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The Influence of Intangible Assets, Financial Flexibility, and Human Capital on Sustainable Growth with Green Innovation as a Moderator

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Abstract: This study, titled "The Influence of Intangible Assets, Financial Flexibility, and Human Capital on Sustainable Growth with Green Innovation as a Moderator," aims to analyze the effects of intangible assets, financial flexibility, and human capital on sustainable growth within energy sector companies in Indonesia, with green innovation serving as a moderating variable. The research is driven by the challenges faced by the energy sector, such as climate change, resource scarcity, and the transition to renewable energy. A quantitative approach was applied, utilizing secondary data from financial reports of energy companies listed on the Indonesia Stock Exchange during the 2020–2023 period, analyzed using STATA software. The findings indicate that intangible assets have no significant effect on sustainable growth, whereas financial flexibility and human capital show positive and significant impacts. Additionally, green innovation strengthens the relationship between the three variables and sustainable growth. This research is expected to provide valuable insights for the development of sustainable business strategies in the energy sector.

Keywords: Intangible Assets, Financial Flexibility, Human Capital, Green Innovation, Sustainable Growth.

INTRODUCTION

The energy sector plays a crucial role in economic development and societal welfare. In Indonesia, the energy sector is not only a major driver of economic growth but also a significant contributor to environmental challenges. The increasing demand for energy, driven by industrial expansion and population growth, has led to higher levels of carbon emissions and resource depletion (*Kementerian Energi dan Sumber Daya Mineral*, 2022). According to the *Badan Pusat Statistik* (BPS), the national primary energy production in 2022 increased by 7.7% compared to the previous year, with coal as the primary contributor, producing 17,267,940 terajoules, followed by natural gas at 2,388,615 terajoules, and crude oil and condensate at 1,364,177 terajoules. This trend indicates the dominance of non-renewable

energy sources in Indonesia's energy production mix, which contributes to environmental degradation and resource scarcity.

Final energy consumption in 2022 also experienced a significant increase, reaching 6,914,802 terajoules or approximately 45% higher than in 2021. The largest consumers of energy were the industrial, construction, and non-oil mining sectors, as presented in Table 1. This surge in energy demand reflects the expansion of industrial activities, which further exacerbates environmental pressures.

Table 1. Energy Consumption by Sector, 2018–2022 (in terajoules)

Sector	2018	2019	2020	2021	2022
Industrial, Construction, and Mining (Non-Oil)	2,022,026	2,463,953	2,158,577	2,006,580	3,691,993
Transportation	1,154,560	987,288	837,094	855,099	1,263,435
Households	1,458,425	1,550,322	1,532,150	1,579,168	1,554,160
Agriculture	18,767	19,438	19,727	19,616	20,102
Other Consumers	293,914	334,005	371,176	308,330	385,111
Total Energy	4,947,693	5,355,006	4,914,960	4,768,794	6,914,802

Source: *Badan Pusat Statistik* (2023)

The dominance of fossil fuels and the rapid growth in energy consumption pose significant challenges for Indonesia's sustainable development goals. Global shifts toward greener energy and reduced carbon emissions have led to declining investments in fossil fuel projects, prompting the need for a strategic transition towards renewable energy and sustainable business practices (*Kementerian Energi dan Sumber Daya Mineral*, 2022).

The Resource-Based View (RBV) suggests that firm-specific resources that are valuable, rare, inimitable, and non-substitutable are essential for achieving a competitive advantage (Wernerfelt, 1984; Barney, 1991). In the context of the energy sector, intangible assets, financial flexibility, and human capital are considered strategic resources that can drive sustainable growth (Hitt, Ireland, and Hoskisson, 2017). Intangible assets, such as intellectual property, brand reputation, and technological know-how, contribute to long-term competitive positioning and market differentiation. Financial flexibility, defined as the company's capability to access capital and adapt financial strategies to market fluctuations, strengthens its resilience to economic uncertainty (Byoun, 2008). Meanwhile, human capital-represented by employee skills, expertise, and innovation capacity-supports the organization’s adaptability and growth (Becker, 1964).

