**CLEAN ENERGY, ECONOMIC DEVELOPMENT AND THE DISTORTIONS IN NIGERIA’S PETROLEUM INDUSTRY**

**ABSTRACT**

Since energy is essential for both socioeconomic growth and the eradication of poverty, obtaining clean and contemporary energy services is a major challenge facing the African continent especially Nigeria. Currently, between 65% and 75% of Nigerians lack access to electricity. Unless the government diversifies energy sources in the residential, commercial, and industrial sectors and implements new technologies to cut down on energy waste and save money, Nigeria's current energy crisis is certain to continue. This paper examined clean energy and the distortions in Nigeria’s petroleum industry. This paper also examined the availability and spread of these resources, determining that biomass and solar energy were the most widely accessible renewable energy sources on a national level utilizing the qualitative method. Regulatory and legislative barriers, insufficient financial investment, infrastructure constraints, and inefficient grid integration were among the problems that were found. The results of this study revealed that Nigeria should integrate proceeds from petroleum industries to efficiently harness and use its abundant renewable resources in joint public-private collaboration.

**JEL Codes:** Q42, Q43, Q44, P18, P48

**Keywords:** Energy, clean energy, economic growth, Africa, Nigeria.

**1. Introduction and Background**

Energy plays a big role in the running of any economy of any nation. You tend to see, for example, that a nation with the highest per capita energy consumption generally represents a country with high standard of living. Two factors are to blame for the current global energy crisis: the world's population is growing at an accelerated rate, and entire societies' standards of living are rising (Ohunakin, 2020). Per capita energy consumption is both a measure of national prosperity and per capita income. Any country without energy is practically equivalent to a dead body. It has no economic momentum, it cannot move, and it cannot progress economically nor does it have security. Today every nation start having a concern for uninterrupted energy supply that made sufficient plant to transit to clean energy as alternative (Etiosa, 2016).

The cheapest, ecological friendly source of long term supply of energy is required to access energy for future long term economic growth. Energy impacts public health, security and the climate change. Energy thus provides basic necessities such as: cooked food, a comfortable temperature for living, lighting, use of appliances, piped water or sewerage, vital health care (refrigerated vaccinations, emergency, and intensive care), educational tools, communication (radio, television, email, Internet) and transportation (Dayo, 2018). According to Iwayemi (2017), reducing energy and poverty are similarly associated relationally with socioeconomic development, concretely, productivity, income growth, education and health. On the other hand, energy scarcity tends to result in destitution and poverty and threaten economic progress. Productive industries like agriculture, commerce, manufacturing, business and mining are all fuelled by energy.

Haven’t said that, we know that Nigeria is blessed with crude oil which is the mother source of petroleum, bitumen, gas, kerosene and others. However, Nigeria has failed to utilize the proceeds from its petroleum industry promote the energy situation of the country. It is evident that quantifiable investment from the petroleum industry previously irrespective of how distorted it is currently would have yielded a significant result and probably bettered Nigeria situation, “this could be mere assumption by the author”. It is on this note that this paper has focused on investigating the impact of clean energy and how it impacts the Nigeria economic growth with the current distortions in the Nigeria petroleum industry.

**2. The problem**

Nigeria is a country with Natural gas, crude oil, renewable energy sources from wind, solar and hydropower. In 1956, oil discovery has been significantly playing a major role in affecting the nation's economy and development (Aderemi et al., 2022). Nigeria has a daily production capacity of about 2 million barrels; Nigeria is currently the sixth-biggest crude oil producer in the world and the largest in Africa. The petroleum sector has historically supported Nigeria’s economy: over 90% of Nigeria’s export revenue and a comparatively sizeable part of its GDP (Trotter, 2016). Nonetheless, Nigeria has abundant energy resources which have, however, been bedevilled by several of the petroleum industry’s inefficiencies which have handicapped the ability of the nation to utilize the same to effectively develop the economy sustainably.

Among other problems, these distortions have shown up as corruption, poor management, inconsistent policies, and a lack of investment (Steurer, Manatsgruber, Jouégo 2016). Using Nigeria's experience as a case study, this paper looks at the main distortions in the petroleum business and their effects. The paper addresses the ramifications for energy security, economic growth, and the nation's overall development while revealing the underlying processes that have contributed to these distortions. The policy implications for addressing the issues raised in this paper, as well as the full potential of the Nigerian energy industry, are outlined in this paper.

