

Renewable energy as circular option: Climate change mitigation in Nigeria energy Sector.

A. Malah Umar, George Nosa Osaghae, H.Ahidjo
Energy Commission of Nigeria
Plot 701C, Central Area Abuja, Nigeria
Corresponding email: amumar99@gmail.com

Abstract: Energy is the engine room that drives the economy of any nation. Nigeria as a nation is blessed with abundant deposit of this energy resources; these include reserves of crude oil, natural gas, coal, tar sands and renewable energy resources such as hydro, fuel wood, solar, wind and biomass. Despite these potential huge energy resources, the nation faces huge challenges meeting its energy demand thereby stalling the economic well-being and social infrastructures in raising the living standard of its citizenry. Nigeria is a Mono-economy with mainstay predominantly from oil whose exploitation has gradually given rise to environmental degradation contributing to global climate change phenomenon.

This paper elucidates the views of Nigerians on the available energy options as they directly affect climate change, which is the defining human development challenge of the 21st century. Analytical model approach was adopted in the survey which involved the administration of questionnaires in the nation's capital, (FCT) Abuja as pilot to be replicated in the six geopolitical zones of the country in future, the responses (feedback) indicated that there is a crucial need to expedite action in diversifying the national energy mix and exploring more environmental friendly sources to mitigate power crisis and climate change.

Keywords: Energy Options, Climate Change, Greenhouse Gas Emission, Power Sources, Nigeria

1.0 Introduction

A necessary factor in fostering human development and economic growth is a secure, affordable, reliable, clean, and sustainable energy supply. Since the discovery of crude oil in Nigeria, a proven reserve estimate of about 37 billion barrels (NEP 2013) which dates back to 1956, with Commercial production starting in 1958, the nation had clearly over depended on it for its foreign exchange, which currently contributes about 80% (NEP 2013). She recorded oil production in December 2013 of about 1.9 million barrels per day (Nigeria Muse 2014), a decline in the last six months of 2013 mainly due to flood and pipeline vandalism, but expected to hit 2.7 million barrels per day in 2020 (Energy mix report 2014).

The annual consumption of electricity has been increasing very rapidly over the last three decades. It increased from 1,273 GWh in 1970 to 30,715 GWh in 2012 (NEP 2013). This however represents a suppressed demand caused by inaccessibility to the national grid and inadequacies of the

electricity supply. One consequence of this is that various industries and other consumers have installed generators whose total capacity is estimated to be at least 80% of installed capacity of the national grid (NEP Draft Review 2013).

The rural populace, whose needs are often basic, depend to a large extent on traditional sources of energy, mainly fuel wood, charcoal which contribute to global warming. This class of fuels currently constitutes about 40% of total energy consumption in the country. This is largely due to inability of low income consumers to pay for, as well as scarcity of, substitutes such as kerosene, cooking gas and electricity.

“Research has shown that the earth has twice as much carbon in it than it had two hundred years ago with much of the increment occurring within the last 30 years. This carbon is being generated by human activities chiefly from burning of fossil fuel. With increasing energy demand, the tendency to burn more fossil fuel to meet this demand will

only increase, thus causing a rapid increase of Green House Gases (GHG) in the atmosphere”(**Ajeigbe, O. Aet al 2011**).

At the moment, populations of low- and middle-income countries have a much lower impact on the global environment. For example, Per capita emissions of GHGs in the USA are almost seven times higher than in China and about 19 times higher than any Africa Country that necessitates prompt actions to reduce GHG emissions in all developed countries. However, while the impact of each individual citizen in developing countries will remain lower than in developed country counterparts for the foreseeable future, the former populations are continuously growing and urbanizing with a resultant increase in consumption rates. For instance, China is poised to overtake the USA as the largest single emitter of carbon dioxide in the nearest future (**Campbell-L. and Carlos C. 2007**). Decisions made in developing-country cities in the next few decades will therefore be among the most important determinants of new and future local and global environmental stresses.

In twenty years, Nigeria’s population is expected to double and aggregate energy demand will triple(**NEP 2013**). Conventional energy sources alone will not meet the challenges of an increasing population at affordable costs and in a flexible manner. To meet the rapidly growing demand for energy, and the challenges posed by climate change there has to be a conscious effort to increasingly include renewable energy into the nation’s energy mix.

According to the special report on Renewable Energy Sources and Climate Change Mitigation (SRREN) published in **May 9, 2011 by the United Nations Intergovernmental Panel on Climate Change (IPCC)**, Renewable energy can contribute to "social and economic development, energy access, secure energy supply, climate

change mitigation, and the reduction of negative environmental and health impacts".