The endogenous growth theory highlights the significance of human capital and innovation as primary factors for long-term economic and business growth (Romer, 1990). In this framework, investments in knowledge and technological capabilities are seen as pivotal for sustainable growth. Furthermore, the concept of dynamic capabilities emphasizes a firm's capacity to integrate, develop, and reconfigure both internal and external competencies in response to rapidly changing environments, ensuring competitive sustainability amid shifts in the industry (Teece, Pisano, and Shuen, 1997).

Based on these theoretical foundations, this study aims to explore how these strategic resources impact sustainable growth in energy sector companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2023 period. Additionally, it examines the moderating effect of green innovation in strengthening the connection between these resources and sustainable growth. Green innovation involves the adoption of technologies that enhance energy efficiency, sustainable production methods, and environmentally conscious corporate policies to reduce environmental impacts while improving competitive positioning.

Operationally, intangible assets are defined as non-physical, identifiable resources controlled by an entity that are expected to provide future economic benefits (PSAK 19, 2015). Unlike tangible assets such as land, buildings, or equipment, intangible assets are characterized by their non-physical nature, including intellectual property, brand reputation, and technological know-how. In this study, intangible assets are measured using the intangibility ratio, representing the proportion of intangible assets to total assets, as suggested by Ramadhan et al. (2022). This ratio captures the extent to which non-physical assets contribute to the company's total asset value, reflecting its strategic investment in intellectual capital and innovation.

Financial flexibility, as defined by Byoun (2008), is the firm's capacity to respond to financial needs through rapid and adaptive resource mobilization, whether by taking preventive measures, adjusting strategies, or exploiting growth opportunities to maximize firm value. The measurement of financial flexibility in this study follows the approach proposed by Teng et al. (2021), which includes two key components: cash flexibility and debt flexibility. Cash flexibility is calculated as the ratio of cash and cash equivalents to total assets, indicating the company's liquidity position, while debt flexibility is measured as 1 - Corporate Debt Ratio, reflecting the firm's leverage and capacity to manage debt obligations effectively.

Human capital is conceptualized as an individual's investment aimed at achieving higher consumption levels in the future, particularly through education and health (Todaro, 2020). In this study, human capital is measured using the salary surplus approach adapted from Widarwati & Haryono (2019), which evaluates the difference between a company's salary costs and industry standards, adjusted by company revenue. This method reflects the firm's commitment to employee development, skill enhancement, and knowledge investment, which are crucial for driving productivity and innovation. Meanwhile, green innovation as defined by Zhang et al. (2019), refers to improvements in products and processes aimed at energy conservation, pollution reduction, waste recycling, and the integration of eco-friendly designs into business operations. Green innovation is measured through content analysis of annual and sustainability reports, as outlined by Agustia et al. (2019), focusing on four indicators: green technology application, sustainable production, eco-friendly product design, and recyclable materials usage. Each indicator is scored based on its disclosure in company reports, with the final score representing the proportion of disclosed indicators to the total number of indicators. The dependent variable, sustainable growth, is defined as the maximum growth rate a company can achieve without external financing while maintaining a stable debt-to-equity ratio (Ross & Jordan, 2000). The measurement of sustainable growth in this study uses the Higgins approach, as applied by Ionita and Dinu (2021). This model evaluates sustainable growth based on two primary indicators: Return on Equity (ROE) and the company's dividend policy, reflecting the firm's capacity to grow organically while preserving financial stability.

The formulation of research problems is summarized as follows: 1. Does intangible assets have a positive and significant influence on sustainable growth? 2. Does financial flexibility have a positive and significant influence on sustainable growth? 3. Does human capital have a positive and significant influence on sustainable growth? 4. Does green innovation strengthen the relationship between intangible assets and sustainable growth? 5. Does green innovation strengthen the relationship between financial flexibility and sustainable growth? 6. Does green innovation strengthen the relationship between human capital and sustainable growth?

