
Effect of Innovation Strategy on the Performance of Private Solar Energy Companies in Kenya

Billy Saverio Lengewa¹, James Mbebe² & Mary Mbithi³
^{1, 2, 3} School of Business and Economics, Kenya Methodist University
Corresponding Author: Billy Saverio Lengewa¹

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Abstract

Innovation has emerged as a critical driver of competitive advantage in the energy sector, especially as firms respond to globalization and technological advancements. Despite the growing role of private solar energy companies in Kenya, limited research exists on how innovation strategies influence their performance. This study aimed to examine the effect of innovation strategies on the performance of private solar energy companies in Kenya. An ex-post facto research design was employed, targeting 1,548 middle- and low-level managers from 12 registered private solar companies. Using stratified random sampling and the Taro Yamane formula, a sample of 318 respondents was selected. Data were collected through structured questionnaires and analyzed using content, descriptive, and inferential statistics, with binary logistic regression employed to test the relationship between innovation and performance. The results revealed a statistically significant and positive effect of innovation strategies, particularly product and technology innovation, on company performance ($B = 4.605$, $p < 0.001$), with firms implementing technology-based innovations being 10 times more likely to achieve high performance. The study concludes that innovation, especially in product and technology areas, is a significant predictor of business performance in Kenya's solar energy sector. It recommends that firms invest more in developing and protecting intellectual property, adopt smart-grid and hybrid solar systems, and integrate AI-powered energy management solutions to enhance efficiency and market competitiveness.

Keywords: *Innovation Strategy, Performance, Private Solar Energy Companies*

INTRODUCTION

Innovation has become the single most important aspect of creating and sustaining a competitive advantage across different industries. As globalization increases and technology advances, firms have to engage in innovative strategies if they are to compete in the current market environment (Palage et al., 2019). Consequently, firms in different sectors have engaged in diverse innovative strategies that lead to the creation of new ideas, processes, and production. Innovation, especially in the energy sector, entails the implementation of new technologies, business models, and processes that enhance energy production, distribution, and consumption. Innovation in the energy sector is thus not just focused on the firm's production processes but also on how the energy used is consumed and utilized (Bach et al., 2019). Innovation in the energy sector is crucial for ensuring secure, affordable, and sustainable energy for the future.

Innovation in the energy sector seeks to implement innovations that simplify and enhance production and the functions in the energy companies. It entails changing the routine norms of doing business by manipulating the systems to increase efficiency (Adungosi & Odollo, 2020). Globally, innovation in the energy sector entails the shift towards more efficient energy sources and production methods that reduce waste. The investment in renewable energy around the globe has increased by 32% in the last ten years, with China and Europe leading the charge (Gerarden, 2023). In the US, the innovation in the energy sector has been critical in driving competitiveness in the industry. Some of the innovation strategies employed include renewable energy technologies and energy storage solutions. In China, innovation strategies have significantly impacted the performance of the energy sector, specifically in the renewable Technological innovation in the use of renewable energy has helped to reduce carbon emissions and improve energy efficiency, leading to better environmental outcomes. The advancement in battery technologies, for instance, has helped reduce the countries' reliance on fossil fuels (Ahmad et al., 2023).

The energy sector in Africa is critical for the economic growth and development of the continent. Different countries have embraced innovation strategies in the energy sector to use renewable energy sources to power the manufacturing and processing sectors. In South Africa, for instance, innovation strategies have been critical in improving the performance of the country's energy sector (Bach et al., 2019). As the country transitions towards to sustainable and reliable energy system, the country has invested in technological advancements, innovations in the business models, and strategic policy frameworks. The use of big data analytics, IoT and utility-scale batteries are essential for driving the efficiency on the energy sector in the Country (Koyluoglu & Dogan, 2021). Innovation strategies have been critical in Ethiopia's energy sector as they have enabled the country to improve efficiency in the production and distribution of energy. The innovation has been employed in renewable energy sources to enhance security and reduce the reliance on traditional fuels as the country shifts towards the use of renewable energy sources (Habtewold, 2023). This innovation has been critical to the achievement of the country's sustainable development goals by bridging the gap in energy access.

