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An Integrated Assessment of Technical, Economic, Environmental, and Social Challenges in Electricity Distribution: Evidence from Abuja Electricity Distribution Company (AEDC), FCT-Abuja

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Abstract **Original Research Article**

This study provides an integrated assessment of the multifaceted challenges facing the Abuja Electricity Distribution Company (AEDC) in FCT-Abuja, focusing on technical, economic, environmental, and social dimensions. Using a mixed-methods approach that includes surveys, interviews, and document analysis, the research examines AEDC's operational inefficiencies and their impact on customers. Findings reveal significant technical challenges, including irregular supply, frequent power surges, and low customer satisfaction with service quality. Economically, the prevalence of estimated and postpaid billing, despite the rise of prepaid meters, leads to widespread dissatisfaction with billing accuracy. Environmentally, the study highlights public scepticism about AEDC's commitment to sustainable energy, although there is strong public support for renewable energy investment and adoption. Socially, the company suffers from poor customer service, delayed fault response, and a perception of unfair electricity distribution, which erodes public trust. Based on the Sociotechnical Systems (STS) theory, the study concludes that AEDC's underperformance is rooted in the deep misalignment between its technical infrastructure and social practices. The findings underscore the urgent need for a holistic strategy that combines technical upgrades with reforms in customer engagement, financial transparency, and environmental responsibility to ensure a reliable and sustainable electricity supply.

Keywords: Electricity Distribution, Abuja Electricity Distribution Company (AEDC), technical, economic, environmental, and social challenges.

1.0 INTRODUCTION

Reliable and cost-effective electricity is essential for fostering inclusive growth, enhancing industrial competitiveness, and improving the overall quality of life; however, distribution utilities in many low- and middle-income nations face challenges in delivering reliable service consistently at scale. Nigeria serves as a prime example: despite having abundant domestic energy resources and ongoing reform initiatives, end-users still experience frequent power outages, voltage inconsistencies, and significant reliance on expensive self-generation. In the Nigerian Electricity Supply Industry (NESI), the distribution sector remains a significant challenge, characterised by high aggregate technical, commercial, and collection (ATC&C) losses, financial instability, and outdated infrastructure that struggles to meet increasing demand (World Bank, 2023). The Abuja Electricity Distribution Company (AEDC)—the utility that caters to the Federal Capital Territory (FCT) as well as Kogi, Niger, and Nasarawa States—lies at the heart of this issue. AEDC's operational area covers approximately 133,000 km², encompassing urban, peri-urban, and rural load centres, serving a diverse customer demographic and operating in various socio-economic environments (AEDC, n.d.; Devex, n.d.).

The implications are significant. Poor performance in the distribution sector hampers productivity, escalates the cost of business operations, and limits overall welfare. Estimates indicate that Nigerian businesses and households spend billions of dollars each year on diesel and petrol generators to manage unreliable grid services—expenses that generally surpass regulated tariffs for end-users and pose considerable environmental consequences (Energy for Growth Hub, 2022; World Bank, 2021). Frequent system disruptions—including nationwide blackouts—highlight systemic vulnerabilities throughout the supply chain and emphasise the importance of

distribution reliability and customer safeguarding (AP News, 2023; Reuters, 2024). While access to electricity in Nigeria has slowly improved, with overall access hovering around 60 per cent in recent times, the country still faces one of the most significant access deficits globally in absolute numbers, and the quality of supply continues to be a significant policy issue (World Bank, 2025; ESMAP/Tracking SDG7, 2024, 2025).

Since its privatisation in 2013, the regulatory structure—founded on the Multi-Year Tariff Order (MYTO) and performance agreements—has increasingly linked distribution company (DisCo) incentives to reducing losses, enhancing metering, improving service quality, and ensuring financial accountability. NERC's quarterly and annual market reports consistently emphasise ATC&C losses as a key element influencing tariff settings and a critical barrier to the sector's sustainability; they also record incremental—but uneven—progress across Distribution Companies (DisCos) (NERC, 2025). In the case of AEDC, the Commission launched a specific Performance Monitoring Framework Order in July 2024 to enhance transparency, evaluate service levels against benchmarks, and align corrective measures with regulatory instruments (NERC, 2024). Concurrent federal initiatives, notably the World Bank-backed Nigeria Distribution Sector Recovery Program (DISREP), are providing funding for loss-reduction strategies, particularly focusing on bridging the metering gap and implementing meter data management systems, while demanding strong environmental and social (E&S) safeguards (World Bank, 2020, 2021, 2024).

