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Alternative Energy, Climate Change and the Future (Nigeria situation)

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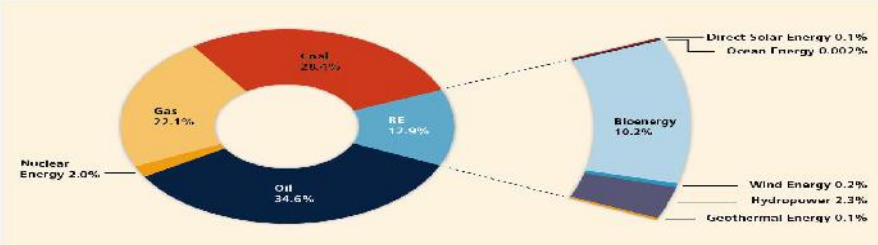
Abstract: **- Energy is a basic human need and without it, everything would come to a standstill. It is a necessary factor in fostering human development and economic growth in a secure, affordable, reliable, clean, and sustainable energy supply. Presently, we face monumental challenges: global warming, the waning of natural resources, explosions in population growth, increasing energy demand, rising energy prices, and unequal distribution of energy sources. These factors contribute to the urgent need to transform the energy sector - which primarily relies on fossil fuels to an alternative energy sources (i.e. - to one that uses renewable energies and energy efficient measures)(1). This paper highlights the effects of climate change in relation to the energy sources use pattern and proffer ways of mitigating the devastating consequences in the continued patronage of the conventional sources of energy for a friendly and sustainable future.**

Keywords: Alternative energy, Renewable energy, Climate change, Greenhouse effect.

I. INTRODUCTION

All societies require energy services to meet basic human needs (e.g., lighting, cooking, space comfort, mobility and communication) and to serve productive processes. Since approximately1850, global use of fossil fuels (coal, oil and gas) has increased to dominate energy supply, leading to a rapid growth in carbon dioxide (CO2) emissions. Greenhouse gas (GHG) emissions resulting from the provision of energy services have contributed significantly to the historic increase in atmospheric GHG concentrations **(2)**

Fig.1 The current global energy system is dominated by fossil fuels.



Shares of energy sources in total global primary energy supply in 2008, (2)

Research has also shown that the earth has twice as much carbon in it than it had two hundred years ago with much of the increment occurring within the last 30 years. This carbon is being generated by human activities chiefly from burning of fossil fuel. With increasing energy demand, the tendency to burn more fossil fuel to meet this demand will only increase, thus causing a rapid increase of Green House Gases (GHG) in the atmosphere"**(3).**

A. *Impact of Fossil Energy Production on the Nigerian Environment*

The major environmental problems related to energy production, distribution and consumption in the country are mainly deforestation and pollution. From available statistics, the nation's 15 million hectares of forest and woodland reserves could be depleted within the next fifty years. These would result in negative

impacts on the environment, such as soil erosion, desertification, loss of biodiversity, micro-climatic change and flooding. Most of these impacts are already evident in different ecological zones in the country, amounting to huge economic losses**.**

Pollution is the other major environmental concern. Combustion of fossil fuels, especially in the transport and industrial sectors, contributes greatly to air pollution in our major cities. The combustion products (CO2, N2O, etc) are greenhouse gases (GHG) and lead to global warming, with attendant negative consequences on agriculture, water supply, forest resources, sea level rise, health, etc. Another source of air pollution is the continued flaring of large volumes of natural gas in the oil fields in the Niger Delta. Government has thus decided that gas flaring should stop **(4).**

II. THE CONCEPT OF CLIMATE CHANGE

Climate change *is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years*. Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as "global warming".

While the global community wrestles with climate change, it must also grapple with a host of issues resulting from current patterns of energy consumption, including energy security, pollution, and enduring energy poverty. The current fossil fuel-heavy energy system is not only environmentally unsustainable, but also highly inequitable, leaving some 1.4 billion people without access to electricity (5). Moreover, much of this growing energy demand is occurring in developing countries, where rising fossil fuel prices and resources constraints are putting additional pressure on the environment and the economy. Fortunately, there is another way. Once considered an "unrealistic" **alternative,** today renewable energies are a growing presence on the global scene. In 2010, **(UNEP)** new investments in renewable energies reached a record high of US$ 211 billion, with noticeable growth in emerging economies. While there is much progress to be made, decreasing costs and increasing deployment experience are making renewables more and more competitive with fossil fuels, especially when the latter's negative externalities, like pollution and health impacts, are taken into account. But in order to move towards a greener energy path, governments and local institutions will need to increase their involvement.

