Investigating the Problems of Prepaid Metering Systems in Nigeria.

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ABSTRACT

The aim of this study is to investigate the problems and challenges faced by the prepaid metering system and efforts geared towards in resolving the identified issues using a human-survey approach termed questionnaires to the EKEDC (Eko Electricity Distribution Company) officials and customers. Some of the identified challenges are absence of vending infrastructure, non-tripping of the contractor, the cost of acquiring the meter, and delays in receiving and installation of prepaid meters.

The analysis of this study was based on the feedback mechanism and results received from the members of the public via questionnaire. The obtained results enabled this study to get to the far-reaching recommendations which are considered to be ideal for the successful implementation of the Prepaid Metering System. These include high quality meters, provision of electricity at all times, computerization of the Prepaid Metering System, introduction of prepayment metering country-wide and periodic training of electricity staff members and officials.

(Keywords: EKEDC, electricity metering, kWh, distribution, IPP, electricity generation)

INTRODUCTION

Metering was introduced in Nigeria in 2005, so as to reduce and eradicate the issue of customers complaining of over-billing, and other related issues. Customers have by-in-large been happy since the introduction of the prepayment metering system; however, there have been problems that have arisen from this innovation.

This study was conducted in the Badagry area of Lagos State. In order to achieve the objectives of the study, both structured and open-ended questionnaires were administered to various staffs in EKEDC and to 200 customers in the Badagry area. Interviews with key personnel such as the Customer Services Manager, Metering Engineer, two (2) Customer Services Officers, and 180 simple randomly selected customers were conducted. Secondary data was collected through desk research.

The electricity meter or energy meter is described as a device that is designed to quantify or measure the volume of electricity consumed at a given point in time by an electrically powered device, residence, commercial premises or an industrial complex. Typically, electricity meters are calibrated in billing units of kilowatt hour [kWh]. The electricity meters are read periodically to establish billing cycles and energy used during the cycle.

The procurement of meters for all the aspects of the electricity business in Nigeria was centrally coordinated at the Head Office of EKEDC where requests were received and treated from a central pool. Metering instruments including Grid Meters for Generation/Transmission, Transmission/Distribution, and Distribution interconnecting points were procured and deployed to all the stations centrally. The distribution companies were saddled with the responsibility of allocating and installing the meters at the premises of customers. A Grid Metering group was responsible for installation and maintenance of Grid meters.

There are three Meter Test Stations located in Lagos, Kaduna, and Port Harcourt. These stations are primarily responsible for calibration

and repair of all the types of meters in the network. They also certify the integrity of the meters before deployment and installation. It should however be noted that with the implementation of Power Sector Reform Act 2005 and the unbundling of PHCN, the processes involved in procurement and deployment of metering systems are also being restructured. Some form of autonomy has been achieved as the Distribution Companies can now procure and install meters independently.

The common types of meters in operation in most jurisdictions include but are not limited to the following:

- Electromechanical Watt-Hour Meters
- Electronic meters
- Electronic meters
- Prepayment Meters

The process of prepayment metering involves the following activities:

- The customer buys electricity energy from a vending station.
- A voucher with twenty (20) digit codes to be keyed into the meter is given to the customer upon payment.
- The customer keys in this code into the meter.
- After keying in the 20-digits code, the meter updates the credit in the meter and becomes ready for use.

LITERATURE REVIEW

Metering is the process and method of utilizing devices to measure the amount and direction of electrical energy flow; particularly for end-use. It can also be defined as the installation of equipment that makes it possible for a utility to determine the amount of electric power a particular customer has consumed. Electricity is provided to customers by wires, often called service drops, emerging from distribution transformers. These wires go into electric meters that measure the quantity of electricity used (measured in kilowatt-hours).

Brief Background of Metering of Electricity in Nigeria

The history of electricity metering in Nigeria is directly linked with the history of electricity development in Nigeria. The production and delivery of electricity to consumers on a commercial basis began in the country in 1896. Electricity generation and distribution were largely decentralized until 1951 when the Electricity Corporation of Nigeria (ECN) was established as a central body responsible for electricity supply. The first 132KV line linking Lagos to Ibadan Power station was constructed in 1962.

