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Consumer Perceptions of Artificial Intelligence (AI)-Driven Smart Grids and Energy Efficiency in Northwest Nigeria's Power Distribution Sector: A Multi-State Case Study of Sokoto, Kebbi, and Zamfara

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Abstract
This study examines consumer perceptions of Artificial Intelligent driven smart grid technologies and their implications for energy efficiency in Northwest Nigeria's power distribution sector, with specific focus on Sokoto, Kebbi and Zamfara States. The study investigates the impact of smart metering technology, automated fault detection and restoration systems and AI-driven renewable energy integration on perceived energy efficiency. A quantitative survey design was adopted and data were collected from 100 electricity consumers across the three selected states. The data were analyzed using descriptive statistics, Bayesian correlation and multiple regression techniques. The findings reveal that smart metering technology has the strongest positive influence on perceived energy efficiency ($\beta = 0.636, p < .001$). Automated fault detection and restoration systems also demonstrate a significant positive effect ($\beta = 0.375, p < .001$), while AI-driven renewable energy integration significantly enhances perceptions of grid stability and efficiency ($\beta = 0.414, p < .001$). The regression model shows strong explanatory power ($R = .865$, $F(3,97) = 96.086, p < .001$). The study concludes that AI-driven technologies play an important role in shaping consumer confidence in electricity distribution within the selected case study states. Strengthening consumer awareness, improving infrastructure, and ensuring effective implementation of smart grid solutions will be essential for achieving sustainable improvements in Nigeria's power sector.

Keywords: *Automated fault detection, Energy efficiency, Renewable energy integration, Smart grids, Smart metering.*

1.0 Introduction

The energy sector worldwide is currently experiencing rapid transformation with the increasing integration of Artificial Intelligence (AI) and smart grid technologies into electricity systems. Smart grids combine digital communication systems, automation and data analytics to improve monitoring, forecasting, and management of power supply [6], [14]. In developing countries such as Nigeria, the modernization of electricity infrastructure has become increasingly important due to persistent challenges in power generation and distribution. Frequent outages, high transmission losses, estimated billing and weak consumer engagement mechanisms continue to undermine service efficiency [1], [12]. In Northwest Nigeria, particularly in Sokoto, Kebbi and Zamfara States, consumers regularly experience unstable power supply and delayed fault response, which negatively affects productivity and household welfare.

To address these challenges, power distribution companies have begun exploring AI-driven smart grid solutions such as smart metering technology, automated fault detection and restoration systems and AI-assisted renewable energy integration [3], [8]. Smart meters, for instance, provide real-time consumption data and improve billing transparency, while automated fault detection systems enhance rapid response to grid disturbances. Similarly, AI-driven renewable energy optimization improves supply stability by balancing demand and generation patterns. However, the success of these technologies depends not only on technical efficiency but also on consumer perception and acceptance. According to the Diffusion of Innovation theory [10] and the Technology Acceptance Model [4], the perceived usefulness and ease of use of a technology significantly influence its adoption. If consumers lack trust in smart meters or doubt the effectiveness of automated systems, the expected benefits of AI-driven solutions may not be fully realized.

Despite the growing global literature on AI applications in smart grids, empirical evidence on consumer perceptions of these technologies within specific regions of Northwest Nigeria remains limited. Previous studies have largely emphasized technical performance, with limited attention given to user experience and consumer perception. Therefore, this study examines how consumers in Sokoto, Kebbi and Zamfara States perceive the impact of smart metering, automated fault detection and AI-driven renewable energy integration on energy efficiency and service reliability.

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The specific objectives of the Study are as follow:

1. To examine the impact of smart metering technology on energy efficiency as perceived by consumers in Sokoto, Kebbi and Zamfara States.
2. To assess the effectiveness of automated fault detection and power restoration systems in improving electricity service reliability for consumers.
3. To evaluate the role of AI-driven renewable energy integration in enhancing the stability and effectiveness of power supply from the consumer's viewpoint.

2.0 Literature Review

2.1 AI-Driven Smart Grids and Energy Efficiency

The integration of Artificial Intelligence (AI) into smart grid systems represents a major advancement in modern electricity management. Unlike conventional grids that rely on manual monitoring and static operational structures, AI-driven smart grids utilize real-time data analytics, predictive algorithms, and automated control mechanisms to improve efficiency and reliability [6]; [14]. These systems enhance demand forecasting, fault prediction, load balancing and renewable energy coordination.

