

# Impact of Prepaid Energy Metering System on the Electricity Consumption in Ogbomoso South Local Government Area of Oyo State

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## ABSTRACT.

Electricity is one of the basic requirements for people and they are widely used for domestic, industrial and agricultural purposes. Every meter is a device that measures the amount of electrical energy consumed by a residence, business or an electrically powered device. This paper presents the impact of prepaid energy metering system on electricity consumption in Ogbomoso South Local Government Area of Oyo state. The results of the paper revealed that about 95% of the pre-paid meter users in the local government area are conscious of electricity management, about 74% of the post-paid meter users were just wasting the energy. The introduction of the pre-paid metering system has increased the revenue collection and hence, reduced the revenue generation of the local government area because of the reliability nature of the metering system. The pre-paid metering system has created a positive impact on the electricity consumption as well as the increment in the price tariff of the electricity.

**Keywords:** *Energy metering system, Electricity consumption, Post-paid metering system, Pre-paid metering system, Solid state electronic meters (SSEM).*

## 1. INTRODUCTION

Nigeria has about 7,500 megawatts of installed capacity and 3,500 megawatts of available generation supplied through its national grid against an estimated total of 10,000 megawatts. Energy meter is a device that measures the amount of electrical energy consumed by a residence, business or an electrically powered device [9].

They are typically calibrated in billing units and the most common one is the kilowatt hour, which is equal to the amount of energy used by a load of one kilowatt over period of one hour, or 3,600,000 joules. Electricity meter operates by continuously measuring the instantaneous voltage (volts) and current (amperes). The product of which gives the instantaneous electrical power (watts) which is then integrated against time to give energy used [8].

Prepaid Energy Meter enables power utilities to collect electricity bills from the consumers prior to its consumption. The prepaid meter is also attributed with the prepaid recharging ability and information exchange with the utilities pertaining to customer's consumption details, automation system is a device use for monitoring and control load [7].

A prepaid energy meter user automatically control load usage. Prepaid meter has relays for demand response shedding of loads. The prepaid meter read energy from devices like incandescent bulbs, computer, television, washing machine, street light etc [6].

Home electrical appliances consume some energy when they are left on standby mode or when being switched ON. This loss is so infinitesimal to be noticed by the consumers, as it ranges between 1w and 30W, but can be significant when they are not performing their main functions or when they are switched off [5].

### 1.1 The Energy Meter

The energy meter is the cash register of an electricity utility. The accuracy of the meters determines the accuracy of recorded revenue. The modern energy meters can capture and store a tremendous amount of data, which can be a goldmine that brings additional revenues to the utility through integrated meter data management solutions. Over the years metering has served primarily as the means to track consumption. Metering today is not limited to revenue collection but has expanded into areas of load control, system planning tariff structuring, reduction in transmission and distribution [4].

## 1.2 Post-Paid Metering Technology

The aged-electromechanical induction watt-hour meters and the recent digital or electronic meter are the main post-paid meters prevalent in Nigeria.

## 1.3 Electromechanical Induction Meters (EIM)

These meters operate by counting the revolutions of a non-magnetic, but electricity conductive, metal discs which are made to rotate at a speed proportional to the power passing through the meters. The number of revolutions is thus proportional to the energy (KWH) consumed [3], [11].

## 1.4 Electronic Meters

These energy meters' operation is similar to the electromechanical induction type, in that the energy used is digitally displayed on an LCD or LED screen, and some can also transmit readings to remote places. These meters sometimes called Solid State Electric Meters (SSEM), have digital signal processing "engine" that codes/processes digital signals received from analogue to digital converters into information that can be analyzed. In addition to measuring energy used, some electronic meters can also record other parameters of the load and supply such as instantaneous and maximum rate of usage demands, voltage power factor and reactive power used etc. [2], [12].

