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The Moderating Role of Environmental Performance on the Relationship between Environmental Cost, Human Resource Accounting, and Financial Performance: Evidence from Indonesia Stock Exchange-Listed Energy Companies (2020–2024)

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Abstract

Financial performance is an important indicator of corporate sustainability, particularly in environmentally sensitive industries such as the energy sector. However, previous studies have produced inconsistent findings regarding the effects of Environmental Cost and Human Resource Accounting (HRA) on financial performance, while evidence on the moderating role of Environmental Performance in Indonesian energy companies remains limited. This study examines the effects of Environmental Cost and HRA on financial performance and investigates whether Environmental Performance moderates these relationships. Using a quantitative approach, this study analyzes secondary data from 18 energy companies listed on the Indonesia Stock Exchange during 2020–2024, resulting in 90 balanced firm-year observations. Financial performance is measured by Return on Assets (ROA), Environmental Cost by the ratio of CSR Cost to Net Profit After Tax (NPAT), HRA by the Historical Cost Model, and Environmental Performance by PROPER ratings. Data are analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4. The results show that Environmental Cost has no significant effect on financial performance ($\beta = -0.075$; $p = 0.686$), whereas HRA has a significant negative effect ($\beta = -0.408$; $p = 0.021$). Environmental Performance does not significantly moderate either relationship. The model explains 10.4% of the variance in financial performance ($R^2 = 0.104$), indicating limited explanatory power and the relevance of other organizational and financial factors.

KEYWORDS

environmental cost; environmental performance; financial performance; human resource accounting.

Introduction

Financial performance remains one of the primary indicators used to evaluate a company's sustainability and long-term competitiveness. However, in environmentally sensitive industries such as the energy sector, financial performance is no longer assessed solely based on profitability but also on the company's ability to manage environmental responsibilities and create sustainable value for stakeholders. The increasing global emphasis on environmental, social, and governance (ESG) practices



Figure 1. Average Financial Performance and Environmental Cost Variables, 2020–2024
Source: Processed secondary data, 2026

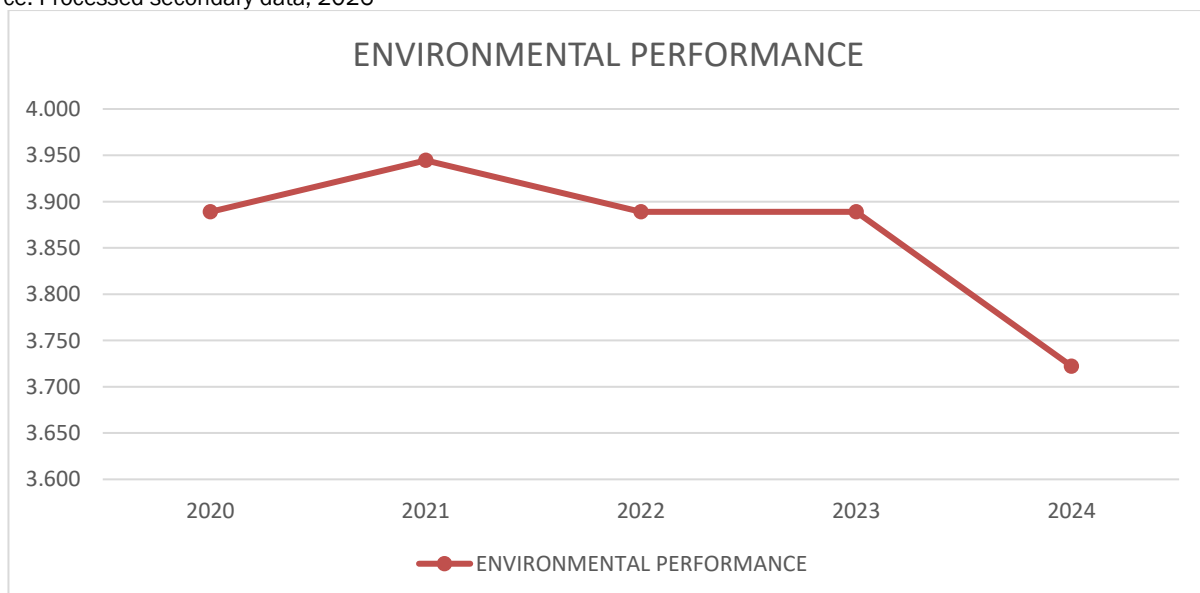


Figure 2. Average Environmental Performance Variable, 2020–2024
Source: Processed secondary data, 2026

has encouraged companies to integrate environmental management into their business strategies, as investors and regulators increasingly consider environmental performance in evaluating corporate value (Velte, 2023; Le, 2024; Alam et al., 2024). This development reflects a shift from traditional profit-oriented business models toward sustainability-oriented corporate governance.

The Indonesian energy sector provides a particularly relevant context for examining this issue because it contributes significantly to national economic growth while simultaneously generating considerable environmental impacts. Energy companies are therefore expected not only to improve profitability but also to comply with increasingly stringent environmental regulations, including the PROPER assessment administered by the Ministry of Environment and Forestry and sustainability reporting requirements under OJK Regulation No. 51/POJK.03/2017. Consequently, firms must demonstrate responsible environmental management to maintain legitimacy and stakeholder trust (Rosaline & Wuryani, 2020; Naciti, 2022).

According to stakeholder theory, companies are responsible not only to shareholders but also to stakeholders

affected by business operations, including employees, communities, and regulators. Therefore, business sustainability increasingly depends on how organizations manage environmental and human resource issues (Freeman, 1984). Corporate activities are inseparable from their environmental impact. Energy companies engaged in natural resource exploration often generate negative externalities, such as environmental damage that harms local communities, particularly through improper waste disposal into waterways. However, companies also contribute positively through community health and environmental programs, scholarships, and other initiatives.

