

Renewable Energy Development in Two Selected African Countries: An Overview and Assessment

¹Shehu Usman Yamusa II, ²Dr. Abdul Haseeb Ansari ³Dr Maizatun Mustafa

¹Ph.D. Scholar, Ahmad Ibrahim Kulliyah of Laws, International Islamic University Malaysia, Malaysia.

²Professor, Ahmad Ibrahim Kulliyah of Laws, International Islamic University Malaysia, Malaysia.

³Assistant Professor Ahmad Ibrahim Kulliyah of Laws, International Islamic University, Malaysia, Malaysia

Abstract: Government officials, academics, independent researchers and private investors have been working since the energy crises in the 1970s towards maximizing alternative and new renewable energy sources. The traditional sources of energy are based on exhaustible natural resources; therefore, the energy that is cleaner and sustainable for sustainable development of the world economy is a sine qua non. The economy of a country is measured with the consumption of energy per capita. Least developed and developing nations of Africa are hard pressed to increase their power generation and maximize other sources of energy. But due to their inherent limitations in terms of financial resources, lack of sophisticated technology, lack of sufficient foreign aid, and ever growing population, their energy needs are going to increase in times to come of financial institution to exploit the available sources for energy generation depend on that. This paper attempts to provide an overview and assess the situation in two selected African countries: Nigeria and Algeria. The paper identifies some barriers and explores the way forward in these countries for successful energy generation by all possible means.

Key words: Energy Law, Sustainable Development, Alternative and Renewable Energy, Energy Efficiency.

INTRODUCTION

Africa has 147 Giga Watt (GW) in total installed electricity capacity, though it lacks a proper continental capacity in terms of energy generation. To put this figure into perspective, Africa's total capacity is what China alone can install in one or two years. The per capita electricity consumption in Africa, excluding South Africa, is 153 kWh/year. About 600 million Africans have no access to electricity, and the continent generates only 6% of the global electricity average. To appropriately fulfil the electricity need of the continent, significant work has to be done to optimise power generation from all possible sources. For the continent to meet its growing energy demand, 250 GW of additional capacity needs to be installed by the year 2030. These larger challenges and objectives can be better understood through relevant case studies, thus, the scope of this paper is restricted to Nigeria and Algeria. It identifies problems with likely solutions to the power generation in these two countries alone. These countries were selected because: Nigeria is the most populous nation in Africa with an abundance of natural resources, such coal, oil, and natural gas, and it has important potential in renewables, specifically solar, wind, and hydropower; and Algeria has made notable breakthroughs in alternative and renewable energy sources, while also having significant natural gas resources. Fully realizing its renewable potential calls for capacity building; this will occur only when the leadership of the country has enough political will to develop the sources. Algeria was also selected because it was the first country in Africa to start modern renewable energy generation with the establishment of its Solar Institution in 1962, but there are remaining hindrances in the development of modern renewable energy sources in the country.

Nigeria and Algeria are struggling to overcome poverty, unemployment, poor education, and slow economic growth. A host of recommendations have been made that economically more developed nations should come to the aid of African countries as they maximising their capability for electricity generation.

Nigeria and Algeria are faced with a lack of political will and with policies that are not improving the situation of the continent. Their problems include: a lack of technology; corrupt practices in the political and regulatory systems; and a lack of administrative efficiency. Even power generation from fossil fuels is not steady. In light of these challenges, it is difficult to see how these countries could develop renewable electricity sources for energy security and sustainable development, as this process is dependent on finance and technology. The condition in most of African countries does not warrant the establishment of legal instrument to support the generation of energy through renewable sources; this would be an impractical next step.

Corresponding Author: Shehu Usman Yamusa II, Ph.D. Scholar, Ahmad Ibrahim Kulliyah of Laws, International Islamic University Malaysia, Malaysia.
E-mail: zashema2@yahoo.com

The Energy State of Play in Nigeria and Algeria:

1. Nigeria:

Exploration for oil and gas has taken place in Nigeria since in 1950s by Shell Development Company of Nigeria, a subsidiary of Shell d'Archy and British Petroleum Company (later Royal Dutch Shell BP). The first crude was exported in February 1958. Despite the fact that the country produces about 2.3 million barrels a day, it does not have enough refineries to process enough oil to meet the local demand. The country exports a large part of its crude and import refined petroleum products for local consumption. If the country had enough refineries, it might save a great deal of foreign currency. Oil and gas production account for 70% of the government's revenue, on which the national developmental programme depends. The country is among the top ten oil exporting countries; large hydroelectric dams and fossil fuels are its major sources of energy, which are used for generating electricity in the country. Historically, the major source of energy has been coal; with the change of the locomotive engines to diesel, coal production has declined considerably from 905,000 tonnes to 52,000 tonnes in recent years. The country has an estimated 639 million tonnes of coal reserves.

