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Assessing Product Pilot as a Strategy for New Product Commercialization: A Case Study of Engie Energy Access Zambia Solar Home System Products

Efron Njobvu[1*] Scotch M. Ndhlovu, PhD[,1]

1.Graduate School of Business, University of Zambia, P. O Box 32379, Lusaka Zambia
Email: *damisoz.en8@gmail.com, scotovu@yahoo,co.uk

Abstract

The purpose of this study was to assess the product pilot as a strategy for new product commercialization at ENGIE Energy Access Zambia. The study focused on three variables namely, (1) Proficiency of departments in utilizing product pilot (2) Communication among the key departments, and (3) Effectiveness of key components of pilot strategy (customer feedback, price, promotions and place). The study employed a mixed-methods approach, integrating quantitative survey responses with qualitative insights from structured interviews to provide a comprehensive analysis of organizational capabilities and constraints in pilot implementation. Quantitative data was collected from a stratified random sample of 110 employees of ENGIE Energy Access Zambia while qualitative data was collected from stratified purposive sample of 16 respondents. The quantitative data was analyzed using R software statistical tool version 4.2.2 while qualitative data was analyzed using thematic analysis, following Braun & Clarke's (2006) six-step framework using NVivo software (version 14) which facilitated the coding and theme development process. Models such as multiple regression, One-way ANOVA, mediation analysis and relative importance analyses were used to conduct data interpretation. The study revealed substantial departmental differences in pilot strategy implementation ($F(3, 75) = 4.86$, $p = .004$, $\eta^2 = .16$), with Product & Operation demonstrating superior KPI proficiency (4.11), communication effectiveness (3.49), and strategy component implementation (4.02) compared to Customer Finance (3.42, 2.75, 3.33, respectively). Additionally, communication effectiveness emerged as a critical predictor of both KPI proficiency ($p < .001$, $R^2 = .83$) and strategy component implementation ($p < .001$, $R^2 = .78$). Further, the study revealed that departments within Engie Energy Access Zambia differed in how well they handled the product pilot process. For instance, some departments were more skilled in tracking performance, communicating clearly, and applying strategy elements effectively, while others were not. Communication was found to be a key factor in effective implementation of the pilot strategy. Some of the common communication problems revealed during the study were lack of information sharing, unclear messages, and weak feedback systems. These issues often caused delays or misunderstandings during pilot implementation. The study concludes that for product pilots to succeed, it is not enough to have technical skills or a good understanding of the market. Success of a product commercialization depends on how well departments share knowledge, communicate, and work together. The study therefore, recommends four main actions for Engie Energy Access Zambia in its sale of solar home system products as: (1) departments should be more integrated during pilot planning, working together from the start; (2) In addition to generic communication protocols each department should have specific communication protocols that suit their needs; (3) a better system for collecting and acting on customer feedback should be introduced; and (4) the company should focus more on improving customer Satisfaction, rather than just lowering prices. These steps will help the company carry out more effective pilots and improve the success of new product.

Key words: *Pilot, Commercialization, Product, strategy*
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1.Introduction

Introducing a new product into the market successfully requires more than just innovation, it depends on a well-structured pilot strategy with defined Key Performance Indicators (KPIs) to monitor performance during the trial phase. These indicators offer vital feedback on how well a product resonates with the intended market, which ultimately shapes the decision to proceed with full commercialization. In the renewable energy space, particularly for solar home systems (SHS), this step is essential. ENGIE Energy Access Zambia, a company that has been offering solar home system (SHS) solutions since its establishment in 2017, has consistently expressed interest in expanding its product line. However, several of its initiatives have failed to move beyond the pilot stage. While ENGIE Energy Access Zambia has embraced a customer-driven pilot product strategy—an approach that empowers customers to influence new product development (NPD) through what is internally known as "product prioritization" commercial uptake has often remained limited. This method involves gathering direct feedback from customers on the types of products they would like to see offered (Fuchs & Schreier, 2010). Despite these efforts, the path from pilot testing to full commercialization appears to be disrupted. This raises crucial questions: Is the pilot strategy being applied as intended? Do key stakeholders fully understand the strategy? Or is the strategy itself potentially flawed?

Product pilot is one of the pathways for product commercialization in renewable energy products (Sompong, Igel, Lawton Smith, et al., 2014). Commercialization is a vital contributor in product diffusion and adaptation. Entrepreneurial orientation during Research and development (R&D) is one of the factors that ensures successful commercialization of a product (Latif et al., 2016). ENGIE Energy Access Zambia uses modern processes of introducing a new product by empowering customers through using a product prioritization process that is based on customer feedback on what solar product they need. This entails that the R&D process incorporates an entrepreneurial perspective during product development (Fuchs & Schreier, 2010). (Ginn & Rubenstein, 1986) Points out that in order to ensure goal compatibility in commercialization of a new product there should be interface among the various stakeholders starting from R&D, Manufacturing through to all departments involved. Research shows that the essential requirements for successful commercialization of renewable energy (RE) technologies where Solar home systems fall are; providing a stable market and stable policies in industry, accurate identification of the potential adopters, designing, developing, and informing user-friendly renewable energy RE products/services, and providing post-adoption supports. There are other factors that affect commercialization of renewable energy products like Solar home systems which are Competition Capability, Government incentives, Product Standards, Economic stability, Infrastructure and technical capability (Millson & Wilemon, 2008) and(Hansen et al., 2014).

This study assessed the extent to which ENGIE Energy Access Zambia effectively used product pilots as a strategy for commercializing its product offerings.

2. Review of the Literature

Product Commercialization requires resources such as technical competence, experience of the industry, customer and market knowledge, the ability to identify the optimal functionality of the product, communication, distribution, and close relationships with key actors (Aarikka-Stenroos & Sandberg , 2009). According to (Aarikka-Stenroos & Sandberg , 2009) he refers to commercialization as the successful launch and interaction of a product to a wider market and Commercialization is the process of transforming ideas, innovations, or technologies into marketable, profit-generating products or services. Commercialization, by its very nature, is a complex and multi faceted phenomenon, requiring extensive research and understanding of the business environment before it can yield the required results (Shakeel, et al., 2017). Findings from the study done by (Shakeel, et al., 2017)suggest that successful commercialization is dependent on a number of factors and it would be unwise to expect that focusing on either one can lead to the successful achievement of objectives. The piloting of new products is a critical area in product commercialisation, particularly in industries undergoing rapid growth, such as the home solar system industry in Zambia. Existing theories emphasize the importance of stakeholder alignment, robust decision-making frameworks, and cross-departmental collaboration for successful commercialization." However, the literature offers limited insights into the sector-specific challenges and internal organizational processes that impact commercialization outcomes in the renewable energy industry. While frameworks exist for cross-functional collaboration, they are often generalized and lack applicability to contexts such as solar home systems products, where resource constraints and diverse stakeholder inputs play significant roles."