This study is expected to provide theoretical contributions to sustainable business strategy development, particularly in the energy sector, which faces increasing environmental pressures. It also aims to offer practical insights for energy companies in optimizing their resources and integrating green innovation into their business strategies to achieve sustainable growth in alignment with global environmental goals.

METHODS

Type of Research

This study adopted a quantitative research design leveraging secondary data to empirically investigate the influence of intangible assets, financial flexibility, and human capital on sustainable growth, with green innovation acting as a moderating variable.

Population and Sample

The target population for this research comprised companies in the energy sector listed on the Indonesia Stock Exchange (IDX) during the 2020–2023 period. A purposive sampling method was applied to select companies that consistently published audited financial statements, sustainability reports, and participated in the PROPER environmental program administered by the *Kementerian Lingkungan Hidup dan Kehutanan*. Based on these selection criteria, 19 companies were identified, contributing to a total of 76 observational data points collected over a span of four years.

Time and Place of Research

The research was conducted from July to December 2024.

Research Instruments and Procedures

The instrument used in this study was a documentation checklist designed to systematically collect data on intangible assets, financial flexibility, human capital, green innovation, and sustainable growth indicators. Data collection involved reviewing and recording quantitative information from company reports.

Research Techniques

Data analysis was conducted using descriptive statistical methods alongside panel data regression analysis with the Common Effect Model (CEM) approach. The regression model underwent testing for normality, multicollinearity, heteroscedasticity, and autocorrelation to ensure robustness before hypothesis testing. The testing methods included t-tests, F-tests, and Moderated Regression Analysis (MRA) to examine the moderating role of green innovation.

RESULTS AND DISCUSSION

Results

Deskriptive Statistical Test

The descriptive statistics show the distribution and spread of data for each variable used in the study. Table 2 presents the mean, minimum, maximum, and standard deviation values of intangible assets, financial flexibility, human capital, sustainable growth, and green innovation.

Table 2. Descriptive Statistical Analysis Results

Variabel	Obs	Minimum	Maximum	Mean	Std. Deviation
X_1	76	0,00000	0,30839	0,032571	0,0645266
X_2	76	0,05506	1,33532	0,678791	0,2938508
X_3	76	-2,56190	0,92289	0,0000005	0,97979627
Y	76	-0,85670	0,25892	0,049724	0,2213594
Z	76	0,25	100	0,740132	0,2177184

Source: Output Stata (2025)

Based on Table 2, the total number of observations in this study is 76, collected from 19 companies over a four-year period (2020–2023). The descriptive statistical analysis reveals that intangible assets (X_1) have an average value of 0.0326 with a standard deviation of 0.0645, indicating significant variation across companies. The minimum value of 0.00 was found in multiple companies across different years, while the maximum value of 0.3084 was recorded by Indika Energy Tbk. (INDY) in 2020. For financial flexibility (X_2), the average is 0.6788 with a standard deviation of 0.2939, suggesting moderate differences between companies, with

Harum Energy Tbk. (HRUM) reaching the maximum of 1.3353 in 2020. Human capital (X_3) shows an average of 0.0000005 and a standard deviation of 0.9798, reflecting significant variability. The lowest value of -2.5619 was reported by Bayan Resources Tbk. (BYAN) in 2023, while the highest value of 0.9229 was recorded by Atlas Resources Tbk. (ARII) in 2020. Sustainable growth (Y) averages 0.0497 with a standard deviation of 0.2214, highlighting disparities in sustainable growth performance. The lowest value of -0.8567 was observed in Bumi Resources Tbk. (BUMI) in 2020, while the highest of 0.2589 was seen in Resource Alam Indonesia Tbk. (KKGI) in 2023. Finally, green innovation (Z) has an average of 0.7401 with a standard deviation of 0.2177, indicating consistent application across companies, with the maximum value of 1 observed in companies like PGAS and PTBA.

Classical Assumption Tests

The classical assumption tests consist of four main evaluations: normality test, multicollinearity test, heteroskedasticity test, and autocorrelation test.

