

Repositioning the Power Industry in Nigeria to Guarantee Reliability in Operations and Services

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Abstract: Nigeria is endowed with reserves of natural gas in excess of 200 Trillion cubic feet (Tcf), to thermally generate enough power for all sectors-home, commercial and industries. While, there is no doubt about the high demand for electricity in Nigeria, the power industry has being marginally functional. This study reviewed the present state of the power industry in Nigeria and investigated the modalities of re-positioning power to guarantee reliability in operations and services. The findings showed that a collaborative and mutually beneficial business initiative with the petroleum industry is desired and should be encouraged and sustained. Power should be classified and traded as a commodity through a private value market, with greater emphasis on best practices in operations and asset management, a free market oriented supply side management structure should be put in place and service contract financing with Construct, Commission, Operate to recover costs and Lease (CCOL) scheme option is desired for all projects in the power sector.

Key words: Power, reliability, PHCN, joint venture, natural gas, independent power plants, commodity market

INTRODUCTION

The quality of life in any country is highly dependent on a reliable supply of power. According to Chigbue (2006), power which is a major component in the requirements for effective industrialization and development is grossly inadequate in Nigeria. The energy, power, steel, communication and agriculture industries are key industries that will impact positively on the effective and sustainable development of Nigeria, subject to the following major constraints:

- A genuine desire for development
- A robust economy
- An effective and sustainable democracy
- Effective policies and decisions of the federal government of nigerian on energy, power, etc.
- Peace within the host communities for each industry

At present, the power industry in Nigeria is beset by major difficulties in the core areas of operation:

- x_1 : Generation
- x_2 : Transmission
- x_3 : Distribution
- x_4 : Marketing

Electric power ($x_1 + x_2 + x_3 + x_4$) will drive the other industries, but will itself, be cost effectively driven and sustained by the energy industry, specifically, natural gas. Thus, it becomes pertinent to ask the following questions.

Is there a master plan for power in Nigeria? If yes, how dynamic and reliable is this plan in driving the user industries and in meeting the present and future power needs of Nigeria?

MATERIALS AND METHODS

- An overview of present status of the power sector in Nigeria
- Analysis of the challenges to reliability in the sector
- Options for power in Nigeria
- Commodity market for power

Present status of the power industry: In Nigeria, the total installed capacity of PHCN power stations is approximately, 6,200 MW as shown in Table 1. However, some of the power stations generate <45% of their installed capacities. Table 2 shows that in 2005, PHCN was marginally generating 3,300 MW, while Table 3 shows the monthly average generated capacities of the power stations. PHCN reports (2005, 2006) showed

that the generating capacity is <3,000 MW, which is supposedly to meet the domestic and industrial needs of about 140 million people. Onohaebi (2006) in his Ph.D thesis, observed that the transmission lines in Nigeria are mainly radial, long and fragile leading to high power losses on the network. The distribution lines are over extended leading to high voltage drop and losses. Thus, we clearly see the major difficulties besetting the core areas of electric power in Nigeria.

However, the AOGR (2003) revealed that The Federal Government of Nigeria intended to increase the power generation capacity to 10,000 MW by the 2007. As at May, 2009, the slogan has changed to 6000 MW by December 2009. A new date for meeting the millennium mandate on power is now set at 2010. The objective of this study is to examine, the present state of the power industry and then, proffer recommendations to enhance efficiency and reliability in the system.

Challenges to reliability: If and when the additional power is available, challenges to reliability in generation, transmission, distribution and marketing of the power, must be addressed. Idigbe (2003) in his study repositioning NEPA postulates that maintenance and possible upgrading of old facilities will go a long way to improve the power supply in Nigeria. Thus, the following questions arise:

- What level of reliability in power will be desired and accepted by customers?
- How will the nation transmit and distribute the additional power? At present, it cannot efficiently transmit and distribute the marginally generated power?
- Should the cost be government-financed or financed through private markets?

According to The World Bank, Nigeria's power sector policy 2003, the investment requirement for achieving a 50% access to electricity by the 2020 is in the order of 300 million US dollars yearly. Between 1989 and 1994, no new investments were made in the power sector, while <100 million US dollars was spent in the sector between 1995 and 1999. This is a far cry from the requirement for a reliable electric power supply and availability in Nigeria.

