

DIGITALES ARCHIV

ZBW – Leibniz-Informationszentrum Wirtschaft
ZBW – Leibniz Information Centre for Economics

Kyari, Adam Konto; Lawal, Labaran Mohammed

Article

An empirical enquiry into stakeholders perception of electricity pricing methodology

Provided in Cooperation with:

International Journal of Energy Economics and Policy (IJEPP)

Reference: Kyari, Adam Konto/Lawal, Labaran Mohammed (2021). An empirical enquiry into stakeholders perception of electricity pricing methodology. In: International Journal of Energy Economics and Policy 11 (2), S. 75 - 82.

<https://www.econjournals.com/index.php/ijeep/article/download/10534/5705>.

doi:10.32479/ijeep.10534.

This Version is available at:

<http://hdl.handle.net/11159/8172>

Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics
Düsternbrooker Weg 120
24105 Kiel (Germany)
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)
<https://www.zbw.eu/econis-archiv/>

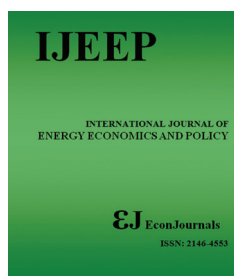
Standard-Nutzungsbedingungen:

Dieses Dokument darf zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden. Sie dürfen dieses Dokument nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen. Sofern für das Dokument eine Open-Content-Lizenz verwendet wurde, so gelten abweichend von diesen Nutzungsbedingungen die in der Lizenz gewährten Nutzungsrechte.

<https://zbw.eu/econis-archiv/terms-of-use>

Terms of use:

This document may be saved and copied for your personal and scholarly purposes. You are not to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public. If the document is made available under a Creative Commons Licence you may exercise further usage rights as specified in the licence.



An Empirical Enquiry into Stakeholders' Perception of Electricity Pricing Methodology

Adam Konto Kyari*, Labaran Mohammed Lawal

Department of Accounting, College of Business Administration, Imam Abdulrahman Bin Faisal University, P. O. Box 1982, Dammam, Saudi Arabia. Email: akkyari@iau.edu.sa

Received: 29 August 2020

Accepted: 28 December 2020

DOI: <https://doi.org/10.32479/ijeep.10534>

ABSTRACT

This study investigates stakeholders' perception of the sustainability of Nigeria's MYTO pricing methodology vis-à-vis government's electricity efficiency objectives. Using a five-point Likert questionnaire, data was collected and analysed via descriptive and regression analyses. The results indicate that 96% of the variations in electricity pricing is accounted for by government's electricity efficiency objectives of acceptability, accessibility and availability. The study concludes that Nigeria's MYTO pricing regime is sustainable. Similarly, the study concludes that there is policy inadequacy in addressing fundamental issues of end users' lack of awareness of pricing system and mistrust between industry players. Although these conclusions have met the objectives of the study, the study recommends further research on the impact of subsidy on sustainability of electricity pricing methodology.

Keywords: Electricity, Pricing, Sustainability

JEL Classifications: E3, L94, P18

1. INTRODUCTION

The design and implementation of a sustainable electricity pricing policy is a major challenge faced by most countries across the world. A sustainable electricity pricing is one that is not only cost effective, just and affordable to the end-users but also easy to implement and allows for income collected from tariffs to meet revenue requirements. However, due to the economic crisis of the last decade, electricity tariff deficit has become an issue of concern to many countries (Linden et al., 2014) leading to various reform programmes aimed at addressing the deficit. One of such reform programmes, particularly in the developing countries, is the implementation of new electricity pricing methodology.

Pricing of electricity, in most developing economies, is based on consideration of a combination of factors including social policy, job consideration and political motives (World Energy Council, 2001). In most cases, this mix of factors leads to many inefficiencies in the system such as technical inefficiencies and

practices below industry benchmarks. Not only that, there are also inefficiencies in the delivery of reliable and adequate electricity as a result of governmental bureaucracy which takes many forms including poor design of subsidies and price falsifications, among others.

Notwithstanding the inefficiencies above, a nation can effectively achieve a sustainable electricity pricing objective if its electricity service is acceptable, accessible and available (World Energy Council, 2001). A pricing system is acceptable when it is known and affordable to the end-users. Public enlightenment on electricity pricing is fundamental in educating the consumers on the various components of the tariff and how they are being charged. In this way, the consumers will come to know whether they can actually afford to use electricity once they are connected to electricity (Winkler et al., 2011). Accessibility, on the other hand, is a fundamental factor in socio-economic development of a nation not only for being a necessary factor of production but also for being critical to both human welfare and household income generation

(Winkler et al., 2011). Thus, in order to provide a reliable electricity services to all household, there is the need to encourage investment in the energy sector by allowing electricity tariff to reflect all necessary costs. However, while this argument is in place, such a tariff is likely to be unaffordable for vast majority of people in less developed countries. Furthermore, availability denotes the delivery of quality and uninterrupted electricity. Sequel to poor state of electrification in developing countries, as noted by Blimpo and Cosgrove-Davies (2019), short term power outage may be acceptable in as much as the supply conditions are known to the end-users. Uninterrupted electricity supply imposes severe costs to society that cannot be overlooked by any nation. Therefore, in order to ensure the supply of uninterrupted electricity supply, the pricing system should be designed in such a way that suppliers can recover their investments by charging a reasonable price and also providing them with adequate incentives to sustain and expand the delivery of their services.