Moreover Nigeria’s over-dependence on oil has slowed down the development of alternative fuels. Diversification to achieve a wider energy supply mix will ensure greater energy security for the nation. The domestic demand for petroleum products is growing rapidly. The development of alternative fuels from locally available clean energy resources should therefore be vigorously pursued.

Renewable energy has the potential to create jobs, improve livelihoods and open up the market in rural areas, the current use of renewable energy in Nigeria, however, is still limited in spite of its vast potential, it is premised upon this fact that Energy Commission of Nigeria conducted a survey on public opinion on energy options and related issues as Climate change. The result is expected to help the commission in recommending a review or possible adjustment of existing national energy policy. The survey, conducted on a pilot scale, was carried out in six locations (Nyanya/Karu, Asokoro/Maitama, Wuse/Garki, Gwarinpa/Jabi, Lugbe and kubwa) in the Federal Capital Territory (FCT), Abuja through the use of questionnaires. One hundred and fifty questionnaires were administered in each of the locations, making a total of nine hundred questionnaires in all.

2.0Matters Arising

2.1 Fundamental Concepts

i. Climate Change

Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions (i.e., more or

fewer extreme weather events). Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as "global warming". ([http://enwww.wikipedia.org/wiki/climate change](http://enwww.wikipedia.org/wiki/climate_change))

ii. Greenhouse Gas Emission

A greenhouse gas (sometimes abbreviated GHG) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone. Greenhouse gases greatly affect the temperature of the Earth; without them, Earth's surface would average about 33 °C (59 °F) colder than the present average of 14 °C (57 °F).

iii. Power Sources

Commercial electricity is generated mainly from hydropower; Coal fired plants and gas turbines in Nigeria. Power can also be generated from a number of sources other than the aforementioned which include Solar, Wind, Nuclear and Biomass.

iv. Sustainability

Sustainability is improving the quality of human life while living within the carrying capacity of supporting ecosystems. Sustainable development is defined as a pattern of resource use that aims to meet human needs by preserving the environment so that these needs can be met not only in the present but also for future generations.

2.2 Survey Methodology

In the conduct of the survey of public opinion on energy options in Nigeria, analytical model approach was adopted. The survey with nine hundred respondents target comprises questionnaires partly devoted to address the suitability and safety of the various power sources and others on coal and climate change. Public Opinion on government effort in combating erratic power supply through privatization and renewable energy development were also sourced from respondents.

The survey covered six selected towns in the nation's capital city, Abuja which includes Nyanya/Karu, Asokoro/Maitama, Wuse/Garki, Gwarinpa/Jabi, Lugbe and Kubwa. Due to the important nature of the study and the cursory effect of public acceptability of the success of public projects, this survey which is a pilot case project will be replicated in the entire country taking into cognizance at least a state in the six geo-political zones of Nigeria namely, North-Central, North-East, North-West, South-West, South-East, South-South. At the end of the study, the results and aggregate opinions will serve as a pointer to reviewing or possibly adjusting the existing energy policy.

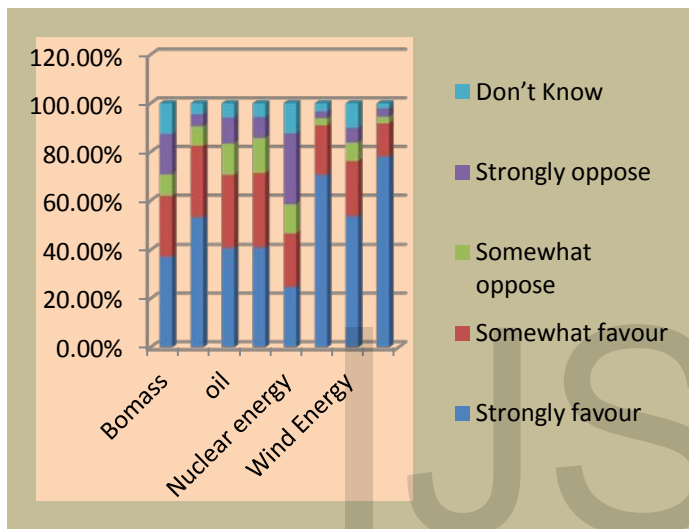
Prior to the project execution, there was a well-articulated feasibility study and planning activities as a timely and excellent project delivery is preceded by a good design and planning network. A six member project team and one coordinator were constituted to work out the modalities for the project execution which were drawn from crop of professionals in Energy sectors and stakeholder agencies.

