PAPER • OPEN ACCESS

Barriers, drivers and prospects of the energy efficiency code in the Lagos real estate market

To cite this article: Basirat Oyalowo *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **588** 022033

IOP Conf. Series: Earth and Environmental Science **588** (2020) 022033 doi:10.1088/1755-1315/588/2/022033

Barriers, drivers and prospects of the energy efficiency code in the Lagos real estate market

Basirat Oyalowo[1*] **Yetunde Ohiro**[2] **Adeyemi Oginni**[3]

[1,2] Department of Estate Management/Centre for Housing and Sustainable Development. University of Lagos, Nigeria
[3] Department of Architecture/Centre for Housing and Sustainable Development. University of Lagos, Nigeria

- Corresponding Author: boyalowo@unilag.edu.ng

Abstract. This paper explores potential bariers and drivers to the uptake of new regulations for energy efficiency currently being introduced into the Lagos real estate market and how professionals percieve this, and then discusses how these might impact on achieveing SDG 7.2. An online survey of thirty real estate professionals involved in property development sector was carried out to ascertain this. The sampled real estate professionals are those listed in directories of Real Estate Developers Association of Nigeria, as well as professionals who had taken part in a federal government sponsored energy efficiency training in Lagos. Analysis of the close-ended questionaire was carried out using simple descriptive statistics, while open ended questions were analysed using ATLAS.ti 8, a computer aided qualitative data analysis software.

There is a very positive outlook for the adoption of the energy efficiency code in Lagos, although professionals believed most of the prescriptions of the code are achievable only in the long term (that is not before the next five years). In reality, this signifies a risk to the process as policy push-backs from change in government has been experienced in recent times. Actions towards promoting policy entrenchment of the code in planning agencies, voluntary adoption of the code by professionals and their clients and engagement of a wider range of built environment professionals are recommended to ensure that Lagos attains a sigificant level of energy efficiency in its real estate development sector in the short to medium term.

1. Introduction

In the quest for the attainment of SDG 7: Affordable and Clean Energy, it is important to promote energy efficiency in buildings while also reconfiguring the role of buildings as renewable energy users as well as the producer of much waste that impacts on the environment. This paper addresses the need to promote energy efficiency in buildings and relates to SDG 7.2 *'double the global rate of improvement in energy efficiency'*.

Energy use is vital to economic development, poverty reduction and the provision of basic services. It is even more crucial to the economic vitality of developing countries. However, its production, distribution and consumption all have significant negative effects on the environment. The built environment is

responsible for more than 40% of global energy use, implying that savings in this sector could substantially improve energy efficiency [1]. Its' use in building systems encompass heating, ventilation, air conditioning and cooling (HVAC) as well as lightning, in addition to the plethora of household appliances that run on constant supply of energy. There is a global pursuit to minimize energy consumption in building systems, and also a focus on the capacity of users to reduce consumption wastes. The study is focused on Nigeria, which recently introduced Building Energy Efficiency Regulations Guidelines. Lagos is one of 36 states of the country, although it is the Primate city and the nucleus of its commercial and real estate activities. Despite being beset with so many urban challenges arising from its population outstripping the infrastructure needs, Lagos still provides exemplary governance and innovation for the rest of Nigeria. This is one of the reasons why at the pilot implementation of its energy efficiency building codes, Lagos was chosen as one of three pilot cities.
This study provides answers to the research questions: What is the level of awareness of real estate professionals with the National Building Energy Efficiency Code and importantly, how feasible is adherence to its prescriptions in the recommended timeframe in the Lagos real estate sector? Finally, what drivers and barriers can be articulated with respect to realisng energy efficiency in the city? In the conclusive note of this paper, areas of further study as well as implications of findings towards enhanced understanding of African cities' prospects for achieving the targets of SDG 7 is presented.

2. Context

Energy efficiency incorporates actions to reduce the amount of energy required to provide products and services alongside energy conservation measures. For instance, insulating a building against heat gain prevents the use of less cooling energy to achieve comfort standards. Also, installing LED lights/natural skylights reduces the amount of energy required for illumination compared to traditional incandescent light bulbs (compact fluorescent lights use two-thirds less energy and last longer than incandescent light bulbs). In countries such as Nigeria, where energy production rarely ever meet up with energy demand, adopting energy efficiency measures will largely impact on energy savings, carbon reduction and efficiency of energy use in the long run. Alternative energy use by the implementation of renewable energy will be an additional advantage. In residential buildings in particular, energy efficiency is paramount. In Nigeria for instance, residential buildings record the highest energy consumption sector of the national economy, accounting for about 50% or more of annual electricity power consumption [2]. Reduction in running costs, improved ambient conditions and increased equipment life are advantages attributable to energy efficiency, with the overall advantage being to reduce environmental impact of these buildings, and these can be achieved with the increased user comfort [3].

