



**LAHDEN AMMATTIKORKEAKOULU**  
*Lahti University of Applied Sciences*

# THE POWER SECTOR AND INDUSTRIAL DEVELOPMENT IN NIGERIA

CASE: POWER HOLDING COMPANY OF NIGERIA

LAHTI UNIVERSITY OF APPLIED  
SCIENCES

Degree programme in International Business

Bachelor's Degree

Thesis

Autumn 2011

Alawiye Abideen Biodun

Lahti University of Applied Sciences  
Degree programme in International Business

ALAWIYE, ABIDEEN: The Power Sector and Industrial Development in Nigeria

Thesis of Bachelor of Business Administration, 63 pages, 1page of appendices

Autumn 2011

## ABSTRACT

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**Background:** The Power Sector has a great importance to our lives and takes a pivotal role in the economic transformation process. The need for electricity is paramount for the growth of a country, access to electricity as the basic form of energy supply to the masses is vital for the development of a nation's economy.

**Aims:** The logic behind this project is to critique the impact of Electricity and Industrial Development in Nigeria, also to find better energy sources for the production of electricity to rural areas in Nigeria by Power Holding Company of Nigeria.

**Methods:** The application of qualitative research method was used in this thesis to answer the research questions. A detailed structured interview was used as part of the data collection method. Analysis of the interview was used to acquire necessary information vital for the implementation of this project.

**Results:** The findings in this thesis indicate that there is a positive impact from the power sector on the industrial development of Nigeria. Also alternative energy source for the production of electricity is vital for effective supply of electricity in Nigeria through various renewable energy sources such as Solar, Wind, and Hydro.

**Conclusions:** A lesson to be learnt in this project is to encourage the growth of the Power Sector to achieve industrial development and economic growth.

**Keywords:** Electricity, Industrial Development, Energy, Economic Growth, Renewable Energy.

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## 1 INTRODUCTION

### 1.1 Background for the Thesis

For over two decades, Nigeria has experienced problem in the area of electricity generation, transmission and distribution. The extent of this is underlined by the fact that Nigeria is the largest purchaser of standby electricity generating plants in the world. (Braimoh and Okedeyi 2010)

A country where importing of electricity generators has become a traditional norm in the society shows the level of problem the Nigerian Government is facing. Recent reports show that highly placed political figures are behind the importation of electricity generators to Nigeria.

The Nigerian Television Authority (NTA) recently reported that the Federal Government plans to eradicate and minimize the importation of generators. This potential eradication is tied to improving the current energy sector, although we can point out that the Government is more concerned with the effect of pollution and other hazardous harm the generators cause to the society.

However, eradicating or minimizing generator importation is mainly not the solution to Nigeria's electricity problem. The Federal Government of Nigeria should gather resources and focus more on tackling the problem that leads to the importation of generators, which is POWER SUPPLY.

In addition, the Federal Government of Nigeria should subsidize other alternative energy sources such as SOLAR, WIND POWER, HYDRO POWER, which can easily address pollution concerns. The key point is focusing on solution, not fringe issues that will not benefit the Nigerian society.

Political instability has also hindered any possibility of progression in the energy sector, with the sacking of numerous high profile figures that have the interest of the Nigerian masses at heart. This selfish act was seen by Nigerian masses as a way the political leaders in this country manipulate the citizens to press on their

own self-interested agenda, while the society infrastructure remained in bad conditions and the people in abject poverty.

Fundamentally, the power sector, a component of which is the electricity sector of the economy has a great importance to our lives and takes central role in the economic transformation process. Currently power generation capacity in Nigeria is estimated to be around 6,000 megawatts, with average working capacity of 2,000 megawatts, to provide electricity for over 150 million people while in Finland the current megawatts is estimated to be around 36,000 megawatts, providing electricity for 5.5 million people.

Over the last two decades the Nigeria Energy Sector has been struggling to supply electricity in excess to the Nigeria population, as a result of this problem, to generate, transmit and distribute electricity has fallen short of the required standard

However, the shortage of electricity supply cannot be placed into a general context. Other factors include the present state of Nigerian Economy, which mainly focused on agricultural production and crude oil extraction.

The poor or near absence of physical infrastructure was also identified as a major problem of the power sector.

Based on several years of electricity research on the need of the nation, the idea to assess the supply of constant electricity to improve industrial development in Nigeria would greatly benefit the Nigerian energy sector in achieving industrial development and national electric power supply goals which entail raising the capital energy consumption over a period of 10 years.

## 1.2 Objectives for the Thesis, Research Questions, Limitations

The aim of this study is to examine the impact of the power sector in industrial development in Nigeria. Also, the aim is to find better energy sources for the production of electricity to rural areas in Nigeria by POWER HOLDING COMPANY OF NIGERIA (PHCN).

### **Research Questions**

The need for electricity is paramount for the growth of a country, access to electricity as the basic form of energy supply to the masses is vital for the development of a nation's economy and improving the standard of living with the Nigerian population.

This study is aimed at seeking answers to the following questions.

- I. Does the power sector have a significance impact on the industrial development?
- II. What impact does the electricity capacity utilization have on the industrial output?
- III. How can the power sector improve in finding solution to the electricity supply?
- IV. What kind of electricity sources can be used in rural areas of Nigeria?

### **Problems faced**

During the process of carrying of this research study, the author faces some problems, which prevent him from achieving the desired result.

The following factors have limited the effectiveness of this research study:

**Finance and Budget Information:** lack of financial and budget information about the power sector of Nigeria, has limited the effectiveness of this research because there was no adequate information of the financial aspect of the sector and this have limited the research on Government investment in the power sector.

Therefore the author has decided not to discuss any financial details about the power sector and the company.

**Number of respondent:** Reluctance of some officials providing sensitive information about the company. Also information about certain issues relating to the company were not readily available and even when available, they were highly protected.

### 1.3 Limitations

Since the subject of this study is wide, the author have decided to focus on the basis of the subject rather than going deeper into the operational mode of both the power sector and the power holding company of Nigeria. The author focuses mainly on how to find better energy source of providing electricity. Also, for the reasons presented among the problems, the author has decided not to focus on financial details of the company and the power sector of Nigeria.

**Data:** Since the study is based on secondary data. Certain constraints are faced in making definite statement. The problem was the inaccuracy and unreliability of data obtained from different sources.

### 1.4 Research Method and Data Collection

#### **Research Methodology**

Research methodology is the application of scientific procedure towards acquiring answers to wide varieties of research; it is also the method of obtaining relevant information by various research techniques, documents and scientific instruments, documents in both passive and active manner.



A method is a systematic and orderly approach taken towards the collection of data so that information can be obtained from those data (Jankowicz 1995), the methods used in gathering the empirical can be categorized into two groups: quantitative and qualitative methods (Jankowicz 1995). However, in carrying out this research study, the study covers the following important area, collection of primary and secondary data.

Qualitative research method will be used in this study.

The research had taken cognizance of the relevant institution that is concerned with power sector and industrial development in Nigeria, which is Power Holding Company of Nigeria (PHCN). The research involves all the activities of PHCN as contained in the data available in annual reports and other government agents concerned with data collection like The Central Bank of Nigeria 2011

### **Primary Data**

Primary data in this study can easily be referred to as the firsthand knowledge gather by the author at the preparation of this study. In carrying out this data collection, detailed questions were asked by the author from the participating guest at the seminar for promoting Solar Energy for electricity generation in Lagos metropolitan area in December 2009. Also a teleconferencing interview was conducted by the author on the 3<sup>rd</sup> of September 2011 with, Mr. BABATUNDE GANIU of Power Holding Company of Nigeria (PHCN) the Head of Operation Lagos – Ibadan District. With the immense help of my Supervisor I was able to get some fundamental information needed in the course of this research.

### **Secondary Data**

Collecting this data refers to qualitative and quantitative materials that are collected directly in relation to this research study and these materials include annual data from various statistical sources such as the Federal Office of

Statistics, Power holding company of Nigeria (PHCN) and Energy Commission of Nigeria.

Various data from the internet were also used in this thesis in order to be familiar with up to date information that are regarded as essential data in the area of my study.

In this process other energy related information and industrial development related information that were available on the internet considered to be essential are properly evaluated for the purpose of this research.

## 1.5 Theoretical Framework

Development of an economy is a process where by an economy enjoy growth in all economic sector, these development can be attributed to some measures like, adopting style to improve in the area of technologies, agriculture, transition from one economic based to different based, by improving the general standard of living of the society.

Common features of a developed economy is the rapid building and development of economic infrastructure, relatively high level of economic growth and security are both considered as an element of developed economy. To classify a country economy as a developed economy varies with opinion. Different nations are at different stages of economic development, some nations are highly industrialized, while others are in the process or focus mainly on agriculture.

Underdeveloped economy mainly focused on agriculture, underutilization of limited available resources, migration of citizens to developed countries, all this factors have contributed to slow economic development, while the need to revitalize the economy is imminent. (Bauer 2011)

The strategic role and policy of generation electricity in the development of an economy has always been appreciated by most developed nations, with the likes of France, Germany, and Italy. All these mentioned countries are well and truly developed countries that sustain the supply of energy to it environment for the purpose if industrial development. (U.S. Department of State 2011)

The power sector provides a platform for economic development; electricity has brought about development in all area of productions and services.

Electricity sources are everywhere in the world. These energy resources fall into two main categories, often called renewable and non-renewable energy resources. Each of these resources can be used as a source to generate electricity. Renewable energy sources are Wind power, Hydro power, Solar Power and Improved Biomass, while Non- Renewable energy sources are: Fossil Fuel, Oil and natural gas, and Coal. (Electricity forum 2011)

Electricity has risen to be the dominance source of industrial power, based on the fact that Electricity could be packaged in almost any size. Electricity has become indispensable to socio-economic and industrial development of any nation. (Odili and Mokwunye, 2003)

Industrialization is a sustained economic development based on factory production, division of labor, concentration of industries and population in certain geographical areas, and urbanization.

