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International Journal of Finance, Management and Governance (IJFMG)
Volume 2, Issue 2, June 2026 - ISSN: 3092-9423

Electricity Pricing and Revenue Performance of Port Harcourt Electricity Distribution (PHED) Commercial Operations in Uyo Metropolis, Akwa Ibom State

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DOI: https://doi.org/10.5281/zenodo.20919022

Citation: Effanga, A. B., Ekong, C. N., & Onwioduokit, E. A. (2026). Electricity Pricing and Revenue Performance of Port Harcourt Electricity Distribution (PHED) Commercial Operations in Uyo Metropolis, Akwa Ibom State. *International Journal of Finance, Management and Governance, 2(2). https*://doi.org/10.5281/zenodo.20919022

Abstract

The study examined the various electricity prices or tariff rates based on the MYTO methodology as deployed by the Nigeria Electricity Regulatory Commission (NERC) and its impact on the revenue performance objective of PHED within the Uyo metropolis. The data used for the study was a 72-month monthly time series data sourced from the PHED database. It employed an Auto Regressive Distributive Lag (ARDL) econometric model to demonstrate if a relationship exists between the dependent variable, such as Total Revenue (TREV), and the independent variables such as Population of Customers Billed (POPB), Total energy received from the grid (RKWH), Total energy billed (BKWH); Total amount of energy billed in naira (PKWH), and Total number of customers that responded to payment (CURS). Furthermore, a proportional analysis was conducted to capture the various efficiency competencies and how the electricity company performed within the period under review (2019-2024). The choice of the period was based on the unavailability of data from 2013 when PHED became an entity. With an average of 52% Average Technical, Commercial, and Collection (ATC&C) losses recorded by PHED within the period, it is concluded that despite the relatively yearly reviewed tariff rates, PHED's revenue performance level appears average. It is recommended that *the management of the company take advantage of the increases in the prices of electricity charged to the customers by ensuring an adequate power supply of about 18 – 20 hours, a reduction in excessive billing to non-metered customers based on estimation, and, above all, a massive deployment of prepaid meters to electricity consumers, which will greatly stem customers' apathy to payment, and this will impact positively on the revenue.*

Keywords: Performance, Revenue, Billing Efficiency (B.E.), Collection Efficiency (C.E.), Average Technical, Commercial, and Collection (ATC&C) Losses.

Introduction

Electricity is a core factor of any nation's development process. Statistics from the International Energy Agency (IEA, 2009) show that there is a strong relationship between electricity consumption and the economic growth of a nation. Furtherance to this statement and as reported, "The Benin Republic and Nigeria have 42.1 percent and 59.5 percent of their total populations that have access to electricity, respectively. This appears relatively low when compared to Ghana with 86.3%, Algeria with 99.8%, the USA with 100%, and Brazil with 99.4% accessibility to electricity" (WBDI, 2023).

For most developing countries, to measure up to the economic level of developed countries, policies directing the raising of electricity supply to meet the ever-rising demand are of utmost importance. This is because developed countries require increasing amounts of electricity for domestic, industrial, and commercial uses. These energy sources are met by many sources ranging from natural gas and hydro to renewable sources. The nexus to balance the demand (consumption) and supply (generation) side management of the electricity value chain for optimum usage, centers on efficient electricity pricing methodology as well as effective service delivery.

Recently, government had total control over the power utilities in most countries. However, these utilities operated inefficiently, accumulating huge deficits that could not be sustained by continued public government management of the utility. Hence, there exists a paradigm shift from a natural monopoly system to a relatively competitive power system. The most important factor that triggered this paradigm shift was to make the utilities efficient and viable and grow their revenue profile, which will guarantee returns on investment.

The power utility in Nigeria, initially called the Nigerian Electric Power Authority (NEPA) but later transformed into the Power Holding Company of Nigeria (PHCN), has been operating as a natural monopoly, which is state-controlled. Over the years, the utility has been fraught with poor service delivery, operational and distributional losses, revenue losses, poor management, poor maintenance, poor funding/underfunding, and poor performance, among others. With the passage of the Energy Sector Reform Act of 2005, the utility was privatized to attract the needed resources to boost the sector and, by extension, generate some economic benefits for the citizens and prospective investors.

The question arising from this exercise is, to what extent have these reforms reflected or impacted the present status of the Nigerian power utility, which has been unbundled into 11 distribution companies (Discos), 6 generation companies (Gencos), and 1 transmission company (Transco), especially with regard to the maximization or efficiency of their revenue profile and service delivery? At the prevailing level of the privatized power sector, the prices of generating, transmitting, and distributing (selling) a kilowatt (kWh) unit of electricity were meant to be cost reflective, which will guarantee operational and revenue performance as well as guarantee returns on private investment.

The main objective of this study is to examine whether the level of electricity pricing has a direct impact on the revenue performance of the utility company, with particular reference to the commercial operations of PHED in the Uyo metropolis. Specifically, the study investigates whether PHED's electricity tariff rates for energy sales ensure the level of revenue efficiency predicted by the economic theory of total revenue, which posits that, *ceteris paribus*, an increase in the unit price of goods or services leads to an increase in total revenue.

Scope of the Study

This study is limited in scope to analyzing the various determined electricity pricing and revenue management of one of the eleven (11) discos that is, the Port Harcourt Electricity Company (PHED), with respect to its commercial operations in the Uyo metropolis, which is one of its franchise areas. Furthermore, the focal point is on the revenue cycle management of the company and not on the entire balance sheet of the company because the cost component such as the operating expenses (OpEx) and capital expenses (CapEx), cannot be easily accessed, and the prevailing electricity market processes are still transient or transitory (USAID, 2019).