In the Nigerian context, electricity distribution remains characterized by technical losses, unstable supply and inefficient monitoring systems [1]. AI-driven grid modernization has therefore been proposed as a practical solution to improve operational performance and service delivery [3]. However, while the technological benefits are increasingly documented, less attention has been paid to how consumers perceive these innovations, particularly in Northwest Nigeria where infrastructural challenges remain pronounced [8]. Energy efficiency within smart grids is not solely a function of technological capability; it also depends on user interaction and behavioral response. Consumers who understand and trust smart technologies are more likely to adjust consumption patterns, thereby improving system efficiency. This highlights the need to examine AI-driven grid development from both technical and socio-behavioral perspectives.

2.2 Smart Metering Technology and Consumer Perception

Smart metering technology is widely regarded as one of the most visible components of smart grid systems. It enables real-time monitoring of electricity consumption, automated billing and remote data transmission. Studies have shown that access to accurate consumption data encourages energy-saving behavior and improves transparency in billing processes [14]. In Nigeria, the introduction of smart prepaid meters was intended to address estimated billing disputes and enhance revenue collection efficiency [3]. However, consumer trust in smart meters remains mixed. Regulatory and operational inefficiencies have contributed to skepticism among electricity users [12]. Similarly, challenges related to metering gaps and infrastructure deficits continue to affect consumer confidence.

From a behavioral standpoint, smart meters provide users with a sense of control over their electricity usage. According to the Diffusion of Innovation theory [10], technologies perceived as advantageous and observable are more likely to be adopted. When consumers can directly observe reductions in energy waste through smart metering, positive perception and acceptance are strengthened. Nevertheless, adoption may be hindered by perceived complexity or lack of awareness.

2.3 Automated Fault Detection and Power Restoration Systems

Automated fault detection and restoration systems use AI algorithms to identify grid disturbances and initiate corrective action without prolonged manual intervention. These systems analyze voltage fluctuations, load variations and fault signals to predict potential failures and minimize outage duration [6]. In developed electricity markets, AI-based automation has significantly improved grid resilience and reduced downtime [14]. However, in Nigeria, infrastructural limitations and limited technological investment have constrained full-scale deployment [1]. System inefficiencies and maintenance challenges continue to undermine service reliability [12].

From a consumer perspective, reduced outage frequency and faster restoration times contribute to improved satisfaction and trust in electricity providers. According to the Technology Acceptance Model [4], perceived usefulness plays a critical role in shaping technology acceptance. If consumers observe tangible improvements in reliability, their perception of automated systems is likely to be positive. However, inconsistent implementation may weaken this relationship.

2.4 Renewable Energy Integration and AI-Driven Grid Optimization

Renewable energy integration is a key objective of smart grid development. Artificial intelligence enhances renewable energy performance by forecasting demand patterns, optimizing energy storage and balancing intermittent supply from solar and wind sources [14]. These capabilities are particularly important in regions with unstable grid infrastructure. Nigeria has increasingly explored solar mini-grid deployment, especially in underserved communities [1]. AI-based optimization can further stabilize these systems by improving grid coordination and reducing supply variability [3]. However, large-scale integration remains constrained by regulatory challenges, funding limitations and technical capacity gaps [8].

From a strategic perspective, effective renewable integration depends on both technical infrastructure and organizational capability. The Resource-Based View suggests that sustainable technological advantage requires valuable and well-managed resources. In the Nigerian power sector, financial investment, skilled personnel and digital infrastructure are critical for AI-driven renewable optimization. Consumer perception of renewable integration is shaped by perceived improvements in stability and sustainability. When renewable systems are efficiently managed, consumers are more likely to associate them with long-term energy security and environmental benefits.

2.5 Theoretical Framework

This study is anchored on two major theories: Diffusion of Innovation (DOI) and the Technology Acceptance Model (TAM). The Diffusion of Innovation theory explains how new technologies spread among individuals and social systems based on perceived advantages, compatibility and observability [10]. In the context of smart grid technologies, consumer perception of benefits such as improved billing transparency and reliable power supply can influence technology adoption.