In 1962, the Niger Dams Authority (NDA) was established with a mandate to develop hydro power stations. The ECN and NDA were later merged in 1972 to form the National Electric Power Authority (NEPA) by virtue of the NEPA Act1. The National Electric Power Authority operated a vertical integrated structure in carrying out its primary functions of generation, transmission, distribution and marketing of electricity in Nigeria. This state of affairs persisted until 2006 when NEPA was unbundled into 18 successor companies in line with the power sector reform program of the Federal Government of Nigeria.

An Overview of Electricity Production and Distribution in Nigeria

The Nigerian economy is an energy-driven one since the pre-colonial era unlike many other developing economies along the West African Coast. This is because electricity has remained the driving force behind all the developmental activities which revolves around industrial, commercial and household purposes. Electricity generation in Nigeria began in 1896, fifteen years after its introduction in England.

The Nigeria Electricity Supply Company (NESCO) commenced operations as an electric utility company in Nigeria in 1929 with the construction of hydroelectric power station at Kura near Jos. The Electricity Corporation of Nigeria (ECN) was established in 1951, while the first 132KV line was constructed in 1962, linking Ijora Power Station to Ibadan Power Station. But shortly after independent, in 1962 the scope of electricity production had expanded to include Kanji electricity dam. By 1988, the National Electric Power Authority (NEPA) was partially commercialized, supported by an upward review in tariffs. As part of the restructuring effort of the power sector, the Electric Power Sector Reform Act 2005 was enacted. Consequently, the

defunct NEPA was renamed as the Power Holding Company of Nigeria (PHCN). The law paved the way for the unbundling of NEPA into the 18 companies – six power generation companies, one transmission company, and eleven distribution companies.

Table 1: Independent Power Productions, Location and Installed Capacity.

Name	License type	Site location	Capacity
Aba Power Ltd	Distribution	Aba, Abia State	
AES Nigeria Barge Ltd	Generation on-grid	Apapa,Lagos	270MW
AgbaraShoreline Power Ltd	Generation on-grid	Agbara, Ogun	100MW
AkutePower Ltd	Generation off-grid	Lagos Water Corporation	13MW
AlaojiGeneration Co. Ltd (NIPP)	Generation on-grid	Alaoji, Abia State	1074MW
Anita Energy Limited	Generation on-grid	Agbara, Lagos State	90MW
AzuraEnergy Limited	Generation on-grid	Ihovbor Benin, Edo State	450MW
Bresson Nigeria Ltd	Generation on-grid	Magboro, Ogun State	60MW
CETPower Projects Ltd	Generation off-grid	WAPCOEwekoro, Ogun State	6MW
CETPower Projects Ltd	Generation off-grid	Tinapa, Cross River State	20MW
CETPower Projects Ltd	Generation off-grid	Nigerian Breweries Ltd., Iganmu, Lagos	5MW
CET Power Projects(Sagamu)	Generation off-grid	WAPCOSagamu, Ogun State	7MW
Contour Global Solutions (Nig) Ltd	Generation off-grid	NBCBottling Plant, Ikeja	10MW
Contour Global Solutions (Nig) Ltd	Generation off-grid	NBCBottling Plant, Apapa	4MW
Coronation Power And Gas Limited	Generation off-grid	Sango Otta	20MW
Delta Electric Power Limited	Generation on-grid	Oghareki, Etiope West LGA	116MW
DILPower Limited	Generation on-grid	Obajana, Kogi State	135MW
Eleme Petrochemical Company Limited	Generation on-grid	Eleme Complex, P.H Rivers	135MW
Energy Company Of Nigeria (NEGRIS)	Generation on-grid	Ikorodu, Lagos State	140MW

Source: www.nercng.org

Nigeria has approximately 6,861 megawatts (MW) of installed electric generating capacity but at present electricity generation ranges from between 2,500 megawatts to about 3,000 even with the inclusion of three gas-powered independent power projects in the Niger Delta region. Thus, making power outages to be frequent as the power sector operates well below its estimated capacity. At policy making level, successive governments in Nigerian have made tireless effort to encourage foreign private investment in the power sector by commissioning Independent Power Production (IPP) to generate electricity and sell it to PHCN. Table 1 is a mirror of the dividends of such efforts.