Despite these reforms, AEDC continues to function within a challenging technical and economic environment. On the technical side, ageing feeders and overburdened transformers exacerbate technical losses and diminish power quality; rapid urban growth in the FCT increases the strain on capacity development, fault resolution, and load forecasting. From a commercial perspective, energy theft, incomplete metering, and billing and collection issues intensify financial pressures. The resulting cash flow deficits restrict the utility's ability to fund network upgrades, modern protective systems, and customer service platforms—perpetuating a damaging cycle seen in many emerging-market utilities (NERC, 2024, 2025; Odje, 2021). Financial documents released by AEDC reveal fluctuations in performance and the extensive capital requirements typical of distribution utilities operating across large service areas with varied demand patterns (AEDC, 2023, 2025).

Distribution challenges have significant environmental and social aspects that are frequently overlooked in discussions about utility performance. Environmentally, a persistent dependence on backup fossil-fuel power generation increases local air pollution and greenhouse gas emissions; concurrently, the expansion of networks and management of equipment pose risks in terms of waste management (such as transformer oil, disused conductors, and poles), occupational health and safety (OHS), and community safety during both construction and maintenance phases. On the social side, changes in tariffs, variability in service quality, and extended outages lead to unequal impacts—particularly for low-income individuals and small businesses struggling with limited coping strategies—making stakeholder engagement, grievance resolution, and targeted customer support essential for an equitable energy transition (World Bank, 2020, 2021, and 2024). In a city like Abuja, where both formal and informal businesses operate, unreliable electricity can inflate production expenses (e.g., diesel can cost hundreds of naira per litre) and diminish competitive edge for micro, small, and medium enterprises (Magaji & Saleh, 2010), which in turn affects employment levels (Shaba et al., 2018) and household well-being (Roy, 2023; IIARD, 2025).

This research contributes to the literature for policymakers and practitioners by providing a comprehensive evaluation of the technical, economic, environmental, and social challenges associated with electricity distribution, with a focus on AEDC as a case study. The integrated methodology is intentional: technical metrics (fault rates, feeder loading, and outage duration) are linked with economic indicators (ATC&C losses, collections, capital adequacy), while environmental protections (waste/OHS management, spill prevention) and social performance (customer involvement, service quality commitments, and equitable access) increasingly influence regulatory demands and financing prerequisites. The analysis synthesizes varied data sources: (i) recent NERC market/quarterly reports and regulatory notices that establish performance standards and tariff structures; (ii) AEDC's corporate and financial statements that reveal operational constraints; and (iii) international program documents (e.g., DISREP) that set investment goals, metering options, and Environmental & Social (E&S) standards in alignment with the World Bank's Environmental and Social Framework (ESF).

The case of Abuja also has broader implications for utilities across Nigeria and the region, which are dealing with similar challenges. Firstly, accurate metering and data are essential: minimising non-technical losses, achieving cost-reflective tariffs, and enhancing cash flow depend on reliable measurement and trustworthy customer interactions (World Bank, 2024). Secondly, focused reinforcement of networks—especially in fast-growing urban areas—can significantly improve reliability if directed by detailed feeder analytics and cost-effective planning. Thirdly, incorporating E&S factors is now a fundamental necessity; financial institutions and regulators expect utilities to embed OHS, waste management, labour standards, and community involvement within their operations, supported by measurable indicators and grievance channels (World Bank, 2020, 2021). Finally, a regulation that prioritises customer needs—through monitoring service levels and providing clear performance dashboards—can hold utilities accountable while conveying to investors that governance is on the rise (NERC, 2024, 2025).