## 1.6 The structure of the Thesis,

There are five different chapters to enunciate the power sector and industrial development in Nigeria.

**Chapter one:** This chapter examines the introductory part of the study, which contains the introduction and background of my studies, the aims, objectives and the research questions. The scope and limitation of the study was also discussed during the first chapter.

**Chapter Two:** This second chapter contains the literature review part, this chapter focus primarily on the writer's scholar's perception in the subject matter. Different economic matters were discussed ranging from the development of economy to electrification and industrialization.

**Chapter Three:** The third chapter contains in-depth information about Nigeria electricity production, problem facing the supply of electricity in Nigeria and the projected structure for industrial development.

**Chapter Four:** This chapter contains the company presentation, introduction of PHCN, production, sales and distribution of electricity in Nigeria.

**Chapter Five:** final chapter conclude the study through a combination of the summary, recommendation and conclusion.

### **Scope of the Thesis**

The scientific aspect of any subject is embedded in the ability to withstand statistical test, therefore it is worthwhile to utilize econometric model in this study, examine the impact of power sector in industrial development in Nigeria. The major policies and measures applied to promote their development and strategies, the policies reforms needed to accelerate the pace of industrialization with emphasis on the capacity and industrial utilization of the nation's industries.

Based on the interest of Power Holding Company of Nigeria (PHCN) I intend to carry out a comprehensive study with the intent of making PHCN more effective in the area of power supply by doing this there will be an opportunity to re-energize the power system in Nigeria.

## 2 DEVELOPING ECONOMIES

### 2.1 The Development of Economy

The Development of an economy is an open expression, which often refers to the effort of political leaders to promote the standard of living of the society, this various effort can involve several areas including development of human resources, provision of social infrastructure, environmental sustainability, social and health safety, education and other initiatives. “Economic development is a policy intervention endeavor with aims of economic and social well-being of people” (Amartya Sen. 1983)

The scope of a developed economy includes the process and policies by which a nation improves the economic, political, and social well-being of its people (O'Sullivan and Sheffrin 2003).

The development of an economy involve economic growth, The increase in income by individuals, attaining a standard of living equal to that of industrialized countries, this development can also be considered as a static theory that documents the state of economy at a certain time (Schumpeter & Backhaus, 2003)

Many industrialized nations focus strongly on the need for qualitative measures for economic development, usually these measures refers to adoption of new technologies, transition in economic based, general improvement in the living standard of the society. The need for energy to aid development is paramount in a developed economy. Increasing energy consumption has long been tied directly to economic growth and improvement in human welfare, the demand for energy services in developed countries is expected to rise considerably, especially in the agriculture and technology sector, which already have a growing demand for services.

However the focus point on this theory will be to access the energy sector of the developed economy. Energy provides services to meet many basic human needs, particularly heat, motive power (e.g. water pumps and transport) and electricity. Business, industry, commerce and public services such as modern healthcare, education and communication are highly dependent on access to energy services.

Meeting energy demand in developed countries thus presents a significant challenge. However, there are a number of the technological options available to provide the energy required. The availability of adequate finance is one of the main challenges in meeting current and future demand for energy in developed economy; Current sources of energy finance in developed countries include governments, multilateral institutions, and private investors.

(Parliamentary office of science and technology 2003)

Given the scale of the challenge, it has been generally acknowledged that the task of ensuring adequate energy supplies is seen as one for the policy makers. The key to this challenge includes structural adjustment and energy sector reform programmes. Furthermore, the World Bank points out that energy investment increased almost 4-fold in the early 1990s, it later declined significantly as a result of a global financial downturn in 2006. The need for rural and urban electrification in modern society has a substantial impact in terms of increase in productivity.

### 2.1.1 Developed Economy

Developed economy is an economy enjoying sustained economic growth and security. Some of the common characteristics of a developed economy are low birth rate and higher life expectancy, high level of literacy and a well trained workforce and the export of high value added goods. High gross domestic product is also a common measure of a developed economy. (Business dictionary 2011)

However a developed economy is an economy that has a high level of economic development in a classified state, according to some criteria. Countries classified



as being developed economy, is quite open to debate. However there are many ways to further the explanation of a developed economy in a developed country. Different nations are at different levels of economic growth. Certain nations are highly industrialized, while in other nations the main occupation of the people is agriculture.

The industrialized nations are wealthy and rich and have been able to get very high levels of income and standard of living while agricultural nations are generally considered as poor countries, with the majority of the country population living in abject poverty. There are some exceptions to this general example, Argentina, New Zealand and Australia etc. are countries that developed predominantly on agriculture but still have large per capita incomes and high standard of living. In the levels of the economic growth, these differences are the result of the difference in the physical and non-physical environments of many nations, though nonphysical environments like science and technology, political situation, social structure etc., are more significant in this respect. (Saraswathi 2011)

On the basis of the level of economic growth or development, many nations of the world are divided into two general kinds of economies. Which are Developed economies and Under- Developed economies.

Developed economies include most parts of the Anglo-American and Western Europe countries. These nations support more than eight percent of the world population including Canada and United States of America in North America, West Germany, Denmark, Belgium, United Kingdom, and Netherlands, Switzerland in Europe and New Zealand in the Pacific Ocean do not possess all the main characteristics of developed economies. (Saraswathi 2011)

However, there many similarities the developed nations shared or have in common. The Dominance of commercial and industrial population, agriculture is highly mechanized, so the yield or productivity per capita is very large in this sector of the economy. Agriculture is highly commercialized and even twenty percent of the labor force engaged in agriculture produces such large quantities of

agricultural products as are enough not only to meet their personal needs but also leave sufficient surplus for trade and even export in certain cases. The means of communication and transportation are highly developed. (Saraswathi 2011)

The high expectation of life in this region: The birth rates are generally low so that the proportion of the people in the working age in the total population is exceedingly high while the proportion of children and young persons in the total population is considerably low. “The citizens of the highly developed nations enjoy the highest expectation of life in the world. This is the result of high living standards and better medical facilities, enjoyed by the people of these nations” (Saraswathi 2011).

Other similarities include the urbanization of most cities which is mainly due to the industrial and commercial character of the population.

Some common features of developed economies in well developed nations are;

**Low unemployment rate:** As there are many exports from developed countries, there are many jobs to deal with the demand. This increases the amount of jobs that are created out of overseas trade. Low unemployment rate is good for both the individual and the communities, workers feel better about this situation and can relatively afford to spend within their means, with low unemployment rate workers can demand higher wages and feel more secure in their jobs. The economy benefits from increased activity and governments receive more tax as a result of more workers. The tax generated from workers can then be spent on schools or hospitals and other social infrastructure. Low unemployment also tends to have a positive effect on social divisions in the society. (Saraswathi 2011)

When unemployment is low, it means that the economy is in good shape because there is demand for labor. Firms are busy and workers are able to negotiate better wages. The overall economy benefits from increased tax receipts both from firms and workers and lower spending on welfare. People in steady jobs tend to spend more on new homes, cars or holidays, thus giving the economy a further boost.

We could also argue that in times of low unemployment, workers have more power to demand higher wages because they know they cannot be easily replaced. Conversely, during high unemployment businesses have more bargaining power because both they and their workers are aware of the competition and that replacing workers is easier. Also the need to lower spending on welfare where more people working means fewer people claiming welfare. With lower welfare spending, governments can put more money into new schools or hospitals. Increased spending on health care and policing, which suggests that areas with high unemployment rates tend to have higher crime rates, too, coupled with the local population's poor health.

The social and psychological effect of low unemployment rate cannot be totally ignored; high unemployment has been linked to psychological and physical disorders, divorce, suicide and crime. (Baumol & Blinder, 2007)

**Better healthcare and quality of life:** There are generally better healthcare systems in developed countries and greater access to healthcare both locally and inexpensively. This helps to increase the life expectancy in these more developed countries. Working on strategies to ensure the provision of the best level of care and improve health within our community. This includes a range of community health initiatives and expanding and renovating our current hospitals and care facilities

**Energy Sector:** Electricity is indispensable to socio-economic and industrial development of a nation, and the strategic role of it and its policy in developed economy has been appreciated by these nations, example, Finland, Germany and France.

The developed world is irreversibly dependent on electricity. Electricity went from a novelty to a convenience to an advantage to an absolute necessity. Despite the headlines about addiction to oil, developed countries are more dependent on electricity. Dependency on electricity is well beyond the point of no return, there is no alternative to electricity. The electricity economy is far from its peak. In fact, three powerful trends are accelerating its growth. The first is the population explosion the growth in the number of people needing electricity. The second is

the “electrification of everything” the growth in the number of devices that require electricity. And the third is “expectation inflation” the growth in the sense of entitlement that turns electrical conveniences into essentials demanded by all. (Berst & Michael 2008)

In developed countries, for example, electric utilities and energy planners have combined planning for electricity capacity increases to meet growing demand with cost effective reductions in the use of electricity (Lawrence Hill 2003). This combination reduces the total amount of electricity needed yet maintains the same level of electricity services. This planning process is called integrated resource planning (IRP). Many Developed economy have been able to alternate the production of electricity, due to the financial involvement, the need to introduce other renewable source of producing electricity, such as wind power, solar energy and Water (hydroelectric).

