# PROVIDING ALTERNATIVE POWER FOR DEVELOPEMENT IN NIGERIA–THE RESIDENTIAL GENERATOR EXPERIENCE

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## Abstract

No meaningful development can take place in a country without a regular, reliable and affordable power supply. National development encompasses material increase, education, health and environmental protection. The power sector in Nigeria has been characterized by inadequate finding, poor maintenance culture, vandalism and inefficiencies to mention but a few. Even with the power reform programmes of the federal government, it has been difficult to meet targets. This resulted in either low power outage; total blackout in both the industrial and residential areas. The ugly situation culminated in the era of generator economy to backup power supplied by the power holding company of Nigeria (PHCN). This paper therefore examines the cost implication of running a domestic generator as backup and its consequences on both the country and her citizenry. An investigation was carried out with four domestic generators: Suzuki, Yamaha, Elemax and Sumec, whose nominal output rating is 2.2kw each. Each generator was loaded to 80% of its rated capacity and run for 4 years to ascertain the fuel consumption rate and the operational cost. This investigation revealed that domestic generator owners spent about $ 89.98 per flat for fueling every month, excluding operational cost of $ 38.55. Consequently residential consumers spent s minimum of Us $ 100 each month per flat. This cost is far above the traffic charge (US $ 14 to US $ 19.35) by PHCN. The study was limited to generators of stated rating which uses Pms as fuel. The study further revealed that with the era of fuel and generators economy the country vision 2020 of being among the best 20 economically developed countries in the world is a mirage except something is done quickly to arrest the situation.

## Introduction

The epileptic power supply in most countries of the world is the major cause of underdevelopment. Development has been defined as "a sustainable increase in living standards that encompasses material consumption, education, health and environment [World Bank, 1991]. After the day long job, residents return home to relax so as recover from the energy loss and stress during the day's work. To achieve this, basic social amities such as water, cooling system, relaxation electronic devices etc. must be available to assist in this mental and social development.

The importance of regular power supply for commercial and residential use cannot be overemphasized. It is the power supply that ushers in the needed increase in living standard such as education, health and environmental protection and this is a characteristic of development. In absence of the power supply people resort to alternative source such as generators, rechargeable lanterns and candles sick. In the developed countries such a private arrangement is met to backup a major source of power supply owned by the local, state or federal government. An individual may even decide to invest in the power sector with a view to providing power at adequate, reliable and affordable charge. Whether private – driven as the case of American or government-driven as the case of china one thing that is common to both is the satisfaction of the consumers. Today, Nigeria is practicing the MIXED method: neither fully America nor Chinese.

The organ responsible for the generation, transmission and distribution of power in Nigeria is National Electric power Authority (renamed power Holding company of Nigeria after the reform act of 2005). The duty of this organization among others is to provide power at adequate, reliable and affordable tariff charges to the consumers. The two classes of PHCN consumers are the residential and commercial. The issue that calls for concern now is:

1. Are PHCN services satisfactory to her consumers?
2. What are the resultant effects of the inadequate / irregular power supply on the consumers?

This paper attempts to examine this problem of inadequate/irregular power supply and the experience of providing an alternative residential generator as a backup.

**Performance Evaluation of NEPA**

The records of the performance evaluation of National electric Power Authority (NEPA) since its inception in Nigeria have been on a downward trend. It has always been the case of having high installed capacity but distributing very low quality to the consumers. In 1990 it was recorded that of the 6,237.4Mv installed capacity only 1,824Mw was available for supply. The 1999 civilian administration seeing the power sector as a pivot of development undertook the rehabilitation of the existing generating units, installation of new generating units and also involved independent power operator to boost the generating capacity to 2934MW [Makoju, 2002]. The detail of the earlier status of power sector in Nigeria is shown in table 1 below.

Table 1: Old Power Plants and Generation Capacities [Agbo, 2007 & Aste, 2006]

| **Station** | **Type** | **Inauguration Date** | **Installed Capacity** | **Current (MW) Output** |
|---|---|---|---|---|
| Oju | Thermal | 1956 | 30 | - |
| Delta | Thermal | 1966—1999 | 900 | 366 |
| Ijora | Thermal | 1978 | 60 | - |
| Sapele | Thermal | 1981 | 1020 | 62 |
| Kanji | Hydro | 1968 – 1978 | 760 | 445 |
| Jebba | Hydro | 1983 – 1984 | 578.4 | 339 |
| Afam | Thermal | 1978 – 1982 | 969 | 85 |
| Egbin | Thermal | 1985 – 1987 | 1320 | 241 |
| Shiroro | Hydro | 1989 -- 1990 | 600 | 281 |
| Total | | | 6,237.4 | 1,824 |

