

# Nigerian Power Reform and Electricity Generation - Prospects and Challenges

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**ABSTRACT:** Regular supply of power is the characteristic of any developed economy. Any country whose power supply is not constant will not develop quickly as investors will not like to invest in that country. This paper reviews the forces driving the movement of power reform and then describes the steps that should be taken to achieve success. Data on actual steps taken and preliminary information on the impact of reform are presented. The elements of a sector power reform were considered. Finally, challenges and prospect of power reform were highlighted.

**KEYWORDS:** Power Generation, Reform, Challenges and Prospect

## I. INTRODUCTION

The history of electricity in Nigeria dates back to 1896 when electricity was first produced in Lagos, fifteen years after its introduction in England [1]. The first power station in Nigeria was built in Lagos in 1898 at the present site for Power Holding Company of Nigeria [PHCN]. [2]. The law which established the National Electric Power Authority (NEPA) in 1972 stipulated that it should develop and maintain an efficient, co-ordinated and economical system of electricity supply for all parts of Nigeria. Thirty eight years after, we are still in the despondency as far as power availability is concerned. At the inception of NEPA in 1973, only five of the then 19 state capitals were connected to the national transmission grid system. Today, practically all state capitals are being served from the national grid, although haphazardly. [3]

In first April 1972, the operation of ECN and NDA were merged in a new organization known as National Electric Power Authority (NEPA). Since ECN was mainly responsible for distribution and sales and NDA created to build and run generating stations and transmission lines, the primary reasons for merging the organizations were [4]:

- It would result in the vesting of the production and the distribution of electricity power supply throughout the country in one organization which will assume responsibility for the financial obligations.
- The integration of the ECN and NDA should result in the more effective utilization of the human, financial and other resources available to the electricity supply industry throughout the country.

Although NEPA, expands annually in order to meet the ever-increasing demand, it is sad to note that the majority of Nigerians have no access to electricity and the supply to those provided is not regular [5]. It is because of this that the federal government has embarked on aggressive power sector reforms with the intention of making it more efficient, effective and responsive to the yawning of the teeming populace.

The principal driving forces behind this reform movement, described by a number of authors [1, 6, 7, 8], include the following: (a) the poor performance of the state-run electricity sector in terms of high costs, inadequate expansion of

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access to electricity service for the population, and/or unreliable supply; (b) the inability of the state sector to finance needed expenditures on new investment and/or maintenance; (c) the need to remove subsidies to the sector in order to release resources for other pressing public expenditure needs; and (d) the desire to raise immediate revenue for the government through the sale of assets from the sector.

This paper looks at the Power Reform and Electricity Generation by PHCN as a utility company in particular and the nation in general.

## II. SOURCES OF ENERGY IN NIGERIA

Production of electrical energy in Nigeria over the century years varied from gas, oil, hydroelectric power stations to coal stations. Privatization of the energy sector has already been initiated through the Electric Power Sector Reform Act of 2005. The former National Electricity Power Authority (NEPA) is being unbundled into generation, transmission and distribution companies that will become privatized. Meanwhile, several Independent Power Producers (IPPs) are already operating in Lagos, Abuja and Port Harcourt.

- Coal:** Coal is found in the following Nigerian states: Enugu, Imo, Kogi, Delta, Plateau, Anambra, Abia, Benue, Edo, Bauchi, Adamawa, Gombe, Cross River and Ebonyi. This is predicated by the fact that the primary fuel sources (Coal, Oil, water, Gas) are readily available. Nigeria's coal reserves are large and estimated at 2 billion metric tones of which 650 million tones are proven reserves. Figure 1 shows the pie chart representation of the coal deposits in Nigeria.

