

Paper Title:

Towards Energy Efficient Buildings in Nigeria: Challenges and Opportunities

Authors:**Dr Ekele Thompson Ochedi**

PhD Sustainable Architectural Design
Principal Lecturer
School of Environmental Technology
Department of Architectural Technology
Kogi State Polytechnic,
P. M. B 1101, Lokoja, Nigeria
writeeto@yahoo.com

Professor Ahmad Taki

Professor of Building Performance and Sustainability
Director of Architecture Research Institute
Leicester School of Architecture
De Montfort University,
Leicester LE1 9BH UK
ahtaki@dmu.ac.uk

Abstract

The need to enhance people's wellbeing by reducing CO₂ emission has necessitated global efforts towards reducing energy consumption by buildings, which is responsible for nearly 45% of world's energy consumption. Energy efficient design approaches have clear consequences on environmental protection and the wellbeing of urban populations. It is a viable means of reducing overdependence on electric generators and possible future retrofit of existing housing stock in Nigeria. Efforts towards achieving energy efficient buildings in this part of the world are not without challenges. Previous studies have revealed opportunities and possible challenges to energy efficiency in buildings in Nigeria. However, there seems to be scarce academic field data on this subject in the Nigerian context. Hence, this paper aims to identify benefits and possible hindrances to the realization of energy efficient buildings in Nigeria. This study adopted semi-structured interview involving 12 architects in Lokoja, Nigeria as the main approach for generating relevant data on this subject. Some of the limitations revealed by the interviewees include poverty, lack of awareness, lack of interest in local technologies and building materials, activities of non-professionals in the building industry and lack of effective regulatory bodies. This paper shows that there is enormous potential to improve people's wellbeing and reduce carbon footprints if we can overcome the possible hindrances to achieving energy efficient buildings in Nigeria. The study concludes that energy efficiency in buildings can be achieved in Nigeria through strong awareness creation and collaboration among the stakeholders in the building industry.

Keywords— Energy consumption, energy efficient buildings, stakeholders, thermal comfort

1.0 Introduction

Buildings are responsible for the largest portion of the world energy compared with other economic sectors (Perez-Lombard et al., 2008). In line with this assertion, other studies showed that buildings consume up to 40% of global energy resource and accounts for nearly one-third of the world greenhouse gas emissions (IEA, 1995; Kasozi and Tutesigensi, 2007 Pearce and Ahn, 2013). Energy demand by buildings have negative impact on people's wellbeing and the environment. These include increase in temperature leading to thermal discomfort in buildings, rising sea levels and flash flooding (Ochedi and Taki, 2019). The factors that affect energy demand and consumption by buildings include climatic zones, building design, building occupants' characteristics and behaviours, artificial lighting and appliances and ventilation systems.

Increasing energy demand and decrease in available energy are leading to mandatory energy efficiency strategies in every sector globally (Petersen and Svendsen, 2010). According to Sadineni et al. (2011), adopting appropriate energy efficiency strategy can significantly reduce energy consumption in buildings. This has led to numerous mechanisms and policies proposed and implemented especially in developed countries towards an energy conscious building development (McLennan and Jason, 2004).

To achieve energy efficiency in buildings and other sectors, appropriate decisions, strategies and efforts are necessary by all stakeholders. Several countries in world have intelligently invested into energy efficiency in order to minimize GHG emissions, mitigate the effects of climate change and the negative impacts on buildings, the environment and communities. (Kallakuri et al., 2016). Some of these efforts, especially in buildings have resulted in concrete agreement targeted at developing and implementing strategies and actions to make buildings more sustainable (du Plessis, 2002). An example was the declaration of the European Union (EU) in conjunction with the G8 to reduce GHG emissions by a minimum of 80% below the 1990 level by the year 2050 (Eley, 2011).

Any government that encourage investment and implementation of policies for energy efficiency will improve economic status of its citizens, decrease environmental pollution and overdependence on energy imports (FMPWH, 2016). Investments in energy efficiency by the 29 member countries of the International Energy Agency (IEA) since 1990 led to a saving of \$550 billion in 2014 only. Nevertheless, energy efficiency in the most underutilized resources

worldwide regardless of its proven benefits and potential to salvage growing energy demand globally (Kallakuri, et al., 2016).

