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EXPLORING THE INTERPLAY OF GREEN INVESTMENT STRATEGIES, STAKEHOLDER ENGAGEMENT, AND SUSTAINABLE DEVELOPMENT OUTCOMES IN THE EGYPTIAN OIL REFINERIES SECTOR

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ABSTRACT

This study examines how green investment strategies and stakeholder engagement affect sustainable development outcomes in Egypt's oil refineries sector. Structural equation modeling was applied to data from 429 respondents across Egyptian oil refineries, testing four green investment dimensions: renewable energy investment allocation, low-carbon technology investment, green finance instruments, and innovation and technology development. All four dimensions directly influence sustainable development outcomes, with stakeholder engagement partially mediating those relationships. The model explains 64.2% of the variance in stakeholder engagement and 68.4% of the variance in sustainable development outcomes. Low-carbon technology investment had the strongest direct effect among the investment dimensions ($\beta = 0.331$, $p < 0.001$), but stakeholder engagement showed a considerably larger effect ($\beta = 0.686$, $p < 0.001$) which suggests that how refineries engage stakeholders may do more for sustainable outcomes than where they direct their investment dollars. For oil refinery operators and policymakers in emerging economies, the results point toward stakeholder engagement as an underleveraged variable in sustainability strategies -one that may deserve more deliberate attention than investment allocation alone typically receives.

KEYWORDS: Green investment strategies; stakeholder engagement; sustainable development outcomes; oil refineries; Egypt; structural equation modeling; green finance; low-carbon technology.

1. INTRODUCTION

Oil refining creates a persistent tension. Refineries are economically central in petroleum-dependent economies and are also significant sources of greenhouse gas emissions (Adebayo et al., 2024). Addressing both at once requires integrating technological innovation, new financing mechanisms, and stakeholder collaboration — none of which is straightforward in practice (Shammah et al., 2025).

Egypt is a useful case for examining this tension. As a major MENA oil producer, it needs to maintain energy security while meeting climate commitments and advancing sustainable development goals (Michailidis et al., 2025). Its oil refineries sector is where those pressures converge most directly — economic interests, environmental obligations, and social considerations all bearing on the same operations.

Green investment strategies have become the primary organizational response: renewable energy deployment, low-carbon technology adoption, innovative financing instruments, and technology development initiatives (Ţăran et al., 2026). Stakeholder engagement has gained recognition alongside these as a mechanism for building legitimacy, exchanging knowledge, and working through problems that organizations can't resolve internally (Alshukri et al., 2024).

Despite growing research on sustainability in extractive industries, how green investments actually produce sustainable outcomes remains underspecified - particularly whether stakeholder engagement mediates that process in refinery contexts. This study examines that relationship using data from Egyptian oil refineries, testing how different green investment dimensions influence sustainable development outcomes through stakeholder engagement pathways.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 *Green investment strategies in oil refineries*

Green investment strategies encompass an organized allocation of both financial and organizational resources toward an eco-sustainable project that seeks to minimize its negative impact on the environment, promoting operational effectiveness (Louis & Kuriakose, 2025). In the oil and gas sector, the concept of green investments has gained considerable traction and is treated as a strategic imperative and not a marginal activity, especially with the added pressure from the government, stakeholders, and the realization that there are long-term competitive advantages to be gained (Cherepovitsyn et al., 2026). Additional investments in renewable green energy entail the construction of the first facilities for new sources of renewable energy (solar, wind, geothermal, etc.) that enable an organization to operate beyond its fossil fuel dependency, while also providing a revenue stream that is congruent to the organization's objectives of decarbonization (Adebayo et al., 2024). Of these tools, decarbonization is an effective method to create market opportunities and mitigate the negative impact of fossil fuels, and research shows that oil and gas companies with renewable portfolios are better positioned to face the challenges of carbon pricing and the instability of fossil fuel markets (Shammah et al., 2025).

Refining operations that are coupled with carbon capture and storage, as well as combined carbon reduction technologies, energy efficient and also new and updated emission monitoring devices, are met with the challenges of low carbon (Hakam & Saraswani, 2025). Research has also shown that the deployment of low carbon technologies improves the environmental efficiency of operations (Mohamed et al., 2025). The green portfolio of financial instruments including, but not limited to, green bonds, loans that are linked to sustainability goals, and investment funds of green are frameworks that aim to encourage the allocation of resources to funding projects that are environmentally responsible (Kaplan, 2025). Research has shown that green financing improves the competitiveness of the projects by providing more attractive financial terms and demonstrates commitment to the environment to the company's investors and stakeholders (Belgacem et al., 2026). Also, Huo et al (2025) posit that innovation and technology development are essential for sustainable transformations as they yield rapid changes that improve environmental and business efficiency.

2.2 *Stakeholder engagement*

Stakeholder engagement programs are a company's means of identifying, communicating, and responding to affected or influencing individuals and groups (Okeowo et al., 2026). Stakeholder theory is framed around the idea that the success of an organization hinges on the management of its multifarious relationships with all its stakeholder groups, including but not limited to, employees, the community, the state, the market, and civil society (Nwankwo et al., 2024b). Effective stakeholder engagement is essential for the oil and gas industry to sustain its social license to operate, manage its conflicts, and achieve sustainable development (Nwankwo et al., 2024a). Research shows that stakeholder engagement strategies focused on communication along the tenets of transparency, dialogue, and participation sustain positive relations, increasing stakeholder involvement and encouraging sustainable development (Okeowo et al., 2026).

Engagement of stakeholders in the extractive industry shows that sustainability performance is positively affected by participation in the planning, implementation, and monitoring phases of the project (Oruwari et al., 2024). It is evidenced that stakeholder engagement works to enhance the effectiveness of corporate social responsibility by demonstrating a direct impact on community needs and expectations (Mohammed et al., 2024). The engagement of stakeholders, in turn, aids in collaborative and innovative activities, the most sustainable and complex of which are sustainability (Alshukri et al., 2024). Researchers have demonstrated and confirmed that stakeholder pressures are essential moderating and mediating effects in the relationships of sustainability performance and environmental strategies (Choi et al., 2025).

2.3 Sustainable development outcomes

The concept of sustainable development emerges from the simultaneous pursuit of advancement across the economic, social, and environmental dimensions of human progress, which embeds the triple bottom line (Huddar & Joshi, 2025). Improved financial performance, operational efficiencies, cost-saving initiatives, and solidifying the organization's competitiveness and positioning in the market can all be regarded as the economic benefits of the organization's Green initiatives (Arslan et al., 2026). It has been shown that stakeholder-driven green investments and engagement of best social practices improve brand reputation, reduces risk, and enhances access to funds from Sustainability Integrated Investors (Darsono et al., 2025).

In the social dimension, there are improvements in the health and safety of the community, as well as of the employees, increased productivity, and stakeholder satisfaction (Emeka-Okoli et al., 2024a). It has been shown that active and stakeholders' interests' engagement improves the corporate social outcomes through proper attention to community needs and deems the activities of the corporation as the right and valued (Emeka-Okoli et al., 2024b).