In Kenya, the innovation strategies in the energy sector entail making improvements on the existing energy systems through making alterations and modifications to meet the market needs. Although the country has a huge potential for renewable energy, such as solar and wind energy, it is highly underutilized (Adungosi & Odollo, 2020). The renewable sector is highly underutilized despite the growing demand for electricity to power industries and for domestic use. The country's energy sector is characterized by frequent power outages, low access to new technologies, and overdependence on oil exports (Kasyoka & Mulyungi, 2019). These challenges pose a serious threat to the country's growing demand for energy and the related environmental concerns about the use of clean energy in the economy. Prolonged droughts in the country and fluctuations in the oil prices have a huge impact on the energy sector, which in turn impacts the country's ability to meet its sustainable development goals (Gebreslassie, 2021).

Statement of the Problem

The energy sector in Kenya plays a crucial role in the attainment of the country's Vision 2030 of transforming the country into a middle-income economy. Different projects have been financed by the government and non-governmental sector to help the growth of the sector due to its strategic role in economic growth and development (Gerarden, 2023). In this regard, the Kenyan energy sector has witnessed a surge in private energy companies that seek to take advantage of the role of energy in development. For instance, companies like M-Kopa, D-light, and Mobisol

have made significant efforts in market penetration in the country (Ombajo & Kavale, 2024). These companies have introduced flexible payment models to help rural people own solar appliances at affordable prices. The entrance of these companies has also led to an increase in the competition in the industry, with each firm trying its best to outmaneuver the rivals. Technological innovation has thus been a critical ingredient in fueling these firms' strategic positions in the market.

While innovation strategies are critical for the success and growth of the private energy sector in Kenya is critical, few studies have examined this subject. Rotich et al. (2024) explored the factors leading to the growth of the energy sector in Kenya, whereby it was noted that a number of factors impact the performance. These factors include competition, lack of government support, high taxes, and high entry barriers in the market. Other factors, such as high risks in the sector, were also found to be very significant determinants in the performance of the industry. In another study, Steen et al. (2019) examined the role of innovation strategies in the renewable energy sector in Norway. The study noted that the use of innovative strategies has helped the private firms in Norway to establish a competitive advantage in the provision of solar and wind energy in the country. However, this study was carried out in another country, thus posing a contextual gap. It is against the backdrop of these research gaps that this study sought to examine the effect of innovation strategy on the performance of private solar energy companies in Kenya.

LITERATURE REVIEW

Theoretical Review

Resource-Based Theory

The resource-based view (RBV) was introduced by Wernerfelt in 1984, whereby it explained that a company's products and its resources are related (Tcvetkov, 2022). This theory posits that a company can acquire a competitive advantage by taking advantage of its unique resources that are valuable. It also explains that firms need not rely on the external environment for success, as they can easily use their capabilities to create a competitive advantage in the market. A firm can leverage the bundle of valuable resources, such as technology, to create a competitive advantage that will be hard to copy by the rivals. A firm's resources must be rare, valuable, non-substitutable, and inimitable for it to create a competitive advantage in a firm. The competitive advantage stems from a firm's ability to develop and implement strategies that improve the efficiency and effectiveness of the firm.

The RBV theory can be used in the energy sector in a two-fold manner: the private firms in the energy sector can leverage unique resources to create a competitive edge in the market. This will enable them to command a huge market share through their unique products that have a unique appeal in the market (Barney et al., 2021). Besides, the RBV can be used to explain how households can accumulate enough resources and funds that enable them to choose the best energy providers in the market. The unique resources and capabilities possessed by the firms will enable them to achieve sustainable competitive advantage, leading to more efficient energy in the economy (Lubis, 2022). The impact of creating a competitive advantage through the use of valuable resources is that the competitors will not be able to copy, leading to more innovation in the market.