Records showed that from 1973 – 1980, 1980 – 1990 and 1990 – 2000 the percentages of power generated to the installed capacity were 15.3%, 6.8% and 1. 3% respectively [Adegbulugbu *et. al*, 2007]. It was reported that the poor performance of the power sector was traceable to losses in transmission/ distribution facilities, unbilled losses due to illegal connection, marketing constraints and organizational inefficiencies [ECN, 2004]. Precisely, only 40 - 50% of the bill of power generated was collected, within 1991 – 2000 [ECN, 2004]. NEPA, as a government parasitical, is heavily dependent on subsidy from government and commercial consumers for survival. For instance, the average tariff charged between 1991 and 2000 was US 2.8 cents/ Kwh. This rose to US $ 3.2 cents /kwh in 2001 but never got to the estimate marginal cost of supply of US $ 6.5 cents/kwh [Adegbulugbu *et. al*, 2007].

This supported the fact that NEPA was dependent largely on the subsidy being provided by both government and commercial consumers. Such subsidy brought total reliance on government funding which culminated in inefficiencies thus rendering the system unproductive.

With the electric reform act passed into law in 2005, NEPA assets came under the control power holding company of Nigeria (PHCN) and was charged with the responsibility of itself being broken into smaller 18 companies facilitate private participation, and the name PHCN disappearing from the scene of the power sector. These companies are made up of one transmission company, six power generating companies and eleven distribution companies [Emeka, 2008]. The National Electricity Regulatory Commission NERC was formed alongside to supervise the power sector for efficiency. These reforms between 1999 and 2005 yield significant results. The reform was to involved all and sundry: PHCN, NNIP (Nigeria Independent Power Projects) international Oil Companies and private investors, such that by 2010 a target of about 23,000MW installed capacity would be achieved and estimated projection of 100,000MW in the future [Adegbulugbu *et. al*, 2007]. It was later discovered that the projection of 23,000MW by 2010 was not feasible and 10,000MW

by 2010 was adopted considering facilities on ground. In pursuance of this target the federal government came out with seven projects shown in table 2 below.

**Table 2: Seven New Federal Government Power Project bin Nigeria Delta [Emeka, 2008]**

| S/N | Power Station | State/Location | Units | Total Output (MW) |
|---|---|---|---|---|
| 1 | Odukpani (Calabar) | Cross River | 5 | 561 |
| 2 | Egbema | Imo | 3 | 338 |
| 3 | Ihovobor | Edo | 4 | 451 |
| 4 | Gharian ubie | Bayelsa | 2 | 225 |
| 5 | Sapele | Delta | 4 | 457 |
| 6 | Omoku | Rivers | 2 | 230 |
| 7 | Ikot Abasi (ALSCON) | Akwa Ibom | 3 | 300 |
| | Sum Total | | | **2562** |

Combining the installed capacity stated in table 1, table 2 and the Plateau (Mamolla Power Project) of 2600MW resulted to about 11,396MW. The new target of 10,000MW was based on this arrangement. Note that the failure to meet 23,000MW was due mainly to the unwillingness of private investors to commit their resources. With the government regulatory agency in place investor's flat consumers are already used to subsidize tariff charge and may run into losses. It is worthy to note that the zeal in pursuing this set target has dropped sharply.
Table 3 below depicts the present state of the power sector.

**Table 3: Data Showing Proposed Generated/Actual Generated Capacities [Emeka,2008, Adegbulugbe et al, 2007]**

| Date | Proposed Generated Capacity (Mw) | Actual Generated Capacity (MW) |
|---|---|---|
| 1999 | 1824 | 1824 |
| 2000 | - | 2500 |
| 2001 | - | 4000 |
| 2005 | 6000 | - |
| 2007 | 11396 | - |
| 2009 | - | 5000 |
| 2010 | 23000 | 5000 |
| FUTURE | 100000 | - |

Presently, PHCN can generate 5000MW but can only distribute 2900MW. The wide margin between generated and distributed values is due to the limitation in gas line network and transmission facilities. [Obiorah, 2009].
In another development, plant available was one of the factors militating against the country power plant [6]. This is depicted in Table 4.

