

Power Sector Reforms-Effects on Electric Power Supply Reliability and Stability in Nigeria

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Abstract: This study seeks to examine the power sector reforms, effects on electric power supply reliability and stability in Nigeria. The methodology adopted was to review the power sector before and after the reform, effects of the reform on electricity supply, reliability and the expected impact of the proposed models on the Nation's economy. The major problems affecting the model been pursued especially in a developing country like Nigeria were also examined. The Electric Power Sector has over the past 25 years witnessed a slow and steady decline leading to near complete failure of the system in 1999 at the beginning of the immediate past civilian government. The federal government of Nigeria using National Council on Privatisation (NCP) in 1998 had therefore, embarked on an electric power sector reform program, which gave birth to 18 companies under the auspices of Power Holding Company of Nigeria (PHCN). These companies unbundled from the defunct vertically integrated Nigeria Power Authority (NEPA) monopolistic utility are characterised with horizontal structure. In February 2007 government of Nigeria awarded contracts of about \$875 million across the country in actualising some of the goals in the power sector reforms. The study opined that if all identified problems militating against NEPA meeting the energy demand of the country is met by the reformed energy sector, in no distant time Nigeria can boast of an Electric Power Industry (EPI) that can meet the needs of its citizen in the 21st century and place the nation as one of the industrialised country in the world.

Key words: Power sector reforms, electric power reliability, power stability, sector drivers, vertical structure, horizontal structure

INTRODUCTION

The reform that is taking place in the Electricity sector in the world is increasing rapidly and the nature of the reforms that are being adopted is becoming more sophisticated. Many large countries like China, India, United States and very small countries like Bolivia have adopted earlier reform models according to their own needs and circumstances. Both developed and developing countries have embarked on a program of liberalizing and reforming their power sectors.

A number of authors have described the principle driving forces behind the need for the reform movement (Bacon, 1995). Some of the reasons are:

Capital scarcity: In the 1980s, there was a recognized major shortage of capital to finance the required expansion of power capacity in developing countries. While, historically, developing country governments had financed their largely state-owned power utilities and supplemented their capital requirements with Multilateral Development Bank (MDB) loans, it was recognized that these 2 sources would be entirely inadequate to finance

power sector investment in the decades to come. The private sector was seen as the only additional source of capital that could close the power sector's financing gap. The challenge in reforming the power sector to attract the needed private investment is now the next task.

Economic inefficiencies: In most developing countries, the power sector has been troubled by high technical losses, a lack of cost recovery pricing, poor maintenance, low equipment reliability, high staff levels, productivity, corruption, a crippling non-payments problem and mounting debt. These factors have resulted in the commercial unsustainability of many developing countries' power sectors, which are unable to attract the needed private investment (Kuale and Tsado, 2006). If the power sector is unable to charge the consumer for the full cost of power, the public must then make up the difference in one form or another through direct or indirect taxes that support subsidies. These stated subsidies necessary for financing the power sector's financial shortfalls have become a mounting burden that is no longer sustainable for many developing countries.

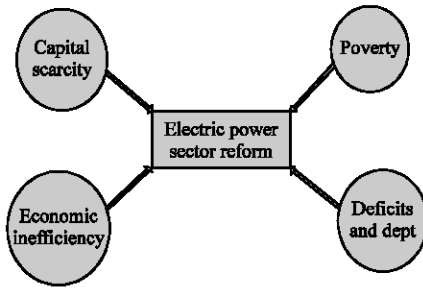


Fig. 1: The drivers of power sector reforms

Persistent poverty: The lack of reliable power and other infrastructure, has had a notably adverse impact on industrial growth and individual development and these has contributed to perpetuating poverty.

Debt and deficits: The power sector in many developing countries is saddled with large debts accumulated from years of not charging cost recovery tariffs, not collecting accrued debt from all consumers, not disconnecting consumers who do not pay and using the utility as a vehicle for subsidies and political patronage for jobs and other favors. For these reasons, power sector.

Reform and privatization have been seen as attractive solutions to the problems of debt and deficits by transferring the power utilities to private companies that will then assume the responsibility for eliminating some of these avoidable losses.

These 4 drivers presented in Fig. 1 have been the most important basis for power-sector reform policy in developing countries for the past few decades.

