Ending Electricity Poverty In Nigeria

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Abstract

Nigeria, a country of 162.5 million people and the apparent giant of Africa, is also one of the world’s most under electrified countries. As of 2010, Nigeria had an operational installed generation capacity of 4 Gw, an unimaginably low number for a country of that size. Developed nation standards suggest a country have 1Gw of power for every million inhabitants. Accordingly, if Nigeria were a developed country, it would require at least 160 Gw of installed capacity to ensure a productive nation. In reality, Nigeria is not a developed country and should not be held to the same standards; however, the range between 4 Gw and 160Gw represents the size of the nation’s energy supply gap, a problem, but also a tantalizing opportunity. Ending Nigeria’s energy poverty could result in significant economic development, not only in Nigeria, but also in the rest of Africa, and eventually the around the world.

This master’s project explores electricity poverty and its debilitating effects on economic development in Nigeria. The project will ultimately emphasize the linkage between electrification and economic development and state some soft conditions necessary for the former to take place. The project looks at Nigeria – bridging the supply demand gap.

The overarching theme of this Masters Project is that there is a strong link between electrification and economic development. Accordingly, many of Nigeria’s economic development plans must consider or acknowledge the importance of the power sector. Nigerian’s are about 6 – 10 times richer than believed to be when considering the steep prices paid for inefficient forms of electrification and lighting. To end electricity poverty in Nigeria, the nation will have to navigate familiar obstacles such as institutional corruption, access to financing, and infrastructure challenges to name a few. Ending Electricity Poverty in Nigeria is very possible, but will surely take time.
Introduction

Despite the importance of electricity as a form of energy in a country’s economic development, many countries in the world still lack the requisite access to electricity to achieve their economic ambitions. Nigeria – a nation of 162.5 million people and Africa’s most populous nation is one such nation characterized by grossly inadequate access to electricity (WB Nigeria Data 2013). After gaining independence from colonialists in 1960, the country presented a promising future, one of the most promising in Africa (Ibeanu 2000). The nation was and still is blessed with an abundance of natural resources including hydro and natural gas resources, which are beneficial for energy development (TPFRN 2010). Despite the abundance of energy resources that characterize the West African nation, the country only has operational generation capability of between 3 and 4Gw, to serve its population. To put this in context, the rule of thumb for most developed nations is that it possesses at least 1Gw of electricity generation and consumption per million people (TPFRN 2010). This would mean that Nigeria requires somewhere in the range of 160 Gw of generation capacity.

Figure 1: Source - TPFRN 2010
Many would suggest that Nigeria is not a developed country and accordingly should not be held to
the same standards of energy penetration, however, its energy adoption still pales in comparison to
countries such as Brazil and South Africa which have 100, and 48 Gw, of generation for their
respective populations of 201 million and 50 million people as of 2010 (TPFRN 2010). It is no
wonder both countries have experienced rapid economic development over the last 10 – 15 years
(TPFRN 2010). Self-generation in Nigeria is estimated to be at 6Gw on the low end with only half of
the nation’s population gaining access to electricity. The disparity between supply and demand for
electricity may answer some of the questions as to why Africa’s most populous nation has, in the
past, experienced slow economic development (Adenikinju 2007). Nevertheless, the country is
growing rapidly at approximately 7.4% per year but could it grow a lot faster if it had the electricity
to be productive (WB Nigeria Data 2013)? How much faster? What is the state of Nigeria’s
electricity crisis, and what is the solution? What conditions are necessary to ensure the solution is
successful and what are the economic costs of failing?

This masters project attempts to answer these questions and to describe what an electrified Nigeria
would look like by 2020. It will explore electricity poverty and its debilitating effects on economic
development in Nigeria. This project will ultimately emphasize the linkage between electrification
and economic development and state some soft conditions necessary for the former to take place.
The project looks at Nigeria – bridging the supply demand gap.

**Materials and methods discussion**

This objective of this paper is to provide readers with a holistic analysis of the electricity crisis that
exists in Nigeria, to describe the proposed government solution, to highlight the role of
electrification in Nigeria’s economic development, to lightly suggest conditions necessary for
successful power reform, and to identify areas for future research.
The paper will rely heavily on research and analysis from the World Bank, The Africa Development Bank, the International Finance Corporation and academic articles. Due to the lack of frequently updated sources on the power situation in Nigeria, some of the most up to date information will be cited from credible news sources.