## 1.5 Pre-Paid Meter or Prepayment Electric Metering Technology

Prepayment electricity meters in Nigeria measure energy in the same manner as a conventional EIM. The main difference with a prepayment meter lies in the intended manner in which the meter is to be operated and used for the sale of electricity. The prepayment electric meters accept token or prepaid cards to get electricity supply. The customer has to pay the charges for the power supply in advance. One can also top-up the amount for extending the period of electric supply or when the balance over the supply is automatically cut off by a relay in the electric meter. Thus electricity consumption is integrally measured but the measurement is actually started and stopped in conjunction with the activation and deactivation of the load circuit by the prepayment control system. To activate the load circuit, the consumer must prepay for electricity usage or purchase a quantity of electricity that may include statutory or fixed charges. The payment information may be loaded on the meter through a specific peripheral control device like the magnetic card reader used by ECG. Once activated, the load circuit will run and remain activated until the monetary or equivalent energy information loaded into the prepayment control system has run out, subject to any other conditions established by the contractor [1], [3].

## 1.6 Benefits:

The following benefits are derivable from the introduction of pre-paid metering system: [10], [7].

### 1.6.1 Benefits to Utility

- a) Up-front payment for electricity:  
Energy is paid for before it is consumed. This is in contrast to the current arrangement of paying for them after use. The benefit will lie in earlier cash flow for Utility.
- b) No unpaid bill  
Because energy is prepaid the problem of collection of arrears and unpaid bills will be no more.
- c) No meter readings: The problems associated with the logistics of meter reading will be eliminated, providing a substantial saving to Utility.
- d) Lower overheads  
As there is no meter reading, no billing, no bill generation, there is a gradual decrease in the overheads. This manpower of Utility can be put for some further value added jobs like vigilance etc.
- e) No incorrect bills: Because no bills are sent, incorrect billing as a result of inaccurate meter readings is no longer a problem.

### 1.6.2 Benefits to Consumer

- \* Pay as you go system; It will allow customer to buy electricity as and when is required by him.
- \* No standing in long queues: The system can provide in future complete flexibility of purchasing electricity via telephone, internet GSM etc.
- \* Allow the consumer to budget: The prepaid meter will empower customer to understand the cost of energy and this enable them to budget their usage in accordance with their financial position and lifestyle
- \* Display of remaining credit: The prepaid meter have the provision to display the actual remaining credit

value as well as the total KWH consumption. This will put consumer in the position to manage their energy purchase to suit their requirement.

## 2. MATERIALS AND METHODS

1. The electricity bills of 100 selected customers located in Ogbomoso South Local Government area of Oyo State that were previously on the post-paid billing symptom and later changed to pre-paid billing system from January 10 2010 to January 2014 and February 15, 2009 to January 5, 2014 were used for this analysis.
2. Questionnaires were also administered for the customer to determine their levels of electricity usage and management to access their power consumption
3. Relevant statistical details such as dates of payment, amount paid, amount owed/total Kwh bought were extracted from the electricity bills to illustrate the pattern of the post-paid electricity bill and the pre-paid payments over the time periods.

The statistical mean, medium and standard deviation were computed for these two billing systems to establish the impact on the revenue generation.

## 3. DISCUSSION OF RESULTS

Observations show that the revenue that around PHCN from the selected 100 customers in the pre-paid bulling system is user than the revenue in the past-paid system. This is as a result of the reliability nature of the pre-paid billing system. Pre-paid billing system ensures that customers are properly billed. No debt is recorded in pre-paid billing system, hence no need for sharp practices in the disconnection of the defaulters coupled with the large human and material resources with dangers associated with disconnection exercise.

In the post-paid billing system a total sum of N36,000 with paid by the customers in Ogbomoso South Local Government Area of Oyo state over a period of 3 years even through the highest bill amount of N3,000 was paid on 23/12/2010, 09/04/2011 and 20/10/2012 while the amount owed are N2,350.54, N2,523.7 and N2,180.50 though the least amount of N1,500 was paid on 05/02/2010, 25/07/2010, 22/08/2010, 01/06/2011, 04/10/2011 and 18/06/2012 while N3,653.40, N685.20, N385.75, N683.53, N2,146.30 and N687.95 were owed during these period as illustrated in Figure 1. From the figure, an mean sum of N2, 027.78 was paid by the customer over the time period while the standard deviation and median were N648.32 and N1, 750 respectively.