From Table 1, the IPPs can be classified into two, the on-grid and the off-grid generation. In all there are ten (10) on-grid generations, contributing 2,570 MW and there are seven off-grids generation contributing 85 MW, making a total of 2,655 MW. The involvement of the IPP will not only increase the availability of electricity, it still stimulates efficiency in the electricity industry. However, the existing evidence does not support this expectation and this is because as at January 2013 the industry has just realized only about 4, 500mw of the target date.

The Concept of Metering: Metering according to Simpson (1996:14) is ''the process and methods of utilizing devices to measure the amount and direction of electrical energy flow; particularly for end-use''. He also defined metering as ''installation of equipment that makes it possible for an utility to determine the amount of electric power a particular customer has consumed''. Electricity is provided to customers by wires, often called service drops, emerging from distribution transformers. These wires go into electric meters that measure the quantity of electricity used (measured in kilowatt-hours).

Prepayment Metering System: Prepayment metering is a well established technology being introduced by more and more utility companies. According to kettless (2004), ''A Prepaymet Metering System is a system where a customer pays for energy before using it''. A prepayment metering system according to kettless (2004:105), basically comprises a system master station (which is a computer that administers the whole system), a vending machine (where customers buy their electricity) and prepayment energy meters (or dispensers, which dispenses the electricity to the customer). This meter has an interface to the customer for managing the transfer of credit and to display the meter and credit status.

Disadvantages of the Prepayment Metering System

Absence of Vending Infrastructure: The Distribution Utilities cited an absence or inadequate vending infrastructure as one of the major obstacles militating against the deployment of prepaid meters in their distribution companies. According to them, their metering plan was in stages and since some areas lacked the vending infrastructure, meters could not be deployed. Vending infrastructure, it was observed, simply comprises software built into a PPM Master Station which automatically allows for vending often on vouchers or on electronic media. Vending in itself was the capability of a point of sale device to generate the prepaid token and conclude the associated prepayment transaction. It is therefore strange to procure prepaid meters independent of a vending infrastructure.

Lack of Presence of Local Manufacturers: The absence of competent local meter manufacturers was considered a critical element that accounted for the delay in meter procurement. As of 2010, Unistar was the only company assembling PPMs in Nigeria. However, the Company enjoys limited patronage from the DISCOs for the singular reason given by the DISCOs that Unistar meters are not Standard Transfer Specification (STS) compliant.

Corruption: Typical of the entire geo-political zone, the allegations of corruption and extortion were raised against some unscrupulous DISCO staff. A unique example was the case of Tudun-Wada community in Lugbe, Abuja, [5] where customers complained of being extorted by a certain contractor (Adume Nig. Ltd) who was neither a licensee of NERC nor a contractor to DISCO. All the consumers feeding from Adume Nig. Ltd. point load 300KVA 33/0.415 transformer pay their bills to the contractor and the consumers are happy with the service. It is unknown how many Adume Nig. Ltd. Type situations we have nationwide and the number of customers under them. Chairman of the Tudun-Wada Residents Welfare Association, Mr. Clement Oba Ehigiator, alleged that the community had been in darkness for the past four years without power, but when the residents, through self-help, bought two transformers, officials of the PHCN refused to have them installed. Instead, the staff connived with the contractor to install another transformer and then compelled residents to pay N5, 000 each to be connected.

