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# The Effect of Electricity Supply on Industrial Production Within The Nigerian Economy (1970 – 2010)

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**Abstract**
There are apparently links between a sustained economic growth and electricity in an economy. In this study, we employ a multiple regression model to examine the effect of electricity supply on economic development and likewise the effect of electricity supply on industrial development. The result of the regression shows that, the electricity (ELEC), Gross fixed capital formation (GFCF), industrial production (INDU) variables and population have the positive sign. That is, they are positively related to RGDP Per capita. Turning to the Industrial production expenditure model, the electricity generation expenditure, gross fixed capital formation and population variables are positively related to GDP Percapita. As a way of facilitating the economic development, it is recommended that issues relating to electricity production and industrial development should be given priorities particularly in the budget scheme and because of this, substantial amount should be allocated to the electricity sector to be able to fix the state of electricity permanently in a good shape.
**Keywords: Electricity supply, Industrial production, Economic Growth..**
We acknowledge the contributions of Mr Jimoh Saka of Department of Economics, Lagos State University Ojo- Lagos, Nigeria.

## I. INTRODUCTION

Electricity is inevitable and is needed to support development. There are apparently links between a sustained economic growth and electricity in any economy. Nigeria with her very high population of over 150 million is facing formidable economic, social, industrial, and human development challenges. And because of all these challenges, the country is seen as one of the poorest countries in the world despite the huge resources from crude oil export. As at the end of 2009, Nigeria has installed electricity capacity of about 6000 MW with only a maximum of about 4,000 MW available. This is made up of a mix of 36% hydro and 64% thermal. The Federal Government is investing heavily in expanding the generation capacity and is encouraging investments in power production through joint ventures and IPPs, with the hope of bringing the total installed capacity to not less than 15,000 MW by 2010 (Energy commission of Nigeria 2010).

In the report of ECN and UNDP (2005), it stated that, 70% of the population lives below $1 per day, while about 91% of the population lives below $2 per day. It has been observed that the citizens of many poor nations of the world have less access to electricity, and the richer countries have more access to electricity and consume far more electricity than the poor countries, suggesting that access to electricity is the driving force for a sustained economy growth of a nation. In real terms, access to electricity is directly proportional to good living standards and that is why Timothy (2005) in his study, stated that about 2 billion people globally live without access to modern energy services. And also, he made it clear that, these numbers of people are concentrated mainly in rural and per-urban areas in developing countries in Africa and Asia. Also, Etiosa (2007), opined that energy is central to all human activities and it is needed to support development.

One of the effects of the Nigerian policy implementation failures is that despite the abundance of natural gas and renewable energy resources in the country, Nigeria has become known for its epileptic power supply. Some communities do not have access to this basic social infrastructure; those that have it cannot rely on the very poor supply from the holding company of Nigeria. This contributed to adverse impacts on industrialization in the country. The production and provision of electric power from renewable energy sources is the new global focus with massive advocacy for increased investment in the Research and development of renewable energy technologies, Mark and Tonye (2009). In fact it has been observed that the collapsing nature of industries are due to lack of accessible electricity, and due to lack of accessible electricity, and the overall result of this, is the loss of jobs in the industries and the impoverishment of many. According to Udah, (2010), he explained industrialization as deliberate and sustained application and combination of an appropriate technology, infrastructure, managerial experts, and other important resources. He went further to explain that industrialization has attracted considerable interest in development economics in recent times. And this makes it very important in any nation because of its critical role in economics development. Industrial production in any nation accelerates the pace of structural transformation and diversification of economies; enables a country to fully utilize its factor endowment and to depend less on foreign supply of finished goods or raw materials for its economic growth. In fact, the ADBG (2009) in their appraisal report, reported that indeed, the gap in the power sector has far reaching implications for improving the business, sustataining economic growth and the social wellbeing of Nigerians. In their report, it was stated that 45% of the population have access to electricity, with only about 30% of their demand for power being met. They went to report that, the power sector is plagued by recurred outages to the extent that some 90% of industrial customers and a significant number of residential and other non – residential customers provide their power at a huge cost to themselves and to the Nigerians economy. As at 2009, the Nigerian installed capacity is 8.000MW, but only 4,000MW is operable of which only about 1,500MW is available to generate electricity ADBG (2009). Without doubt the epileptic nature of electricity supply in the nation has been a bane to development. Due to the lack of electricity, most businesses have had to rely on generators which are very expensive to run. This has forced many companies to close shop or relocate because they can no longer remain competitive.