This theory is applicable in this study as it explains how the firms in the Kenyan energy sector can take advantage of their capabilities and resources to innovate. The innovation will entail the development of products and services that align with the specific needs in the market (Freeman et al., 2021). The theory also explains how firms can overcome some of the challenges in the industry by using their capabilities and unique resources to circumvent the challenges. This

theory will be critical in explaining how firms in the energy sector can gain economies of scale by making initial investments in innovation and creating barriers to duplicity.

Empirical Review

Different scholars have examined the impacts of innovation strategies on firm performance in different sectors and in different countries. Kasyoka and Mulyungi (2019) examined the effects of innovation on organizational performance in Milk processing firms in Rwanda. This research focused on the role of product innovation, process innovation, and market innovation on the firm's performance. A descriptive research design was employed, whereby 256 respondents were targeted. The stratified sampling method was then used to get the samples from the population, whereby both primary and secondary data were collected. Data was analyzed using SPSS, whereby the averages, percentages, and regression analysis were used. The results revealed that market innovation, product innovation, and process innovation have a direct impact on the performance of milk processing firms in Inyanga. Importantly, product innovation was noted to have the greatest impact on performance of the three levels of innovation. The main limitation of this study is that it was done in the milk processing sector, which has a different market dynamic compared to the energy sector. Consequently, the results cannot be generalized to the current research topic.

Bogetoft et al. (2024) explored the impacts of innovation strategies by focusing on Malaysian firms. The focus was mainly on the product innovation, market innovation, and process innovation, whereby 15,000 manufacturing firms were considered. The study evaluated the impacts of these innovations on a societal perspective by using data from data envelopment analysis (DEA). The data was obtained for a period of 10 years between 2005 to 2015. It was noted that innovation strategy has the highest impact on performance compared to both marketing and process innovation. The main limitation of this study is that it was done in Malaysia, which has a different economic and social environment compared to Kenya. Besides, the study was done in the manufacturing sector, implying that the results cannot be generalized in the Kenyan energy sector context.

Koçluoglu and Dogan (2021) exposed the impacts of innovation strategies on business performances by focusing on Turkish technological firms. Several dimensions of innovation strategies were used to determine which of these has the greatest impact on performance. The organizational performance was measured using product performance, business performance, process performance, and employee performance. The Morgan and Strong scale was used to measure the innovation and the business's performance. A total of 345 managers at different levels in the Turkish technological space were targeted in the research. The data was analyzed using Jamovi and SPSS, whereby Pearson's correlation, regression analysis, and factor analysis were employed. The results revealed that innovation strategies have a positive and direct impact on the performance of the Turkish tech firms. Importantly, future-oriented strategies were found to have the greatest impact on performance. The main limitation of this study is that it was done in Turkey, which offers a contextual gap since the current research topic is on the private energy firms in Kenya.

Sonmez and Adiguzel (2023) evaluated how innovative finance strategies impact organizational performance in Indian firms. Specifically, the research focused on sustainability energy companies in India, whereby financial strategies, innovation strategies, and organizational innovation were the center of attention. The data was analysed using the Mplus package, whereby 297 administration staff in the organizations were targeted. SPSS was used in the data analysis, whereby the results were presented in tables and charts. The findings revealed that

innovation is positively related to financial performance in the sustainability of energy firms in India. However, this study was done in the energy sector in India, which is different from the Kenyan market, implying that the results cannot be generalized to the Kenyan context.

Ahmad et al. (2023) studied the influence of innovation strategies on the energy companies in Indonesia. The research focused on process innovation, product innovation at Kencana Company. The data employed quantitative techniques in the data collection, which was done using questionnaires. The respondents consisted of 25 employees of the Kencana company working at different levels of management. It was noted that process innovation has the greatest impact on the performance of the company, followed by product innovation. The main limitation of this study is that it was done in Indonesia, which has a different climate compared to Kenyan economy. Consequently, the results from this study cannot be used to make a generalized conclusion on the current topic.