2.1 Considerations for energy efficient buildings

Three design considerations for energy efficient buildings are identifiable [3]. These are:

- planning/design consideration (the building site, building typology/planform, building orientation, functional distribution, room orientation, landscaping, and the design process)
- building envelope (External walls and finishes, fenestrations and shading, thermal insulation, roof)
- other services (building materials, electrical and lighting installation, air conditioning installation).

Beyond this, there are specific passive design actions that would contribute to a building's energy efficiency. For instance, low window to wall area ratio is a passive energy efficiency strategy, along with building orientation, fixed/operable external shading, thermal mass, nocturnal cooling and stacked windows among others which achieve reduction in energy usage through design by preventing buildings from overheating. This is achieved by blocking solar gains and removing internal heat gains [1].

Energy efficiency in buildings can be achieved in several ways ranging from the reduction in energy consumption to energy savings through the various equipment in use during or after the construction of

IOP Conf. Series: Earth and Environmental Science **588** (2020) 022033 doi:10.1088/1755-1315/588/2/022033

buildings. For a country such as Nigeria which has a limited capacity to mitigate climate change, adaptation measures through the various bioclimatic strategies listed below is paramount.

- day lighting; by the use of roof lights, skylights, high level windows etc to throw natural lighting directly into spaces and reduce the demand for artificial lighting.
- window treatments, for solar control by the use of low e- glass, or sun shading devices and screens are also desirable. These cut off the direct penetration of sun rays preventing the heating up of spaces and dropping cooling loads significantly.
- energy efficient fixture installations are largely involved in energy savings
- passive design, with the use of bioclimatic principles which aids in energy reduction such as thermal walls, cross ventilation, orientation of buildings, solar shading, stack effect, natural ventilation, etc while providing thermal comfort and a good indoor air quality .
- the use of technology through sensor systems will cut off wastage of power supply whenever equipment are not in use. Task lighting, rather than general lighting, as well as renewable sources of energy, such as, water, solar, wind, geo-thermal, bio fuel, nuclear, wood chip etc.

3. Energy Efficiency Policy in Nigeria

Nigeria depends on thermal and hydro power plants for its energy production with statistics from the Nigeria Electricity Regulatory Commission (NERC) showing that 80% of actual generation capacity in 2015 is obtained from gas-based power plants, while the remaining electricity come from hydro power plants [2]. However, Nigeria's average energy generation is 4,000MW, with peak generation amounting only to about 5,000MW in the face of a peak demand forecast of almost 13,000MW and 10,000MW off peak, meaning that the electricity supply of about 60 million Nigerian relies on private diesel and petrol generators [2]. It is also notable that only 40% of Nigeria's urban population and 10% in the rural areas is connected to the National Grid. According to the Energy Commission of Nigeria (2014), households account for about 50% of electricity consumption in the Country. In office spaces, air-conditioning accounted for 40-68% of energy consumption, lighting 13 to 37% and office equipment 12 to 25% [2].

Energy Efficiency policy making in Nigeria is clearly still in its infancy, with clear guidelines only being formalized in the last five years. In 2015, the country released its Renewable Energy and Energy Efficiency (RE and EE) policy, wherein aspirations towards developing energy efficiency guidelines and energy efficiency building codes were outlined.

In June 2016, the Federal Ministry of Power, Works ad Housing working in collaboration with its technical partner, the Nigerian Energy Support Group (NESP) and GIZ released the Building Energy Efficiency Guidelines (BEEG) to promote a shift to energy efficiency practices amongst building design practitioners and users. It provides practical information on the design and construction of energy efficient buildings and was to be disseminated to all major stakeholders in the construction industry. The Guideline was targeted at medium-high cost residential and commercial properties, new builds rather than existing and focusses on cooling and lightning energy use. The Guideline promoted integrated design processes, recognizing the limitations of the conventional design model still generally utilized in the building construction industry, wherein an Architect designs the building without due consideration of other professionals such as structural, mechanical and electrical engineers whose inputs in the early design stage are very crucial for energy efficient building design and lifecycle costing. The guidelines also promoted bioclimatic architectural design, provided pathways for regulation for energy efficiency and a few case studies from other countries [2].