Despite the advantages of energy efficiency, concrete efforts and achievements at other regions of the world, efforts towards achieving energy efficient development in most sub-Saharan African countries are still elementary. This can be attributed to several reasons among which is lack of institutional framework (Ebohon and Rwelamila, 2001; du Plessis, 2002). This applies to Nigeria as GIZ (2015) argued that energy efficiency and renewable energy could boost and improve electrification rate in the country, but consideration for these are insufficient within policy and institutional framework. Moreover, studies have shown that there is scarce development of policies and method employed to mitigate building energy consumption in developing countries (du Plessis 2002; Janda 2009). This study is intended to emphasize the relevance of achieving energy efficiency in buildings in Nigeria, the efforts that has been put in place and the challenges.

2.0 Energy challenges and efforts in Nigeria

2.1 Energy challenges in Nigeria

Efforts towards energy efficiency in Nigeria is key to sustainable development due to current and possible future challenges. Intermittent electricity supply is a major challenge in Nigeria as only about 40% of the total population are connected to the national grid (GIZ, 2015). Therefore, a large percentage of the population relied majorly on electric generators for their businesses and homes. These can have serious negative impact on communities and the environment. In addition to energy shortage, Nigeria faces acute shortage of housing stock with up to 16 million of housing deficits (GIZ, 2014). Energy consumption by the building sector is driven by increase in population owing to migration from low energy consuming rural areas to high-energy demand urban areas and improvement in living standards (FMPWH, 2016). Moreover, the effects of climate change as experienced in other locations in the world are now real in Nigeria. Hence, Nigeria faces a difficult task of developing strong approaches towards mitigating these challenges towards improving people's wellbeing.

2.2 Use of electric generators

Energy shortages and power outages has led to the use of private diesel and petrol electric generators in Nigeria without considering its negative implications on the well-being of the people and the environment. These generators are sources of noise pollution, complex mixture of air pollutants, chronic respiratory diseases and lung cancer and lung diseases in addition to

their contribution to CO₂ emission (Aliyu et al., 2013). Death toll because of the use of electric generators is on the increase (Adebayo, 2009).

Erratic power generation, distribution and frequent blackouts in Nigeria has forced electric users to depend hugely on electric generators for cooling needs and to run electrical devices. Adebayo (1991) revealed that the number of electric generators are twice the number of rooms in Lagos, Nigeria (Akindele, 2016). Previous studies have shown that electric generators have the most extensive impact on the environment because of airborne pollutants, which spread over a wide area (Kempton, 1991; Kates and Torrie, 1998). Human activities involving the production of CO₂ create series of fluctuations in the operation of climatic systems (Cunningham and Cunningham, 2012).

GIZ (2015) argued that electricity generation using small generators are inefficient in carbon terms, very expensive and impractical. Hence, the need to seek and adopt energy efficiency measures to reduce overdependence on these electric generators.

2.3 Energy saving opportunities in Nigeria

There exist several potential means of saving energy in Nigeria. These energy efficiency potentials are in two levels. The first is related to energy generation, transmission and distribution; while the second relates to the way energy is consumed by economic sectors (GIZ, 2015). This research focuses on the latter with specific emphasis on achieving energy efficiency in the building sector, especially residential buildings.

GIZ (2013) based on an analysis conducted in 2013 shows that the largest saving potentials at households' level in Nigeria are from cooling demand, hot water heating and lighting.

2.4 Efforts towards reducing energy demand in buildings

The Nigeria Federal Building Code approved in 2006, does not include detailed energy efficiency measures. This code is undergoing revision to include easy-to-implement efficiency measures, which are cost effective.

The Federal Government of Nigeria made several policy efforts in the past to encourage renewable energy and energy efficiency. These efforts, which include the “Renewable Energy and Energy Efficiency Policy” and the National Energy Efficiency Action Plan were limited in scope as they only mentioned general areas without detailed framework. The “Renewable Energy and Energy Efficiency Policy”, which was approved in 2015, proposed the development of energy efficiency code that will enhance bioclimatic design techniques and other energy saving

measures. In 2015, the National Energy Efficiency Action Plan was also approved to promote energy efficiency in Nigeria (FMPWH, 2016).