Literature Review

Conceptually, electricity pricing is the price or tariff rate at which a unit (kilowatt-hour, kWh) of electricity is sold to the end users or customers. These end users are categorized into residential, commercial, industrial, and special classes. Each of these categories of users is charged differently based on their usage or voltage level. Within the context of this study, it is necessary to point out that these electricity prices are centrally determined by a regulator, and in Nigeria the prevailing prices are determined by the Nigerian Electricity Regulatory Commission (NERC). Generally, performance is viewed as a multidimensional concept that involves effectiveness, efficiency, and the integration of different dimensions and parameters of measurement. Furthermore, performance can be viewed as the achievement of specific tasks measured against predetermined standards of accuracy, completeness, cost, and speed.

Organizational performance refers to how well an organization is doing and how much of its daily tasks and set objectives it successfully completes. Measuring an organization's performance involves comparing its actual outputs or results with the intended ones. This comparison helps organizations determine if they're achieving what they set out to do. Business owners, strategic partners, and managers typically conduct this performance evaluation, and the process includes recognizing and implementing processes that can help improve the company's performance. Examining this concept in its operational terms, it is said that an organization's operational performance includes an evaluation of its marketing, customer satisfaction, product quality, and competitive advantage. It also reviews market share strengths and company sales numbers. Rolstadas (1998) believes that the performance of an organizational system is a complex relationship involving seven criteria that must be followed, namely, effectiveness, efficiency, quality, productivity, innovation, quality of work, and profitability. These criteria are what is normally referred to as performance objectives.

Revenue as applied in the context of this study is the total amount of money collected from the end-users (consumers) of electricity by the utility company from the total electricity delivered and invoiced to customers. As a business process, the utility issued invoices or electricity bills to consumers based on the unit consumed per month, and customers used such bills to effect payments. It is the total amount of money collected per month from all the settled invoices that constitute the revenue of the utility company. Theoretically, this study is anchored on efficiency audit theory, sales/ revenue maximization theory and theory of price discrimination

Efficiency audit theory is premised on a process of checking whether an organization is working as efficiently as possible. According to Black (2004), this could be done internally as management tries to improve profitability or externally by regulatory bodies responsible for supervising privatized utilities. Two standard approaches are used in each case such as the engineering approach and the statistician approach. The engineering approach is comparing practice with what theory suggests as possible, and the statistician approach is comparing performance with that of similar enterprises elsewhere in the economy or in other countries. Within the context of this study, emphasis is on the revenue/collection efficiency of PHED, which is expressed as a ratio of total revenue collected from the sale of electricity to customers in Naira over the total energy (electricity) billed in Naira. The global standard of measuring revenue/collection efficiency is that the ratio must be greater than or equal to eighty percent (80%). The output of the study is compared with the global status. Within the scope of this study, we focused on three (3) efficiency competencies, namely, Billing efficiency (BE), Collection efficiency (CE), and Average technical, Commercial, and Collection Losses (ATC&C).

Sales maximization is one of the objectives of a firm, which involves selling as many units of goods or services as possible. This theory, as propounded by Baumol (1967), raised serious questions on the validity of profit maximization as an objective of the firm. The theory stressed that, in competitive markets, firms would rather aim at maximizing revenue through maximization of sales. Accordingly, sales volumes, and not profit volumes, determine market leadership in competition. Baumol, in his book 'Business Behavior, Value, and Growth,' proposed that the main aim of a firm is to maximize sales. By sales he meant total revenue earned by the sale of goods. Laying credence to this assertion. Ahuja (2013) maintains that firms, especially big national public firms, try not to promote sales but also use sales as a means to further other objectives such as operational efficiency.

More recently, the revenue-maximization dominance hypothesis has been re-proposed by Moro (2004). It is argued that the separation of ownership and control in public companies causes a deviation of management from the pure profit maximization principle and provides a considerable degree of decision-making autonomy for managers. In fact, in an oligopolistic market, each firm may set up its own goal, and the choice to maximize revenue or profit depends on the real interests of the managers, which is also influenced by the corporate culture and institutional arrangements of the country where the firm operates. As pointed out by Moro (2004), the principal objectives of Japanese firms are growth and market share gaining, which imply that they are revenue maximizers. The activities and processes in the Nigerian electricity supply industry show more emphasis on maximizing revenue than maximizing profit.

The theory of price discrimination explores how firms can maximize revenue by charging different prices to different groups of customers within a particular region. PHED employs a price discrimination strategy by segmenting their markets or classifying their feeders or marketing points into different bands, A – E, based on hours of availability, with each band having its unique tariff rate as approved by the regulator, the Nigeria Electricity Regulatory Commission.

From 1972 till the early part of 2006, electricity production and supply in Nigeria had been the monopoly of the federal-owned electricity utility body known as the National Electric Power Authority (NEPA). This utility was charged with the responsibility for the generation, transmission, distribution, and sales of electricity to consumers and was run as a vertically integrated company as shown in Figure 1.

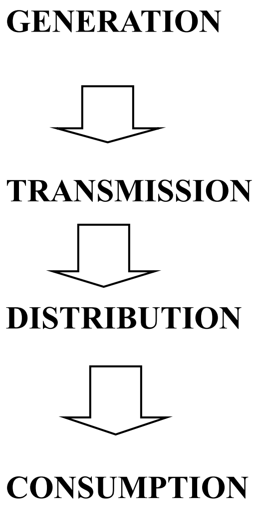

Figure 1: Power Supply model: Adopted from Nkalo and Agwu, 2019.

About seventy-five (75) million Nigerians lacked access to adequate electricity. Nigeria was ranked highest amongst countries with electricity deficits, whereas energy access, efficiency, and renewables are on the increase in many developing economies (Ukoima *et al*. 2018). Electricity is increasingly becoming a major force in the pursuit of sustainable development. As a major source of energy, accessibility of electricity aids in the process of meeting residential and domestic needs, positively contributes to capital and labor productivity, and promotes export potentials of countries (Narayam & Symth, 2009). Electricity is critical to modern economic activity, and it is an important input to many public and social services, yet more than 800 million people lack basic access to electricity services in many parts of the world, and the power supply is limited and highly unreliable. Understanding the development benefits of improved electricity and the key bottlenecks preventing improved electricity take-ups are the key questions development experts, the community of academics, and policymakers are working on to achieve the goal of universal access to affordable, reliable, and modern energy services.

