ASSESSMENT OF ELECTRICITY DEMAND AND PREDICTION MODEL FOR THE FURTURE: RIVERS STATE

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ABSTRACT: *This work is on the Assessment of Electricity demand and prediction model for the future requirement in Rivers State by the year 2025. The data for electricity allocation and load utilization of the state for the period of five years (2011 - 2015) were collated from the central dispatch office of Port Harcourt Electricity Distribution Company office of Port Harcourt. Two different statistical analyses, "Regression exponential and least square methods," calculations, graphs were reviewed and applied to justify the analysis. While predictions are 211.3MW and 207.1MW by using regression exponential and least square analysis models respectively for the first year 2016, the load requirement of Rivers State for the year 2025 is expected to have increased to 2113MW and 2071MW respectively. It is observed that there is a great positive relationship between the electricity demand and the years, which implies that as the years moves forward the demand for electricity increases. The positive relationship is attributed to the fast growth of development in Rivers State. The study reveals that the regression exponential model should be adopted because it captures the elastic demand of the consumers during peak and off-peak time with an appreciable growth rate of 21.6%.*

KEYWORDS: Assessment, predictions-model, Electricity-demand, Regression-exponential and least-square

INTRODUCTION

River State is the treasure base of the nation is one of the 36 states of Nigeria and was created on 27 may 1967, with an alarming population of over 5,185,400 million people (Census, 2006) which is approximately three percent of the people, and makes it the 6th most populated state in the country. It has 23 Local Government Areas with Port Harcourt as its capital and the largest city and is economically significant as the center of the Nigeria oil industry.Electricity is one of the necessities of the ordinary man's life and business and a key driver for economic growth and development. The crucial issues of managing electricity demand are of great importance in formulating the future development policy for the whole country. Since electricity is not storable, it means that the supply of electricity must always be available to satisfy the growing demands.

It is imperative that the power development plan must be well conceived, inevitably, a solid medium and long run load forecast are prerequisites for a well-conceived power development plan (Pernille & Fredrick, 2000). The urbanization factors measure the industrial and economic development of any nation. Moreover, these factors lead to electrical energy fluctuation or under urbanization. Urbanization implies greater access to electricity, since consumers that already had access to electricity before they likely to increase their load consumption once they arrive in the new urban setting and the growth in demand will take place through the use of existing appliance (Pernille & Fredrick, 2000). There is an evidence of demand for electricity in Rivers State due to the broad nature of the industrial and economic activities and the rapid development in the state. It means that there should be plans and policies to match the demand of electricity consumption with the generation and the distribution supply. Therefore, it is necessary to carry out this study of present electricity consumption in the state in other to predict future power requirement of the state.
The problems noted in the electricity distribution system are some of the issues connected with the immediate load demand in Rivers state. Some problems like;

a) The vandalization of distribution lines by criminals and winds.
b) The broken and bent cross arms, oil leakages in transformers, cracked pot insulators, and overload.
c) Inability to perform standard load analysis on the current injection distribution substations by Port Harcourt Electricity Distribution Company.
d) Corruption, Bribery, and Mismanagement in the power sector.
e) Lack of preventive maintenance.

Other problems encountered during this study are non-availability of adequate data and functional metering system. The lack of data exhibited some theoretical and practical problems; the general increment in power demand in the residential areas of the state joined with increased use of electricity for industrial purposes is needed to decide the amount of electrical energy that should be accessible for use. The estimated utilization of electricity is increased intentionally with the second reason for acquiring higher subsidies as believed.

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The objective this study is to assess the present consumption rate of electricity and developing a predictive model for electricity demand of the state in the future. The load allocations will be gotten and matched with load demand requirement. This study will cover the following;

a) The load allocation and the utilized data of previous years were obtained from Port Harcourt Electricity Distribution Company and were used to forecast the electricity demand or need for Rivers State by the year 2025.
b) Plot monthly and annually load allocation and utilization curves.
c) The historical trend was investigated, analyzed and utilized as a part in forecasting the electricity need for the time of ten years.
d) Analyze the difference between the two methods used.