To some extent, many developed countries use electricity and its pricing as an economic development tool. As a matter of policy, they set prices below costs for major consumers, such as industry, to foster economic development, rather than at cost-based levels to reduce electricity demand. In the process, the national governments subsidize electricity production.

### 2.1.2 Under Developed Economy

Under Developed economy is an economy with little or no sustained economic growth and security, these economies include the whole of Africa with the exception of South Africa, the greater portion of central and South America and virtually the whole of Asia-pacific excluding, Japan, Korea and Israel.

The rate of economic growth is very low in these nations. National income grows at the rate of three percent per annum. But this growth is normally neutralized by increasing population and the net increase in per capita income is about one percent only. Various underdeveloped countries are trying to increase their rate of economic growth through central planning. The rate of savings in most of the

underdeveloped nations is very low. In fact, there is no saving for the large mass of people, as savings are in the hands of landowning classes. The lack or absence of financial institutions like banks and insurance companies also proves detrimental to the mobilization of savings in the rural sector.

The dominance of agricultural population, Agricultural economies are very essential in underdeveloped economies. Agriculture everywhere, accounts for a very high proportion of the working population. It is about sixty percent in many of the cordilleran states of Latin America, seventy percent in much of the south east, east and south Asia and a little higher percent in Africa. Techniques are normally primitive and there is practically no utilization of modern technology in agriculture. The holdings are normally small and of uneconomic size.

Low expectation of life - The expectation of life at birth is only half than that in a highly developed country. This results in the structure of population with high proportion of young persons and children who encompasses huge burden in the economy and leads to reduce the standard of living. (Saraswathi 2011).

Some common features of under developed economies in well less developed nations are:

**Poverty:** The economy in general is poverty ridden. Poverty is reflected vividly in its low per capita income. Poverty does not reflect only by low per capita income but also by many other indicators; such as poor health, clothing, shelter and lack of education and medical facilities. Majority of the population is living in extremely bad conditions, 60% of population, particularly in rural areas, does not have access to clean drinking water, and more than 30% has no sanitary disapproval facility.

According to economic point of view, the economy is backward almost in all its sectors. Agricultural sector, the backbone of the economy, is yet in developing state. Only, so far, service sector has shown reasonable progress. The natural resources sector of the economy is also under-developed for most of the resources

are either non-utilized or under-utilized. The contribution of natural resources towards GDP hardly comes to 1.4 %.

**Education and Economy:** An under developed economy needs to invest 10 to 15% of net income to grow and many cannot manage this kind of investment, debt for economic growth has always been badly financed and not invested wisely. Various loans and grants from developed countries often come with strings attached, benefiting the developed country, maintaining neo-colonial economic relationships. Social infrastructure (roads, drainage, sanitation, and fixed telecommunications) is too weak to sustain social and economic development.

In under developed economy, educational provision is very low or inadequate for economic or information needs, this result to the Inability to produce educated workforce for technological growth, Inequality and absence of women's rights undermine essential birth control, education, resistance to custom and good health. While the major problem is the networks of corruption, siphoning of funds and reduce economic efficiency

### **Energy and Electricity:**

The need to increase access to energy in under developing countries has proved to be a challenging issue within the international development community.

Inadequate access to energy also exacerbates rapid urbanization in most under developed countries, by driving people to seek better living conditions.

“It has been estimated that around 1.6 billion people in this countries lack access to adequate energy services. 80% live in rural areas, predominantly in sub-Saharan Africa and South Asia”. (UK Parliament 2002). Around half of all people in these countries are dependent for fuel on wood, dung and crop residue, collectively known as ‘traditional biomasses. Three quarters of these live in China, India and sub-Saharan Africa. The International Energy Agency (IEA) has forecast that use of traditional biomass will decrease in many countries, but is likely to increase in South Asia and sub-Saharan Africa alongside population growth.

Modern energy sources, such as electricity and petroleum-based fuels, generally provide only a small part of the energy use of poor rural people. This is mainly because they are too expensive and because it can prove difficult to achieve regular supplies to isolated rural communities. We could also argue that the availability of adequate finance is one of the main challenges in meeting current and future demand for energy in under developed countries.

In the case of an existing energy services, the major barrier to this will always be the affordability of the people, since the economy is poverty driven, it had to suggest a sustainable way of maintaining the cost of the services, in India for instance, although electricity networks are technically within reach of 90% of the population, only 43% are actually connected, as many remain unable to afford the cost of connection. Where extension of electricity networks is not viable (in remote rural areas), many of the technologies that are best suited to provide energy services to those areas (e.g. solar or wind energy), have high initial capital costs as well as maintenance and replacement costs.

## 2.2 Energy Sector in Economic Development

According to Bihemo (2010) the aim of this chapter is to examine the impact of energy in economic growth and more generally the role of energy in economic development. The energy sector plays a major role in economic transformation of a country, a driven force behind a sustainable economy. The projected growth of an economy depends heavily on the performance and growth of the power sector.

Various policies that promote a secure, competitive, and reasonably priced energy supply will help attract, retain, and expand the growth of an economy. These include policies that support reducing energy costs to consumers, improving the reliability and maintaining its sustainability in developing energy related issues. In addition to these policies, promoting cost effective energy efficiency will improve, energy resource development, with the growth in electricity demand that has occurred over the last decades, adequate and reliable energy supplies are important to economic development.

In order to sustain this economic development, additional energy resources, including electricity generation and infrastructure improvements, must be effectively utilized. Energy is one sector with great impact in the economy; the energy sector can influence the economic development mainly in two ways, Capacity for large investments and price of energy, the investments in the energy sector can stimulate national enterprises and the industrial capacity, while the price of energy is pervasive to all sectors and influences the competitiveness of the country.

Energy is an essential ingredient for economic development. As both agricultural and industrial activities increase, the demand for energy similarly increases. In the developing world provision of a greater access to energy has been suggested by some that will help grow their economies and improve the lives of the poor. As a result progress is being done to provide energy to as much percentage of the population as possible by individuals, firms and governments incentivized from inside and outside the countries and motivated by financial or humanistic interests.

The primary objective of energy sector in economic development is to formulate strategic goals for the development of the energy system and identify the avenues to achieve those goals for sustainable development. It is important to note that, the energy sector is mainly responsible for the provision of energy to a country through various means, as the demand for energy grows; the energy sector is expected to play a central role in fuelling the economic growth and development of a country.



### 2.3 Energy sources of Electricity

Sources of electricity are everywhere in the world. There is a range of energy resources available to generate electricity. These energy resources fall into two main categories, often called renewable and non-renewable energy resources. Each of these resources can be used as a source to generate electricity, which is a very useful way of transferring energy from one place to another

**Non-renewable** sources of energy can be divided into two types: fossil fuels and nuclear fuel.

#### **Fossil fuels**

Fossil fuels are found within the rocks of the Earth's surface. They are called fossil fuels because they are thought to have been formed many millions of years ago by geological processes acting on dead animals and plants, just like fossils. Some examples of fossil fuels are coal, natural gas and petroleum. This source is currently available and it is not dependent upon the weather. Some of the problems of fossil fuel use are that it causes pollution, it is a non-renewable resource and it needs to be mined from the earth.

#### **Oil and natural gas**

Oil and gas are chemicals made from molecules containing just carbon and hydrogen. All living things are made of complex molecules of long strings of carbon atoms. Connected to these carbon atoms are others such as hydrogen and oxygen. A simple molecule, called methane ( $\text{CH}_4$ ), is the main component of natural gas. Crude oil (oil obtained from the ground) is a sticky, mushy black stuff. It contains many different molecules, but all are made of carbon and hydrogen atoms. (Electricity forum 2011)

Natural gas and crude oil can be found in many places around the world, such as the Middle East, Africa and South America. Crude oil is a mixture of different chemicals and is usually separated out into fuels such as petrol, paraffin, kerosene

and heavy fuel oils. The oil-based fuels provide less energy per kilogram than natural gas. Both oil and natural gas produce carbon dioxide, which is a greenhouse gas.

Oil and gas are non-renewable: they will not last forever. New sources of oil and gas are constantly being sought. It is thought that the current resources under the North Sea will last about another 20 years and the world resources will last for about 70 years.

**Advantages:** These sources of energy are relatively cheap and most are easy to get and can be used to generate electricity.

**Disadvantages:** When these fuels are burned they produce the gas carbon dioxide, which is a greenhouse gas and is a major contributor to global warming

## **Coal**

Sources of electricity can include coal, which mainly consists of carbon atoms that come from plant material from ancient swamp forests. It is a black solid that is reasonably soft. You can scratch it with a fingernail. It is not as soft as charcoal, however, and is quite strong. It can be carved into shapes. There are different types of coal. Some contain impurities such as sulphur that pollute the atmosphere further when they burn, contributing to acid rain.

Coal can be found in parts of the world that were once covered with swampy forests, such as the UK, China, USA, Europe and Russia. South Africa also has relatively large deposits.

When coal burns it produces mainly carbon dioxide, some carbon monoxide and soot (which are unburned carbon). Many coals when burned produce smoky flames. Their energy content weight for weight is not as great as oil. When coal burns it produces more carbon dioxide than oil.

Advantages; Coal is relatively cheap, with large deposits left that are reasonably easy to obtain, some coal being close to the surface. It is relatively easy to transport because it is a solid.

Disadvantages; some sources of coal are deep below the ground, as in the UK. They can be difficult, costly and dangerous to mine. Also burning coal without first purifying it contributes to global warming, as well as to the production of smog (smoke and fog), which is harmful to health.

### **Renewable energy**

Renewable sources of energy can be divided into; Wind power, Hydropower, Solar energy, Biomass.