2.4 Mediating Role of Stakeholder Engagement

The role of stakeholder engagement as a mediator between an organization's strategies and performance outcomes has begun to show empirical evidence in disparate settings (Alshukri et al., 2024). According to Darsono et al. (2025), mediation takes place when an independent variable affects a dependent variable through a third variable, thus the third variable explaining the relationship, whether wholly or partially. Researchers argue that stakeholder engagement mediates the relationship between corporate social responsibility and sustainable performance by converting strategic drive into operational practices and results supported by stakeholders (Tian & Tian, 2021). Most studies that examine the role of stakeholder engagement in the green investment context have concluded that it improves the effectiveness of stakeholder engagement, building legitimacy, and cooperative engagement to solve the problem, thus positively reinforcing sustainable performance (Lin et al., 2024).

There is a strong prediction of stakeholder engagement's mediating role through multiple methods. From the resource-based view theory, stakeholder relationships improve performance, as they are critical intangible resources (Ahmad et al., 2025). From the dynamic capability's perspective, stakeholder engagement is the mediating variable that contributes to sensing and acting on an opportunity to make a positive, sustainable change at an organization (Opoku et al., 2025). From the institutionalism perspective, stakeholder engagement is a legitimacy-seeking activity that reinforces an organization's normative goal practice, thus achieving a positive result on sustainability performance (Arslan et al., 2026).

3. CONCEPTUAL FRAMEWORK

The conceptual framework was established after analyzing existing theories and models and was applied to the data collection and data analysis. The aim of this research was to gain a deeper insight into the field of interest by examining the relationship between the independent variables (Green Investment Strategies), mediator variables (Stakeholder Engagement) and dependent (Sustainable Development Outcomes) variable.

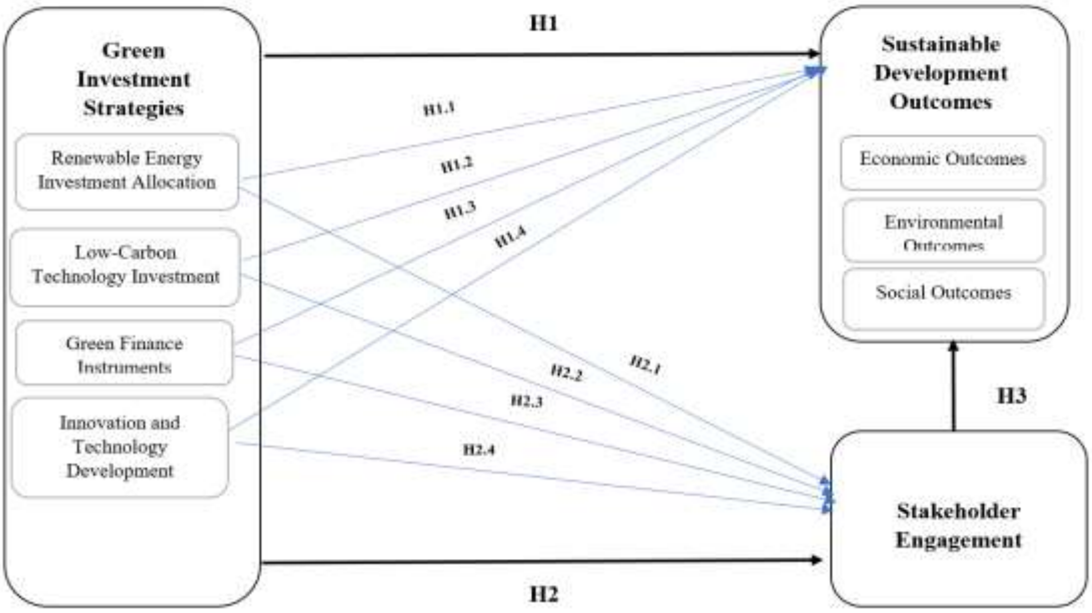

Figure 1: Conceptual Framework.

Conceptual Model Relationships and Research Hypotheses:

H1: Green Investment Strategies have an impact on Sustainable Development Outcomes in the Egyptian Oil Refineries Sector,H1.1: Renewable Energy Investment Allocation has an impact on Sustainable Development Outcomes, H1.2: Low-Carbon Technology Investment has an impact on Sustainable Development Outcomes, H1.3: Green Finance Instruments has an impact on Sustainable Development Outcomes, H1.4: Innovation and Technology Development have an impact on Sustainable Development Outcomes,

H2: Green Investment Strategies have an impact on Stakeholder Engagement in the Egyptian Oil Refineries Sector, H2.1: Renewable Energy Investment Allocation has an impact on Stakeholder Engagement, H2.2 Low-Carbon Technology Investment has an impact on Stakeholder Engagement, H2.3: Green Finance Instruments has an impact on Stakeholder Engagement, H2.4: Innovation and Technology Development have an impact on Stakeholder Engagement

H3: Stakeholder Engagement has an impact on Sustainable Development Outcomes in the Egyptian Oil Refineries Sector,

H4: Stakeholder Engagement mediates the relationship between Green Investment Strategies and Sustainable Development Outcomes in the Egyptian Oil Refineries Sector, H4.1: Stakeholder Engagement mediates the relationship between Renewable Energy Investment Allocation and Employee Outcomes, H4.2: Stakeholder Engagement mediates the relationship between Low-Carbon Technology Investment and Employee Outcomes, H4.3: Stakeholder Engagement mediates the relationship between Green Finance Instruments and Sustainable Development Outcomes, H4.4: Stakeholder Engagement mediates the relationship between Innovation and Technology Development and Sustainable Development Outcomes in the Egyptian Oil Refineries Sector

3.1. Research Problem And Questions

Egypt's oil refineries face a specific combination of sustainability pressures: aging infrastructure, high carbon intensity, resource depletion concerns, and growing stakeholder expectations around environmental responsibility (Jaber & Dulaimi, 2025). Egypt has signed international climate commitments and embedded sustainability goals in national development strategies, but translating those into actual green transformation inside the refining industry involves obstacles that policy commitments don't resolve (Abdelaty et al., 2023). Capital requirements for green technology are large, retrofitting existing facilities is technically demanding, returns on environmental investments are uncertain, and short-term profitability pressures consistently compete with long-term sustainability objectives (Rahayu et al., 2025). The sector also operates within a stakeholder environment spanning government regulators, local communities, employees, investors, environmental organizations, and international partners - each with different expectations and different capacity to shape what refineries actually do. What remains underexamined is how different green investment approaches produce sustainability outcomes in this context, and whether stakeholder engagement mediates that process. The dynamics exist; the empirical evidence specific to Egyptian oil refineries does not.