Energy companies play a vital role in Indonesia's economy. Their performance is closely linked to quality human resource management. Competent human resources support optimal business operations and strategic execution. This study focuses on energy companies listed on the IDX, where the primary objective is profit maximization. Achieving optimal profits and enhancing corporate value maintain credibility and support business growth. Therefore, companies must operate efficiently and effectively to improve revenue.

Figure 1 shows that in 2020, the average financial

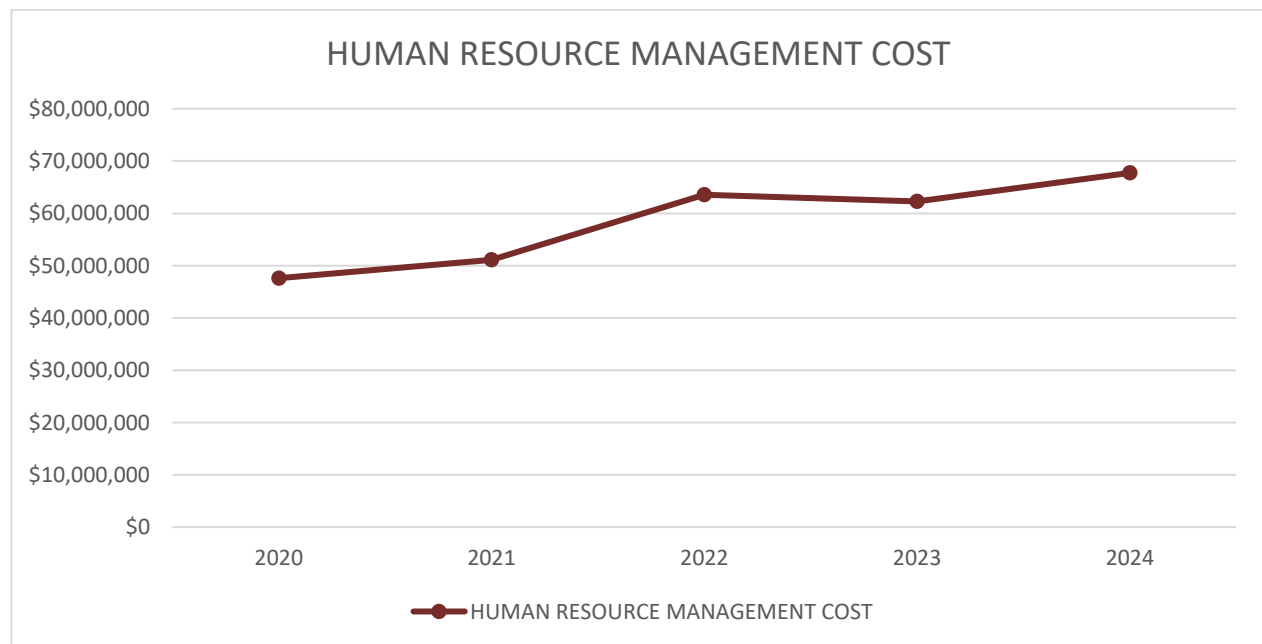


Figure 3. Average Human Resource Management Cost Variable, 2020–2024

Source: Processed secondary data, 2026

performance measured by Return on Assets (ROA) was 0.042. ROA increased to 0.175 in 2021–2022 and continued to rise to 0.254 in 2023. However, this upward trend did not continue into 2024, where financial performance declined to 0.114. ROA measures the return generated from total assets employed; a higher ROA indicates greater net profit from invested assets (Wijaya, 2019).

Environmental issues in Indonesia have become a serious concern requiring immediate action. Companies strive to mitigate negative impacts by allocating funds to environmental costs. Figure 1 indicates an increasing trend in average environmental costs among Indonesian energy companies from 2020 to 2024. However, this increase was not accompanied by improved environmental performance, as shown in Figure 2, where average environmental performance tended to decline over the same period. Companies often perceive environmental costs as reducing profits and being disadvantageous. However, consistent environmental expenditures can enhance corporate image and stakeholder trust, potentially attracting investors and improving financial performance.

Environmental costs help assess the operational performance of companies with environmental impacts. Research by Ladyve, Ask, & Mawardi (2020) suggests that environmental costs significantly affect environmental performance. In contrast, Saputra (2020) found that environmental costs do not positively affect financial performance, as they are often viewed merely as compensation for damages. Saputra (2020) also found that environmental performance positively influences financial performance. However, Angelina & Nursasi (2021) reported no significant effect, indicating that environmental management aligned with PROPER criteria does not guarantee improved financial performance.

The primary goal of corporate activities is profit maximization, which depends heavily on human resources. Employees drive corporate activities, and effective human resource management is essential for enhancing productivity and profitability. Human Resource Accounting (HRA) disclosure facilitates optimal human resource utilization, including fair employee compensation. However, in Indonesia, HRA concepts remain underdeveloped and lack clear regulations. Measuring human resources through financial

reporting recognizes them as assets and integrates them into transaction recording methods. This study focuses on developing HRA to provide accurate information in corporate financial reports.

Figure 3 shows an increasing trend in human resource management costs from 2020 to 2024, contrasting with declining average financial performance in the energy sector in 2024. Despite these regulatory developments, empirical evidence regarding the financial consequences of environmental initiatives remains inconclusive. Several studies have found that environmental cost contributes positively to financial performance by enhancing operational efficiency, corporate reputation, and stakeholder confidence (Xu et al., 2024; López-Arceiz et al., 2022). In contrast, other studies argue that environmental expenditures represent additional operating costs that reduce profitability, particularly in the short term, because the economic benefits of sustainability investments require a longer period to materialize (Saputra, 2020; Usemahu, 2023). Similar inconsistencies are observed in studies of Human Resource Accounting (HRA). While investments in employee development and human capital are theoretically expected to strengthen organizational capabilities and improve financial performance (Kim, 2024; Rahman & Hossain, 2021), several studies report that substantial investments in human resources may initially reduce accounting profitability because they increase operational expenses before generating measurable economic returns (Aitesam-Ullah & Alam, 2024; Kumar, 2023, Oshin & Oluwatoyin, 2018). These contradictory findings indicate that the relationship between environmental investment, human capital investment, and financial performance remains theoretically and empirically unresolved.