**Wind power;** is produced by the wind turning a turbine. Wind power, through using windmills, has been known for many centuries. This source of energy produces almost no pollution, and it is easy to capture in many parts of the world. Wind power convert wind energy into a useful form of energy, such as using wind turbines to make electricity, windmills for mechanical power, wind pumps for water pumping or drainage, Also, in order to be effective, the wind speed at a power site has to be over 12 kilometers per hour. Finally, this source of power is costly and requires special equipment and high level of maintenance.

**Hydropower;** Hydroelectric energy is produced when water falls from a high place to a low place. A hydroelectric power station contains a turbine driven by falling water from a dam. The turbine drives the generator. This form of energy produces little pollution; in addition, it does not ruin the water. The water still can be used for other purposes. Hydroelectric power does not cost any more than fossil fuels. Another advantage is that there are a lot of lakes or rivers where a dam can be built to produce energy. One disadvantage is that fish, such as salmon, cannot climb over the dam, so the dam changes the environment. Another disadvantage is that when a dam is built, a huge area is flooded to make a lake, so the water displaces the people and animals living there.

**Solar energy;** Solar energy is the energy that comes from the sun. We capture solar energy through solar panels. This energy produces no pollution; also it doesn't taint anything. About the equivalent of 22 million barrels of oil of solar energy hits the United States alone per day. This might sound like the perfect energy but it is costly and besides, you can't be sure that the sun will shine brightly without cloud cover everywhere in the country every day. Solar energy is broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

**Biomass;** is biological material from living, or recently living organisms. As an energy source, biomass can either be used directly, or converted into other energy products such as biofuel. Biomass is plant matter used to generate electricity with steam turbines. Biomass is carbon, hydrogen and oxygen based. Biomass energy is derived from five distinct energy sources: garbage, wood, waste, landfill gases, and alcohol fuels. Biomass can be converted to other usable forms of energy like methane gas or transportation fuels like ethanol and biodiesel. Rotting garbage, and agricultural and human waste, release methane gas - also called landfill gas" or "biogas. Biomass used for electricity production ranges by region. Forest by products, such as wood residues, are popular in the United States, Agricultural waste is common in Mauritius (sugar cane residue) and Southeast Asia (rice husks). Animal husbandry residues, such as poultry litter, are popular in the UK. (Electricity forum 2011)

#### 2.4 Electrification and Industrialization

It's very clear that electrification is a prerequisite to modern industrialization; hence we cannot minimize the importance of this notion. It is quite clear that there is no nation which can develop and industrialize without sound electric base.

Today we depend on electricity for basic needs such as food, water, shelter, communication, employment and health care. Those needs are served by infrastructures for food preservation, water treatment, heat and light, phone service, Internet, offices, factories, hospitals and emergency response, to name a few. Yet all of those essentials are without electricity. We could easily argue that population growth is fueling the growth in electricity demand.

The developing world is rapidly catching up to the electricity hungry lifestyle of the industrialized world, Through the electrification of everything which increase the dominance of electricity as the preferred form of energy, Several developments have driven electricity into every aspect of our lives, most notably motors, microprocessors and microwaves. And now another massive change is about to begin: the switch to electric transportation.

In an economic sense, energy performances add value to intermediate products as they are progressively transformed into final consumer goods, electric power is of fundamental importance to the economic, social and industrial development of a nation, electric power is so vital to all aspect of human life, production and service delivery contribute no small measures to the standard of living, as such the right to an adequate standard of living cannot be realized without general electrification.

Electric power is properly considered as a key element of the so called Second Industrial Revolution, having considered agriculture to be the first industrial revolution, Modern industrial societies are commonly described as energy intensive, which is, perfectly accurate. A central feature of industrial development over the past two decades is that it has been characterized by a growth in the amount of energy utilization per worker, or per person. (Rosenberg, 1998)

Electricity's rapid rise to dominance as a source of industrial power was based on a number of compelling advantages. First and foremost, electricity could be packaged in almost any size. In terms of availability, future prospects for electricity appear to be reassuring. "In the industrial world electricity is already

widely available at prices that are typically lower in real terms than they were twenty years ago." (Joskow 1997). The demand for energy in this particular form is further reinforced by its energy saving role that has been emphasized thoroughly, as well as its labor saving features that have been neglected. Moreover, the many possibilities for building "environmentally friendly" new technologies on electrical foundations appear likely to enhance the demand for electricity.

Industrialization on the other hand, is the transformation of a society or country from a primarily agricultural society into one based on the manufacturing of goods and services. Industrialization includes the use of technological innovation to solve problems as opposed to superstition or dependency upon conditions outside human control such as the weather, as well as more efficient division of labor and economic growth. (Investopedia 2011)

An area where industrialization had a massive effect was in Eastern Europe. It emerged as a need to modernize and unify Europe. Although Britain led industrialization at first, it quickly exploded from Spain all the way through Russia. Industrialization has brought many changes and even modernizes most countries; it also had its negative effects. It is evident that the positive affects outweigh the negative. If not for industrialization most of Europe would be in the dark. And industrialization also made the world much smaller by most of the inventions such as the steam engine and mass expansion of railroads. (Economic Change and Effect 2011).

### 3 NIGERIA AND ENERGY SECTOR

Nigeria is situated in West Africa. It borders the Gulf of Guinea and lies between Benin and Cameroon. Nigeria is also bordered by Chad and Niger

#### 3.1 Nigeria and Energy Sector

##### NIGERIA: General Information

Capital(s):	Abuja
Population:	155,215,573 (2010)
Area:	923 768 Km <sup>2</sup>
Currency:	230 naira = 1USD
Language(s):	English, Hausa, Ibo, Fulani and Yoruba.
Time Zone:	GMT+1h00
ISO Code:	NG
Dialing Code:	+234

Table 1: Nigeria general information

#### **Politics**

Nigeria has been under civilian rule since 1999 after a succession of military leaders. President Jonathan Good luck assumed power on 6 May 2011. He is both the chief of state and the head of government. The government is democratic organized in a federal manner.

Religious divisions that exist within the population rule the political situation in the country. There have been various incidents of violence between Muslim and Christian members of the population.

Nigeria's relations with its neighbors can be somewhat strained although the situation does not often deteriorate into violent incidents. The main areas of dispute surround the issue of border demarcations (Mbendi 2011)

### **Economy**

Nigeria has a dual economy with a modern segment dependent on oil earnings, overlaid by a traditional agricultural and trading economy. At independence in 1960 agriculture accounted for well over half of GDP, and was the main source of export earnings and public revenue. The oil sector, which emerged in the 1960's and was firmly established during the 1970's, is now of overwhelming importance to the point of over-dependence: it provides 20% of GDP, 95% of foreign exchange earnings, and about 65% of budgetary revenues. Competition between ethnic and regional groups for power and access to the country's oil wealth are increasing in intensity. (Mbendi 2011)

The largely subsistence agricultural sector has not kept up with rapid population growth, and Nigeria, once a large net exporter, now imports food. Economic growth since the early 1970's has been erratic, driven primarily by the fluctuations of the global oil market. During the 1980's and 1990's Nigeria faced growing economic decline and falling living standards, a reflection also of political instability, corruption, and poor macroeconomic management (most notably the failure to diversify the economy). (Mbendi 2011)

### **Industry Sectors**

Nigeria is a country rich in natural resources; consequently most industry activity revolves around these. Agriculture is an important industry involving a large percentage of the country's workforce. Oil is the country's most important natural resource and generates up to 95% of Nigeria's revenues. The country is a member of OPEC and is the largest oil-producer in Africa. The continued increase in crude oil means continued growth in this sector.



## **Investment**

Nigeria offers the interested investor Africa's largest domestic market as well as the additional attractions of a low-cost labor pool and abundant natural resources. The Foreign Exchange Decree of 1995 re-established the foreign exchange market. Foreign companies can source foreign exchange at the parallel market rate. Companies are allowed to hold domiciliary accounts in private banks. Foreign investors are allowed to bring capital into the country without requiring prior government approval.

The degree of foreign investment in the country is relatively small considering the abundant natural resources. The legislation passed by the government has helped to improve this situation slightly, along with legislation; economic liberalization has also been a government priority. Under the government's improved investment plan, markets other than those in the energy sector, namely, telecommunications, have been developed. (Mbendi 2011)

## **Trade**

Nigeria's main export products are petroleum and related products as well as cocoa and rubber, the country's main trading partners include the US, India, Spain, Brazil and France.

Nigeria's main imports include machinery, chemicals, transport equipment, manufactured goods, food and live animals. Nigeria has signed various trade agreements with various countries. The country's main trading partners are the United States, Brazil, Spain, China, United Kingdom, the Netherlands, France and Germany. (Mbendi 2011)

## **Communications and Infrastructure**

The state of the country's rail services is not good because of years of neglect. There are however, projects underway in order to rectify the situation. A large

amount of the road network is also unpaved and has suffered due to extraordinary use as a result of railroad neglect.

Nigeria's telephone system is below international standards although there are efforts to improve it. The privatization process as well as efforts to encourage competition continues is crucial to the development of the sector. The main problem is the need for expansion

### **Risk**

One of the main areas for concern in Nigeria is the country's banking sector. A large degree of fraudulent activities have occurred in this sector. The government has made efforts to stem the rise in crime. These measures have involved the appointment of ministerial commissions as well as the formation of specialized task forces. The problem remains however and it is best to avoid dealings with anyone whose credentials are not fully investigated until such time as the matter is properly resolved. A large dependence on oil continues to pose a problem for the Nigerian economy and the country is especially vulnerable to fluctuations in the international oil price. (Mbendi 2011)

#### 3.1.1 Industrialization and development Process

Industrialization is the process by which goods and services are produced to meet human needs in a given society at a particular time, which cuts across different activities such as extractive, manufacturing and services. Industrialization involves extensive technology based development of the productive system of an economy. Industrial development, therefore represent a deliberate and sustained application suitable for technology, management techniques and other resources to move an economy from the traditional low level of production to a more automated and efficient system of mass production of goods and services. Rapid industrial development has become the main focus of economic development because of its potential benefits. It enables a country to utilize it

resources and depend less on the external sector for its growth, development and sustenance.

