THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Power Connectivity and Performance of Kenya Power and Lighting Company in Western Kenya

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Abstract:
Electricity has become a preferred form of energy among consumers and producers due to its versatility, cleanliness, and availability. However, the majority of the rural areas in Kenya are characterized by inadequate and poor-quality electric power. The western region of Kenya is particularly trailing in power connectivity with only 27 percent of the household connected to electricity. Studies have cited low connectivity to electricity in rural areas as one of the major impediments to economic development in developing countries as it is a primary resource in enhancing value addition of farm produce. As observed, the legislation and regulation system of the energy industry in Kenya is monopolistic. With the nature of the regulatory structure in place, it was important to have a study that will project the performance of Kenya Power and Lighting Company outside the monopolized market. Thus, the study used variables such as power distribution and facilities for connectivity to explore how connectivity affects the performance of Kenya Power and Lighting Company. The general objective of the study was to examine power connectivity and performance of Kenya Power and Lighting Limited in western Kenya. The study will be useful in adding to the existing body of knowledge and form a basis for further research. The study assessed the various programs which ensure continued growth in the organization as well as positively contributing to customer satisfaction by the company. The study adopted a case study design, questionnaires were used for collection of primary data. Questionnaires were sent to 143 sampled respondents who were determined using the Yamane (1967) procedure, the sample was distributed in the four counties as follows: Bungoma, 36; Busia 34; Kakamega, 37; and Vihiga 36. However, 140 respondents out of the 143 managed to return filled questionnaires representing a response rate of 99 percent. Descriptive statistics methods were used in analysing the collected data. Statistical Package for Social Sciences was used to analyse the collected data. The study found all the variables: Power distribution and, facilities for connectivity to have a positive and significant effect on the performance of KPLC in western region of Kenya.

Keywords: *Power connectivity, Kenya power and lighting company (KPLC)*

1. Introduction

Energy is an essential resource in the contemporary world as its supply has a direct bearing on the economic and social development of economies. There is a close association between energy consumption and economic growth. Abundant, efficient and reliable energy supply is fundamental to the development and improvement of the quality of human life. However, energy, especially oil and natural gas is gradually becoming scarce and progressively costly. This has over the years become a subject of global concern this has led to their restrictions by governments across the world (Ketting, 2012).

As a result, electricity has become a preferred form of energy among consumers, while producers use other types of energy such as coal, nuclear, oil among other sources to generate it. Electricity is deemed ideal as it is versatile, clean and readily available, which has led to its widespread utilization in households where its usage has gone beyond the primary purpose of lighting and now used as a fuel in cooking and baking, powering refrigerators, washing machines among other appliances. Its usage is even extensive in the industrial and commercial spheres mainly for driving machine motors and engines, air conditioning, lighting and powering office appliances (Othieno & Awange, 2016).

On the surface, electricity seems just like any other commodity on the list of consumers' recurrent expenses. However, one of its distinctive features is that in practice, it is not susceptible to storing or being stockpiled. It is worth noting, however, that electricity can be stored in batteries, but this is not feasible for large-scale use and economic development due to enormous prices, reduced performance, and inconveniences that may be caused by the bulkiness of the batteries. It is on this framework therefore that electricity is conventionally generated and transmitted as it is utilized, making the electric power system dynamic, vast and complex (Willrich, 2009).

Due to the enormous and dynamic nature of the electric power system, at any given point, there must exist a state of balance between the supply and demand of electricity. This implies that the generation must always equal the consumption and any disturbance or failure may instantaneously be transmitted across the whole system. It is this unique characteristic of the electricity plays a vital role in the designing, structuring, and operation of the electric energy system (Erez Arriaga et al., 2008).

Another peculiar feature of electricity stems from its transmission. Unlike other products, it cannot be dispatched in containers from a source to the final destination but rather over grids. According to Rollo & Esseni (2017), the pathways of an electric network cannot be determined haphazardly but by Kirchhoff's laws which simply put states that current delivery depends on electrical impedance in the lines and other elements through which electric current flows. Additionally, these physics laws postulate that routes that form the grid are extremely inter-reliant, making any hitch in transmission facility likely to tamper with the flow of power and ultimately resulting in the failure of the entire power system.