At the moment, populations of low- and middle-income countries have a much lower impact on the global environment. For example, Per capita emissions of GHGs in the USA are almost seven times higher than in China and about 19 times higher than any Africa Country that necessitates prompt actions to reduce GHG emissions in all developed countries ***(Greenpeace.org)***. However, while the impact of each individual citizen in developing countries will remain lower than in developed country counterparts for the foreseeable future, the former populations are continuously growing and urbanizing with a resultant increase in consumption rates. For instance, China is poised to overtake the USA as the largest single emitter of carbon dioxide in the nearest future**.** Decisions made in developing-country cities in the next few decades will therefore be among the most important determinants of new and future local and global environmental stresses.

A. Climate Change Mitigation

Climate Change Mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour. It can be as complex as a plan for a new city or as a simple as improvements to a cook stove design. Efforts underway around the world range from high-tech subway systems to bicycling paths and walkways. Protecting natural carbon sinks like forests and oceans, or creating new sinks through silviculture or green agriculture are also elements of mitigation. UNEP takes a multifaceted approach towards climate change mitigation in its efforts to help countries move towards a low-carbon society**.**

B. *Climate Change Mitigation Strategy*

The Global Environmental Facility (GEF 2010-2014) developed a strategy aimed at supporting developing countries and economies in transition to move toward a low-carbon development path through market transformation and investment in environmentally sound, climate-friendly technologies.

1. Promote market transformation for energy efficiency in industry and the building sector.
2. Promote investment in renewable energy technologies.
3. Promote energy efficient, low-carbon transport and urban systems.
4. Promote conservation enhancement of carbon stocks through sustainable management of land use, land-use change, and forestry.
5. Support enabling activities and capacity building.

III. CONCEPT OF ALTERNATIVE ENERGY

Alternative energy *is any source of usable energy that is used to replace fuel sources like coal and oil without the harmful effects to the environment*. At one time nuclear energy was considered an alternative energy source. But times have changed and now nuclear energy has been dropped and energy sources such as wind, solar, biomass, wave and tidal have been added (6)

Table 1.Classification of Energy Sources

S/No	Sources	Examples	Primary Final Energy	Secondary Final Energy
1.	Fossil fuels	Petroleum (oil & gas), coal	Fuel	Heat, electricity
2.	Renewable energy	Solar, wind, biomass, hydro, geothermal e.t.c	Hydro, solar, wind, fuel, heat	Heat, electricity
3.	Nuclear	Uranium, thorium	Heat	Heat, electricity

Source: Goldenberg and Lucon (2010)

A. *Global Renewable Energy Development.*On a global basis, it is estimated that Renewable energy accounted for 12.9% of the total primary energy supply in 2008. The largest renewable energy contributor was biomass (10.2%), with the majority (roughly 60%) being traditional biomass used in cooking and

heating applications in developing countries but with rapidly increasing use of modern biomass as well. Hydropower represented 2.3%, whereas other Renewable energy sources accounted for 0.4 %***).***Renewable energy contributed approximately 19% of global electricity supply (hydropower 16%, other RE 3%) and biofuels contributed 2% of global road transport fuel supply. Traditional biomass 17%, modern biomass 8%, solar thermal and geothermal energy 2% together fuelled 27% of the total global demand for heat ***(The IPCC 2011).***

United Nations target for 2013 is to increase the Renewable energy usage by 50% and reduce the conventional energy source by 50%. The policies shall go in line with the Renewable Energy Master Plan to harmonize them (UNEP).

B. Renewable Energy Sources and Technologies in Nigeria

In twenty years time, Nigeria's population is expected to double and aggregate energy demand will triple **(7).** Conventional energy sources alone will not meet the challenges of an increasing population at affordable costs and in a flexible manner. To meet the rapidly growing demand for energy, and the challenges posed by climate change. There has to be a conscious effort to increasingly include renewable energy into the nation's energy mix.

