does not moderate the effect of Production Costs on Sustainable Development.

#### **Coefficient of Determination Analysis (MRA)**

Based on the estimation results obtained from the Random Effect Model (REM) with the inclusion of the Supply Chain variable as a moderator and its associated interaction terms, the R-squared value is 0.0293. This indicates that Green Accounting, Production Costs, Supply Chain, and their interaction effects collectively account for approximately 2.93% of the variation in Sustainable Development. The remaining 97.07% of the variation is attributable to other determinants beyond the scope of this research model, including corporate environmental policies, governance structures, environmentally oriented technological innovations, regulatory frameworks, social dynamics, and other external factors not incorporated in the analysis.

## **CONCLUSION**

The findings of this study demonstrate that green accounting has a statistically significant impact on Sustainable Development among oil, gas, and coal companies listed on the Indonesia Stock Exchange during the 2021–2024 period. This result is in line with Lestari and Alim (2022), who argue that the adoption of green accounting and material flow cost accounting enhances sustainable development by increasing the transparency of environmental-

related costs and promoting decision-making that is oriented toward sustainability.

The results further indicate that production costs do not exert a significant influence on Sustainable Development. This outcome is consistent with prior research on accounting and material flow cost accounting in the context of sustainable development (2024), which emphasizes that effective management of material flows and environmental costs plays a more critical role in supporting corporate sustainability than the composition of production costs alone.

Moreover, the moderation analysis reveals that the supply chain significantly moderates the relationship between green accounting and Sustainable Development. This finding supports the study by Rakhmawati et al. (2019), which shows that the implementation of green supply chain management positively affects corporate environmental performance and, consequently, reinforces the achievement of sustainability objectives. In contrast, the supply chain does not moderate the relationship between production costs and Sustainable Development. This result is also consistent with Somantri and Sudrajat (2023), who conclude that improvements in corporate sustainability are driven more by the adoption of green accounting practices and environmental performance than by efficiency in production costs.

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#### **REFERENCES**

- Bandura, Albert. 1997. *Self-efficacy - The Exercise of Control*, New York: W.H. Freeman and Company.
- May, S. P., Zamzam, I., Syahdan, R., & Zainuddin. (2023). Pengaruh Implementasi Green Accounting, Material Flow Cost Accounting Dan Environmental Performance Terhadap Sustainable Development. *Riset & Jurnal Akuntansi*, 2506-2517
- Endiana, I., Dicriyani, N. L. G. M., Adiyadnya, M. S. P., & Putra, I. P. M. J. S. (2020). The effect of green accounting on corporate sustainability and

financial performance. *The Journal of Asian Finance, Economics and Business*, 7(12), 731-738.  
<https://doi.org/10.13106/jafeb.2020.vol7.no12.731>

Mulyadi. (2019). *Akuntansi Biaya*. Yogyakarta. YKPN.

Widiyanto, A. (2012). Peran Supply Chain Management Dalam Sistem. *Manajemen Dan Bisnis*, 16(2), 91-98.

International Energy Agency (n.d.). Coal - fuels & technologies. Retrieved November 7, 2022, from <https://www.iea.org/fuels-and-technologies/coal>

Lestari, W., & Alim, M. (2022). Pengaruh green accounting, material flow cost accounting (MFCA) terhadap sustainable development. *Jurnal Digital Akuntansi (JUDIKA)*, 59-67.

A. Rakhmawati, K. Rahardjo, and A. Kusumawati, "Faktor Anteseden dan Konsekuensi Green Supply Chain Management," *Jurnal Sistem Informasi Bisnis*, vol. 9, no. 1, pp. 1-8, May. 2019.  
<https://doi.org/10.21456/vol9iss1pp1-8>

B.

Somantri, A. J., & Sudrajat, A. M. (2023). Pengaruh penerapan green accounting dan kinerja lingkungan. *Jurnal Pendidikan Tambusai*, 7(3), 21397-21401.