**Table 4: performance Indicators for Nigeria's Electricity Supply Industry 1999-2005 [Adegbulugbe et al, 2007]**

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| Average Plant Availability | 30.3 | 27.2 | 42.5 | 46.2 | 47.5 | 44.4 |

Another case in point why Nigeria power sector is still rated low is the power outage. Study revealed that the industrial sector of Nigeria witness between 7.52 – 14.5hours of power outage on the average [Odiaka, 2006]. Residential consumers still witness the reign of blackout in most town and villages, except some few town/cities where residents had 4 (four) hours outage with cut at short intervals [Odiaka, 2006]. Another factor for ranking a country's power sector is the capital consumption for Nigeria is still very low compared to most developed countries in the world. This is shown in table 5.

**Table 5: Comparative Analysis of Consumption of Electricity Worldwide [Emeka, 2008].**

| Country | Population (Million) | Power Generation (GAW) | Per Capita Consumption (KW) |
|---|---|---|---|
| USA | 250.00 | 813 | 3.2 |
| CUBA | 10.54 | 4 | 0.38 |
| UK | 57.50 | 76 | 1.33 |
| UKRAINE | 49.00 | 54 | 1.33 |
| IRAQ | 23.60 | 10 | 0.42 |
| SOUTH KOREA | 47.00 | 52 | 1.09 |
| SOUTH AFRICA | 44.30 | 45 | 1.01 |
| EGYPT | 67.90 | 18 | 0.26 |
| NIGERIA | 140.00 | 5 | 0.021 |

It is evident sought that PHCN services have been inadequate and unreliable. Little wonder therefore that consumers sought for an alternative power supply to compliment PHCN. Study showed that consumers in Nigeria spent US $ 108.38 Billion annually to fuel generator [Odiaka, 2006]. This Estimate included industrial sector such as Telecom, Filling Stations, Factories, Banks, Insurance, Residential and commercial enterprises [Amoda, 2008]. This powers crisis left most of the companies with the attendant problems of "downsizing or at worst relocating to neighboring countries that have more favorable environment for business e.g. Dunlop, Michelin etc. All these testify to the fact that there is power insufficiency. Study also revealed Nigerians as the highest importer of generator in Africa [Emeka, 2008]. Of about $432.2 million spent by Africa countries Nigeria has the highest share of $152million. Earlier survey on the number of operating generations for domestic and small business in the country revealed a fair estimate of 5000,000 [Amoda, 2008].

**Alternative Power Supply and it's Effects**

The story of the residential consumers is not different. Huge amount of money is spent annually in providing alternative power supply for both mental and social development making use of various sizes of domestic generators ranging from 0.8KW to 3.5KW. The sum totals of cost of generator, fueling, spare parts and repair cannot be swept under the carpet, let alone the noise and pollution effects it has on the environment. It is equally on record that domestic generators have claimed many lives due to emission of carbon monoxide. Despites these attendant problems generator economy continued to grow in the country. Could we say that, this alternative is adequate, reliable and affordable?

A study was carried out between 2005 & 2008 with four generators: SUZUKI (GI), YAMAHA (G2), ELEMAX (G3) and SUMEC (G4), which have a nominal output of 2.2kw each. The generators were used in an estate which has a record of total blackout for the stated period. Equally true was that the flats were similar in construction and care was taken to obtain good results. Also the investigation was studied by following the maintenance policy as stated in the owners / manufacturers manual. These generators were run 8 hours everyday ensuring the tank is not empty until the end of the month when the average liter per day was recorded.

**Table 6: Products Specification**

| S/N | Data | G1 | G2 | G3 | G4 |
|---|---|---|---|---|---|
| 1 | Product | Suzuki | Yamaha | Elemax | Sumac |
| 2 | Purchase data | 2000 | 2002 | 2004 | 2004 |
| 3 | Power rating (KW) | 2.2 | 2.2 | 2.2 | 2.2 |
| 4 | Loading % | 80 | 80 | 80 | 80 |
| 5 | Fuel | Gasoline | Gasoline | Gasoline | Gasoline |
| 6 | Power factor | 1.0 | 1.0 | 1.0 | 1.0 |
| 7 | Running hour/day | 8 | 8 | 8 | 8 |
| 8 | Manufacturer | Japan | Japan | China | China |
| 9 | Frequency | 50 | 50 | 50 | 50 |