Renewable energy is energy derived from different sources that regenerates within a relatively short period of time through natural processes. The Nigerian renewable energy resources base is enormous and these include: solar, wind, hydro, hydrogen and other renewable energy sources (geothermal, tidal and ocean waves, etc.)

Renewable energy has the potential to create jobs, improve livelihoods and open up the market in rural areas. Increasing demand for rural water supply, lighting, health services and the needs of micro enterprises are already driving the market for PVs. This trend will continue to drive small hydro and wind power plants if the supporting legislative and regulatory structures are put in place. For Nigeria, to achieve its goals of sustainable socio-economic development, the need for renewable energy cannot be overemphasized.

Table 2. Nigeria's Renewable Energy Potential

Resource		Potential	Remarks
Large Hydropower		11,250MW	Only 1,792MW exploited
Small Hydropower		3,500MW	Only about 64.2MW exploited
Solar		3.5KW/m/day-7.0KW/m/day	Barely exploited
Sunshine Hours		4-7.5hrs/day	Barely exploited
Wind		2-4m/s @10m height mainland	Not exploited
Biomass fuel wood	Fuel wood	11 million hectares of forest and woodland	Widely exploited
	Animal Waste	61million tonnes/yr	Barely exploited

	Crop residue	97million tonnes/yr	Barely exploited

Source: NNPC-2007(16), FMMSD-2008(15), Sambo, 2010 (11)

1) Hydropower

Hydropower is derived from the potential energy available from water due to a difference in height as well as from kinetic energy of water body. Despite its high initial capital cost, hydropower provides one of the cheapest and cleanest sources of electricity. Hydropower is one of the major sources of base load electricity generation in Nigeria. According to World Bank report on electricity production in Nigeria in 2009, it was revealed that about 22.9% of electricity generated in Nigeria is gotten from hydroelectric sources (8).

Prospects for Hydropower in Nigeria

Nigeria is blessed with rivers and dams that have great potentials for power generation. The two major rivers in Nigeria are River Niger and River Benue, there are however other rivers that can be dammed for electricity generation. The Nigerian government has established seven river basins along the major rivers in the country with each having hydropower potentials. Most of the potentials are however undeveloped as shown by Table 3. Also about 12 states are also endowed with great hydropower potentials as shown in Table 4 below.

Table 3: Overall Distribution of Small-Scaled Hydropower Potential among Seven River Basins **(9). D-Developed, U-Underdeveloped**

S/N	River Basin	Status	Type Capacity					
			Micro No	Cap.(MW)	Mini No	Cap.(MW)	Small No	Cap.(MW)
1	Sokoto-	D	-	-	-	-	1	3.0
	Rima	U	10	3.2	11	8.4	10	29.6
2	Hadeija-	D	-	-	-	-	1	6.0
	Jama'ara	U	8	2.8	20	11.4	7	31.6
3	Chad	D	-	-	-	-	-	-
		U	10	2.8	8	-	2	5.6
4	Niger	D	-	-	-	6.8	-	-
		U	16	6.4	23	-	22	191
5	Upper	D	-	-	-	18.2	-	-
	Benue	U	8	3.2	36	27	25	185.1
6	Lower	D	-	-	-	-	5	19.0

7	Benue Cross River	U D U	11 - 17	4.4 - 7	23 - 6	19.2 - 4.6	17 - 5	138 - 21.8
	Total	D U	- 70	- 24.5	- 126	- 95.6	7 86	28.0 704.1

Table 4: Summary of Small Hydropower Potential Distribution According to States. **(9)**

States	River Basin	Hydropower Potential				
		Total Sites	Developed (MW)	Underdeveloped (MW)	Total (MW)	Capacity
Sokoto	Sokoto-Rima	22	8.0	22.6	30.6	
Katsina	Sokoto-Rima	11	-	8.0	8.0	
Niger	Niger	30	-	117.6	117.6	
Kaduna	Niger	19	-	9.2	59.2	
Kwara	Niger	12	-	38.8	38.8	
Kano	Hadeija-Jama'ara	28	6.0	40.2	46.2	
Borno	Chad	28	-	20.8	20.8	
Bauchi	Upper Benue	20	-	42.6	42.6	
Gongola	Upper Benue	32	-	12.7	162.7	
Plateau	Lower Benue	38	18.0	92.4	110.4	
Benue	Lower Benue	19	-	9.2	69.2	
Cross River	Cross River	18	-	28.1	28.1	
Total		277	32	702.2	734.2	

Currently, most of the country's electricity is generated through hydropower. There are three functional hydro power stations in Nigeria as shown in Table 5.