This assessment is paramount because it will help to determine the future electricity demand of the Rivers people and will provide room for proper planning and implementation of conservation measures in the power industry. Forecasting is essential because the future load demand is dubious and it will decide the requirement for new power plants or in the execution of preservation measures of the power supply and the distribution system. It can also be beneficial to the operators of the Rivers state utility companies

LITERATURE REVIEW

The historical backdrop of power advancement in Nigeria can be followed back to the end of the Nineteenth Century when the first producing power plant introduced in Marina, Lagos, in 1898, fifteen years after England introduced theirs. Their power palnt limit was 60kW. After the amalgamation of the Southern and Northern protectorates in 1914 to frame cutting edge Nigeria, different towns in the nation began to create electric power supply framework on the personal scale.

In the following order, are the major cities that had a dose of electricity supply Port Harcourt 1928, Kaduna 1929, Enugu 1933, Maiduguri 1934, Yola 1937, Zaria 1938, Warri 1939, and Calabar 1939. (Claudius, 2014).

The Government and the Native authorities possessed frameworks stayed separate operational entities for quite a while until 1946. In this year, the Public Works Department stopped to have control over the operation of the power producing plants and appropriation framework in the nation. In the same regards, the Nigerian Government Electricity Undertaking (NGEU) was promptly settled (as an arm of the Public Works Department) to assume control over the advantages and liabilities of power supply in Lagos. After four years, in 1950, a focal body was built up to assume control over

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all the different power supply outlets inside of the nation. This body is alluded to and tended to as the Electricity Corporation of Nigeria (ECN). Meanwhile, the Native Authorities (NAs) kept on dealing with their personal frameworks while they additionally introduced Niger Dams Authority (NDA) for the advantage of producing power through hydropower frameworks. (Claudius, 2014). As a result of this, the Colonial Government built up the Electricity Corporation of Nigeria (ECN) under the law no.15 of 1950. The new body, Electricity Corporation of Nigeria (ECN), authoritatively assumed control over all power supply exercises in Nigeria in April 1951 by co-ordinating all the Government possessed and additionally local claimed to create plants and frameworks. (Claudius, 2014). Respectably, this enhanced the electric power supply in the Nigeria through grid connect of generation, transmission, and distribution of electricity. Meanwhile, likewise, the offer of electrical vitality was made in a manner that the arrival on its speculation had a typical handbag. Later, it alluded to the vertically integrated utility (VIU). With the increase in demand for power supply, a few projects were completed in Ijora, Oji River, Kano and Ibadan plants to enhance the availability of power supply. The Ijora power plant was along with this line and also appointed in February 1956, and it served satellite towns like Ikorodu, Shagamu, Ijebu-tribute and different towns in the Ibadan-Ijebu territories which gave the financial change of these western states in front of various parts of the nation.

In 1962, an Act of Parliament set up Niger Dams Authority (NDA) which was in charge of dam development after finding the multitudinous advantages that would collect from the Dam. This Dam prompted the development of Kainji Dam in 1962 and finished in 1968. The endless way of the Nigeria network power transmission framework began operation in 1966 with the communitarian exertion of the old Electricity Corporation of Nigeria ECN and NDA, which connected Lagos with Kainji. Kainji-Kaduna connection was stretched out to Zaria and Kano. In the southern part, Oshogbo-Benin-Ughelli and developed the Benin-Onitsha-Afam (Alaoji) connections. Despite the enormous size of the nation, the national network now connects the thirty-six state capitals and the Federal Capital Territory Abuja. (Claudius, 2014).

On first of April 1972, ECN and NDA converged to shape a brought together body known as National Electric Power Authority (NEPA) with the proper consolidation occurring on the 6th of January 1973 when the first chief was named. The system kept on developing under NEPA and somewhere around 1978 and 1983; the Federal Government had supported two boards of inquiry to mold out models for rebuilding NEPA into a free unit or towards privatizing it out of solid nature. This attempt led to the establishment of the electrification boards whose work is to take power supply to the rural areas and new cities.

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By 1999-2005 (The advent of a democratic government), a demonstration was instituted setting up PHCN, an Initial Holding Company (IHC), as a consequence of Government push to revive power sector. Initial Holding Company was a proposed name for privatization which was intended to exchange resources and the liabilities of NEPA to PHCN. It was formally charged on the fifth of May 2005 and was to do the business of NEPA which is still on. In the same regards, the National Integrated Power Projects (NIPP) was introduced in 2004 to have the capacity to catalyze and fast track the overhauling of adding more ability to the currently available power limit in the nation. NIPP was primarily a private initiative which is as of now being directed by the Niger Delta Power Holding Company (NDPHC). (Claudius, 2014).