4. Energy Efficiency and The Lagos Real Estate Development Sector

Lagos is the commercial hub of Nigeria, with over 10,000 large scale industrial and commercial concerns and hosting the headquarters of many national and international corporations. Sixty percent of Nigeria's value added manufacturing is attributed to the city and forty five percent of the country's skilled labour force are resident in it[4]. It is therefore not surprising that it accounts for 50% of the National energy consumption [4]. As a result, Lagos is easily the lead in the housing and commercial development subsectors in Nigeria [5], with several upper-class developments in Lekki and other coastal areas and low to medium development in its interior and northern corridors. Increased income, increased number of households and the purchase of lifestyle appliances are also likely to increase aggregate energy consumption. However, while 40% of the population do not have access to grid power, of the 4,000MW average generation, Lagos receives about 1,000MW [2], on account of its industrialization, and relatively higher energy consumption per capita. It is against this backdrop that the national building energy efficiency code (BEEC) is being piloted in the city, to provide an impetus for the adoption of energy efficiency practices and the possible implementation of SDG 7 by other cities in Nigeria.

4.1 Summary of the National Building Energy Efficiency Code (BEEC). As presented in the Federal Ministry of Power, Works and Housing (Housing Sector), the aim of the National Building Energy Efficiency Code (BEEC) is to *'set minimum requirements on building energy efficiency and to provide for their proper implementation, control and enforcement' [6].* Key elements of BEEC are outlined as follows:

4.1.1 Content. The code book consists of sections that include minimum energy requirements and verification methods, calculation methods and tools, building energy label and energy efficiency incentives, control and enforcement, qualification of experts and review and adaption amongst others.

4.1.2 Application. BEEC applies to new buildings only. It also limited to only business and professional spaces primarily used for office work and residential buildings, including apartment houses, vacation properties, one or two-family dwelling units and detached one or two-family dwellings.

4.1.3 Prescriptions. Energy efficiency interventions provided in the code are specified based on bioclimatic principles and covers prescription for (i) the reduction of overall window to wall ratio with requirement that for residential and office buildings, it should not exceed 20% (ii) reduction of installed lighting power density with prescription that it should not exceed 6W/m^2 for residential buildings (iii) requirements for roof insulation so that roofs should be constructed to include a layer of insulation, which should be of thermal resistance of not less than 1.25m^{2}K/W for all new residential and office buildings. (v) minimum performance of air conditioning equipment with requirement for the installation of inverter based split units (where necessary), which should have a minimum EER/COP of 2.8.The feasibility of achieving these five prescriptions form the basis for the survey reported in this study.

4.1.4 Enforcement. BEEC requires that Town Planning Authorities should inspect all drawings to check for inclusion of energy efficiency features before construction, and also that building permits should not be issued without inclusion of the above stated energy efficiency features while also providing that town planning authorities should physically inspect all buildings after completion to ensure adherence to energy efficient regulations. The feasibility of these is also reported in this study.

5. Method

A survey of thirty real estate professionals involved in property development and management was carried out to ascertain their professional perceptions of the actualization of the new building energy efficiency code in Lagos. An on-line questionnaire was utilized, using the freely accessible google forms. A link to the questionnaire was mailed to real estate professionals who are listed in directories of Real Estate Developers Association of Nigeria, as well as professionals who had taken part in a training on energy efficiency organized by the Federal Ministry of Works, Power and Housing in Lagos. The questionnaire was designed as a semi-structured one, and framed to ascertain the level of awareness of the professionals with the National Building Energy Efficiency Code and importantly, their professional opinion on the time-frames within which the prescriptive aspects of the code can be actualized. Analysis of the close-ended questionaire was carried out using simple description statistics, while open ended questions were analysed using ATLAS.ti 8, a computer aided qualitative data analysis software.

IOP Conf. Series: Earth and Environmental Science **588** (2020) 022033 doi:10.1088/1755-1315/588/2/022033

6. Findings and Discussion

The respondents are mainly built environment professionals with Architectural, Estate Development, Estate Valuation, Urban Planning, Project Management and Quantity surveying backgrounds. At 83% male and 17% female, there is significant gender disparity possibly reflecting the demographics of the professionals.