The study addresses four questions: how do renewable energy investment allocation, low-carbon technology investment, green finance instruments, and innovation and technology development each influence sustainable development outcomes in Egyptian oil refineries? What is the relationship between green investment strategies and stakeholder engagement? To what extent does stakeholder engagement mediate between green investment dimensions and sustainable development outcomes? And how do the direct effects of green investment on performance compare in size to the effects that run through stakeholder engagement? The answers have practical relevance for refinery operators making investment decisions, policymakers designing regulatory frameworks, and researchers working on sustainable transformation in emerging economy extractive industries.

3.2. Research Aim and Objectives

This research aims to examine the interplay among green investment strategies, stakeholder engagement, and sustainable development outcomes within Egyptian oil refineries, providing empirical evidence regarding direct and mediated pathways through which green investments influence sustainability performance. The study pursues four specific objectives: First, to assess the direct effects of renewable energy investment allocation, low-carbon technology investment, green finance instruments, and innovation and technology development on sustainable development outcomes encompassing economic, environmental, and social dimensions. Second, to evaluate how these green investment dimensions influence stakeholder engagement practices within oil refineries. Third, to examine stakeholder engagement's impact on sustainable development outcomes. Fourth, to test stakeholder engagement's mediating role in relationships between green investment strategies and sustainable development outcomes, determining whether mediation effects are partial or complete. Through achieving these objectives, the research contributes theoretical advancements in understanding sustainability transformation mechanisms while offering practical guidance for Egyptian oil refineries and comparable organizations navigating sustainability transitions in emerging economy contexts.

3.3. Research Methodology

3.3.1. Research Design and Philosophical Approach

This research is founded on a quantitative approach to research and a post-positivist philosophy. The empirical data collection is completed through surveys to facilitate the testing of statistical hypotheses. The study employs a cross-sectional technique to collect data which for the time frame of the study is used to analyze the correlational relationship among the constructs. This technique helps to understand the complex issues systematically which could provide adequate generalization to the Egyptian oil refineries sector. (Hair et al., 2010)

3.3.2. Population and Sampling

The research population consists of employees and managers working in Egyptian oil refineries who are informed about the green investment, stakeholder engagement, and organizational sustainability performance. The study used a stratified random sample structure for the purpose of representation at different organizational levels and different functional areas. The survey was sent to 700 people and a total of 506 survey packets were returned (72.3%). The survey was designed to exclude 77 people who responded but left significant information blank, refused to complete some significant areas or survey questions, or were otherwise ineligible to participate in a survey. The survey was designed to include 194 people who were not able to participate for various reasons, and to include 429 people, which is 61.3% of the total population. The research considered this to be of high adequacy for the purpose of the study and statistical analyses it was seeking to perform (Duy et al., 2024).

3.3.3. Demographic Profile

Demographic details of the participants are included herein. The sample characterized the industry workforce given the gender composition of the respondents. Out of the total respondents, 296 (69.0%) were males and 133 (31.0%) were females. The ages of the respondents were as follows 166 (38.7%) were aged 25-35, 152 (35.4%) were 36-45, and

91 (21.2%) were aged 46 years and older. The demographic participants had an educational attainment of 194 (45.2%) who had obtained a Bachelor's, 180 (42.0%) who had obtained a Master's, and 55 (12.8%) who had obtained a Doctorate. The total number of participants was 429. Partition was as follows: 10+ years' experience 195 (45.5%), 1-5 years 98 (22.9%), 5-10 years 68 (15.9%) and 68 (15.9%) with less than 1 year. Of the sample group, 130 were Executive Management (30.2%), 123 were Middle Management (28.7%) and 84 were Senior Management (19.6%) and 92 were Operational Staff (21.5%). The demographic characteristics of the sample group suggest an abundance of data from experienced professionals across organizational level which improves the data's validity.

3.3.4. Measurement Instruments

The variable " Green Investment Strategies " is measured by four dimensions (Renewable Energy Investment Allocation, Low-Carbon Technology Investment, Green Finance Instruments, Innovation and Technology Development) (Fatima et al., (2024); Gang et al., (2023); Xu et al., (2023); Ramadan, (2025); Smaoui, (2025); Kabeyi & Olanrewaju, (2022); Zhang & Mehmood, (2023)), The variable “Stakeholder Engagement” is measured by 7 items (Hughes et al., (2021); Thai et al., (2025)) and the variable “Sustainable Development Outcomes” is measured by three dimensions (Economic Outcomes, Environmental Outcomes, Social Outcomes) (Mukhtar et al., (2025); Habidin, et al., (2015); Sari, et al., (2015)).

3.3.5 Data Collection Procedure

Data collection occurred through structured questionnaires distributed electronically and physically across Egyptian oil refineries following appropriate ethical approvals and organizational permissions. The questionnaire included clear instructions, construct definitions, and assurances regarding confidentiality and voluntary participation. Pilot testing with 30 respondents ensured question clarity and instrument reliability before full-scale administration.

3.3.6. Data Analysis Techniques

The Structural Equation Modeling (SEM) and AMOS software series were utilized for this data analysis for the reason of the complex model structure, the distinction between the reflective and formative constructs, the predictive and explanatory (theory) void, (Duy et al., 2024). The data analysis was performed in two steps, the first being the measurement model and the second being the assessment of the structural model. The measurement model mainly assessed the constructs' reliability and evaluated convergent and discriminant validity. This analysis tested the constructs' reliability and, assessed the constructs' convergent and discriminant validity, using the Average Variances Extracted (AVEs), cross-loadings, and the ratios of the constructs' heterotrait and monotrait. Confirmatory factor analysis was also utilized for factor structure assessment. The structural model assessment evaluated the hypothesized relationships using the path coefficients, the significance, the size of the effect, and the explained variance (R^2). The bootstrapping procedure was the mediation analysis used (Hutahayan et al., 2025). This was performed using 5,000 resamples to determine the mediation and the indirect effect.

4. DISCUSSION OF STUDY RESULTS

4.1. Measurement Model Results

The measurement model assessment illustrates the psychometric integrity of the constructs. Internal consistency was superb (Duy et al., 2024; Fornell & Larcker, 1981), with Composite Reliability (CR) ranging between 0.837 and 0.946, all exceeding the 0.70 benchmark. CR scores c alculated for the constructs were the following: CR of Renewable Energy Investment Allocation = 0.839, CR of Low-Carbon Technology Investment = 0.842, CR of Green Finance Instruments = 0.918, CR of Innovation and Technology Development = 0.837, CR of Stakeholder Engagement = 0.946, CR of Economic Outcomes = 0.909, CR of Environmental Outcomes = 0.877, and CR of Social Outcomes = 0.852. With the AVE scores ranging within 0.566 and 0.738, with the AVE scores for the constructs of the study exceeding the minimum PQ of 0.50, sufficient convergent validity was documented. Renew able Energy Investment Allocation was AVE = 0.566, Low-Carbon Technology Investment was AVE = 0.574, and Green Finance Instruments was AVE = 0.738. Innovation and Technology Development was AVE = 0.577, Stakeholder Engagement was AVE = 0.715, Economic Outcomes was AVE = 0.712, Environmental Outcomes was AVE = 0.629, and Social Outcomes was AVE = 0.599. (Hutahayan et al., 2025; Hair et al., 2010).