3.0 Result and Discussion

3.1 Trend: Energy options

The respondents were asked to relate their acuity in support of the various energy options for the mitigation of power shortage in Nigeria:

3.1.1 How would you assess your support for each of the following sources of energy as one of the ways in solving Nigeria's energy problem? Please tick only one option for each source of energy?



Base: Nigerians 18+ (n=877 split sample)

Figure 1: Graphical representation of opinion of respondents on energy options

More people showed more preference for renewable energy sources such as solar, wind and hydro and Natural gas

3.1.2 Discussion

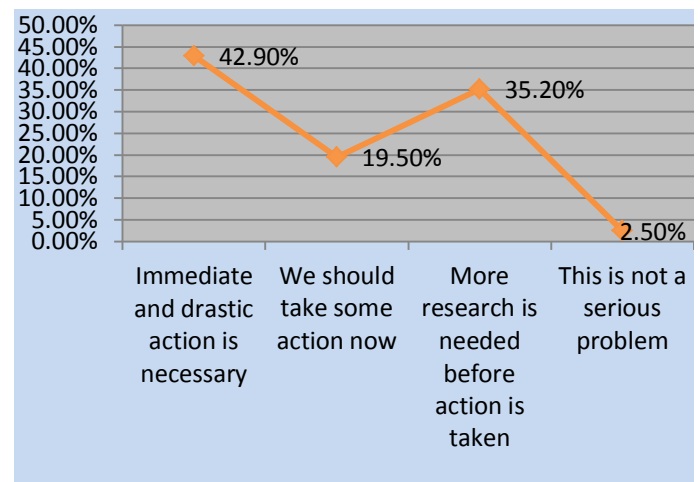
The result of the survey on energy options showed that the respondents preferred renewable energy sources such as solar, wind and hydro. Out of 877 valid responses, solar energy received the greatest support accounting for about 91.8% of the total responses, with 78.2% strongly favouring solar energy and 13.6% somewhat favouring it in meeting the nation's energy need. This was closely followed by

hydro which received the support of 91% of the respondents. 82.4% of the respondents supported Natural gas. Nuclear is the least favoured of the energy options receiving a total support of 46.8%, and the highest strong opposition. 28.9% of the respondents strongly opposed the use of nuclear energy in meeting the nation's energy need. Biomass however has the highest share of those who chose the "Don't know" option on the questionnaire. This is likely an indicator of the level of ignorance of the respondents on biomass.

3.2 Trend: Climate Change

Opinions of respondents were sougged as it concerns the issues of Climate Change caused mainly by human activities:

3.2.1 There is a lot of talk today about climate change caused by carbon dioxide emissions from human activities. Which of the following do you think best describes your view?



Base: Nigeria 18+ (n=896 split sample)

Figure 2: Graphical representation of respondent's view on climate change

Majority of the people are on the opinion that immediate action should be taken now

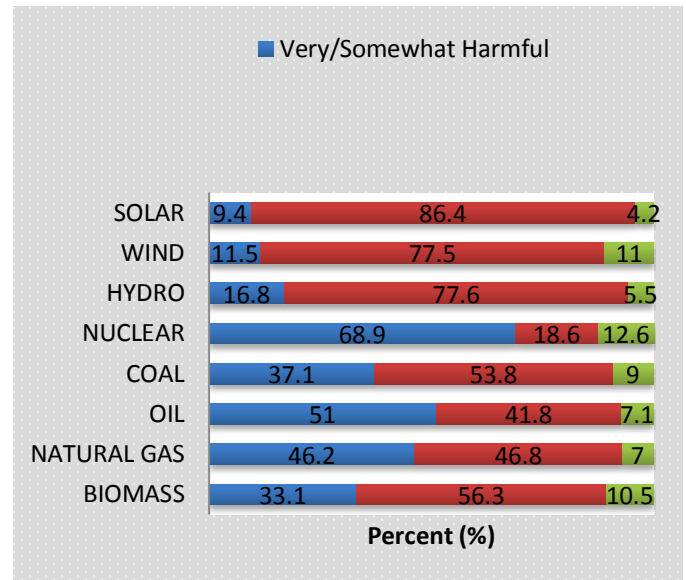
3.2.2 Discussion

The result showed that 62.4% of the respondents want action to be taken with respect to addressing the problem of climate change. About 42.9% of this group of respondents thinks that immediate and drastic action is necessary while the remaining 19.5% shared want some action taken now. 35.2% of the people submitted that there is need for more research before taking action on the issue of climate change while 2.5% of the respondents think climate change is not a serious problem. This is a clear indication that the respondents in this survey are reasonably informed on the issue of climate change.