From a theoretical perspective, the inconsistency of previous findings can be explained through competing theoretical lenses. Stakeholder Theory argues that companies creating value for stakeholders through environmental responsibility and human capital development are more likely to achieve superior financial performance because stakeholder trust strengthens corporate competitiveness (Freeman, 1984). Conversely, Agency Theory suggests that managers may overinvest in environmental and human resource initiatives to pursue personal reputation or legitimacy, thereby increasing agency costs and reducing short-term profitability (Jensen &

Meckling, 1976). Meanwhile, Legitimacy Theory emphasizes that environmental initiatives generate economic benefits only when stakeholders perceive them as genuine commitments rather than symbolic compliance with regulations (Dumay et al., 2016; Guthrie et al., 2022). These competing theoretical perspectives suggest that environmental performance may explain why previous empirical studies have produced inconsistent results.

In addition to the theoretical inconsistency, several empirical and contextual gaps remain. First, previous studies have generally examined environmental cost and Human Resource Accounting separately, with limited research integrating both variables into a single framework. Second, measurements of Human Resource Accounting vary considerably across studies, ranging from disclosure indices to intellectual capital indicators, resulting in inconsistent empirical conclusions (Kumar, 2023; Sari et al., 2024). Third, although environmental performance has frequently been examined as an independent variable, only a limited number of studies have investigated its role as a moderating variable capable of strengthening or weakening the relationship between environmental cost, Human Resource Accounting, and financial performance (Donata Gozali & Januarti, 2024; Dewi & Puspita, 2024). Finally, most previous evidence originates from developed countries or other emerging economies such as China and Nigeria, whereas empirical evidence focusing specifically on Indonesia's energy sector remains limited despite the existence of the PROPER environmental rating system, which provides a unique institutional setting for sustainability research (Horváthová, 2010; Le, 2024). Although previous studies have extensively examined the relationships between environmental cost, Human Resource Accounting (HRA), environmental performance, and financial performance, several important gaps remain. First, from a theoretical perspective, prior studies provide conflicting explanations regarding the financial consequences of environmental investment. Stakeholder Theory argues that environmental initiatives and investments in human capital create long-term value by strengthening stakeholder trust and corporate reputation (Freeman, 1984). Conversely, Agency Theory suggests that managers may allocate excessive resources to environmental and human capital programs for reputational purposes, thereby increasing agency costs and reducing short-term profitability (Jensen & Meckling, 1976). Furthermore, Legitimacy Theory posits that environmental initiatives improve corporate value only when stakeholders perceive them as genuine commitments rather than symbolic compliance with regulations (Suchman, 1995; Guthrie et al., 2022). These competing theoretical perspectives indicate that environmental performance may explain why previous empirical findings remain inconsistent.

Second, from an empirical perspective, previous studies have predominantly examined environmental cost and Human Resource Accounting separately, while only limited research has simultaneously incorporated both variables into a single analytical framework. Moreover, previous studies have employed different proxies for Human Resource Accounting, including intellectual capital disclosure indices, human capital efficiency, and employee-related expenditures, resulting in inconsistent findings across different institutional settings (Kim, 2024; Kumar, 2023; Aitesam-Ullah & Alam, 2024). In contrast, this study measures Human Resource Accounting using the Historical Cost Model, while environmental performance is measured using the PROPER rating, providing a more objective assessment of corporate environmental responsibility.

Third, from a contextual perspective, empirical evidence concerning the moderating role of environmental performance remains scarce in Indonesia's energy sector.

Unlike previous studies conducted in China, Nigeria, and other emerging economies, Indonesian energy companies operate under the mandatory PROPER environmental rating system and sustainability reporting regulations issued by the Financial Services Authority (OJK), creating a unique institutional environment for examining the interaction between environmental investment and corporate financial performance (Le, 2024; Donata Gozali & Januarti, 2024).

Accordingly, this study offers five main contributions. First, it simultaneously investigates environmental cost and Human Resource Accounting within a single research framework. Second, it positions environmental performance as a moderating variable rather than merely an independent variable. Third, it focuses exclusively on IDX-listed energy companies during 2020–2024, providing updated post-pandemic evidence from an emerging economy. Fourth, it applies the Historical Cost Model for measuring Human Resource Accounting and the PROPER rating for measuring environmental performance, thereby extending previous measurement approaches. Finally, this study employs Partial Least Squares Structural Equation Modelling (PLS-SEM) to examine both direct and moderating relationships, enabling a more comprehensive understanding of the mechanisms linking environmental investment, human capital investment, and financial performance.

Hypothesis Development

The Effect of Environmental Cost on Corporate Financial Performance

Many companies still view environmental costs as additional expenses that reduce profits. However, consistent environmental expenditures can enhance public trust and serve as long-term investments, improving corporate legitimacy. Stakeholder theory suggests that investor decisions are influenced by financial performance improvements. Environmental expenditures should not be considered merely as compliance costs. Effective environmental management can create competitive advantages, improve corporate reputation, and contribute to long-term value creation (Porter & Kramer, 2011).

Usemahu (2023) found that environmental costs positively and significantly affect financial performance. According to Stakeholder Theory, environmental expenditures should not merely be regarded as operational costs but as strategic investments that improve environmental efficiency, strengthen corporate reputation, and increase stakeholder confidence. Companies demonstrating greater environmental responsibility are more likely to attract investors, customers, and regulators, thereby improving long-term financial performance (Freeman, 1984; López-Arceiz et al., 2022; Xu et al., 2024). Although environmental investments may initially increase operating expenses, the long-term benefits through efficiency improvements and reputational gains are expected to outweigh these costs.