Table 1 summarizes the reliability and convergent validity statistics for all latent constructs.

Construct	Items	Composite Reliability (CR)	Average Variance Extracted (AVE)
Low Carbon Technology Investment	4	0.842	0.574
Renewable Energy Investment Allocation	4	0.839	0.566
Innovation and Technology Development	4	0.837	0.577
Green Finance Instruments	4	0.918	0.738
Economic Outcomes	4	0.909	0.712
Environmental Outcomes	4	0.877	0.629
Social Outcomes	4	0.852	0.599
Stakeholder Engagement	7	0.946	0.715

Source: created by the authors using primary survey data (2026); analysis performed in Amos v25.

The results of the Confirmatory Factor Analysis point to the presence of satisfactory indices of fit within the given measurement model. The eight-factor measurement model produced the following indices: $\chi^2/df = 1.783$ (less than the 3.0 acceptable upper threshold), RMSEA = 0.044 (less than 0.08), TLI = 0.954 (almost 1.0), and CFI = 0.959 (almost 1.0). These indices collectively demonstrate an excellent fit to the data (Hair et al., 2010). These results confirm the utility of the measurement models for the characterization of theoretical constructs and suggest a solid basis for the analysis of the structural model.

Table 2: Measurement Model Fit Indices (CFA).

	Obtained Value	Recommended Threshold	Interpretation
Degrees of Freedom (DF)	526	> 0	Valid
$\chi 2$/DF	1.783	≤ 3.0	Good Fit
RMSEA	0.044	< 0.08	Good Fit
TLI	0.954	≥ 0.90	Acceptable/Good Fit
CFI	0.959	≥ 0.90	Acceptable/Good Fit

Source: created by the authors using primary survey data (2026); analysis performed in Amos (v25). Notes: DF: Degrees of Freedom, □□/DF: chi-square to degrees of freedom ratio, RMSEA: root mean square error of approximation, TLI: Tucker-Lewis Index, CFI: Comparative Fit Index

4.2. Structural Model Fit

Structural model evaluation reveals satisfactory fit indices: $\chi^2/df = 2.639$ (below 3.0 threshold), RMSEA = 0.064 (below 0.08), TLI = 0.904 (approaching 1.0), and CFI = 0.913 (approaching 1.0), indicating the structural model adequately represents relationships among constructs (Hair et al., 2010). These fit statistics, while slightly lower than measurement model indices due to increased model complexity, remain within acceptable ranges for complex structural equation models.

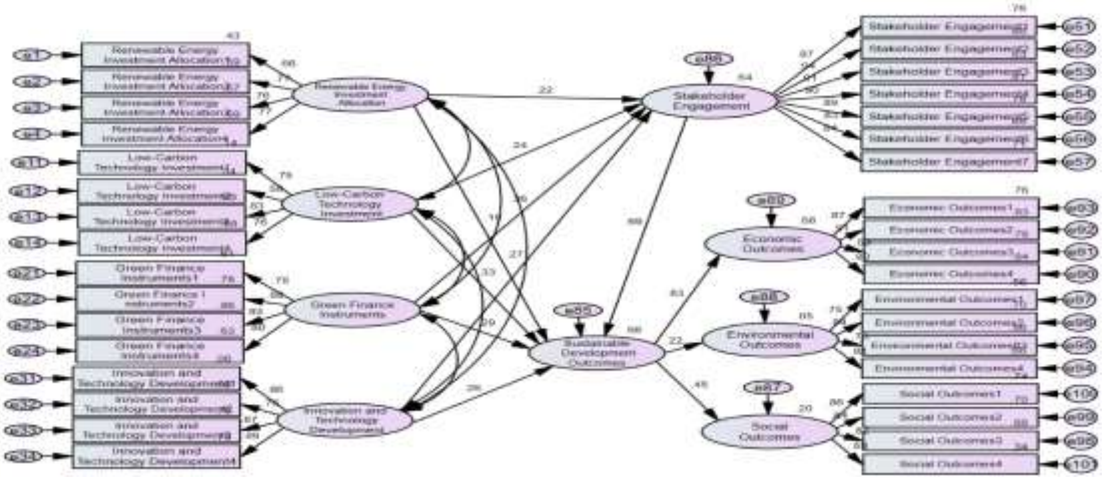

Figure 2: Structural Model.

Table 3: Structural Model Fit Indices (SEM).

Fit Index	Obtained Value	Recommended Threshold	Interpretation
Degrees of Freedom (DF)	541	> 0	Valid
χ2/DF	2.639	≤ 3.0	Good Fit
RMSEA	0.064	< 0.08	Good Fit
TLI	0.904	≥ 0.90	Acceptable/Good Fit
CFI	0.913	≥ 0.90	Acceptable/Good Fit

Source: created by the authors using primary survey data (2026); analysis performed in Amos (v25). Notes: DF: Degrees of Freedom, □□/DF: chi-square to degrees of freedom ratio, RMSEA: root mean square error of approximation, TLI: Tucker-Lewis Index, CFI: Comparative Fit Index.

4.3. Direct Effects of Green Investment Strategies on Sustainable Development Outcomes

Results of hypothesis testing suggest all four investment dimensions in green initiatives positively influence sustainable development in terms of H1 and H1 sub-hypotheses H1.1 to H1.4. The relationship of examined sub-hypotheses shows that Low-Carbon Technology Investment has the strongest impact with ($\beta = 0.331$, CR = 9.438, $p < 0.001$). As interesting as the result might be, the answer to the hypothesis supports the argument that investment in emission reduction technologies, energy-efficient processes, and carbon capture technologies improves the performance of the organization in economic, social, and environmental terms (Hakam & Saraswani, 2025). Further, this result confirmed the finding of Mohamed et al. (2025), which shows that investment in low carbon technologies helps to reduce the negative impact on the environment by simultaneously improving the efficiency of operations and providing savings to the organization. The evidence of the low carbon effect indicates that oil refineries in Egypt that invest in low carbon technologies will experience significant improvements in the field of sustainability in various areas.

Green Finance Instruments support hypothesis H1.3 and show positive and significant influence on sustainable development ($\beta = 0.290$, CR = 3.800, $p < 0.001$). The result suggests that the improvement of sustainability performance through the use of green bonds, sustainability-linked financing, and environmental investment funds is achieved by directing funds to environmentally adequate investments and improving the signals directed to the affected stakeholders (Belgacem et al., 2026). Green financing tools are reported to provide positive and targeted conditions, which help ensure the sustainability of environmental and social projects over the long term (Kaplan, 2025).