This study introduces the 'Product Pilot as a strategy to product commercialisation,' which theorizes that successful product commercialization in solar home system industry is driven by three interdependent factors: (1) alignment of pilot goals with strategic objectives, (2) robust cross-departmental communication (Aarikka-Stenroos & Sandberg, 2009), and (3) systematic evaluation mechanisms for pilot performance. The framework suggests that misalignment in any of these factors leads to inefficiencies, financial losses, reputational damage and failure of the product to be commercilized in the market.

2.1 Global perspective

2.1.1 Factors Influencing Product Commercialization

In examining the existing body of research, several critiques emerge, highlighting limitations and areas for further investigation. A recurring concern is the limited generalizability of findings due to the narrow focus of many studies. From a global perspective, some studies concentrate on a single organization, which restricts their applicability to broader contexts (Ginn & Rubenstein , 1986). Similarly, research limited to specific industries, such as Thailand's food processing sector, may not adequately represent other emerging economies or industrial contexts (Sompong, et al., 2014). Furthermore, the lack of random sampling across diverse industries undermines the representativeness of results (Sompong, et al., 2014). These methodological constraints are compounded by an overreliance on interviews, which risks introducing bias into findings (Ginn & Rubenstein , 1986).

2.1.2 Stakeholder Engagement in Product Commercialization

Another significant limitation involves the scope of the research. The focus on inter-organizational cooperation, while valuable, potentially overlooks other forms of alliances that might yield different insights (Sompong, et al., 2014). Additionally, studies often fail to explore the historical and institutional barriers affecting technology diffusion and adoption, particularly in renewable energy sectors (Brown & Hendry, 2009). The omission of these barriers leaves a gap in understanding the complexities of market creation, especially the role of consumer awareness and institutional constraints (Brown & Hendry, 2009).

2.1.3 Challenges in Market Expansion and Adoption

Moreover, the emphasis on economic factors frequently overshadows other critical aspects, such as technical considerations or stakeholder coherence (Chiesa & Frattini, 2011).The methodology and analytical approaches of these studies also warrant critique. The reliance on cross-sectional data limits insights into the evolution of alliances over time (Chiesa & Frattini, 2011). Similarly, the absence of diverse analytical techniques constrains the depth of the conclusions drawn (Sompong, et al., 2014). Future research would benefit from exploring innovative methodologies and adopting a longitudinal perspective to better capture dynamic processes.

Specific areas of application, such as technology diffusion trials, highlight further gaps. Studies often fail to clearly differentiate between technical and economic demonstration trials, making it challenging to assess their respective impacts (Ginn & Rubenstein , 1986). In addition, limited analysis of specific technologies and market incentives leaves a fragmented understanding of their role in commercialization and market expansion (Ginn & Rubenstein , 1986) and (Chiesa & Frattini, 2011). The lack of literature addressing the commercialization environment in specific contexts, such as Finland, further underscores the need for comprehensive research (Chiesa & Frattini, 2011).

Lastly, the practical implications of these studies are sometimes ambiguous. Recommendations for improving interfaces, for example, are often vague and lack actionable detail (Brown & Hendry, 2009). Similarly, the exploration of superordinate goals and their effectiveness remains superficial, requiring further investigation . These shortcomings point to a need for more robust, actionable frameworks that bridge theoretical insights with practical applications.

In conclusion, the critiques collectively emphasize the necessity for broader, more inclusive research designs, diverse methodological approaches, and a deeper exploration of underrepresented variables and contexts. Addressing these gaps will enhance the applicability and depth of findings, paving the way for more effective strategies in industry and policy development.

2.2 Regional Perspective

2.2.1 Decision-Making Frameworks for Commercialization

From the regional perspective research critically addresses a significant gap in commercialization studies, offering valuable insights into this underexplored areas (Chiesa & Frattini, 2011). By employing historical analysis, the study done by (Chiesa & Frattini, 2011) enhances the reliability of its findings, providing a robust foundation for understanding commercialization dynamics. However, its focus on consumer product innovations limits the generalizability of the conclusions across different contexts. Similarly, the absence of a detailed exploration of process and service innovations further restricts the applicability of the results. These limitations highlight the need for future research to investigate the profitability impacts of commercialization decisions, particularly in diverse industrial settings (Chiesa & Frattini, 2011).

2.2.2 Pilot Strategies in New Product Commercialization

Other researches reviewed effectively incorporates the Stage-Gate model to analyze new product development strategies and utilizes structured interviews to gain qualitative insights into the process (BANSAH, 2019). Insights derived from multiple companies strengthen the relevance of the findings, and comparisons with established firms enhance the credibility of the conclusions (BANSAH, 2019). Nonetheless, the limited focus on quantitative data and the study's failure to explore broader market dynamics may restrict the broader applicability of the results. Theoretical frameworks used in the study may also fall short in encompassing all relevant aspects, necessitating more comprehensive approaches in subsequent research (BANSAH, 2019).

Additionally, challenges inherent in managing the goals of diverse actors during commercialization are underscored, with insufficient empirical studies on network changes within innovation processes being a noted gap (Aarikka-Stenroos & Sandberg, 2009). The study identifies path dependence as a complicating factor, affecting resource interactions and trade-offs during commercialization. A deeper exploration of commercialization networks and their dynamics would enrich the understanding of innovation processes and outcomes.

Another critique is the research's geographical and industrial scope. While focusing on the Nigerian food and beverage industry provides context-specific insights, it limits the study's generalizability (Ogbor & Edem, 2021). Broader research across multiple industries is essential for a more comprehensive understanding. Furthermore, potential biases in self-reported data and the absence of longitudinal analysis to assess long-term impacts are key limitations. Despite these challenges, the sample size of 221 employees and the use of appropriate statistical methods lend credibility to the findings (Ogbor & Edem, 2021).