1. Normality Test

   The purpose of the normality test is to determine if the residual values from the regression model follow a normal distribution. In this analysis, the Skewness test was utilized, producing a probability value of 0.1029, which exceeds the conventional significance threshold of 0.05. This outcome signifies that the residuals are normally distributed, satisfying the normality assumption.
2. Multicollinearity Test

   To detect multicollinearity, the study employed the Variance Inflation Factor (VIF) alongside correlation values among independent variables. All VIF results were below 10, and correlation coefficients did not exceed 0.8, suggesting that the model is free from multicollinearity issues. This indicates that the independent variables are not excessively interrelated.
3. Heteroskedasticity Test

   The Breusch-Pagan method was applied to evaluate heteroscedasticity. The test generated a probability value of 0.4644, which is higher than 0.05. This confirms that the regression model does not exhibit heteroscedasticity, indicating that the residual variances are consistent (homoscedastic).
4. Autocorrelation Test

   The autocorrelation test, carried out with the Pearson Product Moment correlation, shows that only financial flexibility (X_2) has a significant positive correlation with sustainable growth (Y), with a Pearson correlation of 0.4369 and a p-value of 0.0001. Other variables like intangible assets (X_1), human capital (X_3), and green innovation (Z) did not exhibit significant correlations, suggesting there is no autocorrelation problem in the regression model.

Panel Model Selection Test

In conducting panel data regression analysis, three types of estimation models are examined: Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). The process of selecting the most suitable model is carried out using three key tests: Chow Test, Hausman Test, and Lagrange Multiplier Test, with the results summarized as follows:

1. Chow Test

   The Chow Test is performed to evaluate which model fits better between the Common Effect Model and the Fixed Effect Model. The F-probability value obtained was 0.090, which is higher than the standard significance level of 0.05. This indicates that the Common Effect Model is more appropriate for the analysis.

2. Hausman Test

The purpose of the Hausman Test is to verify the consistency of estimates when comparing the Fixed Effect Model with the Random Effect Model. The analysis generated a Chi-Square probability value of 0.054, which surpasses the 0.05 threshold. Consequently, the findings suggest that the Random Effect Model is the more suitable option.

3. Lagrange Multiplier Test

This test is utilized to determine the preference between the Common Effect Model and the Random Effect Model. The resulting probability value of 0.060 exceeds 0.05, affirming that the Common Effect Model is the optimal choice for this study.

Table 3. Summary of Panel Model Selection Tests

Test	Hypothesis	Probability	Final Decision
Chow Test	Common Effect vs Fixed Effect	0,09	Common Effect
Hausman Test	Random Effect vs Fixed Effect	0,054	Random Effect
Lagrange Multiplier	Random Effect vs Common Effect	0,06	Common Effect

Source: Processed by the Author (2025)

Following the results from the three tests, the Common Effect Model (CEM) was determined to be the most suitable model for this analysis, considering its effectiveness and alignment with the features of the panel data.

Goodness of Fit Test

The Coefficient of Determination (R^2) is utilized to evaluate the extent to which variations in the dependent variable are accounted for by the independent variables within the regression model. This measure reflects the model's capability to describe the observed outcomes. Since R^2 typically increases with the addition of more independent variables, the Adjusted R^2 is applied as a more reliable indicator for assessing model fit.

Table 4. Coefficient of Determination (R^2) Test Results

R Squared	Adjusted R Square
0,8007	0,7802

Source: Output Stata (2025)

According to the calculation results shown in Table 4, the Adjusted R^2 reaches a value of 0.7802, indicating that approximately 78.02% of the variation in sustainable growth can be attributed to the independent variables: intangible assets (X_1), financial flexibility (X_2), human capital (X_3), green innovation (Z), along with their interactions. Meanwhile, the remaining 21.98% is influenced by other variables not included in the regression analysis.

Multiple Linear Regression Analysis

The panel regression analysis applied in this study is based on the Common Effect Model (CEM) approach. Data analysis was executed using Stata software, and the findings of the multiple linear regression analysis are documented in Table 5.