The Cost of Acquiring the Meter: A prepayment meter costs as much as three times the cost of a conventional credit (post-paid) meter. When the prepaid metering system was introduced, the price of a single-phase prepaid meter was about ₦25,000 also a three-phase prepaid meter was about ₦50,000. During the course of my research visitation to EKEDC Agbara Business Unit, it was revealed by the EKEDC staff that the prices of the prepaid meters have now increased to ₦39,375 for the single-phase prepaid meter and ₦68,901 for the three-phase prepaid meter.

Non-Tripping of the Contractor: Tripping is an important aspect of a prepayment meter. The quality of the meter affects both EKEDC and the customer. Thus, if the basic aspects like tripping are lacking, the collections may suffer and lead to poor customer service.

Lack of Expertise: The major problems arising from the introduction of the system includes non-availability of the expertise to repair the faulty meters.

Buying of units on Sundays and Holidays: Most respondents complained that they have no access to electricity if their units finish on Sundays or on a Holiday and EKEDC management dos not seems to be concerned with the problem. Most respondents also indicated that they are forced to find alternative sources of power despite the introduction of the system being meant to improve customer service and ensure customer satisfaction at all times.

Some other disadvantages of the Prepayment Metering System are listed below:

- ✓ Bypass frequently by consumers.
- ✓ Delay in receiving and installation of prepaid meters.
- ✓ Single-phase overloading.
- ✓ Experiencing difficulty while trying to change tariff.
- ✓ Network to recharge is sometimes difficult.

METHODOLOGY

The study was conducted in the Badagry area of Lagos State. Out of a total of 900 residential customers already on the prepayment metering system, 200 customers were simple-randomly selected and administered with a questionnaire. Only 180 customers responded, giving us a working sample from a cross section of the Badagry area.
Because of the nature of the study, a survey of the various EKEDC staffs and the 180 simple randomly selected residential customers was conducted. In this case semi-structured and unstructured interviews were conducted in addition to the questionnaires that were administered to both EKEDC Staffs and the customers.

In order to achieve the objectives of the study, both structured and open-ended questionnaires were administered to various staffs in EKEDC and the 200 customers in the Badagry area. Interviews with key personnel such as the Customer Services Manager, Metering Engineer, two Customer Services Officers and 180 simple randomly selected customers were conducted. Secondary data was collected through desk research. This data was obtained from both unpublished and published data sources. The data was obtained from the company's financial reports, budgets, magazines, journals, websites and other published and unpublished documents. Other secondary data was obtained from newspapers, magazines, journals, pamphlets, books and the internet.

Both statistical and non-statistical methods were used to analyze the obtained data. Statistical and non-statistical methods such as graphs, tables, pie charts and responses obtained from interviews from EKEDC officials and the customers.

RESULTS AND DISCUSSION

Our findings reveal the benefits and problems that come with the introduction of the Prepayment Metering System. A total of 200 respondents were administered with a questionnaire, and 180 responded. This gives us a working sample of 180 respondents from a cross section of the Ojo, Badagry area. The data collected was looked at as a series of observations denoting the characteristics of that particular respondent: whether or not he responded yes to the question concerning the easy paying of electricity bills, easy budgeting, monitoring of consumptions and so on. A graph was also constructed to show the decrease in debt. The results from the survey were then analyzed to fulfill the objectives set out in the paper.

Benefits of the Prepayment Metering System

Research has shown that the Prepayment Metering System has many benefits for the customer. This can be seen in the tables below showing the response, number of customers and the percentage for various questions.

Paying Electricity Bills has been Made Easier: Prepayment Metering System has made it easier to pay electricity bills. Below is a table showing response in the first column, number of customers in the second column and the percentage in the third column on whether the Prepayment Metering has made it easier to pay electricity bills.

Table 2: Paying Electricity Bills has been Made Easier.

Response	No. of Customers	Percentage
Yes	175	97
No	5	3
Total	**180**	**100**

A total of 175 customers out of 180 or 97% agreed that paying their electricity bills has been made easier as shown in Table 2. This clearly shows that Prepayment Metering has made it easier for customers to pay their bills. Below is a graph showing the response in percentage on whether the Prepayment Metering System has made it easier to pay electricity bills.