2.2.3 Challenges in Renewable Energy Commercialization

In the context of rural solar system commercialization, the study highlights logistical challenges in maintenance and underscores the potential of the fee-for-service model. However, the model's lack of sustainable growth and its dependency on subsidies restrict its financial independence (Lemaire, 2011) . The research emphasizes the importance of customer training for effective solar system usage and suggests local energy stores as a solution to enhance service delivery. Limited power output from solar systems and the resulting consumer dissatisfaction further underline the need for a robust institutional framework to address these challenges effectively (Lemaire, 2011).

In summary, while the research provides significant contributions to commercialization studies through innovative methodologies and practical recommendations, it also reveals critical gaps that warrant further investigation. Exploring broader contexts, incorporating longitudinal analyses, and addressing identified limitations would enhance the robustness and applicability of future studies in this domain.

2.3 Local Perspective

2.3.1 Institutional Framework for Solar Energy Commercialization

At the time of literutre review there was limited research conducted locally relating to this topic. However some literure research done underscores the critical need for a robust institutional framework to support the effective deployment and utilization of solar energy resources in Zambia, the industry within which this study is conducted. This emphasis aligns with the broader goals of ensuring energy access and sustainable development (MWANZA, et al., 2017). By addressing a significant gap in energy resource information, the study provides a much-needed foundation for informed decision-making in energy planning and policy formulation (MWANZA, et al., 2017).

A key strength of the research lies in its methodological rigor. Utilizing satellite datasets, the study offers a precise and comprehensive analysis of Zambia's solar energy potential. Zambia's solar energy sector holds significant promise, yet its growth is impeded by institutional challenges. While studies like Mwanza et al. (2017) have mapped the country's solar potential using satellite data, they fall short in addressing the practicalities of commercializing Solar Home Systems (SHS), such as consumer financing, marketing, and distribution. The Ministry of Energy's Renewable Energy Strategy and Action Plan (2022) outlines a roadmap for integrating renewable energy into the national grid. However, the implementation of these policies often lags, leading to inconsistencies in regulatory frameworks and support mechanisms for private sector participation (MOE, 2022). The focus of the policies is mainly on mini-grid based offering as opposed to the PayGo SHS off grid offering that most private sector companies like ENGIE energy access Zambia. Overall, these findings highlight that a strong institutional framework is needed not only to support solar energy mapping but also to create clear, practical pathways for SHS commercialization.

2.3.2 Market Readiness and Customer Adoption of SHS Products

The results reveal substantial technical solar energy potential, highlighting the feasibility of harnessing this resource to meet Zambia's growing energy demands. This insight is crucial in supporting the achievement of solar home system product commercialization (MWANZA, et al., 2017). Beyond institutional barriers, customer behavior plays a key role in SHS adoption. Financial constraints remain one of the biggest obstacles, as the high upfront cost of solar systems makes them inaccessible for many low-income households, especially in rural areas (NenPower, 2024). Awareness and perceptions also play a crucial role. Attitudes towards solar energy, perceived benefits, and knowledge about solar solutions significantly influence the intention to adopt these technologies . However, low levels of awareness and misinformation about renewable energy technologies hinder adoption.

NGO-led initiatives provide insights into overcoming these challenges. World Vision Zambia's solar micro-grid project in the Manga community not only supplied electricity but also improved healthcare and education services, demonstrating the multifaceted benefits of solar energy (WVI, 2024) These examples underscore the importance of tailored strategies that address financial constraints, enhance awareness, and leverage technology to improve SHS adoption rates.

3.Methodology

Using an explanatory sequential mixed methods approach, the study assessed product pilot as a strategy for new product commercialization: A case study of ENGIE Energy Access Zambia. This study's population comprises all the full-time employees of ENGIE Energy Access Zambia. Out of an estimated 224 full time employees, a sample size of 110 was determined. (71.8%) for this study was satisfactory and has adequate power to detect small effects. Data was collected over a month from 1st February 2025 to 28th February 2025.

3.1 Design

This study employed an explanatory sequential mixed methods design to comprehensively examine product pilot strategy at ENGIE Energy Access Zambia. This approach was selected because the research problem involved both measurable aspects, such as departmental proficiency and key performance indicators, and contextual factors, such as specific challenges faced during product pilots. As Creswell & Plano Clark (2017) suggest, mixed methods are particularly appropriate when neither quantitative nor qualitative methods alone are sufficient to address complex research problems. The research also adopted a pragmatic paradigm to focus on what works in addressing the research objectives. Quantitative data was collected and analyzed first and was complemented by qualitative data to provide deeper understanding of the quantitative findings. This design enabled the study to identify patterns and relationships through statistical analysis while also exploring the underlying reasons, contexts, and mechanisms through qualitative inquiry. The integration of these methods provided a more comprehensive understanding of product pilot strategy effectiveness than either approach could achieve in isolation.

The primary data collection instrument was a structured questionnaire designed to address the research objectives. The questionnaire contained both closed-ended Likert-scale items and open-ended questions to capture both quantitative ratings and qualitative understandings. It served as an interview guide. The instrument was organized into four main sections:

1. Demographic Information: Role, department, tenure with ENGIE energy Access Zambia, age,

and education level.

2. KPI Proficiency Assessment: Questions measuring departmental understanding, utilization, and effectiveness of product pilot KPIs.

3. Communication Assessment: Items measuring frequency of departmental collaboration, communication challenges, and information flows during pilot implementation.

4. Strategy Component Evaluation: Questions assessing the effectiveness of customer feedback, promotions, price, and other strategy components in pilot success.

Each section included both Likert-scale questions (using 5-point – 1-5 scales ranging from "Strongly Disagree" to "Strongly Agree" or "Never" to "Always" as appropriate) and open-ended questions allowing respondents to elaborate on their experiences and perspectives.

3.1 Procedure

Eligible respondents were drawn from the employee register of ENGIE Energy Access Zambia. The study employed stratified random sampling to ensure proportional representation from each department for quantitative samples. Stratified sampling was chosen over simple random sampling because departments represent distinct functional domains with potentially different perspectives on pilot strategy implementation. This approach ensured that all relevant departmental viewpoints were captured in the sample.