1.1. Overview of Electric Power Consumption and Connectivity in Kenya

Demand for electricity in Kenya has experienced high and sustained growth over the last decade; this was chiefly triggered by an improvement in electrical fixtures and facilities such as voltage, frequency, and current. In 2016, electricity consumption increased by 2.9 percent from 7,826.4 GWh to 8,053.2. The power generation and distribution companies; KenGen and Kenya Power and Lighting Companies respectively have put much emphasis on the creation of standards for electricity products leading to improved service delivery, which, in turn, has created an appetite among households for electricity consumption. The increased demand for electricity has also been enhanced by improved Information and communication technology which has made it possible for the majority of the population to afford and own devices (smartphones, Personal computers, tablets, etc.) which are entirely dependent on electricity (Gitonga & Shibia, 2018).

High electric power consumption is among the strongest pointers of a nation's industrial sector development which eventually translates to economic growth. Additionally, High consumption of electric power is an indication of better living standards of the people and ultimately social development. However, high electric power consumption by itself is not enough, in order to signify social development, the electric consumption per capita has to be meaningful as well as the degree of electrification in a country which is characterized by the percentage of the population living in electrified homes (United Nation Industrial Development Organization, 2011).

For the proper policy planning and implementation and to ensure proper household's well-being, it is imperative that energy services be valued in a way that matches consumer preference. It is in this regard that the Kenyan government since 2002 has initiated a number of electrification expansion programs. Notably among them is the last mile connectivity project. Last Mile connectivity project which is also known as the rural electrification program was initiated in 2004 by the government in conjunction with African Development Bank (AfDB). The aim of the project was to increase electricity access to Kenyans, particularly those in the rural areas and low-income urban households, this was in line with the national vision as goal of increasing universal access to electricity by the year 2020 (Ayieko, 2011).

Recently, the Kenya Power and Lighting Company, the company mandated with the distribution of electric power in Kenya, introduced another initiative to promote connectivity among Kenya households, it was dubbed 'umeme pamoja' which can be loosely translated to mean uniting for electricity connection. Umeme Pamoja was initiated to provide ease in electrical connection and to bring down the cost of electricity. It was developed through the concept of encouraging households to come together and establish joint groups for the purpose of collectively connecting them to a common grid (Njoroge, 2011).

Despite the much government's efforts to promote electricity access, electrification rates vary broadly from one county to another with a clear disparity between rural and urban areas. (Lee et al., 2016). A research conducted by Christian Aid and the Pan-African Climate Justice Alliance (PACJA) in 2017 reveals that only 43percent of Kenyan households are connected to electricity. The research also reveals that, of the total connectivity, 57.2percent of those living in the rural areas have no access electricity access, while 86.75 of those living in urban areas are connected. The discrepancy is credited to inadequate infrastructure in the rural areas and low income among households.

1.2. Problem Statement

One of the major impediments to economic development in developing countries is the inadequate and poor quality of power in rural areas. Research conducted by Infotrak in January 2018, reveals that 57.2 percent of the population in rural parts of Kenya are not connected to electricity whereas only 13.25 percent of the population in urban areas lack access to power. They attributed the disparity to inadequate infrastructure in the rural areas, high connection cost and low income among rural households. The study further shows that even the households that are connected to electricity in rural areas receive poor quality services and constant power shortages and interruptions (Infotrak 2018).

The western region of Kenya was reported to be the area with the lowest power connectivity of 27.3 percent; this implies that only a quarter of the population has access to electricity (Infotrak 2018). As a result, the inhabitants of the region have in the past few years resorted to off-grid sources such as solar and battery from organizations such as one-acre fund, M-kopa, SunKing, Orb energy, Dlight and Green light planet, among others. These firms have gained dominance due to the low cost charged when purchasing them as they operate on installment payment basis.

For profit maximization purposes, it is essential, therefore, that Kenya Power and Lighting Company ensure that it increases the distribution of power in the western region for both domestic and commercial use. It is also worth noting that connectivity alone is not enough, the services provided ought to be of good quality, i.e., accurate billing for domestic consumption; remote metering for energy audits and focusing on quick and efficient attendance in repair and other inquiries.

One of the most significant attributes of the western region is that it is an agricultural and industrial zone that is primarily dominated by cultivation and processing of sugar, maize farming, and dairy farming. Therefore, increased electricity distribution will enhance value addition to the farm products and thus contribute to the GDP growth of the country.

It is against this backdrop that the study sought to find out how connectivity affects the performance of Kenya Power and Lighting Company in western Kenya. Most of the studies reviewed have also mainly focused on the engineering aspects of the performance and service improvement such as 24-hour supply and perhaps the quality of power (see, Gitura 2006; Alston 2011; Fodor, 2017).