Electricity is the major hub of every developing nation around the world as Nigeria is not an exception; this is because it cuts across all facets of nation building and development. It has become obvious that this is the greatest challenge faced by the Nigerian Nation. This condition is due to the poor generation and distribution of power supply within the nation, and as such has resulted in instability in the supply to the various consumers: The consequence of this to any nation is economic impairment and retarded growth.

Moreover, so many related studies have been carried out on the determinants of residential electricity demand functions and have focused on developed countries alone. (Donatos & Mergos, 1991; Ettestol, 2002; Zachariadis and Pashourtidou, 2006; Filippini, 1999), carried out a similar study in some developed countries like; the European countries, such as Greece, Norway, Cyprus, and Switzerland. (Houthakker & others, 1974, Houthakker, 1980, Hsing, 1994, Silk and Joust, 1997). For Canada (Bernard & et al., 1996), the Mexico (Chang & Martinez-Combo, 2003) and the United Kingdom (Dodgson & et al., 1990; Henley & Peirson, 1999; Clements & Madlener, 1999), for Asia-Pacific countries, such as Australia, India, and Taiwan (Narayan & Smyth, 2005; Filippini & Pachauri, 2004; Holtedahl & Joutz, 2005). In G7 countries (Narayan & et al., 2007) and countries in the Middle East (AlFaris, 2002; Beenstock & others., 1999; Eltony & Hosque, 1996; Nasr & others, 2000). There is little literature in the research on energy demand in developing countries, and only a few of the studies accounted for the time-series properties of the response of power consumption to changes in income and relative prices.

The enormous interest in the area means that administration's earnestness in achieving a steady power supply as a solution to a rapid economic development and improvement in the state. In all these efforts made by the previous administration, one thing they failed to do was to carry out a forecast and create a model for the future requirement, so as to strategically plan properly and to enable them to see what the future holds for the people of Rivers state. If all the Rivers State

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Government had accomplished all this, the state would have been harvesting the product of maintainable improvement. This study assessed the current electricity consumption of the Rivers State and predicted the future demand of energy required in the Rivers State of Nigeria to enable a proper and structured planning.

METHODOLOGY

The method of this study developed as a guide for constructing functional models. It proposes two approaches of forecast, exponential and least square methods of projections. The forecasting analysis is conducted to the monthly allocated and utilized loads of about five years ago. In this study, Time-series and extrapolation methods used is because the future behavior of the variables is related to its past values, both actual and predicted. This approach relies on the experience and perception of the forecaster and easily implemented at a low cost. The analysis proved that the proposed methodology accommodates this case study

MATERIALS AND METHODS

The required materials that were used for this prediction, using regression exponential method are as follow;

a) Daily and monthly load utilized and allocated in Megawatts.
b) Annual load allocation and utilization and annual growth rate of load utilized.
c) The assumption of the year index of the year under study.
d) The years under study and the predicted years.
e) The choice of the equation for analysis and estimated base load and growth rate.
f) Books and journals for reference.

The sources of materials used, were daily, monthly and annual load allocated and utilized data, for say about five years ago were be sourced from Port Harcourt Electricity Distribution Company, Port Harcourt, River State.

METHODS

The forecasting method used in this dissertation bases on the extrapolation approach. The extrapolation approach bases on time series analysis of the load demand curve using exponential regression analysis. The least square method will be used with the suitable mathematical curve equations. These equations fit the trend of the load using exponential regression analysis or least square method where the resulting trend line id extrapolated to the future and the projected load

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demand are obtained (Weedy, 1979). However, the biggest problem with this extrapolation approach is the choice of the equation for data in the historical or previous years. The need and relevance of forecasting demand for electricity have become a much-discussed issue in recent past years. It has led to the development of various new tools and methods for forecasting in the last two decades. Straight line extrapolation of historical energy consumption trends served accurately in the past years. In the correlation approach, the demands correlate with the selected consumer characteristics and from the expected change the trend and the future load growth established. Several models are available for forecasting such as Simple Curve Fitting and Extrapolation, Regression Model, Econometric Model, Linear Optimization Model, Fourier Series Model. However, the Regression (exponential) Trend Model was also preferred to others because it can deal with large variations, missing observations and measurement errors. It conserves statistical properties when new models generate from existing ones (Karanta, & Ruusunen, 1991).

