

Renewable Energy Sources. Its Benefits, Potentials and Challenges in Nigeria

Chilakpu, Kingsley Ogueri

Department of Agricultural Engineering, Federal University of Technology, P.M.B 1526, Owerri, Imo State

Abstract.

Increase in national population, rise in industrial activities and global climatic changes among other factors have given rise to high energy demand in our homes and industries. Fossil fuel can no longer meet the energy requirements due to their scarcity and rising cost. Consequently, the need to have an alternative energy source in Nigeria is a priority issue. To achieve this laudable goal, some identified challenges must be properly addressed to pave way for the enormous benefits of using renewable energy sources. This paper will highlight major benefits of using renewable energy technology and address some challenges militating against its full operation in Nigeria.

Keywords : Green-fuel, fossil, geothermal, biomass, and soil remediation.

INTRODUCTION

Nigeria is one of the leading petroleum producing and exporting countries of the world. Prior to the discovery of commercial quantity of petroleum in 1956, Nigeria depended on its Agricultural produce and over 2.7 billion tones of coal reserves. Coal mining declined from a peak of 0.91 million tones in 1959 to no production in 2001⁷. Despite the countries status as the largest oil producer in Africa, greater amount of her domestic oil need is imported. Researches have shown that at the beginning of 2004, the global oil and gas reserves stood at about 1.27 trillion barrels of oil and 6,100 trillion cubic feet of natural gas. Nigeria's fossil energy resources are stated on table 1. The consumption level was found to be about 85 million barrels per day of oil and 260 billion cubic feet of natural gas per day. Given the ever increasing world population and industrialization, these represent about 40 years of oil and 64 years of natural gas consumption⁷.

Nigeria is the 17th populous nation of the world with about 150 million people this is expected to reach about 170 million by the end of 2013. Over 60% of her population has no access to electricity⁴. The shortage in energy supply is majorly due to inadequate supply of power generated from the few functional hydrodams and the high distribution cost over the 924,000 km² land area of the Nation. This situation has forced many homes and industries to depend on fossil fuel generating plants with their attending noise and atmospheric pollutions. The giant of Africa, and most populous black nation, depending on fossil fuel electric generators to providing 60% of her energy needs is unrealistic.

Thus, the diminishing petroleum reserves, and the adverse environmental consequences of exhaust gases from fossil fuel has attracted greater attention and call for a more environmentally friendly and renewable energy sources. Renewable energy is a clean form of energy with little or no environmental pollution. They are from natural occurring sources like; water, sun, wind, the earth crust and biological materials. Hydro powers are generated by building a dam across flowing water to drive turbines which converts mechanical energy into electrical energy. The sun energy is harnessed by the use of photovoltaic system to trap energy from the sun during the day and subsequently convert the trapped energy into electrical or heat energy type for domestic or industrial uses. One of the most widely used sources of renewable energy is the wind energy. This involves the use of wind power to drive a turbine which converts mechanical energy into electrical energy. Biomass is the abbreviated form for biological materials (solid). This include the burning of fire woods, coals etc. to generate energy for heating and electrical purposes. Examples are in charcoal train engines where heat energy is converted to mechanical energy with the use of biological materials (wood/charcoal). Biogas, otherwise known as green fuel is the product of using biological materials such as plant's oil or animal fats to produce diesel. Recently, the technology of biodiesel have been the focus of many research works because of its huge benefits, which includes the availability of raw material and its sustainability. The laboratory preparation of biological fuel involves among other methods the esterification and transesterification of raw plant oil or animal fat into ester compound and glycerol³. Geothermal energy sources have to do with the harnessing of the earth's abundant underground heat for the purpose of generating electricity. This form of energy sources is not widely in use in third world counties due to the high cost implications and the advanced technology involved. Nigeria has the capacity and ability to combine the use of two or more if not all these renewable energy source to address the energy requirement of this nation.