**Table 7: Estimated Cost of Maintenance / year in US $.**

| | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Average per Generator** |
|---|---|---|---|---|---|
| G1 | 130.00 | 34.66 | 34.00 | 42.66 | 35.33 |
| G2 | 31.33 | 32.00 | 44.66 | 40.00 | 37.00 |
| G3 | 30.33 | 52.66 | 38.66 | 43.33 | 41.25 |
| G4 | 31.00 | 31.33 | 59.33 | 40.66 | 40.58 |
| The cost of average maintenance for each Gen. Per year | | | | = | 38.54 |

**Table 8: Summary of the fuel consumption per hour for the four years**

| | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Ave. / Gen** |
|---|---|---|---|---|---|
| G1 | 0.753 | 0.795 | 0.808 | 0.785 | 0.7853 |
| G2 | 0.755 | 0.797 | 0.809 | 0.784 | 0.7863 |
| G3 | 0.754 | 0.797 | 0.806 | 0.787 | 0.7860 |
| G4 | 0.755 | 0.795 | 0.804 | 0.786 | 0.7850 |
| The average consumption for each Gen. Per hour = | | | | | 0.7855 |

**Table 9: Average Litre of Fuel Consumed per Generator**

| Litre/hour | Litre/day (litre/hour X 8 hours) | Litre /month (litre/day X 30.4 days) | Litre/year (litre/month X 12) |
|---|---|---|---|
| 0.7855 | 6.3 | 191.5 | 2298 |

At the pump price of US 0.47 cents/litre, the above table 9 translates to 0.37 cents, US $ 2.96, US $ 89.98 and US $ 1080 respectively.

**Data Analysis / Discussion**

The generators under investigation were Suzuki, Yamaha, Elemax and Sumac with a normal output of 2.2KW each. The average fuel consumed per hour for any of the above is (0.7855 liters). As shown in table 8.

The test also follows strictly the maintenance guidelines as stated in the owner's manual for reliable results. Interestingly, it was discovered that the residential generator owners consumed about 6.3litres for an outage of 8hours, this translates to 191.5litres per month (2298/year). This is evident from table 9, the consumption rate per family unit. The annual average operational cost for each (excluding fueling) can be obtained from table 7. It was not however, possible to ascertain the number of such generators in operation let alone the number of such generators imported into the country annually. Attempt to get such information from the office of statistics and standard organization of Nigeria proved unsuccessful. However, taking a rough estimate of 5 million generators the quantity of fuel would translate to 11.49 billion liters/year. This will amount to US $5.36 Billion if the pump price is 47 cents. Most times the fuel is sold at the stated pump price.

At the family unit level, cost of fuel per month/ flat was US $ 89.98 (US $1080year). It is a bitter truth that such staggering amount of money is being spent by income earner every year. The amount is far higher than the PHCN tariff charge of US$14month/ flat or US$19.35/ month/flat [Adegbulugbe et al, 2007].

The total average operational cost of the generators was (US$1118.5s) PER YEAR excluding the transport fare to and from filling station. The operational cost includes, lubricating oil, labour, fueling and spare parts. Of importance also is the initial cost is the initial cost of the generating set which varies between US$233.33 to US$800

**Conclusion**

From the foregoing, the following statement can be made:

1. Residential generator owners' use about US$100/month/Flat to provide alternative power supply for the family, which is far more than that of PHCN of about US$19.35/month/Flat.

2. The above is as a result of the failure of Public owned Power generation corporations in providing the needed stable and adequate power for the country's use.

3. The practice of owing and operating a residential generator promotes generator economy where importer laughs to his bank with huge sum at the detriment of the foreign exchange of the country.

**Recommendation**

1. The US$13.33 billions spent annually for importing fuel could be use to set up local refineries that will run successfully like the Nigeria Liquidified and Natural Gas Company.
2. Importation of generators should be restricted to avoid dependence on it. This can only be achieved if there is clear indication of improvement in PHCN activities.
3. Reform drive should be put in place by privatizing all the sectors; generation, transmission and distribution.
4. Also a workable and uncompromising regulatory organ like NERC should be strengthened to deliver Nigeria from power doldrums.

5. Nigeria as a country should take advantage of the abundance of gas in the Niger Delta and build gas-fired turbines for it is on record that 1.6Tcf gas is being flared annually. It is pertinent to note that as the population grows the power requirement also increases in the same proportion thus concise effort must be made in this regard.
6. The recent loan obtained from World Bank(US $300) to speed up reforms activities in the power sector is a welcome development. This would make Nigeria achieve the target of 6,000MW in no distant time. This would also make it possible to approach psychotically, America's per capital consumption of 3.2KW from 0.036kw.

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