The Building Energy Efficiency Guide for Nigeria, which was approved in 2016 responds to the renewable energy and energy efficiency “policy target of producing guidelines on all the key components of energy efficiency by 2020” (FMPWH, 2016, p.24). The Nigerian Building Energy Efficiency Code was launched in 2017 towards achieving minimum energy efficiency in buildings. Despite these efforts, there seem to be a very slow pace towards achieving energy efficiency in buildings due to some challenges.

2.5 Possible benefits of energy efficient buildings

Considering the level of energy demand by the building sector of nearly 58% of the total electricity consumed in Nigeria, the acute shortage of electricity generation and transmission, energy efficiency techniques represent the cheapest means of enhancing the state of energy supply. The use of bioclimatic design techniques and highly efficient and relevant active systems will greatly reduce the energy required to cool and light buildings. The combination of the passive and active systems can help to eliminate the need for cooling entirely in some cases. Achieving this will definitely reduce overdependence on the national grid leading to improved energy security in Nigeria (FMPWH, 2016).

Achieving energy efficiency will not only reduce power shortage but will discourage the use of electric generators used by millions of households thereby cutting down carbon dioxide emissions. Businesses and households spent a lot of money on generating sets due to unstable power supply. Vanguard Media Limited in GIZ (2015, p.45) revealed that “small-scale businesses and family spend an average of NGN 3.5 trillion (US\$21.8 billion) yearly to power generating sets with diesel and petrol due to unstable supply of electricity”. The high cost of power from electric generators should encourage the adoption of energy efficient measures. Moreover, adopting energy efficiency techniques in the building sector will no doubt enhance people’s wellbeing. It will reduce their reliance on these alternative power sources due to improved indoor thermal comfort and energy savings through the adoption of energy efficiency measures.

Enhancing energy efficiency will lead to efficient use of available natural resources, reduction of pollution, reduced spending on households’ and other energy expenditures. In addition, investments in energy efficiency measures is a means of achieving long term benefits which include improvement in the local environmental conditions and economic development (Oyedepo, 2014).

3.0 Methodology

This study adopted interview as the main approach for realizing the study focus. Interview provides a means of producing data by asking respondents about issues relating to their daily activities (Miller and Brewer, 2003). Both structured and semi-structured interviews were employed to gather information from architects in Lokoja, Nigeria which was chosen as a case study for this study. The interview instrument has two sections: section A comprise of structured questions for demographic information about the interviewees while section B centred on semi-structured questions aimed at providing data on the challenges to achieving energy efficiency buildings in Nigeria. The opportunities and benefits of energy efficient buildings have been outlined in the literature review.

Non-probability sampling was adopted in this study for the selection of respondents for interviews involving both local practitioners and householders in the study area. Some of the reasons for this is that it is time and cost effective compared with probability sampling (Babbie, 1990). Moreover, it was not practical to use probability sampling method for the target respondents as the study focused on specific inquiry. Hence, every subject do not have equal chance of being selected. Research has shown that the sample sizes for qualitative research are generally smaller than quantitative research (Mason, 2010). Brannen and Nilsen (2011) argue that the sample size should be a function of the quality and logic used for the investigation.

It was difficult for the researcher to find a reliable data on the total number of architects in Lokoja, Nigeria. There was no reliable database of architects practicing in Lokoja both at the state and national headquarters. An available option was to check the attendance register of the members of Nigerian Institute of Architects (NIA) in the state. This revealed a number of architects leaving some who did not feature on the attendance sheet out. List of architects whose name were not on the register were mentioned bringing the total number of architects to about 30. Some of these were full members while others were associate members of NIA.

The selection of respondents was based on their experience with the design of buildings and other processes involved in building development in Nigeria. As it was not practical to interview all the architects in Lokoja for this study, it was decided that an appropriate sample of the population would be adequate for the research focus. Hence, the interview involved 12 architects practicing in Lokoja, Nigeria. Among these were professionals from government ministries and parastatals, academics and private practice.

3.1 Transcription and analysis of interviews

An audit trail was produced for identifying the interview data based on the various respondents and contexts. To this end, identifiers were developed to provide a sense of context (Duffee and Aikenhead, 1992; Brown et al., 1996; Sours, 1998). These identifiers were necessary to maintain anonymity of respondents in line with research ethics. The architects involved in the interview were identified as LPA1, LPA2 ...LPA12.