Table 5: Hydropower Stations in Nigeria and their Capacity.

S/N	Hydro-Power Station	Capacity (MW)
1	Kainji	760
2	Jebba	540
3	Shiroro	600

The United Nations Industrial Development Organization (UNIDO) under her Regional Centre for Small Hydro Power in Africa (RC-SHP) with office in Abuja is working on Hydro Power projects to generate electricity in some states of the Federation. For example, UNIDO is collaborating with Ekiti State government to generate about 1.5MW of electricity from Itapaji Ekiti River. Table 5 shows other ongoing hydro power projects sponsored by UNIDO.

Table 5: On-going UNIDO Projects (**9)**

S/N	Dam/River	Location	Capacity
1	Waya Dam	BauchiState	150KW
2	Ezioha-Mgbowo Dam	Enugu State	30KW
3	Obudu Cattle resort Dam	Cross River State	30KW
4	Ikpoba Dam	Edo State	3.12MW
5	Tunga Dam	Plateau State	1600KW
6	Ta Hoss Community	Plateau State	100KW
7	Omi Community	Oyo State	625KW
8	Oyan Dam	Ogun State	9MW
9	Ikere Gorge	Ogun State	5MW
10	Erin-Ijesha	Osun State	3MW

There is a great prospect for expansion of hydropower potentials in Nigeria. Most hydropower resources in Nigeria are still largely undeveloped as shown by the Tables above. With partnership between various levels of governments and an international organization like UNIDO, hydropower will definitely receive a boost in Nigeria and solve the problem of power in Nigeria.

2) Solar energy

Solar energy is the energy that comes to the earth from the sun generated through thermo-nuclear process within the sun and is renewable from the continuing or repetitive current occurring in the natural environment. Solar generated through thermo-nuclear process within the sun, Renewable Energy Policy radiation incident on the earth's surface varies in intensity with location, season, day of the month, time of the day, instantaneous cloud cover and other environmental factors. Nigeria lies within a high sunshine belt. Solar radiation is fairly well distributed within the country.

The annual average of total solar radiation varies from about 12.6 MJ/m2- day in the coastal latitudes to about 25.2 MJ/m2-day in the far North. Latitude 7.50N has a mean irradiance of 22.4MJ/m2 per day for the month of April.

However, the incorporation of efficient storage devices in solar energy conversion systems will take care of this intermittent nature of the availability of solar radiation. Solar energy utilization is environmentally friendly;

Areas of application of solar thermal technologies include: crop drying, house heating, air-conditioning, preservation of foods and drugs, power generation, heating of process water for industries, hospitals etc. Solar PV power may be utilized in low to medium power applications such as communication stations, television radio, water pumping, refrigeration etc. It may also be used for power supply to remote villages not connected to the national grid. It is also possible to generate PV power for feeding into the national grid. The sun radiates its energy at the rate of about 3.8 x 1023 KW per second. Most of this energy is transmitted radially as electromagnetic radiation which comes to about 1.5kW/m2 at the boundary of the atmosphere. After traversing the atmosphere, a square meter of the earth's surface can receive as much as 1Kw of solar power, averaging to about 0.5 over all hours of daylight.

Prospects of solar energy in Nigeria

Nigeria receives about 4.851x 1012 kwh of energy per day from the sun. This is equivalent to about 1.082 million Tones of oil equivalent (mtoe) per day, and is about 4 thousand times the current daily crude oil production, and about 13 thousand times that of natural gas daily production based on energy unit. This huge energy resource from the sun is available for about 26% only of the day. The country is also characterized with some cold and dusty atmospheric conditions during the Harmattan season, in its northern part, for a period of about four months (November-February) annually.