Table 5. Multiple Linear Regression Analysis Results

Variable	Coef.	Std. Err	t-Statistic	Prob.
Cons	-1,264817	0,4440479	-2,85	0,006
X_1	0,5376816	0,5363222	1,00	0,320
X_2	1,6946640	0,1622166	10,45	0,000
X_3	0,0670821	0,0333218	2,01	0,048
Z	1,1061930	0,4539941	2,44	0,017

Variable	Coef.	Std. Err	t-Statistic	Prob.
X_1.Z	0,0380087	0,0058272	6,52	0,000
X_2.Z	0,5396770	0,0627408	8,60	0,000
X_3.Z	0,0470029	0,0106131	4,43	0,000

Source: Output Stata (2025)

The multiple linear regression equation derived from the CEM model is as follows:

$Y = -1,264817 + 0,5376816\ X_1 + 1,6946640\ X_2 + 0,0670821\ X_3 + 1,1061930\ Z + 0,0380087\ X_1.Z + 0,5396770\ X_2.Z + 0,0470029\ X_3.Z + e$

Based on the multiple linear regression analysis in Table 5, the Common Effect Model (CEM) shows that financial flexibility (X_2), human capital (X_3), green innovation (Z), and all interaction variables (X_1.Z, X_2.Z, and X_3.Z) have a significant positive effect on sustainable growth (Y). A 1% increase in financial flexibility boosts sustainable growth by 169.47%, while human capital contributes 6.71%, and green innovation adds 110.62%. Furthermore, the interaction terms between green innovation and the three main variables also enhance sustainable growth, indicating the importance of integrating sustainable practices with internal resources. Conversely, intangible assets (X_1) does not have a significant effect, suggesting that it alone is insufficient to drive growth without strategic innovations.

Hypothesis Test

1. F-Test

   The F-Test or simultaneous test is conducted to evaluate whether all independent variables collectively have a significant effect on Sustainable Growth (Y). The test results are shown in Table 6.

Table 6. F-Test Results

F statistic (7, 68)	Probability F
39,02	0,000

Source: Output Stata (2025)

The p-value of 0.000 is lower than the 0.05 significance level, indicating that the overall regression model is significant and suitable for further analysis. This means that all independent variables collectively contribute significantly to explaining the variation in sustainable growth.

2. T-Test

   The T-Test is used to evaluate the individual influence of each independent variable on sustainable growth (Y) within the Moderated Regression Analysis model. The decision criterion is based on the probability (p-value) and the t-statistic value. If the p-value is < 0.05 or the t-statistic > t-table, the variable is considered to have a significant influence. The test results are presented in Table 7.

Table 7. T-Test Results

Variabel	Coefficient	t	Probability t	Conclusion
X_1	0,5376816	1,00	0,320	Not Significant Effect
X_2	1,6946640	10,45	0,000	Positive Significant Effect
X_3	0,0670821	2,01	0,048	Positive Significant Effect
Z	1,1061930	2,44	0,017	Positive Significant Effect
Interaction of X_1 with Z	0,0380087	6,52	0,000	Positive Significant Effect
Interaction of X_2 with Z	0,5396770	8,60	0,000	Positive Significant Effect
Interaction of X_3 with Z	0,0470029	4,43	0,000	Positive Significant Effect

Source: Output Stata (2025)

The test results indicate that intangible assets (X_1) do not have a significant effect on sustainable growth, as reflected by a p-value of 0.320, which is greater than the 0.05 significance level. In contrast, financial flexibility (X_2) shows a strong and significant positive influence on sustainable growth, with a coefficient of 1.6946640 and a p-value of 0.000, suggesting its crucial role in supporting long-term business stability. Similarly, human capital (X_3) demonstrates a positive and significant impact, with a coefficient of 0.0670821 and a p-value of 0.048, indicating that improvements in human capital contribute to sustainable growth. Additionally, green innovation (Z) not only enhances sustainable growth but also strengthens its effect through interactions with intangible assets (X_1), financial flexibility (X_2), and human capital (X_3), highlighting the importance of integrating sustainable practices with internal resources.