Developing countries, over the past few decades, have adopted one form of pricing model or the other. For example, India uses Availability Based Tariff (Rai et al., 2013), Ghana employs End -User Tariff (Adom et al., 2019), Saudi Arabia implements Time-of-Use Tariff (Mahmood et al., 2010) and Nigeria adopts Multi-Year Tariff Order (Tallapragada, 2009). Irrespective of the differences in model, the bottom line is to have affordable, reliable and sustainable electricity supply.

The emphasis of this study is on Nigeria for two main reasons. First, Nigeria is one of the West African countries that is pursuing a power reform program that some viewed as too ambitious (Oluleye and Koginam, 2019) following the privatisation of the electricity sector. However, after seven years of private ownership, there is dearth of studies on the effectiveness of the nation's MYTO pricing in improvement electricity supply. Second, stable and reliable electricity supply is a major requirement for the improvement of social and economic activities. Given that about 40.1% of Nigeria's population is living under the poverty line (NBS, 2020), there is the need to investigate whether electricity pricing is acceptable to the users and suitable to the operators to expand their investments towards achieving accessible and available electricity supply.

The sample of this study consists of stakeholders drawn from the electricity industry. These stakeholders were judgementslly grouped into three – regulators, suppliers and academicians – and their responses gathered via a survey questionnaire. Using regression analysis, the study revealed that 96% of the variations in sustainable electricity pricing is accounted for by electricity efficiency goals of acceptability, accessibility and availability. The study also revealed that some of the variables studied – such as end users' education and electricity billing – have negative relationship with sustainable pricing. However, majority of the variables showed positive relationship. Overall, the study revealed that Nigeria's MYTO pricing methodology is acceptable to the users, has led to increase in accessibility and relatively improved electricity availability.

The study contributes to knowledge in so many ways. First, the study contributes to the literature on the relationship

between electricity efficiency and sustainable electricity pricing methodology in developing countries. Majority of studies on electricity pricing relate to developed countries (e.g. Abreu et al., 2010; Hu et al., 2010; Borenstein, 2013; Hyland et al., 2013; Pagani and Aiello, 2015). This study could assist in bridging the gap between what we know about developing and developed countries. Second, the study employed a qualitative research method that sought the perceptions of stakeholders on Nigeria's electricity pricing methodology. This seems appropriate under the current situation as many Nigerians are voicing out their concerns towards the electricity problems the country finds itself. Third, this study contributes to knowledge as it serves as a useful guide towards governments electricity policy decisions. The government will certainly find it useful in consolidating its efforts towards ensuring electricity efficiency in the country.

The remainder of the study is divided into four sections. The section that follows discusses the literature relating to the relationship between electricity efficiency and sustainable electricity pricing. This is followed by the study's methodology in section three. Section four discusses the results of the study and section concludes the study.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Designing a sustainable electricity tariff requires a compromise amongst the various stakeholders whose interests are conflicting (SAARC, 2020). For example, while consumers are asking for lower price and tariff, suppliers are looking for higher profits. The government, on the other hand, desires an electricity tariff that is affordable to the end-users and at the same time allows the suppliers to make a reasonable profit and recover their investments. Still further, the tariff system should lead to an ecologically friendly environment. All of these pose challenge towards designing an electricity pricing system that meets the needs of all the stakeholders.

Literature on electricity pricing has identified various pricing methods that countries adopt. These pricing methods include, among others, marginal cost pricing (Most and Genoese, 2009), average cost pricing (Borenstein and Bushnell, 2015), two-part tariff (Borenstein and Bushnell, 2019), and multi-year tariff (Anosike et al., 2017). Each of these methods has its merits and demerits and the choice of a particular method depends on a nation's characteristics such as availability of reliable information, market responsiveness, and competitive edge, among others (SAARC, 2020). However, irrespective of the method chosen, the fundamental principles of achieving sustainable electricity pricing must not be compromised. These principles, which Munasinghe and Warford (1982) broadly classified into five, are:

- a) Efficient allocation of economic resources among the various sectors of the economy. This suggests that the price of electricity reflects the true economic cost of producing it. In this way, demand and supply can be effectively matched.
- b) Principles of equity and fairness in pricing. This is achieved by allocating cost among different users on the basis of burdens

they impose on the system, ensuring, as much as possible, price stability from year to year and providing minimal services to those who cannot afford full cost.

- c) The electricity price should be reasonable enough to sufficiently raise revenues that meet the financial needs of the electricity industry.
- d) The electricity power tariff must be simple enough to allow the end-users to understand the various components of the billing system and how they are charged.
- e) Consideration of other economic and political requirements including subsidisation of electricity to enhance sectoral growth and geographical development.

2.1. Overview of Nigeria's Electricity Pricing Model

Nigeria has one of the lowest electricity tariffs in the world (Trimble et al., 2016). Given increased costs and inadequacy of tariff in meeting the recovery of investors' capital investment costs and the drop in the collection of tariff, the Nigerian Electricity Regulatory Commission (NERC), in pursuant of the power conferred on it by Section 76 of the Electricity Sector Power Reform (EPSR) Act 2005, established a methodology for the determination of electricity tariff called the Multi-Year Tariff Order (MYTO) which defines the tariff for the generation, transmission and distribution of electricity in the country.