Budgeting for Electricity has been Made Easier: Prepayment Metering System has made it easier to budget on how much to spend on electricity. Below is a table showing responses and the number of customers. Table 3 and Figure 2 show that 80% of the customers surveyed agreed that Prepayment Metering System has made it easier for them to budget on how much to spend on electricity as they are able to determine their average monthly consumption and the equivalent bill.

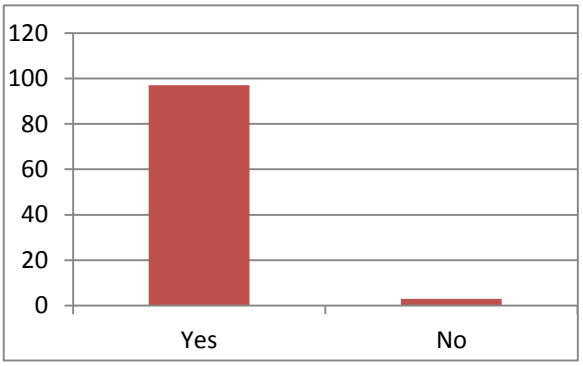

Figure 1: Ease of Paying Electricity Bills.

Table 3: Budgeting has been Made Easier.

Response	No. of customers	Percentage
Yes	144	80
No	36	20
Total	**180**	**100**

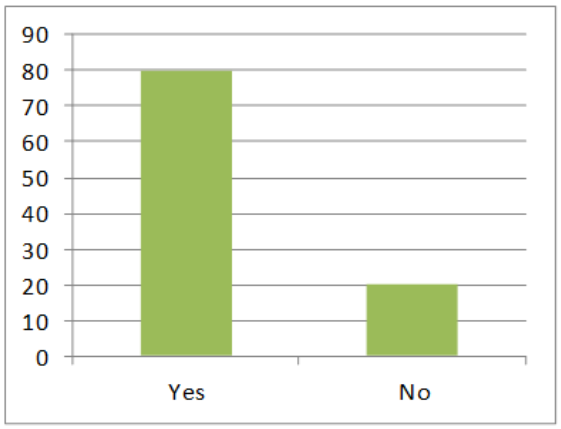

Figure 2: Ease of Budgeting for Electricity Bills.

Easy Monitoring of Consumption: Prepayment Metering System has made easier to monitor consumption of customers. Table 4 and Figure 3 show the responses on monitoring consumption in percentage. Asked whether or not, they are able to monitor their consumption, a total of 170 respondents out of 180 said that they are able to monitor their consumption as they only consume power when they have switched on the geyser (hot water heater) when warming water and when cooking. In other words power is only consumed whenever it is necessary.

Table 4: Monitoring Consumption.

Response	No. of customer	Percentage
Yes	170	95
No	10	5
Total	**180**	**100**

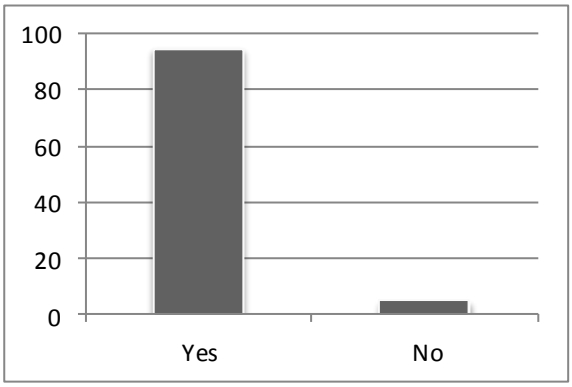

Figure 3: Easy of Monitoring of Consumption.

Benefits Acquired: The benefits acquired from the deployment of prepaid meters are shown in Table 5 and Figure 4. The blue section of the graph is the number of Yes responses that were obtained from the EKEDC customers while the brown section of the graph is the number of No responses that were obtained from the customers.

Table 5: Benefits Acquired.

