



# Does clean energy contribute to economic growth? Evidence from Nigeria



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## ABSTRACT

This paper examines the impact of clean energy on economic growth in Nigeria. Autoregressive distributed lag (ARDL) approach to cointegration was used to determine the existence of cointegration among the variables. The long run results suggest a significant negative relationship between two indicators of clean energy (alternative and nuclear energy and electric power consumption) and economic growth. The result further reveals a significant positive relationship between combustible renewables and waste and economic growth. Mixture of negative and positive relationships between clean energy indicators and economic growth was obtained in the short, although not significantly different from zero. We concluded that Nigeria has Potentials of clean energy to be reaped in near future.

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## 1. Introduction

In recent times, the importance of renewable and clean energy sources has increased significantly as climate change has become a long term threat to global ecosystems and the world economies (Simsek and Simsek, 2013). Alternative energy sources are increasingly required to respond to this threat of climate change and skyrocketing energy demand in the world. The need for a shift from the use of primary energy sources that emits toxic pollutants to the environment to greener energy source is a current issue in energy led growth literature. Most advance countries of the world has established legal framework to encourage the use of renewable energy sources in line with the objectives of global energy organization and global climate change and environmental safety advocacy organization such as International Energy Agency (IEA) and Kyoto Protocol. Among these objectives is to advance the world's energy supply and demand structure by developing alternative sources of cleaner energy and increase the efficiency of energy use.

The objective of this paper is to examine the impact of clean energy on economic growth in Nigeria. Nigeria is one of the countries blessed with clean and renewable energy that include solar energy, wind energy, hydropower, and biomass among others. Interest in the use of clean energy has increased, since petroleum may not last

beyond 8 decades at 2010 rate of reserve and production (REMP, 2012). Despite that promotion of renewable energy sources is central to the country's National Energy Master Plan (NEMP), the development of clean energy technologies has been slow. The country also lacks a separate legal framework in charge of renewable energy. This may have led to the fall in the contribution of energy to Gross Domestic product (GDP) to 13.70% in 2013 from 15.50% in 2010 (ECN, 2013). Therefore, huge amount of clean energy will be required to achieve the nation's mission of growing the economy at the rate of 11%–13% to be part of the 20 largest economies of the world by 2020 (REMP, 2012).

The current government recently announced that it had concluded arrangement to launch a national policy on renewable energy in Nigeria. This is expected to increase the supply of clean and environmentally friendly source of energy. For instance, the 30,000 MW of electric power supply requirement for Nigeria is expected to be generated from renewable sources. Other strategies geared to enhance growth in renewable energy sector include: introduction of renewable energy legal framework, giving license to private sector to invest in clean energy related sectors in Nigeria, attractive tariff for foreign investors in renewable energy among others. Against this back ground, this paper investigates the impact of renewable energy resources on economic growth in Nigeria. The remainder of this paper is scheduled as follows: Section 2 is literature review, Section 3 deals with data, model and methodology, Section 4 presents results and empirical findings while Section 5 focuses on conclusion and policy implication.

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**Table 1**

Fossil energy resources and nuclear energy resources.

Source: NNPC (2010) and CBN (2010).

S/N	Resources	Reserves	Production (2010)	Domestic Utilization (2010)
1	Crude oil	37 billion barrels	0.896 billion barrels	0.164 billion barrels
2	Natural gas	187 Tscf	2.392 Tscf	75.7%—fuel, industries, re-injection and gas lift. 24.3%—gas flare
3	Coal	2.7 billion tonnes	0	Negligible
4	Tar sands	31 billion barrels of oil equivalent	0	0.224 million tonnes
5	Nuclear	Yet to be quantified	0	30 kW experimental nuclear reactor

## 2. Literature review

Energy efficiency and clean energy use has become increasingly a new area of discussion in energy–growth nexus (see for instance, Mandelli et al., 2014, Sanoh et al., 2014, Qi et al., 2014, Oyedepo, 2014 and Mediavilla et al., 2013). This led to the need to investigate clean energy relationship with economic growth in Nigeria. Recently, Olugasa et al. (2014) conducted a conceptual review on clean energy production from biogas for use in Nigeria. Having reviewed the global techniques on how to store and generate clean energy from biogas, point out its potential economic advantages and use in meeting energy demand in Nigeria and other developing countries.

