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TACKLING THE CHALLENGESOF POWER GENERATION IN NIGERIA THROUGH EMPIRICAL DATA ANALYSIS

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Tackling the Challenges of Power Generation in Nigeria through Empirical Data Analysis

Z.A. Adetona

Abstract

The production of energy for domestic, commercial and industrial use in Nigeria is next to nothing. Everyone residing in the country is made a victim of endless power outages against his will. The country rightly called the most populous black African nation is also adjudged, for obvious reasons, one of the lowest per capital energy producers, if not the lowest. This academic write-up critically examines the electrical energy produced in the country for the last five (5) years and determines the peak per capita energy. Based on the 140,000,000 population of the country as released by the National Population Commission in 2006 and an annual population growth rate of 7%, the population for another 15 years was determined using Microsoft Excel. The per capita energy in kilowatt-hour was determined. The same software was also employed to determine what percentage increase in energy production the country should adopt annually to produce up to half per capital energy required by low income countries of the world (1450kWh). The result revealed that Nigeria produces a peak of about 14kWh energy per capital which is about $^{1}/_{210}$ of per capital energy required in low income countries of the world. To raise its energy production to 1450kWh, the country will raise its energy production by about 6000%.

Keywords: Empirical data, Nigeria per capita energy, population growth, power demand, National Grid.

1.0 Introduction

Production of energy for the citizenry is an essential requirement for every modern society. The energy demand by any country is a function of its population. The total capacity of the first electric power generators used in Nigeria was 60kW. That was in the year 1896 when electricity was first produced in Lagos, fifteen years after its introduction in England (NPR[1], 1985). The population at that time cannot be ascertained because the 1896 census was restricted to Lagos Island and parts of the Lagos mainland. However, at that time Nigeria was less developed and had far less population compared to today. The population has increased enormously over more than 11 decades since then. The population officially in 2006 was put at 140 million inhabitants and according to the International Institute for Environment and Development (IIED), the population is expanding at a rate of 7% per year. Thus, the present Nigeria population is no longer 140,000,000 that was counted and announced in year 2006. More than 100 million Nigerians have no access to electricity and three-quarters of the population still use fuel wood for cooking, with all the associated health risks (IIED, 2008).

The inability to produce enough power supply can be attributed to a number of factors namely:

- Poor funding compounded by corruption at various levels of government and parastatals

[1] Niger Power Review

- Lack of planning based on adequate population and population growth data
- Insufficient gas to power existing thermal electricity generating stations compounded by wastefulness as demonstrated in natural Gas flaring
- Poor maintenance of existing electric power infrastructure
- Lack of vision on the part of leaders
- Inability of government to tackle regional upheavals in many parts of the country including the Niger Delta Region
- Inability of government to stop vandalization on electric installations

It is the aim of the study to present a method of tackling the Nigerian power supply problem using empirical data. The data is necessary because lack of proper record will not allow adequate planning and progress monitoring and assessment by the government and other stakeholders in the power industry.

2. Generating Population and Power Consumption Data

Proper power generation planning should focus at present population not past. Using a simple Microsoft Excel table the population for fourteen years after 2006 was determined based on 7% increase each year. The program can be modified to determine the population for any number of years chosen.

From the results of the Excel table given in Table 1, the population for year 2010 is 183,511,441 and all things being equal, by year 2020, the population shall approach 400,000,000. This is illustrated in Figure 1. The power required by the populace in 2010 therefore should not be for 140,000,000 people but 183,511,441. Any wholehearted approach to tackling Nigerian power problem in the long term should take into consideration the results presented in Table 1.

Thus, based on the population figure, the power required by the populace is expected to be the highest for any country in Africa. But this is not the case. For example, Republic of South Africa presently generates about 40,000MW of electric power for a population of about 40million people, an average of 1kW per citizen and, by international standards, the country is one of the cheapest suppliers of electrical power in the whole world. The country at present is aiming at doubling the total energy generated to 80,000MW by year 2012.

Another striking example is Ghana, a country of about 24 million inhabitants. Ghanaian generators have an installed capacity of 2140MW. Available capacity is 1725MW and the peak demand 1200MW while the balance is used as reserve margin (RCEER[2], 2005). The country boasted two years uninterrupted power supply few years back. The country's inhabitants consumed a total of 5,158GWh of electricity in 2004– an average of 3715.22kWh per consumer. Ghanaian generators also supply power to

[2] Ghanaian Resource Center for Energy Economics and Regulation

Côte d'Ivoire's on the west and to Togo and Benin's on the east. In addition, Ghana supplies electric power to Burkina Faso in the north of the country.