Analyzing the pricing modeling of the Polish electricity market, Tomasz et al. (2005) are of the opinion that one of the most important challenges in the Polish electricity market since the transformation that took place in the late 1990s is related to the availability of data and detailed information about electricity consumption of commercial customers assigned to Band A, B, and C tariff groups supplied from various voltage levels. Knowledge of load schedules based on hourly measurement could become the basis for designing innovative tariff strategies, including static tariffs (fixed price or time-of-use) and also dynamic tariffs for this group of customers. The most frequent tariff change studied is from flat-price tariff to time-of-use, and some have analyzed the change from static to dynamic tariffs. These studies are usually performed using residential data, with only a few works using commercial data.

Daniel et al. (2023), using a panel data analysis, identify six (6) drivers that tend to determine electricity pricing (EP) in the East African region, comprising Rwanda, Uganda, Burundi, Kenya, and Tanzania. The objective of their study was to measure to what extent Electricity Net Consumption (EC), Electricity Net Generation (EG), electricity transmission and distribution losses (Losses), International Average Crude Oil Prices (FP), Consumer Price Index (CPI), and Industry Value Added (IVA) could influence the Average Electricity Prices (EP) in East Africa, especially in Rwanda, Uganda, Tanzania, Burundi, and Kenya. Findings from the study showed that the increase in EG, FP, and CPI increases the Average Electricity Prices (EP), while the increase in Losses, EC, and IVA decreases EP. Therefore, they recommended the promotion of long-term investment policies in renewable sources and efficient policies to reduce technical and commercial losses. In addition, the study suggested that appropriate policies relating to subsidized electricity prices would, however, prevent adverse effects related to inefficient overconsumption of electricity.

Desai and Dutta (2013) prove that dynamic pricing is economically more efficient than the traditional flat-rate prices since it absorbs consumer surplus, thereby enhancing total revenue at existing costs. Borenstain and Hollen (2003) also show that static or flat-rate prices are economically inefficient and suggest that to improve efficiency, there is a need for the adoption of a dynamic electricity pricing model, especially in the developing countries. Faruqui and Lassen (2012) analyze the various tariff rates in the dynamic pricing model and the flat rate pricing model with respect to factors like economic efficiency, bill stability, and revenue stability. Using a scoring matrix to compare the various pricing schemes, they arrived at a conclusion as shown in Table two (2) below:

Table 2.1: Comparison of the Various Scheme

Price Scheme	Economic Efficiency	Bill stability	Revenue Stability/Efficiency
Flat Rate	Very Poor	Very Good	Poor
Peak Time Rebate (PTR)	Good	Very Good	Very Poor
Critical Peak Pricing (CPP)	Good	Average	Good
Time of Use (TOU)	Good	Average	Average
Real Time Pricing (RTP)	Very Good	Poor	Very Good

Source: *Adopted from Dutta and Mitra (2016)*

Their assessment therefor identifies RPT as the best price scheme with respect to the critical factor except bill stability. The Nigerian electricity market maintains only a flat rate pricing mechanism and as could be reference from the study of Dutta and Mitra (2016) explains the poor economic efficiency and revenue efficiency of the market.

Generally, two approaches to electricity pricing have been identified in the literature. They are the traditional (or accounting) approach and the modern (or marginal cost) approach. The major concern in the traditional approach is the recovery of the sunken costs. The approach is based on accounting or financial criteria, which include the need to raise sufficient revenue to meet the operating expenses and debt service requirements of the electric utility and the provision of a reasonable contribution towards the resources required for the future expansion of the power system. The approach begins with comprehensive stock-taking and the evaluation of all old and new assets of the utility and the application of certain depreciation rules to determine capacity-related or kilowatt-related costs. After this, various running, fuel, and other energy-related or kilowatt-hour (kWh)-related costs are computed. Finally, customer-related costs, such as the cost of metering and billing, are computed. After these computations, these costs are then allocated through the tariff structure. In practice, there are different types of tariff structures, including the flat rate (or the simple, single kilowatt-hour) tariff, the two-part tariff, the block tariff, and the maximum demand tariff. In the modern approach, the price of electricity is related to the Long-Run Marginal Cost (LRMC) of supplying electricity. The important consideration in this approach is the number of future resources used or saved by consumer decisions. The approach proceeds in two stages.

Firstly, the pure or strict LRMC that reflects the economic efficiency criterion is calculated. The computation of the LRMC is based on the power system's least-cost expansion plan. In the second stage, the pure LRMC is adjusted to meet other objectives, such as financial requirements and other economic, social, and political considerations. Three broad categories of the strict LRMC are usually computed. These are the marginal capacity costs, the marginal energy costs, and the marginal customer costs. The strict LRMC is usually evaluated within a disaggregated framework. The approach permits price structuring so that they vary according to the marginal costs of serving demand by different consumer groups in different geographical locations, at different voltage levels, at different hours of the day, and in different seasons.

The most common form of LRMC-based tariff is the energy charge based on consumers' kWh consumption over a given period of time. Where it is possible to install kWh meters that record consumption continuously over given shorter periods, electricity tariffs that vary by time of use (TOU tariffs) can be implemented. In fact, when possible and justified, time-of-use metering (i.e., peak and off-peak metering) is the best way of applying LRMC-based tariffs, especially for industrial consumers. In practice, however, LRMC-based tariffs may reflect a compromise between many different objectives, some of which conflict with one another, thereby necessitating certain trade-offs between them. In this regard, it is difficult to have an ideal tariff structure. However, by using the modern approach, it is possible to revise and improve the tariff on a consistent and ongoing basis, thereby approaching an optimum price over a period of several years, without subjecting consumers to unfair shocks in the form of large, abrupt price changes and frequent power outages.