The Technology Acceptance Model explains that perceived usefulness and perceived ease of use determine an individual's willingness to accept new technologies [4]. Within electricity distribution systems, consumers are more likely to support AI-driven smart grid innovations if they perceive them as beneficial and easy to use. These theories provide a framework for understanding consumer perception of AI-driven smart grid technologies in Northwest Nigeria.

2.6 Empirical Review

Empirical studies across different regions indicate that smart metering contributes positively to energy conservation and billing transparency [14]. However, outcomes vary depending on consumer awareness and infrastructure quality. In Nigeria, technological implementation alone does not guarantee efficiency without adequate public sensitization [3]. Similarly, studies on automated fault detection show improvements in outage management where AI systems are properly deployed [6]. Nevertheless, infrastructural weaknesses in Nigeria may limit the full realization of automation benefits [1].

Research on renewable energy integration emphasizes the importance of AI-driven forecasting in improving grid stability [14]. However, regulatory and institutional challenges may slow adoption in the Nigerian context [8]. While existing studies confirm the technical potential of AI-driven smart grids, there remains limited empirical investigation into how consumers in Northwest Nigeria perceive these technologies.

2.7 Gap in Literature

Although global research has extensively examined the technical performance of AI-driven smart grids, limited attention has been given to consumer perception in developing economies. Most Nigerian studies focus on policy reform or infrastructural challenges rather than user experience and acceptance. Furthermore, empirical evidence specific to Northwest Nigeria remains scarce. Understanding how consumers perceive smart metering, automated fault detection and renewable integration is essential for designing policies that encourage adoption and maximize efficiency. This study therefore seeks to bridge this gap by providing empirical evidence on consumer perceptions of AI-driven smart grid technologies in Northwest Nigeria.

2.8 Research Hypotheses

Based on the reviewed literature and theoretical foundations, the following null hypotheses were formulated:

H_{01}: Smart metering technology has no significant impact on perceived energy efficiency in Northwest Nigeria's power distribution sector.

H_{02}: Automated fault detection and power restoration systems do not significantly improve electricity service reliability for consumers.

H_{03}: AI-driven renewable energy integration does not significantly enhance the stability and efficiency of power supply from the consumer's viewpoint.

3.0 Methodology

3.1 Research Design

This research employed a quantitative method, specifically a descriptive survey design, to investigate consumer perceptions of AI-driven smart grid technologies in Northwest Nigeria. The survey method was considered appropriate because it allows for the systematic collection of data from respondents regarding their experiences, opinions and perceptions of electricity services.

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3.2 Population and Sample

The target population consisted of electricity users in Sokoto, Kebbi, and Zamfara States, selected as representative states within Northwest Nigeria's power distribution network. These states were chosen due to their relevance within the regional electricity distribution structure and their shared infrastructural characteristics. A multi-stage sampling technique was employed to ensure balanced representation of residential and small commercial electricity users across the three states. The study involved 100 respondents selected across the three states. While modest, this sample size is adequate for multiple regression analysis given the limited number of predictor variables and the statistical assumptions satisfied in the analysis.

3.3 Instrumentation and Measurement

Information for this study was obtained through a structured questionnaire designed on a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument consisted of four main constructs: (1) Smart Metering Technology (4 items), (2) Automated Fault Detection and Power Restoration (4 items), (3) AI-Driven Renewable Energy Integration (4 items), and (4) Perceived Energy Efficiency (4 items). The questionnaire items were developed based on existing literature on smart grid technologies and technology adoption models [4], [10], [14] and were adapted to reflect the Nigerian electricity context.

3.4 Reliability and Validity

To ensure internal consistency of the measurement scales, Cronbach's Alpha coefficients were computed. All constructs recorded reliability values above the recommended threshold of 0.70, indicating satisfactory internal consistency. This suggests that the items used to measure each construct were sufficiently correlated and reliable for analysis. Content validity was ensured through alignment of questionnaire items with established theoretical frameworks and empirical studies on AI-driven smart grid technologies.