In light of these factors, the paper aims to achieve three objectives. Firstly, it records AEDC's recent operational and commercial effectiveness, placing it within the context of national regulatory standards and peer evaluations. Secondly, it computes the economic impacts of distribution inefficiency on customers (emphasising MSMEs) and the utility's capacity for investment, along with the consequences of ongoing reliance on generators. Thirdly, it charts AEDC's environmental and social risk profile in comparison to ESF standards and Nigerian laws,

highlighting institutional improvements—such as upgraded OHS systems, waste monitoring, and enhanced customer engagement—that can mitigate risks associated with capital programs. By merging these aspects, the study aims to inform a practical reform strategy for AEDC and similar Distribution Companies (DisCos), integrating metering and network enhancements with robust E&S frameworks and customer-focused regulation, thereby promoting reliability, affordability, and sustainability in the FCT-Abuja and beyond.

2.0 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Conceptual Review

2.1.1 Technical Challenges

Technical challenges in electricity distribution often stem from inadequate infrastructure, limited grid capacity, obsolete technologies, and poor maintenance practices. In the case of Nigeria's distribution companies, including the Abuja Electricity Distribution Company (AEDC), frequent system failures, high technical losses, and inadequate metering remain critical obstacles to efficient power delivery (Okoye & Achakpa, 2021). The reliance on aged transmission and distribution lines contributes to frequent voltage fluctuations, outages, and energy losses, undermining consumer confidence and productivity. Additionally, the lack of investment in smart-grid technologies and digital metering systems has hindered operational efficiency, thereby sustaining inefficiencies across the electricity value chain (Ariyo & Jerome, 2021).

2.1.2 Economic Challenges

Economic challenges reflect the financial and market pressures that constrain the sustainability of distribution (Adekoya, Magaji, & Ismail, 2025). Poor revenue collection, non-cost-reflective tariffs, and widespread electricity theft limit the ability of companies like AEDC to generate sufficient income for reinvestment in infrastructure (Ebhota & Ogunleye, 2022). Consumers also face affordability challenges due to low income (Enaberue, Musa, & Magaji, 2024). Additionally, irregular billing and estimated charges often lead to disputes and non-payment, further weakening the financial viability of distributors (Adenikinju, 2020). Rising operational costs, driven by inflation, currency devaluation, and the high cost of energy inputs, compound these difficulties, discouraging private sector investments and threatening long-term sustainability (Ismail, Musa, & Magaji, 2024a).

2.1.3 Environmental Challenges

The environmental dimension of electricity distribution concerns the ecological implications of unreliable supply and dependence on fossil-fuel-based alternatives. In Abuja and other parts of Nigeria, inadequate electricity supply forces households and businesses to rely on diesel and petrol generators, which emit significant amounts of greenhouse gases and contribute to air pollution (Akinyemi et al., 2019). This practice undermines Nigeria's commitments to international climate agreements and the Sustainable Development Goals (Yakubu, Magaji, & Magaji, 2025). Furthermore, the absence of renewable energy integration into the mainstream distribution networks, including those managed by AEDC, perpetuates environmental degradation and increases vulnerability to climate change (Obi & Okeke, 2022). Addressing these challenges requires aligning distribution practices with environmental sustainability frameworks and promoting the adoption of clean energy.

2.1.4 Social Challenges

Social challenges in electricity distribution are reflected in issues of accessibility, equity, customer satisfaction, and overall public trust in service providers. For AEDC, weak customer service delivery, poor complaint management, and inequitable allocation of electricity across urban and peri-urban areas have contributed to consumer dissatisfaction (Ariyo & Jerome, 2021). Frequent outages and unreliable supply also disrupt businesses (Magaji, Abubakar, & Mairiga, 2015), healthcare (Ismail, Musa, & Magaji, 2024b), and education (Gabdo, Magaji, & Yakubu, 2025), with broader implications for social development and welfare (Magaji, Muhammed, & Abubakar, 2015). These inadequacies reinforce perceptions of inefficiency and erode trust between consumers and electricity providers. Ultimately, the social dimension of electricity distribution highlights the importance of responsive service delivery, equity, and transparency in building legitimacy and enhancing the developmental role of energy access (Nwachukwu & Akinlabi, 2020).