REGRESSION EXPONENTIAL ANALYSIS METHOD

Accepting 2012 as the datum year, the curve of the data pattern is non-Linear in nature; therefore a non-Linear model which has an exponential relationship was utilized to accomplish the evaluated base load and the yearly growth rate.

Therefore; $Y = Ae^{Bx}$ (1)

The above equation can be expressed as a straight-line equation by taking the natural logarithm of both sides (Stroud & Booth, 2001).

$$\ln Y = \ln A + Bx \qquad (2)$$

The above equation can also be written as a straight line equation, which is;

$$y = a + bx \qquad (3)$$

To solve for the parameters of 'a' and 'b', is by summing up the both sides of equation (2)

$$\sum X \ln Y = \sum \ln A + B \sum X \qquad (4)$$

If we multiply equation (4) by the independent variable 'x' then we have;

$$\sum X \ln Y = n \ln A \sum X + B \sum X^2 \qquad (5)$$

In order to obtain the values of 'a' and 'b', we will apply crammers rule to equation (4) and (5). Where; $\ln a = a$ and B = a (Raymond, 1977)

$$\begin{bmatrix} n & \sum x \\ \sum x & \sum x^2 \end{bmatrix} \begin{bmatrix} \ln a \\ b \end{bmatrix} = \begin{bmatrix} \sum \ln y \\ \sum x \ln y \end{bmatrix} \quad (6)$$

We have;

$$\sum \ln y = n \sum \ln a + B \sum x \quad (7)$$

$$\sum x \ln y = n \ln a \sum x + B \sum_x 2 \quad (8)$$

Therefore; $\ln A = \frac{\sum \ln y \sum_x 2 - \sum x \ln y \sum x}{n \sum_x 2 - (\sum x)^2}$ (9)

$$\mathrm{B} = \frac{\mathrm{n} \sum(\mathrm{x} \ln \mathrm{y}) - \sum \mathrm{x}(\sum \ln \mathrm{y})}{\mathrm{n}(\sum x^2) - (\sum x)^2} \quad (10)$$

LINEAR REGRESSION MODEL

A straight line is the simplest way of approximating a curve. It can be represented by the equation:

$$y = a_0 + a_1 x \quad (11)$$

We need to find the estimates of a_0 and a_1 for equation (11) such that the line forms a good fit to the data. One of the ways to get this is least square method.

$$Sum = S = \sum_{i=1}^{n} (e_i^2) \quad (12)$$

$$= \sum[(Observed\ values) - (Predicted\ values)]^2$$

$$= \sum_{i=1}^{n} [y_{i-} {}_{(a_0 + a_1 x_i)}]^2 \quad (13)$$

Opening the inner bracket, we have;

$$\sum = (y_i - a_0 - a_1 x_i)^2 \quad (14)$$

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The two parameters a_0 and a_1 in equation (14) can be found by minimizing the equation. We can get this by taking the partial derivatives of S with respect to a_0 and a_1 and set them equal to zero respectively.

$$2(y_i - a_0 - a_1x_i) = \frac{dS}{da_0} = \sum 2\,(y_i - a_0 - a_ix_i)(-1) = 0 \qquad (15)$$

$$\frac{dS}{d_{a_i}} = 2(y_i - a_0 - a_1x_i)(-x_i) = 0 \qquad (16)$$

Equation (15 and 16) can be rearranged to the following;

$$\mathrm{n}a_0 + a_1\sum x_i = \sum y_i \qquad (17)$$

$$a_0\sum x_i + a_1\sum x_i^2 = \sum x_i\, y_i \qquad (18)$$

Equations (17) and (18) are often called normal equations and are solved simultaneously. For instance; therefore, in matrix form, equation (17) and (18) now becomes;

$$\begin{bmatrix} n & \sum x_i \\ \sum x_i & \sum x_i^2 \end{bmatrix} \begin{Bmatrix} a_0 \\ a_1 \end{Bmatrix} = \begin{Bmatrix} \sum y_i \\ \sum x_i\, y_i \end{Bmatrix} \qquad (19)$$