3.5 Data Analysis Procedure

The data obtained were processed and analyzed using the Statistical Package for the Social Sciences (SPSS), version 27. Descriptive statistics, including mean, standard deviation, skewness and kurtosis, were used to summarize respondent characteristics and general perception trends. To test the research hypotheses, multiple regression analysis was employed to examine the influence of: (1) Smart Metering Technology, (2) Automated Fault Detection and Power Restoration, (3) AI-Driven Renewable Energy Integration, on the dependent variable, Perceived Energy Efficiency. Multiple regression analysis was utilized to examine the combined effect of the independent variables on the dependent variable.

Additionally, Bayesian correlation analysis was conducted to assess the strength and credibility of pairwise relationships between constructs. The Bayesian approach complements classical regression by providing credible intervals, which offer a probabilistic interpretation of parameter estimates. Statistical significance was determined at the 0.05 level.

3.6 Ethical Considerations

Participation in the study was voluntary. Respondents were informed about the purpose of the research and confidentiality of responses was assured. No personal identifying information was disclosed and the data were used strictly for academic purposes.

4.0 Results and Discussion

This section presents the key findings of the study and interprets their significance in relation to existing literature. The results are analyzed to assess patterns, trends and implications. Comparisons with previous research highlight similarities, differences and potential contributions to the field.

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
AI-Driven Renewable Energy Integration	100	5.00	20.00	11.9900	2.99324	8.959	-.069	.241	.224	.478
Perceived Energy Efficiency	100	6.00	20.00	14.2900	3.66335	13.420	-.253	.241	-1.227	.478

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Smart Metering Technology	100	9.00	20.00	15.6500	2.99284	8.957	-.385	.241	-1.044	.478
Automated Fault Detection & Power Restoration	100	4.00	19.00	11.8700	3.57504	12.781	-.188	.241	-.525	.478
Valid N (listwise)	100									

Statistical Package for the Social Sciences, 27

The results indicate that smart metering technology (15.65 mean score) and AI-driven renewable energy integration (11.99 mean score) are viewed positively by consumers, suggesting confidence in their impact on energy efficiency. Perceived energy efficiency (14.29) also scores relatively high, implying that consumers recognize improvements in energy use. However, automated fault detection & power restoration (11.87 mean score) has a slightly lower rating, indicating that while useful, it may not yet meet full consumer expectations.

The negative skewness across all variables suggests that responses lean toward higher values, reflecting a generally positive perception of AI-driven smart grids. However, moderate standard deviations and variance indicate some diversity in responses, suggesting varying levels of satisfaction or awareness among consumers. The results indicate that consumers in Sokoto, Kebbi and Zamfara perceive smart metering as beneficial for improving energy efficiency.

Table 2: Reliability Test

Construct	Item	Cronbach Alpha *a*
AI-Driven Renewable Energy Integration	4	0.812
Perceived Energy Efficiency	4	0.895
Smart Metering Technology	4	0.904
Automated Fault Detection & Power Restoration	4	0.864

Statistical Package for the Social Sciences, 27

The reliability test results, measured using Cronbach's Alpha, indicate strong internal consistency for all constructs in the study. Smart Metering Technology has the highest reliability ($\alpha = 0.904$), suggesting that responses related to this construct are highly consistent. Perceived Energy Efficiency also shows excellent reliability ($\alpha = 0.895$), indicating that consumer perceptions of efficiency are measured reliably. Automated Fault Detection & Power Restoration ($\alpha = 0.864$) and AI-Driven Renewable Energy Integration ($\alpha = 0.812$) both demonstrate good reliability. Since all Cronbach's Alpha values exceed 0.8, the measurement scales used in this study are considered reliable for capturing consumer perceptions.

Table 3: Bayesian Correlation Results Between AI-Driven Smart Grid Technologies and Perceived Energy Efficiency

Variable	Posterior Mean	Variance	95% Credible Interval
Smart Metering (Perceived Energy Efficiency)	0.614	0.004	[0.492, 0.727]
Automated Fault Detection (Perceived Energy Efficiency)	0.359	0.007	[0.192, 0.527]
Renewable Energy Integration (Perceived Energy Efficiency)	0.497	0.006	[0.357, 0.649]

Note: Analyses assume reference priors (c = 0).