Response	Paying made easier	Budgeting made easier	Monitoring of consumption
Yes	175	144	170
No	5	36	10

Problems of the Prepayment Metering System

The Prepayment Metering System also has come with its own problem as described below.

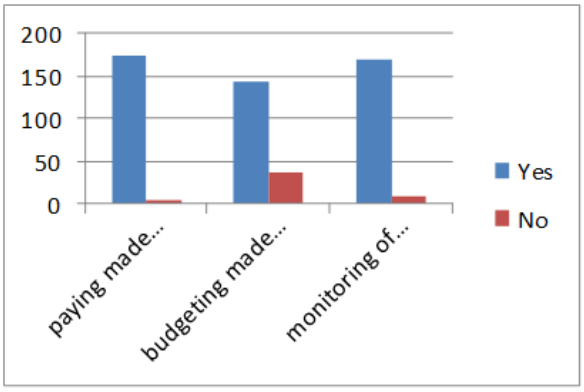

Figure 4: Benefits Acquired.

Non-Tripping of the Contactor: As observed earlier, tripping is an important aspect of a prepayment meter. The quality of the meter affects both EKEDC and the customer. Thus, if the basic aspects like tripping are lacking, the collections may suffer and lead to poor customer service. The study revealed that the quality of meters installed is poor. This is indicated by the fact that a total of 10 meters or 6% of the surveyed meters were found not to be tripping due to contactor, display fault or general meter fault. For instance, if the units are exhausted, the contactor would not trip and then a negative figure would appear on the display. When a customer's account is in negative due to a contactor not tripping, a negative number appears on the display (e.g. -1999). Below is a table showing the number of tripping and non-tripping meters in the survey.

Table 6: Meter Status Survey.

Meter reading	No. of meters	Percentage
(-1999)	10	6
Positive number	170	94
Total	**180**	**100**

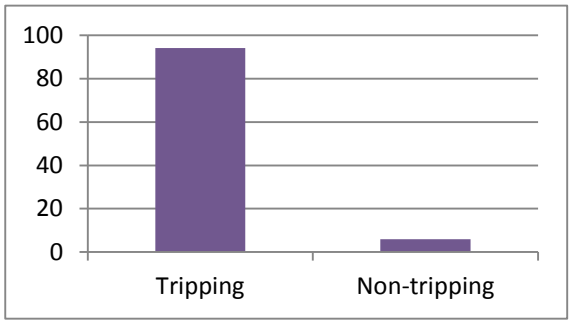

Figure 5: Meter Status Survey.

Buying of Units on Sundays and Holidays: This study has shown that even though customers have benefited in many ways, the Prepayment Metering System has also disadvantaged them in some ways. The study revealed that 93% of the total number of respondents was not satisfied with the way the system is being managed with respect to selling of units on Sundays and holidays. Most respondents complained that they have no access to electricity if their units finish on Sundays and holidays. Most respondents also indicated that they are forced to find alternative sources of power despite the introduction of the system being meant to improve customer service and ensure customer satisfaction at all times.

Table 7: Units Bought on Sundays and Holidays.

Response	No. of customers	Percentage
Yes	12	7
No	168	93
Total	**180**	**100**

The table above shows that a total of 168 customers out of 180 or 93% of the customers are unable to buy units when they run out on Sundays and holidays.

The graph below shows the response in percentage on whether the customers can buy units on Sundays and holidays. 93% of the customers are unable to buy units when they run out of electricity on Sundays and holidays while the other 7% of the customers think that they can buy units.