To quantify the industrial electric power needs, a simple but effective assumption was made to use indexation ratios. For most industrial economies, The Index of Industrial Consumption (IIC) to direct consumer consumption is defined as:

$$\text{IIC} = \text{KWhr per Industrial worker} / \text{KWhr per consumer.}$$

Since the electric power supply by PHCN would not meet either the demand of rural or urban needs not to mention the demand for industrial growth. Therefore based on the demand of electricity, the electric consumption for residential end user would be approximately 1150KWhr. The existence of a wide range of IIC 36 depending on the level of industrialization shows that the United States the most productive society is between 18 and 24.

For the purpose of forecasting, the additional electric demand for the industrial sector, an IIC ratio of between 14 and 20 would be applicable to Nigeria. If we assume approximately seven percent of the population is engaged in the core manufacturing sector then the electric power needs of the residential customer must be doubled to meet the integrated demand for both residential and electric power based load. The equation above is useful because it embodies a measure of productivity.

The quantity of electric power consumption per worker needed to kick into gear an intense industrial sector must greatly exceed the electric power consumption per consumer. The rate of load growth in this sector must also out space the load growth for the consumer at large for sustained growth. In present Nigeria, it's a common knowledge that all banks, major retailers, and manufacturers maintain stand by generators, the operational mode of the stand by generator depends on the availability of power from PHCN, since Power Holding Company of Nigeria frequently has power failure, resulting in high rate of shutdown and start up for the stand by generators. The frequency of startup and shutdown of these generators makes them highly susceptible to higher rate of failure modes.

Furthermore, the cost of operation is significantly higher compared to utilization of micro turbine.

Nigeria's Industrialization and development process can be summarized using the Gross Domestic Product (GDP) per capital figures from 1960, when Nigeria had its political independence to date. The GDP per capital rose steadily from \$283 in 1960 to highest figure of \$860 in 1982 and thereafter declined steadily to an all-time lowest figure of \$250 in 1989, 1996 is put at \$234 below the world's average of \$350 for low income economies. (CBN 1999)

Nigeria's unimpressive performance in industrialization and development process since independence can be attributed to many social, political and economic factors. There has been absence of indigenous solutions to Nigerian peculiar economic, political and cultural problems. The over dependence on petroleum (oil and gas) resources for our economic development to the utter neglect of agricultural, solid mineral and other energy resources (Ukpong 2002).

So far Nigerian developmental process has been characterized by over ambition and lack of moderation in pursuit of ill-articulated and economically isolated project with high external inputs resulting in a very high incidence of capital flight. Until recently some quarters of the Nigerian population have all had the misconception that government should always take the lead in the development process as well as operations of almost all sectors, especially the energy, mineral, transport and communications sectors of the economy.

Recently, economic policies which are to initiate a gradual reintegration of the private sector into the main stream as the leading operator in the nation's industrialization and development process are yet to be actualized. (Sesan Ayodele, 1998)

### 3.1.2 Electricity Production in Nigeria

Electric power is the engine that drives industrialization, which improves communication, helps innovation in science and Technology, provides sound healthcare delivery system and improves citizen's standard of living. Since Electric power is the engine that drives industrialization, a stable Electric power supply is the key for Nigeria to become one of the most 20 developed economy in the world. But it's very unfortunate that the biggest problem in Nigeria is electricity crisis, a crisis without end. (Emovon and Kareem 2008)

A power system is known worldwide, except in Nigeria, as a versatile relatively cheap and cost effective means of providing energy in any Nation or community. It consists of three main hierarchical stages or subsystems known respectively as generation, transmission and distribution. It is effective and indispensable machinery for the rapid industrial and economic growth of any nation. The total grid capacity of 8,876 MW with only 3,653 MW available as at December 2009, thus available power is less than 41% of the total installed capacity.

However, the electricity supply in Nigeria is characterized by frequent power failures and load shedding. Electricity production in Nigeria over the last 40 years has varied from gas-fired, oil fired, hydroelectric power stations to coal-fired stations with hydroelectric power systems and gas fired systems taking precedence. Presently there are a total of 16 power plants in Nigeria 10 owned by Power Holding Company of Nigeria and another six plants belonging to independent power producers. This is expected to generate 6,426 MW of electricity in order to achieve the presidential target of 6,000 MW of electricity by December 2010.

### 3.2 Investment in Power Sector

The Federal Government has concluded plans to increase electricity tariffs by April 2011 as part of the measures to stimulate more investments in the power sector, in accordance with the roadmap launched last year. About \$22 billion is also spent annually by Nigerians to fuel generators for power generation annually.

Putting this in perspective, President Jonathan Good luck has lamented that a whopping \$13 billion (about N1.9 trillion) is being spent yearly by Nigerians to generate power from generators.

Despite the huge amount, less than half of Nigerians have access to electricity. Regrettably, the country only requires about \$10 billion (about N1.5 trillion) yearly in investment over the next few years to develop power generation, distribution and transmission capacities.

The federal government's privatisation drive for the nation's power sector has continued to attract investors with the latest being a Nigerian consortium, Proglobal International Power Consortium, which has disclosed plans to invest about \$600 million in the sector.

Chairman of NERC, Dr Sam Amadi, told the delegation that the Nigerian business environment had improved tremendously in the last 10 years and given the deficit in power supply as well as the cost reflective tariff regime recently put in place by the federal government, noting that now was the best time to invest in the sector. (All Africa.com 2010)

He observed that the US has in recent years refrained from substantial investment in Nigeria, while China and other countries were now making huge investment in the country. He said adequate measures had been put in place by the Federal Government to ensure adequate power generation, transmission and distribution, noting that Nigerians had started witnessing improved electricity supply across the country.

The Federal Government has indicated that only competent and reputable companies would be allowed to handle the nation's power sector to ensure efficient and effective electricity supply.

### **Investment in Capital Subsidies**

Under the third plan PHCN had a projected capital programme of some 927.82 Million Naira with its rural electrification component accounting for 132.33

million naira. However, the actual expenditure on power was some 1.66 Billion Naira, how much of this was to be generated internally in PHCN and how much was to be obtained as loans from the federal government and external source is not stated.

Year	Loan Principal in Million Naira	Interest rate in Million Naira	Principal Repayment in Million Naira
2003/4	212.90 million naira	3.39% for 5 years	3.76 per annum due from 2008
2005/6	120 million naira	3.1 % for 5 years	3.33 per annum due from 2010
2008/9	240, million naira	7.2% for 5 years	8.00 per annum due from 2012

Table 2: Investment in power sector (PHCN Report)

### 3.3 Problem Facing the Supply of Electricity in Nigeria

The primary cause of the current difficulties in meeting the national power demand continually is the aged plants, which have broken down or have been berated because of lack of funds to carry out major overloads. The minor repairs carried out are not sufficient to provide reliable and sustainable power generation. (Sesan Ayodele 1992).

The generating plants in the power stations from 1960 have become obsolete and spares part are unavailable while most of them ought to have been written off. The decline in the funding of the electric power sector since 1987, which has caused no growth of the National Grid Facilities, is a big issue to the production of electricity in Nigeria.

The Low tariff operated by the authority as a result of governments subsidies to electricity on consumers and the exchange rates have further compounded the problem. The availability of hydro plants has been good but the constraint in

hydropower generation is the water in the reservoirs, which is seasonal and dependent on nature. This is why the Hydro reservoirs are used judiciously up to July when additional water inflows are expected.

#### Problems of power generation in Nigeria

Some of the problems confronting power generation in Nigeria are itemized below:

**Poor maintenance planning:** No adequate schedule to maintain the aging plant grids, which are quite not up to date with service performance for the production, transmission and distribution of electricity.

**Inadequate funding:** The Federal Government of Nigeria has failed to realise the need to inject sufficient fund for the course of power generation in Nigeria, as a result of this, generating power has become a big and major problem for the power sector. Siphoning financial allocation to the sector by it personnel is also a major problem, which need to be address as soon as possible.

**Poor electricity pricing:** Considering Nigeria is one of the poorest countries in the world, the price of electricity in Nigeria is quite unaffordable for majority of the population, and electricity pricing is just too high for the masses,

**Monopoly:** Power Holding Company of Nigeria, has the sole responsibility of Producing, Transmitting and Supply electricity to the Nigeria masses, as a result of this, there is limited chances for private investors to invest properly in the production of electricity in Nigeria, despite the clamour for private investor to boost the general performance of PHCN, it has continuously yield no positive response.

**Lack of energy mix:** Lack of various energy sources is a major problem in the energy sector of Nigeria, The availability of energy resources such as crude oil, which the power sector mainly focus on, resulted in no alternate use of other source of energy for electricity usage.



**Vandalization of Generation facilities:** Recent religious crisis in the northern part of Nigeria as resulted in the vandalization of energy facilities, ranging from breaking the power plant and also destroying the regional office of the energy commission of Nigeria.

**Poor inventory management:** Unclear policies and disorganized accounting operations has become a major problem to the power holding company of Nigeria.