The transcription of interview statements was followed by coding which has been referred to as the first step in the analysis of raw data. This involves reading the data carefully in order to develop a set of categories and themes (Strauss and Corbin, 1990; Simon, 2011). Major and sub-themes were identified based on the questions asked and critical examination of the data collected. These first and discrete categories were re-examined to identify some links between them through axial coding (Strauss and Corbin, 1990). These steps were necessary to guide the analysis of the raw data.

3.2 Analysis of demographic data

Basic information relating to the respondents were collected during the survey. Factual data relating to the interviewees were necessary to establish their ability to respond correctly and provide relevant information based on the interview questions. The demographic data covered age group and level of education, practice type, years of practice and level of awareness on energy efficient buildings. All the participants on the interview involving architects were male. This was not intentional but a true reflection of the fact that there are few female practitioners in the field of architecture in Nigeria and arguably in other countries of the world. It was difficult to get a single response from the few female architects in Lokoja. Table 1 shows the summary of respondents' demographic data.

Table 3:1 Respondents age group, level of education, practice type, years of practice and level of awareness on energy efficient buildings

Variable	Number	Percentage (%)
Age group		
20 - 30	0	0
31 - 40	5	41.7
Above 40	7	58.3
Level of education		
Graduate	2	16.7
Postgraduate	10	83.3
Practice type		
Academic	4	33.3
Private	1	8.4
Government (Public)	7	58.3
Years of practice		
1 - 5	2	16.7
6 - 10	4	33.3
Above 15	6	50.0
Level of awareness on energy efficient buildings		
Moderately	7	58.3
Somewhat	5	41.7

4.0 Results and findings

Previous studies identified numerous challenges to achieving or improving as the case may be energy efficiency in buildings in Nigeria. FMPWH (2016) identified four major barriers to advancing energy efficiency in buildings in Nigeria. These are lack of proper awareness and information on the relevance of energy efficiency approaches in buildings; insufficient policy, legal and regulatory frameworks; lack of technical expertise and lack of showcase energy efficient buildings example for stakeholders to derive experience and inspiration. Oyedepo (2014) revealed eight obstacles to the enhancement of energy efficiency in Nigeria, some of which are congruent with those highlighted by FMPWH (2016). These include lack of awareness, lack of trained personnel, lack of proper policy and legislation, low electricity pricing and poor metering systems. This study became necessary as it seeks to gather data from architects who are conversant with building development in Nigeria.

This section presents the challenges that were highlighted during the face to face interview with architects regarding the realisation of energy efficient buildings in Nigeria. The challenges were identified by the interviewees and will be discussed in this section are lack of proper policy and implementation; lack of awareness; lack of interest by government, clients and other stakeholders; lack of interest in local technologies and building materials; corruption on the part

of stakeholders in the building profession; activities of quacks or non-professionals; involvement of foreigners in the building industry and poverty. These might not be all the challenges to achieving energy efficiency in buildings in Nigeria but those identified by the respondents.

4.1 Lack of proper policy and implementation

All the interviewees agreed with the views of previous researchers who maintained that Nigeria is yet to put up strong policies towards achieving energy efficiency in buildings (Oyedepo, 2014; FMPWH, 2016). An interviewee argued that a major possible limitation would be the inability of the government to support this concept through the formulation of relevant policies. Several respondents supported his view on the relevance of government policy in achieving energy efficient buildings. LPA6 said this during his interview: *'I think the major possible limitation would be on the part of government buying into this idea and coming up with relevant policies in support of this.'*

An interviewee argued that even when there are limited policies, proper implementation is a big challenge. He said this during his interview: *'Implementation has always been a problem here in our country and particularly in Lokoja. There might be a very well formulated policy and even design but when it comes to the point of implementation, it is always a problem.'* (LPA1)