**a. Conceptualization**



**Figure 1:** Energy consumption by Nigeria and peer countries.

**Source:** IEA (International Energy Agency)

The Figure above shows that Nigeria is in a distant low of Energy consumption percentage when compared to countries like Bangladesh, Brazil, Indonesia and South Africa. This countries where peer reviewed with Nigeria because they were at par with Nigeria in the 1960/70s, in-fact it could be said that Nigeria was better when compared with these same countries back then in terms of electricity consumption (Oyedepo et al., 2019). However, you see how Nigeria energy crisis has worsened from the figure analysis. In transport, industrial and other energy consumption activities Nigeria is the lowest as depicted above.

**Table 1: Energy Sources in Nigeria (2023)**

|  |  |
| --- | --- |
| Energy Source  | Percentage of Total Energy Mix |
| Natural Gas  | 60% |
| Oil | 30% |
| Renewable Energy | 10% |
| Coal  | 0% |

**Source:** Mas’ud et al. (2023)

Table 1 reviewed energy viability of Nigeria, the natural gas as a source of clean energy which account for over 60% of the total energy resources in Nigeria. Nigeria can exploit this raw materials to properly maximize the great energy potentials in the country. The oil shows that it is fast dwindling with 30% while the renewable energy is at its lowest with a value of 10% while coal is yet to be harnessed at all. This is saddening that Nigeria is still at the rudimentary level of exploring renewable energy despite the high natural gas content which it has as a natural resources. Nigeria can actually convert this natural resources from gas to create renewable energy that will serve the country adequately to create alternative energy like solar.



**Figure 2: Electricity demand projection in Nigeria**

**Source:** Renewable Energy Cooperation Programme (2018)

Figure 2 reveals the project energy (electricity) demand in Nigeria from 2010 to 2035. It further showed the grid and off grid demand. Nigeria's expected electricity demand is expected to increase significantly, especially between 2010 and 2025. However, to meet this demand it would require massive investments in generation capacity as well as infrastructure and renewable energy sources, and would secure sustainability and reliability.

The United Nations Economic Commission for Africa (2012), due to their region’s more than 18% annual energy demand, a mere need for a very energy mix to fully exploit the use of renewable and clean energy in Nigeria, the country is overly relying on fossil fuels to supply energy needs (Oyedepo et al., 2019). They noted that few households, many of which are located in urban areas in Nigeria use solar energy sources. Osunmuyiwa & Kalfagianni (2017), suggested that renewable sources like the sun (photovoltaic and solar thermal), hydro, and wind fuel can be optimized for Nigeria consumer demand. Popoola and Magidimisha (2019) noted that South Africa, Egypt, and Nigeria are the main energy users in Africa citing that with abundant solar radiation in Nigeria which limits its use to some politically motivated “streetlight show-off projects." There is need for Nigeria to harness her energy resources which is in abundance to solve her endemic energy crisis that have lingered for decades since independent (Donwa, Mgbame, & Julius, 2015).

The petroleum business in Nigeria has been found blocked by corruption in the numerous studies and investigations in the sector's transparency, nepotism and financial misappropriation (Aliyu, Modu and Tan, 2018). Many corruption scandals have surrounded the state owned Nigerian National Petroleum Corporation (NNPC) which is accused of mismanaging finances and failing to declare oil income and siphon money. The government has suffered large income losses as a result, and the industry's capacity to fund important infrastructure and development initiatives has been weakened (Trotter, 2016). Like other parts of the government sector in Nigeria, the Nigeria petroleum sector has suffered from a lack of continuity in policy, with periodic adjustments to laws, levies and pricing schemes. Because this has produced an uncertain and unclear climate for investors, investment in the area has been discouraged and needed investment discouraged because of the unclear and unpredictable climate this has produced for investors. As an example, the long delayed Petroleum Industry Bill (PIB) to modernize the industry's legal and regulatory structure has been a source of uncertainty and discouraged investment in the field.’

Significantly less investment has also resulted from the distortions in Nigeria's petroleum industry, especially in the downstream sector. Because of inadequate maintenance, a lack of capital, and the pervasiveness of fuel subsidies, the nation's refineries have been running at a fraction of their full potential. As a result, the nation now heavily depends on imported refined petroleum products, exacerbating industry distortions and adding to the nation's energy instability. The impacts from the activities of the petroleum industry in Nigeria, most especially in the Niger Delta, have been very intense to the environment, with cases of massive pollution, ecosystem destruction from gas flaring and oil spills. As a result, the local communities have lost their means of subsistence, suffered health problems, and was uprooted because of environmental harm.

