Energy efficiency for sustainable development in Nigeria.

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Abstract

Objectives/Scope:
The objectives of the study are as follows; Examine how energy efficiency can promote industrialization and job creation, assess how energy diversification helps in reviving the Nigeria economy, discuss the impact of economic growth with reference to energy efficiency, indicate the ways Nigeria can improve energy capacity with renewable resources, and finally make recommendations for policy decisions.
Methods, Procedures, Process: The methodological framework for the study comprised extensive literature review, and policy analysis. The literature review focused on energy policies and institutional issues in relation to energy efficiency across different regions of the world. The Nigerian government policy on energy efficiency was reviewed to discuss certain hitherto neglected strategies and mechanism with an overall orientation that gives general direction and chart the way forward for sustainable management of energy resources. Relevant literature report from form journals, text books, energy policies and relevant government agencies like the Nigeria National Petroleum Company (NNPC), Energy Commission of Nigeria (ECN), and documents from different multinationals operating in Nigeria were reviewed. Also, articles dealing on energy efficiency and sustainable development were consulted. The policy options that support energy efficiency were analyzed.
Results, Observations, Conclusions: The study findings revealed that energy efficiency resulted in cost saving and revenue generation while the use of renewable sources like hydro and solar energy reduced environmental pollution. Energy efficiency also enhanced energy security and will mitigate climate changes due to reduced emission of green house gases into the atmosphere. In conclusion, energy efficiency can contribute to all the three pillars of sustainable development namely economic, social and technological dimension in the Nigerian economy. The study findings recommended that in order to reduce the challenges associated with energy access and use there should be creation of an enabling environment like provision of fund for energy generation and development to attract investment in energy sector. The Nigerian government should institute a regulatory framework that protect the interest of investors in energy market. There should be correct pricing of energy resources to enable cost recovery by investors. Also, research and development in energy field should be encouraged.
Novel/Additive Information: The paper provides a strategic management model for efficient management of energy resources in Nigeria. The proposed model can be used as an input into wider risk assessment frame work for investment decision.

Key words: *Energy efficiency, sustainable development, energy market, regulatory frame work.*

Background to the study

Despite the investment in energy development, the Nigerian economy is continuously plagued by perennial energy problem relating to:

- Energy supply and distribution inadequacies- petroleum and electricity products
- Inconsistence planning system- inaccurate plant capacity based on inappropriate information and inadequate projection.
- Inaccurate energy record / information basis of inadequate plant capacities
- The lack of reliability associated with the supply of energy still constitutes energy into one of the binding constraints on the pace of economic activity of the country.

Manoha and Adeyanju (2009) submitted that before the discovery of crude oil in Nigeria, many people use coal (which contain low Sulphur and ash content) as source of fuel and till 2023, remain the oldest fuel in the country. With the discovery of crude oil, coal beneficial resource was abandoned with billions of untapped reserves. The energy problem is not just a problem arising from demand and supply gap, but include multiplicity of related problems involving ownership, control and efficiency both in production and use. Infact, the persistence of gap between demand and supply indicates the existence of these other problems as well as the familiar problems of scarcity and discontinuity.

Alams (2006) opined that energy consumption and economic growth are directly proportional, so the impacts of increased consumption led to more revenue generation, which enhances economic activities thereby promoting economic and socio-economic development such as job creation, poverty alleviation, and industrial proliferation among others. The biggest national challenge in Nigeria today is over reliance on petroleum products, which led to non-diversification of energy consumption that would have spurred appropriate energy mix. The prominence Nigeria placed over oil upon discovery is extremely higher practically because is not substitutive in terms of consumption thereby neglecting other sources of energy, which are in abundance like coal in eastern part of the country, believed to be Sub-bituminous i.e., Nigerian coal has slow burning features with effective heat production.

