

## **Electricity Affordability and Household Welfare in Nigeria**

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### **Abstract**

This study examines the affordability of electricity in terms of access to electricity and the cost of electricity vis-à-vis the welfare of households in Nigeria. The study is motivated by the inability of the National grid to provide adequate electricity supply to every households in the country and by the fact that majority of the Nigerian population in both the rural and urban areas depend solely on generators to power their homes in a quest to make up for the National energy inadequacy. To this end, the study enquires into the factors that can enhance households' potentials for generating electricity from solar and inverters, instead of generators, in order to reduce emissions and increase their real incomes. Empirical results confirm that households' captive power generation capacity revolves around the usage of generators while they are less informed about the use of solar panels and inverters. Also, we confirm that

households' income earning potentials determine the choice they make between generator, solar and inverters. We hereby conclude that electricity affordability has a strong correlation with households' welfare in Nigeria.

**Keywords:** Affordability; Access; Electricity; Welfare; Household; Nigeria.

### **Introduction**

It is over a decade now that the Electric Power Sector Reforms Bill was signed into an Act. The law, amongst other objectives, is to ensure a system of electricity generation, transmission, distribution and marketing that is efficient, safe, affordable and cost effective throughout the industry. The effectiveness of the reforms in transforming the sector has remained rather elusive. For instance, the quantity of electricity generated in Nigeria is still very meager while the quality of the service delivery is very poor. Despite the private sector's participation in the business of power sector, the general consensus of the people is that power supply has not significantly improved. A substantial supply gap for electricity generation exists in Nigeria. According to the Federal Ministry of Power, Works and Housing, the current electricity generation in Nigeria is around 7000MW, whereas, the projected electricity demand was put at 31,240MW and 88,282MW for 2015 and 2020 respectively (ECN, 2014; Isola, Mesagan and Alimi, 2017). This shows the huge gap between demand and supply of electricity in Nigeria. For the purposes of comparison, South Africa generates 40,000MW for a population of 50million people; Brazil generates 100,000MW for a population of 192 million people; USA generates 700,000MW for a population of 308 million, while in Nigeria with a population of over 150 million people, electricity generation has been oscillating within the range of 1,700MW and 4,700MW since the inception of the power sector reforms in Nigeria, until recently. This argument has been discussed extensively elsewhere (see Isola, 2011, 2016). While, the population of the country is currently estimated at about 180 million, only about 40% of the population is currently connected to the national grid (Aliyu *et al.*, 2015).

Besides, the issue of having a workable electricity tariffs in Nigeria is still problematic. As part of the restructuring effort of the power sector, the Electric Power Sector Act 2005, a Multi-Year Tariffs Order (MYTO), was adopted to estimate end-user tariff in Nigeria. To date, MYTO has been reviewed several times since inception in 2008. Nevertheless, the issue of adopting a workable tariff structure in Nigeria is still obscure as consumers are dissatisfied with the exorbitant bills and poor service delivery. The recent amendment of the MYTO (2015) representing a 45 per cent hike in electricity tariff has generated heated controversy between the government and stakeholders. The government on its part argued that the old tariff was not sustainable as it would not attract the required investment in the sector. To register their grievances, the stakeholders, including members of the organized labor engaged in mass rallies across the country and issued a two-week ultimatum to government to revisit the decision. In a bid to circumvent the problem of unreliable power supply, households have invested in in-house captive power generation to supplement power supply from the national grid by using different energy sources.

Few of those alternatives revolve around the use generators, inverters, solar panels, and the likes. However, majority of households in Nigeria depend on generators due to its easy accessibility and cost, without minding the environmental threats it poses (Akande and Owoyemi, 2008; Oseni, 2012). To this end, instead of diversifying energy supply mix nationally as several studies have suggested, this study aims at encouraging households to diversify their private source of energy, given several considerations like income, environmental costs, health implications, noise pollution, and so on. In making their decisions, households will consider the potential costs of various energy sources in terms of cash and health implications.

Energy access is very crucial to the development of a nation and it also has the potential to improve the welfare of its citizenry. As noted in Louw *et al.* (2008), access to appropriate, affordable and clean energy provides important stimulus for development. Moreover, Winkler *et al.* (2011) submitted that energy affordability depends largely on the extent to which energy products are consumed. It can also provide the needed impetus for driving the productivity of key sectors in the country (Isola and Mesagan, 2016). In Nigeria, for instance, access to stable electricity is highly problematic since the country generates over 70% (Aliyu *et al.*, 2013) of its energy from non-renewable sources, which is highly

carbon intensive. Its source of supply is also not consistent owing to the incessant vandalization of gas pipelines in the oil producing areas most especially. Hence, the myriads of challenges facing the non-renewable energy sector make the supply of electricity in the country epileptic. Therefore, there is the need to increase the proportion of renewable energy in the Nigerian energy supply mix to improve electricity generation and boost electricity supply.