The results indicate that Smart Metering Technology has the strongest positive relationship with Perceived Energy Efficiency (Mean = 0.614, 95% CI [0.492, 0.727]). This suggests that consumers in the selected case study states generally perceive smart meters as highly beneficial for improving energy efficiency within their respective power distribution systems. The strong correlation implies that consumers believe smart meters help them monitor and control their electricity usage, leading to better efficiency and reduced waste.

The correlation between Automated Fault Detection & Power Restoration and Perceived Energy Efficiency is moderate (Mean = 0.359, 95% CI [0.192, 0.527]). This indicates that consumers recognize some benefits of automated fault detection in improving electricity service reliability, though its impact is not as strong as smart metering. The system's ability to quickly identify and restore faults likely contributes to a more stable power supply, but consumers may still experience interruptions or have mixed perceptions about its effectiveness.

AI-Driven Renewable Energy Integration shows a moderate positive relationship with Perceived Energy Efficiency (Mean = 0.497, 95% CI [0.357, 0.649]). This suggests that consumers believe integrating AI-driven renewable energy sources helps stabilize the power grid and improve energy efficiency. The perception is that AI-enhanced energy systems allow for better management of renewable energy, reducing dependence on inconsistent power sources and contributing to a more reliable electricity supply.

4.1 Regression Analysis

Multiple regression analysis was conducted to examine the predictive relationships between the independent variables and perceived energy efficiency. It helps identify trends, make predictions, and determine the strength of variable associations, providing valuable insights for data-driven decision-making and research conclusions.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R-Square Change	F Change	df1	df2	Sig. F Change
1	0.865[a]	0.748	0.740	1.96783	0.748	96.086	3	97	0.000

a. Predictors: (Constant), AI-Driven Renewable Energy Integration, Smart Metering Technology, Automated Fault Detection & Power Restoration

The model summary indicates a strong relationship between the predictors (Smart Metering Technology, Automated Fault Detection & Power Restoration, and AI-Driven Renewable Energy Integration) and Perceived Energy Efficiency, with an R value of 0.865. This suggests that these three technologies collectively explain a significant portion of the variation in how consumers perceive energy efficiency. A high R value close to 1 implies a strong positive association, meaning that improvements in these technologies likely lead to better perceptions of efficiency. Among them, Smart Metering Technology shows the strongest correlation, while AI-driven Renewable Energy Integration and Automated Fault Detection also contribute positively.

Table 5: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1116.238	3	372.079	96.086	0.000[b]
	Residual	375.619	97	3.872		
	Total	1491.857	100			

a. Dependent Variable: Perceived Energy Efficiency

b. Predictors: (Constant), AI-Driven Renewable Energy Integration, Smart Metering Technology, Automated Fault Detection & Power Restoration

The ANOVA results assess whether the independent variables Smart Metering Technology, Automated Fault Detection & Power Restoration, and AI-Driven Renewable Energy Integration significantly influence Perceived Energy Efficiency. The regression sum of squares is 1116.238, while the residual sum of squares is 375.619, indicating that a large proportion of the variance in Perceived Energy Efficiency is explained by the model. The F-statistic of 96.086 is quite high, suggesting a strong overall model fit. The significance value (Sig. = 0.000) confirms that the model is statistically significant, meaning the three predictor variables collectively have a meaningful impact on how consumers perceive energy efficiency in the power sector within the selected case study states.

Table 6: Coefficients

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	-0.841	.964		-0.873	0.385
	Smart Metering Technology	0.578	0.047	0.636	12.371	0.000

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Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
Automated Fault Detection & Power Restoration	0.329	0.045	0.375	7.252	0.000
AI-Driven Renewable Energy Integration	0.374	0.047	0.414	8.016	0.000

a. Dependent Variable: Perceived Energy Efficiency

The coefficient results provide insight into how Smart Metering Technology, Automated Fault Detection & Power Restoration and AI-Driven Renewable Energy Integration individually contribute to Perceived Energy Efficiency. The constant (-0.841) is not statistically significant (p = 0.385), meaning it does not have a meaningful standalone effect when all predictors are zero.

Smart Metering Technology has the highest standardized beta coefficient (0.636) and a significant p-value (0.000), indicating it is the strongest predictor of Perceived Energy Efficiency. This suggests that consumers associate smart metering with a substantial improvement in energy efficiency.