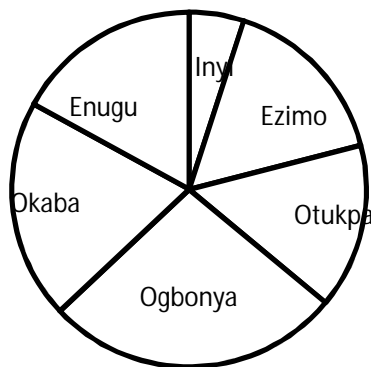


Figure 1: Locations and proven Coal reserves in Nigeria

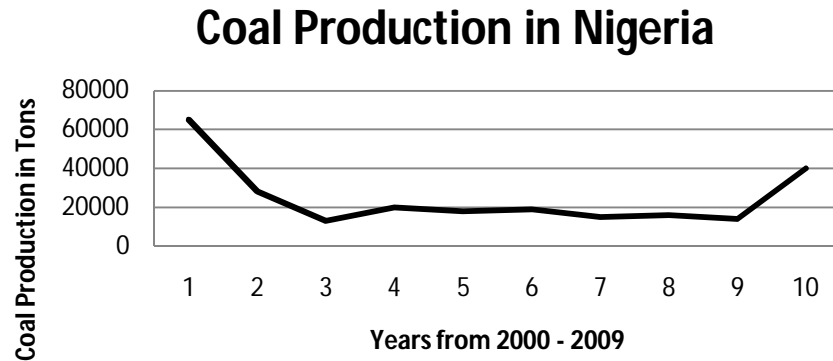
About 95% of the Nigeria coal product has been consumed locally, mainly for railway transportation, electricity production and industrial heating in cement production. Figure 2 shows the graphical representation of coal productions in Nigeria from 2000 to 2009.

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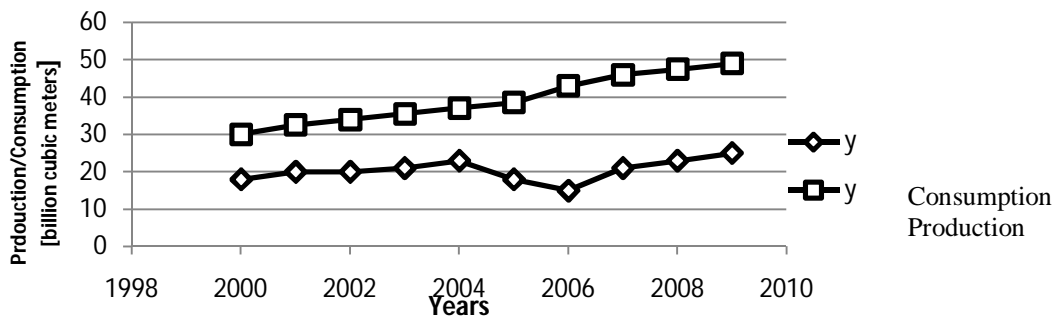
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**Figure 2: Coal production in Nigeria**

2. **NATURAL GAS:** *Oil and Gas Journal (OGJ)* estimates that Nigeria had 184 trillion cubic feet (Tcf) of proven natural gas reserves as of January 2009, which makes Nigeria the seventh largest natural gas reserve holder in the world and the largest in Africa. The majority of the natural gas reserves are located in the Niger Delta. In 2007, Nigeria produced 1,204 billion cubic feet (Bcf) of natural gas, while consuming 456 Bcf. Approximately 749 Bcf were exported, mostly as liquefied natural gas (LNG). In 2007, Nigerian exports of LNG to the US were 95 Bcf, making it the third largest source of LNG imports after Trinidad (447 Bcf) and Egypt (115 Bcf), and are expected to last for more than a century as a domestic fuel and a major export [9]. Figure 3 shows the trend of natural gas production and consumption in Nigeria from 2000 to 2009.



**Figure 3: Natural gas production and consumption in Nigeria [2000-2009]**

3. **Oil:** The third major source of energy is oil. It is Nigeria’s major sources of revenue. According to *Oil and Gas Journal (OGJ)*, Nigeria had an estimated 36.2 billion barrels of proven oil reserves as of