6.1 Awareness about the New Building Energy Efficiency Code in Nigeria

At 65.5%, a good proportion of the professionals indicated that they were aware about the introduction of the New Building Energy Efficiency Code in Nigeria. For most, awareness came from on-line sources, seminar organized by the Government's technical partner GIZ, TV programs and from their own activities as professionals in the service of the Lagos State Government.

6.2 Prospects

Achievement potential of the BEEC's prescription that the window to wall ratio of residential and office buildings should not exceed 20% is deemed achievable, but only in the long term (57%). About 40% believed that this goal can be incorporated into new buildings in the next 2 to 5 years, while only 3% believed that this is not achievable at all, it is interesting to note that none of the professionals believed that it can be achieved in the short term, that is in the next two years.

The prescription that building's lighting power density should not exceed 6W/m2 for residential buildings also shows a positive feasibility outlook as most respondents believed it is achievable. However, only a few, less than 15% believed this to be achievable in the next two years. At 44% and 41% respectively, most professionals in Lagos predict that the code can only be achieved in the long term and between 2 and 5 years. The long-term goal achievement feasibility might be due to the availability of lighting systems within the country and the need for local production as well as for importation of such products.

For the prescription that 'installed energy consumption of artificial lighting should be minimal', which is also design focused, 10% of the respondents believed this is not achievable. Of the 90% that believed otherwise, 27% believed it is achievable in the long term, 41% believed it is achievable in the medium term and 20% believed it is achievable in the short term, within 2 years. Of the other codes, this is the one that appears to enjoy most support as a short-term goal.

The code prescribed that roofs should be constructed to include a layer of insulation and as with other code components, majority also believed that this achievable, albeit in the long term, with 55% providing this range. 24% believe it can be achieved in the medium term, while 13% believed that it can be achieved within the next 2 years. BEEC also stipulated that roof insulation with thermal resistance of not less than 1.25m2K/W should be used for all new residential and office buildings. All respondents believed that this achievable and this is a very positive feasibility outlook. However, perceptions are that this is also a long-term project that cannot be achieved in the next 5 years, while 34% believe that it is achievable in the medium term and 7% believed it is achievable within the next two years.

Given the tropical weather conditions in Nigeria, office buildings and increasingly residential developments in the middle to high end come with consideration for air conditioning cooling systems. Accordingly, BEEC requires that where desired, air conditioning units should be of inverter type. As shown in figure 1, with 58% in agreement, professionals strongly believe this to be a long-term project, while 8% believed it is achievable in the short term and 10% believed that it is not achievable at all. This code also has some cost implication and it is possible to see the passive resistance to it in the proportion of respondents that believed it is achievable in the long term.

In addition, BEEC requires that air conditioning units should have a minimum EER/COP of 2.8. This is a product code that could have cost implications and could be subject to client resistance as well. It is also a code that is out of the hands of the construction professionals and has more to do with end-user behavior as air conditioning installation and reinstallation could occur long after construction,

IOP Conf. Series: Earth and Environmental Science **588** (2020) 022033 doi:10.1088/1755-1315/588/2/022033

when the architect and the builder have left the scene. For corporate and commercial properties, it is certainly in the purview of the facility manager, where available. As a reflection of this, the feasibility outlook for short term is low at 13% in agreement, 55% believed it is achievable in the long term, 27% believed it is achievable only in the medium term and less than 10% believe it is not achievable.

Enforcement is important so BEEC stipulates a number of conditions. First, it requires that Town Planning Authorities should inspect all drawings to check for inclusion of energy efficiency features before construction. All respondents believed that this is achievable, although they differed over the time frame for which it can be achieved. 44% believed it is achievable in the long term, while 31% believed that it can be achieved in the medium term. It is interesting that 24% believed that this is achievable in the short term, given the delays associated with conventional building permit applications in Lagos. As with other code objectives, this also appears to have a long-term feasibility outlook, however relatively more respondents believed it to be achievable in the short term compared to other code components. This is considered to be encouraging for the uptake of energy efficiency in real estate development.