The Nigerian petroleum industry has greatly distorted the country’s overall development, economic growth and energy security. The reliance on imported refined petroleum products, and paucity of funds invested in the downstream sector has debilitated Nigeria's energy security, leaving the country vulnerable to disruptions in the global price and supply chain. Essentially, all this has inhibited the growth of the economy and activity by essentially driving up the cost and accessibility of energy to homes and businesses alike. The imbalances in Nigeria’s petroleum industry have also undermined the country’s economic growth. The oil sector is very much the basis of the economy and is, therefore, subject to the changes in the price of global oil. It is a product of mess up oil income as is such like other lucrative industries. All this has exacerbated the country’s economic stagnation, high rates of unemployment and poverty. It has also acted for the nation in the sustainable development, since it has contributed to the environmental degradation to the petroleum industry active. Harm to the ecology and uprooting of the local communities have destroyed livelihoods and general wellbeing of populace impacted by development and secondary problems further mounted (Trotter, 2016).

**Knowledge gap:** There is more research focus in the area of energy consumption in Nigeria; there is little attention given to clean energy and the distortions in Nigeria’s petroleum industry, no author have specifically and empirically analysed both sector in a single article, although there are a lot of related research work but differs in areas of focus. Furthermore, since clean energy and renewable energy are same, it is important to also say that there is less focus on the area of renewable energy just like the clean energy. This two type of energy have nexus between them and can change the energy available of Nigeria as a nation and help her maximise its abundance natural resources in both clean energy and renewable energy in relation to the distortions in the petroleum industry in Nigeria.

**3. Research Method**

This paper used a mixed-methods design. The secondary data came from books and materials previously published and interviews which were the primary data. The process entails mapping out the nation's possible sources of clean and renewable energy and the distortions it has caused in the Nigeria petroleum industry through a thematic analysis. When examining the possibility of optimizing clean energy to alleviate the nation's energy problems, the geopolitical positioning of Nigeria was taken into account. To learn more about the nation's experience with clean and renewable energy, a thematic literature review was included. Twenty (30) conveniently sampled stakeholders were interviewed about the availability of clean energy in Nigeria, the obstacles to its maximum use in their community, and their perceptions of its accessibility nationwide as seen in table (Table 1). The responses from the interviewees were transcribed, and thematic analysis was used for analysis. Secondary data from the Nigerian Bureau of Statistics was used to map and evaluate the availability of electricity throughout the nation.

**Table 2: Sampled research respondents interviewed**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S/N | Occupation | Sample size | Geopolitical zone | Interest in research area |
| 1. | Business | 2 | South - East  | Interested  |
| 2 | Lecturer | 2 | South - South | Interested |
| 3 | Teacher | 2 | North East | Interested |
| 4. | Farmer | 2 | South West | Interested |
| 5 | Driver | 2 | North West | Interested |
| 6 | Professional Pilot | 2 | Middle belt  | Interested |
| 7 | Lecturer | 2 | South East | Interested |
| 8 | Lecturer | 2  | North Central | Interested |
| 9 | NUC member | 1 | North East | Interested |
| 10 | ASUU member | 1 | South West | Interested |
| 11 | Labourer | 1 | South East | Interested |
| 12 | Barber | 1 | South - South | Interested |
| 13 | Hair Dresser | 1 | Middle belt | Interested |
| 14 | Shoe maker | 1 | North Central | Interested |
| 15 | Okada rider | 1 | North East | Interested |
| 16 | Akara woman | 1 | South - South | Interested |
| 17 | Business | 2 | South East | Interested |
| 18 | Lecturer | 2 | North West | Interested |
| 19 | Teacher | 2 | Middle belt | Interested |
| 20 | Barber | 1 | South East | Interested |
| 21 | Hair Dresser | 1 | South - South  | Interested |
| 22 | Shoe maker | 1 | South West | Interested |
| 23 | Okada rider | 1 | South East | Interested |
| 24 | Akara woman | 1 | South – South | Interested |
| 25 | Farmer | 1 | Middle best | Interested |
| 26 | Driver | 1 | South - East | Interested |
| 27 | Professional Pilot | 2 | South - South | Interested |
| 28 | Lecturer | 2 | North East | Interested |
| 29 | Lecturer | 2 | South East | Interested |
| 30 | Driver  | 1 | South West | Interested |