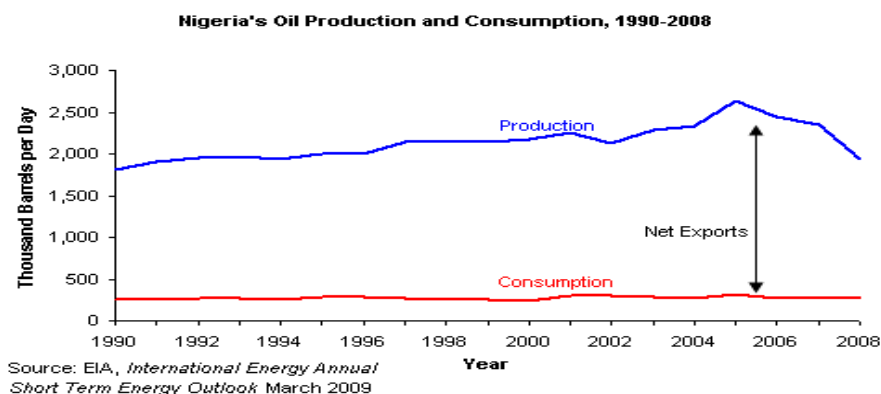
1. January 2009. The majority of reserves are found along the country’s Niger Delta and offshore in the Bight of Benin, the Gulf of Guinea and the Bight of Bonny. Current exploration activities are mostly focused in the deep and ultra-deep offshore with some activities planned in the Chad basin, located in the northeast of the country. The Nigerian government hopes to increase oil production capacity to 4 Mbbl/d ( $640 \times 10^3 \text{ m}^3/\text{d}$ ) by 2010. Nigeria is the world’s eighth largest exporter of crude oil and sends 42% of its exports to the United States. Nigeria is heavily dependent on the oil sector, which accounts for 95% of its export revenues.<sup>[11]</sup> Figure 4 shows the Nigeria’s oil production and Consumption in Nigeria [1990-2008]

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**Figure 4:** Nigeria’s oil production and Consumption in Nigeria [1990-2008]

### III. POWER SECTOR REFORMS

At present, the installed and available electrical capacities in the Nigerian generating stations are shown in Table 1.

Generating plants - grid stations Site	Type	Installed capacity [MW]	Available capacity [MW]	No.of units
Afam	Thermal	700	488	18
Delta	Thermal	812	540	20
Egbin	Thermal	1320	1100	6
Ijora	Thermal	66.7	40	3
Sapele	Thermal	1020	790	10
Jebba	Hydro	540	450	6
Kainji	Hydro	760	560	12
Shiroro	Hydro	600	600	6
Orji River*	Thermal	60	-	4
Others	Diesel	46	18	-

Table: showing Installed and Available capacity

From the above figures we can observe the total installed capacity is not enough. And we are all aware that the available capacity is not up to the installed capacity even though the present installed capacity is too small to meet the energy needs our country. Hence the need to reform our energy system is very paramount at this time.

### IV. ELEMENTS OF A SECTOR REFORM PROGRAM

Power reforms are designed to introduce competition where feasible, which is in the upstream production and downstream supply functions of the industry structure, and to use economic regulation of the wholesale and retail power markets to promote competition and protect consumer interests. Regulation of the power market is essential, as shown by the experience of New Zealand, which tried an approach without the amount of regulation used elsewhere. Their approach was based on mandatory separation of generation, transmission, and distribution, using general competition laws to deal with both the terms of interconnection and conduct generally in unbundled power networks. Sector-specific regulation, especially of electricity prices, was rejected under this approach as being self-defeating, and

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competition was relied on to provide the required market discipline for participants. A full-scale power reform program generally consists of the following main elements.