This could also be attributed to power failure is the over loading because of the increasing population of people using electricity in Nigeria. Other factor includes:

1. Faulty wiring of residential building
2. Damaging of PHCN underground cable by road construction
3. Theft and Vandalization of PHCN equipment
4. Low gas pressure and water level
5. Illegal connection of electricity
6. Lack of investment opportunity
7. Lack of sound payment structured

## 4 CASE COMPANY: PHCN

### 4.1 Introduction of PHCN (Power Holding Company of Nigeria)

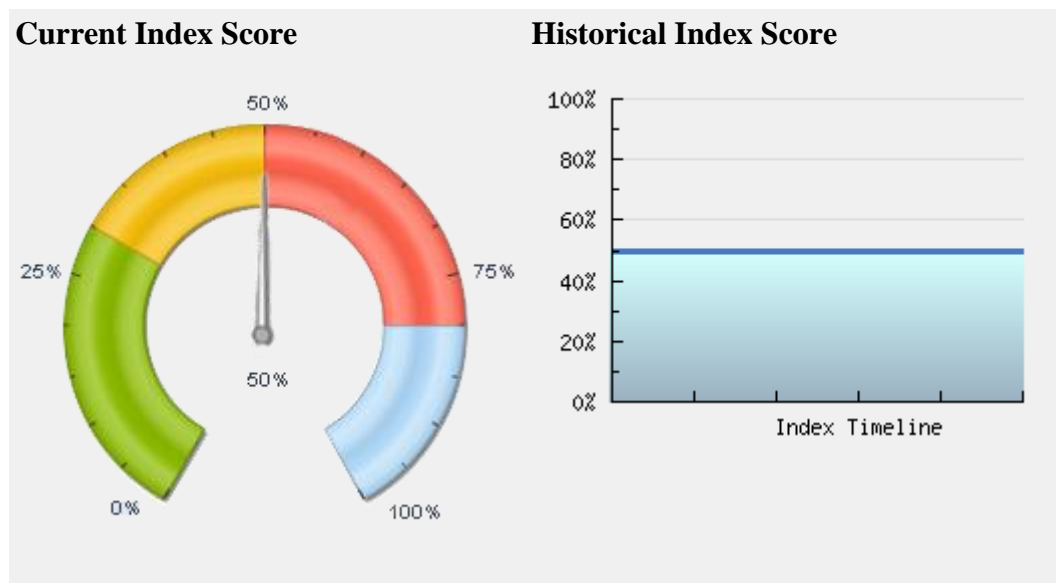
Power Holding Company of Nigeria (PHCN) is a state owned power company in Nigeria. The company is responsible for electricity production and supply in the country. It is active in the area of generation, transmission and distribution of electricity. PHCN was formerly known as the National Electric Power Authority (abbreviated NEPA). The company is mainly responsible for governing the use of electricity in Nigeria. PHCN generates power from thermal plants and hydro power generation. The company has an installed generating capacity of around 6,000 MW. However, the company usually records low availability. The company is focusing on development of new generation projects in the area of power generation, transmission and distribution. PHCN was formed in 2005 as a result of vertical and horizontal unbundling of NEPA. The company is headquartered in Abuja, Nigeria. (Global Data 2011)

Until recently Power Holding Company Nigeria, has been the main electric power monopoly for the generation, transmission and distribution of centralized grid power. In order to engender greater efficiency and sustainability in the system, a process of reforms has been started to remove government's monopoly on generation, transmission and distribution. Thus, in 2005, the Electric Power Sector Reform Act (EPSRA) was enacted. The law is aimed at liberalizing the power sector.

As a consequence of the reform process, the generation and distribution areas of the electricity market are being deregulated. The PHCN is being unbundled into six separate generation companies and eleven distribution companies for the various parts of the country.

In light of the current pathetic power situation in the country, and in spite of the current liberalization process, the Federal Government is still increasing investments in the sector to increase the generation capacity to 10,000MW by

2011 and to 20,000MW by 2015 through the National Integrated Power Projects being implemented across the country. Most of the additional capacity would be thermal (Gas) plants with renewable such as solar, biomass and wind contributing a minimal amount. Nuclear power has been factored into the energy mix, and it is expected that the first nuclear power plant of 1,000MW capacity is expected to be commissioned not later than 2020. (Erepamo 2009)



**Figure 1: Index score (Global data)**

- Power Holding Company of Nigeria currently scores 50% in the index.
- Power Holding Company of Nigeria is currently ranked equal 13 out of 12062. This is in the top 0.11% of Energy companies ranked in the index.
- Power Holding Company of Nigeria is currently ranked equal 19 out of a total of 35419 included in the InfoGrok Company Index. This is the top 0.05% of all companies.
- User perception of the company stands at 50%. This differs 0% over the score attributed to the company by other scoring factors.

## 4.2 Electricity Production of PHCN

The production and distribution of electricity to consumers in Nigeria is the sole responsibility of Power Holding Company of Nigeria, The Company was empowered to maintain an efficient, coordinated and economic system of electricity supply to all the nooks and crannies of the nation.

The company started with humble but steady beginning with only four major power stations namely: Ijora, Delta, Afam thermal power station and Kanji hydro power station, serving more than five million customers nationwide, which propelled the nation's technological and industrial growth.

By this time, Power Holding Company of Nigeria, which was formerly NEPA, has become the fastest and biggest growing electricity industry in Africa and indeed the developing world with projected customer population of about five million. (Adegoke 1991)

Power Holding Company of Nigeria (PHCN) current power generation capacity is estimated to be around 6,000 Megawatts, with an average available capacity of 2,000 Megawatts, over the years the company has laid down active plans to upgrade old power plants and build new central power plants with investment from the private sector.

According to (Imoke 2000) Power Holding Company of Nigeria has nine major generation power stations located strategically nationwide. Three Hydro and five Thermal excluding Oji rivers, which was Coal fired station.

The Stations using Hydro power supply are:

1. Kainji Hydro Power Station (built in December 1968 with an installed capacity of 760 megawatts.)
2. Jebba Hydro Power Station (built in April 1985 with an installed capacity of 578 megawatts.)
3. Shiro Hydro Power Station (built in June 1990 with an installed capacity of 600 megawatts.)

All the above mentioned stations make use of water in Nigeria.

The Thermal Stations are:

1. Sapele Thermal Power Station, Sapele, Delta state (built in June 1990 with an installed capacity of 1,020 megawatts).
2. Afam Thermal Power Station, Afam, River State (built in December 2001 with an installed capacity of 971 megawatts).
3. Delta Thermal Power Station, Ugheli Delta State (built in June 1991 with an installed capacity of 912 megawatts).
4. Ijora Thermal Power Station, Ijora Lagos State (built in January 1920 with an installed capacity of 60 megawatts).
5. Egbin Thermal Power Station, Egbin, Ikorodu, Lagos State (built in December 2001 with an installed capacity of 1,320 megawatts).

The total installed generating power stations are eight major stations excluding the one of Coal power station in Rivers State and the approximately 5,800 megawatts with available capacity of less than 3,000 megawatts. It's obvious that Power Holding Company of Nigeria produce electricity through a mixture of both Thermal and Hydro Systems.

#### 4.3 Electricity Sales and Distribution

The measured electricity sales grew rapidly at an average annual rate of 16.1% from just under three million megawatts per hour in March 2001 to 4,066 million MWH in March 2010 according to the Central Bank annual report for the year ended 2010, sales for the calendar year was 5, 677 million MHW

The sales distribution pattern 2010 is:

2010	000,000 in KWH	%
Industrial	2,023,716	14
Commercial	866,350	12

Street Lighting	2,787,144	20
Residential Building	7,212,122	54
	=12, 889,332	100,00

**Table 3: Electricity sales (CBN bulletin)**

Evidently, electricity supply in PHCN is still urban in orientation, with Lagos alone accounting for 45% and the proportion of sales to residential customer (also mostly Urban) having actually increased from 30% in the 1980s to 47% in 2001, according to the CBN report cited, sales to industrial and commercial inhabitant experienced increased growth in 2001, whereas growth in residential sales experience reduced growth, this being ascribed to supply and distribution bottlenecks

PHCN currently exchange about 3,000 km of overhead lines with underground cables. Thus making the power supply less vulnerable to storm damage and also improves the appearance of the local areas.

Electric energy demand has been projected by PHCN in its power system development plan from the 2005 base, such that electricity availability is continuously outstripped and the deficit doubled in 2010 (Chukwemka 2009). The Government has divided the current PHCN distribution sector into separate companies or entities that will be called Local Electric Distribution Companies among its regions.

The Power Holding Company of Nigeria, PHCN, has made settling customers monthly electricity bills easier, hence the introduction of the bank revenue collection system to complement the operations of the cash offices in PHCN premises. This program is to facilitate prompt and regular settlement of the PHCN's monthly bills, as customers are no longer expected to travel far outside their immediate neighborhoods to settle PHCN Bills.

## 5 CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Findings

#### **Research Question 1: Does the power sector have a significance impact on the Industrial development?**

In Nigeria, as it is around the world, energy issues are top of the developmental agenda by the Government. This was mostly prompted by the recognition that without energy most development objectives, which include industrial development growth, cannot be realized. Nigerian policy makers will need to address various issues in the energy sector, including access to electricity by the majority of the Nigerian population.

We could easily argue with fact and evidence that over the last 2 decades, the gap between energy supply and demand in Nigeria has been growing and it has been forecasted that the gap will continue to grow, and the living condition of the population will suffer in energy poverty and this will seriously slow down the socioeconomic development of the Nation.

The need for proper implementation of the power sector objectives that is the efficient and sustainable supply of energy to the population will promote efficiency and growth in the power sector and also aids industrial development and economic growth. This will also encourage private sector participation and investment in the electricity industry.