2.2 Theoretical Review

2.3.1 Sociotechnical Systems (STS) theory

The Sociotechnical Systems (STS) theory is highly relevant to assessing the technical, economic, environmental, and social challenges of electricity distribution in Abuja. The theory emphasises the interdependence between social and technical subsystems within organisations, arguing that adequate performance can only be achieved when both dimensions are jointly optimised (Trist & Bamforth, 1951). Within the Abuja Electricity Distribution Company (AEDC), the technical subsystem encompasses infrastructure, grid technologies, and metering systems. In contrast, the social subsystem encompasses workforce efficiency, customer service, and stakeholder engagement. By applying STS theory, this study highlights how inefficiencies in electricity distribution are not merely technical or economic issues but are rooted in the misalignment between technological infrastructure and social practices. Thus, addressing the distribution challenges in Abuja requires integrated reforms that balance technical innovations with social, environmental, and economic considerations, ensuring a sustainable and consumer-oriented electricity system (Pasmore et al., 2019).

2.3 Empirical Review

Okafor (2020) examined the effects of privatisation on Nigeria's electricity sector, emphasising the importance of adaptability among distribution companies (DisCos). His

findings revealed that DisCos that restructured their operational strategies and embraced technological innovations were better prepared to operate in the post-privatisation environment. Adaptability, therefore, is not just a short-term reaction but a crucial long-term strategy in Nigeria's dynamic energy landscape. With the growing transition to decentralised power systems, fueled by the affordability and accessibility of solar technologies, DisCos are compelled to align their business models with distributed generation. This may include investing in microgrid infrastructure or forming alliances with renewable energy firms. Additionally, Nigeria's regulatory framework undergoes frequent changes, requiring DisCos to remain flexible to policy amendments. For example, adjustments in tariff policies or the introduction of renewable energy targets require DisCos to revise both their financial and operational frameworks to remain compliant and profitable (Okafor, 2020).

Similarly, Adewale (2021) highlighted the role of risk-taking in fostering innovation in his work on renewable energy integration. He observed that DisCos willing to explore pilot projects and experiment with new business approaches were more successful in advancing distributed energy generation. In Nigeria's context, where renewable adoption is still emerging, calculated risk-taking is vital for addressing technological and financial constraints. This may involve piloting solar mini-grids in underserved areas or experimenting with innovative financing structures to attract private sector investment. Furthermore, DisCos must be prepared to adopt unconventional models, such as peer-to-peer energy trading or energy-as-a-service, to meet the growing demands of consumers. A culture of risk-taking, therefore, is central to positioning DisCos as leaders in Nigeria's transition towards sustainable energy (Adewale, 2021).

Ibrahim (2019) emphasised the importance of continuous learning and knowledge exchange in a study focused on capacity development within the electricity sector. He argued that investing in training and promoting a learning culture strengthens the technical and managerial competencies of DisCos, preparing them to respond effectively to new challenges. Addressing Nigeria's skills gap requires capacity building through training in grid modernisation, renewable energy integration, and customer service improvement. Beyond technical training, Ibrahim suggested fostering platforms for knowledge sharing through seminars, workshops, and conferences to promote best practices and promote the exchange of ideas. Strengthening workforce capacity enables DisCos to better adapt to technological innovations, regulatory shifts, and evolving customer expectations (Ibrahim, 2019).

Similarly, Akinola (2022) emphasised the importance of market responsiveness in enhancing customer satisfaction. His study on consumer perceptions of electricity services in Nigeria found that DisCos engaging actively with customer feedback built stronger trust and reputation. He noted that mechanisms such as call centres, mobile applications, and digital platforms enhanced customer relations by promptly addressing complaints. In a sector where public trust remains fragile, effective responsiveness to customer concerns is essential for building confidence and improving service quality. Conducting periodic customer satisfaction surveys can also provide insights for performance evaluation and strategic adjustments. By prioritising customer engagement, DisCos demonstrate accountability and strengthen long-term service relationships (Akinola, 2022).

Nwosu (2020) examined the role of metering in service delivery, underscoring the importance of accurate billing and transparent communication. He argued that prepaid metering systems and access to real-time consumption data significantly reduced billing disputes and improved customer satisfaction. Accurate billing practices ensure fairness, while transparency builds customer confidence in electricity services. This may involve developing online platforms and mobile applications that provide precise details on consumption and billing structures. By embedding transparency and precision in billing systems, DisCos can reduce disputes, foster trust, and enhance customer relations (Nwosu, 2020).