**Sub Saharan Africa - Turn on The Lights**

**The absence of power in Sub Saharan Africa**

Sub Saharan Africa (SSA) is one of the most under electrified regions in the world. The 48 countries in Sub Saharan Africa, spanning the half of the continent below the Saharan desert, are served by an entire generating capacity of approximately 68 Gw. Excluding South Africa’s generation capacity in 2010 reduces the number to 28 Gw. Of the 28 Gw, approximately 25% is unavailable due to maintenance or operational issues (Eberhard et al. 2008). It is no wonder the map of Africa at night, including Sub-Saharan Africa, is typically in darkness. 68 Gw of generating capacity, for a population of 874.8 million people is an unimaginably low level of access to electricity by many world standards (WB Electricity Consumption Data 2013). As of 2011, the United States alone, with a population of 315 million people was privy to an installed generating capacity of just over 1000 Gw (EIA 2013). In other words, the United States of America has 15 times as much generating capacity as does Sub Saharan Africa.

A natural thought comes to mind – what enables South Africa to have more than half of the generating capacity of Sub Saharan Africa? South Africa is considered an Upper Middle Income (UMI) country according to the World Bank and a member of the BRIC nations (WB South Africa Data 2013). With a population of 50.59 million people, South Africa has provided adequate generation in Giga Watts per million people, but has also fallen short in recent times. The country is now looking to double its generation capacity to 80 000 MW (80 Gw) by 2026 (ESKOM 2013). The
key to South Africa’s ability to meet electricity demand with supply is that it has a developed and energy market that utilizes least cost integrated resource planning to provide energy resources for its growing electricity demand (ESKOM 2013). It also, provides mechanisms and enforceable regulations that enable returns to be recovered from assets put in place for generation purposes. Many Sub Saharan African countries do not.

South Africa could provide electricity to many other countries in SSA that lack adequate electricity. However, as it is, South Africa is already running into its own supply issues. How then do the other countries in SSA including Nigeria, plug electricity supply gaps?

Nigeria in particular is addressing this question and is moving forward with a dynamic plan to get its people access to electricity. Nigeria’s goal is to have installed capacity of 40 Gw by the year 2020 (TPFRN 2010). However, it is an ambitious project that could span multiple political administrations. Therefore, the plan will have to be executed with vision, determination, and the appropriate checks and balances.

**Nigeria’s situation**

In contrast with South Africa’s 48 Gw of installed generating capacity, Nigeria is believed to have approximately 3.6 GW of operational generating capacity or roughly 7.5% of South Africa’s generation base. Nigeria has roughly 3 times as many people as does South Africa. Nevertheless, as of 2011, Nigeria’s GDP grew at a rapid 7.4% while South Africa’s grew at 3.1%. This difference can be due to many factors, which I shall not discuss in detail, but it is important to consider at what pace Nigeria’s economy could grow if it had the power to be productive. Before I explore this thought, it is important to discuss the factors that have created the electricity gap that plagues Nigeria today.
Nigeria’s Recent Political History

Nigeria is made up of three main ethnic groups, the Igbo, the Yoruba, and the Hausa. Each of these tribes have spawn many sub tribes and ethnicities. Although the national language of Nigeria is English, each of the above mentioned tribes have distinct languages that tell a tale of their pre-colonization origins. In fact, Nigeria, or Niger – Area, as it was appropriately called by its colonial masters, never existed as one nation prior to colonization. The three major tribes and their sub groups were confined to the boundaries drawn out by colonial powers and deemed one nation. Although the fabricated country gained independence in 1960, ethnic tensions led to what was known as the ‘Biafran War’ when the South Eastern states tried to break free of the rest of the country (Ibeanu 2000). The Biafran war is a symbol of the diversity of ethnic groups, and opinions that were brought together to form the country now known as Nigeria. Understanding the difference of opinions, incentives, and ambitions of each of these groups is fundamental to understanding why Nigeria has struggled with moving forward as one unified nation with common economic goals (Ibeanu 2000). Understanding this dynamic is also vital in analyzing the reason why the country has failed to provide adequate electricity resources for its fast growing population. The country is a consolidation of ethnic groups with differing agendas, a pressure point that has, for the most part, led to the polarization of Nigerian politics (Ibeanu 2000).