The sample size was determined using the formula for proportion in finite populations (Cochran, 1977):

$n = Z^{2} * p(1-p) / e^{2}$

$n\_adjusted = n / (1 + n/N)$ [1]

Where:

n = sample size; *Z* = Z-score corresponding to 95% confidence level (1.96); *p* = Estimated population proportion (0.5); *e* = Margin of error (0.05); N = Population size (224); and *n*_adjusted = Sample size adjusted for finite population.

The sample was then proportionally allocated across departments based on their representation in the overall population:

1. Customer Experience: 53 respondents (48.2%)
2. Commercial: 21 respondents (19.1%)
3. Product & Operation: 15 respondents (13.6%)
4. Customer Finance: 10 respondents (9.1%)

Random selection within each departmental stratum was conducted using a random number generator to ensure unbiased selection of participants.

However, on the qualitative sample the study employed a stratified purposive sampling to ensure that insights were collected from all departments. The Sample size selected to start with was 15 and data saturation occurred at 20 samples with no new themes, patterns, or insights emerging from additional data collection. This saturation was determined using codebook as well as reoccurring of themes. The criteria used to select responds was as follows;

- At least 6 months of experience working within ENGIE.
- Direct or indirect involvement in product pilot
- Willingness and availability to participate in a semi-structured interview.

The departmental distribution response was as follows:

1. Customer Experience: 6
2. Commercial: 21 respondents 5
3. Product & Operation: 15 respondents 5
4. Customer Finance: 10 respondents 4

This distribution ensured broad representation of departments involved in pilot execution, field challenges, and customer-facing operations.

4.Data Analysis

Quantitative data analysis was conducted using R (version 4.2.2) and followed a structured three-stage approach. In the first stage, descriptive statistics were used to provide a foundational understanding of the data. This involved computing frequency distributions, mean scores, and standard deviations to summarize response patterns across variables such as KPI proficiency, communication effectiveness, and strategy execution. These descriptive metrics also facilitated the identification of trends and variations among different departments.

The second stage involved a range of inferential statistical techniques to test the study's hypotheses. A one-way ANOVA was initially employed to examine whether significant differences existed in KPI proficiency across departments. Where overall differences were detected, Tukey's Honest Significant Difference (HSD) test was used as a post-hoc analysis to determine which department pairs exhibited statistically significant differences. To explore relational dynamics between constructs, a multiple regression model was used to assess the predictive power of communication effectiveness and training levels on KPI proficiency. Further analysis included a mediation model, grounded in the Baron and Kenny (1986) approach, to test whether the influence of communication effectiveness on KPI proficiency was mediated by the extent of employee training. Indirect effects were computed to quantify the strength of the mediating relationship.

To evaluate the broader strategic impact, a hierarchical regression analysis was conducted to determine the incremental contribution of KPI proficiency, communication effectiveness, and pilot strategy execution in explaining variations in customer satisfaction. Finally, a relative importance analysis using LMG (Lindeman, Merenda and Gold) decomposition was performed to disentangle the proportional influence of different strategy components—namely customer feedback mechanisms, promotional activities, and pricing strategies—on customer satisfaction outcomes. Throughout the quantitative analysis, statistical assumptions, including normality, homoscedasticity, and multicollinearity, were rigorously tested and addressed as needed. Significance levels were set at $p < .05$, and effect sizes were interpreted using Cohen's (1988) criteria to ensure both statistical and practical relevance.

The qualitative phase of the analysis was guided by Braun and Clarke's (2006) six-phase thematic analysis framework and was facilitated using NVivo software. The process began with a thorough familiarization with the interview data through repeated readings of the transcripts. This was followed by the generation of initial codes, which captured both explicit (semantic) and underlying (latent) meanings within the text. Subsequently, related codes were organized into thematic clusters, revealing patterns such as "timing issues," "coordination failures," and "information silos." These themes were reviewed for internal consistency and distinctiveness before being clearly defined and named in alignment with the study's research objectives.

In the final phase, key themes were integrated into the analysis narrative using illustrative quotations from participants to enhance contextual depth and authenticity. Importantly, data saturation was confirmed during the thematic development process, with no new codes or concepts emerging after the 17th interview—validating the adequacy of the final sample size of 20 interviews.

5.Findings

5.1 Descriptive Statistics

The study surveyed 79 employees from four departments at ENGIE Energy Access Zambia. Table 1 presents the descriptive statistics for the key variables in the study.

Table 1 *Descriptive Statistics for Key Variables by Department*

Department	n	KPI Proficiency	Communication Effectiveness	Strategy Components Implementation	Customer Satisfaction
Product & Operation	14	4.11 (0.58)	3.49 (0.68)	4.02 (0.54)	4.21 (0.80)
Customer Experience	43	3.92 (0.67)	3.25 (0.71)	3.78 (0.63)	3.67 (0.91)
Commercial	16	3.78 (0.73)	3.09 (0.81)	3.88 (0.67)	3.50 (1.03)
Customer Finance	6	3.42 (0.86)	2.75 (0.69)	3.33 (0.69)	2.83 (1.17)
Total	**79**	**3.89 (0.69)**	**3.21 (0.74)**	**3.81 (0.65)**	**3.69 (0.97)**

Note: Values represent means with standard deviations in parentheses

5.2 ANOVA Results for Departmental Differences

One-way ANOVAs were conducted to test departmental differences across all key variables. Table 2 presents the complete ANOVA results.

Table 2 *One-Way ANOVA Results for Departmental Differences*

Variable	Source	SS	df	MS	F	p	η^2
KPI Proficiency	Between Groups	3.84	3	1.28	4.86	.004**	.16
	Within Groups	19.75	75	0.26			
	Total	23.59	78				
Communication Effectiveness	Between Groups	4.37	3	1.46	5.31	.002**	.18
	Within Groups	20.60	75	0.27			
	Total	24.97	78				
Strategy Components Implementation	Between Groups	3.07	3	1.02	4.23	.008**	.14
	Within Groups	18.12	75	0.24			
	Total	21.19	78				
Customer Satisfaction	Between Groups	10.95	3	3.65	7.41	<.001***	.23
	Within Groups	36.96	75	0.49			
	Total	47.91	78				

*Note: ** $p < .01$, *** $p < .001$*

Significant departmental differences were found across all key variables, with large effect sizes ranging from $\eta^2 = .14$ to $\eta^2 = .23$. These results indicate substantial practical significance in the departmental variations.

