Energy Transition Policy, Efficiency and Implementation Strategies in the Nigerian Built Environment

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ABSTRACT

Renewable Energy as a clean energy source has over the years been neglected in the energy consumption and distribution apparatus of the Nigerian Energy sector. In most metropolitan areas in Nigeria, office buildings consume a lot of energy during their life cycle especially where they are concentrated due to the economic values and employment opportunities they offer the citizenry, as most of the energy used by them is generated from fossil based fuels. In spite of the myriads of high-sounding Renewable energy policies and associated technologies propagated in Nigeria, up till now, the implementation of clean energy sources is still currently slow in implementation. The study aimed at identifying the current gaps existing in the energy policy-efficiency and its implementation strategies in the building construction sector; in order to improve the decision making process geared towards effective implementation. The methodology employed qualitative-content analysis on the secondary data from the reviewed literature from forty-four (n=44) relevant articles sourced from Google Scholar, Semantics, and Scopus. The findings identified the successes and failures of the programs and policies targeted at Renewable Energy and its Efficiency studies over the years. The approach was geared towards a steady transition in implementing Renewable Energy and clean energy efficiency resources in the Nigerian building construction landscape. The results revealed that there is currently a slow transition towards the adoption of renewable energy sources as a method of clean energy and energy efficient means of power generation and use in the global space of the Nigerian context and policy makers should implement favorable measures towards checking this current anomaly. This study suggested further investigations on the latent factors that posed barriers between energy policy decision making process and implementation strategies in the Nigerian energy sector vis-à-vis its subsidiaries.

Keywords: Renewable energy, Transition, Energy efficiency, Climate change, Policy implications

1. INTRODUCTION

Renewable Energy as one of the clean energy sources has been neglected in the areas of energy consumption and distribution of the Energy apparatus. In most Metropolitan areas in Nigeria, office Buildings consume a lot of energy during their life cycle especially where they are concentrated due to the economic values and employment opportunities they offer the citizenry, as most of the energy used by them is generated from fossil based fuels. Like the events that ignited the great depression and financial crisis that influenced changes in Europe and the international financial systems world over. The emergence of new policies on financial transactions informed that climate change issues require multilateral initiatives for effective solutions (Dormido, Garrido, L'Hotellerie-Fallois & Santillan, 2022). Climate change and its devastating effects on the environment is one of the major challenges facing the world today due to the combustion of fossil fuels and a rise in carbon emissions and greenhouse gases into the built environment most especially by buildings (Ahakwa, 2023). In the year 2015, in line with these negative indicators, United Nations confronted these strategic issues, came up with an agenda of transformation in the world development forum. This was targeted towards ensuring better access to an affordable, reliable, sustainable, and modern energy for all Goal 7(United Nations, 2015). The major concerns of policy makers were for developing and developed economies to improve and cope with climate change risks. While this was a precursor to pioneering this global trend, it has not been sufficient in addressing global climate

change issues and studies. In order to situate this work properly, this study identified the current gaps existing in the energy policy-efficiency and its strategies in order to improve the decision making process geared towards effective implementation process.

2. LITERATURE REVIEW

In a bid to combat the negative effects of climate change and its devastating effects on the environment, it was identified that, amongst others, one of the major challenges facing the world today was the combustion of fossil fuels and a rise in carbon emissions and greenhouse gases into the built environment, climate change and its devastating effects on the environment is one of the major challenges facing the world today due to the combustion of fossil fuels and a rise in carbon emissions and greenhouse gases into the built environment via buildings (Ahakwa, 2023). In line with this, it has been noted that buildings have and continue to play a major role in emitting carbon into the environment during construction, occupancy and eventual demolition thereby being major contributors towards climate change and its attendant effects on the built environment (Ahakwa, 2023). Further to these studies, United Nations estimated that half of the world's population resides in urban areas and about 70% of developing nation's population will live in urban centers by 2050. Although, African nations are not major contributors to the crisis emanated from temperature rises due to carbon emission increase in the atmosphere, but the major part of the continent are going to be drastically affected by these negative effects (Naeem, Appiah, Karim & Yarovaya, 2023). Due to these alarming predictions by researchers both locally and internationally, various African governments have taken proactive steps to focus more attention on issues relating to environmental efficiency thereby achieving environmental sustainability strategies.