**Source:** Author’s compilation from interviewed participants from Nigeria’s geopolitical regions (2024)

**4. Results**

The responders to the interview describe a mixed experience with Nigeria's energy situation. In response to domestic circumstances, it was determined that Nigeria's energy status lacked sufficient legislation and investments in the creation of energy resources. In Nigeria, the energy sector produces very little of what is needed for daily consumption in the country, so many other industries equally depend on energy production to thrive, and they include power, industry and transportation. It has been stated that Nigeria's severe energy shortage has multiple causes because it is so much less than the country's average demand. According to Participant 10, this complex shortfall is caused by structural, political, and financial factors, none of which are exclusive of the other. After analysing the shortage and its geographic location, it was determined that the impoverished people living in metropolitan areas and remote rural areas—or, as Participant 5 put it, "the masses" are the groups most impacted by the lack of energy.

According to participant 3, there is "general knowledge that the energy situation in Nigeria is appalling." Although the chain of production and delivery of energy has improved in many ways, it is nearly difficult for these advancements to be sustained. This paper findings is going to solve the problem and have a 'seem positive' energy production going forward. According to data from the Nigeria Bureau of Statistics (2015) and shown in Fig. 1, the country's degree of access to clean energy is decreasing, with the northern region of Nigeria having the lowest level of availability. According to participant 8, the region with the highest documented access to power is the Western section of the Nigeria. It reiterates that the 'welfarist approach' of the government to the exercise of the mechanism of generation and consumption of energy does not capture the wide spread energy porosity in Nigeria. This method's consistent features include significant energy and electricity subsidies, as well as adjustments to pricing and costing structures.

The opinions of stakeholders, including the former governor of the Central Bank of Nigeria, the Nigerian Employers’ Consultative Association, the Chartered Institute of Bankers of Nigeria, the Corporate Affairs Director, the Manufacturers Association of Nigeria, the Center for Social Justice and other academics, were reported by (Awoyinfa 2019). However, it was believed that it was unfeasible and unsustainable to implement fuel and electricity subsidies when the cost implications-calculations were thought to penetrate the nation's debt profile. Edomah, (2016) stated that the only way to address the variance in power distribution, generation, and consumption is to eliminate the subsidy completely, albeit gradually. This argument supports the opinions of those who said that the nation's subpar energy situation was caused by subsidies. Also, Brattberg (2020) stated that "Nigeria is experiencing a quiet energy crisis, with only 10% of homes using renewable energy technology and sources for cooking”.

The purpose of the study was to find out how the respondents, who were conveniently sampled, understood what clean energy meant. Based on typology, minimal or no waste, the ability to not release CO2, and the source of generation from natural sources, the replies show four primary theme. The comments say clean energy is a pollution free, non-greenhouse gas emitting source of energy from resources such as sunshine, wind or hydro. It is also environmentally benign. The study after providing a broad overview of respondents' knowledge of clean energy, it tried to assess the nation's availability to clean energy. According to the evidence, accessibility which is rated as poor to clean energy is still restricted because of the high cost of installation (Participant 2), which is made worse by low- or under-efficient facilities (Participant 6), a lack of providers (Participant 9), the fact that it is capital-intensive, low- and under-awareness (Participant 7), and weak purchasing power (Participant 10).

According to Participant 11, the reasons for which one might lack access to clean energy could be brought to bear in providing an answer on why such is not possible for Nigerians, stressing that since the Mobile Telecommunication Network MTN, Solar (Yellow Box) and Novel Ltd have readily available solutions of clean energy options at fairly low prices, Nigerians should have easy access to clean energy. Hence, it was been determined that using clean energy has positive long-term financial effects. According to Participant 13, 'True green energy is too expensive to set up', emphasizing that government and private sector must invest hugely into clean energy to make it affordable to the average people. According to the interviewee, the concept of "true-green energy" was developed based on installation experiences from less technically skilled businesses over a long period of time.

While participant 17 noted that occasionally, clean energy facility develops a problem before its anticipated warranty expires. On a similar view, Participant 7, clarified that most households and individuals pay the full cost of additional devices like batteries, solar panels, and cables because the installation is not subsidized. But participant 20 was quick to say that installation technicians frequently purchase inferior materials, which renders the installed clean energy unsustainable. Furthermore, participant 22 and 21 explained why Nigerian society is becoming more exposed to renewable energy usage, they stated that it is just a small number of people that have access to energy. Participant 24 said that the Nigerian people do not have access to good energy and that 99.9 percent of the country's energy use is harmful for the environment because of carbon monoxide.