DATA AND METHODS

The study adopted an ex-post facto research design to examine the influence of transformational strategies on the performance of private solar energy companies in Kenya. This design was deemed appropriate as it allows for the investigation of existing conditions and relationships without manipulating the independent variables. The design enabled the researcher to assess the effect of various transformational strategies, particularly innovation strategy, on business performance outcomes within the solar energy sector.

The target population for the study comprised 12 private solar companies registered in Kenya, which formed the unit of analysis. From these companies, the study specifically focused on 1,548 middle-level and low-level managers as the unit of observation. To ensure a representative sample, a stratified random sampling technique was employed, allowing for proportional representation across the different managerial levels. The sample size was determined using the Taro Yamane formula: $n = N / [1 + N(e^2)]$, where n represents the sample size, N the population size, and e the margin of error set at 5%. Applying this formula, the study arrived at a sample size of 318 respondents.

Data collection was conducted using a structured questionnaire, distributed both physically and electronically over two weeks to maximize response rates. The collected data were analyzed using a combination of content, descriptive, and inferential statistical techniques. Qualitative responses were subjected to content analysis, where data were thematically categorized to facilitate interpretation and reporting. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize quantitative data. Inferential analysis was conducted using binary logistic regression to assess the relationship between innovation strategy and business performance. The model used was expressed as: $\text{Log } Y (P/1-P) = \beta_0 + \beta_1 X_1$, where P denoted the odds of high business performance, $(1-P)$ represented the probability of low performance, β_1 was the regression coefficient for the innovation strategy (X_1), and β_0 was the constant term.

RESULTS AND DISCUSSIONS

Response Rate: A total of 290 respondents submitted their answers from a pool of 318 targeted participants, which yielded an exceptional response rate of 91.2%. The remaining 28 participants (8.8%) did not respond.

Descriptive Statistics

Descriptive Statistics on Innovation Strategy

Descriptive Analysis on Innovation Strategy: 3 and 4 were the most frequent choices, showing they were moderate and agreed equally with some practices (Table 1). Overall, the data indicate

a strong organizational emphasis on innovation strategy, especially in areas such as intellectual property development, product diversification, and adoption of solar technologies. While there is broad agreement on these efforts, the presence of significant neutral responses may imply a need for better internal communication or engagement with staff to increase awareness and participation in innovation activities. Müller et al. (2021) were in agreement with the findings when they postulated that innovation involves the adoption of creative and technological advancements to develop new products or improve existing services. Table 1 shows the results.

Table 1: Descriptive Analysis on Innovation Strategy

Indicator for Innovation Strategy	Disagree	N	Agree	Mode
Our organization has invested in Research and development.	13.7% (40)	33.1% (96)	53.1% (154)	3
Our organization has adopted new solar technologies.	20.0% (58)	24.8% (72)	55.1% (160)	4
Our organization has diversified solar product offerings.	14.4% (42)	32.4% (94)	53.1% (154)	3
Our organization has come up with new processes and designs that are protected as intellectual property.	11.0% (32)	20.0% (58)	68.9% (200)	4

Descriptive Statistics on Performance of Private Solar Energy Companies

The descriptive statistics in Table 2 indicate a generally positive perception of performance among private solar energy companies in Kenya. A majority of respondents agreed with all four performance indicators. Notably, 69.7% of respondents reported profit growth in the last financial year, while 66.9% indicated revenue growth over the same period. Additionally, 60.0% observed an increase in staff numbers, suggesting organizational expansion, and 66.9% confirmed an increase in customer base, reflecting growing market reach. Across all indicators, the mode was 4, implying that the most frequently selected response category was "Agree," reinforcing the overall trend of positive performance across financial, human resource, and customer growth dimensions. Results are shown in Table 2.