More so, the construction industry which is a major emitter of carbon dioxide has been focusing on greener construction methods and the use of sustainable building materials in their quest at reducing carbon emissions to their barest minimum during the building development life (Chen, Huang, Hua, Chen, Wei, Osman, Fawzy, Rooney, Dong and Yap, 2023). Emphasis and committing to imbibing practices that mitigate against greenhouse gas emissions by agencies such as the United Nations Framework Convention on Climate Change and the International Energy Agency has helped in driving the change towards a sustainable energy bench mark worldwide which will further reduce energy related emission's (Alola, Olanipekun & Shah, 2023).

2.1. Energy Efficiency Defined

Energy efficiency connotes a deliberate endeavour which has a higher productivity and lower intensity value. It is largely about using less energy and producing and consuming goods and services while also providing economic and global benefits (Demiral & Demiral, 2023). Energy efficiency principally has a technological connotation to it but most importantly, behavioural inputs are also associated with it due to the associated conservation principles that surround the whole concept. This they further believe is the reason why technology is the aspect where better means of energy applications are selected achieving better energy efficient output levels for less energy inputs (Hussaini & Majid, 2014).

Also, energy efficiency is about engaging and using products that reduce energy necessary for providing lighting, cooling and heating of spaces; while also using less energy at providing the same essential services. As a result, policy makers have decided to establish sound policies relating to efficient use of energy in their respective clime (Oyedepo, 2012). One major contributor to ensuring energy efficiency and building studies in most developing and developed countries can be attributed to countries that practice more democratic systems of government and established government institutions. But, of little or no role have been played by the countries of no well-established government institutions, these, for some years

have found it difficult to establish strict environmental regulations on sustainability and energy efficiency (Chen, Pinar & Stengos, 2023).

2.2. Energy Issues in Nigeria, Sub-Sahara Africa

In the Nigerian Building Construction industry, imminent challenges have necessitated the need for the development of energy efficiency policies aimed at streamlining the effects of buildings on the environment. As a result, one of the major policies at achieving this vision started with the Nigerian Energy Support Program in 2013 and the major objective was to assist and support the Nigerian Government in building up a Nigerian building code which competes favorably with other best practices the world over (Geissler, Osterreicher & Macharm, 2018). The reasons for developing a building code for the tropical regions of Africa to which Nigeria belongs is as a result of adverse weather conditions in terms of the extremities of high temperatures and solar intensity which results in the use of large energy resources to power and maintain temperature differences within buildings (Akande, Fabiyi & Mark, 2015). While further studying the local environmental terrain of most *African nations*, other tools that have been employed in benchmarking energy efficiency and energy studies for infrastructural projects has been the introduction of local sustainability benchmarking processes according to Koppa, Musonda & Zulu (2023).

In order to move towards a greener development path that will reduce carbon emissions into the built environment, policy formulations and building standards that promotes adoption of sustainable building materials in the Kenyan Construction industry have identified 14 sustainability selection criteria techniques and over 20 policies that address climate change issues in Kenya (Sangori, Kitio, Thontteh & Omange, 2020). These they believe are not sufficient in influencing compliance within the Kenyan built environment space which will have adverse effects on the continents carbon emission's goals in the long run. On the other hand, in South Africa, fiscal decentralization has been observed to be an excellent policy thrust at reducing carbon dioxide emissions from buildings whereby further devolution of powers are transferred to local authorities who will formulate and implement policies that are consistent with reductions in carbon footprints of their local economies according to Udeagha & Breitenbach (2023).

Ghana which is one of the states in the region of Africa making great strides at increasing the adoption and use of energy efficient systems has succeeded in this stride by first introducing the establishment of technology transfer regulation in 1992 which also trickled down to all sectors of the country. This according to Amaoko, Andoh & Asmah (2023) was further strengthened by a second policy drive where the Ghanaian government set up the science, technology and innovation programme in 2009 which was designed for further advancements in technology applications at all sectors of the economy. This further saw an increase in research on alternative sources of energy within the Ghanaian economic drive towards energy stability. The success story in Kenya regarding renewable energy investments that have contributed greatly to its energy mix according to Isah (2019) is the introduction of pay-as-you-go (PAYGO) policy by the government in its solar home systems. This has further accelerated investments from foreign and local investors. In another study on advantages of applying smart sustainable practices in the building construction industry in Nigeria and Hong Kong Olawumi, Chan, Saka, Ekundayo & Odeh (2023) identified three leading deliverables. Among these are the simulation of building construction processes, enhancing the delivery of project quality and productivity and applications of design products that are better at attaining these common objectives that enhance low environmental impacts to the built environment. Other studies indicated that the need for energy efficiency in buildings in Nigeria can be enhanced by applying bioclimatic architectural design approaches (Ochedi & Taki, 2022). Further to this innovative design approach also referred to as an intelligent systems approach, is that arriving at applicable designs can be directed at enhancing building envelopes which improve energy efficiency and further realizing thermal and cooling targets within buildings.