Table 1: Existing federal government power stations in Nigeria

Power station	Location/state	Status	Installed capacity (MW)
Egbin thermal	Lagos	Operating	1320
Afam thermal	Rivers	Operating	969.6
Sapele thermal	Delta	Operating	1020
Ijora thermal	Lagos	Operating	40
Delta thermal	Delta	Operating	912
Kainji hydro	Niger	Operating	760
Jebba hydro	Niger	Operating	578.4
Shiroro hydro	Niger	Operating	600
Total			6200

Table 2: Summary of generation capabilities of PHCN (2004 and 2005)

Power stations	Availability factor		Average availability (MW)		Installed capacity (MW)
	2004	2005	2004	2005	
Egbin thermal	0.7981	0.87	1053.48	1147.78	1320.0
Afam thermal	0.2451	0.36	152.70	221.20	969.6
Sapele thermal	0.1182	0.10	120.60	104.68	1020.0
Ijora thermal	0.1230	0.00	8.00	0.00	40.0
Delta thermal	0.5081	0.43	463.38	393.45	912.0
Kainji hydro	0.5372	0.54	408.00	411.61	760.0
Jebba hydro	0.8299	0.79	479.99	454.34	578.4
Shiroro hydro	0.8169	0.80	490.12	480.42	600.0

Table 3: Monthly average generated capabilities (MW) in 2005

Months	Egbin	Afam	Sapele	Ijora	Delta	Kainji	Jebba	Shiroro
Jan.	1127.90	117.74	122.35	0.00	499.45	350.65	516.77	391.94
Feb.	1269.64	63.39	121.86	0.00	395.00	394.21	405.00	440.36
Mar.	1145.42	200.16	153.77	0.00	396.94	403.42	486.90	442.58
Apr.	1216.57	181.50	152.20	0.00	374.63	368.33	444.67	462.00
May	1146.97	201.58	130.52	0.00	362.00	299.39	327.58	421.35
June	1191.00	224.07	148.27	0.00	365.27	509.00	414.00	410.00
July	1266.45	166.58	138.26	0.00	311.87	492.26	446.45	521.94
Aug.	1144.84	339.84	128.45	0.00	347.42	463.87	461.61	488.71
Sep.	1084.63	293.90	98.33	0.00	340.90	427.17	465.00	405.57
Oct.	1115.48	309.65	26.00	0.00	401.97	432.90	513.87	590.32
Nov.	1136.63	296.37	35.90	0.00	427.10	398.60	468.00	600.00
Dec.	927.81	259.65	0.00	0.00	498.90	399.52	502.26	590.32
Avg.	1147.78	221.20	104.68	0.00	393.45	411.61	454.34	480.42

Table 4: Commissioned IPP power projects

Power stations	Location/stage	Status	Installed capacity (MW)
AES	Lagos	Commissioned	300
AGIP	Delta	Commissioned	480
Ajaokuta	Kwara	Commissioned	80
Total			860

Table 5: Seven new federal government power projects in the Niger Delta areas

Power stations	Location/stage	Status	Installed capacity (MW)
Calabar thermal	Cross river	Under construction	561
Eyaen thermal	Edo	Under construction	451
Gbaran/Ube thermal	Bayelsa	Under construction	225
Ikot Abasi	Akwa Ibom	Yet to be awarded	300
Thermal (Alscon)			
Sapele thermal	Delta	Yet to be awarded	451
Omoku thermal	Rivers	Yet to be awarded	230
Ikot Abasi			
(Ibom power)	Akwa Ibom	Yet to be Awarded	188
Total			2744

- Must power continue to be sold at its present price to customers? The tariff system in Nigeria is arguably the lowest in the world
- If not, what then is a fair market price for power in Nigeria?
- Will and should the Federal Government of Nigeria continue to own and regulate power in the future?
- Can a private-oriented commodity market be set up for power in Nigeria?

These are some of the challenges that will confront the power industry in the next few years. A key to satisfying the desire of the federal government to generate 10,000 MW is through Independent Power Plants (IPPs). Table 4 shows, three commissioned projects, while Table 5 shows the 7 new power projects in the Niger Delta region, the federal government planned to build. Arising from these, we again ask the following questions:

- How effective will these and any additional plants fit into the master plan (if any?) for power?
- Should the IPPs be managed by the companies or handed over to PHCN?
- At what price will the generated power be sold to PHCN if the companies manage the plants?