Similarly, Ajayi and Ajayi (2013) investigate and analyze the energy policies and legal ethics of renewable energy development in Nigeria. They focus on Nigeria legal framework of clean energy development by appraising the vision 20:2020 of the federal government of Nigeria and the clean energy master plan forwarded by joint efforts of the Energy Commission of Nigeria (ECN) and United Nations Development Programs (UNDP) among others. Some of the policy challenges revealed by the study are inadequacy of economic incentives by government, unfavorable tax and tariff system to promote clean energy technology. They further recommend the amendment of land use act, investment laws and environmental impact assessment decree by Nigerian government.

Pao and Li (2014) investigated economic growth, clean energy and unclean energy in MIST (Mexico, Indonesia, South Korea, and Turkey) economies. The method adopted was panel cointegration. Part of the result of interest suggests long run causality from clean energy use to economic growth and positive feedback causality in the short run. Renewable energy also causes fossil fuel consumption in the long run and a negative feedback effect in the short run. In the same year, Zhang et al. (2014) examine the potentiality of cooperation in renewable energy between United States of America and China. Their finding suggests that such cooperation can foster economic development, mitigate carbon emissions, improve the environmental quality, promotes green growth and mutual benefit between the two countries.

Furthermore, Sbia et al. (2014) documented the link between economic growth and indicators of foreign direct investment, trade openness, carbon emissions and clean energy for UAE. The method used was autoregressive distributed lag approach to cointegration. Their findings reveal that trade openness; carbon emissions, foreign direct investment reduce energy use while clean energy and economic growth have positive effect on energy consumption. Perobelli and Oliveira (2013) conducted a study in 27 Brazilian states by developing an indicator for energy development potentials using factor analysis. The outcome identifies three energy development potentials which include; supply of clean energy, supply of unclean energy and demand for energy.

Again, Kanellakis et al. (2013) investigate energy policies of the European Union and highlighted the union's strategy on energy related matters including the antecedence of the union's creation in 1951. Implemented policies in the union includes; clean energy, energy savings and efficiency, security of energy, energy market, nuclear energy, safety of the environment and research

and development. Pfeiffer and Mulder (2013) also investigate the diffusion of non-hydro clean energy technology for generating electricity in 180 developing countries using two stage estimation techniques. They found that the diffusion increases with the enforcement of economic and regulatory instruments. Similarly, increase aid and openness, organizational policy supports, growth of electricity use, and fossil fuel production delay diffusion of non-hydro clean energy.

Simsek and Simsek (2013) explore recent incentives and potential of clean energy sources in Turkey. The outcome suggests that recent improvement, like development in the renewable legislations, liberalization of the electricity market, has foster growth and investment opportunities on renewable energy in Turkey. Natural endowment of solar, geothermal and wind has facilitated development and attracted global attention to their market. On the other hand Brown et al. (2012) found six myths on clean electricity in the southern US that are either initiated by the public or spread among policymakers. Energy economic modeling mechanism was used to show that the myths are half-truths. Their work further identifies new energy policy improvement where clean production can save user's income and meet most demand growth in the next two decades.

Nigeria is blessed with abundant fossil, renewable and nuclear energy resources. The fossil energy resources include crude oil and natural gas, coal and tar sands while the clean and renewable energy include small hydro, large hydro, biomass, wind and solar. The renewable use of energy sources are still on the infant stage on like nonrenewable sources which have been exploited for decades and used for productive and domestic purposes in the country. Tables 1 and 2 show the nonrenewable and renewable energy potentials in Nigeria.

## 3. Data, model and methodology

This paper tests the empirical impact of clean energy on economic growth in Nigeria. To achieve this, annual data were collected from World Bank development indicator in 2014. The data collected covers the period from 1971 to 2011. Gross Domestic Product (GDP) per capita (constant LCU) was used as a proxy for economic growth while three separate indicators were used to represent clean energy. These include; alternative and nuclear energy (% of total energy use), combustible renewables and waste (metric tons of oil equivalent) and electric power consumption (kWh). These indicators were used to ascertain the influence of renewable energy on economic growth in Nigeria. The trend of the series and descriptive statistics are presented in Fig. 1 and Table 3.

In the series, economic growth, alternative and nuclear energy, and electric power consumption show fluctuations while combustible renewables and waste indicates continuous increase. The descriptive statistics result of Jarque–Bera test shows that all variables fulfil the requirement for normal distribution.

In order to model the relationship between economic growth and clean energy, a functional form model is constructed below.

$$Y_t = f(AN_t, CR_t, EP_t) . \quad (1)$$

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