H1: Environmental Cost positively affects Financial Performance.

The Effect of Human Resource Accounting on Corporate Financial Performance

Human Resource Accounting (HRA) is an accounting approach that measures the value of corporate investment in human resources as strategic assets, not merely as expenses. HRA includes the collection, measurement, and reporting of costs and economic values related to recruitment, training, development, and employee contributions to organizational goals. This approach enhances understanding of how human resource investments impact operational outcomes and overall corporate performance. Human Resource Accounting recognizes employees as strategic assets whose knowledge, skills, and competencies contribute to future economic

benefits. Consequently, investments in human resources should be evaluated not only as expenses but also as value-creating assets (Flamholtz, 1999). Research by Sari, Yani & Pradhani (2024) and Aitesam Ullah, N. K., & Y. Alam (2024) indicates that HRA influences corporate financial performance, demonstrating that HRA disclosure and management can explain broader variations in financial performance.

The growing recognition of human capital as a strategic organizational resource has increased interest in Human Resource Accounting (HRA). HRA provides a framework for measuring, reporting, and evaluating investments in employees, including recruitment, training, compensation, and development expenditures. Recent studies suggest that firms implementing HRA practices are better able to assess the economic contribution of employees and improve decision-making regarding human capital investments. Consequently, effective HRA implementation may contribute to long-term organizational competitiveness and financial performance. Moreover, expenditures on human resource development can enhance employee capabilities, innovation, and productivity, which ultimately support superior financial performance. Nevertheless, the benefits of such investments may not be realized immediately because the economic returns from human capital development often require a longer period to materialize. Therefore, the relationship between HRA and financial performance may vary depending on organizational characteristics, managerial commitment, and the effectiveness of human capital utilization. (Kim, 2024; Khan et al., 2024).

Human Resource Accounting enables organizations to recognize human capital as a strategic resource rather than merely an operating expense. Investments in employee development enhance organizational knowledge, innovation capability, and productivity, which ultimately contribute to superior financial performance (Kim, 2024; Rahman & Hossain, 2021). Nevertheless, previous studies also acknowledge that the financial benefits of human capital investment may not be immediately observable because employee development requires substantial initial expenditure before generating long-term economic returns (Aitesam-Ullah & Alam, 2024). Despite this possibility, the present study expects the long-term strategic benefits of Human Resource Accounting to outweigh its short-term costs. H2: Human Resource Accounting positively affects Financial Performance.

Performance Moderates the Effect of Environmental Cost on Corporate Financial Performance

Stakeholder theory suggests that companies should consider the interests and expectations of various stakeholders, including their environmental responsibilities, as these may influence stakeholder support and organizational outcomes (Freeman, 1984). Similarly, legitimacy theory suggests that companies seek to align their activities with societal expectations in order to maintain organizational legitimacy (Suchman, 1995). In this context, strong environmental performance may enhance the effectiveness of environmental expenditures by demonstrating the company's commitment to environmental responsibility and reducing environmental-related risks. Empirical evidence supports the moderating role of environmental performance in the relationship between environmental costs and organizational outcomes. Siagian (2021) found that environmental performance moderates the relationship between environmental costs and business performance. More recently, Dewi & Puspita (2024) found that environmental performance significantly moderates the effect of environmental costs on financial performance, indicating that stronger environmental performance can

strengthen the positive relationship between environmental cost management and financial performance. These findings suggest that the financial benefits of environmental expenditures may depend not only on the amount of environmental costs incurred but also on the extent to which such expenditures are accompanied by effective environmental performance.

Companies with superior environmental performance are expected to utilize environmental expenditures more efficiently, thereby converting environmental investments into greater stakeholder trust, regulatory legitimacy, and competitive advantage. Consequently, environmental performance measured by the PROPER rating is expected to strengthen the positive relationship between environmental cost and financial performance (Donata Gozali & Januarti, 2024; Degenhart et al., 2024).

H3: Environmental Performance positively moderates the relationship between Environmental Cost and Financial Performance, such that the positive effect of Environmental Cost on Financial Performance becomes stronger when Environmental Performance is higher.

Environmental Performance Moderates the Effect of Human Resource Accounting on Corporate Financial Performance

Stakeholder theory emphasizes that companies must address the expectations of various stakeholders, including communities and environmental regulators. Companies with strong environmental performance meet these expectations, maximizing the value derived from human resource investments. Legitimacy theory suggests that practices aligning with social norms, such as good environmental performance, enhance corporate legitimacy in the eyes of the public and investors, potentially strengthening HRA's contribution to financial performance. Donata Gozali, E. O., & Januarti, I. (2024) found that moderating variables such as environmental leadership or environmental performance can influence the relationship between environmentally oriented accounting practices and financial outcomes.

Organizations with higher environmental performance generally possess stronger sustainability-oriented cultures, enabling investments in human capital to be translated more effectively into operational innovation, environmental capability, and organizational performance. Therefore, environmental performance is expected to strengthen the positive relationship between Human Resource Accounting and financial performance. (Le, 2024; Velte, 2023)

H4: Environmental Performance positively moderates the relationship between Human Resource Accounting and Financial Performance, such that the positive effect of Human Resource Accounting on Financial Performance becomes stronger when Environmental Performance is higher.

Methods

Population and Sample

The population of this study consisted of 81 energy companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2024 period. A purposive sampling technique was employed to select companies that satisfied the research objectives. The sampling criteria were as follows: (1) energy companies consistently listed on the IDX during 2020–2024; (2) companies publishing complete annual reports throughout the observation period; (3) companies disclosing Corporate Social Responsibility (CSR) information; and (4) companies participating in the Corporate Performance Rating Program (PROPER) administered by the Ministry of Environment and Forestry. After applying these criteria, 18 companies were selected, resulting in 90 balanced firm-year observations (18 companies × 5 years) (see Table 1). A balanced panel dataset

Table 1. Sample Selection

No	Criteria	Number of Companies
1.	Energy companies listed on IDX (2020–2024)	81
2.	Companies without complete annual reports	(33)
3.	Companies without CSR disclosure	(1)
4.	Companies not participating in PROPER	(29)
Final sample		18
Firm-year observations (18 × 5)		90

ensures that each sampled company contributes observations for every year of the study period, thereby improving the consistency and comparability of the analysis.