BACKGROUND

The journey to privatisation has been long and NEPA lost its monopoly over the operation of the Nigeria power sector in 1998, when the National Council on Privatisation (NCP) empowered a 23-member Electric Sector Reform Implementation Committee (ERIC) to develop guidelines to promote the policy goals of total liberalization, competition and private sector led growth of electricity sector. The ERIC set out the Electric Power Policy statement, which is to ensure that, Nigeria has an Electric Power Industry (EPI) that can meet the needs of its citizens in the 21st century (Asubiojo, 2007).

The Electric Power Sector was perfected in a bill signed into law on 11th March 2005 by the President and Commander-in Chief of the Federal Republic of Nigeria. Act 2005 gives legal backing to the reform activities, which is, restructuring and eventual privatization of Nigeria Electricity Power Authority (NEPA). The main

ingredients of the reform are deregulation, commercialization, free market economy etc (Campos and Esfahani, 1996). It is aimed at improving the overall efficiency through restructuring, private sector participation and competition, which is a major driver of the nation's economy, through improved customer satisfaction and reduced tariff.

The implementation of the power reform bill kicked off with the incorporation of the initial holding company, called Power Holding Company of Nigeria (PHCN) on the 31st of May, 2005. The Nigerian Electricity Regulatory Commission (NERC) was officially inaugurated on October 31, 2005. The establishment of NERC is one of the main pillars for ensuring the delivery of an efficient power supply in Nigeria. This body is charged among others with the responsibility of providing a legal basis with necessary enabling provisions for establishing, charging, enforcing and regulating technical rules, market rules and standards and others spelt out in this study.

POWER SECTOR STRUCTURE /PERFORMANCE BEFORE THE REFORMS

Since, 1972 till early part of 2006, Electricity production and supply in Nigeria has been a monopoly of the federal owned Electric utility body known as National Electric Power Authority (NEPA). This utility was charged with the responsibility for the generation, transmission, distribution and sale of electricity to customers and was run as a vertically integrated company as shown in Fig. 2.

Lack of adequate funding and managerial strategies resulted in the steady decline in the performance of the utility. The Table 1 showing the generated and the peak demand from 1983 till 2003 illustrates numerically the poor state of the National Power Supply System. In 1993, for example, the electric energy generated was 14,621 GWH, which is equivalent to 1,669 MW power generated. Between, 1981 and 1985, during the fourth National Development plan, there was oil boom and power demand growth rate was over 10% (Ikeonu, 2006). The rapid growth rate makes it difficult for the installed capacity to cope with the load requirement of residential, commercial and industrial consumers. This is shown in Table 2, while the growth pattern is as shows in Fig. 3. The country leadership then did not see any need to invest in the power sector in view of this growth trend. Load shedding, which affected the domestic life as well as the commercial and manufacturing activities of the industrial sector of the economy resulted from this rapid growth. For logistic and financial reasons, electricity plants, transmission tie-lines and the distribution networks are not adequately

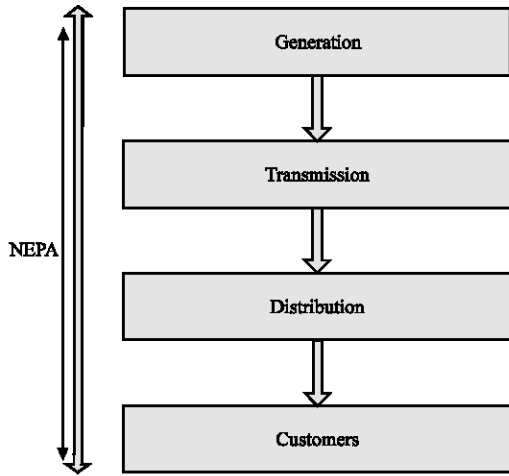


Fig. 2: Monopolistic model

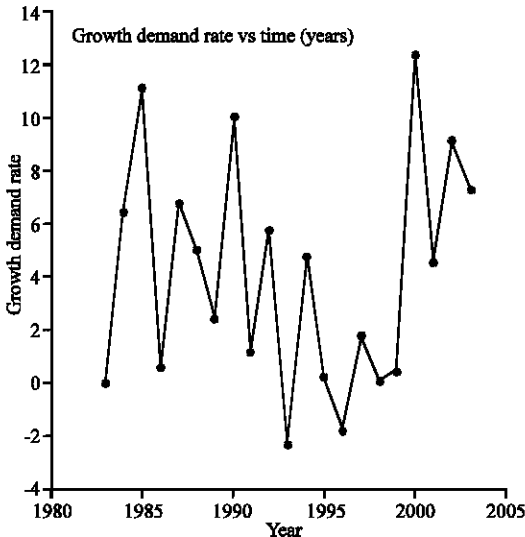


Fig. 3: Growth rate. Source: PHCN sapele transco

maintained. In some cases, where maintenance is attempted, scheduled maintenance that in most cases are very expensive and may not even extend the lifespan of the power system are adopted. Thus, actual average MW power availability is in most cases less than half of the installed capacity.

