Renewable Energy Transition: A Panacea to the Ravaging Effects of Climate Change in Nigeria

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Abstract. There have been global concerns about the continuous rise in the surface temperature of the earth. The rise in temperature is due mainly to numerous human activities. Nigeria contributes to this menace due to poor electricity supplies making some of its citizens rely on cutting down woods from forest and others using fossil fuel generators. Another prominent contribution to the release of carbon dioxide and other greenhouse gas emissions is the unrelenting gas flaring during the refining of much relied crude oil. This paper therefore proposes solar photovoltaic (PV) among other recommendations as ways that Nigeria can contribute to limiting global warming to between 1.5 °C and 2 °C which the 2021 report of Intergovernmental Panel on Climate Change (IPCC) alarmed will be exceeded during the 21st century if unchecked. Literatures were reviewed and online survey was carried out to evidently investigate the current state of grid electricity supply in Nigeria. The result from the survey showed that 75% of the respondents who are connected to the grid do not have electricity supply beyond 12 h. The implication of this is that many of these respondents resort to fossil fuel power supply while seeing solar PV as expensive. Therefore, Nigeria can reduce greenhouse gas emissions through political will that ensures that policies that will strictly prohibit gas flaring and encourage the PV industry in the country are enforced in order to make clean energy accessible to all.

Keywords: Renewable energy transition · Solar PV · Climate change

1 Introduction

It is evident from the 2021 Intergovernmental Panel on Climate Change (IPCC) 2021 report that the globe is still warm [1]. The report clearly indicated that the 1.5 °C to 2 °C earth's surface temperature rise limit may be exceeded within the 21st century alone if drastic efforts are not put in place by the nations of the world [1, 2]. It was therefore recommended, based on physical science perspective, that there is the need for firm, sustained and rapid effort at reaching net zero CO_2 emission and minimize other greenhouse gases (GHG) emission. The consequence of continuous neglect of mitigating these GHGs results in rise in temperature, draught, fire, flood and uncertainty in rainfall [3, 4].

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Research works have shown that the major contributing activity to the GHG emission is the use of coal, crude oil and natural gas for electricity generation [3, 5].

In order to solve the negative effects of the climate change and as a result of the fallout of the Paris agreement signed in 2015, the 2021 United Nations Climate Change Conference called COP26 was organized [6]. The participating parties including Nigeria made known their more ambitious commitment towards the mitigation of climate change. This move is pertinent because despite the fact that Africa has 40% of the solar potential of the world, it unfortunately only has 1% of the world's solar panels which contributes to poor electricity access in the continent [7, 8].

Despite efforts by the Nigerian government to improve the poor electricity situation in the country, the rate of access to electricity in Nigeria is still poor [9]. This calls for more drastic policies in order for the nation to effectively transit to the use of renewable energy (RE) for it to significantly contribute to the solution to the ravaging effects of climate change.

This paper therefore presents the respondents' feedback on the status of electricity in Nigeria, effects of climate change on Nigeria, Nigeria's contribution to curbing the effect as well as recommendations on the way towards the transition to RE.

2 Current Status of Electricity in Nigeria via a Survey and Its Effects

There have since been reports of mismatch in the centralized grid electricity demand and supply in Nigeria with demand outweighing supply due to increase in population. This is without a matchup improvement in supply of electricity despite different government interventions [10–12]. In view of this, in this work, an online survey was carried out among 480 respondents across Nigeria as shown in Fig. 1.

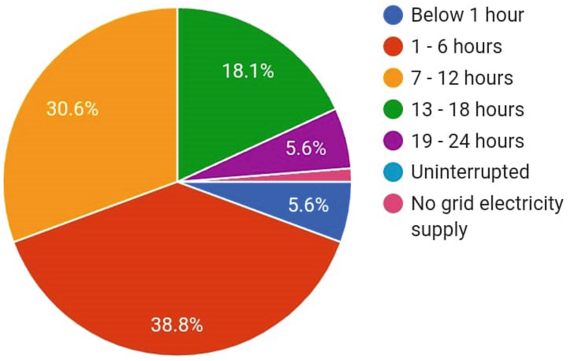

Fig. 1. Status of electricity supply in Nigeria

The results from the survey showed that 5.6% of the respondents reported that they have below 1h daily of electricity supply from the centralized grid. 38.8% of the respondents have between 1 and 6 h electricity supply daily. It was observed that 30.6% of the

respondents are supplied electricity between 7 and 12 h daily while 18.1% have power supply for between 13 and 18 h daily and 5.6% have it between 19 and 24 h daily. None of the respondents indicated that they have uninterrupted electricity supply from the grid while 1.2% said they are not connected to the grid at all. Therefore, the result from the survey indicated that 75% of the respondents who are connected to the centralized grid do not have electricity supply beyond 12 h.