Nigeria had an estimated population of 158.8 million as of 2010, with a Gross Domestic Product (GDP) of \$ 193.7 billion and a per capita income of \$ 1,224. In terms of energy, the country's energy self-sufficiency is 211.3% and has fuel imports of \$ 335 million which is about 1% of total imports. The grid electricity generation is 19.8 TWh, of which 4,529 GWh is renewable, or 22.9%.

The country's grid electricity use per capita is 120 kWh with approximate capacity of 5.9 GW of which 1,938 MW is from renewable sources about 32.9%. The grid electricity access rate is 50.6% therefore; the share of population using solid fuel is about 79%.

In the area of renewable energy, enough has been done on the government scale yet; some private individuals are using the solar energy. The Energy Commission was established in 1979 with the responsibility of planning the country's energy generation. The Commission has been going through a hard time with the National Assembly with the draft bill on renewable energy to see the light of the day since 2007. Serious work is needed to be done for energy generation through new renewable sources since there is no framework for it development. The country has no steady supply of electricity, which is essential for the sustainable development of its economy and energy efficiency and in order to have steady supply for sustainable development. However, the country has the following target: 18% of electricity from new renewable sources by the year 2025 and 20% by 2030. In the small hydro about 100 MW capacity by 2015 and 760 by 2025, in the area of solar photovoltaic 300 MW by 2015 and 4,000 MW by 2025, while in the area of wind energy the country has a target of 40 MW by 2025 and 5% for biomass fired capacity by 2015 and 30 MW by 2025.

The country at present cannot give the actual statistic of the renewable energy generation since it is mostly individual and private with the exception of hydro through the use of solar photovoltaic. The local state-owned Power Holding Company of Nigeria (PHCN) should start to take the statistic so that it will be encourage through the provision of subsidy by the government. It is the best way of providing electricity off grid in the rural area. This will bring about efficiency and energy saving, and it will also support the conventional way of power generation in the country.

At the moment the country is undergoing privatization process of the electricity industry. About 300 entries were sent during the bidding and 212 selected to bid but, at the end 10 distribution and six generating companies where selected to takeover: Jos, Yola, Kano, Abuja, Ikeja, Eko, Portharcourt, Benin Enugu and Ibadan distribution electricity zones available in the country. The six generating companies that succeeded to take over the following stations were: Shiroro Hydropower PLC: was given to North South Power Limited at \$16,748,180.00, Sepele Power PLC: CMEC/EURAFRIC Energy Ltd paid \$30,150,000.00, Kainji Hydropower (PLC): Mainstream Energy Solutions paid \$35,680,500, Geregu Power (PLC): Amperion Power Distribution Limited paid \$19,800,000.15, and Ugheli power (PLC): Transcorp / Woodrock / Sumbion / Medea / PSL / Thomassen, paid \$45,000,000. They are the main generating companies however; the PHCN is the transmission company while Nigerian Electricity Regulatory Commission (NERC) will continue to be the regulator of the industry. This is a clear indication that government monopoly on electricity will continue to exist in the system, and this may continue to be one of the barriers that will hinder the growth of the electricity industry in the country. There should be total unbundling of the power sector, while the NERC can regulate the electricity tariff in the country.

The country is a big market with such high population and has potential for industrial development but electricity utilization is very low with just 2.5 million registered consumers of electricity in the country. The data disclosed 2.1 million are residential customers, 400,000 are commercial, and 33,000 are industrial and only 3,000 for street light customers in the country. There is the need to develop renewable and alternative energy since development can only come where there is enough and efficient power supply which the country is in highly need.