3.3 Trend: Impact of power plants on the Environment

Respondents were asked to express their opinion on the harmfulness to the environment of some ways of generating electricity:

3.3.1 *Some ways of generating electricity may be harmful to the environment. How harmful do you think each of these power sources is?*



Base: Nigeria 18+ (n=880 split sample)

Figure 3: Shows respondents view on environmental impact of various power plants

3.3.2 Discussion

Generating electricity from solar energy received the highest support of over 85% of the respondents' opinion as a source that is not harmful to the environment (Fig. 3.3). Similar opinions were given for wind (77.5%) and hydro (77.6%). Over 50% of the respondents stated that generating electricity through nuclear and oil is harmful to the environment. The view expressed may not be true as nuclear power plants have little or no impact on the environment in terms of CO₂ emission. The respondents' decision could be attributed to their ignorance on nuclear issues as well as the security challenge in part of the country. Since they might be of the believe that it could be used for non-peaceful purposes.

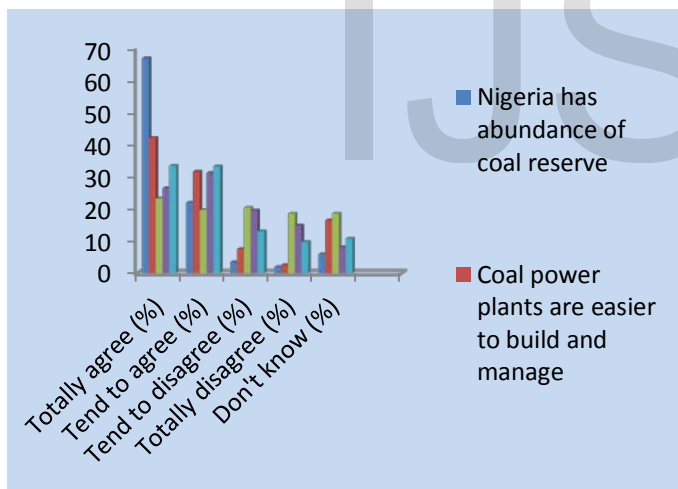
3.4Trend: Coal as a resource

Nigerian coal has been found suitable for boiler fuel, production of high calorific gas, domestic heating,

briquettes, formed coke and the manufacture of a wide range of chemicals including waxes, resins, adhesives and dyes. Their characteristic properties (low sulphur and ash content and, low thermoplastic properties), make these sub-bituminous coals ideal for coal-fired electric power plant. Its use as fuel wood and charcoal for cooking as commonly used in the rural areas by indigent rural dwellers calls for concern considering its health implications and environmental issues.

The views of the people on coal comparative advantages over other energy sources for power generation and its contribution to climate change was asked:

3.4.1 *To what extent do you agree or disagree with each of the following statements on the value of coal as a source of energy? Please tick only one option per statement?*



Base: Nigeria 18+ (n=885 split sample)

Figure 4: Shows the result of respondents' view on Coal as a resource

3.4.2 Discussion

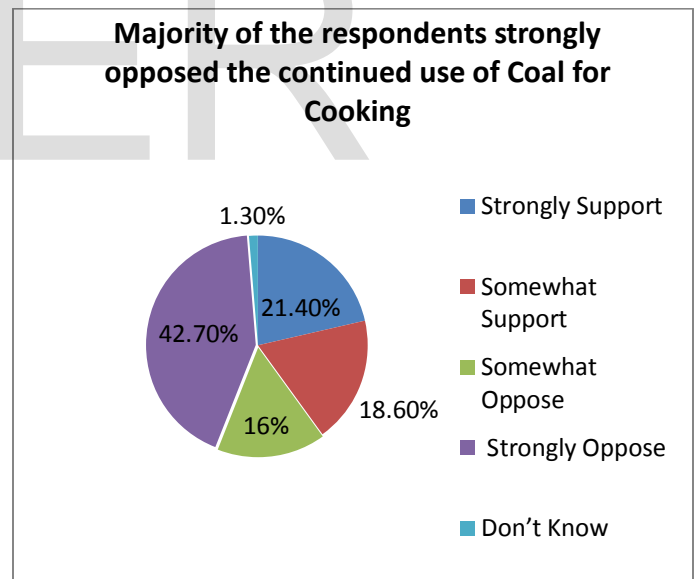
Majority of the respondents agree that Nigeria is blessed with abundance of coal reserve and coal power plants are easier to build and manage compare to others, although

more than 16% of the total respondents could not make up their mind on this. Greater share of the respondents also agree that coal will help us in ending power supply problem in Nigeria and provide more competitive and stable energy prices. The percentage of the respondents who agree that coal will help limit climate change is just a little above that of those who disagree; 18.5% could not decide on this. This response is similar to the response given by the respondents to coal as an energy option.