1. Obliging electricity enterprises to operate according to commercial principles. This obligation extends to state-owned entities that undertake one or more of the basic functions in the supply chain, namely generation, transmission, system control, distribution, and supply services to users of electricity. The supply services function encompasses the sale of electricity procured on the wholesale electricity market to electricity users and the associated customer services of billing, collection, and maintenance. These principles require that enterprises pay taxes and market-based interest rates, earn commercially competitive returns on equity capital, and have the autonomy to manage their own budgets, borrowing, procurement, and labor employment.
2. Introduction of competition in order to improve sector performance in terms of efficiency, customer responsiveness, innovation, and viability. Competition can be developed in the generation- and supply-service segments but in most cases is not feasible in the network segments (transmission, distribution, and system control) because these functions are natural monopolies. Supply services to large electricity users is an intrinsically competitive segment because the cost of competing for their business is small compared with the potential profits. Supply services to all but large electricity users, however, has usually been a monopoly in practice because the profits per customer are too small to stimulate competition. Hence, this element of supply service has generally been carried out by the entity that distributes electricity to these users because both these functions serve the same market.
3. Restructuring of the electric power supply chain to enable the introduction of competition. This involves breaking up ("unbundling") the incumbent power utility into multiple generators and distributors of power that trade with each other in a competitive wholesale power market. To prevent the acquisition of anticompetitive amounts of vertical market power by any generators or distributors, transmission, and system control are placed with independent companies (or they may be combined) with restrictions on ownership or on control (through governance arrangements) of such companies by generators and distributors. Independent electricity suppliers should be allowed to compete with distributors for the custom of large users (this could be delayed in those countries where distribution and supply systems are so dilapidated at the time of privatization that new owners need a period of assured revenues to remedy the worst deficiencies before having to compete for the business of their largest customers), and supply licenses can be granted to generators as well as to firms that specialize in energy trading.
4. Privatization of the unbundled electricity generators and distributors under dispersed ownership, because competition is unlikely to develop properly between entities that are under common ownership—whether state or private. In developing countries, furthermore, private investors and operators are expected to bring in financial resources and technical and managerial expertise that will rectify the prevailing low standard of electricity supply by state-owned power utilities.
5. Development of economic regulation of the power market that is applied transparently by an agency that operates independently from influence by government, electricity suppliers, or consumers. In the wholesale market, the focus of regulation is to prevent anticompetitive abuses of market power. In the retail market, the focus of regulation should be on balancing the interests of suppliers with the interests of their captive customers.
6. Focusing of government's role on policy formation and execution while giving up the roles of operator and investor with divestiture of state ownership in generation and distribution.  
The process of a full reform program therefore consists of the following four main stages:

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- (a). Formation and approval of a power policy by government that provides the broad guidelines for the reform program and the heavy political commitment needed to sustain the reform process, followed by the enactment of legislation necessary for implementing this policy;
- (b). development of a transparent regulatory framework for the electricity market;
- (c). unbundling of the integrated structure of the power supply and establishing a market in which electricity is traded at arm's length; and
- (d). divestiture of the state's ownership at least in most of the electricity generation and distribution segments of the market.

Reform programs for electricity sectors must be built around these basic elements, but the detailed design of each program should reflect the particular circumstances of the country and its electricity sector. Hence, actual reform programs exhibit a variety of designs, particularly in terms of market structure, degree of private involvement, and sequencing of reform stages.

The variety of market structures can be categorized according to increasing degree of competition, as follows (15).

- |         |  |
|---------|--|
| Model 1 | Monopoly has no competition at all, a single monopolist produces and delivers electricity to the users.  |
| Model 2 | Purchasing agencies allow a single buyer or purchasing agency to encourage competition between generators by choosing its sources of electricity from a number of different electricity producers. The agency on-sell of electricity to distribution companies and large power users without competition from other suppliers makes the system inefficient.                          |
| Model 3 | wholesale competitions allows distribution companies to purchase electricity directly from generators they choose, transmit this electricity under open access arrangements over the transmission system to their service area, and deliver it over their local grids to their customers, which brings competition into the wholesale supply market but not the retail power market. |
| Model 4 | (retail competition) allows all customers to choose their electricity supplier, which implies full retail competition, under open access for suppliers to the transmission and distribution systems.   |

Reform programs are designed to progress through these models, starting from model 1 and progressing through model 2 or 3 until eventually reaching model 4. This progression reflects the basic sequence for a reform program, whereby restructuring the supply industry and setting up the legal and regulatory framework precedes the transfer of ownership of power generation and distribution from the state to the private sector. Models 3 and 4 are important for countries contemplating reforming their power sectors because they offer plausible alternatives to the traditional European state-owned, integrated industry structure, and to the rate-of-return based, investor-owned utility model developed in the United States.

Many reform programs in developing countries focus on moving from model 1 to model 3. The key decision is whether to go for model 2 or model 3. Adoption of model 2 in some developing countries has been justified largely as a transition stage to model 3 that is needed to allow time for the generation and distribution sectors to develop sufficiently for the operation of a competitive wholesale electricity market. The main risk with this model is that government can still impose un-commercial practices on the market by manipulating the single buyer. An additional risk is that government's commitment to full reform may weaken to avoid politically controversial consequences of introducing more privatization and competition (16).