Crucially, Innovation and Technology Development are historically significant drivers of sustainable development outcomes ($\beta = 0.258$, CR = 2.994, $p < 0.001$) (evidence for H1.4). Given their historical attributes, it is quite evident that bringing about systematic improvements through investment in the research, development, and deployment of innovative sustainable technologies improves the economic, environmental, and social performance outcomes at Huo et al. (2025). Numerous studies confirm technological innovation as an important enabler of the sustainable transformation of resource-intensive sectors that underpin the economy and demand innovation (Abdulmuhsin et al., 2025).

When it comes to the energetic dimension, the investable Renewable Energy Investment Allocation has a comparatively smaller yet statistically significant positive effect on sustainable development outcomes ($\beta = 0.154$, CR = 3.419, $p < 0.021$) (evidence for H1.1). As would be expected, the performance of the resilience and sustainable lower carbon footprint of the renewable energy diversified investments of wind, solar, and other forms of renewable energy improved (Adebayo et al., 2024). Given the greater maturity of low carbon technologies in Egyptian oil refinery operations, the relatively smaller magnitude of the coefficients is attributable to the incipient stage of renewable energy technologies and their adoption, in comparison.

4.4. Effects of Green Investment Strategies on Stakeholder Engagement

All dimensions of green investment have statistically demonstrated significant positive effects on stakeholder engagement, thereby validating H2 and sub-hypotheses H2.1-H2.4. Green Finance Instruments have the most pronounced effect on stakeholder engagement ($\beta = 0.361$, CR = 14.012, $p < 0.001$), highlighting that stakeholder trust and collaboration are built when green financing activities are undertaken transparently, indicating an organization's environmental commitment (Darsono et al., 2025). That green finance instruments build stakeholder trust by showing evidence of the financial commitment to sustainability was confirmed by validated research (Belgacem et al., 2026).

Innovation and Technology Development also play a critical role in stakeholder engagement (β = 0.267, CR = 13.308, $p < 0.001$) and H2.4 is thus supported. This effect of innovation is the formation of new ways for stakeholders to engage and participate in knowledge and collaborate on projects, which is in agreement with the evidence that the processes of technological development are greatly enhanced by the input of a variety of stakeholders (Alshukri et al., 2024). Low-Carbon Technology Investment also has a significant effect on stakeholder engagement (β = 0.239, CR = 9.438, $p < 0.001$) and supports H2.2 and complements emission reduction efforts for stakeholders to recognize and provide support for sustainability initiatives (Mohamed et al., 2025).

The Investment Allocation for Renewable Energy significantly adds to stakeholder engagement (β = 0.221, CR = 14.012, $p < 0.001$) and supports H2.1. This shows that investment in renewable energy creates engagement opportunities for stakeholders in the community, partnership development and shared value frameworks (Adebayo et al., 2024). Overall, the findings suggest that the adoption of green investment strategies directly enhances an organization's sustainability performance and strengthens stakeholder relationships, which in turn enhances implementation effectiveness and the legitimacy of the strategies.

4.5. Direct Effect of Stakeholder Engagement on Sustainable Development Outcomes

The effect of stakeholder engagement on sustainable development outcomes is statistically significant and substantial (β = 0.686, CR = 9.677, $p < 0.001$), which is a strong case for hypothesis 3 (Alshukri et al., 2024). This is a strong case of hypothesis 3, and suggests that there is a strong case that effective stakeholder engagement is a key driver of and critical success factor for the achievement of economic, environmental, and social sustainability goals. This result is consistent with a large number of studies which show that stakeholder engagement improves project results by meeting the stakeholder demand for project sustainability as a result of the trust and legitimacy created by the stakeholder demand, and the collaborative implementation strategies (Oruwari et al., 2024). This indicates that the focus on stakeholder engagement leads the Egyptian oil refineries to achieve significant improvements in their sustainability performance when compared to the Egyptian oil refineries that do not focus on stakeholder engagement (Mohammed et al., 2024). This result illustrates the key position that stakeholder engagement occupies in the organizational strategy, not only for for statutory or public relations reasons, but also for the purpose of competitive advantage and sustainable value creation for the organization (Lin et al, 2024).

Table 5. Direct Effects: Standardized Path Coefficients (β) and Significance Levels.

Hypothesis	Hypothesized path			Standardized Beta (β)	P-Value
H1.1	Sustainable Development Outcomes	<---	Renewable Energy Investment Allocation	.154	.000
H1.2	Sustainable Development Outcomes	<---	Low-Carbon Technology Investment	.331	.000
H1.3	Sustainable Development Outcomes	<---	Green Finance Instruments	.290	.000
H1.4	Sustainable Development Outcomes	<---	Innovation and Technology Development	.258	.000
H2.1	Stakeholder Engagement	<---	Renewable Energy Investment Allocation	.221	.000
H2.2	Stakeholder Engagement	<---	Low-Carbon Technology Investment	.239	.025
H2.3	Stakeholder Engagement	<---	Green Finance Instruments	.361	.000
H2.4	Stakeholder Engagement	<---	Innovation and Technology Development	.267	.000
H3	Sustainable Development Outcomes	<---	Stakeholder Engagement	.686	.000

Source: Author's analysis based on SEM Results (2026).

4.6. Mediation Analysis Results

All four green investment dimensions and sustainable development outcomes support Hypothesis 4 and Sub-Hypotheses 4.1, 4.2, 4.3, and 4.4, based on mediation analysis and partial mediation through stakeholder engagement. The mediation of Renewable Energy Investment Allocation was significant ($p = 0.004$) through stakeholder engagement on sustainable development outcomes. This outcome demonstrates that technology investments impact sustainability outcomes, both directly through engagement and operational improvements, and sustainability impacts positively through engagement (Darsono et al., 2025). The partial mediation outcome indicates that renewable energy technology investments sustain outcome improvements through operational and technical aspects that do not require stakeholder engagement. However, stakeholder engagement demonstrates positive impacts on renewable energy initiatives' outcomes.

The investment of Low-Carbon Technology demonstrates significant interceding effects on outcomes of sustainable development through stakeholder engagement (p = 0.004) and confirms partial interceding mediation. With low-carbon investments, stakeholder engagement strengthens support, thus improving intervention efficiency and sustainability outcomes (Mohamed et al., 2025). In fact, low-carbon technologies sustain outcome improvements through impact and operational gains, independent of stakeholder engagement. However, this impact diminishes regardless of stakeholder engagement.

Green Finance Instruments have been shown to have a statistically significant effect (p = 0.003) through mediation/substitution, in part due to enhanced stakeholder engagement. This observation suggests that green finance practices improve access to capital and financial conditions, while also helping perform better in sustainability by building trust and creating stakeholder participatory frameworks (Belgacem et al., 2026). Innovation and Technology Development also have a significant effect through stakeholder engagement (p = 0.003), confirming partial mediation. This observation suggests that innovations and their results create value by helping stakeholders achieve technical and administrative improvements (Huo et al., 2025).