There have been many power struggles in the last twenty years involving military coups. The most notable of which included the Babangida years of the early 90’s and the Abacha years of the mid to late 90’s. Both former Presidents of Nigeria, grabbed power via military coups, lacking the proper education or vision to steer the country in a beneficial direction (Hoogenraad and Salomon 2001). Under these military regimes, and periods of instability, the country suffered major blows to economic agendas, inevitably paralyzing infrastructure development plans. African countries, such as Nigeria are not unique in the realm of political instability. Many regions including those in South
East Asia, have endured political instability (Oxford Analytical Ltd 1998). However, many of the countries in South East Asia have moved on and are providing their populations more access to electricity than are African countries such as Nigeria. The Installed Capacity of SSA, excluding South Africa, is approximately a third of South Asia’s. According to the Africa Development Bank, the two regions were equal in 1980 (Eberhard et al. 2008).

**Nigeria – Moving Beyond Power and Politics**

The political instability that has gripped Nigeria for the last 3 decades has resulted in what some commentators refer to as widespread corruption, and institutional inefficiencies (Oxford Analytical Ltd 1998). Corruption, the absence of, or the inability to enforce the rule of law, and the presence of undeveloped markets have impacted Nigeria’s economic development in recent decades. However, the country has experienced two democratic transitions in the last decade causing many international investors to reopen interest and rightly so. The country is growing at 7.4% GDP growth per annum as of 2011 and ranking ahead of India in the World Bank Ease of Doing Business Rankings (WB Ease of Business Data 2013). With current administration, viewing the electrification of Nigeria as a means to further boost the nation’s growth, the power sector has begun to receive significant sums of international investment (Oladipo 2012). The development of the power sector in Nigeria will not only enable the country to grow at a faster rate, but also help alleviate widespread poverty as the country works towards its Millennium Development Goals (AFDB 2009). What are the conditions incentivizing investors from countries such as South Korea, and Canada to enter the Nigerian power markets? Political dedication and commitment are important factors, but there are more structural changes taking place. The next section of the paper takes a closer look at some of the factors incentivizing investors from South Korea and the world over to commit resources to the Nigerian Power Sector.
The Promise of Reform

The Roadmap For Power Sector Reform

In August of 2010, President Goodluck Jonathan released the “Road Map for Power Sector Reform”. The plan builds on the foundation laid out in 2001 by the adoption of the National Electric Power Policy, and the Electric Power Sector Reform Act of 2005, moving the country into the privatization of the national power sector. In the current stage of reform, the country seeks to turn over ownership of power resources to private sources best positioned to efficiently generate electricity. Although it has taken a long time to arrive at this stage, the transfer of ownership to private owners and operators is crucial in moving the plan forward (TPFRN 2010).

In the roadmap, the government sites several obstacles that must be removed to stimulate private sector investment including; the establishment of a pricing regime; the establishment of a bulk purchaser; the provision of Federal Government credit enhancement; the modernization of Nigeria's power sector workforce; the efficient management of Nigeria's Transmission system; and the solidification of regulations governing the industry (TPFRN 2010).

In 2010, when the roadmap was released, the goal was to have an installed generating capacity of 40 Gw by the year 2020. As of 2012, the country is barely on the way to meeting this goal only recently announcing a select number of winning bidders of government owned power plants (Oni 2012). One of the winning bidders, a consortium including Nigerian conglomerate, Transcorp, and Symobion power of the USA, paid an estimated $300 million for a 932 Mw facility in the South Eastern region of Nigeria. Chinese, Russian, and South Korean investors are among those also looking to pour money into the space. (Oladipo 2012).
Selecting the goal of 40 GW by 2020 – The Cost of Unserved Electricity (COUE or CUE)

The Cost of Un-served Electricity (CUE or COUE), an economic expression utilized by the Department of Energy for South Africa and energy institutes around the world, compares the GDP of a nation to its electricity supplied (DOE IRP 2011). This method of determining the CUE is internationally accepted as a minimum value for the economic indicator. In this manner, it provides a minimum measure of the opportunity cost of failing to provide a country's consumers electricity (DOE CUE 2010). The Nigerian government recognizes South Africa as a nation whose 2010 GDP of $363.5 billion it expects to meet by 2020. The Nigerian government also seeks to model itself after South Africa from an installed electricity generation capacity perspective (TPFRN 2010). As such, in Nigeria’s Roadmap for Power Sector Reform, the government utilizes South Africa as a role model economy seeking to achieve South Africa’s 2010 installed generation capacity of 40 Gw by 2020 (TPFRN 2010).