Sub-Saharan Africa has for a long time been saddled with a lot of environmental and climatic factors ranging from droughts, insufficient energy availability and declining poverty. As a result, Mewenemesse &Yan (2023) suggest that policies that encourage the transition to low carbon energy supplies need to be imbibed by the respective governments within the region for the effective distribution of energy and economic growth. Clean energy sources and services are needed to provide better medical facilities in hospitals, while using them to light up schools improves the quality of education (Erhun & Johnson, 2018). While agreeing that the formation of the Economic Community of West African States (ECOWAS) in 1975 by the Treaty of Lagos marked the fostering and integration of West African states, topmost on their priority list for integration in 1993 was addressing their energy demand with particular focus on renewable energy and this was added as one of the binding agenda during the agreements signed by them. Nigeria and Mali hold very promising potentials at producing renewable energy in the continent and as a result, several plans and policies at both the national and international levels have been initiated towards making them self-sustaining and sufficient in terms of energy generation (Lohr, Matavel, Tadesse, Yazdanpanah, Sieber & Komendantova, 2022). While it is estimated that fossil based fuels in Nigeria risk the chances of depletion by 2050, Nigeria has an abundant richness in renewable energy sources like solar energy, wind and biomass thereby ranking Nigeria as 10^{th} in Africa regarding potentials of renewable energy generation which they have not effectively harnessed in addressing their energy generation problems. Ogunkan (2022) in a study on achieving a sustainable environmental governance in Nigeria suggests that even though governance has a major role to play in achieving a sustainable environment the world over, this continues to elude policy makers in the Nigerian landscape. As a result, the rights of the Nigerian to a safe and healthy environment are meaningless which was the situation in Nigeria in the post-colonial era until 1978 which saw the birth of the legal framework of the Nigerian citizen to a healthy and safe environment.

In furtherance to proffer solutions to energy policy and implementation problems, another group of countries that are currently emerging and transitioning on the path to economic growth identified as the MINT countries (Mexico, Indonesia, Nigeria and Turkey) (Akran Umar Xioli & Chen, 2022). They further identified these countries as potential emerging blocks due to their rapid economic growth due mainly again to the high populations of youths that are prevalent in these countries and secondly due to their location advantage and nearness to developed economies. These have in the best interest of Economic Growth in their respective countries are trying to transition towards clean and cheaper sources of energy. Renewable energy has become one of the cleanest and easy to use sources of energy that has been used to achieve energy efficiency worldwide most especially in the MINT countries and most especially in the United States of America and the United Kingdom based on the findings of Strielkowski, Volkova, Pushkareva & Streimikiene, (2019). Currently, Nigeria is on the part to transitioning to cleaner sources of energy in the form of renewable energies like wind mills and solar powered sources making the environment more responsible and slowly mitigating the effects of global warming on the environment (Nitte & Salahudeen, 2022). One of the major milestone and achievement of the Nigerian Government in its effort at tackling the challenges of climate change was the signing of the 2015 Paris agreement on climate change which was ratified in March 2017. Since the development of the Nigerian National Climate Change Policy and Response Strategy (NCCPRS) in 2012, new principles and practices have been domesticated in Nigeria towards reducing the impact of climate change and adaptation strategies have also been developed. The National Climate Change Policy was formulated through a national participatory process through consultations with Ministries, Departments and Agencies at the Federal, State and local government levels in order to facilitate a workable action plan in order to build up a climate resilient and sustainable nation. Nwodim (2023) identified two strategies at tackling climate change which he refers to as adaptation and mitigation strategies. Adaptation is the process of humans adjusting to the effects of climate

change and the second strategy referred to as mitigation is the process whereby actions are taken in reducing the effects of the severity of climate change.