2. Algeria:

The Algerian economy squarely depends on natural resources. For example, coal, oil and gas are used for the generation of electricity and for other energy uses. The case of Algeria is not much different from others. One of the world's most extensive gas reserves is found in the country. The country has great potential for renewable energy sources. It has established solar institutions as early as 1962, but till date the generation of new renewable is not up to 5 per cent of the total energy generation. It should have been more than 20 per cent due to timely lead start.

The major energy generation source is natural gas. The country is dependent on it for its economy; thus, for capitalizing it, it exports a major portion of it to Europe. The country has all that it takes for renewable energy sources. It has an existing National Policy on renewable energy but the political will is absent like in any other African country. Though the country is among the leaders in natural gas supply, it is faced with the environmental problems. There are problems of unemployment and poverty like other African countries. Gas exportation is up to 60 billion cubic meters. The country established its liquefaction plant as far back as 1964 with imported technology. The country is still maintaining its two Trans-Mediterranean pipelines one that goes to Spain and the other that reaches Portugal. The country has the capacity of 11 billion M³/year and has a plan to expand to 18 billion M³/year of gas exportation in the future. The country has a target of exporting 85 billion cubic meters from 2010.

In 2010, Algeria had a population of 35.4 million with 159.4 billion USD, (GDP) and 4,501 USD (GDP) per capita. The primary energy supply is 1,664.6 PJ of which 3.6 PJ (0.2%) is renewable and with energy self-sufficiency of about 383.0%. The imported fuel use is about 413 million USD, that is, 1.1% of total import. The energy generation is 42.8 TWh of which 342.0 GWh is renewable (0.8%), the electricity per capita is 973 KWh with capacity of 8.1 GW, of which 280 MW is renewable with (3.4%) and the accessibility rate is 99.3% with share of population using solid fuel of about 5%.

The renewable energy development started despite the strength in natural gas production, the first and major field is placed in the most hydrocarbon region blessed with natural gas, to curb CO₂ emission. It is one of the prospective countries in Africa where conditions are most conducive for the generation of new renewable energy.

Solar energy field is located in the region of gas production with the intention to have a hybrid solar and gas project. This was done to improve the production, transmission and distribution of electricity with the intention to connect to the National grid. The New Energy Algeria (NEAL) Company is responsible for the project. It is a project expected to reduce the emission of hydrocarbon of the natural gas production. The greenhouse gas emission will be reduced and energy generation will be added and this will add to the supply with sustainable environment. The project has the following targets: Additional 5% of renewable by 2017, 20% by 2030 and 100MW from wind energy by 2015 and 170 MW of concentrating solar power by 2015 and 5.1 MW from solar photovoltaic capacities by 2015.

Currently, Sonelgaz the state-owned utility has signed an agreement with consortium charged with the deserted CHP programme to investigate project for exporting 1GW of electricity to Europe. The Sonelgaz is also putting structure at the moment to build 4.2 GW of renewable energy power by 2022, to provide for the need of the country and create electricity export market. This programme is starting with 1.228 MW from PV power plant in 2013, and concentrated solar (CSP) of 2,475 MW with wind energy of about 516 MW by 2022. To provide employment opportunity the company reiterated that much of the new capacity will be manufactured within the country. This development is the outcome of the country's efficient electric grid an important energy potential that will allow for a significant power generation from renewable sources that may supply the European market.

The above global investment programme is divided into two periods i.e. 2010- 2015 and 2016- 2020 to add a total capacity of over 10 GW. The cost implication is about \$18 billion. It means 5,000 MW to be generated in 2015 to cover the northern interconnected system and 4,500 is to be generated during the period of 2016- 2020 this will rise the installed capacity of the south from 465 MW to 768 MW. A total of 4,219 MW is expected from renewable by 2020, starting with 441 MW capacities in 2015.

Table 1.0: Energy Profile of Nigeria and Algeria, 2010.