This survey has shown that these respondents who are in dire need of energy will resort to any alternative means available to them such as coal and other fossil fuels. With many Nigerians resorting to coal, many trees are continuously fallen especially for cooking and heating. Others resort to fossil fuel powered electric generators all of which contribute to the warming of the earth and affects Nigeria as a country.

3 Climate Change and Its Effects on Nigeria

Energy security has been a long quest for humans. Many industrialized nations such as the USA, China, Germany and Japan have seen energy independence as a key factor to ensure their socio-economic stability as well boosting industrialization thereby utilizing crude oil, gas and coal in large quantity [13]. However, these non-renewable forms of sources of energy are causing more damage to the existence of human race through their emission of GHGs.

Nigeria, among other developing nations have also joined as the use of wood and charcoal as fuel for domestic cooking and heating account for over 80% [14]. Others who can afford or are in the urban centers depend on kerosene and gas. Oil production in Nigeria remains another challenge due to the fact that oil spillage and continuous gas flaring have really contaminated the air, land and crop with about 7.4bn cubic feet of gas being flared in only 2018 and a total of 478.7MT in CO_2 equivalent has been flared between 1970 and 2015 as shown in Fig. 2 [15].

Meanwhile, in commercial utilization as a whole, the major sources of electricity generation in Nigeria are natural gas and hydro. Even though hydro is a form of renewable energy, its commercial utilization is just 10% while other sources such as solar and wind are completely not connected to the national grid as shown in Fig. 3 [15, 16].

With the pervasive epileptic nature of electricity in the country, the use of unclean fuels by many Nigerians is rife. This has made Nigeria to be among the countries of the world with the most deforestation rate with an average annual loss of 525,000 hectares [17]. Evidently, coal has been rated as one of the dirtiest fuel that has added 81% of the carbon dioxide (CO_2) present in the atmosphere of the earth since 1870 and responsible for 40% of the annual CO_2 emission globally [18, 19]. Nigeria is therefore seen as a nation that is contributing to the emission of GHGs and so has not been spared from the ravaging effects of climate change such as flood, inconsistent rainfall and desertification. These have made the Nigerian government to put some effort at adopting REs.

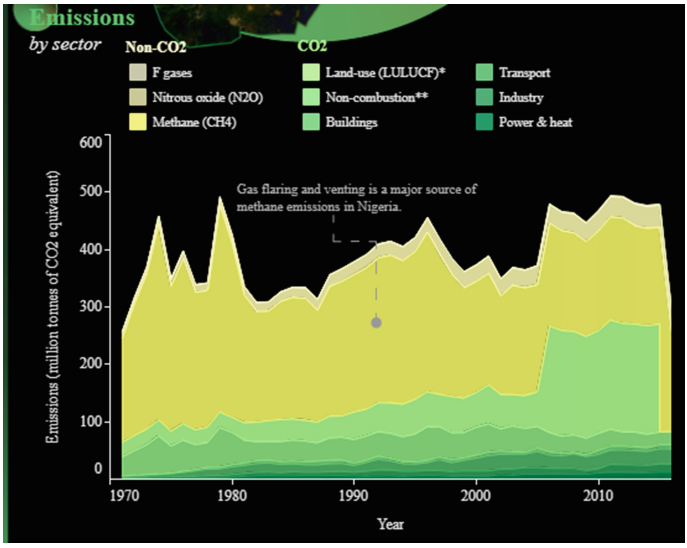

Fig. 2. Gas flaring in Nigeria in CO_2 equivalent [15]