Based on the land area of 924 x 103 km^2 for the country and an average of 5.535kWh/m^2/day, Nigeria has an average of 1.804 x 1015 kWh of incident solar energy annually. This annual solar energy insolation value is about 27 times the nation total conventional energy resources in energy units and is over 117,000 times the amount of electric power generated in the county in 1998 **(10).** In other words, about 3.7% of the national land area is needed to be utilized in order to collect an amount of solar energy equal to the nation's conventional energy reserve.Most solar-thermal technologies can be supported by the technical expertise existing within the country. However, National Agency for Science and Engineering Infrastructure (NASENI) and Sokoto Energy Research Centre (SERC) has commenced the production of solar panels in the country.

The use of solar energy technologies in Nigeria is improving especially in the areas of street-lighting, The Energy Commission of Nigeria through its pilot and intervention project has so far deplored above 12MW of solar PV for water-pumping and rural electrification across the country. However, substantial work need to be done in the development of solar technology equipment, standards for materials, design and equipment manufacture.

3) Wind energy

The Wind is a natural phenomenon related to the movement of air masses caused primarily by the differential solar heating of the earth's surface. Seasonal and location variations in the energy received from the sun affect the strength and direction of the wind.

The annual average wind speed at 10m heights varies from about 2 m/s in the coastal areas to about 4 m/s in the far north. It is possible to convert wind energy to rotary mechanical energy and electrical energy for a variety of uses. Wind energy has been utilized for centuries for water pumping as well as for the milling of grains. For meaningful exploitation of wind energy, a necessary prerequisite is the optimization of the components of wind water pumping and wind electricity generation.

In the year 2003, the Federal Ministry of Science and Technology constituted an Inter-ministerial Team with members drawn from the Federal Ministry of Power, Energy Commission of Nigeria and its energy research centres, and the Nigerian Metrological Agency to work on a project that produced the onshore wind resource map of Nigeria. Layhmeyer International was consulted on the project. The software produced provides information on sites which can generally be considered as potential wind farms. Thus, the product of the project can serve as a useful decision

making tool for prospective wind farm developers as well as for communities who would like to determine most suitable sites for small scale wind energy generation.

It is in this regard that the Commission has been engaged in executing renewable energy pilot projects to demonstrate the feasibility of renewable energy technologies. It is also to be noted that on the basis of the information obtained from the WIS software, the Federal Government has commenced the development of a 10MW wind farm in Katsina State.

Promising attempts are being made in Sokoto Energy Research Centre (SERC) and Abubakar Tafawa Balewa University, Bauchi, to develop capability for the production of wind energy technologies

4) Bioenergy

The term bioenergy generally refers to energy derived from non-fossil type organic matter of biological origin referred to as biomass. Common feedstock's for bioenergy systems include waste wood, forest debris, Jatropha, algae and municipal waste. Currently, there is growing interest for ecologically sustainable biofuels.

i) Biomass

Biomass is an organic, non-fossil material of biological origin. The biomass resources of Nigeria can be identified as wood, forage grasses and shrubs, animal wastes and wastes arising from forestry, agricultural, municipal and industrial activities, as well as aquatic biomass. The abundant energy available from biomass can be meaningfully introduced into the nation's energy mix through the development of a comprehensive programme. The programme should encompass fully supported research, development, demonstration and manpower training components.

ii) Biodiesel

Biodiesel is a renewable and biodegradable fuel refined from vegetable oil (or animal fat). What is attractive about biodiesel is that besides not being refined from crude oil it is environmentally friendly. It reduces carbon monoxide (CO), carbon dioxide (CO2), and other particulate matter emission that cause respiratory damage. Biodiesel also eliminates the cloud of dense black smoke normally associated with diesel vehicles. The exhaust fumes from an engine running biodiesel smells like popcorn or fresh fires. It also has better lubricity than diesel fuel because of its higher viscosity.

iii) Bioethanol

Ethanol fermented from renewable sources for fuel or fuel additives are known as bioethanol. Additionally, the ethanol from biomass-based waste material is considered as bioethanol. Bioethanol is made from sugar and starch. The technology for the production of bioethanol from sugar have been refined and developed over the years, notably in Brazil and the United States of America. Sugarcane has the advantage that besides, the sugar which is fermented to produce bioethanol the cellulosic component of the plants stalk known as BAGASSE can be used to provide energy for the production of bioethanol, thus increasing overall energy efficiency**.**

iv) Biogas

Biogas is similar to natural gas by its composition. Synonyms for biogas are such words as methane gas, sewage gas and marsh gas. Biogas consists of approximately 50-70% of methane (CH4) and 50-30% of carbon dioxide (CO2).