Similarly, there is the need for individual households to participate actively in electricity generation as they currently do to make up for the supply deficiency usually associated with power generation from national grid. Hence, this study determines the affordability of renewable electricity in the country with a view to increase households' access to electricity, reduce carbon emissions produced by generators and improve welfare. Hence, we inquire from residents how accessible are electricity alternatives to them? What information is available to them regarding the affordability of alternative energy (like inverters and solar panels)? What factors can attract them to shift attention from the usage of generators to the usage of inverters and solar? Which basic indicator of welfare is more important to them? It is against this background that this study examines electricity affordability and household welfare in Nigeria.

### **Literature Review**

In the literature, several expositions have been provided on the electricity affordability, electricity crisis, household size, energy technologies, and their environmental implications. For instance, Bailis *et al.* (2005) examined the impact of green-house-gas (GHG) emissions generated from energy consumed by households on mortality in Africa. In the study, a database of current and future energy use of households in the continent up to 2050 was developed. It identified the use of charcoal for fuel as the main cause of GHG emissions. It suggested that GHG emissions can be lowered by about 36% by shifting to sustainable use of biomass, as well as, transiting to petroleum-based fuels. However, they identified high costs of fuel processing and affordability of fuel by individual households as the major obstacles to GHG reductions in Africa. Louw *et al.* (2008) beamed searchlight on what determines demand for electricity in Africa by households that are newly electrified. The study was able to assess those factors that affect households' electricity consumption decision in South Africa between

2001 and 2002. It was observed that iron ownership, income, credit obtained, and wood usage, were the major drivers of households' electricity demand. Winkler *et al.* (2011) focused on the electricity affordability and access in developing economies using a case study of Brazil, Bangladesh and South Africa. In terms of electricity affordability, the study examined the burden of energy expenditure on households' income. It was confirmed that both institutional and legal frameworks play significant roles in promoting electricity access. Also, on the average, households in South Africa spent more (4.7%) on electricity consumption than in Brazil (3.4%) and in Bangladesh (8%).

Moreover, Lahimer *et al.* (2013) studied the decentralized energy technologies of household size that are available to rural dwellers. Decentralized energy technologies that received attention in the study include Pico hydro, wind, diesel generator, battery, photovoltaic solar system for homes, and pedal generator. In the study, Pico hydro was selected as the preferred source of generating electricity by majority of the rural households. The next source is wind, solar and then, diesel generator. The preference was based on availability, feasibility, rural development, residues disposal, characteristics of use by consumers, and government policies governing usage. It was recommended that rural households' electricity access will increase if payment schedule of costs is extended and taxes or interest rates are jettisoned. Mohammed *et al.* (2013) assessed the potential of renewable energy in electric power generation in Nigeria. In the study, basically, the potential of hydro, biomass, wind, and solar were reviewed. It was reported that renewable energy is the best option in the quest to ensure sustainable energy supply in the country as it is environmentally friendly. It suggested that hydro power alone is potentially suited to address the energy crisis and put the country on the path of sustainable development. It opined that diversifying into renewable energy may be beyond the reach of rural dwellers due to cost but suggested that the use of biogas generated from bio-wastes can provide cheaper alternatives.

Aliyu *et al.* (2013) focused on electricity crisis in Nigeria in terms of power generation expansion potential and its environmental consequences. In the study, overdependence of the country on fossil fuel sources of electricity was identified as the major factor of electricity crisis. Hence, to solve the problem and achieve energy security, diversified energy sources were recommended. However, for desperate effort to address energy poverty in the country, expansion of readily

available conventional energy with little environmental impact is advocated. Shaaban and Petinrin (2014) researched into the potentials of renewable energy in filling the energy gaps in the rural areas in Nigeria. In the study, various renewable energy sources were dissected and their potentials for electricity generation were analyzed. Also, the study outlined the various government policies to develop renewable energy sources in the country and found that they are mere green paper policies. It therefore, advocated for the reengineering of renewable energy technologies to alleviate rural electricity crisis and boost energy resources generally in the country. Recently, Akorede *et al.* (2017) presented a review of renewable energy sources in Nigeria by examining the present energy status in the country. It also provided a discussion of the government's various energy policies, analyzing the projected energy targets in the country up to 2030. Although, the study identified that the current level of electricity consumption is low, and the country is well positioned in diversifying its energy mix for sustainable development.