5.3 Post-hoc Analysis of Departmental Differences

Table 3 presents the results of Tukey's HSD post-hoc tests examining specific departmental differences for KPI proficiency.

Table 3 *Tukey's HSD Post-hoc Tests for KPI Proficiency*

Comparison	Mean Difference	SE	p	95% CI
Product & Operation - Customer Experience	0.19	0.15	.621	[-0.20, 0.58]
Product & Operation - Commercial	0.33	0.18	.267	[-0.14, 0.80]
Product & Operation - Customer Finance	0.69	0.24	.008**	[0.15, 1.23]
Customer Experience - Commercial	0.14	0.15	.809	[-0.25, 0.53]
Customer Experience - Customer Finance	0.50	0.22	.021*	[0.02, 0.98]
Commercial - Customer Finance	0.36	0.23	.412	[-0.24, 0.96]

*Note: * $p < .05$, ** $p < .01$*

Similar post-hoc analyses were conducted for all variables showing significant ANOVA results, with Customer Finance consistently showing the lowest performance across all metrics.

5.4 Pilot Strategy Performance: A Multi-Dimensional Assessment

Analysis of the survey data (n=79) revealed an interaction of factors influencing pilot strategy effectiveness at ENGIE Energy Access Zambia. The findings demonstrate significant variation in pilot strategy implementation across departments, with systematic patterns arising in three crucial dimensions: KPI proficiency, communication effectiveness, and strategy component implementation.

5.6 Departmental Performance Differentials

As shown in Tables 1-3, significant differences in overall pilot strategy performance were observed across departments ($F(3, 75) = 4.86$, $p = .004$, $\eta^2 = .16$). Product & Operation consistently demonstrated superior performance across all metrics, while Customer Finance showed the lowest performance in all areas. These differences were most pronounced in KPI proficiency (mean difference = 0.69, $p = .008$) and communication effectiveness (mean difference = 0.74, $p = .006$).

The qualitative data revealed that these departmental differentials stemmed from systemic factors rather than individual capabilities. Product & Operation's superior performance was attributable to clearer interpretation of KPIs, more established communication channels, and greater perceived relevance of pilot metrics to daily work. As one Product Manager explained: "Our technical focus naturally aligns with the metrics used to evaluate pilots, making implementation more straightforward." Conversely, Customer Finance reported significant barriers: "We often receive pilot parameters after key decisions have already been made, making it difficult to incorporate financial considerations appropriately."

5.7 Predictors of Pilot Strategy Success

5.7.1 The Central Role of Communication

Multiple regression analysis revealed that communication effectiveness was the strongest predictor of successful pilot implementation across all departments. Communication effectiveness significantly predicted both KPI proficiency ($\beta = 0.63$, $p < .001$) and customer satisfaction ($\beta = 0.47$, $p < .001$), with direct and indirect effects observed throughout the pilot implementation process (Table 4).

Table 4 *Regression Results: Impact of Communication Effectiveness*

Dependent Variable	B	SEB	*β*	*T*	*p*	95% CI	R²	ΔR²
KPI Proficiency	0.62	0.09	0.63	6.89	<.001***	[0.44, 0.80]	83	-
Strategy Component Implementation	0.48	0.10	0.46	4.80	<.001***	[0.28, 0.68]	78	-
Customer Satisfaction (Step 1)	0.59	0.12	0.47	4.92	<.001***	[0.35, 0.83]	68	68***
Customer Satisfaction (Step 2) †	0.22	0.11	0.18	2.00	.049*	[0.01, 0.44]	84	.16***

*Note: After controlling for KPI Proficiency and Strategy Component Implementation; * p < .05, *** p < .001*

The dominant impact of communication was further evidenced by the challenges identified across departments. Poor communication was cited by 72.2% of respondents as a primary barrier to effective pilot implementation, with specific manifestations including information silos (68%), communication style differences (53%), and feedback loop failures (47%). These communication failures created cascading effects throughout the pilot process, as illustrated by one Customer Experience Officer: “When technical specifications aren't clearly communicated, we can't properly prepare the market or set accurate customer expectations, which ultimately impacts adoption and satisfaction.”

Mediation analysis revealed that communication effectiveness operated through both direct and indirect pathways. Training level partially mediated the relationship between communication and KPI proficiency, accounting for 13.8% of the total effect (indirect effect = 0.09, SE = 0.03, *p* = .003). This finding suggests that communication influences pilot success partly by enabling more effective training and knowledge transfer across departments.

Table 5 *Mediation Analysis*

Path Relationship		Effect	SE	p-value	95%CI
c	Total Effect (Communication → KPI Proficiency)	0.65	0.08	<.001***	[0.49, 0.81]
a	Path a (Communication → Training)	0.44	0.11	<.001***	[0.22, 0.66]
b	Path b (Training → KPI Proficiency)	0.20	0.09	.047*	[0.02, 0.38]
c'	Direct Effect (Communication → KPI Proficiency)	0.56	0.08	<.001***	[0.40, 0.72]
a×b	Indirect Effect	0.09	0.03	.003**	[0.03, 0.15]

Path Relationship	Effect	SE	p-value	95%CI
Proportion Mediated	13.8%			

Note: * p < .05, ** p < .01, *** p < .001

5.7.1 Strategy Component Hierarchy

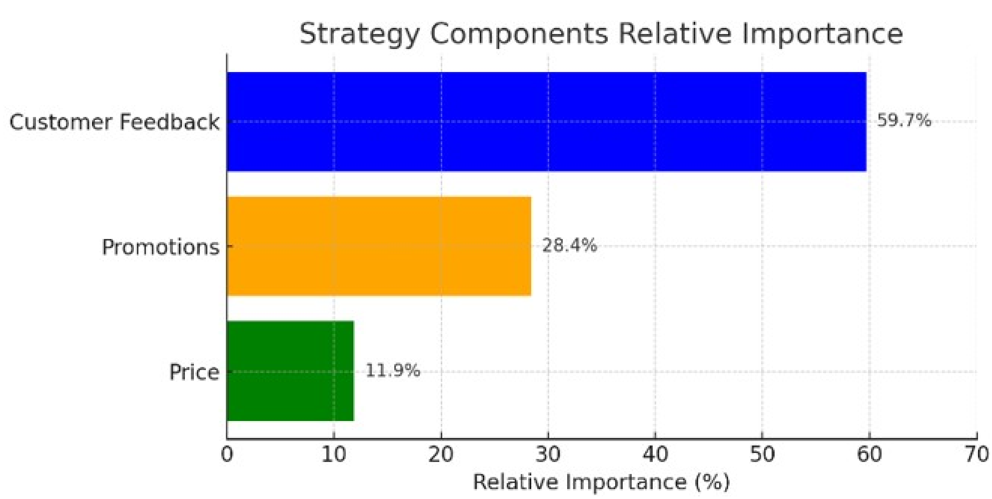
Analysis of strategy components revealed a clear hierarchy of importance in predicting customer satisfaction and pilot success. Customer feedback was the dominant component (relative importance = 59.7%), followed by promotions (28.4%) and price (11.9%). This hierarchy was consistent across all departments, though implementation effectiveness varied significantly (Table 6).