Taking a ratio South Africa's 2010 GDP (Rand) to the 2010 kwh of electricity sold by Eskom (South Africa's main power generation company), results in a CUE of 10 Rand Per KWh. Utilizing an exchange rate of 20 Naira per Rand, this converts into a CUE of 200 Naira per KWh (TPFRN 2010). However, given that this conversion represents an aspirational GDP scenario, this CUE of 200 Naira/ KWh, represents an upper bound on Nigeria’s CUE. Nevertheless, the Nigerian government suggests that if Nigeria’s installed generation capacity did not progress past 5000 MW as of 2020 and its diesel and petrol generation fleet doubled from 6000 MW as of 2010 to 12 000 MW, there would be a gap of 23 GW or 23,000 MW of un-served energy needs in Nigeria by 2020. The cost of that unserved energy using the 200 Naira per KWh CUE, is 20 trillion Naira a year or $130 billion a year in lost potential GDP (TPFRN 2010). Figure 2 below better illustrates this concept.
All else being equal, if Nigeria were to pursue its goal of 40 Gw of power by 2020 in the ten years between 2010 and 2020, and assuming the $130 billion in annual lost GDP could be recovered overnight, Nigeria would experience a 53.2% boost to its GDP in one year alone, not to mention the potential ripple effects for years to come. However, overnight build out of about 40 Gw of power is inconceivable. Instead, if Nigeria adds an equivalent amount of power on to its grid over the nine years between 2011 and 2020, and assuming Nigeria recovers 10, 20, 36, 54, 70, 84, 93, 97, and 100% of the lost annual GDP per year due to under electrification, Nigeria’s GDP could hit $491 billion by 2016, surpassing South Africa’s projected GDP Of $487 billion. Figure 3 below illustrates this analysis.
The illustration above provides a very optimistic and upper bound on the total opportunity cost of unserved electricity. Accordingly, a more conservative approach to calculating the annual CUE for Nigeria would be to apply the 200 Naira / KWh CUE to Nigeria's 2010 actual demand. The World Bank's suggests 2010 per capita electricity consumption for Nigeria of 136.5 KWh per person per year, one of the lowest in the world (WB Electricity Consumption Data 2013). However, in the case of Nigeria, this number is far from the true pent up demand in the country. In 2009, The Africa Development Bank suggested that only 30% of Nigeria’s electricity demands were being met by the power sector (AFDB 2009). If we apply this to the amount of electricity consumed by Nigerian’s in 2010, we would arrive at a true demand of 455 KWh/person per year. Figure 4 below outlines this calculation.
Taking the difference between Nigeria’s stated electricity consumption of 136.5 KWh per person per year for 2010 and the approximation of its true electricity demand of 455 KWh per person per year results in an estimate of Nigeria’s electricity consumption supply gap of 318.50 KWh per person per year for 2010. Multiplying Nigeria’s 2010 population of 158.4 million people by the electricity supply gap figure yields a national electricity supply gap of 50.45 billion KWh/yr. Multiplying the national electricity supply gap figure by the CUE of 200 Naira per KWh yields an annual CUE of 10.09 trillion Naira, or $67.27 billion dollars, under half of what is projected by the government. Figure 5 below outlines these calculations.
All else equal, using the $67.27 billion as the annual opportunity cost of unserved electricity would lead to Nigeria potentially catching up with South Africa from a GDP perspective by 2018. This is illustrated in Figure 6 below.

![Chasing Nigeria's GDP Potential](image)

**Figure 6 Analysis conducted using information in TPFRN 2010**

**Proposed Structure of Nigerian Power Sector Reform**

The Power Holding Company Of Nigeria (PHCN) is the former government body, which oversaw the generation and distribution of electricity in Nigeria (TPFRN 2010). As part of the reform initiative, PHCN is to be split into successor companies in the following manner:

- The Hydro power facilities of the Kanji Dam, Jebba, and Shiroro are to be operated under concession;
- the thermal generating plants to be privatized through the sale of at least 51% equity to core investors that demonstrate technical and financial feasibility;
- the Transmission Company of Nigeria turned over or transitioned to a credible private sector operator under 5 year contracts;
and the privatization of all distribution companies following the 51% minimum equity ownership model (TPFRN 2010). The Nigerian government is also in the process of establishing a credible bulk purchaser to ensure electricity is purchased from independent power producers.