Options for power in Nigeria: There are three main options available for power in Nigeria:

- Present status quo: state owned
- Privatization of PHCN-unbundling
- A commodity market for power

Continuing with the present status quo, where the federal government is allowed to generate, transmit,

distribute and market power, cannot meet the need for the effective industrialization in Nigeria. Reliability in power will not and can never be assured by this option, as shown over the years. This is the first option.

The Federal Government itself has realized the shortcomings in the present status quo and has thus, mandated the Bureau of Public Enterprises (BPE) to effect the privatization of PHCN, which is the second option. This was signed into law by the Federal Government of Nigeria in March 2005, to facilitate the process of privatization, deregulation and unbundling of PHCN into Generating Companies (GENCOs), Transmission Companies (TRANSCOs) and Distribution Companies (DISCOs). With the facts on ground, it is very clear that this process has not improved the reliability of power in Nigeria.

The third option available for power in Nigeria will be to evolve a private valued market for power. Here electric energy will be traded as a commodity like crude oil, coal, etc. bought by states, Local Governments, companies, etc. We propose a new company called Electric-Power Investments and Management Services Plc., to replace PHCN. This will be a joint stock company, with shareholding by:

- The Federal Government
- The State and Local Governments
- Petroleum Industry and Power Companies
- Financial Institution and the Business Community
- General Public

This new company, analogous to the NNPC, will enter into venture partnership with companies in power generation, transmission, distribution and marketing. The venture partnership could be in the form of:

- Joint Venture Agreements (JVA)
- Power Sharing Agreements (PSAs)
- Sole Risks Agreements (SRA)

The generated power by private companies will be delivered to the new joint stock company to be traded in an open market. Commodity exchange marketers for electric power can be designated for states, regions, etc. it is hoped that transmission and distribution facilities will be privately owned and services will then be effectively priced and managed. However, the following key requirements must be met.

- A clear and well defined strategy for power in Nigeria
- An effective master plan for power
- The effective rehabilitation of power facilities in Nigeria
- A proper restructuring of the power industry that must continually create value

- Effective policies and decisions by the federal government to encourage competition
- Security of investments of venture partners
- Economic pricing structure of power product(s) through a private market structure-the commodity exchange
- Easy access to/and repatriation of income by venture partners
- Fiscal discipline by the Federal Government
- Trust, integrity, accountability, cordial and long-term relationships between all parties-mutually beneficial and sustainable

RESULTS AND DISCUSSION

Synergies between partners: To meet the challenges of change in the power industry will require effective synergies.

- Can any synergies be effectively established between the Federal Government of Nigeria and Venture Partners to guarantee long-term sustainability and reliability of power in Nigeria?

Power needs to be continually available in Nigeria. Capital, expertise, good management (best practices), creativity and right technology are all important, but it will take beneficial and sustainable partnership to achieve this. We propose an effective collaborative business initiative-venture partnership in power with the petroleum industry because of the following:

- Leading gas companies in Nigeria. The companies have the reserves gas companies in Nigeria. The companies have resources of natural gas that can continually supply the needed volumes to drive the generation of power. At present the Egbin power Plant is shutdown because of non availability of natural gas
- Financial and commercial strength of these companies, they have the money and can also attract the funds that will be needed for the development and sustenance of power in Nigeria
- Operational experiences of these companies in power in foreign countries, e.g., shell gas and power in some Africa and Latin America countries
- These companies have easy access to value and emerging technologies in power
- They are disciplined and profit-oriented business-centered organization-value based companies
- They practice proper assets management
- They are guided by the principles of best practices in operations

The global nature of the multinationals in the petroleum industry, positions them to effectively participate in evolving and sustaining a new power industry in Nigeria. These multinationals have best experiences in power in both developed and developing countries in various continents. The companies have the financial strength and connections to international lending institutions to attract the necessary funds that will be required to rebuild and sustain the power industry in Nigeria. Recently, shell and its joint venture partners were commissioned on rehabilitate, Operate to recover costs and Transfer (ROT) contract by the federal government of Nigeria, to rehabilitate the old Afam power station.

The transfer syndrome is a major problem in Nigeria. Most often a system collapses after transfer, as evident in major power projects over the years. We recommend that all existing facilities should be on Rehabilitate, Operate to Recover costs and Lease (ROL) contract scheme. The lease option ensures the availability of spare parts, best practices and proper management of facilities. The companies will lease facilities for specified years with proper compensation-through shareholding, etc. This contract funding scheme is similar to what obtains in the petroleum industry in Nigeria. However, all new facilities generation, transmission distribution etc., should be on the Construct, Commission, Operate to recover costs and Lease Scheme (CCOL).