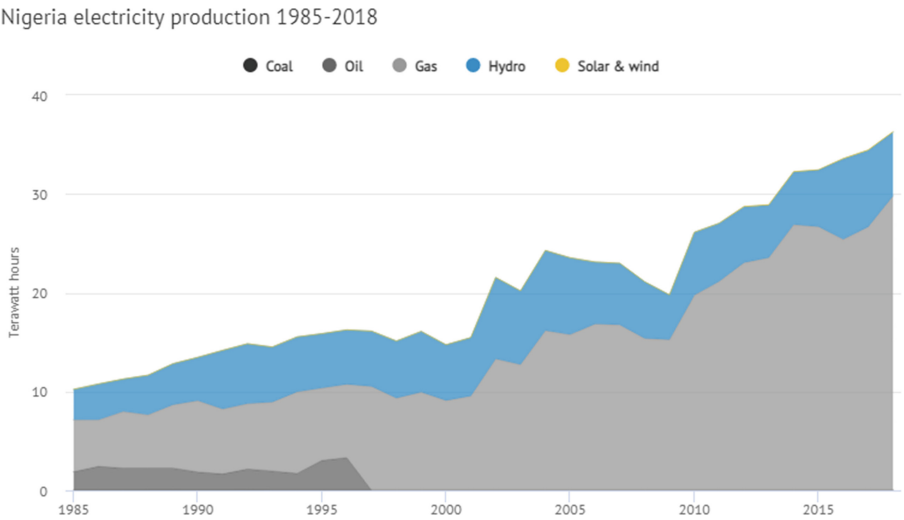

Fig. 3. Sources of electricity in Nigeria [15]

4 Nigeria's Efforts at Mitigating GHGs

Nigeria has been making some frantic efforts at reaching net zero emissions by improving the renewable energy (RE) sector in the country in order to contribute to the mitigation of the ravaging effects of climate change. In 2011, the Federal Government established NASENI Solar Energy Limited for the purpose of doing local manufacturing of solar photovoltaic (PV) modules as well as providing solar energy solutions to the citizens

[20]. The economic recovery and growth plan (ERGP) which ended in 2020, even though has been replaced with National Development Plan (NDP) for 2021–2025, had a good plan of significant inclusion of RE and addition of 1.1GW of solar PV power in particular to the national grid although not achieved [21, 22, 23]. Through one of its agencies, the Rural Electrification Agency (REA), Nigeria has launched solar home systems scheme for 5million home as indicated by Nigerian President during the COP26 conference 2021 in Glasgow [24]. Also, during the conference, Nigeria, having appreciated the level of desertification in the Northern part of the country and its negative socio-economic effects, pledged that it will be net zero by 2060 [24]. Nigeria therein called for investment and partnership as well as financial assistance in the areas of clean technologies especially in solar power [19]. In the area of wind energy, which either in planning stage or abandoned, Nigeria has invested in wind farms including the 10 MW in Katsina state [25, 26]. More efforts are however required especially in the area of effective policy implementation.

5 Conclusion

In this study, it was established through a survey that 75% of respondents among Nigerians who are connected to the centralized grid do not have electricity supply beyond 12 h. It was also evident from this work that poor electricity supply, leading to the use of fossil fuel coupled with gas flaring during oil production, have made Nigeria to be among nations with significant CO_2 and other GHGs emission. Efforts by Nigerian government towards the 2060 net zero were provided. With the provided recommendations, this work will serve as a guide for policy making and implementation towards the realization of energy transition to RE in mitigating the effect of climate change.

6 Recommendations

This study considered the challenges posed by the ravaging effect of climate change in Nigeria in order to provide recommendations that will serve as framework for effective energy transition towards RE. These are as follows:

- Nigeria needs to as a matter of urgency redirect its present resources for capacity development in home grown research, development and commercialization of technologies in the areas of RE and allied solutions such as solar PV manufacturing, storage systems and electric vehicles.
- Emphasis should be more on transfer of RE technologies to developing countries than financial assistance. This is more required because many of the developed countries may deliberately fail or genuinely get affected by the effect of COVID-19 pandemic to redeem their financial pledges as agreed in the COP26 conference.
- Decentralization of the national grid needs to be done urgently with increase in the present limit of 1MW [27] to which mini grid can generate. This will give more degree of freedom for the evolution of privately operated micro and mini grids to supply unserved and underserved communities.

- Since solar PV technology is adjudged to be one of the most economically feasible REs in Nigeria [28], there is the need to give tax holidays for local manufacturers of solar PV modules and balance of system. This will encourage private individuals to establish solar PV manufacturing companies.
- Research works [29, 30] have shown that majority of installed solar power systems in Nigeria are not connected to the grid and are owned by individuals, private and government organizations, there is need for the provision of incentives and subsidies for the adopters of the technology. This will make solar power system components to be cheaper and enticing to adopt.
- Other sources of REs should be embraced. Since hydro is an existing adopted technology for power generation, all available and suitable water sources should be utilized. Wind energy technology also needs to be revived in Nigeria. The technology has high potential with capacity factor ranging between 11% and 45% across the country according to [16].

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