Nigeria is said to be undergoing a power crisis since it cannot adequately provide necessary electric power to cater for its citizens' demand for domestic, commercial and industrial use. To tackle the perennial power problem, a top-down, holistic approach is needed. Commenting on the same issue, Nmoka (2010) maintained that a "critical synopsis of the issue here before us reveals that the power situation via-a-vis the energy crisis pandemic in Nigeria demands a holistic approach". This view should be mindfully considered by all stakeholders in the Nigerian power system.

Table 1: Nigeria's estimated/projected annual population for 14 years after 2006

S/N	Year	Population
1.	2006	140,000,000
2.	2007	149,800,000
3	2008	160,286,000
4.	2009	171,506,020
5.	2010	183,511,441
6.	2011	196,357,242
7.	2012	224,809,406
8.	2013	240,546,065
9.	2014	257,384,289
10.	2015	275,401,190
11.	2016	294,679,273
12.	2017	315,306,822
13.	2018	337,378,300
14.	2019	360,994,781
15.	2020	386,264,415

Nigeria now has an available capacity to generate 5,000MW of electricity out of an installed generation capacity of 8,634 MW. The Power Holding Company of Nigeria has estimated the daily load demand to be 6000MW–a grossly inadequate estimate. However, the peak electric power that has ever been generated in Nigeria is 4000MW. Presently, the value has dropped down to between 2500W and 3000MW.

The per capital energy in Nigeria in 2006 was put at 109.5kWh (nationmaster.com, 2010). This figure is far higher than the current true power situation in the country. If the peak electrical energy generated in 20009/2010 (3000MW) can be maintained throughout the year and you divide this on every citizen you get a peak of 16W per person. This amounts to an availability of 143.2kWh for 24 hours in a day per person annually while the world's average for electricity consumption is about 2,900kWh per person in low income countries like Nigeria and more than 8,000kWh per person in high income countries (RCEER, 2005). It is also said that the average person globally uses 2255 Watts of power continuously (answers.com 2010).

The household bulbs Nigerian residents use are rated between 25 Watts to 200 Watts. The 2-ft fluorescent lights consume around 20 Watts and the 4-ft type around 40W. Thus, if all the electricity generated is used exclusively in homes (with nothing for industries, businesses and commercial centers), there is insufficient power to light one bulb for one citizen daily.

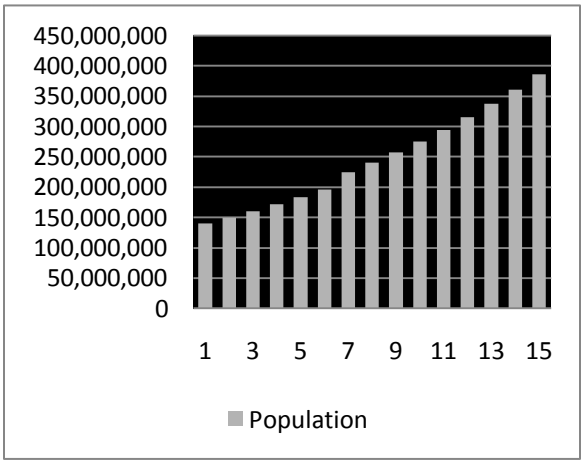

Figure 1: Nigerian projected population for 15 years form 2006

Adebiyi[3](2010) opined that on average, if all electricity generated is used entirely in houses and residences, less than 3kWh of electricity can be supplied per household per day in Nigeria for the foreseeable future. How pathetic the situation is!

3.0 Analysis of Data Gathered

The job of determining the Nigerian per capita energy/power generated or consumed is a tedious one. One reason being that power generation in Nigeria has ever been fluctuating and as such any steady increase or decrease cannot be determined. Another is the fact that Nigerian annual population grows at an enormous rate while power remains epileptic. Given in Table 2 is the energy generated and supplied to the National Grid for five consecutive years from 2005 to 2009.

From the table it can be observed that the energy was highest for year 2005 and lowest for year 2007. Also for the five years reported on, the highest monthly energy are 2254368.62MWh in December 2005 and 2360468.2MWh in October 2006 and the lowest of 161324MWh appeared in March 2007. So there is no regular pattern the production of energy took for the years documented.