In recognition of the importance of electricity on industrial production for economic growth in Nigeria, the federal government has adopted a four pronged approach to resolving the supply constraint : 1. Rehabilitate and reinforce existing assets; 2. Continue to implement the (NIPP - National integrated power project) ; 3. Extend electricity meter coverage, and 4. Implement the gas master. The objectives of the NIPP was three – fold; 1. Complete construction of three new power stations by end – 2007. 2. Provide an additional 2,700MW of generation capacity (increased to 4,800MW) and, 3. Reinforce and expand the transmission and distribution infrastructure. This is what made the power holding to introduce the pre – payment maters in order to improve revenue collection and the prospect of private participation.

Okafor, (2008) reported that in 2007, that installed electricity generation capacity was 7,011MW while utilization rate was 37.4 percent. This electricity crisis that results to low industrial production activities is exampled by such indicators as electricity black outs and persistent reliance on self generating electricity. Indeed, this was noted by Ekpo (2009), that Nigerian is running a generator economy with its adverse effect on cost of production. The aim of this study is to investigate the relationship between electricity crisis, industrial development and economic development in the Nigerian economy. The objectives of this study are: first, to examine the effect of electricity crisis on economic development. Second, to also examine the effect of electricity crisis on industrial development.

The paper is divided into 5 sections. The next section discusses review of relevant literature and theoretical background on electricity crisis;3 methodology; Section 4 data analysis and discussion of results; 5 contains the concluding remarks.

## 11. LITERATURE REVIEW

Nigeria is a richly endowed country with abundant human and natural resources. The country is blessed with a variety of mineral deposits including petroleum, natural gas, uranium, tin, columbite, coal, precious metals and gemstones. All these minerals when harnessed by industries contribute to economic growth. The relationship between industrialization and economic growth is that, Industrialization acts as a catalyst that accelerates the pace of structural transformation and diversification of economies; enables a country to fully utilize its factors endowment and to depend less on foreign supply of finished goods or raw materials for its economic growth, development and sustenance. It is also a deliberate and sustained application and combination of an appropriate technology, infrastructure, managerial expertise, and other important resources that contribute to economic development.

In recognition of the importance of industrialization to economic growth and development, Nigeria since independence has adopted various policies, incentives and schemes to promote industrialization. Some of this policy include the import substitution that gained currency in the 1960's; the indigenization policy that started in 1972; structural Adjustment Programme (SAP) of the late 1980's; in 2000, Bank of Industry, and small and medium equity investment schemes was established to reduce credit constraint faced by entrepreneurs. And recently in 2007, the federal government adopted the National Integrated Industrial; Development (NIID) blueprint.

Despite these policies and incentives, available statistics indicate that the industrial sector seems to be experiencing sluggish growth. The sluggish growth was attributed to lack of power in the country. The Nigerian economy needs electricity to grow. Electricity in any nation boasts industrial production. In boasting the industrial production, electricity supports an expansion of a nation and at the same time, as the industrial production of goods and services increases at a rate higher than increases in population, there is economic growth. In an effort to define the attributes of economic growth Romer (1990) developed a new theory. In his paper, he stated that technological change was (1).is an economic good and is driving force of economic growth, (2)arises due to people responding to market incentives, and (3) is inherently different from other economic goods. Romer (1990) stated that technology was a good that was neither a conventional nor a public good but instead is a non-rival, partially excludable good. This theory of Romer (1990) is referred to as endogenous or new growth theory. Endogenous growth theory holds that investment in human capital, innovation, and knowledge are significant contributors to economic growth. The theory also focuses on positive externalities and spillover effects of a knowledge-based economy which will lead to economic development.

Studies and experiences have shown that power generation in Nigeria has been bad and unable to compare with what obtains in smaller African countries, Due to the lack of reliable electricity, many people and companies supplement the electricity provided by the grid system with their own generators. According to Julia et al (2008) the electricity from private generators is more expensive than that from the national power grid, thus raising the price of domestic goods. He strongly argued that for Nigeria to jump and accelerate the pace of economic growth and development, the country should fix power supply problem. Aigbokan (1999) argued in his paper that fixing the energy sector is tantamount to shifting the production possibility curve of the country's economy. Adenikinju (2005) provided a strong argument to support the importance of energy supply. The poor nature of electricity supply in Nigeria, he argued, has imposed significant cost on the industrial sector of the economy.