Partial mediation suggests that in this context, through green investment, stakeholder engagement is by no means the only or the main channel through which green investments motivate improvements in sustainability. This evidence is in fact supportive of frameworks of theorization which balance technical-operational with social-relational aspects of criteria for green investments and for social sustainability (Alshukri et al., 2024). The study has shown that to achieve the greatest social and sustainability effects, green investments must achieve optimization in the technical realm while stakeholder engagement processes must be developed to the greatest degree possible.

Table 6. Indirect Effects.

Hypothesis	Indirect Path	Indirect Effect	P-Value	Mediation Type
H4.1	Effect Renewable Energy Investment Allocation on Sustainable Development Outcomes Through Stakeholder Engagement	Significant	0.004	Partial
H4.2	Effect Low-Carbon Technology Investment on Sustainable Development Outcomes Through Stakeholder Engagement	Significant	0.004	Partial
H4.3	Effect Green Finance Instruments on Sustainable Development Outcomes Through Stakeholder Engagement	Significant	0.003	Partial
H4.4	Effect Innovation and Technology Development on Sustainable Development Outcomes Through Stakeholder Engagement	Significant	0.004	Partial

Source: Author's analysis based on SEM Results (2026).

4.7. Variance Explained and Model Predictive Power

The structural model demonstrates a high degree of explanatory power. Overall, green investment strategies explain 64.2% of variance in stakeholder engagement (R^2 = 0.642), thus illustrating that stakeholder engagement intensity and quality are determined by allocations of renewable energy, investments in low-carbon technologies, green financing, and innovations (Duy et al., 2024). That green investments help organizations to create opportunities for stakeholder engagement, as well as enhancing the organization's commitment and the stakeholder's willingness to participate, is confirmed by these findings. Green investment strategies, both directly and through the mediation of stakeholder engagement, explain 68.4% of variance in sustainable development outcomes (R^2 = 0.684). Predictive power of the model demonstrates that the conceptual framework captures the core mechanisms of driving the performance of sustainability in the context of Egyptian oil refineries (Hutahayan et al., 2025). The high R^2 values are above the traditionally accepted criteria in social science, indicating a sufficiently specified model and well-developed theories (Anwar et al., 2025).

Table 7: Variance Explained (R^2 Values).

Dependent Variable	R^2 Value	Percentage of Variance Explained
Stakeholder Engagement	0.642	64.2%
Sustainable Development Outcomes	0.684	68.4%

5. RESEARCH RECOMMENDATIONS

To promote sustainability in Egyptian oil refineries, practical strategies can be identified from findings of several reports (e.g. Ţăran et al. 2026; Okeowo et al. 2026; Arslan et al. 2026; Belgacem et al. 2026; Abdulmuhsin et al. 2025; Nwankwo et al. 2024d; Rahayu et al. 2025). Reports propose moving within the industry from implementing ad-hoc initiatives, i.e. becoming results oriented. Organizations are also encouraged to implement dedicated structural governance to sustainability and green investments where legally obliged stakeholders will be invited to participate. Advanced stakeholder engagement strategies lead to the systematic improvement and upgrading of sustainability initiatives, i.e. to understand the diversity and complexities of the population and organized interest groups in the industry.

Organizations are also encouraged to invest in training and developing their human resources to sustain such gradual sustainability initiatives over the long term. Financial assistance/green finance and a collaboration of various stakeholders (e.g. government, financial institutions, industry, etc.) will promote a significant improvement in the planned transitions. The government should develop and promote regulations and policies, i.e. incentives for green investments, to motivate future sustainability efforts. The government must also establish domestic sustainability standards within the oil refinery industry.

5.1. Limitations

Multiple limitations must be considered. Cross-sectional research shows mostly time-specific correlations. This means it's not possible to determine causation or how relationships may change over time (Duy et. al. 2024). Causation and temporal relationships would be more clearly defined in longitudinal research focusing on various stages of green investment, stakeholder engagement, and sustainability outcomes. Survey self-reports, the primary data source, invokes various biases and subjectivities (Hutahayan et al., 2025). The bias and the validity of the research could be improved through future studies that consider objective metrics of performance, and assessments from other sources and perspectives that may be integrated.

Third, the aim of this study is on the oil refineries in Egypt alone, and this may affect how other nations, industries, and global organizations may relate to the subject. This is especially true if they encounter different sustainability-related challenges and have different institutional and stakeholder-related structures. Transformative research focusing on strategically sustainable development and design may define relationships and their constraints in context more clearly. Fourth, even if a model captures a significant amount of variance on the outcomes of engagement and sustainable development, it means that some variance is still left unexplained, and that other factors should be explored. There are various factors, from competitive to developmental and socio-political to even organizational, that may affect the sustainability of the transformations (Opoku et al., 2025). Fifth, the aggregate nature of this study's stakeholder engagement wraps a variety of issues and may affect relations. The overlooked variation on the engagement quality and its effectiveness and/or the outcome may interest further research (Mohammed et al., 2024). Community engagement, employee involvement, and relations (and/or collaboration and/or engagement) with investors and government may yield different and unexplored variables and mechanisms.

5.2. Future Research Directions

This research offers a number of promising extensions. Longitudinal studies of organizations during their sustainability transformation journeys could reveal the temporal development of dynamic capabilities and how they use green investments and stakeholder engagement, alongside the outcomes of their sustainability transformations. Comparative studies across the MENA countries could reveal the distinct sustainability transformation mechanisms driven by the region's diverse institutional, cultural, and economic contexts (Michailidis et al., 2025). The extraction of mining, petrochemicals, and natural gas processing will assist in identifying sustainability transition sector-specific drivers, and relationship generalizability.

Research that looks at how moderating variables that either strengthen or weaken the relationships between green investments, stakeholder engagement, and sustainability outcomes is particularly interesting. The type of organizations that might serve as potential moderators include those that vary by size, ownership structure (state-owned, private or public), and those with varying levels of technological sophistication, regulatory stringency, competitive intensity, and leadership characteristics (Opoku et al., 2025). Assessing the different levels for stakeholder-based engagement would enhance the understanding of the different value-creating pathways for the stakeholder groups. Research that consists of qualitative methods, (e.g., case studies or interviews and process analyses) would shed light on the most difficult part of the implementation, the challenges, and learning dynamics of the organization.

Research regarding the potential contribution of modern digital technologies (including artificial intelligence, big data, blockchain, and the Internet of Things) to the efficiency of green investments and the quality of stakeholder engagement is considered to be of particular value in the context of digital transformation (Halsey, 2024). Analysing the potential contribution of green investments and stakeholder engagement in coping with market fluctuations, regulatory changes, and climate disruptions enhance the understanding of organizational resilience and adaptability, and potentially reveals other broader strategic advantages beyond immediate sustainability outcome. Finally, the study of the micro- processes of stakeholder engagement, such as the exchange of ideas for sustainability, the collaborative innovative work, the building of confidence/ legitimacy and the development of social capital, will contribute to the understanding of the relational mechanisms that are integrally involved in sustainable value creation.