Table 6 *Strategy Component Effectiveness in Predicting Customer Satisfaction*

Component	B	SE B	*β*	*t*	*p*	Relative Importance
(Intercept)	-0.87	0.47		-1.85	.068	-
Customer Feedback	0.63	0.11	0.52	5.73	<.001***	59.7%
Promotions	0.41	0.13	0.28	3.15	.002**	28.4%
Price	0.26	0.11	0.21	2.36	.021*	11.9%

*Note: * p < .05, ** p < .01, *** p < .001; Overall model: R^2 = .85, F (3, 75) = 137.75, p < .001*

Figure 1. *Strategy component relative importance.*



The qualitative data further provided crucial perspectives on why customer feedback dominated other components. Respondents across all departments acknowledged the essential role of customer input in product refinement: “Customer feedback is where reality meets our assumptions about what will work in the market” (Commercial Manager). However, implementation challenges were prevalent, with 61% of respondents citing difficulties in translating feedback into product modifications. These challenges were particularly acute in the interface between customer-facing departments and technical teams: “We collect substantial customer feedback, but the mechanisms to incorporate it into product refinement are inconsistent” (Product & Operation Manager).

The relative importance of price was the lowest quantitatively (11.9%), but qualitative data suggested its role was more complex. Price sensitivity varied significantly by market segment and was highly dependent on how value propositions were communicated. As one Commercial Specialist noted: “Price becomes less of an issue when customers clearly understand the benefits, but becomes the primary concern when value isn't effectively communicated.”

Hypothesis Testing

This section presents the findings of the hypotheses. As mentioned earlier, the hypotheses were tested at a 0.05 level of significance, and the regression model fit was assessed through the inferential statistics described in the preceding chapter.

The null hypothesis examined the effect of interdepartmental communication on the success of product commercialization, and it was hypothesized based on the null hypothesis:

Interdepartmental communication does not affect success of product commercialisation.

The regression output in table 4. (a) under this model it shows the coefficient of determination R square (R^2) described as percent variance in the dependent variable explained by the independent variable. The model had an R^2 of 0.463, which, when adjusted to control for overestimation, resulted in an adjusted R^2 of 0.456.

Table 7 (a): Model Summary Results for (interdepartmental communication)

Model Summary

Model 1	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.68[a]	.463	.456	.65155

Table 4.7 (b) shows the results of the F – test for the analysis of variance (ANOVA) between supply source risks and supply chain performance. As can be seen, the F – test result, (1,83) = 71.474, was significant at a 0.05 level of significance.

Table 7 (b): Analysis of Variance Results for model1 (Interdepartmental communication)

ANOVA

Model 1	Sum of Squares	Df	Mean Square	F	Sig.
Regression	30.342	1	30.342	71.474	.000[b]
Residual	35.235	83	.425		
Total	65.576	84			

5.8 Integrated Model of Pilot Strategy Effectiveness

Hierarchical regression analysis demonstrated that KPI proficiency, communication effectiveness, and strategy component implementation jointly predicted 84% of the variance in customer satisfaction ($F(3, 75) = 133.58$, $p < .001$), with each factor contributing unique explanatory power (Table 8).

Table 8 *Hierarchical Regression Predicting Customer Satisfaction*

Predictor	Model 1	Model 2	Model 3
KPI Proficiency	0.53***	0.44***	0.29**
Communication Effectiveness	-	0.36***	0.21*
Strategy Components Implementation	-	-	0.47***
R^2	.62	.71	.84
Adjusted R^2	.61	.70	.83
ΔR^2	.62***	.09***	.13***
F	127.32***	96.47***	133.58***

*Note: Values are standardized beta coefficients; * $p < .05$, ** $p < .01$, *** $p < .001$*

This integrated model revealed complex interrelationships between the three primary factors, with communication effectiveness influencing both KPI proficiency ($\beta = 0.63$, $p < .001$) and strategy component implementation ($\beta = 0.46$, $p < .001$). The sequential nature of these effects suggests that communication foundational capability upon which other aspects of pilot strategy effectiveness are built.

The qualitative data supported this integrated model, with respondents consistently describing systemic interdependencies between factors. As one Product & Operation Manager explained: “Issues in one area cascade into others—poor communication affects how we interpret KPIs, which affects how we implement customer feedback.” Similarly, a Customer Experience Specialist noted: “There's a domino effect when communication breaks down; it ultimately impacts our ability to respond to customer needs.”

5.9 Implementation Challenges and Barriers

Analysis of implementation challenges revealed both common and department-specific barriers to effective pilot strategy implementation (Table 9).

Table 9 *Implementation Challenges by Department*

Challenge Type	**Overall** (%)	**Product & Operation** (%)	**Customer Experience** (%)	**Commercial** (%)	**Customer Finance** (%)
Poor communication	72.2	71.4	74.4	68.8	66.7
Limited resources	58.2	57.1	60.5	62.5	33.3
Lack of continuity	51.9	50.0	53.5	50.0	50.0
Inadequate training	34.2	35.7	34.9	31.3	33.3
Unclear objectives	25.3	21.4	25.6	31.3	16.7
Executive indecision	24.1	21.4	25.6	25.0	16.7
Stakeholder conflicts	27.8	28.6	27.9	25.0	33.3

Poor communication was the dominant challenge across all departments, though its specific manifestations varied. For Customer Experience, communication challenges centered on timing issues: “By the time we receive information about pilot parameters, it's often too late to properly prepare our customer-facing teams” (Customer Experience Manager). For Product & Operation, the challenges revolved around technical specification clarity: “Technical details get lost or oversimplified when communicated to other departments, leading to misaligned expectations” (Product & Operation Specialist).