1.3. Objectives of the Study

The broad objective was to examine the power connectivity and performance of Kenya Power and Lighting Company in the western region of Kenya. The specific objectives are to:

- To examine the effect of power distribution on the performance of Kenya Power and Lighting Company
- To determine how facilities for connectivity affects the performance of Kenya Power and Lighting

2. Literature

Kenya is one of the largest producers of geothermal energy in Africa forming one of the main sources of electric energy including hydroelectric sources. The main generation of electricity in Kenya is now predominantly done by Kenya Electricity Generating Company (KenGen). However, the electric distribution market of power is monopolised by KPLC.

A World Bank study on enterprises reveals that Kenya has an average of 56 days power disruptions yearly. In comparison, the United States of America, power interruptions occur for a day in 10years. It found that more than half of the large firms in Kenya possess back-up generators which is an indicator of poor consistency and reliability of the power distribution from electric power utility firms (Public Utility Research Centre University of Florida 2013). This is attributed to poor generation, transmission and distribution systems plagued with ineffective maintenance and upgrade programs.

The consistency of power generation in Kenya is affected by drought, overdependence on hydro-power, as well as high demand for electricity relative to generation plants capacity, and inadequate capital for hydroelectric power plant development. The inconsistencies arising above challenge the distributive role of KPLC. The underproduction of electrical energy that inhibits the ability of KPLC to meet demand adversely affects its financial performance, indicating underperformance in KPLC.

According to NEMA (2010), the cost to be incurred by KPLC to carry out an environmental impact assessment of the proposed power plant project along Thika Road amounted to USD 125,000,000. The assessment sought to identify both the constructive and undesirable effects of the proposed project and compute potential impact expected from project construction, implementation, and operation. The need to spend such a copious amount of money to carry out environmental impact assessments for power generation plants affects the performance of KPLC on account of high initial costs.

KETRACO was incorporated as a company in 2008 and listed under the Companies Act with the mandate to create, construct, run and sustain high voltage electricity transmission structures that would be the pillar of the National Transmission Grid (The GRID, 2013). KETRACO is a fully state-run corporation commissioned to develop the national transmission grid network and enable retailing electric power by way of its transmission web.

Gitura (2006), analysing the factors affecting the quality of power supplied to manufacturers revealed the frequency of power surges and dips that caused damage to equipment and consequently loss of revenue. According to the study, transmission and distribution of electricity over extensive distances are proven to be challenging. Power-lines are predisposed to weather-related troubles like thunder and lightning.

Other factors such as heavy rainfall and strong winds can destroy power lines. The subsequent disruptions and voltage spill out play a part in the inferior quality of electric energy delivered to the end-user. Rapid growth in some cities results in overstressing and overloading of power-line equipment, which can result in low voltage or equipment failure and hence a power outage. Alstom (2011), indicates that a voltage surge can cause damage to electronic control equipment resulting in plants shut down.

In order to stifle these challenges, there is a need for KPLC to adopt a smart grid transmission system where it benefits from automatic notification of electricity outages, remote management of electricity connect and disconnections and efficiency gains that reduce future generation, transmission, and distribution investments (Taneja, 2017).

The resulting effect is interferences and power surge related damage that render KPLC liable. The cost of assessing and compensating claims is an expenditure that affects the performance of the company.

3. Methodology

3.1. Research Design

This study used a descriptive research design. Descriptive research portrays an accurate profile of persons, events or situations (Yin, 2009). It also allows one to collect quantitative data, which can be analyzed quantitatively using descriptive and inferential statistics (Saunders, Lewis, & Thornhill, 2015). A descriptive study describes the existing conditions and attitudes through observation and interpretation techniques. In addition, the study incorporated both qualitative and quantitative research**.**

3.2. Sample Size Determination

To determine the sample size the study used stratified random sampling on the population of 224 employees in the operations and maintenance, customer service, marketing and design and construction departments. (Yamane, 1967) designed a simplified formula for estimating the sample size. The formula is provided in equation 1.

$$n = \frac{N}{1+N(e)^2} \text{.......................................} 1$$

Yamane assumes a sample size of 95 percent confidence level and a p-value of 0.5. In the equation, n is the sample size, N the population size while e is the level of precision. When the formula is applied to the population size of the study it yields equation 2.

$$143 = \frac{224}{1+224(0.05)^2} \text{..............................} 2$$

Equation 2 shows that the appropriate sample size for the study is 143. This sample size was distributed to the KPLC of the four countries based on the ratio of the population size arrived at in table 1.