Analyzing the reviewed studies, we conclude that researchers have dealt more on the efforts done by the national governments in mitigating the energy supply gap in several countries and regions. However, Louw *et al.* (2008) focused on determinants of households' energy demand; Winkler *et al.* (2011) looked at energy affordability and energy access, while Bailis *et al.* (2005) focused on environmental impact of household energy consumed. Mohammed *et al.* (2013), Shaaban and Petinrin (2014), Akorede *et al.* (2017) examined the generating potential of renewable energy, while Aliyu *et al.* (2013) only beamed searchlight on electricity crisis in Nigeria. Hence, while these studies have been able to recommend a policy approach for solving energy crisis to the government, little have been offered in terms of household efforts at mitigating the electricity supply gap. This study aims to fill this gap. In addition, the study attempts to extend the frontiers of knowledge by accessing the challenges and prospects of households in their private electricity generation efforts to encourage their participation in sustainable generation of electricity.

### **Research Methodology**

The survey research design, as well as the cross-sectional analysis was adopted for this study. There where chosen taking into account the raised research questions and the stated hypotheses. The

approach is employed to ascertain the relationship between electricity affordability and household welfare in Lagos state, Nigeria. The residents of Lagos metropolis constitute the population of this study. The state was selected since it is the second most populated state and the commercial capital of Nigeria. A sample of 150 people is drawn from residents residing around Surulere, Iwaya and Onike areas of Lagos. The sample covers both, Surulere Local Government and the Lagos Mainland Local Government. These areas are selected basically because it is just a pilot study and for the cost minimizing. Surulere, Onike and Iwaya and also afford us the opportunity to harvest opinions of typical highbrow and lowbrow residential areas of Lagos pertaining to energy affordability and its effect on human welfare. Random sampling technique was employed in selecting the sampled respondents. A structured questionnaire showing the socio-demographic information of the respondents as well as key questions which border on electricity affordability and households' welfare were administered. Also, we employ both, qualitative and quantitative methods of analysis. The statistical analyses suitable for the stated objectives are employed to arrive at the findings of the study.

In addition, we conducted the validity test of our instruments using the Pearson Product Moment Correlation (PPMC) techniques. The values of our validity test were 0.872 and 0.931 for demographic factors and questions in section two respectively, which are larger than its critical value at 5 per cent. The reliability test using the Cronbach's-alpha values were 0.935 and 0.964 for demographic data and questions in the second section correspondingly. It implies that the instruments are valid because the values are greater than the benchmark value of 0.78. Graphs and tables are used to present the opinion of respondents. The Relative Importance Index (RII) was also used to identify and rank alternative electricity sources Lagos residents are familiar with, the one that is cost effective, environmentally friendly in terms of pollution and space and factors that can make households shift from the use of generators to inverters and solar. The equation of RII is presented as:

$$RII = \frac{\sum W}{AN}$$

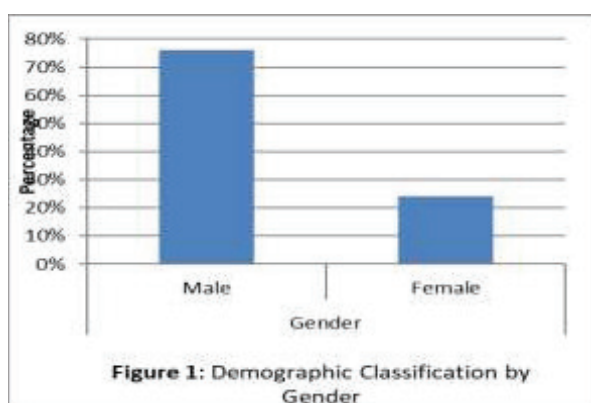
The value of RII ranges between 0 and 1 (i.e.  $0 \leq RII \leq 1$ ). Where;  $W$  = the weights given to each factor by respondents ranging

from 1 to 5;  $A$  = is the weight for height i.e. 5; and  $N$  = is the total number of respondents.