## V. CHALLENGES AND OPPORTUNITIES

Power sector reforms in a developing economy such as Nigeria poses great challenges not only to the government that initiated the program, but also to the populace who are the consumer of energy and to the new born PHCN which parades itself as a better alternative to the moribund NEPA. These challenges can be broadly classified as follows::

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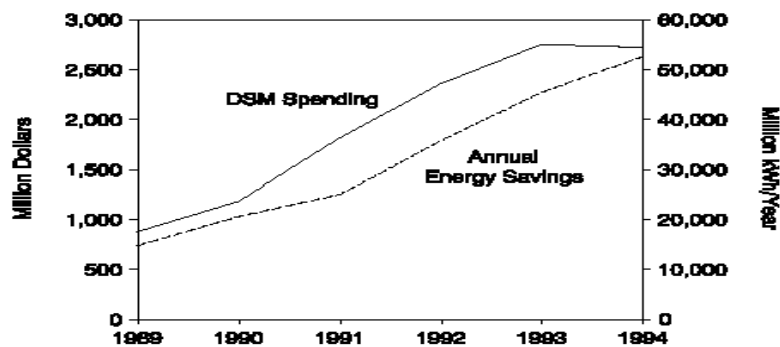
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**Economic and Social:** It is no longer debatable that the primary aim of the power sector reform by the federal government is to enhance the efficiency of the nation’s power industry as well as make energy affordable and available to the consumers. This means generating more power to the national grid and re activating most of the ‘dead’ units in the nation’s power stations. In order to satisfy the demand of electricity by consumers, new power stations must be constructed by the federal government, the PHCN and the independent power producers (IPPs). Construction of new power stations and comprehensive maintenance of dysfunctional already existing units are usually capital intensive. There is always a price to pay for constant power supply in our homes. This will definitely translate to more money being given out to the utility companies by end users since the former primary concern will be to make profit.

**Technical:** It is not just enough to generate power adequately without recourse to the strength of the existing transmission line capabilities as well as how the power could be used for the overall interest of both the PHCN and the consumers. The former emphasis the need for transmission line and substation re-enforcement and construction of additional transmission lines in order to ease evacuation of energy especially in areas where the IPPs cluster as result of proximity to energy sources [10]. The latter calls for establishment of the demand side management (DSM) program by the PHCN. Demand-side management programs usually consist of the planning, implementing, and monitoring activities of electric utilities that are designed to encourage consumers to modify their level and pattern of electricity usage. Instead of building new power plants to respond to increasing customer demand, electricity producers can also endeavor to minimize their customer’s demand for power by offering special programs for homeowners, businesses, institutions and industry. To determine the success of such programs, the costs and benefits of DSM opportunities should be directly compared with the costs and benefits of building new power plants and transmission lines [11]. Figure 5 shows such successes recorded in the U.S. electric utility DSM program from 1989 to 1993.



**Figure 5:** DSM program showing energy savings and utility expenditures between 1989 to 1993 [11]

**Political issues:** There is a need of creating and ensuring level playing field for all stakeholders in the emerging power sector will open itself to key players within and outside the country. This means that the IPPs should expect a conducive political atmosphere before they can agree to invest their money. Majority of the IPPs will like to construct their plants within the Niger Delta area where sources of energy needed to run their plants are guaranteed. At present the hostile environment in the Niger Delta predicated by armed ethnic militia and youth restiveness will definitely scare intending power investors. This brings to fore the need to sustain the nation’s democratic structures with the view of ensuring government policy stability. By so doing, the envisaged comprehensive national energy policy that will take care of conservation, storage, consumption, construction and distribution will be sustained when it becomes operational.

**Environmental Factors:** The nature of power plant to be built in a given locality is dependent on the nature of the environment. For instance, a city which has already cement industry and chemical industry may fraud at hosting thermal power plant because of high level of Carbon monoxide (CO) emission. In order to guard against this scenario, government must create Environmental Inspection Agency (EIA) to monitor and regulate the extent of damage caused

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by pollution to the environment and the inhabitants. Again, the IPPs may be confronted by high compensation fees for economic trees, properties and right of ways in their quest to erect a power plant in any given city. These high compensation fees may run in millions and can invariably pose as a deterrent to potential IPPs.

