

## **Sustainable Development of Renewable Energy Technology in Nigeria: An Overview**

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### **Abstract**

Nigeria has set for herself the target of being within the 20 largest economies in the world by 2020; within the challenges of climate change, rising population and unemployment as well as low access to energy. For the economy to grow at the targeted rate of 11% - 13%, studies by the Energy Commission of Nigeria show that huge amount of energy would be required which would have to be sourced from a basket of fossil, nuclear and renewable energy sources. Development and Sustenance of Renewable Energy have being identified to be the most suitable. Renewable Energy is derived from a source that can be regenerated within a reasonably short time through natural sources. These sources include Solar, Wind, Hydro, biomass, Geothermal etc. Nigeria has huge oil and gas reserves of about 37 billion barrels and 87 TSCF, respectively; and the largest oil producer and exporter in Africa. It has therefore over 70% of its foreign earnings from petroleum hence the need for promoting renewable energy in such an economy, since petroleum can finish on consumption. Energy from these renewable sources can be transformed to supplement the final energy from conventional energy needed to grow the economy in a sustainable manner. Indeed, renewable electricity is expected to contribute up to 20% of the total fuel demand. Africa and indeed Nigeria is well positioned to embark on a clean energy growth path and climate-compatible development this paper therefore recommends that renewable energy technologies be viewed as an opportunity for stronger private sector involvement, accelerating growth and reducing poverty as well as embarking on a green growth path.

**Keywords:** Sustainable Development, Renewable Energy Technology, Nigeria.

**1. Introduction**

Energy is fundamental to human activities. All human activities depend on one form of energy or another. It is a very important catalyst for economic development of any country. Despite the importance of energy to socio-economic development, Nigeria has not being able to generate the maximum required amount of energy it needs for her population.

Nigeria had a population of 140 million in 2006 and grows at 3-2% annually (NBS, 2011). The land area is vast and estimated at 79.4 million hectares (ECN, 2005). It is endowed with huge and diverse energy resource, unevenly distributed within the country [ fig. 1]. Crude oil, with reserves of about 36.2 billion barrels, and natural gas with reserves of about 187TSCF mainly in the Niger Delta region of. Coal resource with reserves of about 2.7 billion tones, mainly found within the South Eastern and central region of the country. The hydropower resource, with potentials of about 14,750mw, is found mainly in the northern and central regions (Sambo, 2011; ECN, 2005). Solar energy resource is available in all parts of the country with intensities ranging between 4.0kwh/ /day and 6.5kwh/ /day and (Ojosu, 1990) as is indicated in Table 1. However, the Northern part is more endowed with solar energy and therefore more suitable for solar electricity generation systems. The solar radiation map produced by European Union (EU).



Source: GENI (2013)

**Fig. 1:** Nigerian Energy summary/National Energy Grid index..

These huge energy resources are technically convertible to electricity, which is one of the most suitable forms of final energies required to drive the economy. However, the grid connected electricity in Nigeria is currently at about a paltry 4000mw only, produced mainly from natural gas fired power plants and large hydropower. Also, despite the high intensities of solar energy and its suitability for driving sustainable development, it is yet to be used for electricity generation and grid-connected.

Sources of renewable energy

Ajibola (2011) identify that the word renewable emanated from renew which implies “to give new strength to something”. Renewable Energy thus mean: Energy that can be given new strength to. Sources of renewable energy include the following;

## **2. WAVE**

Waves are created by the wind blowing across the sea and by the gravitational force of the moon. Wave power uses the heat that comes from deep rocks under the surface of the Earth. The temperature of the Earth increases towards its centre. The hot water or steam that comes from deep within our planet can be used to make electricity.

## **3. Hydro-electric**

Hydro-electricity is generated from running water. Dams are built across lake or river in a valley to trap water. The water flows through tunnels and turns the turbines which make electricity.

## **4. Solar**

The Sun releases an amazing amount of energy due to the nuclear fusion of hydrogen taking place within its core. Solar panels, called photovoltaic cells are used to convert the Sun's energy into electricity. The Sun can also be used to heat water passing through special solar collectors.

## **5. Wind**

Wind is made when the Sun heats the Earth and the area above land gets hotter than the area above water. The hot air above land rises upwards leaving an area of low pressure. Cooler air moves into this area of low pressure making wind which we use to turn wind turbines and make electricity. Wind used to be used to turn windmills to grind wheat into flour.

## 6. Biomass

Biomass uses the energy from plants and waste materials to make electricity. For example, wood or animal droppings can be burnt to make steam that turns turbines to make electricity. Even though Biomass is form of renewable energy, Biomass combustion emits  $CO_2$  and other pollutants.

## 7. Tidal

Tidal energy comes from the movement of water in the sea by the tides. These tides happen twice a day. The flow of water that is created by the tides is used to turn generators that make electricity.

## 8. Energy Resource in Nigeria

Nigeria is a great country of proven energy resources. Sustainable energy development must entail energy security, affordable, low carbon, renewable and environmentally friendly energy systems. The current pattern of energy production and utilization shows a sharp gap in sustainable development and threatens biodiversity and other environmental concerns.

Energy resources may be identified as fossil, nuclear or renewable energy. Energy, and indeed power, is essential and necessary for the creation of national wealth and economic growth. The form of energy available to end-users in the economy – household, industrial, transportation and services sectors, following conversion from primary energy carriers – crude oil, natural gas, coal, tar sands, hydropower, solar radiation, wind, biomass etc is referred to as final energy.