County	Population Ratio	Sample Size (Population Ratio X 144)
Bungoma	0.25	36
Busia	0.24	34
Kakamega	0.26	37
Vihiga	0.25	36
Total	1	143

Table 1: Sampling Design
Source: Author's construct, 2019

3.3. Regression Model

Data was also empirically analysed using inferential statistics with a focus on linear regression to test the relationship between the dependent and independent variables. Statistical Package for Social Sciences (SPSS) was used in the analysis of the data.

The following regression model was specified:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \varepsilon \qquad (1)$$

Where Y denotes performance
X1= Power Distribution
X2= Facilities for connectivity
B0=Y-intercept
B1, and B2 are partial slope coefficients
.ε is the error term

4. Findings

This study obtained data from primary sources, this was aided by the use of structured questionnaires through the pick and drop approach. The questionnaires were dropped in relevant departments in the morning and collected after three days. A follow up was done through phone calls to hasten the process of filling up the questionnaires.

4.1. Reliability of Research Instruments

A pilot study was conducted at KPLC station in Ruiru for the purposes of ascertaining the reliability and validity of the questionnaire. Cronbach's method was used to check for internal consistency of the Likert scale items in questions that corresponded to the study objectives. The reliability results are shown in Table 2.

Variable	Number of Items	Cronbach's Alpha
Power Distribution	5	0.836
Facilities for Connectivity	8	0.823

Table 2: Reliability Results
Source: Research data, 2019

The study established that power delivery which had five items had a Cronbach alpha of 0.836 whereas facilities for connectivity had eight items with a coefficient of 0.823 All the variables had met the threshold of 0.7, meaning that the tool was reliable and could be used for future studies.

4.2. Power Distribution and Performance of Kenya Power and Lighting Company

The study sought to examine the effect of power distribution on the performance of KPLC. Likert type questions with statements were to be rated on a scale of 1-5 by respondents to indicate the extent to which they agreed with the statements contribution to KPLC performance. The analysis was done through mean scores and standard deviation. Statements with mean score of more than 3.00 are generally regarded as large extent of agreement, while those below 3 are generally considered little extent of agreement. Low standard deviation i.e. below 2.00 is an indication that the respondent's perceptions were varying to a little extent and that they were speaking in one voice. Table 3 indicates the results of the mean and standard deviation while table 4 shows the distribution of responses from the participants of the study.

Statement	N	Mean	Std. Deviation
Quality of power distributed	140	3.91	1.498
Reliability of power	140	3.81	1.367
Frequency of Power fluctuations	140	3.94	1.358
Geographical coverage of power outages	140	3.89	1.241
Response rate to power interruption	140	3.92	1.592
Overall Results	140	3.89	1.411

Table 3: Analysis of Power Distribution on the Performance of KPLC
Source: Research Data, 2019

The mean and standard distribution of power distribution shows a common trend. On a scale of 1 to 5, where 1 denotes to no extent while 5 denotes to a very great extent. The mean for power distribution tends from 3.8 to 4, with an overall mean of 3.89. This is an indication that respondents feel that power distribution affect performance of KPLC to a great extent. The overall standard deviation was 1.41, an indication that the view was uniform among all the respondents. Frequency of power fluctuations is perceived to be an important determinant in the performance with a mean of 3.94, followed closely by the response rate of power interruption with a mean of 3.92, quality of power distribution was also perceived to be an important aspect in power distribution and its influence on performance of the company, geographical coverage of power outages 3.89, and reliability of power with a mean of 3.81.

4.3. Facilities for Connectivity and KPLC performance

The study sought to determine the effect of facilities for connectivity on KPLC performance. To do this, a scale with 8 items was used to get the respondents' perception of the aspect that the company considers prior to undertaking connectivity projects and how they influence performance. The Findings are displayed in Table 4.