The driver-natural gas: Natural gas, the cleanest fossil fuel is expected to effectively drive the new power industry in Nigeria. Table 6 shows the 2006 estimated volumes of natural gas in Nigeria.

As the quest for crude oil goes into deeper offshore environments, greater volumes of natural gas are being discovered. According to Esau (2003), the records of NAPIMS show the total estimated reserves of natural gas in excess of 200 Trillion cubic feet (Tcf). Nigeria has province. Natural gas will continually be available for power generation.

In Nigeria, we believe there should be clearer directives to using our huge reserves of natural gas, especially in power. For example, the Second Regional Meeting of the World Petroleum Congress, Qatar (2003), exclusively dedicated its associated natural gas to domestic uses, such as power generation. The non-associated natural gas is used for export-oriented

Table 6: Reserves of natural gas in Nigeria

Category	Reserves (Tcf)
Associated Gas (AG)	100.00
Non-Associated Gas (NAG)	120.00
Total	220.00

projects, such as Liquefied Natural Gas (LNG), Compressed Natural Gas (CNG) etc. We believe Nigeria should do the same, particularly now that there are Ministers of State for Energy (power). A greater synergy is now possible between petroleum and power. A master plan for power should evolve with a major emphasis on thermal-based power. The hydro-based power has definitely not met the requirements for power in Nigeria.

A commodity market for power: At present in some State in Nigeria, PHCN is experimenting with pay as you use. This is equivalent to selling power as a commodity. The customers are made to buy power at a price dictated by PHCN. Is this a fair market price of power? In Nigeria, a major part of the consumers of power-industrial and residential, do not pay because of:

- Lack of meters for consumers
- Broken down meters that are never repaired
- Lack of easy access to the meters in the homes of consumers
- Corruption on the part of PHCN workers who come to disconnect power, but end up collecting bribes from consumers
- Illegal connections, which are not properly documented with PHCN

Over the years, PHCN has cried over insufficient funds for operations, new facilities, etc. How can PHCN have sufficient funds when a substantial part of its revenue is not collected? The Federal Government of Nigeria has subsidized PHCN over the years. Competition has not fared well. Inefficiency in PHCN has always been rewarded with more funds. How long can this trend continue?

We propose a commodity market, where power will be bought and then sold to consumers through transmission and distribution facilities, which will be privately owned. The proposed market must meet the following conditions:

- Reliability in supply (at what level)
- Performance-oriented and value-based
- Fair competition-no monopoly of any sort by any party
- Fair pricing of power, property dedicated by the rules of supply and demand
- Adequate security for power and venture investments

In Nigeria, there is an enormous demand for power. Table 7 shows a projected demand for power in Nigeria for the next 5 years. For example, PHCN presently sells power

Table 7: Potential for power in Nigeria

Years	Residential users (millions)
2004	40
2005	45
2006	50
2007	55
2008	60
2009	70

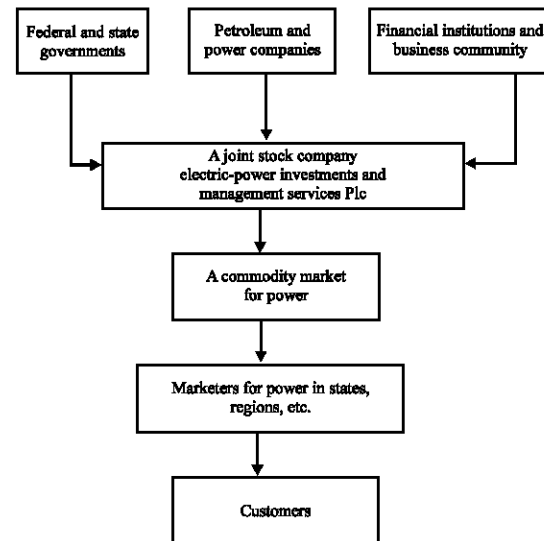


Fig. 1: Proposed new power industry

to residential consumers at 4 ₦ kWh⁻¹. Even at this rate, if properly collected, huge revenue will be available to any venture partners. There is great potential for partners to make money. This enormous demand can only be met through fair competition that will guarantee reliability in supply. The fair competition will dictate a market price that will be fair to sellers and buyers of power. Figure 1 shows a proposed structure for a new system for power in Nigeria.