It was therefore, not surprising that by 1999 when the immediate past civilian administration came on board, one of the key thrusts of the government is economic reform strategy, which was to ensure the complete overhaul of the power sector leading to the setting up of a working group (Haggard and Webb, 1993) specifically, focusing on the adoption of the National Electric Power Policy (NEPP), which defined the framework for the power sector reform in Nigeria.

Table 1: Energy demand and generated between 1983-2003

Years	Energy generated in (GWH)	Peak max. demand GWH
1983	8456	12562
1984	8927	13420
1985	10155	15067
1986	10665	15155
1987	11191	16250
1988	11471	15348
1989	12700	17538
1990	13364	19438
1991	14212	19675
1992	15066	20875
1993	14617	20411
1994	14557	21427
1995	15793	21480
1996	15771	21112
1997	15446	21471
1998	16253	21444
1999	16291	21532
2000	15227	24519
2001	17637	25706
2002	21544	28233
2003	22612	30479

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Table 2: National peak demand rates between 1983-2003

Years	Peak max. demand (MW)	Growth demand rate
1983	1434	
1984	1532	6.4
1985	1720	10.9
1986	1730	0.6
1987	1855	6.7
1988	1952	5.0
1989	2002	2.5
1990	2219	9.8
1991	2246	1.2
1992	2383	5.7
1993	2330	-2.3
1994	2446	4.7
1995	2452	0.2
1996	2410	-1.7
1997	2451	1.7
1998	2448	0.1
1999	2458	0.4
2000	2799	12.2
2001	2934.49	4.6
2002	3223	9.0
2003	3479.30	7.4

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In a bid to expedite action in savaging the frequent power supply challenges, the immediate past administration decided to tackle the Nation's power supply problems in order to ensure uninterrupted power supply within 3 years without first studying the problems in the NEPA establishment. This led to huge financial investment on the upgrading of the generating capacity. There was however, no corresponding investment on the transmission and distribution networks. This investment actually showed a positive growth in the available power generated in 1999 (Fig. 2). These positive growths do not reflect on the consumers since the transmission and distribution infrastructures on ground could not cope with the increase in the power generated.