It is also an enforcement requirement that building permits should not be issued without inclusion of the above stated energy efficiency features. A significant 55% believed this to be achievable only in the long term, implying that there should be a five year gap for which new build properties could be brought up to energy efficiency standards and that the regulations should be enforced then, 20% believed that this can be achieved in the medium term and interestingly another 20% believed that it can be achieved in the short term. There is an interesting contestation about this but given the equal split between the time frames, it is feasible that this can be achieved more readily than the others.

Similarly, for effective enforcement, BEEC requires that town planning authorities should physically inspect all buildings after completion to ensure adherence to energy efficient regulations. As shown in figure &&&, all respondents believed that this is achievable, although there were disparities in the time-frame for possible achievement. 41% believed that this can be achieved in the long term, but 37% believed that it is achievable in the medium term while 20% believed it is achievable in the short term. This is rather encouraging because it indicates that a progression can be made from the short term to the long term.

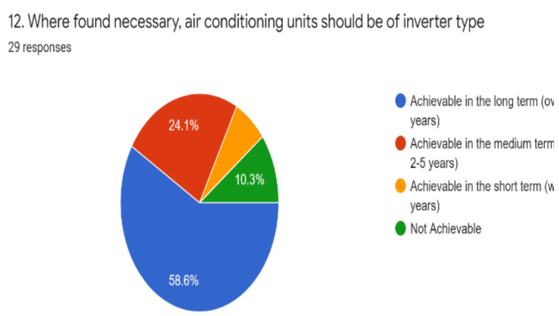

Figure 1. Perception of professionals on achieving BEEC’s air-conditioning prescription.

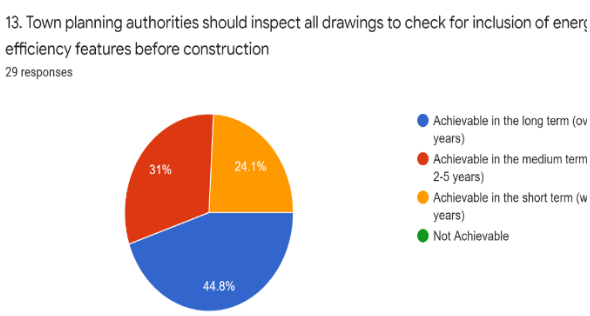

Figure 2. Perceptions of professionals on achieving BEEC’s pre-construction prescription.

6.3 Barriers to energy efficiency

Respondents were asked to provide their views on possible barriers that could impede energy efficiency uptake. A word cloud, shown in figure 3 was generated to show the prominence of a few key words that were then subjected to further manual extraction. The analysis shows that the weakness in

IOP Conf. Series: Earth and Environmental Science **588** (2020) 022033 doi:10.1088/1755-1315/588/2/022033

government regulations and implementation framework, lack of funding of applicable (enforcement) institutions and lack of enforcement of laws or policies targeted at ensuring adherence to energy efficiency practices are barriers to uptake. Other barriers are identified as inability to monitor buildings under construction effectively and (lack of) legislation and execution. There were also concerns about bureaucracy and corruption in planning approval processes. Issues such as high cost of energy efficiency solutions, lack of widespread availability of efficient energy products and lack of data management in new property registration and processes were also reflected in the answers.

Figure 3: Word Cloud showing barriers to energy efficiency

6.4 Drivers for improved uptake

Professionals' recommendations of actions to be taken to improve uptake fall into six categories, which are (i) advocacy interventions such as enlightenment and public awareness to improve occupants' demand for energy efficient components, (ii) introduction of punitive measures like non-compliance fines after 5 years of introduction of BEEC and (iii) tax rebates in the energy efficient building materials value chain. Others are (iv) promoting institutional efficiency, (v) effective monitoring protocols of development permit processes, and (vi) financial incentives such as incentivized voluntary compliance, and soft loans to stimulate the green energy products market.

7. Conclusion

The Nigerian National Building Energy Efficiency Code (BEEC) is akin to a transformational plan for energy efficiency in its built environment, albeit being in a very early stage of actualization. It was developed with a conscious effort to reduce the introduction of new cost outlays in the building construction process, and to focus on a few feasible but readily acceptable energy efficiency strategies. This aligns with previous researches [1] [3] [7] that hypothesize that the most cost-effective energy reduction in a building usually occurs at the design process, implying that energy efficiency is now an important design factor.