Finally, Oluwole (2021) emphasised the relevance of customer-centric strategies in addressing changing energy demands. He noted that DisCos providing flexible and customised solutions were more successful in retaining customers. Given Nigeria's diverse energy requirements, such solutions may include solar home kits for rural households, storage systems for industrial users, and demand-side management programs to promote efficiency. By aligning service delivery with customer-specific needs, DisCos enhance competitiveness while fostering lasting consumer loyalty. A customer-oriented approach, therefore, is crucial for sustaining growth and ensuring long-term relevance in Nigeria's evolving energy market (Oluwole, 2021).

3.0 METHODOLOGY

3.1 Research Design

This study will adopt a mixed-methods research design, combining quantitative and qualitative approaches. The quantitative component will involve surveys and statistical analysis of AEDC's performance. The qualitative component will involve in-depth interviews, focus group discussions, and document analysis to gather insights into the perspectives of various stakeholders.

The mixed-methods approach will provide a comprehensive understanding of AEDC's efficiency and sustainability in energy distribution. The quantitative data will provide statistical evidence of the company's performance, while the qualitative data will offer contextual insights into the factors influencing its operations.

3.2 Study Area

The study was conducted within the operational area of the Abuja Electricity Distribution Company (AEDC), which includes the Federal Capital Territory (FCT). This represents diverse urban and rural settings, providing a comprehensive view of AEDC's operations. The study will focus on selected locations within these states to ensure the representation of different customer segments and operational characteristics.

3.3 Population of the Study

The population of the study will include:

I. AEDC Customers: Residential, commercial, and industrial customers across the operational area.

II. AEDC Employees: Staff at various levels, including management, technical, and customer service personnel.

iii. Government Officials: Representatives from regulatory bodies, ministries, and agencies involved in the electricity sector.

IV. Industry Experts: Consultants, researchers, and professionals with expertise in energy distribution and sustainable energy practices.

3.4 Sample Size and Sampling Technique

The sample size will be determined using statistical formulas to ensure adequate representation of the population. The sampling techniques will include:

i. Stratified Random Sampling: To select a representative sample of customers from different customer segments (residential, commercial, industrial) and locations (urban, rural).

ii. Purposive Sampling: To select government officials, industry experts, and AEDC employees with relevant knowledge and experience for interviews and focus group discussions.

iii. Convenience Sampling: To gather data from readily available AEDC customers for surveys and quick feedback.

3.5 Sampling Procedure

The sampling procedure will involve the following steps:

1. Identification of Sampling Frame: Develop a list of AEDC customers, employees, government officials, and industry experts.
2. Stratification: Divide the customer population into strata based on customer segments and locations.
3. Random Selection: Use random number generators to select customers from each stratum.
4. Purposive Selection: Identify and select government officials, industry experts, and AEDC employees based on their expertise and availability.
5. Convenience Sampling: Administer surveys to available AEDC customers at service centres and public locations.

3.6 Sources of Data

The study will utilize both primary and secondary data.

i. Primary Data:

a. Surveys of AEDC customers.

b. In-depth interviews with government officials, industry experts, and AEDC employees.

c. Focus group discussions with AEDC customers and employees.

d. Observations of AEDC's operations and service delivery.

ii. Secondary Data:

a. AEDC's operational and financial reports.

b. Regulatory documents and policy papers.

c. Academic journals, books, and research reports.

d. Industry publications and reports.

e. Government statistics and databases.

3.7 Instrument of Data Collection

The instruments for data collection will include:

i. Questionnaires: Structured questionnaires for AEDC customers, covering aspects such as service quality, customer satisfaction, and perceptions of AEDC's performance.

ii. Interview Guides: Semi-structured interview guides for government officials, industry experts, and AEDC employees, covering regulatory frameworks, operational challenges, and improvement strategies.

iii. Focus Group Discussion Guides: These are discussion guides for facilitating focus group discussions with AEDC customers and employees, covering themes like service delivery, customer experience, and community engagement.

iv. Observation Checklists: These checklists document observations of AEDC's operations and service delivery, including customer service centres, substations, and distribution networks.

3.8 Validity and Reliability of Instruments

The validity and reliability of the instruments will be ensured through:

i. Content Validity: Expert review of questionnaires, interview guides, and observation checklists to ensure they cover the relevant topics and indicators.

ii. Pilot Testing: Pilot tests will be conducted with a small sample of respondents to identify and address any ambiguities or inconsistencies in the instruments.

iii. Internal Consistency: Cronbach's alpha is used to assess the internal consistency of the questionnaire items.

iv. Triangulation: Using multiple data sources and methods to cross-validate findings and enhance the reliability of the study.