COUNTRY	EXISTING ENERGY SUPPLY (PJ)	EXISTING ENERGY NEEDS (MW)	EXISTING ELECTRICITY GENERATION (TWh)	ELECTRICITY USE PER CAPITAL (KWh)	POPULATION (MILLIONS)
Algeria	1664.6	7900	42.81	973	35.4
Nigeria	4532.3	20000	19.8	120	158.8
TOTAL	6196.6	27900	62.61	1093	194.3

Source IRENA, 2012

KEY OF Fig. 1A-4A

1. EXISTING ENERGY SUPPLY (PJ)
2. EXISTING ENERGY NEEDS (MW)
3. EXISTING ELECTRICITY GENERATION (TWh)
4. ELECTRICITY USE PER CAPITAL (KWh)
5. POPULATION (MILLIONS)

Figure 1A-4A below are derived from above Table 1.0.

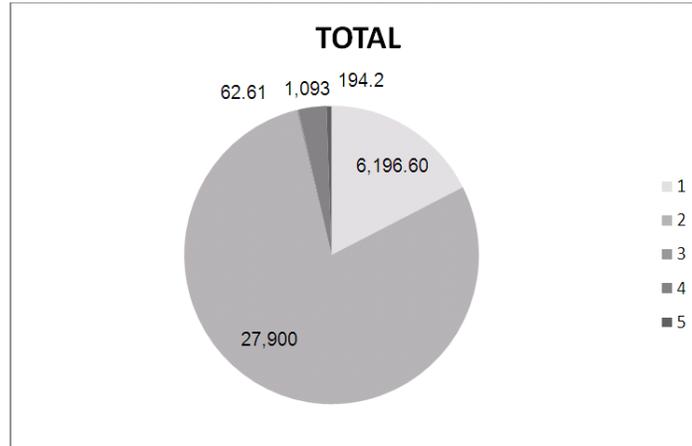


Fig. 1A above: This figure is showing the total existing energy supply (PJ), existing energy needs, existing electricity generation, existing electricity per capita (Kwh) and the total population of the two countries.

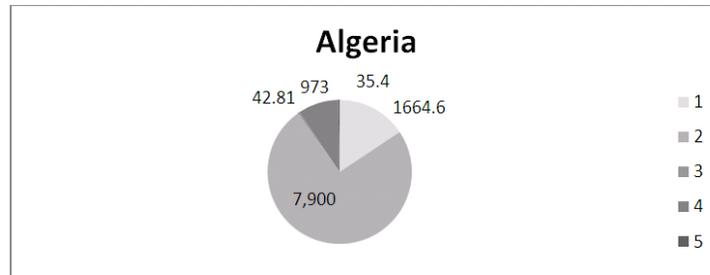


Fig. 2A above: Is showing the total existing energy supply (PJ), existing energy needs (MW), existing electricity generated (TWh), existing electricity use per capita (KWh) and population of Algeria.

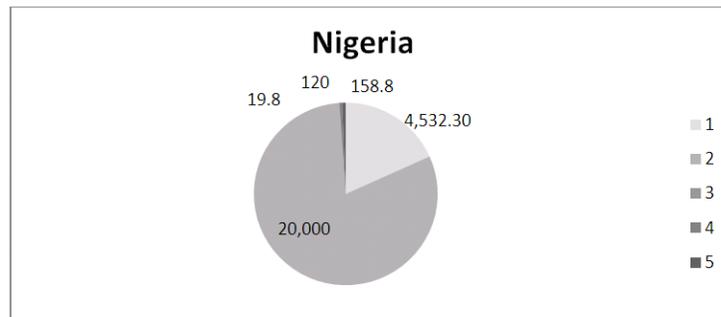


Fig. 3A above: Is showing the total existing energy supply (PJ), existing energy needs (MW), existing electricity generated (TWh), exiting electricity use per capita (KWh), and population of Nigeria.

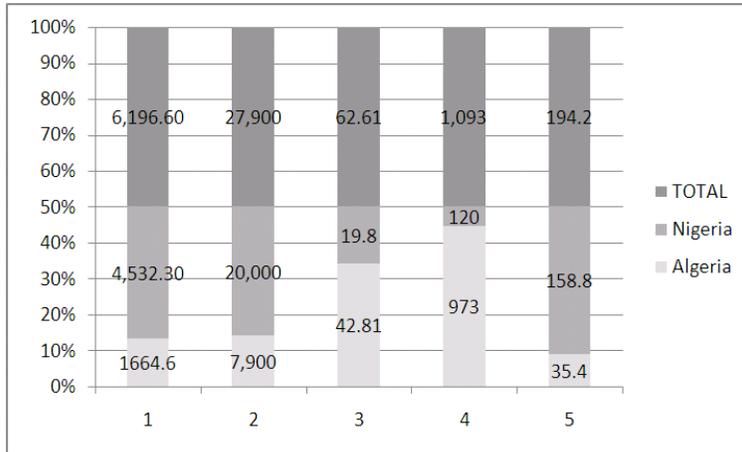


Fig. 4A above: Is showing the existing energy Supply (PJ), existing needs (MW), existing electricity generation (TWh), existing electricity use per capita (KWh) and population of the two countries by percentage.