Automated Fault Detection & Power Restoration has a standardized beta of 0.375 and is also statistically significant (p = 0.000). Although its effect is positive, it is weaker than Smart Metering Technology, implying that while consumers see automated fault detection as beneficial, they do not perceive it as strongly improving energy efficiency compared to smart meters.

AI-Driven Renewable Energy Integration has a standardized beta of 0.414, also statistically significant (p = 0.000), suggesting that consumers recognize its contribution to energy efficiency. However, its impact is still less pronounced than that of smart meters.

4.2 Discussion of Results and Hypothesis Testing

The study examined the impact of AI-driven smart grid technologies on perceived energy efficiency, reliability, and stability within the selected case study states of Sokoto, Kebbi and Zamfara power distribution sector. The hypothesis testing was conducted using multiple regression and Bayesian correlation analyses. Based on the statistical results, we determine whether to accept or reject each null hypothesis.

4.2.1 Hypothesis 1: Impact of Smart Metering Technology on Perceived Energy Efficiency

The findings revealed that smart metering technology has a strong positive effect on perceived energy efficiency ($\beta = 0.636$, $p < .001$). Since the p-value is below the 0.05 significance level, we reject the null hypothesis (H_{01}) and conclude that smart metering technology significantly enhances energy efficiency as perceived by consumers. This finding is consistent with existing literature suggesting that smart metering technologies improve transparency, enhance consumer monitoring behavior and contribute to improved energy efficiency within modern electricity systems.

4.2.2 Hypothesis 2: Effectiveness of Automated Fault Detection and Power Restoration

The study also found a significant positive relationship between automated fault detection and power restoration systems and perceived service reliability ($\beta = 0.375$, $p < .001$). As the p-value is below 0.05, we reject the null hypothesis (H_{02}) and confirm that automated fault detection systems enhance electricity reliability. This result aligns with prior research emphasizing that AI-based fault detection systems enhance grid resilience and reduce downtime, particularly where monitoring systems are effectively implemented. However, infrastructural constraints may limit the full realization of these benefits in developing regions.

4.2.3 Hypothesis 3: Role of AI-Driven Renewable Energy Integration in Grid Stability and Efficiency

The regression analysis showed that AI-driven renewable energy integration significantly contributes to perceived energy efficiency and grid stability ($\beta = 0.414$, $p < .001$). Given the strong relationship and the p-value being below 0.05, we reject the null hypothesis (H_{03}) and conclude that AI integration in renewable energy enhances energy stability. These findings are consistent with research indicating that AI-enhanced renewable energy forecasting and optimization contribute to improved grid stability and operational efficiency. Nevertheless, the effectiveness of such systems depends on infrastructural readiness and regulatory support.

5.0 Conclusion

This study demonstrates that AI-driven smart grid technologies significantly influence consumer perceptions of energy efficiency and service reliability within the selected case study states of Sokoto, Kebbi and Zamfara in Northwest Nigeria. Among the technologies examined, smart metering emerged as the strongest predictor of perceived energy efficiency, highlighting the importance of transparency and real-time monitoring in electricity management. Automated fault detection and renewable energy integration also contribute positively to consumer perception, although their impact appears to depend on infrastructural effectiveness and implementation consistency. The findings suggest that technological advancement alone is insufficient without adequate consumer awareness and stakeholder engagement.

While the results provide valuable regional insights, they should be interpreted within the context of the three selected states. Nevertheless, the findings may offer useful implications for similar electricity distribution environments across Nigeria.

5.1 Recommendation of the Study

i. Since smart metering technology has the strongest impact on perceived energy efficiency, electricity providers and policymakers should invest in public awareness campaigns, consumer education programs, and incentives to encourage widespread adoption. This will help consumers better understand and utilize smart meters for efficient energy consumption.

ii. To improve electricity reliability, power distribution companies should enhance the deployment of automated fault detection and restoration technologies. This includes upgrading infrastructure, integrating real-time monitoring systems, and ensuring prompt response mechanisms to minimize power outages and service disruptions.

iii. Given the significant role of AI in stabilizing power supply through renewable energy integration, policymakers should promote increased investment in AI-powered renewable energy systems. This includes optimizing grid management, expanding renewable energy sources, and ensuring seamless integration with existing power distribution networks to improve efficiency and sustainability.

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