3.9 Technique of Data Analysis

The data analysis techniques will include:

i. Quantitative Data Analysis:

a. Descriptive statistics (frequency distribution) will summarise the survey data.

c. Statistical software (SPSS, R) for data analysis and visualisation.

Based on your research questions and objectives, we need to define the dependent and

3.10 Ethical Considerations

The study will adhere to the principles of ethics throughout the research process. These include:

i. Informed Consent: Obtaining informed consent from all participants before data collection.

ii. Confidentiality and Anonymity: Ensuring the confidentiality and anonymity of participants' responses.

iii. Voluntary Participation: Ensuring that participation in the study is voluntary and participants can withdraw at any time.

iv. Data Security: Protecting the security and privacy of data collected during the study.

v. Transparency and Integrity: Maintaining transparency and integrity in research and reporting findings.

4.0 DATA ANALYSIS, PRESENTATION, AND DISCUSSIONS OF FINDINGS

4.1 This chapter will present and analyse data collated from the fieldwork.

Table 4.1 Demographic Characteristics of the Respondents

Serial Number	Characteristics	Frequency	Percentage
1	Gender		
	Male	156	56.52
	Female	112	40.58
	Prefer not to say	8	2.90
	Total	276	100
2	Age		
	18-20	12	4.35
	21-30	74	26.81
	31-40	93	33.70
	41-50	61	22.10
	Above 50	36	13.04
	Total	276	100
3	Occupation		
	Civil Servant	81	29.35
	Private Sector	58	21.01
	Self-employed	65	23.55
	Students	42	15.22
	Unemployed	30	10.87
	Total	276	100

Source: Fieldwork, 2025

Table 4.1 disclosed the gender distribution of the respondents. The table reveals that the majority of respondents (56.52%) are male, followed by 40.58% female. Only a small fraction (2.90%) preferred not to disclose their gender. The table disclosed the age distribution of the respondents. Those within the 31–40 age group form the largest share (33.70%) of respondents, indicating that middle-aged adults are the most represented in electricity use and assessment.

The findings from the table show that individuals in the civil service and those self-employed are the most dominant consumers of electricity services, reflecting the working-class dominance in Abuja, which constitutes more than 50% of the total respondents.

Table 4.2: Consumer Type

Serial Number	Type	Frequency	Percentage
1	Residential	178	64.49

2	Commercial	46	16.67
3	Industrial	18	6.52
4	Governmental	34	12.32
	Total	276	100

Source: Fieldwork, 2025

Table 4.2 reveals that residential users of electricity constitute more than half of the total population, with 64.49%, indicating a dominance in electricity usage in Abuja. This also highlights the importance of a stable household supply in Abuja.

Table 4.3: Electricity Supply

Serial Number	Responds	Frequency	Percentage
1	Electricity Supply Regularity		
	Very regular	24	8.70
	Irregular	108	39.13
	Very poor	46	16.67
	Total	276	100
2	Hours of Supply		
	Less than 4 hours	38	13.52
	4–8 hours	87	31.52
	9–15 hours	103	37.32
	Above 15 hours	48	17.39
	Total	276	100
3	Satisfaction with Supply Quality		
	Very satisfied	18	6.52
	Satisfied	71	25.72
	Dissatisfied	122	44.20
	Very dissatisfied	65	23.55

Source: Fieldwork, 2025

The 4.3 reveals that most respondents (39.13%) find the electricity supply irregular, while only 8.70% enjoy very regular power, and 16.67% experience an inferior electricity supply in their areas, indicating inefficiency in distribution. The table also disclosed the hours of electricity supply in the study area. The table shows that only 37.32% receive electricity between 9 and 15 hours daily, while only 17.39% enjoy more than 15 hours of supply, indicating that supply challenges persist. The table again shows that a significant portion (67.75%) is dissatisfied or very dissatisfied, suggesting that quality improvement is urgently needed in the study area.