The recent survey on power distribution to the industrial sector in Nigeria showed that average power outage in the industrial sector increase from 13.3hours in January 2006 to 14.5 hours in march 2006. According to (Odaka, 2006), he opined that in a worsening experience, the outage increased to 16.48 hours per day in June, and that in other words, power distribution in the month of June, 2006 to the industrial sector, on the average, was 7.52 hours per day.

Etosa (2007) in his study revealed that there are strong link between energy and poverty and that about 60 – 70% of the in Nigeria do not have access to electricity and modern energy services. Also, Nnimmo (2007) revealed in his study on electricity that lack of access to electricity inflate production cost and make competition in the global market difficult for developing countries.

Emeka, (2008) identified several causes of inadequate power supply and argued that this precarious situation has serious negative implications for the operations of industrial sector in the country, as most organization spent fortunes generating their own power and that this situation represents a major setback on the country's quest for industrial development.

Ndebbio (2006) argued that electricity supply drives industrialization process. He submitted that one important indicator whether a country is industrialized or not is the megawatt of electricity consumed. He further argued that a country's electricity consumption per-capita in kilowatt hours (KWH) is proportion to the state of industrialization of that country. Ukpong (1976) established the existence of a positive relationship between electricity consumption and economic development. In addition, he submitted that the expansion of energy sector on the demand side is important factor in accelerating the growth of the industrial sector.

## 111. METHODOLOGY

In this study, we employ a multiple regression model to examine the effect of electricity crisis on economic development and likewise the effect of electricity crisis on industrial development.

**Specification of the model**

We start by adopting the simple model of endogenous growth. This growth model has been used by Stern (1991); Romer(1986, 1990), Salai-martin(1990); Ndiyo(2003) etc. According to Romer, the economy-wide capital stock has a positive impact on the output at the industrial level. Therefore concentrating on the issue of

electricity crisis and industrial development, this research adopts the endogenous growth model. The general endogenous production function is taken as:

$GDPPC=AK^{\alpha}L^{\beta}$ , where GDPPC is real GDP Per capita. The GDPPC per capita in this case is taken to proxy standard of living and therefore representing economic development. Issue of development has been debated over time especially on the way it is measured.

A is the total factor productivity which incorporates the electricity generation expenditure and industrial production expenditure, K is the capital stock and L is the labour. The total factor productivity is important because electricity and industrial production operates through the total factor productivity before they affect economic development. With this explanation, the model can be written as GDPPC=f(K,L elec, indu, u) where elec= the amount devoted to electricity infrastructure, indu=the amount devoted to industrial production and U is the error term. The reason behind using the proportion of electricity and industrial expenditures in real GDP is because they capture the efficiency in these utilities and more over the electricity and industrial indices are not up to the current period hence the decision to use expenditure on electricity and industrial production. Also attention is focused on electricity and industrial production variables leaving out the technology variable assumed to have been part of the explanatory variables. The gross fixed capital formation has been used as a proxy for capital (K) while the population proxies the labour force(L) on the assumption that a high population involves physically active individuals.

The model can then be written explicitly as $GDPPC=BGFCF^{\alpha}\ POP^{\beta}\ ELEC^{\delta},\ INDU^{\sigma},U\ )$

The log transformation is $\ln GDPPC=A_0+\alpha\ \ln GFCF+\beta \ln POP+\ \delta \ln ELEC\ +\sigma \ln INDU\ +\ U$. Where GFCF is the gross fixed capital formation and POP is the population. The $A_0,\alpha,\beta,\delta$ and $\sigma$ are parameters and are taken to be elasticities. Each of the explanatory variables is expected to affect GDPPC positively except for inflation rate, although effect of population may be ambiguous. This implies that the natural log of the original data is taken except for the inflation rate. This is done to reduce the variation among the observations. The original data is presented.

The effect of electricity expenditure on industrial production expenditure can also be observed by the following model:

$\ln INDU= a_0 +a_1 \ln GFCF+a_2 \ln POP+a_3 \ln ELEC+a_4 INF+U$ where the variables have the same definitions as above. The explanatory variables are to affect the INDU variables positively except for inflation rate. In the two models, the inflation rate serves as macroeconomic instability.