Animal waste (e.g. animal slurry from a farm) can be treated to provide gases that can be burned to generate electricity. Landfill sites emit gases (mainly methane) that can also be used to provide energy.

5) Tidal Power

It takes a high tide and special configuration of the coastline, a narrow estuary which can be dammed, to be a tidal power site of value. Only about nine viable sites have been identified in the world. Two are now in use (Russia and France) and generate some electricity. Damming estuaries would have considerable environmental impact. Tides are caused by the gravitational pull of the Moon, and to a lesser extent the Sun, on the oceans around the world. The difference between high tide and low tide can be many meters, and the energy of the tidal movement can be used to generate electricity**.**

6) Geothermal energy

Geothermal energy is heat derived from deep underneath the earth's crust. In most areas, this heat reaches the surface in a very diffuse state. However, due to a variety of geological processes, some areas, including the western part of the USA, west and central Eastern Europe, Iceland, Asia and New Zealand are underlain by relatively shallow geothermal resources. These are classified as low temperature (less than 90°C), moderate temperature (90° - 150°C) or high temperature (greater than 150°C).The uses to which these resources can be put depend on the temperature. The highest temperature is generally used only for electric power generation. Current global geothermal generation capacity totals approximately 10,700 MW, and the leading country is currently the USA, with over 3,000 MW, followed by the Philippines (1,900 MW) and Indonesia (1,200 MW). Low and moderate temperature resources can be used either directly or through ground-source heat pumps.

C. Renewable energy technologies ready for local adoption

The Energy Commission of Nigeria through its Research Centre has developed large number of renewable energy devices in various parts of the country. The devices which are ready for incorporation into the economy especially for rural areas as follows:

i. Solar Cookers: These are box-type arrangements where most local dishes can be cooked within one hour under average sunshine conditions.

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

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

iv. 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.

v. Water Pumping

Many workers have demonstrated the use of photovoltaic solar modules for pumping water from wells and boreholes especially in rural areas for providing the water requirements of entire communities. Photovoltaic powered pumps can also be employed for irrigation purposes.

vi. Storage of Vaccines and Drugs

Photovoltaic power components have also been shown to adequately provide the electricity for refrigerators and deep freezers in which vaccines and drugs can be safely stored without losing their potencies.

vii. Street Lights and Traffic Controllers

Photovoltaic modules have been used to provide uninterrupted electricity during the day and night for traffic controllers in city centres. With the use of storage batteries they have also been shown to power street lights continuously without the power outages commonly associated with the mains supply.

viii. 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.

ix. 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. **(11,12)**

IV. IMPACT OF RENEWABLE ENERGY

Renewable energy is eminently clean and environmentally friendly especially with application of new technologies.

Impacts of Renewable Energy Utilization

Renewable Energy Resource	Impact	Remark
Solar	No carbon emission, no noise	Positive, high installation cost
Fuel wood	Deforestation, soil erosion, loss of bio-diversity, indoor smokes, air pollution, infection	Negative but reversible
Saw dust	Utilization of waste product	Positive
Charcoal	Air pollution, infections. Utilization of waste product, women empowerment	Negative but reversible
Oil palm by-product its residue	Poor combustion, air pollution, infection	Negative production of Bio diesel from palm oil could be positive

Source: (11)

V. BARRIER TO RENEWABLE ENERGY DEPLOYMENT

A. *Barriers in Global alternating energy development includes:*

• Institutional and policy barriers related to existing industry, infrastructure and regulation of the energy system;

• Market failures, including non-internalized environmental and health costs, where applicable;

• Lack of general information and access to data relevant to the deployment of RE, and lack of technical and knowledge capacity; and

• Barriers related to societal and personal values and affecting the perception and acceptance of RE technologies.(13)