Table 3: Transformer loading for the month of January to December 2003

Month	T/Fs	KVA rating	Voltage rating	MW	MVA loading	MVA (%)	Date	Time
Jan.	T ₂₁	60	132/33KV	42.0	50.0	83.0	02/02/04	2100
	T ₂₂	60	132/33KV	41.5	49.4	82.0	08/01/04	2100
	T ₂₃	30	132/33KV	24.8	29.6	98.6	28/01/04	1000
Feb.	T ₂₁	60	132/33KV	43.0	51.2	85.0	05/02/04	2200
	T ₂₂	60	132/33KV	42.6	50.7	85.0	14/02/04	2200
	T ₂₃	30	132/33KV	25.2	30.0	100.0	24/02/04	1800
March	T ₂₁	60	132/33KV	43.0	51.2	85.0	16/03/04	1900
	T ₂₂	60	132/33KV	42.6	50.7	85.0	29/03/04	2000
	T ₂₃	30	132/33KV	25.9	31.0	103.0	03/03/04	900
April	T ₂₁	60	132/33KV	45.0	53.6	89.0	23/04/04	2100
	T ₂₂	60	132/33KV	48.6	59.0	98.0	20/04/04	1900
	T ₂₃	30	132/33KV	25.9	31.0	103.0	16/04/04	1000
May	T ₂₁	60	132/33KV	46.6	55.5	93.0	05/05/04	2000
	T ₂₂	60	132/33KV	48.5	57.7	96.0	16/05/04	2100
	T ₂₃	30	132/33KV	24.9	29.6	99.0	26/05/04	1800
June	T ₂₁	60	132/33KV	46.9	55.8	93.0	17/06/04	2100
	T ₂₂	60	132/33KV	48.0	57.1	95.0	22/06/04	2100
	T ₂₃	30	132/33KV	25.4	30.2	101.0	11/06/04	1200
July	T ₂₁	60	132/33KV	47.2	56.2	94.0	04/07/04	2200
	T ₂₂	60	132/33KV	48.5	57.7	96.0	19/07/04	2200
	T ₂₃	30	132/33KV	25.4	30.2	101.0	28/07/04	1900
Aug.	T ₂₁	60	132/33KV	47.8	56.9	95.0	01/08/04	2100
	T ₂₂	60	132/33KV	48.2	58.2	97.0	20/08/04	2100
	T ₂₃	30	132/33KV	25.0	29.8	99.0	26/08/04	900
Sept.	T ₂₁	60	132/33KV	46.6	56	93.0	23/09/04	2200
	T ₂₂	60	132/33KV	48.6	59	98.0	20/09/04	2100
	T ₂₃	30	132/33KV	25.9	31	99.0	16/09/04	1900
Oct.	T ₂₁	60	132/33KV	49.4	59.3	99.0	02/10/04	2000
	T ₂₂	60	132/33KV	48.9	59.0	98.0	08/10/04	2100
	T ₂₃	30	132/33KV	24.8	30.0	103.0	30/10/04	1800
Nov.	T ₂₁	60	132/33KV	47.6	57.1	95.0	16/11/04	2100
	T ₂₂	60	132/33KV	46.2	55.4	92.3	21/11/04	2100
	T ₂₃	30	132/33KV	24.6	30.0	100.0	30/11/04	1900
Dec.	T ₂₁	60	132/33KV	46.8	55.8	93.0	22/12/04	2100
	T ₂₂	60	132/33KV	57.1	57.1	95.0	18/12/04	2200
	T ₂₃	30	132/33KV	31.0	31	103.0	24/12/04	1800

PHCN sapele transco

This can be seen clearly when one of the interconnected network components was observed closely for 1 year as shown in Table 3. The 3 power transformers feeding Benin City and environs (i.e., interconnected areas) are shown with their rating and the percentage MVA loading in the Table 3. The percentage MVA loading in some cases were >100% as shown in Table 3. This shows that, even if generation is doubled, the power that will be available to the consumers will still be limited by the installed capacity of the distribution transformers, associated transmission lines as well as the available circuit breakers if they are not upgraded.

Another factor, which was not properly considered before the huge investment was the inadequate manpower in NEPA (Managerial and Technical Personnel). NEPA did not have sufficient indigenous manpower to deal with the sophistication in a modern energy and power industry as reflected in the poor state of the infrastructures in most of the generated power stations (Haggard and Webb, 1993). This situation is compounded by the politicisation of key positions under the cover of federal character and geographical representation syndrome. This is also

coupled with our over-dependence on overseas manufacturers for the supply of power plant equipment, facilities and spare parts. These hindered the efforts of NEPA to reduce the frequency and duration of outages thereby ensuring uninterrupted power supply. The immediate past administration had spent huge amount of money to boost electricity generation in the country. As a matter of fact in February 2007, the Federal Government of Nigeria awarded 43 power generation/transmission contracts under the National Integrated Power Project (NIPP) at the cost of about N105 billion across the country (Nigeria First, 2005).

THE EXTENT OF THE REFORMS IN NIGERIA

The reform in Nigeria had so far led to the corporatization and unbundling of the nations' owned Utility, now known as the Power Holding Company of Nigeria (PHCN). The unbundling had led to the establishment of 18 successor companies from NEPA comprising 6 Generation Companies, one Transmission Company and 11 Distribution Companies. The sector has

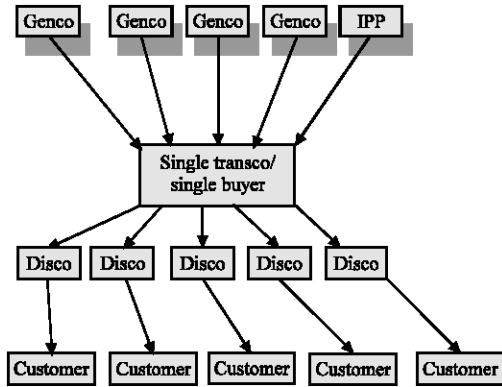


Fig. 4: Unbundled variant/single buyer

also been deregulated leading to private sector participation in the generation sector and a number of IPPs are in operation in the country today. Each of the 18 companies has its own management, that is self accounting and not dependent on government funding so to say. The present horizon structured model is as shown in Fig. 4.