By applying Gaussians elimination method (i.e matrix triangular) to equation (19) as follow, we have;

$$\begin{bmatrix} 1 & \frac{\sum x_i}{n} \\ \sum x_i^2 & \sum x_i^2 \end{bmatrix} \begin{Bmatrix} a_0 \\ a_1 \end{Bmatrix} = \begin{Bmatrix} \frac{\sum y_i}{n} \\ \sum x_i y_i \end{Bmatrix} \qquad (20)$$

By multiplying row 1 by $-\sum x$ and adding same to row 2 we have;

$$\begin{bmatrix} 1 & \frac{\sum x_i}{n} \\ 0 & \sum x_i - \frac{(\sum x_i)2}{n} \end{bmatrix} \begin{Bmatrix} a_0 \\ a_1 \end{Bmatrix} = \begin{Bmatrix} \frac{\sum y_i}{n} \\ \sum x_i y_i - \frac{\sum x_i \sum y_i}{n} \end{Bmatrix} \qquad (21)$$

By performing backward substitution on equation (21) we have;

$$\left[\sum x_i^2 - \frac{(\sum x_i)2}{n}\right] a_1 = \sum x_i y_i - \frac{\sum x_i \sum y_i}{n} \qquad (22)$$

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$$a_1 = \frac{\sum x_i y_i - \frac{\sum x_i \sum y_i}{n}}{\sum x_i^2 - \frac{(\sum x_i)^2}{n}} \quad (23)$$

$$a_1 = \frac{n \sum x_{i y_i} - \sum x_1 \sum y_i}{n \sum x_i^2 - (\sum x_i)^2} \quad (24)$$

From equation (19), making a_0 the subject of the formula we have;

$$a_0 = \frac{\sum y_i - a_1 \sum x_i}{n} \quad (25)$$

RESULT

Table 1 PEAK AND AVERAGE LOADS FOR ALLOCATED AND UTILISED LOAD WITH THE GAPS

YEARS	2011	2012	2013	2014	2015
ALLOCATED LOAD AT PEAK (MW)	151.9	183.8	191.2	223.7	219.8
UTILISED LOAD AT PEAK (MW)	151.2	183.4	188.8	224.6	208.9
UTILISED AVG. LOAD (MW)	130.3	161	168.6	166.9	166.3
MEAN LOADS UTILISED (MW)	140.8	170.3	178.7	195.8	187.6
ERROR (MW)	11.1	13.5	12.5	27.9	32.2

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Table 2 LOAD DEMAND FOR REGRESSION EXPONENTIAL AND LEAST SQUARE METHOD

YEARS (N)	YEAR INDEX X	ANNUAL UTILISED PEAK LOAD, Y (MW)	Iny	xIny	x^2	xy
2011	-2	151.2	5.019	-10.038	4	-302.4
2012	-1	183.4	5.212	-5.212	1	-183.4
2013	0	188.8	5.241	0	0	0
2014	1	224.6	5.414	5.414	1	224.6
2015	2	208.9	5.342	10.684	4	417.8
	∑x = 0	**∑y = 953.1**	**∑Iny = 26.203**	**∑ xIny = 0.869**	**$\sum x^2$ = 10**	**∑xy = 156.6**

USING REGRESSION EXPONENTIAL ANALYSIS METHOD

Recall equation (3.9):

Therefore:

$\sum x$ = 0

$\sum y$ = 956.9

$\sum \ln y$ = 26.228

$\sum x \ln y$ = 0.848

$\sum_x 2$ = 10

$\sum xy$ = 156.6

For the estimated load;

By substituting the values in Table 1 into the above-recalled equation (3.9), we have;

$$a = \frac{(26.228)(10)-(0.848)(0)}{5(10)-(0)}$$

$$= \frac{262.28-0}{50-0} = 5.2456$$

Therefore $a = 5.2456MW$

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Solving for 'b', recall equation (3.10)

$$b = \frac{5(0.848) - (0)(26.228)}{5(10) - 0}$$

$$= \frac{4.24}{50}$$

Therefore $b = 0.0848$

Recall equation (3.2) $\ln y = \ln a + Bx$

By substituting the of a and b into the above equation, we have; The value of $e^{5.2456} = 189.7$

Therefore $a = 189.7MW$

But recall equation (1)

$$y = Ae^{Bx}$$

By substituting the value of 'a' into the above equation (1) we have;

$$y = 189.7e^{0.0848}$$

Since the growth rate of 'b' is gotten from the slope of equation (3.2) which is; $0.0848 - 1$