Methodology

The study adopted an ex post facto research design. In this case all the data were obtained from the database of the company and were not easily manipulated**.**

The study utilized the ARDL econometric technique to estimate the anticipated model by exploring the causality and the long-run effects of the independent variables on the explanatory variable. The theoretical foundation is rooted in the microeconomic revenue function framework. This framework posits that Total Revenue (TR) is a product of Price (P) and Quantity (Q).

TR = P x Q ……………………………………………………………Equation 3.1

Where;

TR = Total Revenue

P = Price

Q = Quantity.

Based on the framework as expressed in Equation (1), the analysis is that the total revenue (TREV) collected by PHED, being the dependent variable, is a function of the electricity tariff rate/price (PKWH), total energy received from the national grid (RHWH), total energy billed (BKWH), total no. of customers billed (POP), and total customer response (CRUS), which in this case are the independent variables. Thus:

Revenue collected = f (electricity rate/price, total energy received, total energy billed, total number of customers billed, and total customer response).

Functionally, the above expression could be specified as:

TREV = f (POPB, RKWH, BKWH, PKWH, CUSR) ……………………. Equation 3.2

The econometric specification of the model is therefore expressed as

TRC = f ($\beta_0 + \beta_1$POPB + β_2RKWH + β_3BKWH + β_4PKWH + β_5CUSR + μ) …Equation 3.3

Where:

TREV = Total revenue collected

PKWH = Electricity monthly price (using monthly total energy amount billed as a proxy)

RKWH = Total energy received from the national grid by PHED

BKWH = Total energy billed

POPB = Population billed

CUSR = Customer response

β_0, β_1, β_2, β_3, β_4, β_5 = Coefficients

μ = Error term

To answer the question of whether the various yearly electricity prices or tariff rates as applied to Port Electricity Distribution Company (PHED) are sufficient for the company to maximize their sales revenue, the study adopted an econometric analytical method to determine the impact of yearly tariff rates or prices on the yearly revenue generated by the company. It was also shown with the help of a relationship equation how the total revenue of the company is impacted. Furthermore, a percentage analytical technique was applied to the historical data sourced from the PHED database. The descriptive statistic technique with the historical data was analyzed by determining the following parametric efficiencies, which are used globally in analyzing the viabilities and performance of utility companies.

The efficiencies are Billing Efficiency (BE), Collection Efficiency (CE) and Average Technical Commercial and Collection Losses (ATC&C). Each of the efficiency or key performance indicators (KPIs) is expressed in percentages spanning through certain thresholds. The definition, determination, and calculation of each of the above-mentioned efficiencies is the main thrust of section 4.

The study covered the period from 2019 to 2023 and relies on monthly secondary data sourced from the PHED database. The use of the monthly data instead of yearly data was to increase the sample size for effective analytical purposes since sourcing data from the company data was challenging, especially within the early years of the company operations. To guide the study, the following data was requested and generated from the PHED database these include; Total of energy received from the grid (RKWH), Total Energy Billed (BKWH), Total Energy Amount Billed in Naira – PKWH, Total Revenue Collected (TREV), Total Population Billed (POP) and Total number of customers that responded to monthly payment (CUSR).

Data Presentation, Analysis and Discussion of Findings

The historical and quantitative analysis of the data obtained was represented to show the performance matrix of PHED commercial operations in Uyo metropolis.

Table 4.1: PHED Disco Approved Tariffs - N/kWh (2015 – 2024)

Tariff Class	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	REMARKS
R1	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	Rural Residential
R2	15.09	24.91	30.23	31.78	31.93	32.27	32.27	26.12	25.86	25.64	Single phase Residential
R3	29.58	48.35	48.39	50.81	51.05	50.20	49.89	32.32	32.11	31.84	Three phase Residential
R4	29.58	48.35	50.76	53.30	53.55	52.00	51.67	33.69	33.47	33.19	Maximum demand Residential
C1	21.75	35.88	38.96	40.86	41.05	41.24	40.98	30.13	29.94	29.68	Single phase Commercial
C2	27.50	43.72	46.72	49.04	49.86	48.41	48.11	31.50	31.30	31.03	Three phase commercial
C3	27.50	44.30	48.39	50.81	51.05	50.20	49.89	32.87	32.66	32.28	Maximum demand commercial
D1	29.58	36.19	41.81	42.64	42.84	42.31	42.05	30.13	29.94	29.68	Single phase industrial
D2	28.83	44.01	46.72	49.04	49.26	48.41	48.11	31.50	31.30	31.03	Three phase industrial
D3	28.83	44.59	48.39	50.81	51.05	50.20	49.89	32.87	32.66	32.38	Maximum demand industrial
A1	21.24	35.05	40.60	42.64	42.84	43.03	42.76	30.13	29.94	29.68	Single phase special class
A2	21.24	35.05	45.58	47.97	48.19	48.41	48.11	31.50	31.30	31.03	Three phase special class
A3	28.32	46.73	49.07	51.52	51.76	52.00	52.00	51.67	32.89	32.38	Maximum demand special class
S1	21.75	35.88	40.62	42.64	42.84	43.03	42.76	31.50	31.30	31.03	Street Light

Source: *NERC Annual report, 2024*

As shown in Table 4.1, there were minor changes in the approved tariff prices or rates for the fourteen (14) customer classes of PHED by NERC, and this was also based on the MYTO policy. Given the extant laws governing the setting of the Nigerian Electricity Regulatory Commission (NERC) and in keeping with the MYTO methodology, which prescribes major tariff reviews every five years, MYTO 2020 with a major tariff review became operational in the year 2020. The implication of this is that the approved tariff prices or rates for the year 2020, as shown in Table 4.1, were suspended, and a new tariff price was adopted and implemented. It is important to note that these approved prices or tariff rates for PHED are applicable to all its franchise areas such as Rivers, Bayelsa, Cross River, and Akwa Ibom.