Owing to this fact, mathematical/statistical or software-based methods of power prediction that could otherwise have been applicable in determining energy produced in relation to each person of the population (per capital energy produced) are not applicable. Further, ordinary methods of power prediction failed woefully due to the same reason. Thus, the only reliable approach applicable is to obtain the value of energy generated from the supply authority,

[3] Professor George Adebiyi is a seasoned University doyen in Mississippi State University (USA). His research interests largely focus on Solar/Renewable Energy/Fuel Cell applications, Mathematical modeling of advanced energy systems including Thermal Regenerators (such as Packed Bed Storage Systems utilizing Phase-Change Materials), Heat and Mass Transfer Regenerators (such as Desiccant Dehumidifiers, Crop Dryers).

obtain population figures and manually determine the per capital energy produced.

Table 2: Yearly energy produced in Nigeria for years 2005 to 2009 (NCC, 2010)

Month	2005	2006	2007	2008	2009	Lowest	Average
	E(MWh)	E(MWh)	E(MWh)	E(MWh)	E(MWh)	E(MWh)	E(MWh)
JAN	1866339.08	2294575	211636	2017868.09	1935216.05	211636	1665126.844
FEB	1726164.68	1821117.8	172732	1862735.05	1781329.421	172732	1472815.79
MARCH	2017713.94	1901374.03	161324	1771143.49	1980352.49	161324	1566381.59
APRIL	1844339.13	1861211.39	177637	1719883.16	1707245.19	177637	1462063.174
MAY	1796022.84	1733491.79	201634	1350341.64	1646292.54	201634	1345556.562
JUNE	1846308.93	1630743.9	168493	1283706	1386430.42	168493	1263136.45
JULY	1981084.3	1843069.22	178277	1508964.62	1298779.05	178277	1362034.838
AUGUST	2216951.98	1791266.83	238221	1914715.45	1556086.82	238221	1543448.416
SEPT	2115024.54	1906705.25	216100	2065693.69	1709825.04	216100	1602669.704
OCT	2257890.92	2360468.2	189806	2306229.48	1786373.6	189806	1780153.64
NOV	2156473.91	2096558.58	198555	1700317.45	1929651.43	198555	1616311.274
DEC	2254368.62	2046616.28	204236	1807453.77	2175850.75	204236	1697705.084
Lowest	1726164.68	1630743.9	161324	1283706	1298779.05		
Average	2006556.90	1940599.85	193220.91	1775754.324	1741119.4		

of energy generated from the supply authority, obtain population figures and manually determine the per capital energy produced.

Using the highest energy generated[4], the peak per capita energy generated in Nigeria since the year 2006 is determined as follows:

Total energy produced,

$$E = 1940599.856\text{MWh}$$

Year population, $Yp = 140{,}000{,}000$

Per capital energy,

$$PCE = \frac{\text{Total energy produced, } E}{\text{Year population, } Yp}$$

$$\therefore PCE = \frac{1940599.856 \times 10^6}{140{,}000{,}000}$$

$$= 13.86\text{kWh}$$

$$\approx 14\text{kWh}$$

Let world average consumption per person be WACPP then,

$$\frac{PCE}{WACPP} \cong \frac{14}{2900} \cong \frac{1}{210}$$

Thus, $PCE = {}^{1}/_{210}$ WACPP

4.0 Results and Discussion

Nigeria has only been able to generate about 14kWh energy per capital. Thus it is clear that Nigeria generates for each of her own citizens annually about ${}^{1}/_{210}$ of the power required per person in low-income countries. Notice from the accompany Figure 2 that the

[4] The peak energy generated actually occurred in 2005 but cannot be used since a valid population figure for the year is not available.

total energy produced in the country took a downward trend since year 2005 with year 2007 having the lowest.

Table 3: Projected energy increase up to year 2020 based on population increase

Year	Projected Population	Assumed Per Capital Energy Required (kWh)	Expected Energy Required (GWh)	% on Pre-vious Year
2006	140,000,000	1450	203000	N/A
2007	149,800,000	1450	217210	7
2008	160,286,000	1450	232414.7	7
2009	171,506,020	1450	248683.72	7
2010	183,511,441	1450	266091.58	7.0
2011	196,357,242	1450	284718.00	7.0
2012	224,809,406	1450	325973.63	14.5
2013	240,546,065	1450	348791.79	7.00
2014	257,384,289	1450	373207.21	7.00
2015	275,401,190	1450	399331.72	7.00
2016	294,679,273	1450	427284.94	7.00
2017	315,306,822	1450	457194.89	7.00
2018	337,378,300	1450	489198.53	7.00
2019	360,994,781	1450	523442.43	7
2020	386,264,415	1450	560083.40	7.00
Ave				7.53

Based on this value, Nigeria would require up to 183,500MW of electric power daily for residential use only in 2010. This means an increase of more than 6000% from the present unstable peak of 3000MW. This value will keep increasing as the population grows. As investors that have deserted the country begin to return, the energy required for accurate planning to be carried out by all the stakeholders, population growth at any material time of interest is essential. Assume, on the average, that a citizen requires 1kW of electric power for daily.
for commercial and industrial sectors of the country will soar and it will be clear that Nigeria energy production should be in Giga-watts (if not Terawatts) and not in Megawatts.