Statement	N	Mean	Std. Deviation
Economics of alternatives	140	3.08	0.914
Transmission line length	140	3.28	0.832
Customer transformer characteristics	140	3.22	0.882
Customer Switching	140	3.05	0.955
Effect on protective relaying at remote terminals	140	3.34	0.784
Problems of large through-power on looped lines	140	3.20	0.841
Extent of customer facilities	140	2.98	0.772
All customer connected to the transmission system must be assured high-quality, reliable service, including transmission system stability	140	3.27	0.864
Overall Results	140	3.18	0.745

Table 4: Analysis of Facilities for Connectivity on the Performance of KPLC
Source: Research Data, 2019

The mean of the results ranged between 2.98 and 3.28, meaning that facilities for connectivity influence KPLC performance to a moderate extent. The overall mean was 3.18, while the overall standard deviation was 0.745 meaning that the respondents' views did vary to a small extent

4.4. Regression Analysis

This section presents regression results for the relationship between the dependent variable (return on asset) and independent variables; Power distribution and Facilities for connectivity.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.939[a]	.881	.666	3.937

Table 5: Model Summary
a. *Predictors: (Constant), Power Distribution, Facilities for Connectivity*
Source: Research Data, 2019

Table 5 shows the model summary of the regression results. The coefficient of determination, R square measures the variation of the dependent variable as explained by the independent variables. The R square coefficient was 0.881, an indication that 88.1% of the variation in performance of KPLC in western region is caused by power distribution, and facilities for connectivity. The rest, 11.9% is explained by other factors that are not included in the model.
On the other hand, R is the correlation coefficient, it shows the magnitude and direction of the relationship among the variables. In this case, 0.939 meaning that the variables have a positive and strong relationship.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.745	2	3.372	65.446	.000[b]
	Residual	7.678	149	.052		
	Total	14.422	151			

Table 6: Analysis of Variance Results
a. Dependent Variable: Return on Asset
b. Predictors: (Constant), Power distribution, Facilities for connectivity
Source: Research data, 2019

Table 6 shows the analysis of variance results. The population parameters have a P value of 0.000, this is significant when compared to the conventional critical value of 0.05. The data is therefore ideal for making a sound conclusion on the population's parameter. The findings confirm that power distribution and facilities for connectivity significantly influence performance of KPLC in western region of Kenya.

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	.911	.156		5.845	0.000
	Power Distribution	.259	.0504	.205	5.132	0.000
	Facilities for connectivity	.274	.0.042	.213	6.459	0.000

Table 7: Regression Results
a. Dependent Variable: Return on Asset
Source: Research data, 2019

The regression equation derived from the regression results as presented in table 4.18 is:

Y = 0.911 + 0.259 (Power distribution) + 0.274 (Facilities for connectivity)

The Y-intercept is 0.911, meaning that return on asset for KPLC in western region would be 0.911 in absence of the independent variables: power distribution, facilities for connectivity. A unit increase in power distribution would result in an increase in return on assets of KPLC in western region by a factor of 0.259 while a unit increase in facilities for connectivity would lead to an increase in return on assets of KPLC in western part of Kenya by a factor of 0.274.
The study established that the P-values for coefficients of power distribution and facilities for connectivity were 0.00 and thus less than 0.01, indicating a one percent level of significance. The low p-values indicate that the effect of power distribution and facilities for connectivity on the performance of KPLC in western region is significant.

5. Conclusion

It can be concluded that the objective of examining the effect of power connectivity on the performance of KPLC in western region of Kenya was positively achieved. All the independent variables were found to affect KPLC performance. On the objective of examining the effect of power distribution on the performance of KPLC in the western region of Kenya, the study established that the quality and reliability of power distribution are key in determining the performance of KPLC. Power quality and distribution reliability have been a major challenge in western part of Kenya, it has mainly been characterized by voltage sags and momentary interruptions and this has not only contributed negatively to the performance of KPLC but also to the businesses and inhabitants of that part of the country.

Facilities for connectivity also play a big role in KPLC performance, aspects such as presenting customers with alternatives that are based on cost, giving them assurance of transmission system stability and taking into account their specifications emerged key to the determination of the performance of KPLC in western region. The western part of Kenya is mainly made up of majority of rural poor and therefore it is important to present them with a power connection offer that matches their financial capacity.

6. Recommendations

Power distribution and quality remain the key challenges facing the electric utility industry. Technology alone cannot provide a solution to power quality problems, and there is need to put in place a variety of procedures and programs that can ensure reliable and high-quality electricity. The programs should provide a proper framework and a roadmap to better performance of power utility companies and eventually higher efficiency.

There is need for managers involved with power connectivity and connection projects to assess stakeholders' probability to act and express their interest in project decisions and how they are likely to react or respond in various situations (e.g. by a sensitivity analysis), in order to plan how to influence them to enhance their support and mitigate potential negative impacts. Since their interests may be positively or negatively affected by the execution or completion of the project, project managers should balance their interests and ensure that the project team interacts with stakeholders in a professional and cooperative manner.