4.2 Lack of awareness

Lack of awareness was regarded by majority of the interviewees as one of the major challenges to achieving energy efficiency in buildings in Nigeria. An interviewee maintained that energy efficiency is a new concept that requires proper awareness in the study area. This was expressed during his interview: *'Energy efficiency is a new paradigm, it is a new thing that is here and not so many people are even aware of it'* (LPA2). To make buildings in Nigeria energy efficient, LPA1 suggested that proper awareness is required for designers and other stakeholders to comply with energy efficiency guidelines when provided. LPA7 agrees with this perspective when he stressed the need for awareness on energy efficiency in buildings. He declared this during his interview: *'Make sure you create awareness for professionals, the developers and building occupants so that they know what energy efficiency is even all about'* (LPA2). Another interview who echoed this view said: *'Well, it is not as if we have much awareness in this area of energy preservation, energy consumption of buildings, we are coming into the awareness. Nobody has come to talk about what is the level of energy consumption in buildings'* (LPA3). Hence, it is clear from the respondents that there is an urgent need to create awareness among all the stakeholders in the built environment so as to promote energy efficiency in buildings in Nigeria. It is practically impossible for people to key into what they know nothing about. This study

revealed that even some design professionals in the study area have little or no knowledge about energy efficient buildings.

4.3 Lack of interest by government, clients and other stakeholders

To achieve energy efficiency in buildings in Nigeria, all the interviewees seem to agree that the government and all other stakeholders in the built industry must key into the efforts. An interviewee maintained that *‘The government must, first of all, see the need and take the lead so that they can form a synergy with other relevant stakeholders in the built industry’ (LPA1)*. LPA6 stressed that the government *‘have a major role to play ... in the area of policy and regulations’ (LPA6)*. Other means of government involvement as identified by interviewees include funding and implementing research on energy efficient buildings, support and involve professionals in the planning approval process, device means of achieving energy efficiency in buildings using experts and elimination of quacks in the building industry. They maintained that it is difficult to achieve energy efficiency in buildings if these are not in place. LPA11 and LPA12 added that where there are government policies and building regulations, there should be properly enforced. At the moment, they seem to say that the interest of government in this regard is very low.

All the interviewees agreed that it is very difficult if not impossible to achieve energy efficiency in buildings in if clients and building developers refused to embrace the idea. To them a major challenge is a lack of interest by clients and developers. An interviewee stated that *‘A lot of people here do not consider energy efficiency in their buildings. All they are concerned about is to have a roof on their heads. So energy efficiency to me is the least considered factor in residential buildings’ (LPA11)*. Hence, to achieve energy efficiency in buildings, LPA11 maintained that clients should be made to support the efforts towards achieving energy efficiency in buildings.

All the interviews maintained that stakeholders in the building industry, especially design professionals are key to achieving energy efficiency in buildings. The interviewees were of the view that, at the moment, there seem to be little or no interest by building stakeholders on need for energy efficient buildings in Nigeria. LPA4 stated that any structure *‘starts from the design and if the professionals are ready, the clients are ready then the result will be close to what we are looking for’ (LPA4)*.

4.4 Lack of interest in local technologies and building materials

Most of the interviewees argued that lack of interest in local technologies and building materials pose a big challenge to the realization of energy efficient buildings in Nigeria. To make buildings

more sustainable, LPA2 emphasized the need to promote local building materials that are not alien to our environment. LPA9 stressed that designers should strive to design buildings based on local climate. He added that people should embrace the traditional architecture style, which to him has been abandoned. Some interviewees pointed out the need to work towards achieving a balance between local and modern building materials and technologies. To promote energy efficiency in buildings LPA3 stated that *we need to tie the concept of energy efficient buildings 'to the traditional buildings and traditional architecture of the people'*.

4.5 Poverty

Poverty was mentioned by some interviewees as one of the challenges to achieving energy efficiency in buildings in Nigeria. An interviewee argued that considering the poverty situation in the country and the need for accommodation, *'A lot of people here do not consider energy efficiency in their buildings. All they are concerned about is to have a roof on their heads' (LPA11)*. These interviewees maintained that it is more expensive to build energy efficient buildings. Hence, it is difficult for 'poor people' to embark on such project, instead they might choose to maintain the status quo.