**Techniques of estimation**

With the model above and to know the effect of capital, labour, electricity, industrial production variables on economic development and to also know the effect of electricity variables and others on industrial production, the Ordinary least square least method is adopted. Attention would therefore be focused on the multiple regression analysis.

**Source of data**

The data is obtained from the central bank statistical bulletin; the inflation rate data for 2010 was based on December, 2010 and obtained from statistical bulletin 2010. The population data was from UNCTAD and given in thousands but was converted to million for the purpose of the analysis. The real GDP Percapita as a measure of development was computed by dividing the real GDP by the population.

## 1V. DATA ANALYSIS AND DISCUSSION OF RESULTS

**The Empirical Analysis and Results**

Dep var: RGDPPC

| Variable | Coeff | t-statistic |
|---|---|---|
| C | 6.201 | 2.808 |
| ELEC | 0.099 | 5.194 |
| GFCF | 0.0831 | 1.908 |
| INDU | 0.227 | 1.112 |
| INF | -0.00019 | -0.256 |
| POP | 0.444 | 1.223 |

R-square: 0.976
S.E OF Regression: 0.076
Durbin-Watson stat: 0.627
F-statistic: 192.8166
Dep. Var: INDU

| Variable | Coeff | t-statistic |
|---|---|---|
| C | 9.031 | 7.618 |
| ELEC | 0.011 | 0.622 |
| GFCF | 0.074 | 1.837 |
| INF | -0.00029 | -0.398 |
| POP | 0.349 | 1.002 |

R-square: 0.918
S.E OF Regression: 0.074
Durbin-Watson stat: 0.926
F-statistic: 69.714
The result of the regression above shows that, the electricity (ELEC), Gross fixed capital formation (GFCF), industrial production (INDU) variables and population have the excepted sign. That is, they are positively related to RGDP Per capita. Precisely, a one percent increase in the electricity generation expenditure brings about 0.09 percent increase in GDP Percapita and this supports the fact that electricity can bring about sustained growth in the Nigerian economy. And again, a one percent increase in the gross fixed capital formation gives rise to about 0.08 percent increase in the GDP Percapita showing the importance of investment. while industrial production expenditure grows by one percent, the GDP Percapita would grow by about 0.23 percent. Also an increase of one percent on the population would create about 0.44 percent growth in the GDP Per capita. Thus this can prove that in some cases population brings about labour force and this impact positively through massive production and transformation of the economy. However, in some cases, the belief is that high population may impede growth rate and may lead to social crisis especially if unemployment persists. In Nigeria specifically, the low level of development may not have been a population problem. Nigeria has the capacity to develop man power and utilize this for better growth. In China, the huge population is not retarding the growth of the country. The inflation rate variable has a negative impact on economic development and this is not strange. On the significant nature of the variables, only electricity and gross fixed capital formation variables are significant. This further informs us of their relevance in the economy. The coefficient of determination has shown that about 98 percent variation in the GDP Percapita has been explained by the explanatory variables. The Durbin-Watson value indicates some positive autocorrelation in the model. Finally, the F-statistic shows that the overall model is significant.

Turning to the Industrial production expenditure model, the electricity generation expenditure, gross fixed capital formation and population variables are positively related to GDP Percapita. A one percent increase in the electricity expenditure would bring about 0.01 increase in the GDP Per capita and a one percent increase in the gross fixed capital formation would also bring about 0.07 percent increase in the GDP Percapita. For population too, a one percent increase in the population brings about 0.35 percent increase in the GDP Per capita. Thus it appears that the population variable makes positive impacts both on the GDP Percapita and on the industrial production. The inflation variable still has a negative impact on the industrial production but this impact is negligible based on the regression. It may mean that a high cost of production may not support massive production.
The coefficient of determination is also high for the industrial production model which about 0.92. Moreover, only the gross fixed capital formation is significant in this model explaining the strength of investment in industrial production. Generally, the model is also significant as shown by the F-statistics value (69.714). However, autocorrelation is positive.