Table 4.2: PHED Tariffs (N/kWh) in 2020

BANDS	NEW TARIFF CLASS	TARIFF RATE
Life Line	R1	4.00
A – Minimum of 20hrs/day	A-Nmd	55.20
	A – Md 1	54.80
	A – Md 2	52.20
B – Minimum of 16hrs/day	B – Nmd	54.80
	B – Md 1	52.20
	B – Md 2	51.70
C – Minimum of 12hrs/day	C – Nmd	51.70
	C – Md 1	49.20
	C – Md 2	49.20
D – Minimum of 8hrs/day	D – Nmd	37.90
	D – Md 1	45.61
	D – Md 2	49.50
E – Minimum of 4hrs/day	E – Nmd	37.9
	E – Md 1	45.50
	E – Md 2	49.50

Source: *NERC Annual Report, 2024.*

The issuance of MYTO 2020 has been the source of much debate within the NESI and the general public at large because it introduces a dramatic tariff increment for certain customer classes, among other unprecedented changes to the tariff framework of Band A-E (Ayaji, 2020). Such changes were to align the tariff paid by end-users with the quality of service (minimum hours of power availability). The available historical data reveals that MYTO 2020 was operational from January 2020 to August 2021.

Furthermore, there was another minor review of tariff prices from September 2021 to January 2022 with a subsequent minor review from February to December 2022. It is pertinent to also point out that another minor review was carried out, and it became operational from January to September 2023. Within the extant laws of EPSRA 2005, a major tariff review was adopted and implemented from October 2023 to March 2024. Finally, in April 2024, another major review was adopted and implemented effective April 2024 but limited to end-users in Band A with 20 hrs/day power availability only, while the tariff prices of other end-users in Bands B-E remained unchanged. The implementation of the April 2024 tariff rate by PHED and other distribution companies attracted negative reactions, which necessitated a minor downward review in May 2024. Table 4.3 captures the various reviews.

Table 4.3 Port Harcourt Disco Tariffs (N/kWh) Reviews (Major and Minor) 2021-2024

Band	Tariff	Sep-Dec. 2021(minor)	Jan. 2022 (minor)	Feb-Dec. 2022	Jan-Sep. 2023	Oct-Mar. 2023	Apr.2024	May.2024
Lifeline	R1	4.00	4.00	4.00	4.00	4.00	Nil	Nil
A	A-Nmd	57.16	57.16	60.67	65.38	72.67	225.00	206.00
	A-Md 1	56.79	56.79	59.64	64.95	71.62	225	206
	A-Md 2	54.18	54.18	54.94	61.86	69.88	225	206
B	B-Nmd	56.79	56.79	59.64	64.95	68.96	68.96	68.96
	B-Md 1	54.18	54.18	57.89	61.86	67.18	67.18	67.18
	B-Md 2	53.69	53.69	57.84	61.28	67.12	67.12	67.12
C	C-Nmd	50.15	50.15	55.15	61.28	56.38	56.38	56.38
	C-Md 1	48.45	48.45	53.45	58.36	54.64	54.64	54.64
	C-Md 2	48.45	48.45	53.45	58.36	54.64	54.64	54.64
D	D-Nmd	35.31	35.31	38.81	54.46	39.67	39.67	39.67
	D-Md 1	50.72	50.72	54.22	57.66	55.43	55.43	55.43
	D-Md 2	50.72	50.72	54.22	57.66	55.43	55.43	55.43
E	E-Nmd	35.08	35.08	38.58	51.71	39.44	39.44	39.44
	E-md 1	50.72	50.72	54.22	56.47	55.43	55.43	55.43
	E-Md 2	50.72	50.72	54.22	56.47	55.43	55.43	55.43

Source: *Author's computation using data obtained from NERC Annual Report, 2024*

Based on the various tariff reviews (major and minor), we will used that to depict the trend to show the movement or volatility of the PHED electricity pricing within the period under review. To depict the trend therefore, we determine the Weighted Average Price (WAP) and use it to show the trending. The determination of the WAP is given as:

$$WAP = \sum TR_{it} \ /n_t \qquad (Equation\ 4.1)$$

i = 1…….., 16; and t= 2019…….2024

Where:

TR_{it} = Total tariff rate of each class within a year
n = total number of tariff class in each year.

Table 4.4: The Weighted Average Price for PHED (N/Kwh) 2019 – 2024

CATEGORY	2019	2020	2021	2022(A)	2022(B)	2023(A)	2023(B)	2024(A)	2024(B)
Total tariff	611.27	740.32	756.81	756.81	756.81	896.71	887.92	1344.75	1287.75
No of tariff class	14	16	16	16	16	16	16	15	15
Weighted Average	43.66	46.27	49.30	49.30	49.30	50.84	55.50	89.65	85.85

Source: *Author's computation using data obtained from NERC Annual Report, 2024*

From Table 4.4, it shows there is steady rise in the weighted Average Electricity prices in PHED, even though at a minor rate from N46.66 in 2019 to 2023 but with a significant increase of N89.65 in 2024.

Table 4.5: Summary of PHED Period of End User Tariff Changes (Major & Minor)

Year	Tariff Change Description	Remarks
JAN.2015 – DEC.2019	MYTO 2.0	
JAN.2020 – AUG. 2021	MYTO 2.0 MINOR REVIEW	Introduction of Bands A- E with different availability hours
SEPT.2021 – JAN. 2022	MYTO 2.0 MINOR REVIEW	
FEB. 2022 – SEPT. 2023	MYTO 2.0 MINOR REVIEW	
OCT.2023 -MARCH. 2024	MYTO 2.1 MAJOR REVIEW	
APRIL 2024	MYTO 3.0 MAJOR REVIEW	
MAY 2024	MYTO 3.0 MINOR REVIEW	

Source: *Author's computation using data obtained from NERC Annual Reports, 2024*

As could be seen in Table 4.5, within the period under review there are four (4) and two (2) minor and major tariff changes, respectively. The basic aim of these changes was basically to consolidate the cost-reflective tariff, which guarantees efficient returns on investment by investors and ensures or sustains better revenue performance.