Moderation Variable Test

The results of the moderation analysis indicate that green innovation plays a significant role in strengthening the relationship between independent variables and sustainable growth. According to Solimun et al. (2017), green innovation is classified as a quasi-moderator, as it acts both as an independent predictor and as a moderator. For the relationship between intangible assets (X_1) and sustainable growth, the significance value of green innovation (β_4) is 0.017, while its interaction with intangible assets (β_5) is 0.000, both of which are below the 0.05 threshold. This demonstrates that although intangible assets alone do not have a significant direct effect, their interaction with green innovation generates a positive and significant impact.

Similarly, green innovation also strengthens the effect of financial flexibility (X_2) on sustainable growth. The interaction effect (β_6) has a significance value of 0.000, confirming that green innovation enhances the positive impact of financial flexibility, leading to sustainable growth in energy companies. Lastly, the interaction between human capital (X_3) and green innovation (β_7) is also significant, with a p-value of 0.000, indicating that green innovation amplifies the contribution of human capital to sustainable growth. These findings suggest that green innovation not only serves as a strategic resource on its own but also effectively moderates the influence of intangible assets, financial flexibility, and human capital, resulting in stronger and more sustainable business growth.

Discussion

Intangible Assets Do Not Significantly Affect Sustainable Growth

The results indicate that intangible assets (X_1) do not exhibit a significant impact on sustainable growth, leading to the rejection of H_1. This suggests that the intangible asset levels within energy sector companies did not notably influence their sustainable growth throughout the 2020–2023 period. This outcome is linked to the minimal number of energy firms reporting intangible assets in their financial disclosures. Among the 76 observations, 25 companies did not report any intangible assets, highlighting a preference for physical assets and operational activities over intellectual property, patents, or technological investments. This trend was observed consistently in firms such as AKRA, APEX, BYAN, ENRG, HRUM, MBAP, and TEBE, which over several years did not prioritize or even record intangible assets. This explains the limited optimization of intellectual capital, which is essential for driving innovation. These findings are consistent with Ionita and Dinu (2021), who found that intangible assets identified as innovative competencies did not affect Sustainable Growth Rate (SGR) or firm value in Romanian companies. Conversely, Citrahartani & Dewi (2023) reported a positive relationship between intangible assets and sustainable growth.

Financial Flexibility Has a Positive and Significant Effect on Sustainable Growth

The analysis reveals that financial flexibility (X_2) has a positive and significant influence on sustainable growth, resulting in the acceptance of H_2. This suggests that robust financial flexibility enables energy sector firms to sustain growth amidst market fluctuations. Companies like HRUM (2020), BYAN (2021), MBAP (2022), and TEBE (2023) demonstrated high levels of financial flexibility in their respective periods, largely driven by strong cash and debt management. For example, HRUM's financial statements in 2020 reflected a cash-to-asset ratio of 42.34% and debt flexibility of 91.19%, signifying optimal liquidity control. Similar patterns were evident in BYAN, MBAP, and TEBE, showcasing their capability to mitigate economic uncertainties and support strategic expansion. These outcomes align with the principles of Resource-Based View (RBV) and Dynamic Capabilities Theory, which highlight the strategic importance of internal resources in fostering competitive advantages and resilience. Moreover, the findings support the research of Citrahartani and Dewi (2023) and Fahlenbrach et al. (2021), which found that companies with greater financial flexibility are better equipped to withstand market shocks and economic downturns.

Human Capital Has a Positive and Significant Effect on Sustainable Growth

The analysis confirms that human capital (X_3) significantly contributes to sustainable growth, supporting the acceptance of H_3. This finding emphasizes that the quality of human resources is a key determinant of competitiveness and sustainability in energy companies. Companies like Atlas Resources Tbk. (ARII) reported the highest human capital during the 2020–2023 period, reflected in strategic workforce management and competitive employee benefit structures. ARII maintained a balance between revenue growth and labor costs, showcasing efficient human resource management that supports financial stability and competitiveness. This positive relationship is consistent with the Endogenous Growth Theory, which views human capital as a primary driver of long-term growth. The results also align with studies by Radulescu et al. (2025), which demonstrated that investments in human capital significantly contribute to sustainable development across European Union countries.