Table 2: Shows the future projection in the Nigeria and Algeria electricity by Percentage in new renewable energy.

COUNTRY	2020 (Percentage)	2030 (Percentage)
Nigeria	18	20
Algeria	5	20
TOTAL	23	40

Key of the Fig below

1. 2020 (Percentage)
2. 2030 (Percentage)

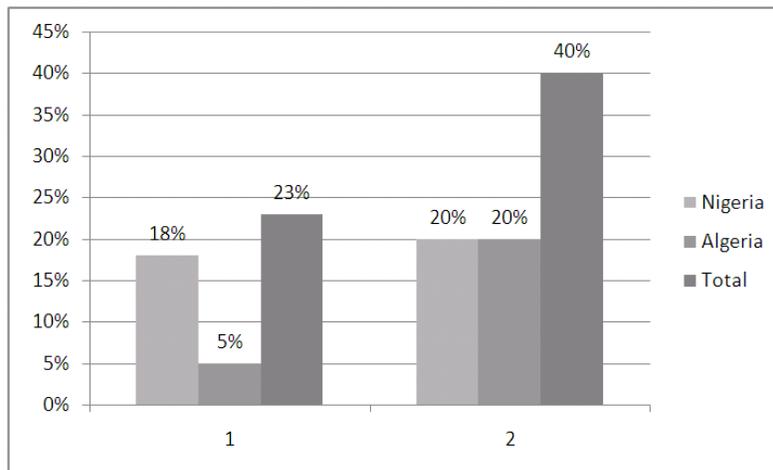


Fig. 1B above: Is showing the present and the future projection in Nigeria and Algeria electricity by percentage in new renewable energy.

Renewable Energy Development:

In promoting the generation of renewable energy to support electricity in these countries, certain facts are needed to be elaborated. The countries are composed of pretty less developed and partly developing economy. The existence of poverty, illiteracy, poor governance and poor method of exploitation of the natural resources without regard to the environment contribute to its underdevelopment. It might be difficult to introduce a cleaner technology in exploitation of the resources and for the development of new renewable energy sources. It may be due to cost implications and the need to generate more revenue by these countries that are richly endowed with natural resources but poorly managed.

It is of interest to know that the present high standard of living in the developed countries is due to the high per capita consumption of energy, mostly from the constants supply of electricity. The present generation of

energy for electricity in these countries is through fossil fuels and the traditional biomass, which are not sustainable. The production has an adverse effect on the environment, thereby causing harm to human and their properties. The effect of the harm happens through CO₂ emission and causes disruption on the earth. It is of importance to know that fossil fuels have limit presses within which they will not be available enough for the consumption of human nature forever.

Based on the above, one can say there is a pressing need to explore and maximise alternative and renewable sources. Several studies have indicated that for the high standard of living and for the purposes of reliability and sustainability of energy supply for electricity can be done through renewable energy. This has been a success story in many countries especially in the countries of the European Union where countries are targeting the year 2040 that Europe might have 40% of its energy needs met by various renewable energy sources. Also, with the information available it has been shown from different sources that the world has enough new renewable energy sources that are sufficient for the whole world to benefit from without any detriment to the future generations or to the environment. A good example is the solar radiation available on the earth on a daily basis, which alone provides enough energy to be consumed worldwide for one complete year if captured.