Table 4.4 Response to Faults

Serial Number	Responses	Frequency	Percentage
1	Faults		
	Very prompt	22	7.97
	Prompt	88	31.88
	Delayed	104	37.68
	Very poor	62	22.46
	Total	276	100
2	Experience with a power surge		
	Yes	207	75.00
	No	69	25

	Total	276	100
3	Perceived Fairness Distribution		
	Yes	78	28.26
	No	124	44.93
	Not sure	74	26.81
	Total		

Source: Fieldwork, 2025

Table 4.4 reveals that 60.14% of customers experience delayed or poor responses to fault reports, reflecting customer dissatisfaction with AEDC's maintenance services. The table also shows that a worrying 75% have experienced power surges, highlighting major concerns with voltage stability. The table also revealed that nearly 45% believe the distribution is unfair, signalling potential biases in service coverage or favoritisms.

Table 4.5 Billing

Serial Number	Responds	Frequency	Percentage
1	Types of Billing		
	Prepaid meter	121	43.84
	Postpaid billing	79	28.62
	Estimated billing	76	27.54
	Total	276	100
2	Satisfaction with Billing Accuracy		
	Yes	67	24.28
	No	123	44.57
	Sometimes	86	31.16
	Total	276	100

Source: Fieldwork, 2025

Table 4.5 reveals that prepaid meters are most common among respondents (43.84%), suggesting a trend towards user-controlled consumption. However, a significant portion still relies on postpaid and estimated billing, which may contribute to billing disputes. The table also shows that nearly half (44.57%) are not satisfied with their billing accuracy, while only 24.28% expressed satisfaction. This reflects distrust in the billing system, especially among postpaid and estimated billing users.

Table 4.6: Customer Service Rating

Serial Number	Rating	Frequency	Percentage
1	Excellent	22	7.97
2	Good	88	31.88
3	Poor	96	34.78
4	Very poor	70	25.36
	Total	276	100

Source: Fieldwork, 2025

Table 4.6 indicates that customer service is a significant weakness, with 60.14% of respondents rating it as poor or very poor. Less than 8% find the service excellent, highlighting a substantial area for improvement.

Table 4.7: Complaint Resolution Experience

Serial Number	Complaint resolution	Frequency	Percentage

1	Yes resolved	82	29.71
2	Yes, but unresolved	91	32.97
3	No	103	37.32
	Total	276	100

Source: Fieldwork, 2025

Table 4.7 shows that only 29.71% of complaints were resolved satisfactorily. The majority either received no resolution or did not report at all, showing low confidence in complaint mechanisms.

Table 4.8 Perception of AEDC's Sustainability Commitment

Serial Number	Perceptions	Frequency	Percentage
	Strongly agree	17	6.16
	Agree	86	31.13
	Disagree	108	39.13
	Strongly disagree	65	23.55
	Total	276	100

Source: Fieldwork, 2025

Table 4.8 reveals that only 37.32% believe AEDC is committed to sustainable energy, while 62.68% either disagree or strongly disagree, showing scepticism about long-term planning and environmental responsibility.

Table 4.9: Awareness of AEDC Renewable Initiatives

Serial Number	Responds	Frequency	Percentage
1	Yes	98	35.51
2	No	178	64.49
	Total	276	100

Source: Fieldwork, 2025

Table 4.9 indicates that the level of awareness of AEDC's renewable energy initiatives is low, with nearly two-thirds of respondents being unaware of these efforts. This suggests a lack of effective communication and public engagement.

Table 4.10 Support for Renewable Energy Investment

Serial Number	Responds	Frequency	Percentage
1	Yes	203	73.55
2	No	42	15.22
3	Insufficient	31	11.23
	Total	276	100

Source: Fieldwork, 2025

Table 4.10 shows that a large majority (73.55%) supports more investment in renewable energy, indicating substantial public support for sustainable alternatives.

Table 4.11: Willingness to Adopt Alternative Energy (e.g., Solar)

Serial Number	Responds	Frequency	Percentage
	Very willing	114	41.30
	Willing	95	34.42

	Not willing	67	24.28
	Total	276	100

Source: Fieldwork, 2025

Table 4.11 reveals that over 75% of respondents are willing or very willing to adopt alternative energy, showing a readiness for transition provided support and infrastructure are available.