B. Problems with implementing alternative energy projects in Nigeria

1) Lack of Capital

Development of renewable energy systems in Africa is hampered due to low income per capita stigma of most African countries, These challenges arise from lack of access to capital; lack of means of life support; lack of information by appropriate financial institutions; lack of investment; scale of energy systems; inappropriate subsidies by the government or other agencies; size of organizations etc.The cost for renewable energy systems in Africa may continue to be high because of high financial input and low profit margin in the course of manufacturing the component parts caused by low patronage and high cost of research and development.
Investment in renewables in particular is inhibited by the existing tariff structure and lack of competition. Nigeria Electricity Regulatory Agency (NERC) has recently concluded its technical preparations for implementing a Feed-In Tariff (FiT), but recouping costs still takes 10 to 15 years. The Central Bank of Nigeria has finally provided the Bank of Industry US$ 3.3 billion (N 500 billion), additional funding through a Power Intervention Fund at a maximum 7% interest with 10-15 years tenure. The Bank of Industry / UNDP Energy Access Programme also seeks to support renewable energy.

2) Technical challenges:

Inadequate technical competence remained a challenge towards the development of renewable energy systems in Nigeria. The technical failures of RE systems can be traced to lack of understanding of local energy requirements; lack of research and development to adapt technologies to local government conditions, resources and requirements; lack of local skilled labour to install, operate and maintain the equipment properly; and lack of access to spare parts.

3) National Policies and Awareness Programme Challenges

Activities of the government are highly instrumental to the success or failure of any matters of national interest including the programmes that will tend to enhance the very life status by introduction of new ways of living. The rate of growth of the programme can only increase or decrease within the context of the government interest. Though Energy Commission of Nigeria and other government stakeholder organizations are doing well in this regard much is still needed to be done especially in the area of legislation, getting a legal framework that will support the development of RE in Nigeria. Private sector investment needs to complement this to meet the goal of greatly improved energy access. However, in a high risk environment and in the absence of a strong legal framework, Nigerian financial institutions are reluctant to invest(14)

4) Social, cultural and environment constraints

Social acceptance of the renewable energy technology is very important, as its absence can be a major challenge. If the local Community does not accept the technology; there will be no demand for its services. For example, it may not make much sense to install solar cookers in communities which forbid women to cook in the middle of the day. Most renewable energy installations failed because the beneficiaries are not carried along during the decision making to deploy the energy systems to them. Involving the end users may generate more interest as they tend to benefit more, having been given the chance to express their very need or convinced on what is being provided.

5) Political, institutional and legislative barriers

Massive deployment of renewable energy systems in Nigeria has great future if only the right political and legislative framework can be put in place. Since the technology is foreign, there is need to put proper legislation in place, to prevent turning the country into a dumping ground by the technologically advanced nations. Proper legislation may see Nigeria imposing zero taxes to renewable products, since with zero taxes and large subsidy, the poorest of the poor are the targets. Also the importation of sub-standard goods will be adversely reduced.

6) Challenges based on the security of the installation

Insecurity of installations is not only an African problem. Globally, the security of the installation is paramount in the decision as to how and where to install the systems. In most cases, the security provisions will simply make the cost grow unreasonably high. Most known major projects have suffered one level of vandalism or the other. Installed equipment in one site can be found in the market within 24 hours after its commissioning. This barrier cuts all nature of installations from personal solar home stations to community mini solar and solar street lights.