However, slope is the antilog of the value 0.0848 which is $= 1.216$

So, $b = (1.216 - 1)x = 0.216 \times 100 = 21.6\%$

Therefore, annual growth rate 'b' = 21.6%

Estimated peak base load 'a' = 189.7MW

By substituting the values of a and b into equation (3) $y = a + bx$

Therefore, $y = 189.7 + 21.6x$

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Table 3 PREDICTED LOADS Y FOR REGRESSION EXPONENTIAL ANALYSIS FUNCTION $Y = Ae^{Bx}$

S/N	PREDICTED YEARS	PREDICTED VALUES y = a + bx	NEW PREDICTED VALUES (MW)
1	After year 1 2016	(189.7 + 21.6)1	211.3
2	After year 2 2017	(189.7 + 21.6)2	422.6
3	After year 3 2018	(189.7 + 21.6) 3	633.9
4	After year 4 2019	(189.7 + 21.6)4	845.2
5	After year 5 2020	(189.7 + 21.6)5	1056.5
6	After year 6 2021	(189.7 + 21.6)6	1267.8
7	After year 7 2022	(189.7 + 21.6)7	1479.1
8	After year 8 2023	(189.7 + 21.6)8	1690.4
9	After year 9 2024	(189.7 + 21.6)9	1901.7
10	By the 10th year 2025	(189.7 + 21.6)10	2113

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USING LEAST SQUARE METHOD

Recall equation (26), by substituting the appropriate values of Table (3) into the above equation, we have;

Where; $\sum x = 0$, $\sum xy = 156.6$, $(\sum x^2) = 10$, $\sum y = 956.9$

$$b = \frac{5(156.6) - (0)(956.9)}{(5)(10) - (0)^2}$$

$$= \frac{78.3}{50} = 15.7$$

Therefore, $b = 15.7\%$

For ‘a’, recall equation (27)

$$a = \frac{\sum y_i - b \sum x_i}{n}$$

$$= \frac{956.9 - (15.7)(0)}{5}$$

$$= \frac{956.9}{5} = 191.4$$

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Table 4 PREDICTED LOADS Y FOR LEAST SQUARE MODEL

S/N	PREDICTED YEARS	PREDICTED VALUES y = a + bx	NEW PREDICTED VALUES (MW)
1	After year 1 2016	(191.4 + 15.7)1	207.1
2	After year 2 2017	(191.4 + 15.7)2	414.2
3	After year 3 2018	(191.4 + 15.7)3	621.3
4	After year 4 2019	(191.4 + 15.7)4	828.4
5	After year 5 2020	(191.4 + 15.7)5	1035.5
6	After year 6 2021	(191.4 + 15.7)6	1242.6
7	After year 7 2022	(191.4 + 15.7)7	1449.7
8	After year 8 2023	(191.4 + 15.7)8	1656.8
9	After year 9 2024	(191.4 + 15.7)9	1863.9
10	By the 10th year 2025	(191.4 + 15.7)10	2071

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Table 5 PREDICTED LOADS FROM 2016 – 2025 AND THE GAPS BETWEEN THEM

YEARS	PREDICTED LOAD WITH EXPONENTIAL MODEL (MW)	PREDICTED LOAD WITH LEAST SQUARE MODEL (MW)	GAPS BETWEEN THE PREDICTED LOADS (MW)
2016	211.3	207.1	4.2
2017	422.6	414.2	8.4
2018	633.9	621.3	12.3
2019	845.2	828.4	16.8
2020	1056.5	1035.5	21
2021	1267.8	1242.6	25.2
2022	1479.1	1449.7	29.4
2023	1690.4	1656.8	33.6
2024	1901.7	1863.9	37.8
2025	2113	2071	42