According to Participant 23, carbon monoxide emissions in transportation, from crude oil production, and from cooking were harmful to the environment. Participant 27 highlighted the importance of energy diversification among Nigerians. Despite increased reliance on solar energy over the past three years, fuel and diesel generators, known as "I am better than my neighbour," are still primarily used as alternatives to the national grid, resulting in carbon emissions and noise. In Nigeria, Oyedepo et al (2019) indicate the unviability of alternative energy sources (generators), because of high energy demand gaps, poor generation capacity from conventional power sources, and dilapidated electricity infrastructure, especially in rural areas. According to the study, increasing renewable energy is crucial for industrialization and economic sustainability.

According to participant 29, Nigeria is blessed with an abundance of renewable energy resources, but the nation nevertheless faces several energy-related problems. Nanki et al. (2010) and Bamisile et al. (2017) supports participant 29 conclusions. Nanki et al. (2010) and Bamisile et al. (2017) stated that utilizing renewable energy to its fullest potential would significantly lessen the nation's current state of energy “poverty". Participant 30 however noted that the four primary categories of renewable energy resources in Nigeria are biomass/biogas, wind, hydropower, and solar energy, the participant noted that there is no denying the potential for these energy sources to be optimized, the amount of energy produced by them varies over time.

Nigeria is blessed with good renewable energy resources, and participant 1 noted that that the nation is also plagued with some energy related problems as a result of how the country mismanages these natural resources. Participant 18 agreed with the view of participant 1 added that the situation will change for Nigeria energy sector when the country begins to invest into the clean energy. The participant 12 stated that the four primary categories of renewable energy resources in Nigeria includes biomass/biogas, wind, hydropower, and solar energy, participant 12 went ahead to state that Nigeria has failed to utilize this listed energy resources. Participant 14 emphasized that although there is no denying the potential for these energy sources in Nigeria, the participant however noted that the lack of optimization and feasible planning has sabotaged Nigeria energy resources. Participant 15 lamented that the amount of clean energy that would have accessed/produced by Nigeria naturally endowed energy resources would have been enough to serve the entire national.

Participant 26 noted that solar energy is supposed to be Nigeria’s first source of energy, considering the favourable climates that the Nation enjoys. Participant 28 went further to buttress the importance of the clean energy as produced by the sun in Nigeria, criticising its lack of exploitation of this energy resources by Nigeria. Participant 19 did say that Nigeria is located inside a high sunlight belt which any reasonable country should utilize efficiently to position its energy sector as one of the best in the world. In all of this analysis Nanki et al. (2010) and Bamisile et al. (2017) averred that utilizing renewable energy to its fullest potential would significantly lessen Nigeria’s current state of energy poverty and clean energy distortions in petroleum industry. The globe is displacing oil. Nigeria would be left behind as a fossil fuel mausoleum to the dreams of a once-great industry if it does not take action. Rhetoric has served its purpose. Nigeria's economy might collapse and have long-term effects if it doesn't address its energy crisis to replace its fast fading oil riches (Trotter, 2016).

**4. Conclusion and Recommendation**

This paper looked at sustainable energy and the corruption in Nigeria's oil sector, its aims to delve deeper into the utilization of renewable energy resources, energy efficiency strategies, and the implementation of energy conservation measures across many industries, including transportation, residential, commercial, and industrial building development was to find out the true cause of energy crisis in Nigeria. The availability and distribution of these resources were also looked at in this study, and it was found that the most generally available renewable energy sources in the country were solar energy and biomass. Nigeria's energy distortions remain one of the worst in Sub-Saharan Africa. This is visible in Nigeria's electricity situation. When it comes to energy availability, many homes continue to be underserved, according to public perception.

While the country's energy status is considered below average, the research found that Nigeria's energy situation remained intermittent, with variations in states' access to power infrastructure. The difference in power access between states can be attributed to accessible energy resources and location (urban, capital city, historic capacity for administration, and proximity to power generation sites). In terms of location, the country's northern area continues to be substantially underserved by power infrastructure. The expression of research information on the state of accessibility to clean energy remains limited to neighbourhood and circulation lighting and water infrastructure (mostly SDG water-related initiatives in remote regions and health institutions). The study's findings indicate that there is a need for additional investment in raising awareness of the country's availability to renewable energy.