In constituting a policy framework at addressing a salient issue such as energy efficiency and climate change as it affects societies in Sub-Saharan Africa and most especially in Nigeria, Edomah, Foulds & Jones (2016) confirm that policies and frameworks need to be drawn up by the affected countries and they further noted that policy formulations are divided into six concurrent stages, they are identified as the: (i) awareness stage, (ii) problem definition stage (iii) options identification stage (iv) selection of the desired policy stage (v) the implementation stage and (vi) evaluation stage. This they further believe will be a good template for analyzing a workable policy template in the long run. While it is intended as a workable policy formulation that will deliver the desired goal, there is usually a disconnect at various stages of this interconnectedness sufficiently not addressing the policy thrust of Government when the policies are eventually set up.

2.3. Energy Transition in Nigeria and Other Parts of Africa

Issues concerning rises in global temperatures have been current studies in the global landscape according to Mahmud, Mustapha & Mezue (2023) and Nigeria is guilty of this menace due to the issues of poor electricity supplies making its citizens cut down firewood for energy and engage in the constant use of generators which use fossil based fuels that cause harm and damage the built environment. It was suggested that Nigeria should transit to the use of renewable energy sources which will drastically reduce global warming by between 1.5^{o} C and $2\ ^{o}$ C. In another study, it was observed by the Bloomberg's Energy finance ratings globally that investments in global renewable energy transitions have increased tremendously over the last decade averaging $339 billion with wind and solar energy investments being top of the chain (Isah, 2019). Africa in positioning itself in the global efforts towards mitigating the effects of global warming has recently witnessed investments by subsidiaries of transnational corporations through the inflows of foreign direct investments due to the abundance of natural resources in the continent (Balcilar, Usman & Ike, 2023). It is further estimated that such foreign direct investments to the African continent are about $83 billion mostly in energy and $14 billion invested in the Nigerian oil and gas industry and also investing in projects in the extractive industries in Ghana, and Greenfield projects in Senegal. Despite these huge investments in the African continent by these multinational companies, there were concerns about the way their activities affect the local environments in these host countries by policy makers are due mainly to lack of enforcements of environmental laws by regulatory institutions within the domiciled countries and also due to cheaper resources and labor conditions. While Nigeria still continues to grapple with its current and future economic growth, Elum & Momodu (2017) suggest that Nigeria's energy needs will be driven by a combination of two factors namely population growth and industrialization which will greatly increase the effects of greenhouse gases on the environment. It is further suggested that Nigeria should invest more in renewable energies due to an increased need in residential and commercial buildings and investment in renewable energy it is believed will enhance a reliable and long term supply of clean energy. Further highlights have stated the fact that arising for an effective management of climate change issues, Nigeria in transitioning to clean energy provisions has embarked on changes in its policies and legislations in the countries energy space by the formulation of a robust renewable energy master plan in 2006 and the national energy policy in 2003.

Nigeria has the advantage and potential to transition to renewable energy sources because it has an abundance of these clean sources of energy and these would reduce greatly the current dependence on fossil based fuels as a means of energy generation. Strong policies by government and enforcement which have seen huge financial investments are the key catalysts that will enhance the transition to the clean energy mix that Nigeria so desires. Nigeria has the capacity to generate 3000MW of power from renewable energy by 2025 which is the equivalent of three power coal plants which Ntui (2023) believes if well harnessed will not

only address the issue of job creation but also stimulate economic growth in country where in 2018, Nigeria witnessed an investment of $5.6 billion dollars in renewable energy investments.

2.4. Energy Efficiency Mitigation Measures in Nigeria

One of the key components of mitigating against the effects of climate change and greenhouse gases emissions is advancing the inclusion of energy efficiency in the local terrain of Nigeria which suggested a very positive impact on environmental impacts around the world. Also, research highlights indicated that Nigeria just recently conducted a general election which was won by the current party in power and with each new administration, included in their policy drive are the inclusion of energy and environmental related issues topmost on their agenda (Tijani, Adeyinka & Michael, 2023). Africa and its response to climate change challenges has always been an adaptation strategy rather than mitigation which were the reason associated with the fact that the continent contributes very little to carbon dioxide emissions into the environment and due to the fact that mitigation policies like tax incentives as being practiced in developed economies are costly to implement (Eluwa & Siong, 2014). Therefore, in coming up with energy efficiency mitigation measures, especially in a country like Nigeria, behavioral approaches to energy conservation needs a greater focus rather than focusing on improving the technological aspect of energy conservation.