The first MYTO is developed in 2008 for each of the three sectors of the NESI for maximum period of 15 years with a provision for a short-term minor and long-term major reviews (Tallapragada, 2009). However, since 2008, the MYTO 1.0 model was subjected to only two major reviews in 2012 and 2015 and named MYTO 2.0 and MYTO 2015 respectively. Section 7 of the MYTO 2.0 provides for minor bi-annual review for all the three sectors of the NESI using four criteria of foreign exchange rates, gas prices, inflation rate and generation capacity. The MYTO-2015, on the other hand, is a 10-year tariff pathway that ensures that necessary investments are made and recovered between 2016 and 2024.

There are five main objectives for which the MYTO is designed to achieve. These objectives as identified by NERC (2020) listed below.

- a) Cost recovery/financial viability - to enable regulated entities to recover the cost of investments and also to earn a reasonable return on capital.
- b) Certainty and stability of pricing framework - to encourages an efficient level of investment by the regulated entities.
- c) Provision of adequate incentives – to improve performance through cost reduction, improved quality of service and efficient use of network.
- d) Risk allocation – to promote efficient allocation of risks.
- e) Simplicity and cost effectiveness – to make the pricing system easy to understand and implement.

With the above objectives in mind, the NERC identified three different MYTO each for the generation, transmission and distribution sectors of the NESI. In order to achieve fairness and non-excessive regulatory costs, the NERC use the “building block approach” in determining the regulated prices for the three sectors of the NESI. The approach is based on the premise that it brings the

benefits of both price cap and incentive-based regulation (NERC, 2020). In other words, the approach aimed at bringing together all necessary industry costs in a consistent framework to allow a fair market-based return on capital invested, recoup capital over assets useful life and achieve efficient operating and other overhead costs.

2.2. Hypotheses Development

Proper end-user education is fundamental for acceptance of a pricing methodology. While adequate consultations are made by governments prior to the introduction of a new pricing regime, evidences have shown that some governments do not subject the underlying assumptions and financial model of pricing methodology to public scrutiny (Tallapragada, 2009). Information about tariff will influence both the attractiveness and understanding of the tariff which, in turn, influence their acceptance. Electricity tariffs need to be communicated to end-users so that they can understand the billing system and plan their expenses. Research on acceptance of tariff has shown considerable variation across studies (Nicolson et al., 2018). For example, Buscher and Sumpt (2015), discover that trust and confidence in new electricity system reduces complexity of the system and enhances public acceptance. Soland et al. (2018), on the other hand, suggest that electricity acceptance should not be an issue once the pricing system does not interfere with individual's privacy and autonomy. Furthermore, the World Energy Council (2001) finds that pricing methodology can only be acceptance if it leads to the production and use of electricity in a way that the environment is protected and preserved. On the basis of the discussion above, the following hypothesis is formulated.

H₁: There is a positive relationship between electricity acceptability and sustainable electricity pricing methodology.

Making electricity accessible to all household requires huge investment in the electricity sector by allowing electricity tariff to reflect all necessary costs (World Energy Council, 2001). This will encourage suppliers to sustain and even expand their investment. For example, in order to achieve the Sustainable Development Goal (SDG) of providing electricity for all by the year 2030, the IEA (2017) estimates that an annual investment of US\$52 billion is required on infrastructure and power generation. However, it is imperative that the drive for higher accessibility is accompanied by increased consumption through affordable prices and tariffs. Thus, in order to serve the needs of households, electricity must be provided at the right time and at an affordable price and tariff (IEA, 2018). Despite government efforts towards ensuring improved access to electricity at affordable price, evidence has shown that access to electricity is still not encouraging in developing countries. For example, Blimpo and Cosgrove-Davies (2019) reveal that more 600 million people in Africa live without electricity. This calls to question the effectiveness of electricity pricing methodology in promoting accessibility. On the basis of this discussion, the study hypotheses as follows.

H₂: There is a positive relationship between electricity accessibility and sustainable electricity pricing methodology.

The provision of qualitative and uninterrupted electricity supply is closely linked to the pricing methodology employed by a

nation. Thus, a nation's pricing methodology should be designed in such a way that operators are not only allowed to charge a reasonable price but also incentivised to expand their investments. However, because regulated electricity tariffs in most developing countries are often below cost recovery levels, maintenance and expansion of investments necessary for the provision of reliable and uninterrupted electricity is constrained (Blimpo and Cosgrove-Davies, 2019). This has left many households and firms in developing countries without power for several hours in a day. For example, Tanzania and Burundi experienced power outage of an average of 63 and 144 days in a year (Eberhard et al., 2011). Similarly, in Liberia about 50% of households connected to electricity reported that they never have electricity (Blimpo and Postepska, 2017). Furthermore, more than 50% of the households connected to electricity in Ghana, Guinea and Zimbabwe reported they received electricity for less than six months in a year (Blimpo and Cosgrove-Davies, 2019). Based on this discussion, the following hypothesis is developed.

H_3 : There is a positive relationship between electricity availability and sustainable electricity pricing methodology.

3. METHODOLOGY

3.1. Sample and Data

The population of the study is made up of the entire stakeholders of the Nigerian electricity industry. These stakeholders are conveniently grouped into three, namely: regulators, suppliers and academicians. Consistent with Patton (2002) and Taherdoost (2016), this study, having considered the time and resources available, selected a total of 200 respondents judgementally from the population. The choice of judgemental sampling appears suitable because it gives room for the determination of a sample size with a reasonable level of correctness (Thietart, 2001).