Resource limitations showed the greatest departmental variation, with Customer Finance (33.3%) reporting significantly fewer resource constraints than other departments (57.1%-62.5%). This counterintuitive finding was explained by qualitative data suggesting that Customer Finance faced more fundamental barriers related to process integration: “Our challenge isn't primarily resources, but rather structural integration into the pilot process from the beginning” (Customer Finance Officer).

6.Discussion of the findings

This study revealed substantial departmental variation in how pilot strategies were implemented, emphasizing that structural differences within the organization generate persistent knowledge asymmetries. The findings revealed significant departmental differences in pilot strategy implementation ($F(3, 75) = 4.86$, $p = .004$, $\eta^2 = .16$), with Product & Operation demonstrating consistently superior performance (KPI proficiency = 4.11, communication effectiveness = 3.49, strategy components implementation = 4.02) compared to other departments, particularly Customer Finance (KPI proficiency = 3.42, communication effectiveness = 2.75, strategy components implementation = 3.33). These differences stemmed from systemic factors related to organizational architecture rather than individual capabilities, with departmental positioning significantly influencing knowledge flows and implementation effectiveness.

Communication effectiveness was a fundamental orchestration mechanism, strongly predicting both KPI proficiency ($\beta = 0.63$, $p < .001$, $R^2 = .83$) and strategy component implementation ($\beta = 0.46$, $p < .001$, $R^2 = .78$). The specific communication barriers identified—information silos (68%), communication style differences (53%), and feedback loop failures (47%)—varied systematically by department, with Customer Experience primarily experiencing timing challenges while Product & Operation struggled with technical specification clarity. Training mediated only 13.8% of communication's effect, highlighting the limitations of formal knowledge transfer mechanisms. Despite communication predicting KPI proficiency and satisfaction, it is plausible that better-performing teams also communicate better.

Analysis of strategy components revealed a clear hierarchy of importance in predicting customer satisfaction, with customer feedback dominating (59.7% of explained variance), followed by promotions (28.4%) and price (11.9%). Despite universal recognition of customer feedback's importance, 61% of respondents reported significant difficulties implementing customer insights, revealing a substantial knowing-doing gap. This implementation challenge represented a critical barrier to effective commercialization of piloted products.

The hierarchical regression analysis demonstrated that KPI proficiency, communication effectiveness, and strategy component implementation collectively explained 84% of the variance in customer satisfaction ($F(3, 75) = 133.58$, $p < .001$), with each factor contributing significant unique explanatory power ($\Delta R^2 = .62$, .09, and .13 respectively). This integrated model revealed the complex adaptive system characteristics of organizational capabilities, where issues in one domain consistently cascaded into others (reported by 58% of respondents).

These findings substantially challenge conventional understanding of renewable energy innovation in emerging markets, particularly the assumption that price sensitivity dominates adoption decisions. Instead, customer experience factors—specifically feedback implementation—demonstrated significantly greater influence on satisfaction and commercialization success, suggesting that Zambia's renewable energy market has evolved beyond initial diffusion stages to an early majority phase where user experience increasingly drives adoption.

7.Conclusions and Recommendations

The study recommends that organizations adopt a phased, cross-functional approach to improve its product pilot strategy and commercialization outcomes, emphasizing that customer satisfaction—not price—is the primary driver of adoption. Departments should be integrated from the start of pilot planning, with shared decision-making authority, cross-functional KPIs, and dedicated collaboration mechanisms like knowledge brokers and rotational programs to reduce silos. Tailored communication protocols are needed for each department, including structured lead times, simplified documentation, and templates that embed financial insights early in the process. To address the gap between collecting and acting on customer feedback, the organization should standardize feedback mechanisms, mandate cross-functional reviews, and implement a response tracker to ensure accountability. Co-creation channels such as user panels and workshops should also be introduced. Ultimately, the organization should shift from a price-centric to a customer experience-led strategy, emphasizing usability, reliability, and perceived value in marketing, product design, and customer engagement to drive long-term adoption and scalability.

The study concludes that the effectiveness of product pilot strategies in renewable energy organizations hinges on cross-functional collaboration, structured communication, and the strategic use of customer feedback. First, pilot KPI proficiency is not simply a matter of technical skill but is strongly influenced by organizational integration; departments that worked collaboratively across functions achieved higher KPI scores and better pilot outcomes. Second, interdepartmental communication was identified as a critical driver of pilot success, explaining nearly half the variance in outcomes. However, communication barriers—stemming from silos, inconsistent information access, and divergent work styles—limit this potential, and cannot be solved through training alone. Structured, department-specific communication protocols and informal collaboration mechanisms are essential. Third, the study shows that customer feedback significantly shapes commercialization outcomes, but the organization struggles to act on insights due to a knowing-doing gap. Experience-centric factors such as usability and satisfaction outweigh price in determining market success, indicating a necessary shift in strategy. Overall, the research highlights that effective pilot implementation is less about individual departmental excellence and more about orchestrating knowledge across teams. By integrating structural, communication, and feedback mechanisms, renewable energy organizations can enhance their commercialization success, foster clean energy adoption, and drive broader social and environmental impact.

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Conflicts of Interest
The author declares that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

References
Aarikka-Stenroos, L., and Sandberg, B. (2009). From new-product development to commercialization through networks. Journal of Business Research, 62(2):198–206.

Abdelkafi, N., and Täuscher, K. (2016). Business models for sustainability from a system dynamics perspective. Organization & Environment, 29(1):74–96.

Bandarian, R. (2007). Evaluation of commercial potential of a new technology at the early stages of development with fuzzy logic. Journal of Technology Management & Innovation, 2(4):73–83.

Bansah, E. K. (2019). Developing a Promotion Strategy for a New Product: Using Three Firms in Nigeria. European Journal of Business and Management, 11:155–168.

Baron, M. R., and Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51(6):1173–1182.

Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2):77–101.

Brown, J., and Hendry, C. (2009). Public demonstration projects and field trials: Accelerating commercialization of sustainable technology in solar photovoltaics. Energy Policy, 37(7):2560–2573.

Brown, J. S., and Duguid, P. (2001). Structure and spontaneity: knowledge and organization. In: Nonaka, I. and Teece, D. J. (eds). Managing Industrial Knowledge: Creation, Transfer and Utilization. London: SAGE, pp. 44–67.