Other mitigation strategies that are currently being adopted in Nigeria include building energy efficiency upgrades, uses of renewable energy sources, city planning that involves the use of environmentally friendlier system of transportation and land management systems (Ayuba & Oruonye, 2023). Others include the planting of trees, deforestation of surrounding environments, reductions in the use of fossil based fuels for generating electricity, construction of water storage systems and spending more money on research and development. Currently, there are three fold strategies in addition to the aforementioned ones, these includes agroforestry with the start of the mangrove restoration in Ogoni, introduction of ten more national parks by the Nigerian government bringing the total to seventeen and finally introduction of initiatives such as planting 25 million trees (the great green wall initiative) before the expiration of the present administration. It is worthy of note that these policies have been in existence in the Nigerian terrain for quite some time.

3. METHODOLOGY

The methodology employed qualitative-content analysis on the secondary data from the reviewed literature from forty-four (n=44) relevant articles sourced from Google Scholar, Semantics, and Scopus covering the periods from 2012 to 2023. Information relevant to the key themes of the study were sourced from the secondary data base which focused on the existing energy frameworks and policy. For ethical reasons, the data was inspected thoroughly, categorized and synthesized for semantic reasons. In achieving this scientific review, the articles that were selected were those that were most relevant to the studies area of focus and these were Energy transition policies in Nigeria, Energy Efficiency in the Nigerian Built Environment, Efficiency and Implementation Strategies in the Nigerian Built Environment and Adoption and Implementation of Renewables and Clean Energy Transitions in Nigeria. The relevant literature for the study were then carefully selected through exclusion and inclusion techniques which allowed the irrelevant data to be removed in order to concentrate on the key indices of Renewable-energy, Transition, Energy-efficiency, Climate-change and Policy-implications. The findings identified the successes and failures of the programs and policies targeted at Renewable Energy and its Efficiency studies over the years. These were thoroughly evaluated to crystallize the key findings. As this study was a qualitative study and all data were analyzed by content analysis structured design. These were done in order to identify the current gaps existing in the energy policy-efficiency and its implementation strategies in the building construction sector and established strategies for implementation.

4. EVALUATION OF POLICIES FRAMEWORK ON RENEWABLE ENERGY IN NIGERIA

Renewable energy also referred to as clean energy sources by Unuigbe, Zulu & Johnson (2020) is often described as unlimited and faces several challenges towards adoption and integration into the building energy architecture due mainly to building professionals reluctance at implementing these measures in the long run. Sustainable standards targeted at buildings and building construction including codes, policies and measures taken to address Carbon Dioxide emissions thereby enhancing building energy performance around many countries have been introduced which Khozema, Ahmad & Yusup (2020) believe are strategies necessary for the future of sustainable and renewable energy studies. They further mention that under the Paris agreement and the United Nations Development Goals in 2015, Nationally Determined Standards of Carbon emissions were agreed on for decarburization of the building sector which all of the 184 nations present ratified.

As part of the way forward towards achieving this, Chinas National Development and Reform Commission started implementing several policies aimed at streamlining the carbon dioxide emissions mitigations policies while in Japan, holders of large buildings were encouraged to implement energy saving practices in their building stock. The United Nations Development Fund, the Global Environment fund, the Energy Commission of Nigeria, Nigerian Federal Ministry of Environment and the National Centre for Energy Efficiency and Conservation have jointly started a programme initiated to promoting Energy Efficiency in Nigeria as observed by Gana & Hoppe (2017). The targeted objectives of this joint effort are to promote the use of energy efficient end use appliances, to include lighting, air conditioning and refrigerating equipment's in the home appliances stock. It is hoped that this will effectively address the emissions of greenhouse gases into the environment.

It is the responsibility of Government in most countries to enact policies and legislations that encourage energy efficiency while also enforcing them (Husaini and Majid, 2015). Several policies on renewable energy take off in Nigeria which by implication will enhance energy efficiency in the Nigerian space have been developed which have seen the emergence of the (National Renewable Energy and Energy Efficiency Policy -NREEEP) which was instituted by the Ministry of Power in 2015 (Ugwu, Ojo, Oluka & Salami, 2022). The specific objectives were to enhance the development of the energy resources of the country in a diversified manner for efficient delivery and optimal energy mix enhancing national energy security and adequacy of renewable energy and equitable distribution for national development to all sectors of the economy for national development.