There is a need for the government to boost power supply to increase power demand. This can mainly be attained through, adoption of technology in running of the grid systems. The government should provide grid with metering, control and communication functions for easy detection of faults within the facilities for connectivity as well as improving efficiency in handling the technical challenges in the connection system.

In the spirit of establishing government controls and regulations, the government should involve customers and power utility companies so as to work out a structure that suits all the parties. Energy Regulatory Commission (ERC) is charged with the mandate of establishing regulations and laws that govern all the players in the energy market. It is imperative therefore that the commission ensures that the laws and regulations it comes up with are favorable to the growth of industries in energy by enhancing lower cost of energy to consumers of electricity, and most importantly catalyzing the country's development process.

Additionally, Tariff setting and electricity pricing is important, as they reflect the actual costs of efficient energy industry operation. Energy Regulatory Commission should balance the following factors in the tariff structure: affordability, the environment, efficient consumption, efficient investment (create incentives) and return on investment to cover costs of installations, generation, and transmission of electricity to consumers.

10. References

i. Alstom, G. (2011). *Network protection & automation guide*. Stafford, England.
ii. Ayieko, Z. O. (2011). Rural Electrification programme in Kenya. *AEI Practitioner's Workshop*, (November), 27.
iii. Erez A. I. J., Rudnick, H., & Rivier, M. (2008). Electric Energy Systems. An Overview. *Electric Energy Systems: Analysis and Operation*, 1–64.
iv. Fodor, V. (2016). Queueing theory and teletraffic systems What is queuing theory ? What are teletraffic systems ?, *Journal of Energy*, 15(4)1–29.
v. Gitonga, A., & Shibia, A. G. (2018). Policy Monitor. *KIPPRA*, (9). June 15, 2018
vi. Gitura, P. K. (2006). Analysis of factors affecting the quality of power supplied to manufacturers in Kenya. (Unpublished Master's Thesis). University of Nairobi.
vii. Infotrak. (2018). Energy Efficiency Market Report:Executive Summary. *Energy Efficiency Market Report*, *39*(4), 11–12.
viii. K.P.L.C, (2017). Republic of Kenya Energy , Infrastructure and Information , Communications Technology (Eii) Sector Mtef Budget Report Fy 2017/18 – 2019 /20, (October 2017).
ix. Ketting, N. G. (2012). Towards a sustainable energy future. *Energy Policy*, *23*(7), 637–638.
x. Lee, K., Brewer, E., Christiano, C., Meyo, F., Miguel, E., Podolsky, M. & Wolfram, C. (2016). Barriers to Electrification for "Under Grid" Households in Rural Kenya. *Development Engineering*, *1*, 26–35.
xi. Njoroge, J. (2011). Enhancing connectivity through affordable connection schemes. In *enhancing connectivity through affordable connection schemes*.
xii. Othieno, H., & Awange, J. (2016). *Energy Resources in Africa*.
xiii. Rollo, T., & Esseni, D. (2017). Energy minimization and kirchhoff's laws in negative capacitance ferroelectric capacitors and MOSFETs. *IEEE Electron Device Letters*, *38*(6), 814–817.
xiv. Saunders, M., Lewis, P., & Thornhill, A. (2015). *Research Methods for Business Students*. *Research methods for business students*. Pearson Education Ltd., Harlow.
xv. Taneja, J. (2017). *Measuring Electricity Reliability in Kenya*. Amherst, U.S.A. University of Massachusetts.
xvi. United Nation Industrial Development Organization. (2011). *Industrial Development Report 2011 Industrial Energy Efficiency for Sustainable Wealth Creation*.
xvii. University of Florida, (2013). 34th *International Training Program on Utility Regulation and Strategy*. Public Utility Research Centre, University of Florida, USA. May 17-21, 2013
xviii. Willrich, M. (2009). Electricity Transmission Policy for America: Enabling a Smart Grid, End to End. *Electricity Journal*, *22*(10), 77–82.
xix. Yamane, T. (1967). Statistics, And Introductory Analysis, 2nd Ed., New York: Harper and Row.
xx. Yin, R. K. (2009). *Case Study Research: Design and Methods*. *Essential guide to qualitative methods in organizational research*. Thousand Oaks, CA: Sage.