The two countries should turn to renewable energy for their economic development. They are sources that can be captured with modern technology to generate energy for electricity; this will reduce the greenhouse (GHG) emission, though the countries are not part of those that is mandatory for them to reduce GHG. They renewables have to be exploited to reduce dependence on the imported fossil fuel for energy that is done on daily bases. They have double benefit in form of generating electricity and employment. They have to be captured to reduce high prices of fossil fuels that the world is experiencing today. The development of new renewable energy in Nigeria and Algeria has some identified barriers and impediment that can be as follows:

A) Renewable energy is expensive and capital intensive to be financed, normally at the beginning of its development. But as the development goes on cost generation declines. It is advisable for government to encourage investors in its generation in developing countries.

B) The technology innovation that needs to be developed, tested and transferred has to be done in collaboration with the developed nations. Developed nations should come to aid the least developed and developing nations for the purposes of renewable energy generation. For example, the developed nations have technology that stand the test of time that can be transfer through understanding and agreement for better growth of the African countries.

C) Other facts that are very important and most common among the countries are the problem of institutional, political and legislative barriers. These need mass education and capacity building and can be done at three stages, top policy makers (that include legislators) and business investors, institution of higher learning and the general public in the country embarking on the advocacy.

D) The problems of insufficient grid capacity should be solved through government and private participation. And development of renewable, help in providing electricity in villages off grid for rural development.

Certain ways can also be adopted to enhance RES development in Nigeria, and Algeria. These are some methods applied by the European Union, and they are possible ways to be applicable by the developing nations. These include:

A) Setting of target by countries to be achieved within a period of time and the commitment of meeting up those targets.

B) Financial subsidies given on fossil fuel should be reduced gently and move to support the generation of RES, equally standard of living be improve to ordinary citizens.

C) Clean Development Mechanism (CDM) of the Kyoto Protocol that has been approved in Doha to continue till 2020 should be practice by the countries. The developing countries are benefiting from it. A practical example is what Germany is doing with Malaysia by upgrading their generating engine; the benefit is from three angles. (1) Modern are benefited for efficiency by developing countries; (2) The developed countries get less CO₂ carbon dioxide credited to them and (3) The environment will benefit with less pollution.

D) Government and private sector jointly to support RES for sustainable development; and

E) Cooperating among members' countries in development of a continental grid of sufficient capacity by connecting to remote renewable sources.

Consequent upon this, RES are cleaner and mostly at zero CO₂ emission compared to the fossil fuels. They are sustainable, reliable and efficient and can be captured to be used for energy security through storage. The mother earth is not destroyed as in the case of fossil fuel during exploitation, with no adverse effect on the environment. There is no air, noise and water pollution during generation. Renewable Energy sources (RES) have no carbon and no gas flaring like in the crude oil exploitation. RES are easier in energy conservation and cleaner in storage system.

Conclusion:

Nigeria and Algeria must be encouraged, by all means, in energy generation through renewable sources by the government, private sectors and multinationals. This can only be done through a strong and stable energy

policy and supported by a legal framework that will guarantee appropriate investment. Presently, Nigeria has no law governing energy generation through renewable sources. All the energy policies are absolute and overdue for update since 2007; therefore, government should quickly do something about it.

On the contrary, Algeria has three laws governing the generation of renewable energy: The Energy Management Act, 1999, the Laws on Electricity and Public distribution of Gas pipeline 2002 and the Executive decree on the costs of diversification of electricity production 2004. The country is very slow in renewable energy development and out of the 0.8 per cent renewable energy generated only 0.02 per cent is used for producing electricity. This battle-nick should be removed through support from the multinationals and the developed countries.

In order to have an optimal result, the government of Nigeria and Algeria must have political will to encourage investment in this sector. Likewise, the collaborating developed nation's government must be willing to assist through its technology, upgrade the existing plant to be less pollutant just like what Germany and China did with Malaysia. This means that Clean Development Mechanism (CDM) of the Kyoto protocol that has been retained in the new agreement should quickly start working between developing and developed countries since the protocol has been extended.

Governments and private partnerships must be encouraged to generate energy through renewable sources. The partnership should be given legal backing in the law governing the generation of energy through new renewable sources.

Finally, governments should be as transparent as possible through capacity building and the application of justice must be made clear to encourage participation. Bad practices must be identified and avoided by all the parties involved in the energy generation. The two countries must have strong legal backings that are enforceable with a plan of action to be followed and agreed upon. The system to be adopted can be like that of European Union Directives with targets that must be achievable within certain period of time.

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