Table 4.6: Summary of Performance Indicators for Uyo PHED (2019 2024)

YEAR	POPB	RKWH	BKWH	PKWH	TREV	CURS	BE	CE	ATC&C
2019	474,504	124,891,747	99,913,397	3,553,465,889.11	2,054,956,056.22	247,402	80	58	54
2020	603,445	126,580,199	101,264,159	3,924,190,018.75	2,292,044,242.50	328,780	79	56	56
2021	852,802	148,786,774	119,029,393	5,350,575,636.71	3,578,208,620.98	508,514	80	67	46
2022	672,276	107,078,417	85,662,735	5,850,094,514.15	3,293,162,267.27	204,317	81	56	55
2023	739,504	119,303,936	95,443,149	7,438,981,061.21	4,471,872,354.05	212,070	80	60	52
2024	705,890	113,191,131	90,552,942	6,644,537,788.01	3,882,517,311.17	208,194	80	58	53
TOTAL	4,048,421	739,832,204	591,865,775	32,761,844,907.94	19,572,760,852.19	1,518,477	80.	60	52

Source: *Computed by the Author*

Further analysis in Table 4.6 shows at a glance the status of the commercial operations of PHED within the Uyo metropolis for the period 2019 - 2024. While it appears that the company was able to manage the total energy of 739.8m kWh received from the grid and billed about 591.8m kWh, which represents 80% billing efficiency and is within the threshold of global standards. Given this billing efficiency achieved by the company, we could say the company managed and accounted efficiently for the energy received within the period under review. A 60% collection efficiency of the company indicates that PHED is not managing its revenue operations efficiently, recording a deficit of about 20%. The interpretation of this is that, out of the N32.8 billion amount of energy that was billed, which the company accounted for in its energy management process, only N19.6 billion was collected. The final output of this business process is the percentage of the calculated ATC&C, which from our analysis is put at 52%.

This reflects, therefore, a huge deficit from the global standard of 10% and 20% for developed and developing countries (Nwohu et al., 2017). As earlier pointed out, the ATC&C loss is the difference between the amount of electricity received by a distribution company from the transmission company and the amount of electricity for which it invoices its customers plus the adjusted collections loss. We have earlier also identified the various feeders that radiate energy to the end users in our scope of study and that make up the Uyo metropolitan area. Further analysis of the historical data reveals the contribution of each feeder to the high ATC&C losses of 52% for PHED in the Uyo metropolis within the period 2019–2024. Table 4.2 shows the percentage contribution of each feeder to the huge 52% of ATC&C recorded by PHED in the Uyo metropolis.

Table 4.7: Summary of Feederwise Billing Efficency, Collection Efficeincy and ATC&C.

FEEDER	BE(%)	CE(%)	ATC&C(%)	GLOBAL RATIO(%)	DEFICIT(+/-)(%)	REMARKS
Afaha Ube	80	75	40	20	- 20	High yield feeder
Champion Breweries	80	107	14.4	20	+3.6	High yield feeder
Four lane	80	65	48	20	-28	High yield feeder
Ibesikpo A	81	57	54.4	20	- 34.4	Low loss feeder
Ibesikpo B	80	20	84	20	-64	High loss feeder
Le Medirian	80	101	17.	20	+2.8	High yield feeder
Oron Road A	82	58	52.4	20	-32.4	Low loss feeder
Oron Road B	81	22	82.2	20	-62.2	High loss feeder
Itam Junction	80	27	78	20	-58	High loss feeder

Source: *Computed by the Author*

As shown in table 4.7, the high-loss feeders of Ibesikpo B, Oron Road B, and Itam Junction contributed greatly to the poor performance of PHED operations in the Uyo metropolis within the period under review. The general implication of this is that even with various tariff reviews approved by NERC for the Disco, it could not maximize its revenue to cover the cost of energy wheeled to the company and to pay its Market Operators (MO) bill. Consequently, an improved ATC&C loss reduction would be achieved if PHED adopted a combination of strategies that would ensure reduction in commercial and collection losses in addition to aggressive deployment of meter assets. However, in practice, factors causing technical and commercial losses are never constant, as system components depreciate/burn out with time; energy theft and pilferage and meter tamper/bypass are on the increase daily; and meter deployment is not aggressive enough to match utility customers' growth. Hence, the adoption of combined modern strategies in addition to aggressive metering in tandem with customers' growth has to be employed by the company in a deliberate attempt to reduce ATC&C losses (Odje *et al.,* 2021). ATC&C loss is the sum total of technical losses, commercial losses, and collection losses (shortage due to the inability to collect the total billed amount). ATC&C loss remains the key determinant for evaluating the financial health of a power utility. The concept of ATC&C losses was adopted in the Multi-Year Tariff Order (MYTO-2.1) by the NERC during the period leading to the privatization of the power industry in 2013 (NERC 2014). It was a pivotal criterion for deciding on how utility companies would manage their entire business processes.

Based on the foregoing, we can conclude that despite the MYTO reviews over the period under review, PHED in the Uyo metropolis is operating at a low optimum capacity and hence seems not to maximize its revenue. Worthy of note here is that the company tends to ignore the network maintenance and management, which greatly affects the power availability and service delivery. Energy experts, international donor agencies, and the World Bank have taken interest in finding a solution to the dwindling poor performance of the Nigerian Electricity Supply Industry (NESI) to ensure competitiveness in the industry.

The basic facilitator of improving the fortune or revenue of utility companies, PHED inclusive, is adequate funding, investment, and reduction in the ATC & C losses. The French Development Agency (FDA) study of the Nigerian power sector performance revealed that the 11 Discos can reduce their ATC&C losses if they invest about N 216.144 billion ($ 600 million) within the next 5 years from 2019 (Odje *et al.,* 2021). Further research studies by Ramadoni (2015), Amit and Jitender (2017), Gershon and Ezurum (2018), Kapoor (2019), Nwohu *et al.* (2017), and Odeje (2021) have identified measures to combat reduction in ATC&C and, by extension, increase revenue and service delivery. Identifying and listing the measures includes the following: Improve management of distribution transformers and regular network maintenance culture to prevent tripping of transformers. Integration of modernized solutions, especially for fault identification on lengthy and swampy area network lines; aggressive deployment and installation of smart prepaid energy meters with tamper and load survey logging features for all categories of consumers. Adopt and install a good billing system / payment solutions; regularly train personnel on work ethics, especially as it borders on good customer relationships and attitudinal and changed agents; and institute strict sanctions, penalties, and rewards to curb corruption within and outside the system.