Table 2: Descriptive statistics on Performance of Private Solar Energy Companies

Indicator	Disagree	N	Agree	Mode
We had a profit growth in our last financial year.	6.2% (18)	24.1% (70)	69.7% (202)	4
We registered revenue growth in our last financial year.	9.6% (28)	23.4% (68)	66.9% (194)	4
The number of our staff has grown since last year.	9.6% (28)	30.3% (88)	60.0% (174)	4
Our customers have increased over the past year.	4.2% (12)	29.0% (84)	66.9% (194)	4

Binary Logistic Regression Analysis

The study sought to test the null hypothesis that Customer-centric strategies do not have a significant influence on the performance of private solar energy companies in Kenya. The results from the bivariate logistic regression analysis (Table 3) show a significant relationship between innovation strategies and the performance of private solar energy companies in Kenya. The model summary indicates a good fit, with a Cox & Snell R Square of 0.314 and a Nagelkerke R Square of 0.538, suggesting that approximately 31.4% to 53.8% of the variation in company

performance can be explained by innovation strategies. The -2 Log Likelihood value of 144.435 also points to a reasonable model fit.

The variables in the equation, product/technology innovation (coded as 1), had a statistically significant positive effect on performance ($B = 4.605$, Wald = 38.527, $p < 0.001$). The odds ratio for this variable was 10.1, indicating that companies employing product or technology-based innovation were 10 times more likely to report high performance compared to those using strategic or capacity-based innovations (coded as 0). Results are shown in Table 3.

The findings of the current study, which revealed that product and technology innovation had a significant effect on the performance of private solar energy companies in Kenya, are consistent with previous literature that highlights the critical role of innovation in enhancing firm performance across various sectors and countries. Kasyoka and Mulyungi (2019) similarly found that product innovation had the strongest effect on performance in Rwanda's milk processing firms. Bogetoft et al. (2024) also reported that product innovation was the most influential factor in driving manufacturing firm performance in Malaysia. Likewise, Koyluoglu and Dogan (2021) demonstrated a positive link between innovation strategies and business performance in Turkish technological firms, emphasizing future-oriented strategies. Additionally, Sonmez and Adiguzel (2023) and Ahmad et al. (2023) found a positive association between innovation and organizational performance in the energy sectors of India and Indonesia, respectively.

Table 3: Bivariate Logistic Regression Between Innovation and Performance of the Solar Company

		Model Summary					
Step	-2 Log likelihood	Cox & Snell R Square			Nagelkerke R Square		
1	144.435 ^a	.314			.538		
		Variables in the Equation					
		B	S.E.	Wald	df	Sig.	Odds
Step 1 ^a	0 = Strategic/Capacity-based innovation	0	0	0	0	0	0
	1 = Product/Technology innovation	4.605	.742	38.527	1	.000	10.1
	Constant	4.605	.711	41.995	1	.000	100.000

a. Variable(s) entered on step 1: Innovation Strategies

b. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Conclusions and Recommendations

Specifically, product and technology innovation strategies were shown to greatly increase the odds of achieving high business performance. Given this strong empirical evidence, the null hypothesis stating that innovation strategies do not have a significant influence on performance is rejected. This affirms that innovation is a key driver of competitive advantage and business growth within the sector. It is recommended that private solar energy companies in Kenya actively adopt and invest in innovation strategies to improve their performance. Given the strong effect of technology-based innovations, companies should prioritize the development and protection of their intellectual property, including securing patents for new and improved solar

products. Firms are encouraged to embrace emerging technologies such as smart-grid solutions and hybrid solar systems, which can offer more efficient and reliable energy options for customers. Additionally, with the rapid advancement of artificial intelligence, solar companies should integrate AI-powered energy management tools to optimize energy generation, storage, and distribution. This will not only enhance product quality but also improve operational efficiency and customer satisfaction in the growing renewable energy market.

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