



Renewable energy potentials in Nigeria: Meeting rural energy needs

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ABSTRACT

Nigeria is endowed with abundant energy resources, both conventional and renewable, which can potentially provide the country with a sufficient capacity to meet the ambitions of both urban and rural Nigerians of a full, nationwide electrification level. Yet, Nigeria has one of the lowest consumption rates of electricity per capita in Africa. With the demand superseding the generation, there is inequitable access of rural communities to the electricity service in the country. There are inherent obstacles militating against the effective implementation of an orderly energy policy in Nigeria. The inefficiencies overshadowing the allocation of energy resources coupled with the near depletion of fossil fuels, make it imperative for the country to exploit its huge natural renewable resources to avoid a worsening energy supply scenario and provide feasible electricity to rural dwellers. This paper presents a review of renewable energy potentials in Nigeria to be tapped for useful and uninterrupted electric energy supply. The extent of renewable energy resources is described and existing government policies are articulated. Various policies, that could possibly incentivize the realization of wider renewable energy applications in rural Nigeria, are proposed. The challenges and future prospects of renewable energy are also discussed. Dissemination of decentralized renewable energy resources will not only improve the wellbeing of rural Nigerian communities, but also enhance Nigeria's energy and economic prospects for potential global investment.

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1. Introduction

Nigeria is located in West Africa, bordered by Cameroon to the east, Niger to the north, Benin Republic to the west and the Atlantic Ocean to the south. The terrain varies from coastal swamps and tropical forest in the south, to savannah and semi-desert in the north. Nigeria lies within latitudes 4.32° N and 14° N and longitude 2.72° E and 14.64° E as shown in Fig. 1, with land area of about 924,000 km² and a population of 165 million [1,2].

Nigeria is richly blessed with reasonably high qualities of various energy resources [3], such as crude oil, tar sands, natural gas and coal. About 90% of the country's economy is dependent on crude oil [4]. In 2006, Nigeria was ranked the 10th largest crude oil producer in the world with a reserve estimated to be about 36 billion barrels, which is about 4.9 billion ton of oil equivalent (toe) [4]. The country is endowed with more of natural gas than oil, with an estimation of 5210 billion m³ (187 trillion SCF) as of 2006. This includes associated and non-associated reserves; placing Nigeria among the top 10 countries with the largest gas reserves globally [1]. Nigeria also possesses other energy sources including 4.1 billion toe of tar sands and 1.52 billion toe of coal and lignite. However, it has been estimated that Nigeria's fossil fuels will be depleted to an uneconomical point by the year 2050 [3]; going by the present extraction trend. Moreover, Nigeria, surprisingly,

imports over than 70% of its petroleum product requirements [3].

Nigeria is equally blessed with renewable energy (RE) resources like wind, solar, biomass and hydropower [5]. Hydropower has the utmost RE potential, which amounts to 10,000 MW for large hydropower and 734 MW for small hydropower (SHP). Further RE sources include wind energy with a potential of 150,000 terra joule per year, generated by an average wind speed of 2.0–4.0 m/s, solar radiation estimated at 3.5–7.0 kWh/m², and biomass at 144 million ton per year [6]. However, these resources are yet to be explored.

Despite the abundance of energy resources available, Nigeria is only able to generate 1600 MW effectively out of 6000 MW of installed generating capacity (less than 30%). This is because most of the power grid facilities are poorly maintained. Nigeria's power sector retains high energy losses, between 30% and 35%, from generation to billing. This is significantly high as compared with the US, where power losses across lines usually come to less than 7%, even across long distances [7]. In addition, there is a low collection rate, 75–80%, and low access to electricity by the population. Since there is insufficient cash generation, because of these inefficiencies, the Power Holding Company of Nigeria (PHCN) is consequently reliant on fuel subsidies and state funding of capital projects. Declining electricity generation from a number of domestic power plants has sent the country into an energy crisis during

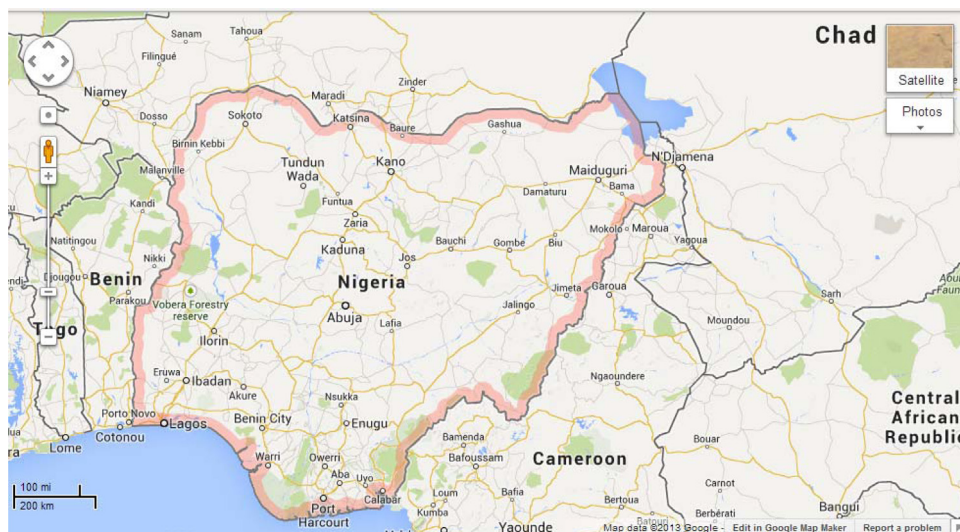


Fig. 1. Map of Nigeria.

Table 1
Nigeria Conventional Energy Resources and its Potentials.
Source: Renewable Energy Master Plan (2009).

Resource type	Reserves		Production	Domestic Utilization (natural units)
	Natural units	Energy units (Btoe)		
Natural gas	187 trillion SCF	4.19	6 billion SCF/day	3.4 billion SCF/day
Crude oil	36.22 billion barrels	5.03	2.5 million barrels/day	450,000 barrels/day
Tar sands	31 billion barrels of equivalent	4.31	Insignificant	Insignificant
Coal & lignite	2.175 billion ton	1.52	–	–
Nuclear element	None	–	–	–

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