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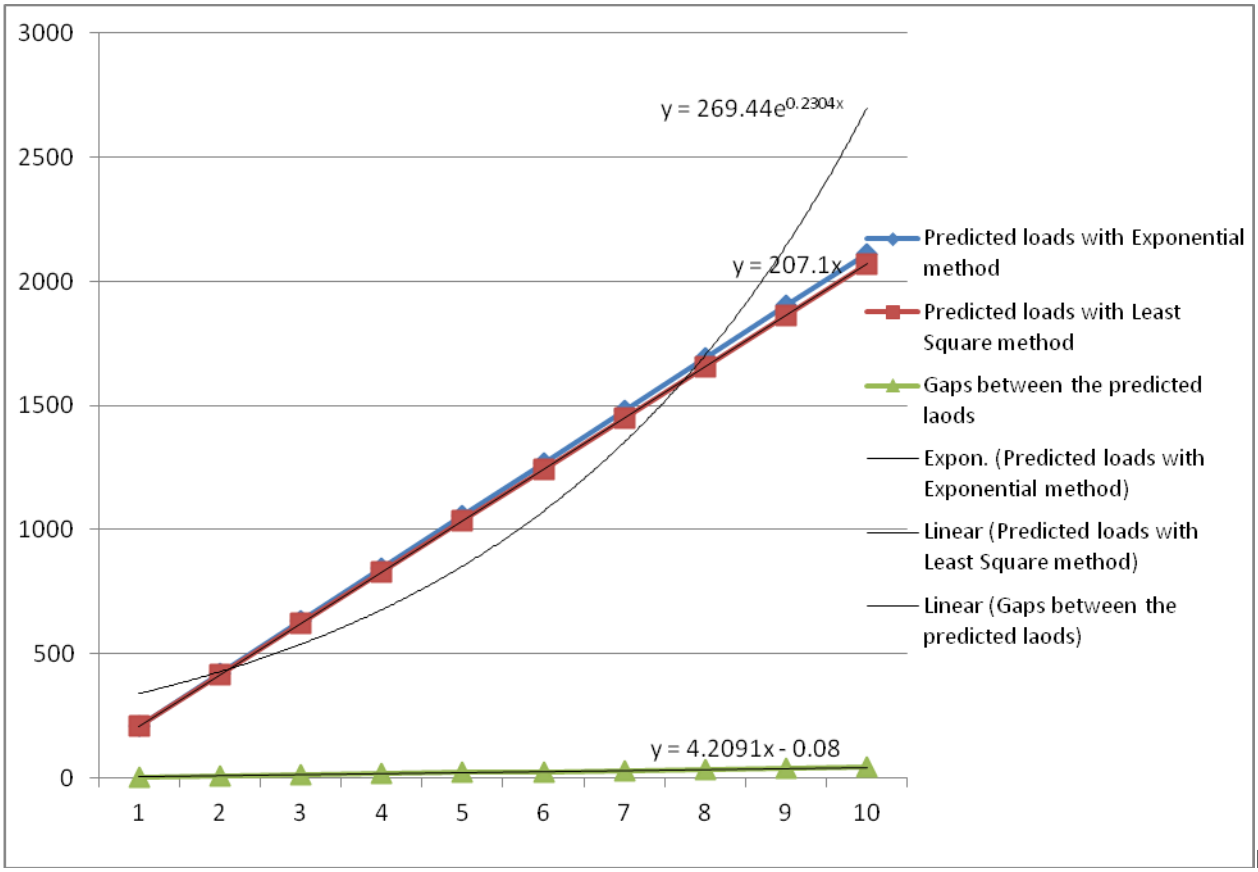

Figure 1 Curves for Predicted Load of 2016 - 2025

DISCUSSION

Based on the available data the base load as calculated with the exponential method is 189.7MW with annual growth rate of 21.6%. When applied to the exponential model it had 211.3MW for the first year while using the least square method the load is 191.4MW with 15.7% growth rate and applied to the least square model we had 207.1 for the first year. Therefore, the observation is that the load for the exponential model was greater than the least square model by 4.2MW. Therefore, the regression exponential model is more realistic because it captures the elastic demand of the consumers during peak and off-peak time with an appreciable growth rate of 21.6%.

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The Curves for Future Load Demand 2016 -2025

The straight line graph of the predicted energy demand for Rivers State shows in Fig. 1. The graph demonstrates that the linear prediction of the exponential model has a very wide range compared to the other model of the least square model for quite a while and it is the sign of a satisfactory forecast. There exists a solid positive relationship between the electricity demand and the Years, which simply means that as we grow in years, the electricity demand increases. This positive relationship between the two factors; "the Demand and Time" shows in the two methods applied to the forecast. This positive relationship is credited to the fast rate of development in Rivers State.