**REGRESSION ANALYSIS**

Dependent Variable: RGDPPC
Method: Least Squares
Date: 02/22/12 Time: 13:06
Sample(adjusted): 1981 2010
Included observations: 30 after adjusting endpoints

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 6.200960 | 2.208034 | 2.808362 | 0.0097 |
| ELEC | 0.099318 | 0.019121 | 5.194102 | 0.0000 |
| GFCF | 0.083172 | 0.043599 | 1.907656 | 0.0685 |
| INDU | 0.227303 | 0.204394 | 1.112087 | 0.2771 |
| INF | -0.000192 | 0.000752 | -0.255741 | 0.8003 |
| POP | 0.443673 | 0.362858 | 1.222717 | 0.2333 |

| | | | |
|---|---|---|---|
| R-squared | 0.975711 | Mean dependent var | 12.69085 |
| Adjusted R-squared | 0.970650 | S.D. dependent var | 0.443510 |
| S.E. of regression | 0.075981 | Akaike info criterion | -2.139807 |
| Sum squared resid | 0.138555 | Schwarz criterion | -1.859568 |
| Log likelihood | 38.09711 | F-statistic | 192.8166 |
| Durbin-Watson stat | 0.627455 | Prob(F-statistic) | 0.000000 |

Model Summary
GDPPC = 6.200960 +0.099318ELEC +0.083172GFCF +0.227303INDU +-0.000192INF +0.443673POP
(P=0.0097) (P=0.0000) (P=0.0685) P= 0.2771)
(P=0.8003)
(P=0.2333)

Dependent Variable: INDU
Method: Least Squares
Date: 02/22/12 Time: 13:07
Sample(adjusted): 1981 2010
Included observations: 30 after adjusting endpoints

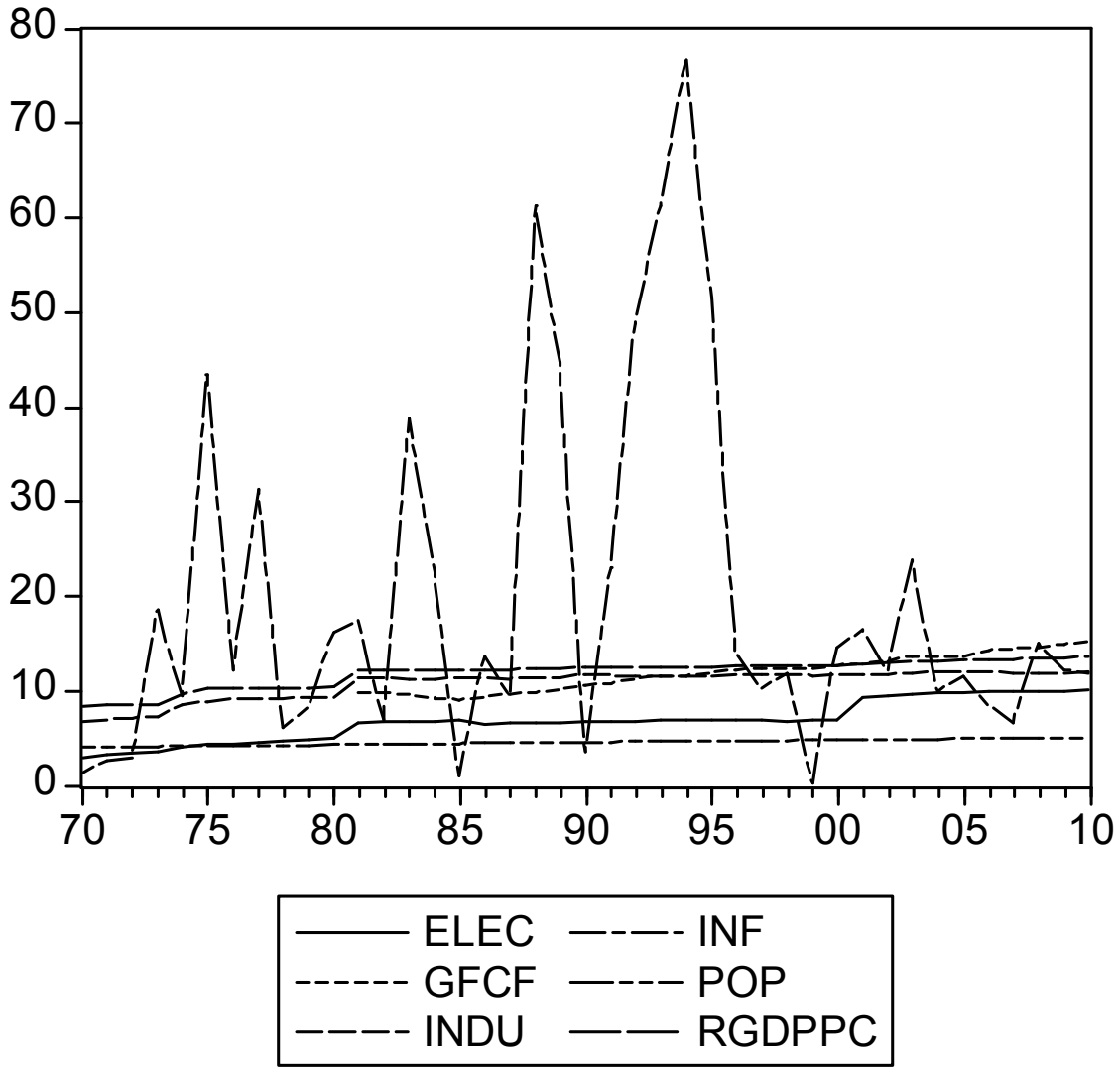
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 9.031398 | 1.185506 | 7.618182 | 0.0000 |
| ELEC | 0.011540 | 0.018567 | 0.621546 | 0.5399 |
| GFCF | 0.073548 | 0.040046 | 1.836599 | 0.0782 |
| INF | -0.000292 | 0.000734 | -0.398024 | 0.6940 |
| POP | 0.348787 | 0.348138 | 1.001864 | 0.3260 |