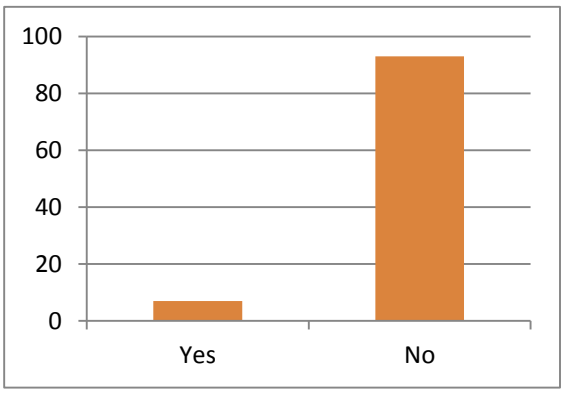

Figure 6: Buying of Units on Sundays and Holidays/

Using Electricity without Paying: When respondents were asked on whether they are able to use electricity before paying for it, the majority indicated that they are not able to do so. The table below shows that 174 of 180 customers or 96% of the customers cannot use electricity without first paying. The other 6 out of 180 customers or 4% are able to use electricity without paying because their meters do not trip when units run out. The system was introduced to ensure customers have electricity at all times, both day and night. But research has shown that customers whose units run out on Sundays and Holidays cannot use electricity during these days because EKEDC offices are closed during these days and there are no vending machines.

Table 8: No Electricity before Paying.

Response	No of customers	Percentage
Yes	6	4
No	174	96
Total	**180**	**100**

The graph below shows the response in percentage on whether the customers can use electricity before paying. 96% of the customers are unable to use electricity without first paying while the other 4% are able to use electricity without paying because their meters do not trip when units run out.

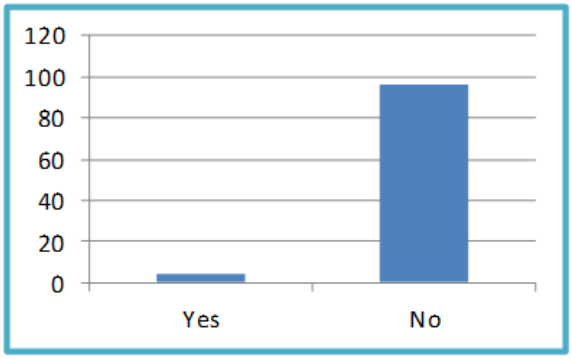

Figure 7: No Electricity before Paying.

Problems Acquired: In the graph below, the blue section of the graph is the number of Yes response that was obtained from the EKEDC customers while the brown section of the graph is the number of No responses that was obtained from the customers and is shown in Table 9 and Figure 8.

Table 9: Problems Acquired

Response	Non-trigging of the contactor	Buying of units on Sundays & Holidays	No electricity before paying
Yes	10	12	6
No	170	168	174

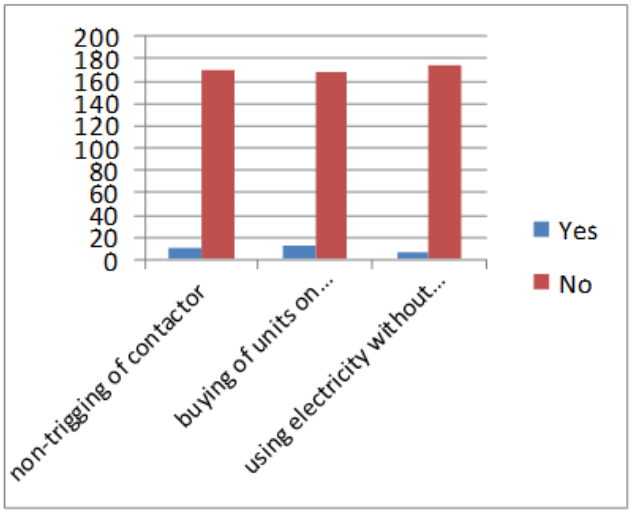

Figure 8: Problems Acquired.

Information on further problems of Prepayment Metering System obtained through primary data (one-on-one interviews with the EKEDC staffs and customers).