ERROR ANALYSIS

Error estimation or measurement assumes a very critical part in the following or tracking forecast accuracy, checking for special cases and benchmarking the forecasting process. Interpretation of these statistics can be precious especially when working with a low volume of data. This portion of forecasting statistics analyzes the advantages and disadvantages of each and exams their reasonableness under an assortment of conditions.

The MAPE

MAPE means; Mean Absolute Percent Error: it measures the level of error in percentage terms. Is computed as the average of the unsigned percentage error, and calculated by the below formula;

$$M = \left(\frac{1}{n}\sum \frac{A_t - F_t}{A_t}\right) \times 100$$

$$\begin{aligned} where\ A_t &= Actual \\ F_t &= Forecast \\ n &= Numbers\ of\ the\ year\ under\ study \end{aligned}$$

By applying the above formula to the regression exponential and least square methods, we have;

For Regression Exponential

$$where \sum A_t = 956.9$$

$$\sum F_t = 189.7$$

$$n = 5$$

$$M = \left(\frac{1}{5}\sum \frac{956.9 - 189.7}{956.9}\right) \times 100$$

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$$= \left(\frac{1}{5}\sum\frac{767.5}{956.9}\right) \times 100$$

$$Therefore;\ M = 16.0\%$$

For the Least Square method

$$where;\ \sum A_t = 956.9$$

$$\sum F_t = 191.4$$

$$n = 5$$

$$M = \left(\frac{1}{5}\sum\frac{956.9 - 191.4}{956.9}\right) \times 100$$

$$M = \left(\frac{1}{5}\sum\frac{765.5}{956.9}\right) \times 100$$

$$Therefore;M = 15.9\%$$

With the above values, it can be concluded that in the regression exponential and least square methods are off by 16.0% and 15.0% respectively.

CONCLUSION

Forecasting in the power industry is the main task in the planning of generation transmission, and distribution of electricity because it decides the obliged assets to work the power plants, for example, everyday utilization of power supply. Besides, it is the foundation of making arrangements or planning for electric plants and network systems. The literature reports that the electric load style is exceptionally intricate. It is hence important to grow new strategies to diminish the vulnerability of the forecasts. This study has indicated that each electric system and plant needs its unique anticipating technique because every nation is uninterested in the elements that influence electricity demand. In the developing countries, electricity demand develops with dynamic and high growth rate.

Rivers State as strategically located, given its socio-economic and industrial importance to Nigeria as a nation with regards to oil and gas sector. It was a difficult task sourcing for data from Port Harcourt Electricity Distribution Company (PHED), and in some cases, it was either the records

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were not available or not comprehensive, however at the end the study, a reasonable amount of data gathered as shown in Figure 4.1 and from the results of the survey. Electricity survey is a comprehensive review of electrical demand and supply pattern designed to identify areas where inefficiencies are negatively impacting on the financial and the service performance of the power system. The frequent power failure and fluctuations have resulted in the assessment of the electricity load demand, and the future electricity load demand of the Rivers State can be determined by accepting this analysis. The report analyzed with two different statistical analysis method and applications including calculations, sketches, curves and graphs. The result obtained using regression exponential method had shown that by 2025 the electricity load demand in Rivers State should increase to 2113MW of electricity. In this study, time-series and extrapolation methods were used, because the future behavior of variables is related to its past values, both actual and predicted. This approach relies on the experience and perception of the forecaster and easily implemented at a low cost. They depend on the assumption that stable, systematic structure accounts for changes that the forecast variable will undergo in the future. It could be simple, such as the single independent variable linear equation specification, or complex using nonlinear, simultaneous equations, each with several independent variables.

RECOMMENDATIONS

The following recommendations are necessary for further research area of study:

- Strategic expansion program should be in place for the generation, transmission, and distribution to accommodate the annual growth rate.
- This study should be used to eliminate the risk of planning errors that could arise from many uncertainties during the power upgrade planning process.
- A system upgrade should be well planned to enable it to provide the necessary power requirement by the year 2025.
- A standard information database is also highly recommended.
- The forecasting process has to take into account the effect of new technologies that may be in the future.
- Further study should be carried out to establish the level of accuracy or otherwise the two methods adopted in this study should be acceptable
- Load demand forecasting should be carried out periodically to enable power system planning and development

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