**Fuel Mix and Generation resources**

Nigeria has relied heavily on its Hydro, Coal and Gas resources for to provide electricity to its population. Figure 7 below, shows the distribution of total existing and some planned nameplate generation capacity in Nigeria as of 2005 (Adenikiju 2007)

![Figure 7 Source - Adenikiju 2007](image)

Although the country is rich in energy resources, it’s access to natural gas reserves are some of the most envious in the world and as a result, the country plans to utilize natural gas as its main fuel source for power generation (TPFRN 2010). Figure 8 below, outlines Nigeria’s energy resources.
Some observers report Nigeria’s Natural Gas reserves, including associated and non-associated gas reserves to represent a third of Africa’s gas reserves (Economides et al. 2000). Despite this flourishing existence of natural gas, in the past the country had flared most of its associated natural gas, due to the absence of structures requiring the use of natural gas (Economides et al. 2000). With the government now focused on developing the country’s power sector, it is no surprise gas is viewed as the preferred fuel of choice.

The country plans to build most of its power plants in the southern region (South East and West), and will use natural gas as the fuel of choice. Although, this is a reasonable plan, the lack of gas transportation capabilities places a significant constraint on this effort, and could leave almost 3000 Mw of new generating capacity stranded by December 2013 (TPFRN 2010). Such constraints require the use of a dynamic and integrated approach to tackling the power reform process. Many chicken, and egg scenarios and problems may arise, deterring potential investors if adequate resources are not committed to supply the gas to existing and proposed plants. Furthermore, the fuel transportation dilemma also represents a significant investment opportunity for Independent Oil and Gas Service companies from around the world to partake in the build out of critical infrastructure.
Transmission

The medium term goal for transmission development as of July 2010 was to have expanded transmission capacity from 4500 Mw to 8653 Mw by December 2013 to compensate for the expected increase in generation capacity (TPFRN 2010). In the long term, to ensure available generation capacity can be evacuated as capacity is increased, the government plans to build a super grid to be managed by a third party but still owned by the government of Nigeria. As of March 2013, Manitoba Power and Electric, a Canadian power company, is in the process of taking over operations of the Transmission Company of Nigeria and will most likely manage the build out of the country's super grid (Oni 2012).

Though the process is far from where it should be to meet its stated goal of 40 Gw by 2020, it is important to consider the dynamics of a Nigeria with 10 times more access to electricity. First, it is important to address this issue of willingness to pay for electricity.

The Cost of Electrification – Who will pay and how much?

Many Nigerians connected to the grid currently pay the PHCN for energy services rendered (and in many cases hypothetically rendered), however, at admittedly low tariffs according to the Nigerian government. As of December 2009, excluding government subsidies of 4 Naira per kwh or 6 US Cents per kwh, Nigerians, connected to the grid were paying, on average, 7 Naira per kwh or 10.5 US Cents per kwh, much lower than prices paid in many parts of West Africa. See Figure 9 below for a comparison of West African countries and their average electricity Tariffs below (TPFRN 2010).
Figure 9: Source TPFRN 2010

Given such low tariffs, it is no surprise that the PHCN is unable, for the most part, to operate independently instead having to rely on government subsidies and assistance. The PHCN has traditionally charged a terribly low tariff for electrification handicapping its ability to operate seamlessly. Some speculate that as of 2009, the true average cost of electricity in Nigeria, across customer classes (residential, industrial, commercial), was 22 Naira per kwh or 33 US cents per kwh (TPFRN 2010).

Using the price of 10.5 US cents per kwh as a base, if Nigeria were to charge customers relying solely on grid generated electricity the suggested true average cost of electricity, this would imply a 214% increase in the price per kwh per house hold. At this juncture, it is unclear whether consumers would continue to purchase electricity or simply resign to darkness.