A five-point Likert questionnaire was used in collecting the data for the study. The questionnaire was constructed and pilot tested across the stakeholders (Blaxter et al., 2010). Next, the questionnaire was subjected to reliability and validity tests in order to reduce the threats to the reliability of the results of the study (Golafshani,

2003). The questionnaire was then administered using email and personal administration methods. A total of 156 questionnaires were returned completed and accurately filled. This number accounts for 78% of the administered questionnaire indicating that the questionnaire was well constructed (Walonick, 2004).

3.2. Description of Variables

Two sets of variables – dependent and independent - were used in this study. The dependent variable is electricity pricing methodology while the independent variables are electricity efficiency and individual stakeholder specific attributes. Table 1 presents the variables and their descriptions.

3.3. Model Description

This study employs multiple regression analysis to measure the impact of electricity efficiency on sustainability of electricity pricing methodology. Accordingly, the following model is tested.

$$EM = \beta_0 + \beta_1 UE_{it} + \beta_2 AW_{it} + \beta_3 EB_{it} + \beta_4 PP_{it} + \beta_5 FC_{it} + \beta_6 EI_{it} + \beta_7 SE_{it} + \beta_8 CI_{it} + \beta_9 II_{it} + \beta_{10} ES_{it} + \beta_{11} GN_{it} + \beta_{12} SX_{it} + \beta_{13} EX_{it}$$

NB: The description of all the variables are given in Table 1.

4. RESULTS

4.1. Descriptive Statistics

Table 2 presents the study's descriptive statistics. Table 2 reveals that the majority of the respondents are male with 6-15 years of experience in the electricity sector. Similarly, except for user education (UE), electricity billing (EB) and electricity stability (ES), the respondents are of the view that all other variables tested point towards sustainable electricity pricing methodology. However, since the respondents are unsure of users' ability and willingness to pay (AW) as well the impact of pricing on the generation and use of environmentally friendly electricity (PP), it is not possible to draw any conclusion from these results.

4.2. Correlation Coefficient

Table 3 gives the correlation coefficient of the all the variables used in the study. The test result shows electricity pricing having

Table 1: Description of variables

Type	Name	Proxy	Description
Dependent	Sustainable electricity pricing methodology	EM	Sustainable electricity pricing is a function of electricity acceptability, accessibility and availability
Independent (electricity efficiency)	Acceptability	UE	Electricity users' awareness and education
		AW	Ability and willingness of users to pay for electricity
		EB	Users satisfaction of electricity bills issued
		PP	Users satisfaction on the production and usage of environmentally friendly electricity
		FC	Full cost of electricity as reflected in electricity price
	Accessibility	EI	Improvement in access to electricity consequent to the introduction of multi-year tariff order
		SE	Improvement in social and economic activities due to improvement in access to electricity
		CI	Suitability of pricing methodology in allowing capital investment recovery
	Availability	II	Suitability of pricing methodology in attracting increased level of investment
		ES	Stability of electricity due to introduction of multi-year tariff system
Independent (individual specific attributes)	Gender	SX	Male or female respondent
	Experience	EX	Stakeholder's years of experience in the electricity industry in ranges

significant positive relationship with all the variables under the three electricity efficiency objectives of acceptability, accessibility and availability. In the same vein, all the three electricity efficiency objectives have significant positive relationship with one another.

4.3. Regression Results and Discussions

Table 4 presents the regression results of the study. The summary result from the Table reveals that 96.3% of the variations in sustainable electricity pricing is accounted for by all the independent variables put together. Of this percentage, 96% is accounted for by electricity efficiency. The regression model is significant at 0.000 level.

Looking at each of the variables individually, the regression results show a number of negative relationships. Firstly, the test results

show a negative relationship between consumers' ability and willingness to pay and sustainable electricity pricing. This negative relationship might not be unconnected with the poverty level in Nigeria. As at 2019, 40.1% of Nigeria's population, representing 82.9 million Nigerians, are living below the nation's poverty line of N137,430 (\$381.75) in a year (NBS, 2020). Similarly, as Nigeria's pricing system allows for tariff review to reflect full cost of electricity production, consumers ability to pay tend to be eroded each time price is reviewed given their income level. For example, in recent months, attempts by the Nigerian government through the Nigerian NERC to increase electricity tariffs were halted due to public outcry (Olaniyi, 2020) which arguably suggests government's confirmation of users' inability to pay.

Similarly, in relation to electricity billing, the results negate the expectation of the study. Billing is one of important variables that influence user's acceptance of electricity pricing. A user is entitled to know the accuracy of his/her bills. However, in the case of Nigeria, electricity billing has been inaccurate for quite some time. Recently, the NERC admitted that despite the guideline on training of meter installers, the existence of faulty metering installations has led to billing errors and safety hazards with serious negative effects on human life and property (Akpan, 2020). Similarly, the result is consistent with the controversy surrounding the use of estimated billing system by the distribution companies (Discos) in Nigeria. As noted by Okafor (2020), the Discos use the practice of estimated billing to short-charge customers by paying more for less electricity.