The Bureau for Public Enterprise (BPE) is now preparing each of these companies for privatisation. The Goals of NERC, which was set up as an Independent and self-funding sector regulator is expected to perform the following primary functions:

- Ensure orderly development of a competitive power market.
- Ensure efficient, safe and adequate production of electricity.
- Promote competitive and private sector participation.
- Protect consumers and the public interest.
- Evolve standard and codes that measure with international best practice.
- Evolve stable and equitable rates thereby ensuring reasonable profit.
- License and regulate persons engaged in Electricity business.
- Settle disputes amongst industry participants.
- Ensure expansion of access to rural and urban dwellers.
- Establish and administer the power consumer Assistance fund for subsidising under privileged consumers (Haggard and Webb, 1993).

IMPACT OF POWER SECTOR REFORM ON THE ELECTRICITY SUPPLY RELIABILITY

Improving the quality and reliability of Electricity supply was a major factor driving some of the reform

programs in Africa. Instability in the power sector, negatively affects the domestic and economic lives of the people. Individual and organisations are forced to invest on expensive backup systems. In addition, reliable service can reduce costs, improve efficiency and stimulate growth for small business that rely on electricity, which can have a huge impact on the lives of rural and urban dwellers by creating jobs.

Introducing private sector participation can greatly improve quality, efficiency and ensure reliability in power supply. Power sector reforms will, in the long term, affect the quality of power in Africa through special customer service arrangements. New prepayment method when introduced will allow people to choose and monitor how much they wish to spend on electricity each month.

Potentially, the most far reaching impact of power sector reform is on the facilitation of economic development by creating a reliable and affordable electricity supply for power industries and small businesses. Although, power reform may lead to the removal of many cross-subsidies and hence, increase the price of electricity for small businesses and domestic consumers, stable and reliable electricity that is always available may reduce operational costs.

There will be no need for individuals or organisations to invest on costly backup systems. New businesses can now be established in welding, sewing, ice making, battery charging, telecommunication services, etc.

Reforms have the potential to affect access levels in many ways. Improving the efficiency and financial soundness of the power sector, reforms can attract new investors or free up government resources to be used in expanding access provided there is an effective demand. Power sector reforms will however, introduce market-driven private sector participation that may encourage utilities to focus on providing electricity to communities that are viable and profitable.

PROPOSED REFORM CHALLENGES AND EXPECTATIONS

A look at the reform in Nigeria so far shows that the Government is pursuing a plan of unbundling of the power sector, establishing an independent regulator and eventually privatizes its assets. At this stage, the focus should be on privatizing distribution companies to bring the pricing of wholesale and retail power to cost recovery levels, to improve collections and to enforce disconnections for non-paying customers. The privatization of distribution companies (or discos) need to be pursued so as to monetize the power sector, which had often relied on artificially low tariffs and Government

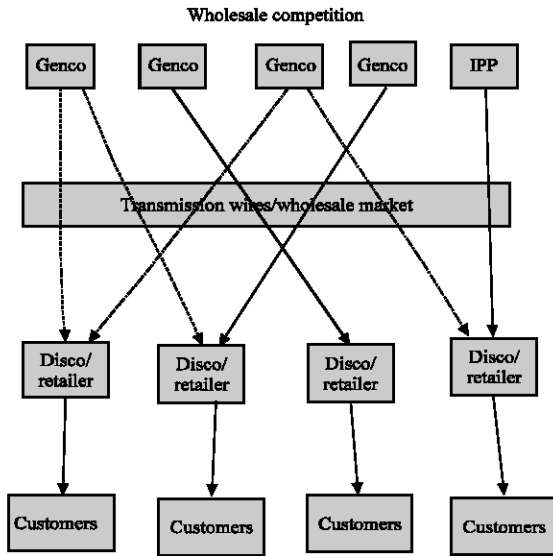


Fig. 5: Power market model

subventions to maintain their financial stability. This push to full power sector restructuring and unbundling based on the competitive market model involved an even higher level of complex financial engineering. At this point, investors willing to finance projects in the power sector require a secured legal structure, regulatory framework and institutional capacity. Guarantees had to be commensurate with the new risk profile.