From figure 2, a total sum of N27, 434.01 was owed by the customers in post-paid billing system. This amount is almost equivalent to total amount paid by the customer for the time period which is a big loss to the utility company rendering the electricity services to their. During this period, the mean value of the amount owed is N1, 524.11 while the standard deviation and median value for the amount owed are N1, 036.47 and N1, 233.64 respectively. The standard deviation from the mean of the energy consumed in the post paid billing system in higher which indication the arbitrary allocation of units in estimated bills. The cost of energy consumed in higher in the pre-paid billing system than in the post-paid system suggesting that if power is available all the units, the pre-paid consumers will generate more revenue which will eventually influence the consumer to willingly embark on energy during methods that will reduce the power demand, loses and wastage on the power system.

Figure 3 shows that in the pre-paid billing system, a total sum of N10,500.07 was paid even though a least sum of N1,391.05 was paid on 09/03/2013 whiled the highest amount paid on 10/11/2014 was N2,200 even through 347.8KWH and 550KWH were bought on those dates. A total of 2625.2 KWH was bought by the customers during the study period. The values of mean, median and standard deviation from the mean are N1, 750.09, N1, 799.76 and N389.47 respectively as shown in figure 3.

Figure 4 shows that the values of the mean, median and standard deviation from the mean from the pre-paid customers during the study period are 437.60KWH, 438.7KWH and 88.36KWH respectively. A least amount of 347KWH was bought on 10/03/2013 while the highest amount of 550KWH was bough on 10/11/2014.

The purpose of introducing the pre-paid system was revenue collection. It is evident that utility companies must improve power reliability in order to increase its revenue. In the post-paid billing system, the customers are given estimated bills; hence they bear the brunt while customers in the pre-paid billing system buy whatever energy is needed.