Additionally, the reflection of full cost of generating electricity in pricing also negates the expectation of the study. This might

Table 2: Descriptive statistics

Variables	Observations	Mean	Median	Standard deviation
EM	156	3.1346	4.0000	1.16445
UE	156	1.9038	2.0000	0.92826
AW	156	3.1346	3.0000	0.94416
EB	156	2.1282	2.0000	1.00783
PP	156	3.0000	3.0000	0.87988
FC	156	3.4487	4.0000	1.10304
EI	156	3.3013	4.0000	1.14959
SE	156	3.4808	3.0000	0.91208
CI	156	3.1410	4.0000	1.13847
II	156	3.4744	4.0000	1.10977
ES	156	2.3974	2.0000	1.15104
SX	156	1.3269	1.0000	0.47060
EX	156	2.0577	2.0000	0.72058

NB: The description of all the variables are given in Table 1

Table 3: Pearson correlation coefficient

	EM	UE	AW	EB	PP	FC	EI	SE	CI	II	ES	OC	EX
EM	1												
UE	0.758** 0.000	1											
AW	0.740** 0.000	0.825** 0.000	1										
EB	0.689** 0.000	0.910** 0.000	0.829** 0.000	1									
PP	0.812** 0.000	0.711** 0.000	0.901** 0.000	0.764** 0.000	1								
FC	0.917** 0.000	0.773** 0.000	0.846** 0.000	0.731** 0.000	0.897** 0.000	1							
EI	0.948** 0.000	0.704** 0.000	0.753** 0.000	0.701** 0.000	0.836** 0.000	0.946** 0.000	1						
SE	0.716** 0.000	0.855** 0.000	0.868** 0.000	0.880** 0.000	0.844** 0.000	0.746** 0.000	0.673** 0.000	1					
CI	0.969** 0.000	0.788** 0.000	0.750** 0.000	0.698** 0.000	0.812** 0.000	0.915** 0.000	0.924** 0.000	0.754** 0.000	1				
II	0.909** 0.000	0.746** 0.000	0.838** 0.000	0.730** 0.000	0.892** 0.000	0.984** 0.000	0.944** 0.000	0.729** 0.000	0.891** 0.000	1			
ES	0.701** 0.000	0.906** 0.000	0.900** 0.000	0.923** 0.000	0.841** 0.000	0.768** 0.000	0.689** 0.000	0.917** 0.000	0.720** 0.000	0.756** 0.000	1		
SX	0.567** 0.000	0.737** 0.000	0.713** 0.000	0.727** 0.000	0.701** 0.000	0.536** 0.000	0.497** 0.000	0.849** 0.000	0.600** 0.000	0.516** 0.000	0.854** 0.000	1	
EX	0.798** 0.000	0.790** 0.000	0.851** 0.000	0.843** 0.000	0.916** 0.000	0.820** 0.000	0.812** 0.000	0.841** 0.000	0.792** 0.000	0.821** 0.000	0.882** 0.000	0.800** 0.000	1

**Correlation significant at the 0.01 level

Table 4: Regression result

Variable	Expectation	Beta (β)	Significance
UE	+	0.278	0.001
AW	+	-0.068	0.205
EB	+	-0.155	0.038
PP	+	0.183	0.058
FC	+	-0.476	0.001
EI	+	0.493	0.000
SE	+	-0.016	0.801
CI	+	0.534	0.000
II	+	0.329	0.001
ES	+	-0.081	0.349
SX		0.036	0.505
EX		-0.048	0.483

$R^2=0.963$, Adjusted $R^2=0.960$, $F=312.427$, $Sig.=0.000$

not be correct for at least two reasons. First, the government has subsidised the price of electricity in Nigeria. For example, between 2015 and 2018, the Federal government has paid about N1.12 trillion to cushion the effect of the reflection of full generation cost on electricity price (PwC, 2019). Second, evidence has also shown that the reflection of full cost of electricity generation in pricing has led to increase in the accessibility of electricity in Nigeria over the past few decades. Records available to IEA (2019) indicates access to electricity in Nigeria has increased steadily over the past two decades from 40% in 2000 to 54% in 2010 and then settled at 60% in 2018.

Furthermore, the results show that social and economic activities consequent to the introduction of MYTO system has a negative relationship with sustainable electricity pricing. While there has been improvement in access to electricity over the years as noted above, this negative relationship might be due to the insistent electricity outage Nigerians are experiencing. Electricity supply in Nigeria is so unreliable that Nigerians are experiencing power outage for several days in a month (Oluwole et al., 2012). In recent years, electricity interruption in Nigeria is so disturbing that the economic activities and private investments needed to lift over 100 million Nigerians out of poverty has been stifled (World Bank, 2020). Thus, while access to electricity is a necessary condition for boosting social and economic activities, it cannot be a sufficient condition if there is no power stability.

On the other hand, all other variables have shown a positive relationship with sustainable electricity pricing. For example, in terms of users' education, the relationship is significantly positive. This result is consistent with McRae and Meeks (2016) who discover that the best understanding of electricity tariff does not only enhances consumers acceptance of pricing but also helps consumers plan their consumption pattern. Similarly, Stojanovski et al. (2020) confirms that providing end-users with information is a first step for making them more price responsive. Thus, any attempt to improve electricity efficiency, for instance through pricing that reflects full cost of electricity delivery, will arguably depend on users understanding of how this action impacts on their affordability.

Moreover, on environmental friendliness and pricing sustainability, the test results show a positive relationship as expected. This result is consistent with the World Energy Council (2001) assertion

that electricity pricing methodology is more acceptable to users if it is produced and used in an environmentally friendly way. Environmentally friendly electricity, also referred to as "green electricity," is electricity that is produced mainly from renewable energy sources such as solar, wind and hydro. Such electricity has a much lower environmental impact than one produced using fossil fuels. Thus, the finding of this study has confirmed the desire of Nigerians to shift from the traditional fossil fuel-based electricity, which accounts for about 86% of the nation's electricity source (Oyewo et al., 2018), to renewable energy-based electricity.