The final energies are mainly:

- Electricity
- Fuel; and
- Process heat.

## 9. Energy Production and Utilization in Nigeria

S/No.	Resources	Reserve		Production	Domestic Utilization (Natural Units)
		Natural Units	Energy Units (Btoe*)		
1.	Crude oil	35 billion Barrels	4.76	2.5 million Barrels/day	450,000 Barrels/day
2.	Natural gas	187 trillion SCF	4.32	6 billion SCF/day	3.4 billion SCF/day

3.	Coal and Lignite	2.175 billion Tones	1.92	Negligible	Negligible
4.	Tar sand	31 billion Barrel of Equivalent	4.22	-	-
5.	Nuclear Element	Not yet Quantified	-	-	-

Source: ECN

## 10. Renewable Energy Technologies in Nigeria

### 10.1 Solar Energy

Sambo (2011) states that there are many solar thermal systems especially solar water heaters and solar dryers in use in many parts of the country. Solar cookers, solar stills, solar chicken brooders and solar thermal refrigerators developed by research centres and confirmed to be of practical applications. However solar photovoltaic applications have wider current installation in the country and these include solar photovoltaic water pumping systems, solar powered vaccine refrigerators as well as telecommunication repeater stations that are powered by solar photovoltaics. There are also solar photovoltaic power plants that are providing electricity to entire villages and also others that are powering on stand-alone basis, some specific projects such as rural health centres television viewing centres.

### 10.2 Biomass

Many versions of efficient wood-burning and charcoal stoves have been developed and are being used in many parts of the country with the overall objective of curtailing the amount of trees that are perennially cut to provide fuel wood and charcoal. Biogas digesters, which are capable of producing biogas that could be used for domestic and industrial uses, have been developed in many parts of the country.

### 10.3 Wind Energy

Wind energy used to be relied upon in the 1950s and 1960s for provision of water in many locations of the northern part of the country. However this was largely abandoned when the development of petroleum products reached advanced stages. The development of the Poldow wind pump in Bauchi using locally available materials is surely a move in the right direction. Of course it should be mentioned that there a few modern wind water pumps in some parts of the country. There is also one wind electricity generator currently supplying electricity from wind energy at Sayya Gidan Gada in Sokoto State.

## 11. Renewable Energy Technologies Ready for Local Adoption

Sambo (2011) identify that a large number of renewable energy devices have been developed by Nigerian researchers in various parts of the country. The devices which

are ready for incorporation into the economy especially for rural areas as follows:  
Solar Cookers: These are box-type arrangements where most local dishes can be cooked within one hour under average sunshine conditions.

### **12.Solar Water Heater**

The heaters which are based on flat-plate collectors with appropriate storage units can produce water at temperature of up to 80°C will find applications in hospitals, hotels, industry and private residences and are capable of significant reduction of electricity bills.

### **13.Solar Dryers**

Both portable cabinet dryers, for individual private use, as well as large-scale units, for community utilization, have been developed. The dryers who typically attain temperatures of up to 60-70°C are suitable for drying a variety of agricultural produce.

### **14.Solar Stills**

Solar stills are designed to produce distilled water from brackish water and will be useful for hospitals, industry and laboratories. When sized appropriately they can provide for the needs of comprehensive health centres of semi-urban localities.

### **15.Improved Wood-Burning Stoves**

Clay-based improved cook stoves, of various designed have been developed and these conserve the amount of fuel wood consumed by up to 50%, lead to faster cooking and with the attachment of chimneys they allow for organized exit of smoke and consequently reduce smoke inhalation.

### **12.4 Production of Biogas**

With biogas digesters, which are typically constructed from sheet metal or empty drums and fed with slurries of animal dung they can produce biogas and after 2-3 days. This gas which has a reasonable content of methane is combustible and can be relied upon for the production of gas for domestic cooking. It can also be used for powering internal combustion engines for electricity generation in rural areas.

### **16.Wind for Electricity Generation**

In Nigeria, for quite some time, only laboratory trials have been made in the area of using wind for electricity generation. Such trails have been made with models of three-bladed aero turbines and the results obtained indicate the potential for stand-alone utilization especially in the Sahelian zone as well as the coastal areas of the country.

Recently, however, an increasing number of wind water pumping sets and wind electricity conversion systems have been installed.

### **17.Challenges of Renewable Energy in Nigeria**

- Inadequate funds and lack of access to available funds;
- High upfront cost of renewable energy technologies;
- Lack of appropriate institutional framework;
- Inadequate institutional capacity;
- Inadequate local technical expertise;
- Lack of regulatory and technical standards;
- Lack of attractive incentives;
- Low public awareness;

### **18.Summary and Conclusion**

Nigeria is endowed with sources of renewable energy such as solar, wind, biomass, hydropower, geothermal and ocean waves in addition to fossil fuel sources.

Energy from these renewable sources can be transformed to supplement the final energy, from conventional energy, needed to grow the economy in a sustainable manner. Indeed, renewable electricity is expected to contribute up to 20% in meeting the total electricity demand, while biofuel (bioethanol and biodiesel) is to meet between 10% and 20% of the total fuel demand. Firewood will continue to play a significant role in meeting the domestic heat requirements of many Nigerians; however, its contribution is expected to decline over the years.

Consistent political will, planned appropriate activities and adequate incentives backed by legal instruments are imperative to support the penetration of these new energy sources into the nation's energy supply mix, in view of its relative high initial investment costs.

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