The actualization of energy efficiency for the Lagos residential and commercial real estate is dependent not only on the introduction of the BEEC, but also crucially, on its rapid uptake by core professional stakeholders in the built environment, who interact daily and make decisions with (and sometimes for) property investors, government agencies and users. This is a small, but indicative survey of such a group that operate in the busy Lagos real estate market. Given the high level of awareness of this group about the content and prescriptions of the National Building Efficiency Code and the generally positive outlook for the feasibility of the achievement of the prescriptions of this code, there are indications that there would be widespread influence from the professional class to the users (where they manage properties), to the clients (where investment decisions are to be made), and this would impact positively on the prospects of attaining SDG 7 in Lagos. However, further research efforts are required to authenticate this empirically.

IOP Conf. Series: Earth and Environmental Science **588** (2020) 022033 doi:10.1088/1755-1315/588/2/022033

Nevertheless, it is remarkable that professionals' perception of timeframes for actualizing design stage prescriptions such as ensuring that window to wall ratio does not exceed 20%, and the maximum threshold for lighting power density, is that they cannot be achieved in the short term. This is remarkable because the implementation of these codes are adaptable to the current skillset of professionals and does not require extensive training and re-orientation to actualize. Similarly, prescriptions such as the requirement for additional layer of thermal insulation for roofs, which are design-based but with potentially additional cost implications to clients are deemed to only be feasible on the long term. These long-term perception for actualizing energy efficiency indicates that there are risks to the immediate attainment of energy efficient buildings in the Lagos real estate sector. This risk is further exacerbated by the political risks that are associated with policy push-backs in case of change in governance. To mitigate this risk, it is important that the planning agency under whose remit implementation falls, formally adopts the energy efficiency code as a component of its development control activities and hence develop structures to ease the process of checking for compliance. In addition, voluntary uptake of energy efficiency codes by professionals and investor can be fast tracked through incentives such as faster planning permit and approval processes, reduction in planning fees and awards for compliance. These actions will minimize the institutional weaknesses that this study finds to be significant barriers to energy efficiency uptake. It is also critical that there has to be a responsibility for engaging with other groups of professionals (not just architects, builders and engineers) whose work can significantly improve the city-wide uptake of the code. Examples are property managers, facility managers, investment appraisers, property developers and property valuers.

Traditionally, excluding macro and micro economic policies, government intervention could impact the real estate through building codes and through public infrastructure provision. The impact of building codes is to guide development in such a way as to ensure that pecuniary or rent seeking behaviour is not achieved to the detriment of the public good. In addition to this, BEEC regulations provide a direction for the design, construction and use of buildings in such a manner as to ensure consideration for the environment. Thus, in general energy efficiency codes need to be developed and introduced in developing countries along the lines of least resistance. In line with findings from this study and previous researches, it has to be developed with a conscious effort to reduce the introduction of additional cost expenditures. Energy efficiency is now an important design factor. This means that governments interested in implementing energy efficiency protocols must provide guidance for, and monitor the building design processes to ensure compliance. They must also be ready to work alongside professionals in the built environment and ensure they provide incentives for voluntary, rather than punitive compliance. In our view, these actions are very critical to global adoption of energy efficiency and the realization of SDG7.2.

References

[1] Aliyu, A.M and Abubakar A. 2018 Optimizing energy efficiency of office buildings in tropical composite climatic belt of Abuja, Nigeria. Dutse Journal of Pure and Applied Science **2** 551-564.

[2] Federal Ministry of Power, Works and Housing 2016 *Building Energy Efficiency Guidelines for Nigeria* (Abuja: Federal Ministry of Power, Works and Housing (Housing).

[3] Hussaina I.U 2018 Households' energy efficiency practices in a bereft power supply economy of Nigeria. DOI:http://dx.doi.org/10.5772/intechopen.81408.

[4] Lagos State Ministry of Economic Planning *2013 Lagos State Development Plan 2012-2025* (Lagos: Ministry of Economic Planning).

[5] Centre for Affordable Housing Finance in Africa 2018 *Housing finance in Africa 2018* (South Africa: Centre for Affordable Housing Finance in Africa).

[6] The Federal Ministry of Works, Power and Housing 2019 *The Nigerian Building Energy Efficiency Code* (Abuja: The Federal Ministry of Works, Power and Housing)

[7] Oyalowo B. 2014 *Barriers and Drivers Of Sustainable Building Construction And Management In Lagos Metropolis,* Nigeria Proceedings of the CIB W107 2014 International Conference, Lagos, Nigeria, 28th-30th January, 2014 pg.159-170.