The dynamics for market: The dynamics for the operation of the commodity market of the new power industry will be in the following step wise approach:

- A total rehabilitation and repositioning of the distribution and billing systems
- Appointment of venture partners with clear mandates in generation, transmission, distribution and marketing
- The setup of the joint stock company, Electric-power Investment and Management Services Plc
- The placement of the Electric-power Investments and Management Services Plc, on the stock market
- Appointments of marketers of power in all states of the federation

- First, selling of power through the marketers to the major industrial users in the market
- Second, selling of power to major companies and offices through the markers
- Third, selling of power to individual consumers

This step-wise approach is designed to minimize any logistic problems that will arise. It is not feasible that the marketer can start operating at the same time for all customers. These logistic problems will be solved for each category of customer, at the right time.

Investment opportunities in power: A great opportunity for investment in power exists in:

- Power generation (effective rehabilitation of old and construction of new plants)
- Construction of gas pipelines to the power stations
- Construction of new substations-power boosters
- Rehabilitation of old transmission lines
- Construction of new transmission lines
- Innovative distribution systems
- Evolving effective assets management solutions-consultants

The transmission lines, distribution and billing systems of PHCN are barely meeting standard international requirements for power. The number of substations in Nigeria is grossly inadequate. Assets are into properly managed by PHCN. The poor assets management has resulted in:

- Frequent breakdown of facilities
- Inadequate billing of customers
- Poor services to customers
- Costly operations-most PHCN operations are not cost effective

The Federal Government of Nigeria should immediately implement the following:

- Put the old generation stations on JVAs
- New generation stations to be privately-owned
- Rehabilitate and sell all transmission and distribution facilities
- New facilities to be privately-owned

Idigbe (2006) in his lecture and consultancy notes on functional development of crude oil fields, indicated that asset management workflow process is a standard

requirement in the petroleum industry, for field optimization. The power industry must therefore, take a cue from the petroleum industry and prioritize their business into:

- Core
- Non-core business

This will enable the proposed company, electric-power investments and management services Plc, to effectively manage power, monitor the activities of the venture partners and implement policies.

A new power industry is expected to evolve after this. This is a necessary condition for that effective industrialization of Nigeria. To enhance the industry to continually deliver and sustain value-based development in power, there must be:

- A major policy for power, with a phase vision, articulated to achieve electricity for industrialization by target dates
- The designation of new power projects as pioneer
- A separate and distinct federal ministry of power and electricity to evolve from the present ministry of power and steel
- The appointment of a minister to exclusively oversee all activities on power
- A total de-regulation of the new power industry
- Knowledge centers for troubleshooting, market research and problem solving

This will guarantee benefits and value to all parties, which will facilitate the repositioning of the system for optimum generation, transmission, distribution and marketing of power.

Benefits to all parties: To Nigeria, the following benefits are expected:

- A properly re-engineered, reoriented and functional power industry
- New and long awaited technologies in the power and allied Industries
- The emergence of new life to the other industries dependent on power
- Global economic outlook for Nigeria-basic infrastructure in place
- Positive impact on the national economy
- Positive impact on the human resource in the power industry-exchange and addition of vital knowledge

To any venture partners:

- A great opportunity to earn great economic rewards in a marginally exploited industry
- A greater opportunity to grow into wider West African markets
- Long-term economic relationship and partnership with Nigeria and local investors
- Creation of global markets for power and allied products

CONCLUSION

Power is a major input to the effective industrialization and subsequently, the sustainable development of Nigeria. At present, the power industry in Nigeria is characterized by State ownership, incessant breakdown of facilities, poor services to customers, very poor management of assets, non-economic pricing of power, etc. Thus, for a new beginning in power in Nigeria, we suggest:

- Effective synergies with the petroleum industry on the road to effective delivery of power in Nigeria
- A culture of effective assets management
- A community market for trading in power

To achieve an effective re-positioning of the power industry in Nigeria, there must be total rehabilitation of all power systems and greater competition in the industry. Capital, expertise, good management, creativity and right

technology are all important to ensure that power is continually available, but it will take beneficial and sustainable partnership to achieve this. We suggest a mutually beneficial relationship be established between all parties, through a sincere, cordial and long-term understanding of wants and values.

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