REFERENCES

Abdelaty, H., Weiss, D., & Mangelkramer, D. (2023). Climate policy in developing countries: Analysis of climate mitigation and adaptation measures in egypt. Sustainability. https://doi.org/https://doi.org/10.3390/su15119121

Abdullahi, U., Dhahi, A. K. A., Mohamed, A. M., Khalid, M. S. bin, Mahmoud, M. A., & Allumi, N. A. (2025). Energy management practices, renewable energy supply chain, government incentives and environmental performance among manufacturing firms. International Journal of Energy Economics and Policy, 15(2), 123-136. https://doi.org/10.32479/ijeep.20933

Abdulmuhsin, A. A., Alkhwaldi, A. F., Dbesan, A. H., & Tarhini, A. (2025). Empirical insights on organisational sustainability: exploring the influence of communities of practice and associated technologies. Sustainability Accounting, Management and Policy Journal. https://doi.org/10.1108/sampj-02-2024-0155

Adebayo, Y. A., Ikevuje, A. H., Kwakye, J. M., & Esiri, A. E. (2024). Energy transition in the oil and gas sector: Business models for a sustainable future. International Journal of Management & Entrepreneurship Research, 6(10). https://doi.org/10.51594/ijmer.v6i10.1611

Ahmad, I., Abdullah, A., Khalik, A., & Putra, A. (2025). The mediating role of green accounting management on financial performance: Integrated stakeholder theory and natural resource-based view. International Journal of Energy Economics and Policy. https://doi.org/10.32479/ijeep.18135

Alshukri, T., Ojekemi, O. S., Öz, T., & Alzubi, A. (2024). The Interplay of Corporate Social Responsibility, Innovation Capability, Organizational Learning, and Sustainable Value Creation: Does Stakeholder Engagement Matter? Sustainability, 16(13), 5511. https://doi.org/10.3390/su16135511

Anwar, N., Anugrah, R. W., & Jensen, H. (2025). Assessing the influence of green supply chain initiatives on corporate performance using SmartPLS. APTISI Transactions on Management (ATM). https://doi.org/10.33050/atm.v9i1.2423

Arslan, Dr., Faheem, A., Syed, I., & Tariq, A. B. (2026). Driving sustainable performance through CSR, green HRM, and green banking practices: The mediating role of employee green behavior and the moderating effect of FinTech adoption. Periodicals of Management Studies. https://doi.org/10.65181/poms.06.01.0104

Belgacem, I., Gafsi, N., Mazzitelli, D., & Ed-dafali, S. (2026). Do green finance, green insurance, and renewable energy really matter for sustainability? Corporate Social Responsibility and Environmental Management. https://doi.org/10.1002/csr.70378

Cherepovitsyn, A., Shabalina, A., & Kruk, M. (2026). Adaptation of national oil and gas companies of china and russia to the global energy transition: A comparative study of sustainable development strategies. Sustainability. https://doi.org/10.3390/su18062844

Choi, A., Kim, D., & Na, J. (2025). Disaggregating ESG mechanisms: The mediating role of stakeholder pressure in the financial performance of logistics firms. Sustainability. https://doi.org/10.3390/su17198840

Darsono, D., Hersugondo, H., Yuniawan, A., Kusumaningrum, H., Latan, H., & Ali, M. (2025). Linking green finance to sustainability performance: The mediating role of CSR and the moderating effect of stakeholder pressures. Journal of Economic and Administrative Sciences. https://doi.org/10.1108/jeas-04-2025-0221

Duy, P. K., Khanh, P., & Duy. (2024). STRATEGIC MANAGEMENT OF RENEWABLE ENERGY ENTERPRISES: A PSM AND PLS-SEM APPROACH TO SUSTAINABLE BUSINESS MODELS IN VIETNAM. Tạp Chí Khoa Học Và Công Nghệ Trường Đại Học Hùng Vương. https://doi.org/10.59775/1859-3968.228

Emeka-Okoli, S., Nwankwo, T. C., Otonnah, C. A., & Nwankwo, E. E. (2024a). INTEGRATING SUSTAINABLE DEVELOPMENT GOALS INTO OIL & GAS OPERATIONS: A COMPREHENSIVE REVIEW. International Journal of Management &Amp; Entrepreneurship Research. https://doi.org/10.51594/ijmer.v6i3.878

Emeka-Okoli, S., Nwankwo, T. C., Otonnah, C. A., & Nwankwo, E. E. (2024b). STRATEGIES AND OUTCOMES OF CORPORATE SOCIAL INVESTMENT IN THE OIL & GAS INDUSTRY: A REVIEW. International Journal of Management &Amp; Entrepreneurship Research. https://doi.org/10.51594/ijmer.v6i3.877

Fatima, T., Razzaq, A., Nghiem, X. H., & Meo, M. S. (2024). How environmental policy stringency, green investment, and renewable energy contribute to environmental pollution and load capacity factor in G11 countries? Environmental Sciences Europe, 36, 573. https://doi.org/10.1111/1477-8947.12573

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. Journal of Marketing Research, 18(1), 39–50. https://doi.org/10.1177/002224378101800104

Gang, C., Sha, H., & Qamruzzaman, M. (2023). Nexus between energy efficiency, green investment, urbanization and environmental quality: Evidence from MENA region. PLOS ONE, 18(12), e0295628. https://doi.org/10.1371/journal.pone.0295628

Habidin, N. F., Zubir, A. F. M., Fuzi, N. M., Latip, N. A. M., & Azman, M. N. A. (2015). Sustainable Performance Measures for the Malaysian Automotive Industry. World Applied Sciences Journal, 33(6), 1017-1024

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate data analysis (7th ed.). Pearson.

Hakam, D., & Saraswani, R. (2025). Sustainable carbon capture and storage (CCS) investments in oil and gas: Real options analysis under energy transition and government incentives. Greenhouse Gases: Science and Technology. https://doi.org/10.1002/ghg.2389

Halsey, T. (2024). A grand challenge: Digital transformation for the upstream oil and gas industry. Journal of Petroleum Technology. https://doi.org/10.2118/0724-0047-jpt

Huddar, V., & Joshi, D. N. (2025). Exploring the triple bottom line: A systematic review OF sustainable development in the epc oil and gas industry. Journal of Information Systems Engineering & Management. https://doi.org/10.52783/jisem.v10i47s.9218

Hughes, M., Hughes, P., Hodgkinson, I., Chang, Y., & Chang, C. (2021). Knowledge-based theory, entrepreneurial orientation, stakeholder engagement, and firm performance. Strategic Entrepreneurship Journal, 16(3), 633–665. https://doi.org/10.1002/sej.1409

Huo, C., Hameed, J., Albasher, G., & Dar, A. A. (2025). Digital and sustainable synergies: Insights into green investment, technological innovation, and low-carbon economies. Energy &Amp; Environment. https://doi.org/10.1177/0958305x251395638