4.6 Poor or no metering system

Almost all the interviewees agreed that it is difficult to know the actual quantity and cost of energy that are consumed in many homes in Nigeria due to challenges with and lack of metering systems as the case may be. An interviewee stated that *'many houses do not have meter to determine the quantity of energy consumed. And for those that have meters, we are not sure if the meters have any effect on their electricity bills as bills are almost the same whether the occupants used their buildings or not' (LPA10)*. Hence, it is difficult for building owners to key into efforts towards energy efficiency in buildings as they do not seem to see the importance.

4.7 Corruption on the part of stakeholders

Some interviewees pointed out that, where there are provisions in terms of policies regarding building development, corruption on the part of stakeholders can be a challenge to implementation. When asked for further comments during the interview, LPA12 stated that *'There is need to bring in stakeholders in the building industry to enhance the enforcement of building laws. Then, there is the need to also work towards eliminating corruption in terms of the enforcement of building laws.'* The interviewees stressed that corruption in this regard can take place during design, approval and construction processes. For instance, if government should state that any building design that does not comply with energy efficiency standards

should not be approved, staff in the planning approval office may push such drawings through approval processes due to corruption.

4.8 *Activities of quacks or non-professionals*

Almost all the interviewees agreed that non-professionals or quacks are greatly involved in the design and construction of buildings in Nigeria leading to unsustainable building development. To achieve energy efficiency in buildings, an interviewee stated that there is an urgent need to eliminate these non-professionals from the building industry. During his interview, he said '*what I think needs to be checked is the infiltration of quacks into the industry, people who do not have a sound know-how of the arts and science of the profession*' (LPA9). Another interviewee argued that some measures which were put in place in the past were not incorporated into buildings due to the activities of quacks or non-professionals in the building profession (LPA8).

4.9 *Involvement of foreigners in the building industry*

An interviewee argued that foreigners are heavily involved in building design and construction processes in Nigeria. Regarding this, an interviewee argued that '*There is pre-furtherance of foreigner into our urban space, the situation where we flood our construction industry with foreigners, all kinds of people and they are coming with their own technology. We are not trying to evolve and improve our own original technology to see how we can make it better than how we met it. These are the limitations*' (LPA2). This can have marked effects on the availability and specification of building materials which are not suitable for our local climate. For instance, the introduction of dark color roofs and their application in buildings are not suitable for our tropical climate, which is predominantly hot. This may be due to what is in vogue in their countries but are not suitable for our climates. This calls for the need for caution in the involvement of foreigners in building development in Nigeria.

5.0 Discussion of findings

This study focused on identifying benefits and possible challenges to achieving energy efficient buildings in Nigeria. The review of previous studies in section 2 showed energy saving opportunities and possible benefits of achieving energy efficiency in buildings in Nigeria. The interview with architects confirmed the challenges to energy efficiency in buildings identified by previous studies. Over two decades ago, Weber (1997) revealed four typologies of the barriers to efficient use of energy. These are institutional barriers, obstacles conditioned by the market, operational barriers and behavioural barriers. A study conducted by Schleich (2009) outlined some barriers to achieving energy efficiency. This include lack of perfect information, hidden costs, risk and uncertainty and access to capital. Other studies have highlighted some challenges

to achieving energy efficiency in buildings in Nigeria (Oyedepo, 2014; GIZ, 2015; FMPWH, 2016).

This study corroborated the possible obstacles to advancing energy efficiency in buildings in Nigeria as revealed in previous. Furthermore, it identified additional challenges in the Nigerian context which can slow down the efforts towards realising energy efficiency in buildings. These challenges seem to explain why Nigeria has not achieved much through its campaign for energy efficiency in buildings despite the launch of the Nigerian Building Energy Efficiency Code in August 2017 and other previous efforts.

6.0 Conclusion

This study has revealed the energy saving opportunities, potential benefits of energy efficient buildings in Nigeria and the possible challenges. These show the need for more conscious efforts towards advancing energy efficiency in buildings in order to tap into its numerous benefits. To do this, there is an urgent need for strong awareness creation and collaboration between all the stakeholders in the building industry. The aforementioned barriers to realizing energy efficiency in buildings and other sectors suggest that efforts in this regard should not focus on technical aspects only but also on the social context where lies the majority of these challenges. Moreover, these challenges show the need for research efforts towards achieving energy efficiency in the various sectors of the economy, especially the building sector which accounts for a larger share of the country's energy consumption.

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