Operational Definition

This study employs a quantitative research method. Secondary data include annual financial reports and sustainability reports of energy companies listed on the Indonesia Stock Exchange from 2020 to 2024, obtained from www.idx.co.id and official company websites. The research variables are as follows (see [Table 2](#)).

Data Analysis

This study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 4 to examine both the direct and moderating relationships among environmental cost, Human Resource Accounting, environmental performance, and financial performance.

Although the study utilized secondary financial data with single-item observed variables, PLS-SEM was considered appropriate for several reasons.

First, the objective of this study is prediction-oriented rather than theory confirmation. PLS-SEM is particularly suitable for exploratory and predictive research that aims to maximize the explained variance (R^2) of endogenous variables while simultaneously estimating complex structural relationships, including interaction (moderating) effects ([Hair et al., 2022](#)).

Second, the proposed research model incorporates moderation effects, requiring the simultaneous estimation of both direct and interaction relationships within a single analytical framework. PLS-SEM provides greater flexibility in modelling interaction terms without requiring strict assumptions regarding multivariate normality or homoscedasticity ([Hair et al., 2022](#)).

Third, the study is based on a relatively small sample size (18 companies with 90 firm-year observations). Compared with covariance-based SEM and panel regression approaches, PLS-SEM is more robust when applied to small-to-medium samples and is less sensitive to violations of normality assumptions ([Hair et al., 2022](#); [Sarstedt et al., 2022](#)).

Furthermore, this study employed single-item observed variables derived from audited financial statements and official environmental performance ratings. Since each construct was represented by a single observable indicator (ROA, environmental expenditure, Human Resource Accounting expenditure, and PROPER rating), conventional measurement model assessments such as Cronbach's Alpha, Composite Reliability, Average Variance Extracted (AVE), and discriminant validity were not applicable. Instead, the analysis focused on evaluating the structural model through path coefficients, coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and bootstrapping with 5,000 resamples to assess the significance of the hypothesized

relationships.

Justification for Using SmartPLS 4

This study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 4 to examine the direct and moderating relationships among Environmental Cost, Human Resource Accounting, Environmental Performance, and Financial Performance. PLS-SEM was selected because it is suitable for prediction-oriented research, supports moderation analysis, and performs well with relatively small samples (18 companies or 90 firm-year observations). ([Hair et al., 2022](#)).

All variables were measured using single-item observed indicators derived from audited annual reports and official PROPER ratings. Therefore, conventional measurement model assessments, such as outer loadings, Cronbach's Alpha, Composite Reliability, AVE, Fornell–Larcker Criterion, and HTMT, are not applicable because these procedures are designed for latent constructs measured by multiple indicators. Accordingly, this study focuses on structural model evaluation, including path coefficients, R^2 , f^2 , VIF, SRMR, and bootstrapping. In line with the latest SmartPLS recommendations, predictive model assessment follows the procedures available in SmartPLS 4, where the Blindfolding (Stone–Geisser's Q^2) procedure has been discontinued ([Hair et al., 2022](#)).

Structural Model (Inner Model) Analysis

This study uses Partial Least Squares (PLS) analysis, a robust technique not reliant on strict statistical assumptions. PLS is suitable for small sample sizes, missing data, or multicollinearity. The moderating variable in this study also justifies the use of PLS. SmartPLS software was used for analysis, starting with structural model specification and hypothesis testing. Partial Least Squares Structural Equation Modelling (PLS-SEM) was selected because the proposed model simultaneously estimates direct and moderating relationships while focusing on prediction rather than theory confirmation. In addition, PLS-SEM is appropriate for studies with relatively small sample sizes and does not require multivariate normality assumptions. Although the variables are measured using secondary financial data, PLS-SEM enables simultaneous estimation of interaction effects and provides robust parameter estimates through non-parametric bootstrapping ([Hair et al., 2022](#)).

R^2 for endogenous latent constructs:

Classified as strong (0.67), moderate (0.33), or weak (0.19). ([Chin, 1998](#)).

Data Screening and Treatment

Before hypothesis testing, the dataset was screened for missing values, outliers, and data consistency. No missing observations were identified because only companies with complete annual reports during the observation period were included. Extreme values were evaluated using standardized residuals and boxplots. Continuous variables were standardized to reduce scale differences across companies. The Environmental Cost variable was calculated consistently for all firm-year observations using CSR cost divided by net profit after tax. The resulting ratio was entered into the analysis as the observed value. No additional transformation or winsorization was applied.

Hypothesis Testing

Structural relationships were estimated using the bootstrapping procedure with 5,000 resamples, as recommended by [Hair et al., \(2022\)](#). Statistical significance was evaluated using path coefficients (β), t-statistics, p-values, and confidence intervals.