Hutahayan, B., Sitompul, H., Hidayat, K., & Sunarti, S. (2025). Does the use of renewable energy influence firm performance? An empirical study on the indonesian energy sector. Business Strategy &Amp; Development. https://doi.org/10.1002/bsd2.70237

Jaber1, T. D., & Dulaimi, H. A. A. (2025). Future potential for infostructure enhancement of oil refining industry in iraq. Journal of Information Systems Engineering & Management. https://doi.org/10.52783/jisem.v10i30s.4840

Kabeyi, M. J. B., & Olanrewaju, O. A. (2022). Sustainable energy transition for renewable and low carbon grid electricity generation and supply. Frontiers in Energy Research, 10, 743114. https://doi.org/10.3389/fenrg.2021.743114

Kaplan, F. (2025). Green finance and sustainable policies: Driving the transitıon to a low-carbon economy. International Journal of Islamic Economics and Finance Studies. https://doi.org/10.54427/ijisef.1644322

Lin, W. L., Chong, S., & Wong, K. K. S. (2024). Sustainable development goals and corporate financial performance: Examining the influence of stakeholder engagement. Sustainable Development. https://doi.org/10.1002/sd.3259

Louis, B. D., & Kuriakose, S. (2025). Fuelling a greener future: The role of green venture capital in sustainable development. Ecology, Environment & Conservation. https://doi.org/10.53550/eec.2025.v31i02s.056

Michailidis, M., Zafeiriou, E., Kantartzis, A., Galatsidas, S., & Arabatzis, G. (2025). Governance, energy policy, and sustainable development: Renewable energy infrastructure transition in developing MENA countries. Energies. https://doi.org/10.3390/en18112759

Mohamed, A.-M. O., Mohamed, D., Fayad, A., & Nahyan, M. T. A. (2025). Environmental management and decarbonization nexus: A pathway to the energy sector's sustainable futures. World. https://doi.org/10.3390/world6010013

Mohammed, A., Graham, E., Fuseini, M. N., & Tomo, B. K. (2024). Community expectations versus corporate social responsibility practices in ghana's oil and gas sector. Cogent Business &Amp; Management. https://doi.org/10.1080/23311975.2024.2390684

Mukhtar, B., Shad, M. K., & Lai, F. W. (2024). Fostering sustainability performance in the Malaysian manufacturing companies: the role of green technology innovation and innovation capabilities. Benchmarking: An International Journal, 32(3), 992–1016. https://doi.org/10.1108/bij-07-2023-0468

Nwankwo, E., Emeka-Okoli, S., Nwankwo, T., & Otonnah, C. A. (2024a). Communication strategies for effective CSR and stakeholder engagement in the oil & gas industry: A conceptual analysis. World Journal of Advanced Research and Reviews. https://doi.org/10.30574/wjarr.2024.21.3.0663

Nwankwo, E., Emeka-Okoli, S., Nwankwo, T., & Otonnah, C. A. (2024b). Corporate governance and CSR for sustainability in oil and gas: Trends, challenges, and best practices: A review. World Journal of Advanced Research and Reviews. https://doi.org/10.30574/wjarr.2024.21.3.0662

Nwankwo, E., Emeka-Okoli, S., Nwankwo, T., & Otonnah, C. A. (2024c). Environmental stewardship and corporate social responsibility: A review of case studies from the oil and gas sector. World Journal of Advanced Research and Reviews. https://doi.org/10.30574/wjarr.2024.21.3.0661

Nwankwo, E., Emeka-Okoli, S., Nwankwo, T., & Otonnah, C. A. (2024d). The evolution of CSR reporting in the oil and gas industry and its future direction: A conceptual review. World Journal of Advanced Research and Reviews. https://doi.org/10.30574/wjarr.2024.21.3.0664

Okeowo, O. P., Obasohan, J. N., & Ariori, O. (2026). Reframing community relations: Communication-based stakeholder engagement in oil and gas production in nigeria. International Journal of Innovative Research & Development. https://doi.org/10.24940/ijird/2025/v14/i12/dec25011

Opoku, R., Ampah, J., Korsi, N. J. N., Manzoor, A., Kaku, G., & Nsiah-Sarfo, D. J. (2025). Achieving sustainable performance through dynamic capabilities in disruptive manufacturing environments: Does technology innovation matter? Business Process Management Journal. https://doi.org/10.1108/bpmj-02-2025-0221

Oruwari, H., Obunwa, Q., Ahuchogu, J., & Ayuba, S. (2024). The effect of stakeholders engagement on corporate social responsibility project sustainability in niger delta. SPE Nigeria Annual International Conference and Exhibition. https://doi.org/10.2118/221641-ms

Rahayu, S. A. P., Puteri, D. S., & Pratomo, N. B. A. (2025). Green investment effect on upstream oil and gas activities in indonesia. Arena Hukum. https://doi.org/10.21776/ub.arenahukum2025.01803.3

Ramadan, A. (2025). Financing the future: Green investment, policy innovation and sustainable energy transitions in Egypt and Jordan. Mediterranean Review of Socio-Economic Research, 1(2), 78–95. https://doi.org/10.1108/msar-02-2025-0078

Sari, E., Shaharoun, A. M., Ma'aram, A., & Yazid, A. M. (2015). Sustainable Maintenance Performance Measures: A Pilot Survey in Malaysian Automotive Companies. Procedia CIRP, 26, 443–448. https://doi.org/10.1016/j.procir.2014.07.163

Shammah, N., Favour, C., Precious, N., & Emeka, N. (2025). Towards a low-carbon energy industry: Financial and reputational resilience strategies of integrated energy companies. SPE Nigeria Annual International Conference and Exhibition. https://doi.org/10.2118/228677-ms

Smaoui, A. (2025). Driving the green transition: The role of renewable energy, environmental technology, FDI, and globalization in South Africa's sustainable growth: Evidence from a CS-ARDL approach. Sustainability, 17(23), 10866. https://doi.org/10.3390/su172310866Xu, P.,

Țăran, A., Noja, G., Ionașcu, A., Diaconu, M., & Lobonț, O. (2026). Towards green transition: Sustainable energy future and its effects on companies' financial strategies. Energies. https://doi.org/10.3390/en19010277

Tian, H., & Tian, J. (2021). The mediating role of responsible innovation in the relationship between stakeholder pressure and corporate sustainability performance in times of crisis: Evidence from selected regions in china. International Journal of Environmental Research and Public Health. https://doi.org/10.3390/ijerph18147277

Vo Thai, H.-C., Thao, H. T., & Tran, M.-L. (2025). Propelling sustainable competitive performance in the digital age: the nexus of dynamic managerial capabilities, stakeholder engagement, and corporate digital responsibility. Management Research Review, 48(11), 1529–1559. https://doi.org/10.1108/mrr-12-2024-0968

Zhang, J., & Mehmood, U. (2023). How do green investments, foreign direct investment, and renewable energy impact CO_2 emissions? Measuring the role of education in E-7 nations. Sustainability, 15(19), 14052. https://doi.org/10.3390/su151914052