### Result and Discussion

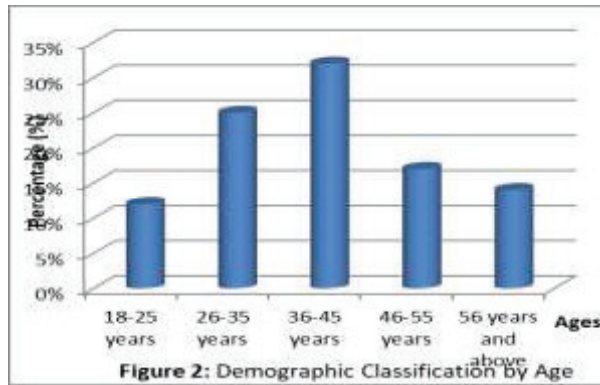
The results from the data collected from the questionnaires administered to respondents are presented in this section. We first present the demographic characteristics of respondents reported in Figures 1-4. The demographic classification by gender showed that 76% are males, while 26% are females. The occupation of the respondents revealed that 59% are civil servants, while the remaining 41% are business owners. The family size of the respondents indicates that 27%, 44%, 19% and 10% have a family size ranging within the values of 1-3, 4-6, 7-10, 11 and above respectively. The age distribution of the respondents shows that 12%, 25%, 32%, 17% and 14% correspondingly are within the age bracket of 18-25 years, 26-35 years, 36-45 years, 46-55 years, 56 years and above.

The income level of each respondent reveals that 17%, 35%, 31%, 13% and 4% earn annual income less than ₦500,000, ₦500,000 - ₦1Million, ₦1.1 - ₦5Million, ₦5.1 - ₦10Million and ₦11Million and above respectively. This implies that majority of the respondents are male, within the working age group and engages in paid jobs. They have a relatively large family size within 4 -10 and earn income less than ₦5million annually.

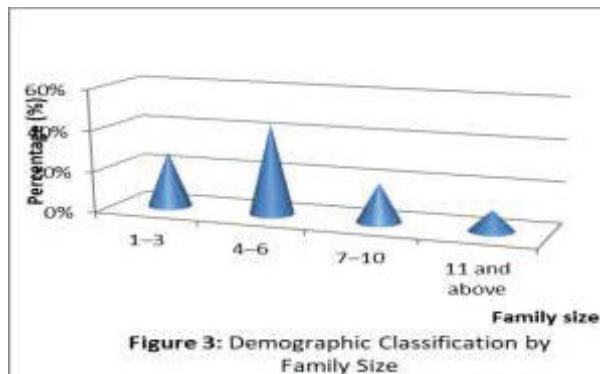


**Source:** Authors' Computation from Field survey (2018)

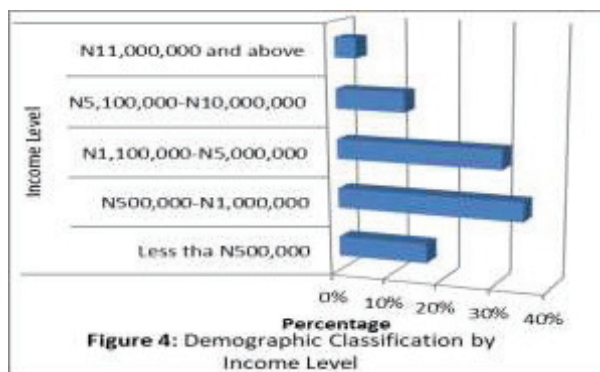




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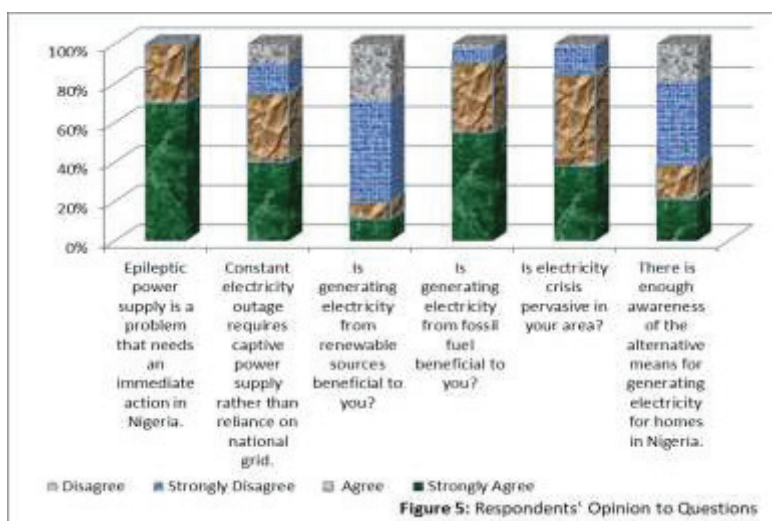
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Source: Authors' Computation from Field survey (2018)

Figure no. 5 reports respondents' perception on questions relating to energy affordability among Lagos residents. The figure suggests that all the respondents view epileptic power supply as a

problem that requires urgent attention in Nigeria. About 75% of respondents agreed that constant electricity outage requires captive power supply rather than reliance on national grid, while only about 20% of respondents agreed that generating electricity from renewable sources is beneficial to them. This implies that the awareness about generating electricity from alternative sources is still very low in Nigeria. Moreover, about 91% of the respondents agreed that electricity generated from fossil fuels is more beneficial to them, while about 85% of respondents confirmed that electricity crisis is pervasive in their areas. However, 40% of respondents confirmed that there is enough awareness of the alternative means for generating electricity for homes in Nigeria, while a sizeable number disagreed.