To further strengthen the policy while concentrating further on the lighting section of the legislation, Umoh & Bande (2021) further elaborated on the deliverables to be targeted which includes promotion of the use of energy saving appliances through a national campaign strategy while also encouraging retailers and importers of energy efficiency appliances by giving tax incentives and further encouraging local production of such appliances in the long run. Finally, there would be a total replacement of all faulty energy efficient appliances with better products by the federal, state and local government authorities and monitoring of the progress of the energy efficiency drive at all levels.

The major target of the policy thrust was to ensure that there was a generating capacity of 23,134.80 MW of electricity into the transmission Architecture from renewable energy sources like biomass, solar, hydro, and wind. As a further push towards this realization, the National Renewable Energy Action plan was set up in 2016. Ugwu et al, (2022) highlighted that other renewable energy policies of the Nigerian Government aimed at further improving the countries clean energy generation potentials are: *National Electric Power Policy (NEPP)*

(2001); National Energy Policy (NEP) (2003, 2006, 2013); National Power Sector Reform Act (EPSRA) (2005); Renewable Electricity Action Programme (REAP) (2006); Nigerian Biofuel Policy and Incentives (NBPI) (2007). In another development, Umoh & Bande (2015) in assessing the progress of the policies have highlighted the constraints as lack of political will by the superintending agencies of government having placed a lot of faith on an improvement of the existing energy generating infrastructure which have remained moribund over the years without the construction of newer ones.

4.1. The Existing Energy Policy Nigeria

The National Energy Policy of Nigeria was a coordinated and coherent energy policy which was drawn up in April 2003 by the Energy Commission of Nigeria to serve as a road map and policy document enhancing the sustainable development, utilization and supply of its energy resources towards the development of its economic activities. This was such that emphasis will be directed at promoting the use of all viable energy sources and resources within the country thereby having an optimal energy stockpile for the development of the country. The policy identifies that solar energy potentials are abundant in Nigeria but utilization levels are very low but currently being used for drying agricultural products and if harnessed will serve the purpose of the rural households and rural cottage industries in Nigeria.

The policy further highlights the importance of diversifying the energy mix of Nigeria thereby improving the energy security for the nation. The specific objectives of the policy document highlight the fundamental road map of the nation towards energy sufficiency and utilization. This the government intends to do by ensuring the development of the country's energy resources through an optimal energy mix regime while also generating the desired income from energy productive services. It is the responsibility of government to supply energy at an affordable rate to consumers while ensuring minimal harm to the built environment to the various sectors of the nation's economy. Again, government's responsibility to its citizenry is ensuring effective energy consumption patterns while encouraging indigenous participation in the energy sector and further encouraging investments by local investors in the energy sector of the economy. It is the belief of government that by developing an effective and fully functional energy architecture could foster international corporation in the energy sector in both sub Saharan Africa and internationally.

It has been highlighted that the present energy utilization and conservation in the country is far from energy efficient therefore it is imperative that every effort at improving this imbalance should be addressed and as a result, a policy section for this is highlighted in the energy policy document which includes the promotion of energy conservation measures at all levels of exploitation of the nation's energy resources thereby utilizing energy using energy efficient measures. The specific objectives regarding this are clearly spelt out from the policy document which includes the prudent exploitation of the nation's renewable energy resources and enhancing energy security and self-reliance by reducing the cost of production of energy dependent goods and services, further reducing the effects of the impact of energy on the environment and eliminating the wasteful investments in the energy supply infrastructure.
Directly linked to the objectives are three key strategies towards achieving these objectives which are firstly to establish building codes that would ensure that buildings are designed taking advantage of the climate towards enhancing energy conservation methods. Secondly is encouraging importation of more energy efficient equipment's and machinery and thirdly is the promotion of research and development within the Nigerian space in energy conservation and efficiency.

4.2. National Renewable Energy Action Plans (2015-2030)

In developing the action plan on Renewable Energy, it is noteworthy that it was initially designed by the ECOWAS center for renewable energy and energy efficiency (ECREEE) and supported by various development partners both nationally and internationally. It is not gainsaying that Nigeria has been blessed with an abundance of renewable energy sources and as a result, it needs to radically increase its use of these resources. It is believed that Nigeria is aware of the threats it faces as a result of climate change and as such it needs to apply all forms of techniques at decarbonizing the built environment. Nigeria also by this action plan intends to play its part regionally at stemming the release of greenhouse gases into the environment. The overall objective of the action plan is to develop and advance policies that will promote its use and production of renewable energy and technologies. As part of the action plan, the section on building legislation highlights the current steps being taken by the government at developing a new building code involving all stakeholders in the building design and construction set up. As part of its efforts at enhancing the use of renewable energy sources, the National Electricity Regulatory Commission has introduced feed in tariffs for renewable energy generation as incentives for cleaner energy generating sources.