Green Innovation Strengthens the Influence of Intangible Assets on Sustainable Growth

The findings reveal that green innovation serves as a moderating factor that amplifies the connection between intangible assets (X_1) and sustainable growth. While intangible assets on their own may not significantly impact sustainable growth, their interaction with substantial levels of green innovation demonstrates a noteworthy effect. This indicates that green innovation not only enhances but also unlocks the latent potential of intangible assets in propelling sustainable growth. These findings are aligned with the Resource-Based View (RBV) and Dynamic Capabilities Theory, which suggest that internal resources, including intangible assets, can foster competitive advantages when optimized through sustainable business strategies. This observation is consistent with the research of Supriyanto et al. (2021), who concluded that green innovation contributes to the ongoing enhancement of company performance.

Green Innovation Strengthens the Influence of Financial Flexibility on Sustainable Growth

The analysis also highlights that green innovation enhances the positive influence of financial flexibility (X_2) on sustainable growth. Energy companies that possess robust financial flexibility are better positioned to achieve sustainable growth when integrated with green innovation strategies. This synergy supports long-term business sustainability by leveraging stable financial resources for projects in renewable energy, clean technology, and eco-friendly products. Statistically, the moderating effect of green innovation reveals that the impact of financial flexibility intensifies with higher levels of green innovation. These results correspond

with the Dynamic Capabilities Theory, which emphasizes a firm's ability to adjust and reconfigure its resources in response to environmental changes. Furthermore, the findings align with studies conducted by Supriyanto et al. (2021) and Zhang et al. (2020), which underscore the crucial role of financial flexibility in promoting corporate sustainability amid volatile market conditions.

Green Innovation Strengthens the Influence of Human Capital on Sustainable Growth

Empirical evidence suggests that green innovation operates as a moderating variable, significantly enhancing the positive impact of human capital (X_3) on sustainable growth. This implies that highly skilled human resources are more capable of driving sustainability objectives when paired with green innovation practices. The synergy between human capital and green innovation establishes a strategic advantage, boosting productivity, environmental efficiency, and corporate social responsibility. These findings resonate with the Endogenous Growth Theory, which asserts that human capital and innovation are key drivers of long-term growth. This perspective is further supported by Alfaliah (2025), who discovered that green innovation substantially strengthens the effect of human capital on sustainable growth by optimizing production efficiency and minimizing environmental impact.

CONCLUSION

The results of this research indicate that intangible assets (X_1) do not have a meaningful influence on sustainable growth within energy sector companies. This outcome is primarily attributed to the limited emphasis on intellectual property and technological investments in the industry. The insufficient allocation of investments toward intangible assets implies that these resources are not being effectively utilized to promote sustainable performance. On the other hand, financial flexibility (X_2) and human capital (X_3) show a positive and significant impact on sustainable growth, underlining their crucial role in enhancing corporate resilience and supporting long-term business stability. Organizations with strong financial flexibility are better positioned to endure market fluctuations and fund sustainable initiatives, while those prioritizing human capital development foster greater innovation and productivity.

Furthermore, green innovation (Z), acting as a moderating variable, is observed to amplify the effects of intangible assets (X_1), financial flexibility (X_2), and human capital (X_3) on sustainable growth. This suggests that green innovation not only independently supports sustainability but also significantly enhances the effectiveness of these internal resources when combined with sustainable business practices. These findings are consistent with the principles of the Resource-Based View (RBV) and Dynamic Capabilities Theory, emphasizing the strategic significance of maximizing internal capabilities through green innovation to achieve sustainable growth. For energy companies, strategic investments in financial flexibility, human capital, and green innovation are pivotal for optimizing resource efficiency and bolstering competitiveness in increasingly eco-conscious markets.

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