Furthermore, the results reveal a positive relationship between improvement in access to electricity and the introduction of Nigeria's MYTO system. In 2008, when MYTO was introduced, only 50.3% of Nigerians had access to electricity (World Bank, 2020b). However, ten years after, in 2018 about 60% of Nigerians have access to electricity (IEA, 2019). This increase in accessibility is an indication that investors are sustaining investments in Nigeria's electricity sector.

Additionally, consistent with the expectations of the study, two availability variables of investment recovery and investment inflow have both positive relationship with sustainable electricity pricing methodology. These results are consistent with Bricene-Garmendia and Shkaratan (2011) claim that electricity pricing is a guide for investment decisions with emphasis on the recovery of costs. With suppliers recovering their investments through charging reasonable price, as allowed by the MYTO pricing regime, the Nigerian electricity sector has seen improvements in electricity supply over the past few years. The recent announcement by the Transmission Company of Nigeria (TCN) that it has achieved an all-time transmission peak of 5,420 MW in 2020 (Okafor, 2020) is an indication that the MYTO is a sustainable pricing regime.

Finally, the findings also suggest that the respondents' personal attribute of work experience is negatively related to sustainable electricity pricing. While majority of the respondents have between 6 to 15 years of experience in the electricity industry, their negative perception might not be unconnected with the developments in the electricity sector over the years. For example, there is the government's proposal to remove subsidy in the electricity sector (Mammam, 2020). The implication is that any removal of subsidy could lead to increase in price of electricity (OECD, 2013) and thus renders the MYTO pricing unaffordable. Similarly, the negative result is confirmed by the lack of willingness on the part of the DISCOs to take delivery of electricity from the TCN (Bello, 2019) in what the DISCOs claimed that the TCN was transmitting electricity to where the DISCOs have low distribution needs and leaving out where distribution needs are high (Sunday, 2017). This lack of understanding between the DISCOs and the TCN has been causing serious disruption to electricity supply in Nigeria.

5. CONCLUSION

This research work examines the association between electricity efficiency and sustainable electricity pricing. Precisely, the impact of three goals of electricity efficiency - namely acceptability, accessibility and availability - on electricity pricing sustainability

was studied. While some of the variables studied revealed negative relationship with sustainable pricing, the summary result indicates that electricity efficiency goals explained 96% of the variable in sustainable electricity pricing suggesting that the Nigerian electricity stakeholders are of the view that Nigeria's MYTO pricing regime is sustainable.

From the discussions above, this study makes a number of conclusions. First and foremost, the attainment of electricity efficiency is a fundamental requirement for a sustainable electricity pricing methodology. An electricity pricing method should not only be acceptable to the end-users but must also encourage electricity suppliers to sustain and expand their investment to achieve improvement in accessibility and availability of electricity.

Secondly, it is also the conclusion of this study that there is inadequacy of policy reform. More policy reform needs to be done in order to address the issues of misunderstanding between the three operators in the industry, namely GENCOs, TCN and DISCOs, and in particular between the TCN and DISCOs. Evidence from the discussions above disclosed unpleasant relationship between the operators as one of the constraints for reliable electricity supply. This can be addressed through continuous reform of the dispute resolution mechanism.

Thirdly, the study concludes that enough is not done to carry the end-users on board. There is the need for adequate enlightenment of users each time there a review of the pricing methodology is carried out. This will keep the users abreast on various issues such as changes in tariff, customers classifications and health and safety issues, among others. All of these will go a long way in influencing users' decisions to accept a given pricing system.

Finally, despite the above conclusions, the study recommends that further research be conducted on the effect of government subsidy on electricity pricing. Many have questioned governments continues subsidy of electricity despite the privatisation of the industry. As the debate continues and given the fact government is considering its position on subsidy, any study on the impact of subsidy on price sustainability will go a long way in shaping policy review.