3.5 Trend: Coal use for fuel wood and Cooking

The respondents were asked their opinions on coal as used for cooking:

3.5.1 *Do you support or oppose the continued use of firewood and charcoal for cooking?*



Base: Nigeria 18+ (n=893 split sample)

Figure 5: shows the graphical representation of the result 3.5.1 Discussion

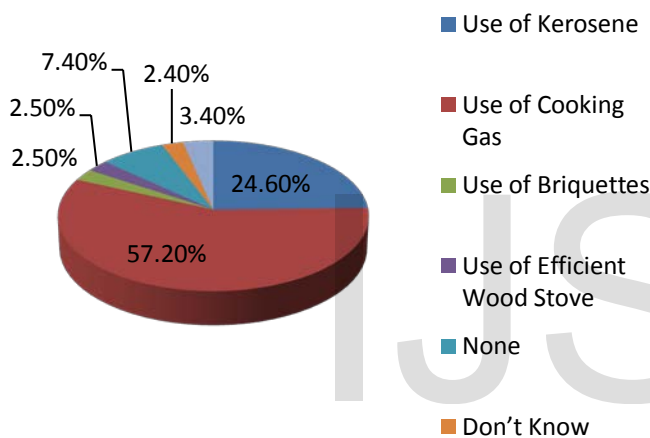
The continued usage of firewood and charcoal for cooking was opposed by 58.7% of the respondents; 73% of this fraction strongly opposed it while the remaining 27% somewhat opposed it. 40% of the respondents thrown their

weight in support of the continued use of firewood and charcoal for cooking, this is however attributable to poverty as the people especially in the rural areas may not be able to afford the alternatives fuel for cooking.

3.6 Trend: Reducing the use of charcoal

The respondents were asked to shed insights on ways of reducing the use of coal for cooking:

3.6.1 If you must suggest a way to reduce the use of firewood and charcoal, which of the following would you favour most?



Base: Nigeria 18+ (n=886 split sample)

Figure 6: Shows ways of reducing the use of firewood and charcoal as Suggested by the respondents

3.6.2 Discussion

In response to the Question which requested the respondents to suggest the best way to reduce the use of firewood and charcoal, the most favoured way is the use of cooking gas and was followed by the use of kerosene. Only

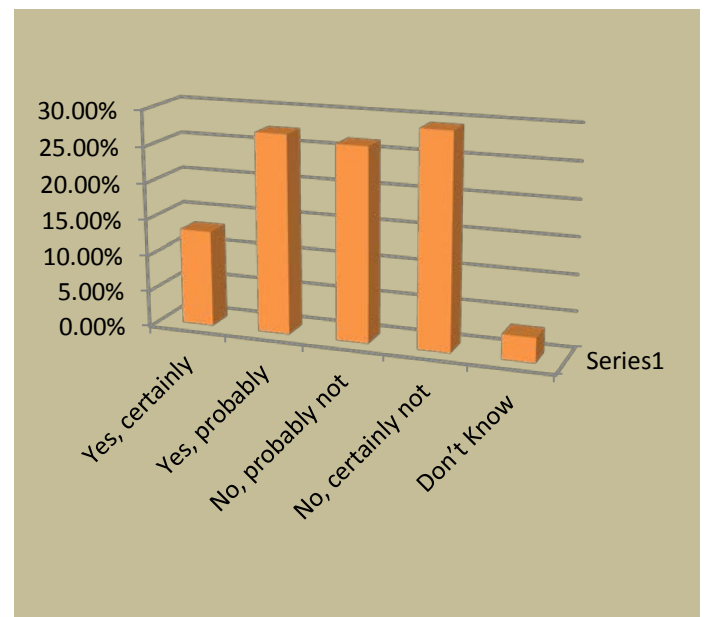
2.5% of the respondents each made suggestions for the use of briquettes and efficient wood stove, this shows that efficient wood stove is unpopular with Nigerians though its usage will go a long way to help the rural dwellers in minimizing Co2 emission and also preserving the environment.