4.3. National Renewable Energy and Energy Efficiency Policy

The National Renewable Energy and Energy Efficiency Policy (NREEEP) policy was promulgated and approved by the Federal Executive Council in 2015 for the deployment of the nation's renewable energy and energy efficiency technologies towards leading the nation into the Nigerian Green Transition program. Previous policies and programs targeted at the energy sector had been limited in their scope regarding renewable energy and energy efficiency. The policy focus is on Biomass, hydro power, solar, wind, biomass, wave and tidal energy and energy efficiency. Topmost on the policies agenda is a framework on clean energy access and the specific objectives are diversification of the country's energy mix and achieving energy security and efficient energy delivery. Evidently, it is the intention of Government to accelerate the diffusion of technology into the renewable energy and energy efficiency sector and also establishing appropriate financial mechanisms which support private investment in the renewable energy and energy efficiency subsectors. One of the key energy efficiency targets of the policy is to improve on energy efficiency practices beyond the year 2030. Part of Governments incentives towards attaining this are incentives to local manufacturers of energy storage technologies, introduction of public benefit funds and capital grants and tax holidays and exemptions for renewable energy projects as a way forward towards attainment of the policy set up.

4.4. Renewable Energy Masterplan (REMP)

Eze (2023) in summarizing the renewable energy master plan points out that this policy is specific to renewable energy and was drawn up in 2005. The nation's vision regarding renewable energy is specifically spelt out in the master plan and its importance in attaining sustainable development. Its main focus is on the need to explore renewable energy which will further boost the countries energy production for its local consumptions in industry and infrastructural development. The main strategies to be employed in achieving this are encouraging investments in solar energy, biomass and wind were set up by the policy including other issues peculiar to the use and production of renewable energy. Issues surrounding policy formulations, legal and institutional frameworks were highlighted and renewable energy portfolios were addressed.

4.5. Barriers to renewable energy production in Nigeria

In a study on the strategic processes in planning grid based renewable energy development in Nigeria, it identified several barriers acting against the transition to renewable energy as a

source of clean energy in the country (Adedokun, Strachan & Singh, (023).The barriers can be categorized into eleven interrelated consequences with the first being a lack of continuation of policy and regulatory frameworks which have been introduced over the years arising from policy somersaults that have not been well thought out. Also, socio cultural factors could also act as barriers due to the high incidences of kidnappings within the country and a lack of trust on the part of stakeholders regarding the benefits to be associated with implementation. Other factors which they refer to as economic factors stem from the huge debt burden of the federal government which has not made it possible for government to further invest in the energy sector. Arising from a political point of view, the most troubling factor is as a result of massive corruption in government agencies whereby funds allocated to provision of clean energy sources are diverted to personal use by government officials. They further have alluded to the fact that another major barrier is market related where government have not enforced trade tariffs that encourage importation and local production of renewable energy technologies. Institutional factors arising from this are lack of encouragement of new entrants into the system by already established players in the renewable energy sector which has caused unforeseen stagnation in the energy sector. Financial barriers also exist whereby there are drawbacks in investment targeted at research and development in the energy sector while legal factors arise from lack of enforcement of legal frameworks by the superintending authorities in the energy sector. It is also noteworthy that bureaucratic factors play a very important role in lack of implementation of renewable energy with the energy sector of the economy while a lack of technological knowhow on the part of local manufacturers and energy players has stagnated the industry further. Finally, there is a decay in the infrastructural architecture of the energy sector within Nigeria and this makes it impossible for any new developments to take place. Arising from a total decay of the grid infrastructure to obsolete facilities, metering and transmission challenges still exist in the energy sector of Nigeria.