Table 2. Operational Definitions of Variables

Number	Variable	Definition	Indicator
1.	Financial Performance (Y)	Financial Performance (FP) was measured using Return on Assets (ROA), calculated as net income divided by total assets. ROA was selected because it reflects management efficiency in utilizing corporate assets to generate earnings and is one of the most widely used profitability indicators in accounting research.	$ROA = \frac{\text{net profit after tax}}{\text{Total Assets}} \times 100\%$ Sources: (Damayanti & Shinta Budi Astuti, 2022)
2.	Environmental Performance (Z)	Assesses corporate contribution to environmental preservation using PROPER ratings (Setiadi, 2021).	PROPER Ranking Criteria Scores Gold : 5 Green : 4 Blue : 3 Red : 2 Black : 1 Sources: https://proper.menlhk.go.id (Rosaline & Wuryani, 2020)
3.	Environmental Cost (X1)	Environmental Cost (EC) is measured as the ratio of Corporate Social Responsibility (CSR) expenditure to net profit after tax. This ratio reflects the relative magnitude of CSR-related expenditure compared with the company's profitability.	The formula is expressed as follows: $EC = \frac{\text{CSR Cost}}{\text{net profit after tax}}$ Sources: (Qatrunnada, 2023) CSR expenditure and net profit after tax are measured in the same currency (USD) to ensure consistency in the calculation. The resulting ratio is used as the observed value of Environmental Cost in the analysis. Negative Environmental Cost values do not indicate negative CSR expenditure. Rather, they occur when a company reports a negative net profit after tax, which serves as the denominator of the ratio.
4.	Human Resource Accounting (X2).	Human Resource Accounting (HRA) is measured using the Historical Cost Model, which estimates the value of human resources based on the historical costs incurred by the company to recruit, train, compensate, and provide benefits to employees.	HRA is measured by the total costs incurred by the company for employee recruitment, training, compensation, and benefits. $HRA = \text{Recruitment Costs} + \text{Training Costs} + \text{Compensation Costs} + \text{Employee Benefits}$ Sources: Brummet, Flamholtz & Pyle (1968), Kumar (2023).

Path Coefficients:

Indicate the magnitude of relationships among latent constructs. Hypotheses are supported if t-statistics exceed critical values, original sample signs align with hypotheses, and p-values < 0.05.

Indirect Effects:

Assess how exogenous variables affect endogenous variables through moderators. Significance is determined by p-values < 0.05 and t-statistics exceeding critical values.

Since this study employs single-item observed variables derived from audited secondary financial data, the assessment focuses on the structural model rather than the measurement model. Therefore, reliability and validity statistics commonly reported for latent-variable models (e.g., Composite Reliability, AVE, HTMT, and Fornell-Larcker Criterion) are not applicable in the present study.

Result and Discussion

Descriptive Analysis

Descriptive statistics (Table 3) show an average ROA of 0.148 with a standard deviation of 0.153, indicating considerable variability in financial performance.

Environmental performance averaged 3.867 with relatively high consistency, while environmental costs and human resource accounting exhibited wider variations

Coefficient of Determination (R-Square)

The R-Square value represents the extent to which variation in the dependent variable can be explained by the independent variables in the model. The higher the R-Square value, the better the model's ability to explain or predict the dependent variable. The following presents the calculation results of the R-Square value using SmartPLS 4 (see Table 4).

The coefficient of determination ($R^2 = 0.104$) indicates that the proposed model explains approximately 10.4% of the variation in financial performance. According to Chin (1998), this value reflects relatively weak explanatory power. Therefore, the findings should be interpreted cautiously because a substantial proportion of financial performance remains explained by factors beyond the variables included in this study. Several important determinants, such as firm size, leverage, liquidity, firm age, board governance, ownership structure, market competition, and macroeconomic conditions, were not incorporated into the present model. Their exclusion may contribute to the relatively low explanatory power observed. Nevertheless, the study remains valuable because it specifically investigates the moderating role of

Table 3. Descriptive Statistics

	Mean	Median	Min	Max	Standard Deviation
Financial Performance	0.148	0,101	-0,080	0,616	0,153
Environmental Performance	3.867	4,000	3,000	5,000	0,824
Environmental Cost	0.017	0,008	-1,893	0,797	0,235
Human Resources Accounting	58.451.699	\$ 11.171.580	\$ (6.605)	\$ 593.371.399	\$ 124.266.994

Source: SmartPLS 4 Output, 2026

Table 4. R-Square

	R-square	R-square adjusted
Financial Performance	0.104	0.047

Source: Output SmartPLS 4, 2026

Table 5. Inner VIF Value

Relationship	VIF
Environmental Cost → Financial Performance	1.043
Human Resource Accounting → Financial Performance	3.848
Environmental Performance → Financial Performance	1.011
Environmental Performance × Environmental Cost	1.049
Environmental Performance × Human Resource Accounting	3.839

Source: SmartPLS 4 Output, 2026

Table 6. Effect Size (f²)

Relationship	f ²	Interpretation
Environmental Cost → Financial Performance	0.006	Negligible
Human Resource Accounting → Financial Performance	0.048	Small
Environmental Performance → Financial Performance	0.019	Negligible
Environmental Performance × Environmental Cost	0.051	Small
Environmental Performance × Human Resource Accounting	0.017	Negligible

Source: SmartPLS 4 Output, 2026

environmental performance in the relationship between environmental cost, Human Resource Accounting, and financial performance within Indonesia's energy sector, providing initial empirical evidence for future studies employing more comprehensive models.

Despite the robustness of the structural model estimation, this study has several limitations. First, the proposed model explains only a relatively small proportion of the variance in Financial Performance, indicating that other determinants such as firm size, leverage, corporate governance, liquidity, firm age, and macroeconomic conditions should be incorporated in future studies. Second, all variables were measured using single-item observed indicators obtained from audited secondary data, limiting the applicability of conventional latent-variable measurement assessments. Third, future research is encouraged to compare the findings obtained from PLS-SEM with panel regression or moderated regression approaches to evaluate the robustness and consistency of the estimated relationships.

Traditional Stone-Geisser Q² was not reported because the Blindfolding procedure is no longer available in the current version of SmartPLS used in this study. Predictive

assessment using PLSpredict was not included because the study primarily focuses on testing the proposed direct and moderation relationships.

Structural Model Evaluation

The structural model was evaluated using collinearity diagnostics, coefficient of determination (R²), effect size (f²), model fit indices, and bootstrapping procedures. Since all constructs were measured using single-item observed variables obtained from audited financial statements and official PROPER ratings, the evaluation focused on the structural model rather than the measurement model.