Table 4.8: Unit Root Test using Augmented Dickey Fuller (ADF) Statistics

Variable	ADF Statistics	5% Critical Value	Order of Integration
TREV	-13.32276	-2.867576	1(1)
POPB	-11.54354	-2.867549	1(1)
RKWH	-3.642235	-2.867563	1(0)
BKWH	-3.632904	-2.867563	1(0)
PKWH	-13.17017	-2.86763	1(1)
CUSR	-11.28937	-2.867549	1(1)

Source: *Computed by the author using E-view 10.5 version.*

The unit root test for the stationarity of the time series data used, as shown in Table 4.8, shows that RKWH and BKWH were found to be stationary at levels 1(0), while TREV, POPB, PKWH, and CUSR are stationary at the first difference 1(1). The status of the various variable statistics, therefore, informs us on the use of the Autoregressive Distributed Lag (ARDL) econometric technique for the estimation of the model used in the study. Furthermore, the fact that most of the variables are non-stationary at levels indicates that using them at their levels could generate spurious regression results; this then heightened the need to conduct a cointegration bound test to see if their linear combinations could still generate meaningful long-run relationships.

Table 4.9: ARDL Bound Test for Cointegration

F – Statistic	Significant Level	1(0)	1(1)
107.6976	10%	2.26	3.75
K =5	5%	2.62	3.79
	2.5%	3.41	4.13
	1%	3.41	4.68

Source: *Computed by the author using E-view 10.5 version.*

From the result of the bound test, the F-statistic of 107.6976 is greater than the upper and lower bound critical values at various levels of significance. Hence, the null hypothesis is rejected, indicating that there is a long-run relationship among variables. In other words, in the long run, the independent variables can be estimated using the specified independent variables without generating spurious results.

To further investigate the impact of the independent variables on the dependent variables as specified in the models, we analyzed the estimated long-run results of the model as presented in Table 4.10.

Table 4.10: Presentation of the Long Run Estimation of the Model

Variables	Coefficient	Std.Error	t- statistics	Probability
POPB	0.101145	0.016544	6.113696	0.0021
RKWH	14.13570	25.30521	6.547785	0.5841
BKWH	-0.336604	2.203610	-0.152504	0.3154
PKWH	0.707374	0.039003	18.13652	0.0020
CUSR	0.216212	0.027877	7.755842	0.0000

Source: *Computed by the author using E-view 10.5 version.*

From Table 4.10, the result as presented shows that there is a positive and significant relationship between the population of customers billed (POPB), the total naira amount of energy billed (PKWH), the total number of customer responses (CURS) to payment, and the total revenue of the company (TREV). This implies that a unit increase in POPB, PKWH, and CURS will lead to a significant increase in the total revenue. This is in line with our a priori expectations. The interpretation here is that a one percent (1%) increase in POPB, PKWH, and CURS will cause the total revenue to increase by 0.10 unit, 0.71 unit, and 0.22 unit, respectively. Also revealed in the analysis is that even though there is a positive relationship with a positive coefficient of 14.13570 between the total energy received (RKWH) from the grid and the total revenue collected by the company from the sales of electricity, it is not significant. Operationally, there appears to have always been a determined infraction between the distribution companies (DISCOS) and the transmission companies (TRANSISCO) on the actual energy wheeled and delivered on each monthly business cycle.

Further analysis as shown in Table 4.10 indicates a negative coefficient of -0.336604 and an insignificant probability value of 0.3154, revealing a negative relationship between total energy billed (BKWH) and total revenue collected. This could be attributed to wrong billing emanated from the billing system of the utility company and complaints of overbilling by customers and subsequent development of apathy towards payment of electricity bills. Since generation of revenue is the core business competency of the distribution companies, customer dissatisfaction and payment apathy, if not well managed, will mitigate against its operational efficiency, resulting in commercial and collection losses.

To further test the validity of our data and the model statistic used for the study, we ran the short-run error model (ECM), and the summary of the result is shown in Table 4.11. The Error Correction Model technique of ADRL directly estimates the speed at which a dependent variable returns to equilibrium after a change in other variables, or, we say, ECM captures the speed at which the variables return to their long-run equilibrium after a shock (Gujarati, 2013).

Table 4.11: Short Run Error Correction Test Result (ECM)

Variables	Coefficient	Std.Error	t-Statistic	Probability
C	56.39521	60.18557	9.370220	0.000
D(RKWH)	0.163737	1.754278	14.61421	0.100
D(PKWH)	0.552856	0.029209	18.92763	0.0000
D(CURS)	0.125292	0.021143	12.42189	0.1010
Coin.Eq(-1) *	-1.109032	0.043397	-25.55533	0.0000
R-Squared	0.923230			
Adjusted R^2	0.922583			
Dubin –Watson	1.940441			
F – Statistic	142.5079			
Prob.F-Statistic	0.000016			

Source: *Computed by the author using E-view 10.5 version*

The result of the error correction regression shows that in the short run, total energy received (RKWH), total energy amount billed in Naira (PKWH), and total customer response (CURS) have a positive effect on total revenue (TREV) at zero lag with a positive coefficient of

0.163737, 0.552856, and 0.129032, respectively. The size of the coefficients shows the net effect of the above-mentioned independent variables on the total collection or revenue of the company. This further suggests that appropriate management processes such as metering of the various trading points or boundaries, deployment of a robust and efficient billing system, and maintaining a good customer relationship will play a significant role in improving the revenue profile of PHED.