**Source:** Authors' computation (2018)

Table no. 1 reports various alternative electricity sources for homes in Lagos state. From the table, generator was ranked as the best alternative source of electricity for homes with a Relative Importance Index of 0.987. The second key alternative source was inverter (RII = 0.742) which still depend on the conventional source to be use by home. Other alternative sources according to ranking are solar energy (RII = 0.492), wind mills (RII = 0.412) and tidal waves (RII = 0.376).

**Table no. 1.** Alternative sources of electricity for homes in Lagos state

Energy Source	Relative Importance Index	Ranking
Inverter	0.742	2
Solar energy	0.492	3
Tidal waves	0.376	5
Wind mills	0.412	4
Generator	0.987	1

**Source:** Authors' computation (2018).

Table no. 2 presents the ranking of all alternative sources of electricity for homes that respondent consider being more cost effective. In Table no. 2, respondents opine that generator is the most cost effective as it was ranked first with a RII of 0.743. This is followed by inverter (RII = 0.701), solar energy (0.654), wind mills (RII = 0.476) and tidal waves (RII = 0.391), in that order.

**Table no. 2.** Cost effectiveness of alternative sources of electricity for homes in Lagos state

Energy Source	Relative Importance Index	Ranking
Inverter	0.701	2
Solar energy	0.654	3
Tidal waves	0.391	5
Wind mills	0.476	4
Generator	0.743	1

**Source:** Authors' computation (2018)

The environmental friendliness of alternative source of electricity for homes and human welfare were reported in Table no. 3 which identified solar energy as the best environmentally friendly electricity source with a relative importance index of 0.871. This is followed by inverter (RII = 0.821), wind mill (RII = 0.591), tidal waves (RII = 0.427) and generator (RII = 0.312).

**Table no. 3.** Environmental friendliness of alternative source of electricity for homes

Energy Source	Relative Importance Index	Ranking
Inverter	0.821	2
Solar energy	0.871	1
Tidal waves	0.427	4
Wind mills	0.591	3
Generator	0.312	5

**Source:** Authors' computation (2018)

Table no. 4 presents the result of factors that can make Lagos residents shift from the use of generator, to inverter or solar. The most important factor is less air pollutant with a RII of 0.913. The second factor is less noise production with a RII of 0.881. This is followed by easy operation after installation (RII = 0.778), the maintenance cost (RII = 0.497) and procurement cost (RII = 0.451), in that order.

**Table no. 4.** Factors that makes consumer shift from Generator use to Inverter/Solar

Energy Source	Relative Importance Index	Ranking
Less noise pollutant	0.881	2
Less air pollutant	0.913	1
Easy to operate	0.778	3
Maintenance cost	0.497	4
Procurement cost	0.451	5

**Source:** Authors' computation (2018)

### Summary and Conclusion

This study investigates the nexus between electricity affordability and household welfare in Nigeria, using Lagos state as a case study. This is a pilot study that involves the administering of one hundred and fifty questionnaires to residents in Surulere, Onike and Iwaya areas of Lagos State, covering two Local governments (i.e. Surulere and Lagos Mainland). In the results presented according to the respondents' responses, there is an epileptic supply of electricity in their areas. Residents also opined that there is less awareness about

generating electricity from non-renewable sources. It was also confirmed that generator is still the best alternative source that households use for generating electricity because of its easy access and cost. Alternative sources like inverters and solar are still at infant stage of getting recognition among households in the Lagos metropolis. This is because many respondents opined that both inverters and solar are very expensive to install and requires high level of expertise for its maintenance, unlike generators. However, despite the perceived huge cost and maintenance difficulties, households opine that both solar and inverters are more environmentally friendly compared to the usage of generators. This is because they generate lesser noise and emissions of carbon. Going by the result of this scientific enquiry and for the fact that households' income determines the affordability of electricity, which in-turn has environmental implications on households, we hereby conclude that electricity affordability has a strong correlation with households' welfare in Nigeria. To this end, it becomes very important for every household in the country to diversify its captive energy supply into the use of inverters and solar, rather than using generators to supplement energy supply from the national grid.

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