3.7 Trend: Information Management, Advocacy and other Issues

There is need to Intensify information dissemination and R&D on existing energy efficient and environmentally friendly technologies in the exploitation and utilization of various energy resources to minimize harmful environmental effects.

This sought to determine the views of respondents on whether the energy information provided by the media is sufficient or not:

3.7.1 For you to draw your own conclusions on the risks and benefits of energy choices, do you think that the information the media offer is sufficient?



Base: Nigeria 18+ (n=879 split sample)

Figure 7 Shows respondents' views on the Sufficiency of the information offered by media

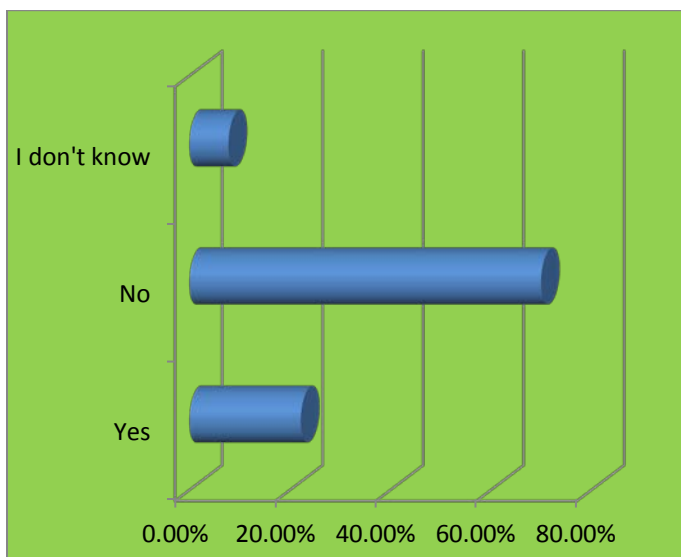
3.7.2 Discussion

Above 50% of the respondents indicated that the media does not offer sufficient information on energy options and their associated benefits and risks, out of this value, about 52% believed that the media has certainly not done enough in energy information dissemination. While the remaining fraction option posited that it is not probably offering sufficient information. Just as above 40% respondents believed that the information from the media is adequate sensitization on energy options and related issues.

3.8 Trend: Renewable Energy Development:

Question was also put forward to the respondents to know their take on the effort made so far in Nigeria in respect to renewable energy development:

3.8.1 *In your opinion, do you think the country is giving enough attention to the development of renewable energy (wind, solar, biofuel, water) technologies?*



Base: Nigeria 18+ (n= 884 split sample)

Figure 8 Shows opinion of respondents on renewable Energy development in Nigeria

3.8.2 Discussion

Majority of the respondents are of the opinion that the country is not giving enough attention to the development of renewable energy. This is evident in the result of their response to the above Question. At least 70% of the respondents answered "No" when asked if the country is giving enough attention to the development of renewable energy; 22.2% answered "yes", while 7.8% answered "I don't know".

4.0 Conclusion

The need to promote and inculcate renewable energy technologies into the Nigeria energy mix in cushioning the effect of the short supply of energy which has hampered the socio-economic development of the nation over a long period of time is inevitable. This can be inferred from the result of the survey taking into cognisance the support enjoyed by renewable energy having been favoured by verse majority of the respondents as the success of any policy depends to a large extent on its public acceptability.

It can also be deduced that as infrastructure and energy systems develop, technologies required to meet a majority share of total energy demand can be obtained through the supply of suitable renewable resources and clean development mechanism (CDM). The government needs to boost its supportive role and vigorous pursuit in the deployment of renewable energy technology by way of incentives and patronage, as the majority of the people are

of the views that the government has not done enough in this regard.

Considering the huge deposit of coal in the country, Government is advised to tap into the abundant coal reserve for electricity generation with the adoption of Carbon Capture and Storage (CCS) technology to minimize environmental impact. The respondents generally agreed that utilizing coal as a means of generating electricity will help to address the power problem currently facing the nation.

Climate change is the defining environmental problem of the 21st century which is presently receiving global attention, as Nigeria tends to meet its energy need, effort should also be geared towards maintaining the sustainability of energy and the environment. For instance, the current government initiative encouraging shift from the use of fuelwood to the use of cooking gas and other cleaner energy technologies in order to preserve our vegetation and mitigate climate change has to be intensified and possibly through a change in strategy to achieve better result.

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