4.2 Discussion of Findings

The demographic analysis revealed that most respondents were male (56.52%) and fell within the 31–40 years age group (33.70%), indicating a segment of the population that is both economically active and heavily reliant on electricity for work and household use. Civil servants (29.35%) and self-employed individuals (23.55%) were the most represented occupational groups, indicating participation from both formal and informal sectors. Residential consumers dominated the sample (64.49%), which highlights that the findings primarily reflect household-level electricity consumption experiences.

The results revealed a high level of dissatisfaction with the electricity supply. Only 8.70% of respondents described supply as very regular, while the majority rated it as irregular or very poor. Although 37.32% reported receiving 9–15 hours of supply daily, 13.77% had access to fewer than 4 hours, exposing a significant service delivery gap. Dissatisfaction with power quality was widespread, with 67.75% of respondents citing voltage instability and interruptions. Fault response was also poor, as 60.14% reported delays or inadequate service when outages occurred, and 75% had experienced damaging power surges. Moreover, 44.93% believed electricity distribution was unfair across neighbourhoods, reinforcing perceptions of inequity and unreliability.

Billing and customer service also emerged as critical areas of concern. While 43.84% of respondents used prepaid meters, significant portions still relied on postpaid (28.62%) or estimated billing (27.54%), both of which were prone to inaccuracies. Nearly half of respondents (44.57%) expressed dissatisfaction with billing accuracy, while only 24.28% were satisfied. Customer service performance was rated poorly, with 60.14% describing AEDC services as poor or very poor. Complaint resolution was largely ineffective, as 37.32% of customers had never had their issues resolved, and only 29.71% reported successful outcomes from their complaints. These findings highlight persistent inefficiencies in billing and customer service that undermine trust in AEDC.

The study further revealed a significant sustainability gap. While only 37.32% of respondents agreed that AEDC was committed to sustainability, 62.68% disagreed. Awareness of AEDC-led renewable initiatives was low (64.49%). Yet, there was overwhelming support for change: 73.55% of respondents advocated for greater investment in renewable energy, and 75.72% expressed a willingness to adopt alternative sources, such as solar and wind, if supported. Overall, the findings underscore four critical issues: unreliable service delivery, poor customer experience, inequitable distribution, and weak sustainability engagement. Addressing these challenges requires targeted policy interventions, including infrastructure upgrades, the broader adoption of prepaid metering, enhanced customer service training, sustainability awareness campaigns, and partnerships to expand access to renewable energy sources.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study has highlighted that the challenges facing the Abuja Electricity Distribution Company (AEDC) are not isolated technical or economic issues but a complex, interconnected web of technical, economic, environmental, and social factors. The findings highlight a significant discrepancy between AEDC's operational practices and the needs of its consumers. From a technical standpoint, the persistent issues of irregular supply, frequent power surges, and outdated infrastructure directly impact service quality. Economically, a lack of transparent billing and revenue collection inefficiencies hinders the company's financial viability. Environmentally, the over-reliance on alternative power sources contributes to pollution and a widespread public perception that AEDC lacks a commitment to sustainability. Socially, the company suffers from a significant deficit in customer trust, poor service delivery, and a perception of unfairness in its electricity distribution. The findings confirm the study's theoretical foundation in Sociotechnical Systems (STS) theory, demonstrating that without a holistic, integrated approach that addresses both technical and social subsystems, AEDC will continue to struggle in providing a reliable and sustainable electricity supply to FCT-Abuja.

Recommendations

To address these systemic challenges, this study recommends a multi-pronged approach focused on integrated reform. Technically, AEDC should prioritise investments in modern smart-grid technologies, particularly smart metering, to improve billing accuracy and reduce technical losses. This should be coupled with a comprehensive maintenance schedule to address frequent equipment breakdowns and voltage fluctuations. Economically, the company must reform its billing practices to be more transparent, phasing out estimated billing in favour of a complete migration to prepaid meters. This will not only improve revenue collection but also build consumer trust. Environmentally, AEDC should proactively integrate renewable energy sources into its distribution network and communicate its sustainability initiatives to the public. Finally, from a social standpoint, the company must overhaul its customer service mechanisms by establishing a responsive, reliable complaint resolution system and engaging more

effectively with customers. By implementing these recommendations, AEDC can begin to establish a resilient, efficient, and sustainable electricity distribution system that meets the growing needs of the metropolis.

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