However, Nigerians are not easily defeated and many companies, urban, and rural households have come to almost fully rely on self-energy generation by way of diesel generators, and kerosene lanterns and candles for lighting for significant portions of the day (Adenikiju 2007). As the laws of economies of scale go, it is those least financially capable that are burdened with the heaviest cost of electrification. As of 2010, lower income consumers in Nigeria paid an average of 80 Naira (or
$3.20 per kwh, manufacturers paid 60 Naira ($2.40) per kwh, and all others paid between 50 and 70 Naira ($2.00 - $2.80) per kwh. This is illustrated in Figure 10 below.

Figure 10: Analysis done using information in TPFRN

The question arises – if Nigeria were to plug all its electricity consumers into the grid, and charge the suggested true reflective cost of electrification of 33 US cents per kwh, who would and would not pay? It would seem based on the analysis above that most members of society would be willing to pay – that is of course if all segments of society were fully aware of the current prohibitive prices paid for self electrification.

Based on the above analysis Nigerians are somewhere in the order of 6 to 10 times wealthier than they are believed to be. Therefore, although electrification cannot fully solve poverty alleviation and economic issues in Nigeria, it is important to grasp the magnitude of its potential economic impact.

An under-electrified Nigeria

If Nigeria were to wake up tomorrow to a country with access to reliable electricity, what would that Nigeria look like? Nigeria, a nation of 162.5 million people, and as a result the giant of Africa, has failed to realize the economic promise of its size (TPFRN 2010). Although Nigeria has pumped
close to $2$ billion per annum of capital into its power industry over the past couple of decades; the
country has little to show. Between, the waste, theft, and the mismanagement of facilities and funds,
the power situation in Nigeria remains bleak. However, perhaps the more important story behind
the inefficiencies in Nigeria’s power dilemma is the cost of lost productivity or GDP. The
astronomical cost of diesel and or petrol fuel in Nigeria (between $2.15$ / kwh and $3.00$ kwh)
combined with the lack of power generation capacity has tempered the country’s productive and
commercial industries (TPFRN 2010). By 2020, the opportunity cost of this foregone GDP would
amount to USD $130$ billion per annum (TPFRN 2010). Figure 11 illustrates the correlation
between electrification and GDP / Capita.

![Electricity consumption and GDP in 134 countries of the world](image)

*Figure 11: Source - TPFRN 2010*

To overcome this electricity shortage, Nigeria will have to invest approximately $3.5$ billion a year
in the power generation sector and corresponding amounts in generation fuel infrastructure, power
transmission, and power distribution networks. That amounts to approximately $14$ billion a year
in annual power sector investment, an amount that represents a steep cost, but also a significant
opportunity, for indigenous and international power sector players. Moreover, it also represents
widespread opportunity for skills development, and knowledge transfers to Nigeria. A return of $130 Billion per year in GDP, for an investment of 14 certainly sounds worth the effort – especially in an environment in which investment risk will be spread across the public and private sectors.

Although there are many structural deficiencies hampering economic development in Nigeria, access to electricity is arguably one of the most important, if not the most. Close to 4 Gw of installed capacity for a nation of 162.5 million people is an unimaginably low level of electrification, and a ratio that is serving as a gate keeper to the true economic potential of Nigeria. Figures 12 and 13 illustrate how Nigeria (considered a Low Middle Income Country by the World Bank) has lagged behind South Africa (a country Nigeria seeks to model its power sector after) and other countries in its economic classification in terms of electricity consumption per capita.

Figure 12: Developed using information from WB Electricity Consumption Data 2013
A model of the type of economic development that could take place in the country can be seen in the country's mobile telephony space (Emerald 2006). Nigeria’s telecom space suffered from many of the same ills that the power sector suffers from today, but privatization of the country’s sole telecom provider – Nitel, in the late 90’s led to sweeping changes and capital market forces rapidly tapped into pent up demand for mobile communications capabilities. Nigeria’s telecom sector is now one of the fastest growing in the world. In 2004 alone, telecommunication subscriptions grew at an alarming 155% and by 2007, mobile telecommunications subscriptions were expected to total 23 million, up from 8.6 million in 2006 (Emerald 2006). It is arguable that an almost similar opportunity exists in the country's power sector today. Accordingly, it is exciting to think of the changes that the Nigeria's populace will experience if they gain adequate and reliable access to electricity.
Power Sector Gaps and Poverty in Nigeria