The Power sector has the ability to massively expand in Nigeria through privatization of Power Holding Company of Nigeria (PHCN). New power facilities by the private sector will provide new capital injection into the economy. This will create an enabling environment for investment and privatization of PHCN will bring about investment opportunities which will always attract both local and international Independent Power Producers.

Privatization of the electricity sector brings about competition and allows management of privatized companies' full freedom to realize their optimum potentials. In order for any company to take a lead over the other, its products must be second to none. Such excellence in quality of products could only be achieved through research. With emerging power sector development, other sources of renewable energy such as wind, solar and biomass are expected to be explored.

**Research Question 2: What impact does the electricity capacity utilization have on the industrial output?**

Nigeria is endowed with sufficient energy resources to meet its present and future development requirements. The country possesses the world's sixth largest reserve of crude oil. Nigeria has significant biomass resources to meet both traditional and modern energy uses, including electricity generation. (ICEED 2006)

Given the importance and relevance of energy in industrialization to economic growth and industrial development, Nigeria since independence has put in place various policies, incentives and institutions to drive industrial development. Power generation in Nigeria is estimated to be 6,000 megawatts, with actual availability capacity of 2,000 megawatts over the past couple of years.

The current installed capacity of grid electricity is about 6000MW, of which about 67 percent is thermal and the balance is hydro-based. Between 1990 and 2000, there was no new power plant built and the same period witnessed substantial government under-funding of the utility for both capital projects and routine maintenance operations. Generating plant availability is low and the demand – supply gap is crippling.

PHCN's business operations are inefficient; the system suffers from chronic under-investment, poor maintenance, and under billing arising from majority of un-metered connections. The utility's financial performance, as well as its ability to serve customers satisfactorily has been consistently poor. Access to electricity



services is low. About 60 percent of the population – Over 80 million people are not served with electricity. Per capita consumption of electricity is approximately 100kWh against an average 4500kWh in developed countries (ICEED 2006).

Under this situation the proportion of Nigerians without access to electricity services will continue to increase over time. The chronic shortage of available generating capacity has negatively affected the industrial and manufacturing sectors. With self-generation prevalent in the industrial, commercial and domestic sub-sectors, the electrical energy demand in Nigeria currently estimated at 10,000 MW is actually not known. The Federal Government is undertaking comprehensive reforms to address the electricity situation in the country

**Research Question 3: How can the power sector improve in finding solution to the electricity supply?**

Since the last two decades, Nigeria has been facing an extreme electricity shortage. This deficiency is multi-faceted, with causes that are financial, structural, and sociopolitical, none of which are mutually exclusive. Nigeria's power sector has high energy losses from generation to billing, a low collection rate and low access to electricity by the population. There is insufficient cash generation because of these inefficiencies and the power sector is consequently reliant on fuel subsidies and funding of capital projects by the government. At present only 10 % of rural households and 40% of the country's total population have access to electricity supply (Obadote 2009)

Improving the power sector for electricity supply, the Federal Government of Nigeria should ensure level playing fields for the independent power producers and other genuine investors in the power business. Also consumers of energy should be provided with a good education on the most efficient use of energy. Other measures that should be taken in resolving the power crisis in Nigeria includes the provision of community and military security to prevent vandalism of oil, gas and electrical equipment and lines, There is need for efficient pricing of electricity so that the price of electricity will not be lower than the average production cost. This will encourage private partnership participation.

Alternative source of energy for the production of electricity must be prioritized, since there is too much reliant of fossil fuel and thermal. Other renewable energy source like Solar, Wind, and Biomass can be used for the production of electricity, both for urban and rural electrification.

**Research Question 4: What kind of electricity source can be used in rural areas of Nigeria?**

Nigeria is blessed with abundant resources of fossil fuels as well as renewable energy resources. With the availability of renewable energy resources in all parts of the country, there is the urgent need for Power Holding Company of Nigeria to adopt practical measures that will introduce various renewable energy sources for the production of electricity in rural areas of Nigeria. For the purpose of this study the following energy sources will be considered for rural electrification in Nigeria. **Wind Power, Hydro Power and Solar Power.**

**Wind Power:** In an attempt to discover wind energy potential in the country, several sites (Enugu, Jos, Ikeja, Abuja, Warri, Sokoto and Calabar) which differ in natural conditions and having different wind characteristics were selected for this study. During the course of this study, it was discovered that the annual wind mean speed at a height of 10m above the ground ranges between 3.3m/s to 5.4m/s for sites along the coastal areas and 4.0m/s to 5.9m/s for high land areas and semi-arid regions.

Therefore, using wind energy conversion systems for electric power generation and supply in northern part of Nigeria which is predominantly rural areas, especially around the Sokoto axis will be cost effective. The use of wind power for the supply of electricity broadens the energy base and reduces environmental pollution. It is particularly practical if it can be made economically competitive. The use of wind energy will be suitable for rural farming companies that require lighting and some limited supply of electricity which will be costly to get due to the location of farms.

Considering the current rate of electricity supply in Nigeria, wind energy resources should be included in the renewable energy resources development programme of Nigeria for rural electrification.

**Solar Power:** Solar energy is estimated worldwide to be average power potentials of 24W per square meter of the earth's surface. Solar energy is the most promising of the renewable energy sources in view of its apparent limitless potential. Most of this energy is transmitted radially as electromagnetic radiation which comes to about 1.5kW/m<sup>2</sup> at the boundary of the atmosphere. It has been confirmed that Nigeria receives  $5.08 \times 10^{12}$  kWh of energy per day from the sun. (Sambo, 1996) Among renewable resources, solar power is regarded as the leading choice for off-grid power generation. There are a number of reasons for this.

Firstly, its versatility; solar technology can be installed in almost any location - including mountains, deserts, jungles and off-shore locations - and can suit any power requirement, so long as enough photovoltaic (PV) panels are installed. Secondly, its reliability; solar systems utilize the latest technology but perform a relatively simple operation where little can go wrong.

Solar power's ability to provide efficient on-site power production means it is suitable to a wide range of applications and industries, ranging from the oil and gas sector to rural electrification. Solar power is ideally suited to humanitarian applications. The most common of these is rural electrification, the process of bringing power to remote off-grid areas. According to the International Energy Association, nearly 1.5 billion people do not have access to electricity, of which 83% live in rural area. Bringing sustainable electricity to rural communities is highly rewarding and challenging task. As a company, Power Holding Company of Nigeria (PHCN) must endeavor to establish itself in rural electrification project all over the country.

**Hydro Power:** Hydro Power systems rely on the potential energy difference between the levels of water in reservoirs, dams or lakes and their discharge tail water levels downstream. The water turbines which convert the potential energy of water to shaft rotation are coupled to suitable generators. The hydropower potential of Nigeria is very high and hydropower currently accounts for about

29% of the total electrical power supply. The first hydropower supply station in Nigeria is at Kainji on the river Niger where the installed capacity is 836MW with provisions for expansion to 1156 MW. Indeed small-scale (both micro and mini) hydropower systems possess the advantage, over large hydro systems, that problems of topography are not excessive. In effect, small hydropower systems can be set up in all parts of the country so that the potential energy in the large network of rivers can be tapped and converted to electrical energy. In this way the nation's rural electrification projects can be greatly enhanced. Power Holding Company of Nigeria can focus more on small scale hydro power since it is economical and more effective for rural electrification in Nigeria.

In conclusion, the aforementioned energy sources have major advantages which include the simplicity of the technologies, ease of maintenance as well as their enhanced environmental friendliness over fossil fuel systems. There is clear evidence of the use of renewable energy technologies at the moment. However there is the necessity to increase the use of the system especially for rural development.

## **CONCLUSION**

Over the year, the Federal Government of Nigeria has recognized the important role industrial development can play in ensuring sustainable growth and development in the Nigerian economy. Towards this end, a number of policies and programmes have been introduced to assist the growth of power sector in the economy.

One of the major areas of assistance is that of improving access of energy resources through the establishment of the National Economic Empowerment and Development Strategy (NEEDS) for wealth creation, employment generation, poverty reduction and value reorientation and the need for Nigerian to meet her developmental goals, which requires improvement in the electric power sector. NEEDS recognized power as a strategic sector and the most important infrastructure requirement to move the private sector forward, it stated that

Nigeria's power sector is so inadequate that it has held back economic progress and social well-being. With the continuous focus of NEEDS on economic growth and employment generation, it is imperative that power sector reforms are fast tracked for the realization of various proposed target in capacity utilization and industrial output.

Notwithstanding, it is necessary to note that the power sector and industrial development in Nigeria is gradually packing up and it will be a matter of time before development is achieved.

Conclusively, for Nigeria to improve the industrialization process and efficiency in production and distribution of goods and services, this should not be left alone for the government in the development of industries. We need to embrace and encourage the growth of power sector and we should reason in line with developed nations like Germany, Finland, England and so on that embrace industrial development and power sector as one of the cornerstone of their economic development.

## 5.2 Recommendations

In order to be a real player in the world economy, we need to embrace ways to meet our energy needs and to embrace better choices of energy consumption. We must continue to invest in technology, to develop the technologies that would allow us to conserve more energy and better stewards of the environment. All effort must be made to remove causes of inefficiency and ineffectiveness; this will require growth with equity and can be achieved in the following ways:

1. PHCN
2. POWER SECTOR DEVELOPMENT
3. INDUSTRIAL DEVELOPMENT

## **Power Holding Company of Nigeria**

In order to be an excellent utility Unit providing safe, reliable, quality, low operational cost electricity supply to customers, with fair and reasonable earning to the company, Effective implementation of network maintenance and reinforcement must be achieved by consistent improvement in customer care services.