The result of the F-statistic value of 142.5079, which measures the joint significance of the explanatory variables, is found to be positive and statistically significant. This shows that the overall model is significant. Furthermore, given the coefficient of determination (R^2) value of 0.923230, this implies that 92.32 percent of the variations in the dependent variable TREV on average are explained by independent variables as specified in the model, while 7.68 percent of the variations of the dependent variable are explained by other factors outside the model. The fit of the regression model remained still high after adjusting for the degree of freedom, as indicated by the adjusted R^2 of 92.29 percent. The Durbin-Watson (DW) statistic of 1.940441, as shown in the regression result, is observed to be higher than the R^2 of 0.923230, meaning that the model is non-spurious and the problem of autocorrelation among the variables is ruled out. Our model is stable, efficient, and suitable for policy simulations. The coefficient of the error correction term (Coin.Eq(-1)) is negative with a value of (-1.109032) and is significant. This value implies that about 11.09 percent disequilibrium in total revenue, which occurred in the previous month, is corrected in the current month. The significance of the ECM is an indication and a confirmation of the existence of a long-run relationship between total revenue and the explanatory variables used in the study.

Summary, Conclusion and Recommendations

The privatization of the power industry by the federal government of Nigeria was a thoughtful attempt to improve electricity supply, its quality, and reliability across the country (Odje et al., 2018). This exercise resulted in the creation of 6 privately owned generation companies (Gencos), 11 privately owned distribution companies (Discos), and 1 government-owned transmission company (TCN). The government and its citizens were optimistic that the privatization exercise would help solve the erratic electricity supply. Unfortunately, the unbundling exercise undoubtedly had some gains but also came with its own huge challenges as it exposed the weakened power infrastructure, generation limitations, and transmission and distribution constraints that have deprived the power sector of tangible progress in spite of the huge government appropriation over the years. More so, the failure of some Discos to attract the needed capital investment required for the dramatic turnaround of their licensed network coverage area necessitates the Nigerian Electricity Regulatory Commission (NERC) determining electricity prices with major and minor reviews under the MYTO tariff orders of

2015, 2020, and 2021 (NERC, 2022). Presently the electricity service providers are clamoring for a major tariff review, which the regulator is reluctant to grant approval. The essence of the adoption of the MYTO electricity pricing methodology by NERC was to make the prices of electricity cost-reflective, which will guarantee a return on investment for the investors and make the industry viable and competitive. Port Harcourt Electricity Distribution Company (PHED) is one of the 11 Discos, with its operating franchise area of Rivers, Akwa Ibom, Cross River, and Bayelsa states. PHED has benefited from the various MYTO reviews that should facilitate their maximization of their revenue, but the analysis of the historical data obtained from the company data within the period 2019-2021, with the Uyo metropolis as the scope of our study, also reveals that the company is not financially viable, as reflected in a high ATC&C loss of 52%. This is a deficit of 32% from the global ATC&C threshold of 20% for developing countries.

The reasons why Technical, Commercial, and Collection (ATC&C) losses occur in distribution systems span from inadequate investment in infrastructural improvement and over-lengthiness of distribution lines (HT/LT), the lack of adequate maintenance of equipment, substations, and lines, aging equipment, overloading of existing systems, insufficient reactive power compensation and allocations, the lack of proper network reconfiguration and reconductoring to optimize the length of feeder lines, load balancing, automatic network response capacities, and elimination of undersized conductors and cables. The reasons for commercial and collection losses include energy theft and pilferage, poor metering efficiency, non-reading and erroneous reading of meters, inefficient billing, underbilling, faulty bill distribution, software errors, prolonged disputes, inadequate revenue collection caused by the nonchalant attitude of staff personnel, insufficient collection avenues, and consumer inability to pay for consumed energy. If reasons identified as affecting the high ATC&C of the utility are checked, PHED will be able to efficiently manage their revenue collection in line with global practice and the prevailing tariff price under MYTO 2020 and 2021. While it is necessary to view the activities of the distribution company with a view to improvement in their competencies, it is important for the federal government to re-examine the whole privatization process with a view to assessing if the private investors are actually keeping to their mandate on the performance bond signed before taking over the entities of the electricity supply chain in Nigeria.

After a critical study and establishment of facts based on the available data obtained from the various NERC annual reports and analyzing the same, it is obvious that PHED operations in the Uyo metropolis are not optimum, and hence they need to strategize to maximize their revenue performance to justify the adoption of the various MYTO tariff-pricing policies. The following recommendations were made, and if implemented, they will help change the narratives, especially reducing the high ATC&C recorded by the company:

i. The management will first and foremost carry out a technical audit process of the network as well as embark on new projects on network expansion to sustain power availability and delivery.

ii. Based on the output of the technical inspection and auditing, proper funding of the anticipated investment emanating from identifying infrastructural deficits above will facilitate and guarantee system reliability for effective service delivery.

iii. The company should embark on a strategic enumeration of consumers using electricity illegally but not captured in the database for billing. While minimizing manual enumeration to avoid duplication of customers captured, the usage of efficient modern digital applications like Geographic Information Systems (GIS) will boost the outcome and increase customer growth.

iv. Provision of smart prepaid meters to customers will not only close the metering gap but will also reduce apathy for payment and reduce customer complaints on overbilling and issuance of excessive and estimated billing.

v. Creation of more service or fault reporting centers will bring the customers nearer to the company. Alternatively, creating a franchise area for management by third parties will boost and ease operations as well as revenue collection.

vi. There is an urgent need for reorganization and reengineering of the workforce to realign the personnel to new job functions to boost capacity and curb corruption. For instance, it is imperative for the staff to be trained on how to manage customers to make payments instead of disconnection. The disconnection process constitutes serious leakages on revenue management because the disconnected customers are reconnected illegally for a fee and thus breaking the revenue cycle management.

vii. There is a need for customers' education to change their perception towards electricity management, especially as it concerns its uses. Electricity is like any economic commodity or service, which must be purchased and paid for at the point of sale. Electricity should not be viewed as a social service that is provided by the government.

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