The collinearity assessment indicates that all predictor variables have VIF values ranging from 1.011 to 3.848 (Table 5), which are below the recommended threshold of 5.00 (Hair et al., 2022). Therefore, multicollinearity is not considered a concern in the structural model.

The effect size analysis shows that all predictors have relatively weak practical effects on Financial Performance (Table 6). Environmental Cost (f² = 0.006), Environmental Performance (f² = 0.019), and the interaction between Environmental Performance and Human Resource Accounting (f² = 0.017) exhibit negligible effects. Meanwhile, Human Resource Accounting (f² = 0.048) and the interaction between Environmental Performance and Environmental Cost (f² = 0.051) demonstrate small effect sizes. According to Hair et al., (2022) these findings indicate that each predictor contributes only modestly to explaining variations in Financial Performance.

Predictive relevance was evaluated using the procedures recommended in the latest SmartPLS software. The current version of SmartPLS (Version 4) no longer implements the Blindfolding procedure for calculating Stone-Geisser's Q² because this approach has been deprecated by the software developers. Instead, predictive assessment is performed using PLSpredict together with structural model evaluation, including R², f², VIF, SRMR, and bootstrapping results (Hair et al., 2022). Accordingly, the present study follows these updated methodological recommendations.

In accordance with the latest SmartPLS methodology, predictive model evaluation was based on PLSpredict rather than the traditional Blindfolding procedure. SmartPLS Version 4 has discontinued the implementation of Stone-Geisser's Q² because predictive assessment is now recommended through out-of-sample prediction using PLSpredict (Hair et al., 2022). Therefore, this study reports R², effect size (f²), collinearity diagnostics (VIF), model fit indices, and bootstrapping results as the primary structural model evaluation criteria.

Structural Model (Inner Model) Analysis

The structural model was evaluated using SmartPLS 4, as shown in Figure 4.

Hypothesis testing (Table 7) shows that environmental cost does not significantly affect financial performance ($\beta = -0.075$; $p = 0.686$). This aligns with Qiu et al. (2021), who concluded that the relationship between environmental expenditure and financial performance is complex and moderated by contextual factors. The Natural Resource-Based View (Hart & Dowell, 2011), explains that financial impacts of environmental investments materialize in the long term through dynamic capabilities, which may not be captured in short-term measurements.

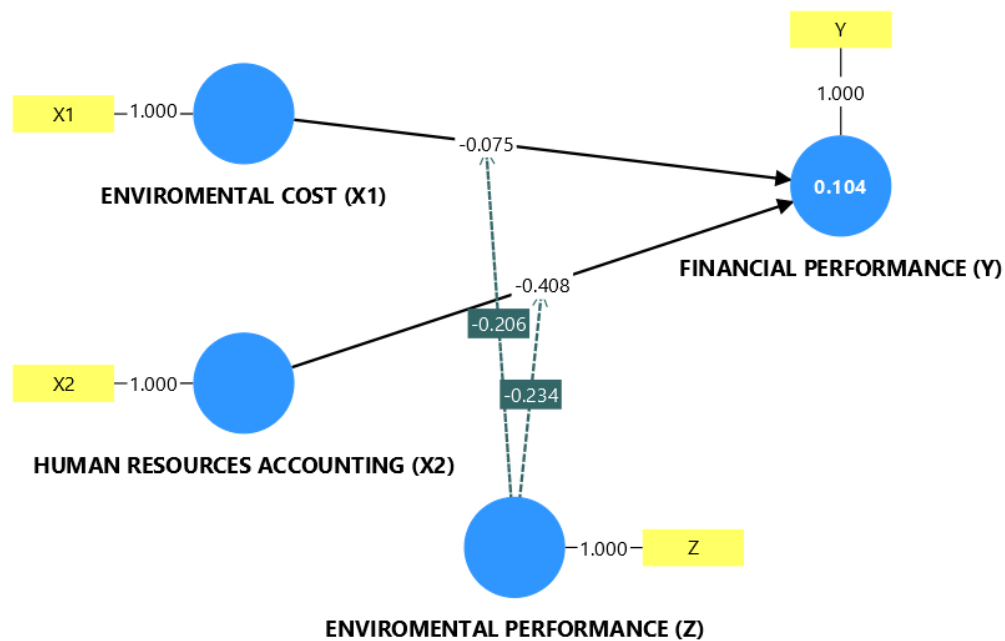


Figure 4. Structural Model (Inner Model) Analysis

Source: SmartPLS 4 Output, 2026

Table 7. Path Coefficient Results

Variable	Original Sampel (O)	t Statistics (O/STDEV)	P Values	Result
Environmental Cost (X1) -> Financial Performance (Y)	-0.075	0.404	0.686	Negative but Insignificant
Human Resources Accounting (X2) -> Financial Performance (Y)	-0.408	2.315	0.021	Negative and significant
Environmental Performance → Financial Performance	-0.131	1.320	0.187	Negative but Insignificant
Environmental Performance (Z) X Environmental Cost (X1) -> Financial Performance (Y)	-0.206	0.801	0.423	Negative but Insignificant
Environmental Performance (Z) X Human Resources Accounting (X2) -> Financial Performance (Y)	-0.234	1.529	0.126	Negative but Insignificant

Source: SmartPLS 4 Output, 2026

Similarly, environmental performance does not significantly affect financial performance ($\beta = -0.131$; $p = 0.187$). This supports [Endrikat et al. \(2020\)](#), who reported small and inconsistent direct effects. The relationship depends on mediating factors like corporate reputation and innovation capability. [Busch et al. \(2021\)](#) found that symbolic environmental performance ("greenwashing") yields no financial benefits, explaining its insignificance. The interaction between environmental performance and environmental cost is also insignificant ($\beta = -0.206$; $p = 0.423$), indicating no material synergy or trade-off affecting financial performance.