Lack of Expertise

The introduction of the Prepayment Metering System has not only deprived EKEDC of the necessary financial resources but also brought more problems to the corporation. The major problems arising from the introduction of the system includes non-availability of the expertise to repair the faulty meters. The study has revealed that EKEDC lacks the expertise or qualified personnel necessary in the maintenance and repair of the prepayment meters. The study also revealed that faulty meters when removed are not repaired and customers have no replacement because there are no new meters while customers continued in certain situations to

enjoy electricity despite their meters being identified as non-tripping. Out of the total of 180 meters surveyed, 10 meters were found not to be tripping when units finished and customers continued enjoying electricity.

Additional cost of Acquiring Prepayment Meters

Table 10 gives a comparison of the costs which have been incurred on the installation of the Prepayment Metering System as opposed to the Conventional Credit Metering. Based on 100 single-phase meters, and 100 three-phase meters, Prepayment Meters cost more than Conventional Credit Meters by ₦1,437,500 for single-phase meters and ₦2, 390,100 for three-phase meters as shown in the tables below.

Table 10: Cost Comparison of the Two Types of Meters (single-phase)

Meter type	Quantity	Total (₦)
Prepayment	100	3,937,500
Credit	100	2,500,000
Difference		1,437,500

Below is a representation of the table in a bar-chart.

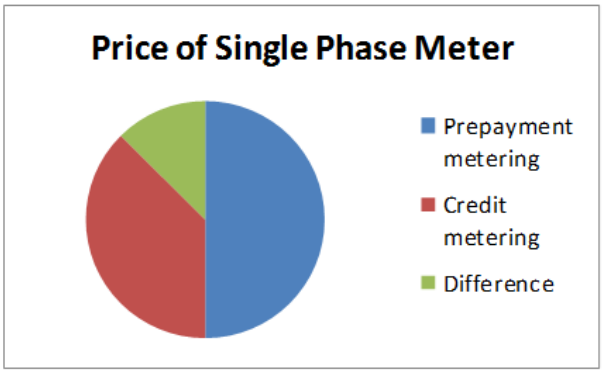

Figure 9: Price of Single-Phase Meter.

Table 11: Cost Comparison of the Two Types of Meters (three-phase)

Meter type	Quantity	Total (₦)
Prepayment	100	6,890,100
Credit	100	4,500,000
Difference		**2,390,100**

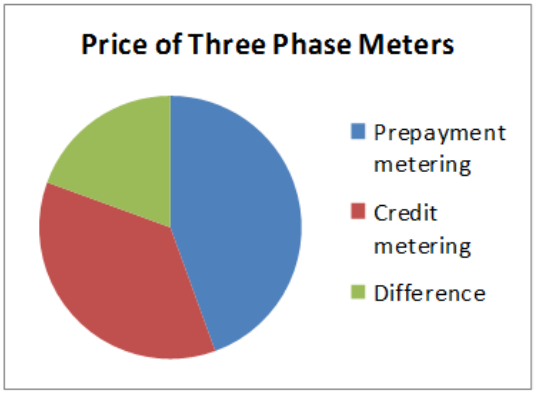

Figure 10: Price of Three-Phase Meter.

CONCLUSIONS

Our conclusions are that the state of metering in the Nigerian Electricity Supply Industry is in dire need of emergency response to correct the wide gap in satisfaction. The situation is so alarming that if urgent remedial measures are not implemented, it may threaten the reform of the power sector by the Federal Government of Nigeria.

The introduction of the prepayment metering system is a good way of ensuring customer satisfaction and also ensuring the corporation collects revenue promptly. However, the failure rate on the type of meters installed is high. This is mainly due to the fact that the quality of the Prepayment Meters that were installed does not suit our environment leading to dissatisfaction on the part of some customers and loss in terms ofmoney to replace them on the part of EKEDC.

RECOMMENDATIONS

One of the objectives of the study was to make appropriate recommendations for the successful implementation of the Prepayment Metering System. Thus, the following listed recommendations are considered to be ideal for successful implementing the Prepayment Metering System.

- High Quality Meter
- Provision of Electricity at all Time
- Averting Future Problems
- Computerization of the Prepayment Metering System

- Introduction of Prepayment Metering Country-wide
- Training of staff and introduction of customer service center nationwide.

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