The progression of the power market model from a vertically integrated, Government-owned monopoly shown in Fig. 2 to the proposed unbundled competitive structure shown in Fig. 5 will be the expected goal of government. This desired restructured power sector will definitely lead to increased competition, more complexity and uncertainty that will requires new management mechanisms.

The industrialized countries have been in the forefront of this move to competitive power sector markets and they have been better able to manage this new complexity and uncertainty because their power utilities are more commercially viable, their regulatory institutions are more mature, their capital markets are more developed and their ability to finance and implement the necessary Information Technology (IT) is greater. The ability of the power industry in developing countries like Nigeria to adapt to more complex power sector market and financing structures has raised new challenges, which those responsible for the power sector reform have been less equipped to address.

Industrialized countries have embarked on the move to competition after developing mature power sectors that have achieved full cost recovery, have well-established

subsidies to poor consumers, provide full electricity coverage for the entire population and have met basic environmental objectives. In contrast, Nigeria have been led to introduce competitive markets even though their power sectors often have not achieved full cost recovery, no subsidy delivery programs in place, inability to generate half of the electricity needs of its population and failure to meet the environmental and social objectives.

The country is still trying to attract major private investors in the power sectors. When a vertically integrated state-owned power company is broken up into separate generation, transmission and distribution companies and when private investors and market participants are introduced, risk management at the sector and project development levels require different financing and risk-management mechanisms. In addition, this proposed structure increases the demand for management talent for all the new power sector companies that are being created. Finding, the management professionals to guide these new companies in ways that serve the financial interests of international investors will definitely presents new challenges.

CONCLUSION

With the establishment of the Nigerian Electricity Regulatory Commission (NERC), the reform of the Power Sector in Nigeria has indeed become a reality. Nigeria with its enormous energy potentials, high power demand and rapid economic growth remains a green field full of potentials for would-be investors in the power sector. NERC is mindful of the onerous responsibilities placed on it to revamp the ailing power sector and the development of its licensing framework was formulated with this responsibility in mind. NERC will, in its initial years of operation, endeavour to make a positive impact on the general populace, industry participants, potential investors and consumers.

Power sector reform will improve the stability of electricity supply, improve cost recovery and increase the availability of investment capital. To improve cost recovery and the financial health of utility systems in developing countries, there is increasing pressure to price electricity at its marginal cost and allow Independent Power Producers (IPPs) to sell power to the grid. Several models of regulation have also emerged through the reforms, ranging from independent commissions that conduct a broad range of planning and regulatory functions to bodies within government that primarily manage generation dispatch and fix tariffs. Reforms have also affected the quality of power in Africa through special customer service arrangements. New prepayment

methods have allowed poor people to choose and monitor how much they wish to spend on electricity each month. The point to note in this reform is that if NERC, BPC and all the concerned bodies are unable to play down on the political issues and the so called Nigeria factors, the confidence of intending investors in the power sector reform will not be boosted to yield the expected enhanced efficiency, quality and availability of power supply and usher in the expected technological revolution of the country.

REFERENCES

- Asubiojo, L., 2007. The Guardian Newspapers. pp: 09. letters@nrguardiannews.com.
- Bacon, R.W., 1995. Privatization and reform in the global electricity supply industry. *J. Energy Environ. Ann. Rev.*, 26: 331-359. DOI: 1146/annurev.Energy.26.1.331.
- Campos, J.E. and S.H. Esfahani, 1996. Why and when do governments initiate public enterprise reform. *J. Oxford University Press. The World Bank Econ. Rev.*, 10 (3): 451-85. <http://wber.oxfordjournals.org/>.
- Haggard, S. and S.B. Webb, 1993. What do we know about the political economy of economic policy reform. *J. Oxford Journals, Oxford University Press, World Bank Res. Observer*, 8 (2): 143-68.
- Ikeonu, I., 2006. The Nigerian Electric power sector Reform: Establishing an effective licensing Framework as a tool for attracting investment. *J. Institute for public-private partnerships, Inc., Regulation Resources Inform. Series*, pp: 39-49.
- Kuale, P.A., Tsado Jacob, 2006. Optimization approach to independent power production. *J. Elect. Electronics Eng. (JEEEE)*, 10 (1): 1-10.
- Nigeria First, 2005. Power sector Reforms. www.nigeriafirst.org.