Nigeria has accumulated a significant amount of the nation’s wealth due to its activity in the oil and gas sector. Although, governance issues and mismanagement of the cash flows from oil based economic activities in Nigeria have severely impacted development and poverty alleviation efforts, the power sector gap has also had a significant role to play in impeding progress (TPFRN 2010). Many Nigerian’s and companies are not part of the oil-based economy, which has served as a huge cash cow to the country – these people and entities are part of the country’s non – oil based economy (AFDB 2009). According to the Africa Development Bank, inadequate power resources have adversely impacted growth in this economy; poverty alleviation and job creation have suffered accordingly (AFDB 2009). The level of electricity penetration is troublesome for a country as robust as Nigeria – 45% of the country has access to electricity and only 30% of those have their energy demands being met (AFDB 2009). It would seem obvious that there is an immediate need for power sector development, but as discussed, there are factors that have prevented this from occurring.

Research suggests that investment in infrastructure development will spur non-oil sector development and the realization of the World Bank’s Millennium Development Goals (MDGs) for Nigeria. Poverty is terribly rampant in the country, with 54.7% of Nigeria living below the poverty line (AFDB, 2009). This becomes even more apparent in rural parts of the country. Many of those below the poverty line could benefit from growth in the non-oil sector of the economy, but the absence of reliable power infrastructure impedes this possibility. Without reliable access to electricity, companies are required to produce their own electricity, resulting in prohibitive operational costs. In fact, some believe the lack of reliable access to electricity in Nigeria to be the most restrictive constraint on doing business in the country for more than 80% of firms with electricity induced losses approximating 61% (AFDB,2009).
An Electrified Nigeria in 2020

Energy development in developing countries has been linked to significant improvement in socio economic conditions. Reduced smoke exposure, the use of cleaner fuels, the refrigeration, and the use of boiled water, have wide spread health benefits yielding a healthier population and workforce (Toman and Jemelkova 2002).

People in rural areas, especially women, would be able to allocate more time to other productive activities, including education, and or work as supposed to fuel source gathering enhancing income generation for rural families. Urban families would enjoy an improved quality of life that does not involve significant amounts of self electrification utilizing diesel generators. Private companies are more efficiently able to operate given the implied lower operating costs in the absence of self-electrification (Toman and Jemelkova 2002).

Reaching the goal of 40 Gw of electricity generation by 2020 would produce a markedly different Nigeria – a potentially happier one. Though 40 Gw does not solve Nigeria’s electricity crisis completely (by developed economy standards, 1 Gw is required per million people, resulting in 160 Gw for Nigeria (TPFRN 2010)), it will provide for a more productive nation. Nevertheless, before dwelling on what Nigeria could be with a higher level of electricity access, it is important to discuss the constraints that could prevent this goal from being realized.

Soft Conditions for meeting the 2020 goal

Gas Supply & Transportation Infrastructure

Gas is viewed is abundant in Nigeria and is expected to be the fuel of choice in the short and long term future of Nigeria. As of 2010 Nigeria, total gas production of 900 MMScfd was sufficient to power the nation’s three, 382Mw of gas fired generation plants. However, if Nigeria is to come close
To achieving as little as three quarters of its 40 Gw by 2020 goal, the total available gas production will have to surpass 8 Billion scfd, assuming the use of open cycle power plants, or 5.5 Bscfd, assuming the installation of combined cycle power plants (TPFRN 2010). The more efficient combined cycle power plants will likely be utilized due to the significant savings that would accrue from lower fuel intake and environmental benefits could potentially be realized. Regardless of which type of gas-fired power plant is used, gas supply infrastructure is critical for efficient operation.

**Financing**

The reforms slated for Nigeria’s power sector will cost approximately $14 billion per year but are suggested to save approximately $130 billion per year in forgone GDP once complete. Moreover, it is inconceivable that the government will bare the $14 billion a year cost on its own. Accordingly, private sector financing will be instrumental in achieving the stated goals of the reform process. In fact, international financing, and private sector funds will be required to achieve the requisite annual capital injections. Therefore, it is essential that the Nigerian government strengthens its monetary policies, and capital flow controls to incentivize international and private investors to partake in the nation’s power sector opportunity. (AFDB 2009)