Table 1; Fossil Type Energy Sources in Nigeria

S/N	RESOURCE TYPE	RESERVES
1	Crude oil	36.2 billion barrels
2	Natural gas	187 trillion SCF
3	Coal and lignite	2.7 billion tones
4	Tar sand	31 billion barrels of oil equivalent

Source; (Sambo,2010)

BENEFITS

The benefits associated with the use of “clean energy” sources are enormous. Environmental analysts have shown that the use of renewable energy sources have contributed to the reduction of green house gases by at least 3.2kg carbon dioxide equivalent per one kilogram of biodiesel. It is well established that there is about 99% reduction for sulphur oxide emission, 20% reduction for carbon, 32% reduction for hydro carbons, 50% reduction in soot and 39% reduction for particulate matters⁵. Beside the unequalled environmental protection records of renewable energy sources, they are good foreign exchange earners. The technical expertise and energy provision services could be exported as is the case in developed countries of the world. The energy information administration forecasts global renewable energy consumption to rise from 9.9 percent in 2005 to 15 percent in 2035. It is also on record that at least 96 countries have adopted policies to promote renewable electricity with approximately half being in developing countries⁸.

Renewable energy also improves energy security by providing greater diversity in the overall energy mix, thereby reducing dependence on the non-renewable energy source. This will guarantee Nigerian’s position as a member of petroleum producing and exporting nation. Beside the positive social and economic developments attracted by renewable energy, it is also a means of providing affordable energy to rural areas without access to centralized energy system. No doubt, renewable energy programme if vigorously pursued by Nigeria will be a means of local job creation for the youth and will kick-start new domestic industries that can support growing international market for renewable energy technologies. The sustainability of this form of energy source which never runs-out carves a notch for itself and places it far above non- renewable sources of energy in this nation.

POTENTIALS

Renewable energy sources have the potential to provide enough primary energy or electricity to meet our national demand as shown in table 2. However, the development and utilization of clean energy is dependent on having the technological know-how, right policies, financing and infrastructure in place to ensure access to the abundant energy source with low or zero fuel and maintenance cost. The Nigeria’s energy demand as shown in table 3 cannot be met with her current energy production statistics in as shown in table 4.

Table 2, Renewable Energy Potentials in Nigeria.

RESOURCE	CAPACITY	REMARK
Big hydro power	11,500MW	Only 1972 MW exploited
Small hydro power	3,500MW	Only about 64.2 MW exploited
Solar	3.5KW/m/day to 7.0KW/m/day	
Sunshine hours	4 to 7.5 hrs. / day	
Wind	2 to 4 m/s at 10m height mainland	
Biomass	fuel wood	11 million hectares of forest & woodland
	Animal waste	245 million assorted (2001)
	Energy crops & agric residue	72 million hectares of agric land

Source, central bank of Nigeria (2007)

Table 3. Projected Sectorial Energy Demand In Nigeria Based On 7% Growth Rate.

S/N	SECTOR (%)	2005 BASE YEAR	2010	2015	2020	2025	2030
1	Industry	13.81	28.92	37.01	40.75	44.69	48.78
2	Transport	30.80	27.62	24.56	22.92	22.27	21.62
3	Household	49.29	38.16	33.05	30.62	27.27	24.12
4	services	6.13	5.30	5.39	5.72	5.78	5.49
	Total Mtoe	32.14	49.92	76.45	112.67	158.95	224.54

Source. Energy commission of Nigeria (2008)

Table 4, Energy Production in Nigeria.

S/N	TYPE	2003	2004	2005	2006	2007
1	Coal(million tons	0	0	0	0	0
2	Oil (million barrels/day)	2.3	2.5	2.5	2.2	2.2
3	Natural gas(billion M ³) (Flared %)	52.75 44.1	59.76 40.4	58,35 39.4	61,80 36.1	70.1 31.1
4	Electricity generation(billion trillion WH	22.03	22.92	24.22	23.47	16.94

Source. National bureau of statistics (2007)

Due to the broad spectrum and peculiarities of renewable energy sources, it will be more appropriate to examine most of the sources mentioned above on their individual merits.

SOLAR ENERGY

In 2003, the Federal Government approved a national energy policy, which encourages the effective utilization of the country's renewable energy resources. This has positioned her for the integration of solar energy into the nation's energy mix. Nigeria lies within latitude 4.32°N and 14°N and longitude 2.72°E and 14.64°E. The sun radiates energy at the rate of about 3.8×10^{23} KW/s and Nigeria receives about 4.85×10^{12} KW/h of energy per day¹. This comes to about 4-7.5 hours per day of sun light on the average. With this enormous sustainable and free clean energy source, this nation can achieve enough in the areas of – agricultural product drying, cooking/boilers and generation of electricity for domestic and industrial uses.