REFERENCES

- Abreu, J., Pereiray, F., Vasconcelos, J., Ferrao, P. (2010), An Approach to Discover the Potential for Demand Response in the Domestic Sector. Waltham, MA: IEEE Conference on Innovative Technologies for an Efficient and Reliable Electricity Supply. p240-245.
- Adom, P.K., Agradi, M.P., Bekoe, W. (2019), Electricity supply in Ghana: The implications of climate-induced distortions in the water-energy equilibrium and system losses. *Renewable Energy*, 134, 1114-1128.
- Akan, U. (2020), Why we have Inaccurate Electricity Billing NERC. *Vanguard Newspaper*. Available from: <https://www.vanguardngr.com/2020/08/why-we-have-inaccurate-electricity-billing-nerc>. [Last accessed on 2020 Jul 06].
- Anosike, N.B., Dara, J.E., Ngwaka, U.C., Enemuoh, F.O. (2017), Analysis of Nigerian electricity generation multi year tariff order pricing model. *Energy and Power Engineering*, 9, 541-554.
- Bello, O. (2019), Blame Game Continues between TCN and Discos Over Load Rejection. *Business Day Newspaper*. Available from: <https://www.businessday.ng/energy/power/article/blame-game-continues-between-ten-and-discos-over-load-rejection>. [Last accessed on 2020 Sep 20].
- Blaxter, L., Hughes, C., Tight, M. (2010), *How to Research*. Maidenhead: McGraw-Hill/Open University Press.
- Blimpo, M.P., Cosgrove-Davies, M. (2019), *Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors*. Washington, DC: World Bank. Available from: <https://www.elibrary.worldbank.org/doi/book/10.1596/978-1-4648-1361-0> [Last accessed on 2020 Jul 02].
- Blimpo, M.P., Postepska, A. (2017), Why is household electricity uptake low in Sub-Saharan Africa? *World Development*, 133, 1-41.
- Borenstein, S. (2013), Effective and equitable adoption of opt-in residential dynamic electricity pricing. *Review of Industrial Organization*, 42(2), 127-160.
- Borenstein, S., Bushnell, J. (2015), The US electricity industry after 20 years of restructuring. *Annual Review of Economics*, 7(10), 437-463.
- Borenstein, S., Bushnell, J. (2019), Do Two Electricity Pricing Wrongs Make a Right? Cost Recovery, Externalities, and Efficiency. *Energy Institute at HAAS, Working paper 293R*. Available from: <https://www.haas.berkeley.edu/wp-content/uploads/WP294.pdf>. [Last accessed on 2020 Apr 12].
- Briceño-Garmendia, C., Shkaratan, M. (2011), Power Tariffs Caught between Cost Recovery and Affordability. *Policy Research Working Paper No. 5904*. Washington, DC: World Bank. Available from: <https://www.elibrary.worldbank.org/doi/abs/10.1596/1813-9450-5904> [Last accessed on 2020 May 04].
- Büscher, C., Sumpf, P. (2015), "Trust" and "confidence" as socio-technical problems in the transformation of energy systems. *Energy, Sustainability and Society*, 5(34), 1-13.
- Eberhard, A., Rosnes, O., Shkaratan, M., Vennemo, H. (2011), *Africa's Power Infrastructure: Investment, Integration, Efficiency*. Washington, DC: World Bank. Available from: <https://www.openknowledge.worldbank.org/handle/10986/2290>. [Last accessed on 2020 Jan 07].
- Golafshani, N. (2003), Understanding reliability and validity in qualitative research. *The Qualitative Report*, 8(4), 597-607.
- Hu, W., Chen, Z., Bak-Jensen, B. (2010), Impact of Optimal Load Response to Real-time Electricity Price on Power System Constraints in Denmark. Cardiff, Wales: A Paper Presented in 45th International Universities Power Engineering Conference. (UPEC). p1-6.
- Hyland, M., Leahy, E., Tol, R.S. (2013), The potential for segmentation of the retail market for electricity in Ireland. *Energy Policy*, 61, 349-359.
- IEA. (2017), *Energy Access Outlook: World Outlook Special Report*, OECD/IEA. Available from: <https://www.iea.org/reports/energy-access-outlook-2017>. [Last accessed on 2020 Mar 20].
- IEA. (2018), *Accelerating SDG 7 Achievement: Policy Briefs 01: Achieving Universal Access to Electricity*. Available from: <https://www.sustainabledevelopment.un.org/content/documents/17462PB1.pdf>. [Last accessed on 2020 Jul 12].
- IEA. (2019), *World Energy Outlook: Electricity Access in Africa*. Available from: <https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity>. [Last accessed on 2020 Aug 01].
- Linden, A.J., Kalantzis, F., Maincent, E., Pienkowski, J (2014), Electricity Tariff Deficit: Temporary or Permanent Problem in the EU? *European Economy, Economic Papers No. 534*, European Commission. Available from: https://www.ec.europa.eu/economy_finance/publications/economic_paper/2014/ecp534_en.htm. [Last accessed on 2020 Feb 26].
- Mahmood, S., Alyousef, Y., Alusaimi, Y., Yassind, I., Alelvane, A. (2010), Time-of-use tariff program in Saudi Arabia: Design, implementation, and evaluation. *Journal of King Saud University Engineering*