Conversely, human resource accounting negatively and significantly affects financial performance ($\beta = -0.408$; $p = 0.021$). Although Human Resource Accounting was found to have a statistically significant negative effect on financial performance, this finding should be interpreted cautiously. Rather than indicating that investments in human resources are inherently detrimental to firm performance, the result may reflect the short-term accounting treatment of employee-related expenditures. Human capital investments generally require considerable financial resources before producing measurable economic returns. Consequently, firms with relatively higher employee development expenditures may temporarily experience lower profitability because these

expenditures are recognized immediately as operating expenses, whereas their benefits materialize over a longer period ([Aitesam-Ullah & Alam, 2024](#); [Kim, 2024](#)). Furthermore, the observed relationship may also be influenced by omitted variables such as firm size, leverage, corporate governance, ownership structure, or operational efficiency, which were not incorporated into the present model. Therefore, the negative coefficient should not be interpreted as evidence that Human Resource Accounting reduces firm value, but rather as indicating that the short-term financial consequences of human capital investment differ from its long-term strategic benefits.

The negative significant effect of HRA should not be interpreted as evidence that investment in human resources is inherently detrimental to financial performance. Because HRA is measured using nominal historical costs, the measure may partly reflect differences in firm size and the magnitude of employee-related expenditures across companies. In addition, recruitment, training, compensation, and employee benefit costs are generally recognized as current-period expenses, while their potential benefits may materialize over a longer period. Therefore, the negative relationship may reflect short-term cost recognition rather than a failure of human resource investment to create long-term value. The negative effect of Human Resource Accounting differs from the positive

relationship predicted by Stakeholder Theory and several previous studies (e.g., Sari et al., 2024; Aitesam-Ullah & Alam, 2024). This inconsistency may be attributed to differences in industrial characteristics, measurement approaches, and the accounting treatment of human resource expenditures. Unlike previous studies conducted in manufacturing or service sectors, energy companies require substantial long-term investments, causing employee-related expenditures to be recognized immediately as expenses while their economic benefits may only materialize in future periods. Consequently, the present findings highlight that the financial implications of Human Resource Accounting are highly context-dependent and may differ across industries and institutional settings.

The interaction between environmental performance and human resource accounting is insignificant ($\beta = -0.234$; $p = 0.126$), suggesting these practices are implemented separately without strategic integration, as required by Integrated Reporting (IIRC, 2021). Future research is encouraged to conduct robustness analyses using panel regression, alternative Human Resource Accounting measurements, and additional control variables to verify the stability of the reported relationships.

Conclusion

This study examined the effects of Environmental Cost and Human Resource Accounting on Financial Performance, as well as the moderating role of Environmental Performance in Indonesian energy companies listed on the Indonesia Stock Exchange during the 2020–2024 period. Based on the empirical results, Environmental Cost did not have a significant effect on Financial Performance, indicating that environmental expenditures alone have not yet generated measurable financial benefits. In contrast, Human Resource Accounting had a significant negative effect on Financial Performance, suggesting that employee-related expenditures may reduce short-term profitability because their economic benefits are realized over a longer period. Furthermore, Environmental Performance did not significantly moderate the relationship between Environmental Cost and Financial Performance or between Human Resource Accounting and Financial Performance. These findings indicate that the PROPER rating has not yet functioned as an effective mechanism for strengthening the financial benefits of environmental or human capital investments in the Indonesian energy sector.

Nevertheless, these findings should be interpreted cautiously because the structural model demonstrates relatively weak explanatory power ($R^2 = 0.104$; Adjusted $R^2 = 0.047$), indicating that a substantial proportion of Financial Performance is explained by factors beyond the variables included in this study. Variables such as firm size, leverage, sales growth, commodity price fluctuations, corporate governance, and operational efficiency may provide additional explanatory power and should be considered in future research.

Theoretically, this study extends the application of Stakeholder Theory, Legitimacy Theory, and the Resource-Based View by showing that environmental performance, as measured by the government-issued PROPER rating, does not necessarily strengthen the relationship between environmental investment, human resource investment, and financial performance. This finding suggests that regulatory environmental ratings alone may be insufficient to generate superior financial outcomes unless accompanied by effective strategic resource management and organizational capabilities.

Practically, the findings imply that managers of energy companies should not expect immediate financial returns from environmental and human resource expenditures. Instead, these investments should be integrated into long-term corporate strategies supported by effective governance, innovation, and operational efficiency. For regulators, the results suggest the importance of strengthening policies that encourage firms to translate environmental compliance into sustainable competitive advantages rather than merely fulfilling regulatory requirements.

This study employed balanced panel data consisting of 18 energy companies observed over the 2020–2024 period (90 firm-year observations), rather than a cross-sectional design. Several limitations should be acknowledged. The relatively low explanatory power indicates that important determinants of Financial Performance were not incorporated into the model. In addition, the analysis relied on single-item observed variables derived from secondary financial data. Future studies are therefore encouraged to include additional control variables, such as firm size, leverage, firm age, board characteristics, ownership structure, and commodity price exposure, and to compare the findings using panel regression or other alternative analytical approaches to improve the robustness and generalizability of the results. A further limitation concerns the panel structure of the dataset. Although the study contains 90 firm-year observations from 18 companies over five years, observations belonging to the same firm may not be fully independent because they can be affected by persistent firm-specific characteristics. The study therefore does not claim that the PLS-SEM estimates fully address unobserved firm-level heterogeneity. Future research could complement the PLS-SEM approach with fixed-effects or random-effects panel regression to provide additional robustness.

Author contributions

Faridhatun Faidah was responsible for conceptualization, data collection, data analysis, interpretation of findings, and preparation of the manuscript draft. Keke Tamara Fahira contributed to methodology development, data validation, and manuscript revision. Annisya Lutfi Septanti contributed to theoretical development, literature review, and critical review of the manuscript. Tri Handayani contributed to data validation, methodological review, and critical revision of the manuscript. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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