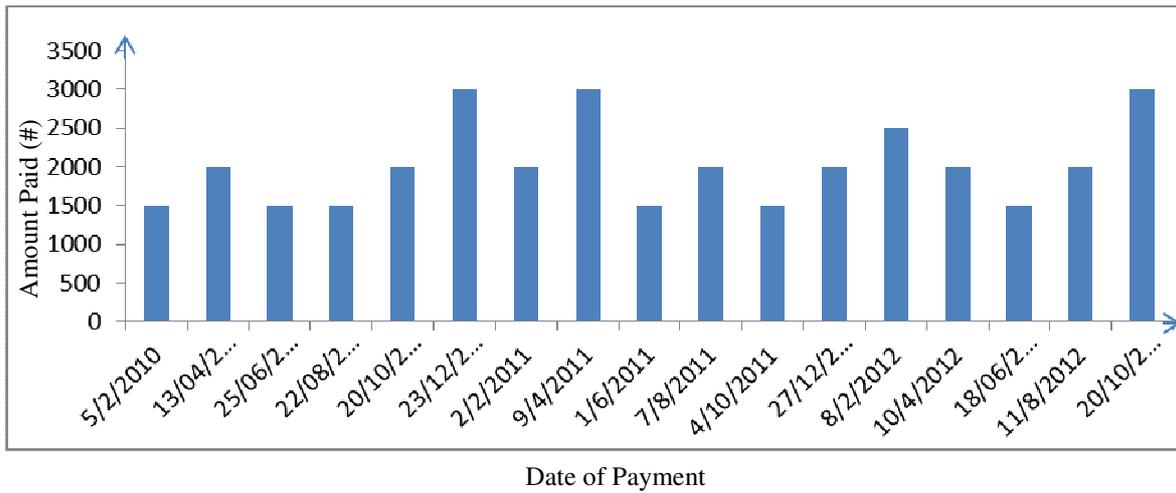


Figure 1: Amount Paid Versus Date Of Payment In Postpaid Billing System

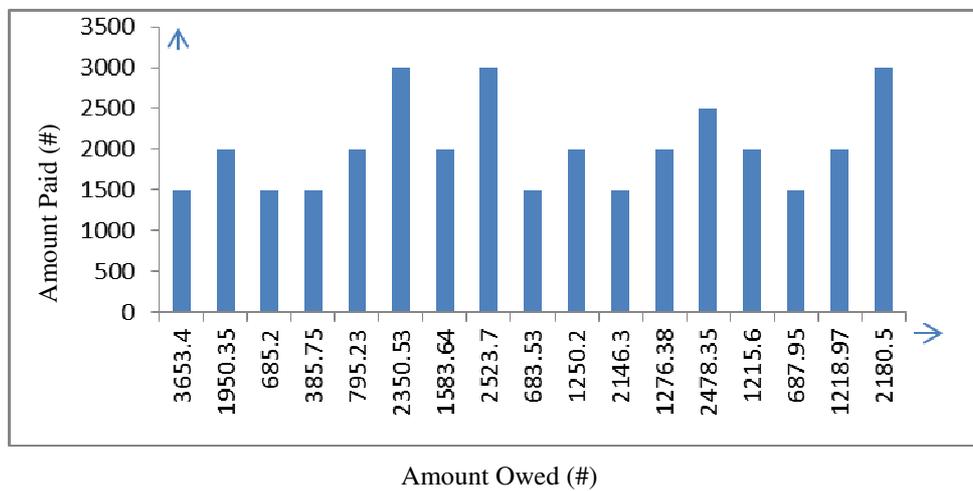


Figure 2: Amount Paid Versus Amount Owed In Postpaid Billing System

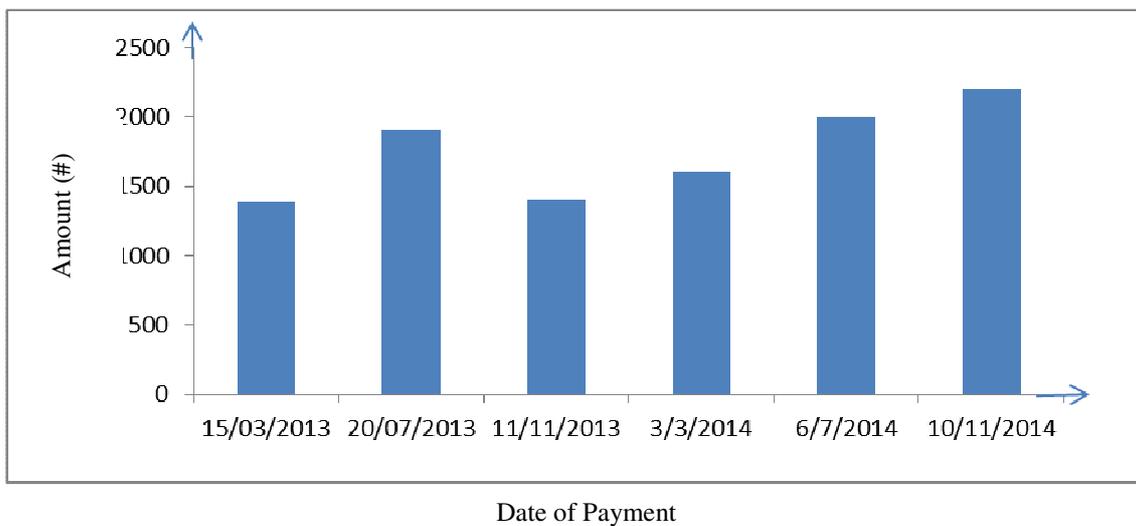


Figure 3: Amount Versus Date Of Payment In Pre-Paid Billing System

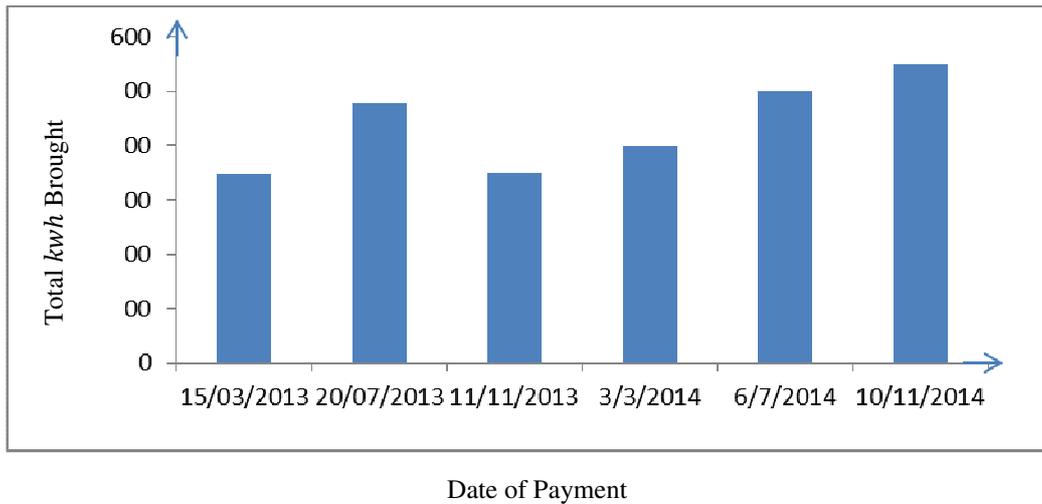


Figure 4: Total kwh Bought Versus Date of Payment In Pre-Paid Billing System

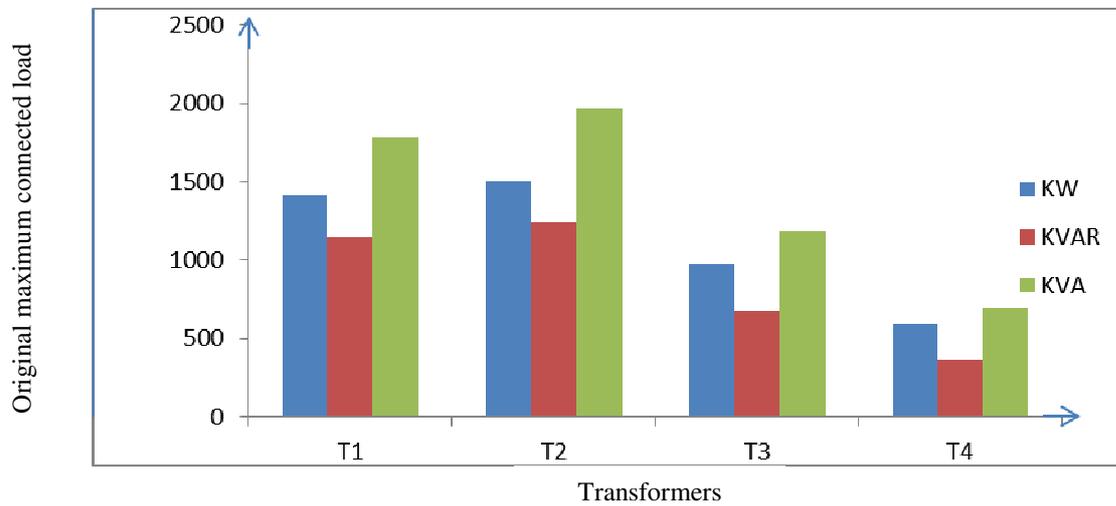