HYDRO POWER

Nigeria is blessed naturally with good flowing waters. Policies are in place allowing private sector participation in hydro power generation. Our major hindrances here are technological expertise and financial constrain. Between 1968 and 1990, this nation can only boast of three functional major hydro powers at Kainji, Jebba and Shiroro.(table 5) It is sad to note that all these plants are running below their installed capacities due to political and technological reasons which include dependence on foreign firms for the maintenance of these dams and employment of unqualified management staff based on ethical or political affiliations. These have resulted to serious energy shortage in the nation. Hydro power source is the major source of electricity for industrial and domestic purposes in Nigeria. Despite the huge financial involvement for its installation, the economic benefits are overwhelming.

Table 5, Major Hydro Power Plants in Nigeria

s/n	Name Of Hydro Power Plant	Year Established	Installed capacity (MW)	Availability as of June 2010(MW)
1.	Kainji	1968	760	465
2.	Jebba	1986	578	482
3.	Shiroro	1990	600	450
		Total	1,938MW	1,397MW

Source; (Sambo, 2010)

WIND ENERGY

Wind has consistently been one of the fastest growing renewable energy markets in the world adding nearly 36GW in 2010. In terms of required wealth, technical potential for world development, wind power exceeds global electricity demand. Technically wind is of higher projected potential than hydro power⁴. Nigeria with about 924,000 KM² of land mass including desert and semi arid areas has enough un-obstructed spaces to install wind power plants that can serve its energy needs.

BIO ENERGY

Bio mass and biodiesel energy sources are one of the most environmental friendly sources of energy in recent times. Bio mass provides about 10% of world's primary energy supplies⁴. Biodiesel sources in addition to meeting our social economic needs, contributes positively to agriculture through natural remediation of land. Nigeria has vast uncultivated agricultural land to meet her green fuel needs, which in turn provide employment for her teaming unemployed working population. Federal Government renewable energy policy of 2003 creates enabling environment for profitable investment for both public and private investors in renewable energy sources.

CHALLENGIES

The enormous physical potentials of renewable energy notwithstanding, the development of these energy sources

are highly dependent on some key factors which include;-

- The right economy,
- Available technology.
- Political condition of a nation.
- Weather conditions.

When the right economic policies are in place, investors will have interest and confidence in investing in our economy. The bank lending rates must be attractive. Adequate competition protection should be available for new firms. The Federal Government in her budgetary provisions should create a smooth frame work for the operations of renewable energy programs.

In the technical areas, exchange programs should be organized with more advanced countries for an effective technological transfer. This will guard against inadequate staff training and man power development from stalling the growth of any renewable energy venture.

More so, unstable government and security challenges in any nation will deprive her of good investment opportunities. Recently, the international community rated Nigeria as one of the most unsafe Nations of Africa. This is because of the menace of different armed groups in northern and southern parts of the nation. International opinions of this nature pose a great challenge to the economic and infrastructural development of any nation.

Renewable energy sources have their root from nature; this poses a challenge in terms of controlling the basic factors playing out in the system. The management of wind velocity, rainfall or sun intensity at different times the year poses a great challenge in the renewable energy sector

To address these and more issues, the relevant authorities in Nigeria should appreciate the huge renewable energy potentials in the nation while making policies affecting this sector. Any existing policies should be reviewed and passed into an energy law for proper implementation.

REFERENCE

1. Adeyemo, S.B. (1997), "Estimation of Direct Solar Radiation Intensities" Nigeria society of Engineers Technical Transaction. 32 (1-9).
2. Central bank of Nigeria, (2007) "annual report and statement of accounts"
3. Chilakpu, K.O, (2013). Jatropha Seed Based Biodiesel Production Using Modified Batch-Reactor and evaluation in a Single-Cylinder Engine" PhD thesis, Federal university of technology Owerri.
4. Douglas, Arent; (2012), Energy and National security program. Center for strategic and international studies. Washington DC.
5. Korbitz, W. (1999); "Biodiesel production in Europe and North America and Encouraging prospects" Austrian biofuel institute Vienna Austria.
6. National Bureau Of Statistics,(2007)."Annual Abstract of Statistics.
7. Palligamai, T; Vasudevan and Michael Briggs (2008), – "Biodiesel production – current state of the art and challenges". Society for industrial microbiology.
8. Sambo, A.S. (2010), "Renewable energy development in Nigeria". Paper presented at the world future council/strategy workshop on renewable energy, Accra, Ghana

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:

<http://www.iiste.org>

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: <http://www.iiste.org/journals/> All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: <http://www.iiste.org/book/>

Academic conference: <http://www.iiste.org/conference/upcoming-conferences-call-for-paper/>

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