It's important to find better energy sources for the production of electricity to rural areas in Nigeria by POWER HOLDING COMPANY OF NIGERIA (PHCN). Rural electrification has long been a top priority on the development agenda of most African countries. However, a huge percentage of the Nigerian population is still in darkness. The percentage of rural population that has access to electricity is as low as five percent. The aim at increasing energy services in rural areas has focused on grid extensions and distribution of electricity from large-scale generation facilities. Experience has revealed that successful electrification depends on; the ability to recognize that some areas are more viably served through locally generated electricity such as grid extension.

Therefore the need to alternate other energy source is imperative for the development of the company and Nigerian energy sector. The following energy sources are considered important for the production and distribution of electricity in rural areas in Nigeria:

**Hydropower systems** – Hydropower systems use the energy in flowing water to produce electricity or mechanical energy. these tend to have high capital costs but relatively low maintenance costs, a long service life, high operational reliability (given water availability) and low environmental impact.

## Hydro Power System



Table 4 Hydro Power system (Electricity forum 2011)

**Solar energy systems:** solar electricity is renewable energy that is converted from the sun and it has few environmental impacts, but initial costs can be high. Maintenance and replacement may be difficult in isolated communities. Solar Energy is better for the environment than traditional forms of energy. Countries like Nigeria with an abundance of sunlight and a population currently without electricity, represents the fastest growing potential market for solar energy, with the largest domestic market being the utilities sector.

Solar Energy is clean, renewable (unlike gas, oil and coal) and sustainable, helping to protect our environment. It does not pollute our air by releasing carbon dioxide, nitrogen oxide, sulphur dioxide or mercury into the atmosphere like many traditional forms of electrical generation does. Therefore Solar Energy does not contribute to global warming; it actively contributes to the decrease of harmful greenhouse gas emissions.

## Solar Energy System



Table 5 Solar Energy system (Electricity forum)

**Small scale wind energy systems** – Small wind energy systems can be used in connection with an electricity transmission and distribution system these tend to have high capital costs but low running costs. Supply is intermittent and so energy storage is necessary for reliability. Wind is derived from solar energy. When the sun heats the earth's surface unevenly, it creates differences in air temperature and atmospheric pressure, which causes wind. Wind turbines for domestic or rural applications range in size from a few watts to thousands of watts and can be applied economically for a variety of power demands.

Today's wind power systems are durable, reliable, and efficient, capable of producing clean, cost-effective power



### Wind Energy for Rural electrification



Table 6 Wind energy system (Electricity forum 2011)

### Urban Residential electrification



**Improved biomass:** this is focused on enhancing the use of biomass through technologies such as improved cooking stoves, aimed at increasing efficiency and reducing air pollution. A considerable amount of development aid has been targeted towards improving the current use of biomass, based on the adaptation of traditional stoves to increase efficiency and limit adverse effects.

### An improved biomass stove



Table 7 Biomass Stove (Electricity forum 2011)

## POWER SECTOR

Deregulation of the power sector and the privatization of PHCN, because of the inherent gains to consumers of electricity. This policy, which formed part of the power sector reform programme, will change Nigeria's socio-economic landscape, far more than what the country has seen in telecommunications, following the sector's liberalization. It will provide the Nigerian population with uninterrupted and quality electricity but also attract Foreign Direct Investment, create

employment and business opportunities, enhance the living standards of electricity workers.

Deregulation Policy that include:

1. Generation and transmission – proposed for centralization
2. Distribution and sales – proposed for decentralization
3. Urgent rehabilitation of power infrastructure facilities for generation, transmission and distribution should be undertaken with adequate funds provided and released promptly.
4. Debt owed should be recovered for more resources to be available for the authority to execute its primary responsibilities.
5. Privatization of Power Holding Company of Nigeria (PHNC) to enhance competition and greater efficiency in power sector.

### **Bilateral Relations with Finnish Organization**

The Federal Government of Nigeria and its Finnish counterpart should ensure exploration of economic potentials towards trade and investments in both countries. Though the volume of trade and investment portfolios have, in recent times, been abysmally low.

Nigeria and Finland should improve their bilateral trade relations by tapping each country's areas of comparative socio-economic advantages for their mutual benefits. To create the needed forum for prospective investors to interact and share ideas and evolve strategies on realising the broad objectives of a new bilateral agenda, for the purposes of exploring opportunities in energy, environmental technology and supply.

Nigeria can be seen as a big economy with potentials for global leadership if the problems of corruption and insecurity are tackled head on, also there are listed areas where Finnish companies could help in adding value to the Nigerian

economy with the application of Finnish technologies in renewable energy and clean power production.

Presently, three Finnish companies are already helping to improve the power, mining, and clean environment situations of Nigeria. On the clean environment technologies, Nigeria could benefit from the clean tech Industry of Finland, which could be relevant in the drive toward cleaner environment with the application of the Finnish Waste-to-energy technology in cities like Abuja and Lagos.

### **Government Owned Company**

Power Holding Company of Nigeria can enlist Fortum in the area of Electricity Solutions ranging from, generation distribution and supply. In this sense the company can benefit from the area of expertise which the Finnish company has grown into over the last decades. Since Fortum's purpose is to create energy that improves life for present and future generations, provide sustainable solutions that fulfill the needs for low emissions, resource-efficiency and energy security, Power Holding Company of Nigeria can easily benefit from this mode of operation, which can help the company grow in the area of providing electricity to rural area in Nigeria for rural development, through various energy sources, such as solar, wind etc. Also Fortum can provide financial aid to power holding company of Nigeria.

### **INDUSTRIAL SECTOR DEVELOPMENT**

Industrialization tends to propel economic growth and achievement of structural transformation and diversification of economics.

It enables a country to utilize fully its sector endowment and to depend less on external sectors for growth and sustenance. Industrial development, an economy versatility and resilience enable it to raise the standard of living of its people to cope better with stressed constraint.

This can only be achieved through the following:

1. **FINANCIAL PRUDENCE:** Government expenditures should show financial prudence. Overseas tours by the president and the ministers should be reduced to the minimum. Nigerian diplomatic mission abroad should handle some of the transactions for ministerial visit.
2. **PROMOTION OF EXPORT:** Strenuous effort should be made to promote the sale of Nigerian exports in the world market. The export of primary products should, as much as possible be reduced and this could be achieved if the economy is sufficiently diversified.
3. **INDUSTRIAL POLICY:** Policies have to do with rules and regulations made to enhance the smooth running of an organization, society or a nation. It is concerned with the production of goods and services. From the analysis made above industrial policy simply connotes rules and regulations formulated to endure industrial advancement, good industrial relations (employers and employees) industrial management and the smooth running of industrial affairs.

### 5.3 Suggestion for future research

The suggestions for future research will be divided into electricity supply, electricity demand, and fuel switching.

#### Electricity supply

The current situation provides strong indication that thermal and hydro source of energy dominates the overall supply of energy for electricity supply. It would be useful to know how the supply curve changes when wind energy gain importance, and function as a part of source for electricity supply in Nigeria. What major impact will renewable energy source have in the supply of electricity to the nation?

## Electricity demand

We would argue that there are enough resources to prove that electricity supply in Nigeria should be on the increase, but limited knowledge is known about the fundamentals of electricity demand. The search for more accurate estimates of key electricity demand parameters is paramount. It is important to map out other technical measures to curb the increasing electricity demand.

## Fuel switching

Future research should continue searching for effective means of promoting fuel switching and for a better understanding of the persistence of wood and other biomass use. . Future research should not rely excessively on the energy ladder model but consider using a household economics framework incorporating opportunity costs and nonmonetary aspects in the analysis, considering the standard of living of the Nigerian populace. Need to identify low-cost interventions in the areas of improved stoves, better biomass, and renewable energy sources.

## SUMMARY

This research was embarked upon due to the problem confronting power sector and industrial development in Nigeria.

The problems of inadequate findings, high cost of production and so on were highlighted.

The Federal Government of Nigeria has made several efforts to assist in the growth of power sector and industrial development, however the corruption on the act of government officials who are supposed to handle this project have limited the success of the project.

Against the background of this problem the study highlights some policy measures adopted by government to develop Nigeria's energy resources, assess the outcome, indicate factors contributing to energy in the country and recommend some policy measures aimed at minimizing the crisis.

In the preceding chapters, the results obtained completely validate that industrial growth rate in Nigeria has contributed to economic development.

From the result of the regression, there is a co-efficient of multiple determinants, which determine the proportion of the variation in dependent variables (INDUSTRIAL GROWTH RATE) explained by changes in Aggregate Energy Index (AEI). With the above parameters in line with prior expectations, the overall regression line was shown to be statistically significant. Hence the power sector has a significant impact on the industrial growth within the period under study. Aggregate Energy Index is directly correlated to the capacity utilization of the industrial sector. Thus the capacity utilization has a positive impact on the industrial output within the period under study.

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## APPENDICES

### APPENDIX 1

#### **Semi-structured interview guide questions**

Participant's name: Mr. Abdul Ganiyi Babatunde

Position: Head of Operation, Lagos- Ibadan District

System adopted: Videoconferencing

**Power Supply:** Problem with the power supply unit

What were the factors of power supply shortage?

What were the Causes of Power Failures?

Who were involved in the decision making of power supply?

**Power Sector Reform, Development and Implementation:** Period after the decision to reform the power sector for industrialization and economic growth

How the developmental process of the power sector was carried out?

Who were involved?

How was the implementation process?

What were the factors influencing the implementation process?

**Evaluation:** Period after the adoption of the Power Sector Reform process was completed.

What were the impacts of the reform on electricity supply?

Do you feel it was a success? Why?

Would you consider adopting any Power sector reform in the future?