Figure 3: Original Maximum Connected Load Versus Transformers

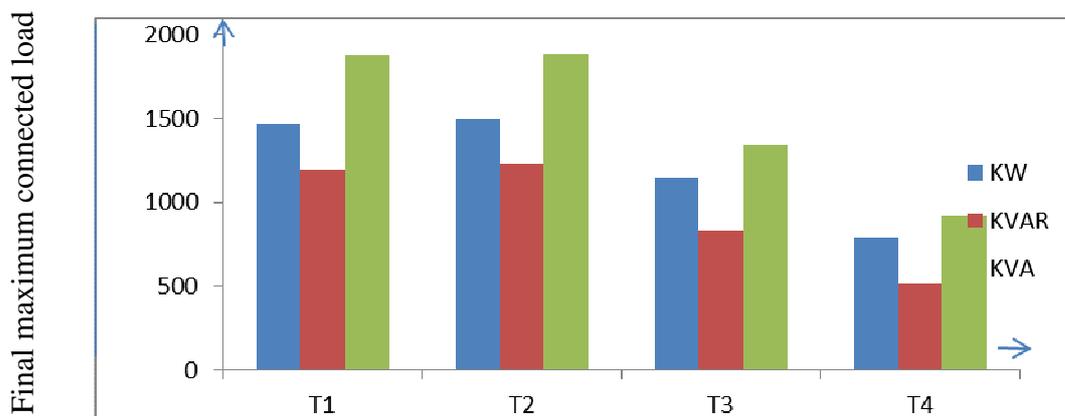


Figure 4: Final Maximum Connected Load Versus Transformers

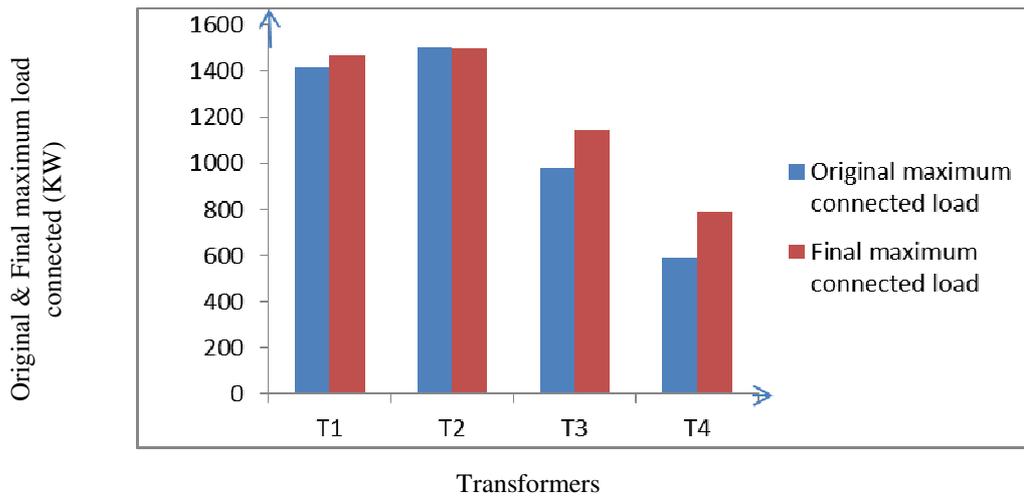


Figure 5: Original And Final Maximum Connected Load (Kw) Versus Transformers

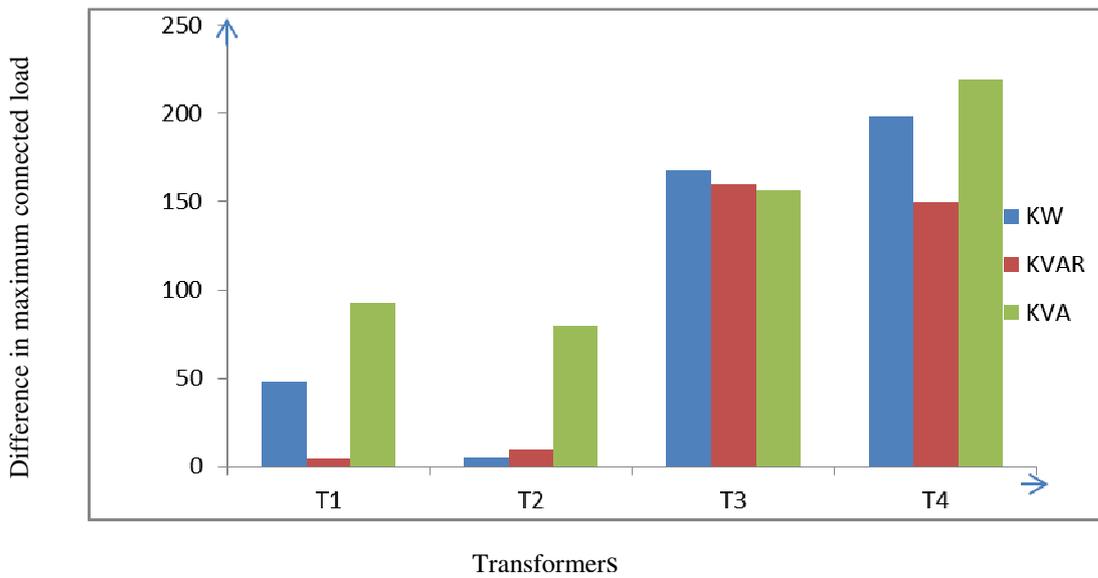


Figure 6: Difference In Maximum Connected Load Versus Transformer

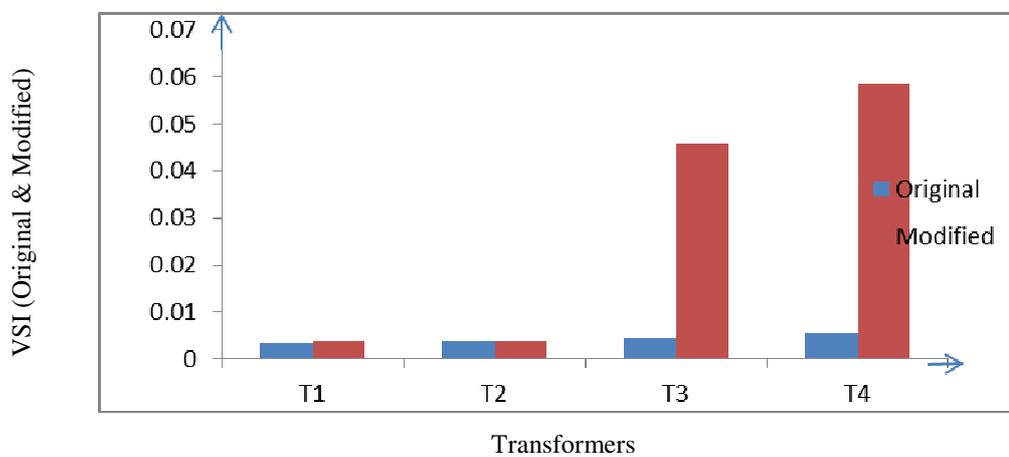


Figure 7: VSI (Original & Modified) Versus Transformers

#### 4. CONCLUSION

The impact of prepaid energy material system on electricity consumption in Ogbomoso South Local Government Area of Oyo State has been presented.

The results of the paper showed that about 95% of the prepaid meter users are consumers of electricity management while just 5% were not consumers of electricity management. From the paper, it was who ground that about 74% of the post-paid meter users were wasting the energy. The introduction of the pre-paid meter in Ogbomoso South Local Government Area of Oyo State increases the revenue collection, reduces revenue generation because it is reliability will increase the revenue generation in the prepaid billing system. It ensures that the consumers pay only for energy consumed and not the estimated bill in postpaid los can be been in the large standard deviation from the mean in the units of energy consumed. The prepaid billing system has had a positive impact on electricity consumption as well as an increase in the price of the electricity.

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