| | | | |
|---|---|---|---|
| R-squared | 0.917724 | Mean dependent var | 11.63041 |
| Adjusted R-squared | 0.904560 | S.D. dependent var | 0.240660 |
| S.E. of regression | 0.074348 | Akaike info criterion | -2.209112 |
| Sum squared resid | 0.138190 | Schwarz criterion | -1.975579 |
| Log likelihood | 38.13667 | F-statistic | 69.71419 |
| Durbin-Watson stat | 0.925542 | Prob(F-statistic) | 0.000000 |

Model Summary
INDU = 9.031398 +0.011540ELEC +0.073548GFCF -0.000292INF +0.348787
(0.0000) (0.5399) (0.0782) (0.6940) (0.3260)

LINE GRAPH




## V. SUMMARY OF FINDING, CONCLUSION AND RECOMMENDATION

**Summary of finding**

Statistics indicate that the industrial sector seems to experience sluggish growth further worsened by electricity crisis such as electricity blackouts and the use of electricity generating devices.

Electricity generation has the tendency of improving the industrial sector if revenues are directed to the development of electricity generation.

The results of the analysis made have shown that electricity generation and industrial production can promote economic development since both variables show some positive impact on economic development(Coefficient of elect = 0.099318, P= 0.0000 and Coefficient of Ind = 0.227303, P = 0.2771) while electricity variable too can impact positively on the industrial sector through adequate flow. This will definitely improve the performance of the industrial sector.

Other control variables used in the two models that is, the economic development model and the industrial production model such as gross fixed capita formation, population, inflation rate including the main variables

which serve as explanatory variables have shown high explanatory power of more than 90 percent variation in the dependent variable as explained by the independent variables in each of the cases and that generally the two models are significant.

**RECOMMENDATIONS/CONCLUSION:**

Economic development which can be measured through adequate standard of living depends on some many economic and non-economic factors. Among these factors are the adequate electricity and industrial development. Adequate electricity generation would give rise to massive production at a low cost which then leads to low price for the demand. Such demand improves the aggregate demand thus adding positively income which tends to improve the standard of living. There has been a prolong power supply in the country and this prolong epileptic power supply has the tendency to retard growth and even economic development. This experience has been a major setback to the economy among all other African states.

There have been various attempts to rectify the poor electricity state of the Nigerian economy but unfortunately such attempts are not bringing what is expected. We thereby recommend that the state of electricity production and industrial development needs an urgent attention in the country at the moment. As a way of facilitating the economic development, it is recommended that Issues relating to electricity production and industrial development should be given priorities particularly in the budget scheme and because of this, substantial amount should be allocated to the electricity sector to be able to fix the state of electricity permanently in a good shape. And again, the industrial sector should be supported through the provision of adequate working tools including good electricity generation to be able to develop man power and improve productivity growth. Finally, it is important to mention here that Nigeria is a very important market to not only domestic investors but to international investors, therefore, efforts should be made to boost power generation in the country by government.

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