- Sciences, 22(2), 165-172.
- Mammam, S. (2020), New Electricity Tariffs and Removal of Subsidies. Daily Trust Newspaper. Available from: <https://www.dailytrust.com/new-electricity-tariffs-and-removal-of-subsidies>. [Last accessed on 2020 Aug 15].
- McRae, S., Meeks, R. (2016), Price Perception and Electricity Demand with Nonlinear Tariffs. Available from: <http://www.robymeeeks.com/wp-content/uploads/2019/10/price-perception-and-electricity-demand.pdf>. [Last accessed on 2020 Aug 04].
- Most, D., Genoese, M. (2009), Market power in the German wholesale electricity market. *Journal of Energy Market*, 2(2), 47-74.
- Munasinghe, M., Warford, J.J. (1982), *Electricity Pricing: Theory and Case Studies*. Baltimore, London: The Johns Hopkins University Press, US.
- NBS. (2020), Nigeria Living Standards Survey 2018-2019. Available from: <https://www.nigerianstat.gov.ng/nada/index.php/catalog/64>. [Last accessed on 2020 Jun 06].
- NERC. (2020), Electricity Tariff in Nigerian Electricity Supply Industry. Available from: <https://www.nerc.gov.ng/index.php/home/myto>. [Last accessed on 2020 Jun 20].
- Nicolson, M.L., Fell, M.J., Huebner, G.M. (2018), Consumer demand for time of use electricity tariffs: A systematized review of the empirical evidence. *Renewable and Sustainable Energy Reviews*, 97, 276-289.
- OECD. (2013), *Analysing Energy Subsidies in the Countries of Eastern Europe, Caucasus and Central Asia*. Available from: https://www.oecd.org/env/outreach/energy_subsidies.pdf. [Last accessed on 2020 Apr 13].
- Okafor, P. (2020), Electricity: Nigeria Records Highest Grid Transmission, Vanguard Newspaper. Available from: <https://www.vanguardngr.com/2020/08/electricity-nigeria-records-highest-grid-transmission>. [Last accessed on 2020 Aug 24].
- Olaniyi, M. (2020), FG, NASS Agree to Postpone Hike of Electricity Tariff. Daily Trust Newspaper. Available from: <https://www.dailytrust.com/fg-nass-agree-to-postpone-hike-of-electricity-tariff>. [Last accessed on 2020 Jan 01].
- Oluleye, F.A., Koginam, A.O. (2019), Nigeria's energy sector privatization: Reforms, challenges and prospects. *South Asian Research Journal of Humanities and Social Sciences*, 1(2), 189-197.
- Oluwale, A., Samuel, O., Festus, O., Olatunji, O. (2012), Electrical power outage in Nigeria: History, causes and possible solutions. *Journal of Energy Technologies and Policy*, 2(6), 18-24.
- Oyewo, A.A., Aghahosseini, A., Bogdanov, D., Breyer, D. (2018), Pathways to a fully sustainable electricity supply for Nigeria in the mid-term future. *Energy Conversion and Management*, 178, 44-64.
- Pagani, G., Aiello, M. (2015), Generating realistic dynamic prices and services for the smart grid. *IEEE Systems Journal*, 9(1), 191-198.
- Patton, M.Q. (2002), *Qualitative Research and Evaluation Methods*. London: SAGE Publication.
- PWC. (2019), Solving the Liquidity Crunch in the Nigerian Power Sector. Available from: <https://www.pwc.com/ng/en/assets/pdf/solving-liquidity-crunch-nigerian-power.pdf>. [Last accessed on 2020 Jun 11].
- Rai, J.N., Gupta, R.K., Kapoor, R., Garai, R. (2013), Tariff setting in power sector: An overview. *Journal of Electrical and Electronics Engineering*, 6(1), 97-108.
- SAARC. (2020), Pricing Mechanisms for Electricity in SAARC Member States. Available from: <https://www.saarcenergy.org/wp-content/uploads/2017/12/study-report-on-pricing-mechanisms-of-electricity.pdf>. [Last accessed on 2020 Jul 10].
- Soland, M., Loosli, S., Koch, J., Christ, O. (2018), Acceptance among residential electricity consumers regarding scenarios of a transformed energy system in Switzerland a focus group study. *Energy Efficiency*, 11, 1673-1688.
- Stojanovski, O., Leslie, G.W., Wolak, F.A., Wong, J.E.H., Thurber, M.C. (2020), Increasing the energy cognizance of electricity consumers in Mexico: Results from a field experiment. *Journal of Environmental Economics and Management*, 102, 102323.
- Sunday, S.E. (2017), DisCos Reject 10,200 megawatts in 1-month. Daily Trust Newspaper. Available from: <https://www.dailytrust.com/discos-reject-10200-megawatts-in-1-month-4>. [Last accessed on 2020 Apr 10].
- Taherdoost, H. (2016), Sampling methods in research methodology: How to choose a sampling technique for research. *International Journal of Academic Research in Management*, 5(2), 18-27.
- Tallapragada, P.V.S. (2009), Nigeria's Electricity Sector: Electricity and Gas Pricing Barriers. *International Association of Energy Economics*. Available from: <https://www.africacheck.org/wp-content/uploads/2014/07/nigeria%e2%80%99s-electricity-sector-electricity-and-gas-pricing.pdf>. [Last accessed on 2020 Jul 13].
- Thietart, R.A. (2001), *Doing Management Research: A Comprehensive Guide*. Thousand Oaks: Sage Publication.
- Trimble, C., Kojima, M., Arroyo, I.P., Mohammadzadeh, F. (2016), Financial Viability of Electricity Sectors in Sub-Saharan Africa: Quasi-Fiscal Deficits and Hidden Costs, Policy Research Working Paper, No. 7788. Washington, DC: World Bank. Available from: <http://www.documents1.worldbank.org/curated/en/182071470748085038/pdf/WPS7788.pdf>. [Last accessed on 2020 Mar 12].
- Walonick, D.S. (2004), *Survival Statistics*. Bloomington, MN: StatPac.
- Winkler, H., Simoes, A.F., La-Rovere, E.L., Alam, M., Rahman, A., Mwakasonda, S. (2011), Access and affordability of electricity in developing countries. *World Development*, 39(6), 1037-1050.
- World Bank. (2020), Access to Electricity (% of Population) Nigeria. Washington, DC: World Bank. Available from: <https://www.data.worldbank.org/indicator/EG.ELC.ACCS.ZS?end=2018&location=s=NG&start=1990&view=chart>. [Last accessed on 2020 Aug 02].
- World Bank. (2020b), Nigeria to Keep the Lights on and Power its Economy. Washington, DC: World Bank. Available from: <https://www.worldbank.org/en/news/press-release/2020/06/23/nigeria-to-keep-the-lights-on-and-power-its-economy>. [Last accessed on 2020 Aug 04].
- World Energy Council. (2001), *Pricing Energy in Developing Countries*. Available from: http://www.regulationbodyofknowledge.org/wpcontent/uploads/2013/03/WorldEnergyCouncil_Pricing_Energy_in.pdf. [Last accessed on 2020 Feb 15].