## VI. PROSPECTS

The last section has enumerated the enormous challenges involved in the government power sector reforms. Here, the opportunities derivable from such laudable steps in terms of efficiency and reliability of services, investment opportunities, employment opportunities, Transfer of technical manpower and encouragement of research will be discussed.

**Efficiency and Reliability of services:** Proper implementation of the reform program will promote efficiency and growth in the power sector. The reform will lead to improved electricity services as it will encourage private sector participation and investment in the electricity industry. The evidence can be seen in the form of better telecommunication services in the country brought about by the private sector participation in the provision of GSM services [12].

**Investment Opportunities:** The power sector reform has the ability to massively expand the personal share ownership in Nigeria. It is believed that over 800,000 shareholders can be created after privatization of NEPA. This is a welcome development which enables capital formation and economic growth [13]. It can reduce the reliance of public enterprises on the government for finance. Unbundling of NEPA, will make the successive companies to easily raise funds through the capital market once the necessary investor confidence has been developed; thus changing their growth and expansion of their business outfit.

**Employment Opportunities:** The power sector reform will in the long run create a reasonable employment opportunities to Nigerians. This is because, the companies that are expected to participate will look for both skilled and unskilled labour in the task of executing their businesses [14]. It is expected that when the reform is fully implemented, many graduate engineers and technologists roaming the streets in search of unavailable jobs will finally heave a sign of relief as most of them will be absorbed by the emerging independent power producers.

**Transfer of Technical Manpower:** Subsidiary companies that will compete in the power sector, which some of them must be foreign companies have to come with their expatriate. These companies in a bid to set up their operational structure will impact knowledge and skill in areas of demand side management, power system protection and planning, voltage collapse and stability, co-generation, etc to Nigerians through their foreign expatriate. This area of technology transfer if well tapped by Nigerians will go along way in breaching the gap between the developed and developing nation in terms of technology advancement.

**Encouragement of Research:** Privatization 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, her product must be second to none. Such excellence in quality of product could only be achieved through research. With the emerging power sector reform, other sources of renewable energy such as wind, solar and biomass are expected to be explored. For instance in UK, prior to privatization of electric sector, coal and gas turbines were widely used. With privatization, research was conducted in combined heat and power plants. With the eventual success in the research, generation companies rose from 10 to 32 while supply companies rose from 16 to 34 in 1990 because of new innovations in the field [13]. Definitely, the new owners of the privatized NEPA will embark on research, motivated by a different set of imperatives as new rules, more professional standards, new performance criteria and better training will emerge.



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## VII. CONCLUSION AND RECOMMENDATIONS

The paper has highlighted the on-going federal government of Nigeria power sector reform program. The challenges as well as the opportunities inherent in such reform program have been discussed. It is envisaged that the reform program will usher in competitive energy market, break the monopoly enjoyed by NEPA and increase the rate of technology development as well as provide jobs for both technical and non-technical graduates.

However, for the program to bring about the above positive changes the following recommendations should not be glossed over:

1. Government should ensure level playing ground for the independent power producers and other genuine investors in the power business.
2. Members of the Nigerian Electricity Regulatory Commission should be effective, efficient, un-biased in its role and corruption-free while the body itself should be truly independent.
3. Consumers of energy should be provided with a good education on the most efficient use of energy.
4. Pricing schemes to promote load management should be encouraged. Demand-driven pricing provides customers with an incentive to minimize their energy consumption during peak periods.
5. The old-time "Estimated billing method" should be discouraged. Rather accurate billing system should be introduced while rebates or subsidies introduced by energy companies as a way of supporting DSM improvements.
6. The Nigerian Engineers should be adequately represented in the planning and implementation of all aspect of the power sector reform program.
7. Lastly, the consumers of energy must come to terms with the fact that the rules have changed. They must be ready to pay for any amount of energy consumed since the utility companies are purely driven to make profit as well as to render good services.

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