Bukhari, S. A. R. (2021). Sample Size Determination Using Krejcie and Morgan Table.

Bukovszki, V., et al. (2020). Energy modelling as a trigger for energy communities: A joint socio-technical perspective. Energies, 13(9):2274.

Carlile, P.R., 2004. Transferring, translating, and transforming: An integrative framework for managing knowledge across boundaries. Organization Science, 15(5), pp.555–568.

Chiesa, V. & Frattini, F., 2011. Commercializing technological innovation: Learning from failures in high-tech markets. Journal of Product Innovation Management, 28(4), pp.437–454

Chirico, F. et al., 2024. Orchestrating resources with suppliers for product innovation. Journal of Product Innovation Management, 41(4), pp.735–767.

Cochran, W.G., 1977. Sampling Techniques. New York: John Wiley & Sons.

Cohen, J., 1988. The effect size. In: Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Abingdon: Routledge, pp.77–83

Cohen, W.M. & Levinthal, D.A., 1990. Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly, 35(1), pp.128–152

Cooper, R., 1990. Stage-Gate Systems: A New Tool for Managing New Products. Business Horizons, 33(3), pp.44–54.

Creswell, J.W. & Clark, V.L.P., 2017. Designing and Conducting Mixed Methods Research. 3rd ed. Thousand Oaks, CA: SAGE Publications.

Eisenhardt, K.M. & Martin, J.A., 2000. Dynamic capabilities: What are they? Strategic Management Journal, 21(10–11), pp.1105–1121.

Falahat, M. et al., 2020. SMEs internationalization: The role of product innovation, market intelligence, pricing and marketing communication capabilities. Technological Forecasting and Social Change, 152, p.119908.

Feldman, M.S. & Pentland, B.T., 2003. Reconceptualizing organizational routines as a source of flexibility and change. Administrative Science Quarterly, 48(1), pp.94–118.

Feldman, M.S. et al., 2016. Beyond routines as things: Introduction to the special issue on routine dynamics. Organization Science, 27(3), pp.505–513.

Freeman, R.E., 1984. Strategic Management: A Stakeholder Approach. Boston: Pitman.

Freeman, R.E. & McVea, J.F., 2001. A stakeholder approach to strategic management. SSRN Electronic Journal. [online] Available at: https://doi.org/10.2139/ssrn.263511 [Accessed 19 Apr. 2025].

Fritz, C.O., Morris, P.E. & Richler, J.J., 2012. Effect size estimates: Current use, calculations, and interpretation. Journal of Experimental Psychology: General, 141(1), pp.2–18. Gil-

Lafuente, J. & Rojas-Mora, U., 2010. The selection of the pilot product best suited to a target segment. Unpublished.

Ginn, M.E. & Rubenstein, A.H., 1986. The R&D/Production Interface: A case study of new product development. IEEE Transactions on Engineering Management, EM-33(3), pp.158–169.

GOGLA, 2022. Global Off-Grid Solar Market Report. [online] GOGLA. Available at: https://www.gogla.org [Accessed 19 Apr. 2025].

Henderson, R.M. & Clark, K.B., 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. Administrative Science Quarterly, 35(1), pp.9–30.

Hill, N. & Brierley, J., 2017. How to Measure Customer Satisfaction. 2nd ed. London: Routledge.

Jansen, M.S., Groenwold, R.H. & Dekkers, O.M., 2024. The power of sample size calculations. European Journal of Endocrinology, 191(5), pp. R181–R184.

Kohli, A.K. & Jaworski, B.J., 1990. Market orientation: The construct, research propositions, and managerial implications. Journal of Marketing, 54(2), pp.1–18.

Leal-Rodríguez, A.L. et al., 2014. Absorptive capacity, innovation and cultural barriers: A conditional mediation model. Journal of Business Research, 67(5), pp.763–768.

Levinthal, D.A. & Warglien, M., 1999. Landscape design: Designing for local action in complex worlds. Organization Science, 10(3), pp.342–357.

Lemaire, X., 2011. Off-grid electrification with solar home systems: The experience of a fee-for-service concession in South Africa. Energy for Sustainable Development, 15(3), pp.277–283.

Mwanza, M., Chachak, J. & Çetin, N.S., 2017. Assessment of solar energy source distribution and potential in Zambia. Periodicals of Engineering and Natural Sciences, 5(1), pp.103–116.

NenPower, 2024. How is the solar energy system in Zambia? [online] NenPower. Available at: https://nenpower.com/blog/how-is-the-solar-energy-system-in-zambia/ [Accessed 19 Apr. 2025].

Ogbor, J.O. & Edem, N.C., 2021. New product development strategies and marketing performance in the

Nigerian food and beverage industry. Journal of Business and Management, 12(9), pp.2–23.

Rogers, E.M., 2003. Diffusion of Innovations. 5th ed. New York: Free Press.

Saraswati, P. & Devi, A., 2023. Mixed methods–Research methodology: An overview. Mathews Journal of Nursing and Health Care, 5(4), pp.1–3.

Shakeel, S.R., Takala, J. & Zhu, L.-D., 2017. Commercialization of renewable energy technologies: A ladder building. Renewable and Sustainable Energy Reviews, 78, pp.854–864.

Sharma, D.L.R. et al., 2023. Exploring the mixed methods research design: Types, purposes, strengths, challenges, and criticisms. Global Academic Journal of Linguistics and Literature, 5(1), pp.3–10.

Sieradzki, D. & Żarski, W., 2017. Sample allocation in estimation of proportion in a finite population divided among two strata. Statistics in Transition, 18(3), pp.541–548.

Sompong, K., Igel, B. & Smith, H.L., 2014. Strategic alliance motivation for technology commercialization and product development. Management Research Review, 37(5), pp.518–530.

Venkatesh, V., Brown, S.A. & Bala, H., 2013. Bridging the qualitative–quantitative divide: Guidelines for conducting mixed methods. MIS Quarterly, 37(1), pp.21–54.

World Vision Zambia (WVI), 2024. World Vision Zambia launches solar micro-grid bringing sustainable energy to over 5,700. [online] Available at: https://www.wvi.org/newsroom/zambia/world-vision-zambia-launches-solar-micro-grid-bringing-sustainable-energy-over-5700 [Accessed 19 Apr. 2025].