The importance of energy governance in exploring the decentralized nature of Nigerian communities away from the national grid in order to maximize the location of particular clean energy resources must be investigated and implemented. It is believed that by maximizing "place-specific clean energy resources," the goal of removing the urban-urban or South-Western and Northern energy disparity can be met. Based on the interview results, it is determined that achieving this will require the implementation of energy policies that reduce clean energy purchase and maintenance costs while also increasing public awareness of the opportunities available for households, settlements, and sectoral activities to use clean energy at a subsidized local level in all of their households or small-scale businesses.

This paper observed a number of petroleum industry distortions, including as corruption, subsidies, poor infrastructure, environmental concerns, erratic policies, and low public participation, impede Nigeria's shift to clean energy. This paper emphasizes strong that in order to promote a sustainable energy future that places equal emphasis on economic growth and environmental health, it is imperative that these issues be addressed.

**REFERENCES**

Aliyu A, Modu B, Tan C., (2018). A review of renewable energy development in Africa: a focus in South Africa, Egypt and Nigeria. Renew Sustain Energy Rev 81:2502–2518.

Aderemi, T. A., Alejo, A., Omoyele, O. S., Olaoye, O. P., Olanipekun, W. D., & Azuh, D. E. (2022). An Econometric Analysis of Clean Energy Supply and Industrial Development in Nigeria: Implications for Sustainable Development. *International Journal of Energy Economics and Policy*, 12(3), 209–215. <https://doi.org/10.32479/ijeep.13109>.

Awoyinfa S, Popoola N, Onuba I, Okon A (2019). NECA, CIBN, MAN, others back Sanusi’s call for fuel subsidy removal. Available at: <https://punchng.com/neca-cibn-man-others-backsanusis-> call-for-fuel-subsidy-removal/. Accessed 4 July 2024.

Bamisile O, Dagbasi M, Babatunde A, Ayodele O, (2017). A review of renewable energy potential in Nigeria; solar power development over the years. Eng Appl Sci Res 4(4):242–248.

Brattberg, E. (2020). Reinventing Transatlantic Relations on Climate, Democracy, and Technology. Working Paper. Carnegie Endowment for International Peace. Heinrich Boll Stiftung, Washington DC.

Dayo F. B., (2018). Clean Energy Investment in Nigeria The domestic context. International Institute for Sustainable Development (IISD).

Donwa, P. A., Mgbame, C. O., & Julius, O. M. (2015). The effect of oil price volatility on the economic growth in Nigeria. *Journal of Accounting and Taxation*, 7(3), 53-62.

Etiosa U., (2016). Energy Efficiency Survey in Nigeria: A Guide for Developing Policy and Legislation. International, Rivers, pp 1–37.

Eleri E, Ugwu O, Onuvae P (2012). Expanding access to pro-poor energy services in Nigeria. Abuja, Nigeria: International Centre for Energy, Environment & Development Energy sage. 2019. Solar energy: what you need to know. https://www.energysage.com/solar/. Accessed 13 July 2024.

Edomah, N. (2016). On the path to sustainability: Key issues on Nigeria’s sustainable energy development. Energy Reports 2 (2016) 28–34.

Famuyide O. O, Anamayi S. E, Usman J. M: (2011). Energy Resources’ Pricing Policy and Its Implications on Forestry and Environmental Policy Implementation in Nigeria. Continental Sustainable Development 2011, 2: 1–7.

Iwayemi, A., (2017). Nigeria's dual energy problems: Policy issues and challenges. Int. Association. Energy Econ., 53: 17-21.

Ohunakin O.S., (2020). Energy utilization and renewable energy sources in Nigeria. Journal of Engineering and Applied Sciences 5(2):171–7.

Osunmuyiwa O., Kalfagianni A., (2017). Transitions in unlikely places: exploring the conditions for renewable energy adoption in Nigeria. Environ Innov. Soc. Trans 22:26–40.

Oyedepo S, Dunmade I, Adekeye T, Attabo A, Olawole O, Babalola P, Oyebanji J, Udo M, Kilanko O, Leramo RO (2019). Bioenergy technology development in Nigeria - pathway to sustainable energy development. Int. J. Environ Sustain Dev 18(2):175–205.

Steurer E, Manatsgruber D, Jouégo E (2016). Risk clustering as a finance concept for rural electrification in Sub-Saharan Africa to attract international private investors. Energy Procedia 93:183–190.

Trotter P., (2016). Rural electrification, electrification inequality and democratic institutions in sub-Saharan Africa. Energy Sustain Dev 34:111–129.

Popoola A. A, Magidimisha HH (2019). Rural energy condition in Oyo state: present and future perspectives to the untapped resources. Int J. Energy Econ Policy 9(5):1–14.