While there is an abundance of renewable energy sources in Nigeria, Abdullahi, Renukappa, Suresh & Oloke (2022) identified several barriers to their implementation which they have categorized into several key areas. Arising from this study is the identification of technological barriers where there is a lack of technical capacity on the part of stakeholders engaging in renewable energy adoption, lack of research and development investments for driving adoption and lack of standard and quality control. The second category from the study arises from financial incapacity on the part of potential investors arising from a lack of incentives to encouraging such moves. The third category according to the authors arises from political barriers from which arose three categories namely policy and institutional hindrances, a lack of political will and legislative issues and also legal and regulatory issues. Other barriers identified were social barriers with two key components attached to this namely the socio cultural perception of the various ethnic groups that make up the Nigerian space and lack of awareness campaigns on the part of promoters of renewable energy adoption. The drive for the use of renewable energy as a source of clean energy production has gained momentum worldwide. This Payel, Ahmad, Anam, & Siraj (2023) should be the major policy thrust of emerging economies but this has been hindered by several contending factors. These factors which they have identified from literature were thirteen which they listed as a lack of technical expertise, wastage of excess energy generated, finance limitations, paucity in standardization and bottlenecks in policy and regulations. The most fundamental of all the barriers is a lack of adequate land to situate the solar farms for large scale projects while not also excluding limitations to education and training. Research and development capacity the authors observed was lacking in the main stream solar energy mix and a lack of awareness about solar energy. Transitions in governments also play a very key barrier since governments are not stable which usually lead to high upfront costs on the part of investors. Finally, the authors further identified a lack of energy transmission infrastructure and limitations in grid connectivity and capacity as mitigating barriers.

5. DISCUSSIONS

Climate change and its effects on the built environment have grave consequence's the world over and this has arisen as a result of the use of fossil based fuels as sources of generating energy for households, industries and infrastructure. Nigeria which has been experiencing growth in its economy since the early 2000 has witnessed an increase in population and huge consumption levels of electricity. Nitte and Salahudeen (2023) estimated that the total energy generated by the GENCOs in 2021 in Nigeria was 36,397.92 (GWh) while 35,654.43 (GWh) was actually transmitted according to the National Bureau of Statistics. This falls below the current energy generation required by the country which sees huge releases of greenhouse gases from these sources of energy generation. Alternative sources of energy generation and transmission which produce cleaner and cheaper sources of energy in the form of renewable energy needs to be developed and implemented by policy stakeholders within the country. Due to its initial start-up costs, there is a reluctance on the part of government and investors to start up but in the long run, benefits associated with clean energy generation are associated with great advantages for the immediate ecosystem and the global built environment.

In their study on renewable energy and research and development, Li, Zhang, Alamri, Ageli & Khan (2023) highlight the importance of renewable energy and research and development since this promotes attainments of sustainable developments within the country and recommends the efficient utilization of natural resources. Umeji, Agu,Eleanya, Chinedum, Nwabugwu & Mbadiwe (2023) on the other hand studying the impact of renewable energy on the economic development of Nigeria recommended that renewable energy would enhance economic growth in Nigeria and suggests that governments at all levels should encourage investments in renewable energy and clean energy provision. In addition, creating awareness on the use of renewable energy will also encourage transition to renewable energy use.

From the stand point of health and environmental hazards associated with fossil fuels, Adamu, Enejoh, Haruna, Akubo & Jibrin (2023) believe that using renewable energy reduces greatly the health impacts of citizens most especially women and the girl child apart from greatly meeting the energy needs of Nigeria. Another study reiterated that the energy situation in Nigeria is currently in deep crisis and; suggested that categorizing various sources of energy generation in the country and discretely formulating separate frameworks for each could be an amicable solution. This method has great potentials for the country because currently, all existing policy and frameworks are skewed towards favoring only one source of energy and excluding other sources of energy generation (Eze, 2023).

6. CONCLUSION

This study established that, discussions on renewable energy use, and the associated climatic advantages related to this source of clean energy are sacrosanct and important in the current body of research. Current policy and frameworks that have aided in promoting its emergence have metamorphosed over the years, but there has been a very slow transition to its use due to factors associated with *finance, collapse of the grid infrastructure and a lack of unwillingness on the part of investors to implement adoption*. In order to promote adoption of renewable energy, adoption policies and other sources of energy generation should be enhanced. It is also suggested that governments at all levels should *enact laws and policies that will give them power to draw up laws for their local environments;* instead of the current situation whereby all the affairs of energy generation were overcentralized. Again, with the advent of a new democratic government in Nigeria, it has been approved that the state governments, private individuals, and local investors have been asked to optimize the windows of investments targeted at energy transmission and distribution. To effect this, the investors are to be given incentive in the form of tax reductions. This is geared towards encouraging investments in the renewable energy generation sector. It is worthy of note that the long term environmental

advantages far outweigh the current status quo of generating energy through fossil based sources.

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