VI. THE WAY FORWARD

- The energy-environment nexus is progressively becoming prominent in energy infrastructure development. It therefore becomes necessary that Nigeria government enhances mainstream efforts in integrated energy planning processes, such that central energy planning becomes the basis for all sub-sectoral policies and programmes
- To ensure efficient energy technology development and adaptation, the Nation cannot but fall inline with global trends. Hence, conserted efforts is advised to equally mainstream energy efficient systems that also mitigates adveerse climatic effects while deploying energy and power projects
- Climate change scenarios and projections should inform new policies, programmes and measures that will support climate change adaptation since as at today Nigeria lacks climate change legislation to guide its low-carbon development.
- Energy Legislation: Passage of the National Energy Policy, National Energy Master Plan and the National Renewable Energy Master plan into law by the act of National Assembly will enhance and promote the rapid development of renewable energy in Nigeria.
- Government should invest in emission-reducing projects so that Certified Emissions Reductions (CERs) credits can be used to rehabilitate degraded areas/waste land.
- Capacity building in the training of Energy experts in Renewable energy technology. Identifying definite need for capacity building both at institutional and personnel level for acquiring technical, organizational, and managerial skills required for increased development of renewable energy.
- Establishment of more energy efficiency and conservation and Renewable Energy equipment /devices manufacturing plants in the country to complement the two we already have in Nigeria.
- Existing government agencies and commissions saddled with the responsibilities for the strategic planning and co-ordination of national policies relating to climate variability/change in Nigeria should be sufficiently strengthened.
- Government should create a renewable energy fund i.e. devoting about 1% of her earning to renewable energy development and deployment in Nigeria. In view of the vital importance of RETs to kick start rural industrialization and the need for harnessing and channeling multilateral and bilateral funds to that purpose, it is recommended that a renewable energy funding/financing agency like India's IREDA (Indian Renewable Energy Agency) be established.
- Development of efficient Waste to energy technologies should be encouraged for the recycling of municipal waste to produce biogas and other viable by-products as well as recycling of waste water to clean and portable water.
- Climate change adaptations and mitigation measures should be inculcated into school syllabus. Government should develop a school curriculum that will teach stakeholders to shun the degradation of the environment and use energy more efficiently.(14)
- Increasing adoption of government fiscal incentives for Renewable energy development and deployment.
- Government, NGOs and development agencies should sensitize and encourage stakeholders to adopt the use of renewable energy and energy efficiency technology and practices.

VII. CONCLUSION

Government should make sure the policies that are energy and environmentally based makes up the core of other sub sectorial programmes. Climate change is the defining global environmental problem of the 21st century, a threat which demands nothing short of an Energy Revolution - a transformation that has already started, as renewable energy markets exhibit huge and steady growth globally. At the core of this revolution will be a change in the way that energy is produced, distributed and consumed. Additional policies would be required to attract the necessary increases in investment in technologies and infrastructure.

As Nigeria tends to meet its rising energy need, effort should be geared towards achieving the environmental friendliness and sustainability. Renewable Energy resources and technologies stand out as the best options for the provision of adequate, reliable and efficient energy for sustainable development and Climate change mitigation. Many nations of the world have embraced RETs and have put in place, policies, laws and strategies to achieve their targets. The efforts of the nations are further given a boost by IRENA which many nations are signatories to (1) Though the initial cost of installation of RE devices is high but the life cost is competitive with conventional energy sources. Government should continue to ensure that fiscal and non-fiscal incentives are put in place for private investors that are willing to invest in RE.

REFERENCES

[1] Dioha I. J. , International Best practices in Renewable Energy Technology. 2009 *Paper presented at a workshop on strengthening advocacy for use of alternative sources of energy for sustainable development by women in leadership positions on October 2009 at Shehu Musa Yar'dua Centre, Abuja*.
[2] (lPCC)2011, Special report on renewable energy sources and climate change mitigation.
[3] Ajeigbe A etal 2012, Energy Efficiency & Conservation: a recipe for reducing global warming.
[4] National Energy Policy (NEP), Energy Commission of Nigeria, 2003
[5] World Energy Outlook, 2010.
[6] Concept of Alternative energy (Richard Smith 2008).
[7] National Energy Policy (NEP), Energy Commission of Nigeria, (Revised Draft Edition) 2013.
[8] Electricity Generation through Hydropower available on www.unido.rc.org/nigeria.
[9] Ikuponisi F.S. States of Renewable energy in Nigeria. 2004
[10] Adeyemo S.B 1997, Estimate of direct solar Radiation site. Nigeria society of Engineers (NSE).Technical transaction (32 (1):1_9).
[11] Sambo(2005, 2009), Renewable energy for rural development of Nigeria perspective Http//www.Isesco.org.
[12] Odinakadotnet, Hanessing renewable energy in Nigeria.
[13] Yale project on Climate change communication 2013, Public support for climate and energy policies.
[14] O. Arogbemi and C.A Komolate 2011, potential for sustainable renewable energy development in Nigeria.
[15] Federal Ministry of Mines and Steel Development 2008
[16] Nigerian National Petroleum Corporation (NNPC) Report 2009.