**Regulatory Reform**

Power Sector Reform is a worthy ambition for the Nigerian government and its people but will likely fail if there is an absence of adequate sector regulation. As mentioned above, the power sector in Nigeria is anticipated to have a number of privately owned independent power producers, one Transmission company, a bulk purchaser and an increasing number of distribution companies. As in most developed countries, it is essential that an institutionally sound regulator provide checks and balances on the rates at which bulk purchasers sell power to distributors, and in turn to end
users. In most developed countries such as the USA, generators are allowed to recover their costs, and a little bit of profit by charging a fair rate of return on generation assets in place (Geddes 1992). Though Nigeria is not considered a developed country, the absence of a fair rate of return practice will most likely result in generators charging outlandish prices to speed up the cost recovery process leading to a vicious cycle in which end users may experience difficulty or discomfort in paying requested tariffs. Regulation is not only required in the generation piece of the power sector value chain, but also in the upstream aspects of the industry (AFDB 2009).

**Technological Innovation and Freedom**

Many parts of Nigeria lack electricity transmission lines and those that do suffer from losses and poor voltage stability. Building out transmission lines to reach rural parts of Nigeria will be very costly, not to mention improving or repairing existing transmission lines. Accordingly, the government should strongly consider the benefits of off-grid energy solutions such as solar energy for rural consumers who have low electricity consumption patterns while considering the future build out of a nation wide transmission network. This will enable those in rural neighborhoods to replace costly, environmentally unfriendly, and unhealthy generation sources with increasingly cheaper, and more environmentally benign electricity sources. (Turkson and Wohlgemut 1999).

**Legal & Enforcement Reform**

Nigeria’s legal system suffers from many inconsistencies and its enforcement agencies and civil servants are renowned for wide spread corruption (WB Ease of Business Data 2013). Though it is impossible to abolish corruption in rapid succession, it is imperative that Nigeria makes adjustments to the strength of its legal and enforcement infrastructure, as this will affect the willingness of international partners to engage in the power reform process. Though there are other ways of compensating investors for excessive risk taking, such as through higher discount
rates, rampant corruption is difficult to adjust for and can frustrate international partners to the detriment of infrastructure projects. The absence of widespread corruption in the power reform process is essential and affects all other conditions necessary for success in the reform process.

**Competition in the distribution piece of the Value Chain**

Nigeria’s plan is to have a one-bulk purchaser sell electricity to a pool of distributors – a pool that will become larger over time. The belief is that competition will ensure consumers are allocated the lowest cost of electricity and will thus benefit from competition on the retail end of the power supply value chain. Competition may certainly have the desired effect of marginally accurate prices, but it is essential that appropriate regulation is in place to prevent scandals similar to the Enron scandal from developing in Nigeria.

**Areas for further research**

This paper has focused on reviewing how Nigeria became an electricity-deprived nation, understanding the opportunity cost of this electricity deprivation, suggesting soft conditions necessary for successful power reform, and briefly on evaluating how much power Nigeria actually needs. Admittedly, this paper perhaps raises more questions than it answers. Accordingly, the following areas will provide useful topics of analysis for future research papers on Nigeria’s electricity crisis:

1. Nigeria’s Optimal Generation Mix
2. The Environmental impact of powering Nigeria with natural gas
3. Challenges in eliminating the stronghold of the diesel generator in Nigeria
Conclusion

The overarching theme of this Masters Project is that there is a strong link between electrification and economic development. Accordingly, many of Nigeria’s economic development plans must consider or acknowledge the importance of the power sector in economic development. Nigerian’s are about 6 – 10 times richer than believed to be when considering steep prices paid for inefficient forms of electrification and lighting. The poor, especially, bare the brunt of lack of access to reliable and affordable electricity in Nigeria. Although, the country has suffered many set backs preventing the establishment of a reliable power sector, the country has the opportunity to do so now and hopes to achieve this through the government’s Roadmap For Power Sector Reform or vision of 40 Gw of capacity by 2020. The goal presented in the roadmap is a noble and timely one – the country looses somewhere in the range of $67 to $137 billion a year in GDP due to under electrification. The government and the private sector in Nigeria will have to navigate familiar obstacles such as institutional corruption, access to financing, and infrastructure challenges to ensure the goal of 2020 is within grasp. Ending Electricity Poverty in Nigeria is very possible, but will surely take time.
References