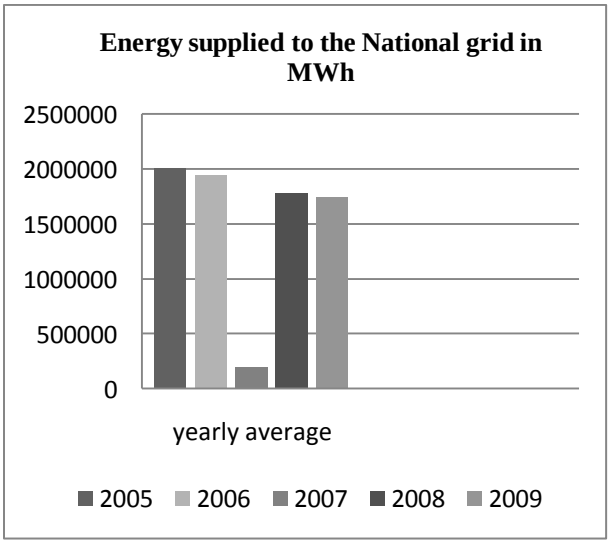

Figure 2: Average energy supplied to the National grid from 2005-2009

If half the world average of 2900kWh energy required per person in low-income countries is assumed, and employing another simple Excel table to determine annual energy requirement for the years in question then Nigeria should be planning to produce up to 326GWh of electric power in 2012 and 560GWh in the year 2020. The results are given in Table 3.

5.0 Conclusions and Recommendations

To overcome the perennial power problem in Nigeria government and other

stakeholders need to employ not a halfhearted effort to the issue but employ a proactive approach based on the foregoing empirical data analysis. Aside this, the country's inhabitants would have to perpetually languish in extremely insufficient energy. This means a radical, wholehearted solution has to be deployed right now to combat the power issue. In addition, to salvage the present energy crisis, continuous data accumulation and its subsequent analysis are needed. In addition, all the stakeholders should take cognizance of such data accumulation and plan with it otherwise electricity for all shall be an elusive prospect in the country.

The following points are strongly recommended:

1. All alternative power production methods should be accessed in power production. In Nigeria such alternative methods available include:

- Solar energy production
- Wind energy
- Energy from biomass

Some of these energy production alternatives are suited for rural areas while others are better employed in specific regions of the country. For example, wind energy would be better employed in the southern part of the country while solar energy would be easily tapped in the north.

2. Whereas the population increases by 7% annually, a long term plan to increase power production annually by up to 7.5% (as indicated in Table 4) should be put in place and the job should be given to professionals that will plan, execute and supervise its progress and not corrupt politicians. As shown in Figure 3, if this is done, at the end of the year 2020 (year number 15 on the figure) the annual power would approach 600GWh.

3. Government should focus attention on infrastructural development in the rural areas. Such infrastructural development

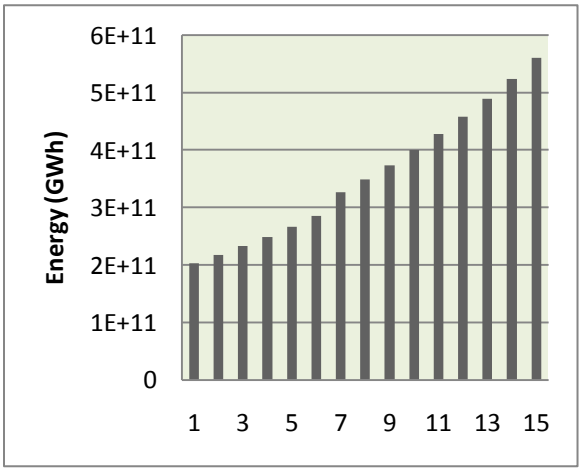

Figure 3: Expected energy requirement based on a WACPP of 1450kWh

should include the production of locally generated electricity which shall reduce the cost of energy production since there won't be the need to connect such communities to the national grid.

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