According to Dickson (2010) energy is one of the strategic resources for economic development and social well being of any nation, especially in sectors like manufacturing, transportation, construction, residential, commercial, industrial and institutional buildings Energy is a major input into the production system and its availability is determined by the cost and efficiency. By strategically buiding energy efficiency decision into production, entrepreneur will understand new ways to cut cost, raise productivity and improve share holders value, improve managerial

performance, meet environmental standard, create efficient product and market opportunities, improve their competitive position and ensure better community relation.

Industrial development strategy is enhanced by encouraging the development of energy efficient technology. Ayeni and Ola (2020) noted that Nigeria government need to develop and integrate policies on energy efficiencies into the current energy policies. The implication of this is that implementing energy efficiency decision in Nigeria will result in cost reduction in the development of energy resources thereby improving sustainability of the energy resources. Hence there is the need to encouraging energy conservation through the efficient use of energy.

Specifically, the study has the following objectives:

- Examine how energy efficiency can promote industrialization and job creation.
- Assess how energy diversification helps in reviving the Nigeria economy.
- Discuss the impact of economic growth with reference to energy efficiency.
- Indicate the ways Nigeria can improve its energy capacity with renewable resources and finally make recommendations for policy decisions.

Literature review

1.0 Significance of energy efficiency:

According to Phylipsen (2010): Energy efficiency (E.e.) is widely recognized as a crucial pillar of energy policy, positively contributing to both national and international agendas. Energy efficiency improvement can help reduce a country's reliance on imported energy sources, avoid the cost of new energy generation (and distribution) capacity, improve industry's competitiveness, increase access to energy and reduce local, national and international pollution (including emissions of greenhouse gases).

The quality of life can be improved by energy efficiency in all facets of human endeavor. Energy efficiency is a fundamental principle associated with enhancing living standard all over the world. Energy efficiency simply using less energy to get the same job done. E.e. is a significant tool in reducing the amount of energy needed to provide products and services. Dipanker (2007) submitted that energy efficiency is a significant parameter in ascertaining a safe, affordable, reliable and sustainable energy system for the future. This measure is the cheapest and easiest means of addressing energy security as well as environmental and economic challenges ranging from combating climate change, cleaning of the natural air, enhancement of business competitiveness and drastic reduction of energy cost for consumers. Doing more energy

requiring tasks with a less energy have an outstanding effect on our national economy by saving huge amount of money from reduced costs, spurring innovation, unemployment inter alia.

According to Porter (2003), corporation which uses energy more efficiently establish competitive advantages over their competitor. Also subsidizing the innovation and development of devices and equipment for improving energy efficiency, nurture the growth of specialized industry and the implementation of energy efficiency improves the engineering capability which is a core competency in the oil and gas industry. Efficiency has become the key message emanating from government and other multilateral agencies such as the World Bank, African Development Bank (ADB) and the United Nation development Programme (UNDP).

Energy management is the strategy for energy optimization and adjustment. Energy management encompasses an expansive range of activities and expertise in optimal use of energy (ANRE, 2006). The energy use include but not limited to areas of control and measurement; development of management strategies, plans and programs, essential implementation of techniques, technology and tools to improve efficiency, productivity and most significantly, a sustainable energy. Energy is a requisite force driving most Nigerian economic activities, and it's pertinent to know that 'The greater the energy consumption, the more the economic activities and that translates to emergence of a greater economic nation. The 9th session of commission on sustainable development concludes that energy is central in achieving sustainable development. According to Ronald (2010) sustainable energy management is the collective and fully integrated suite of considerations and activities required to maximize energy performance where energy performance is defined as: unit of currency/unit of energy/unit of product or service. In order to evolve a sustainable pattern of long-term development, stakeholders should improve energy efficiency in all the production process.

Ronald (2010) maintained that those adopting sustainable development practice are the ones that are increasing their profitability, while at the same gaining public support. According to Sambo (2007), inefficiency in energy use has brought a significant negative impact on the cost competitiveness of the manufacturing sector in Nigeria thereby increasing cost of goods which has a negative effect on the cost of local goods. Furthermore Ronald (2010) maintained that those adopting sustainable development practice are the ones that are increasing their profitability, while at the same gaining public support. According to Sambo (2007), inefficiency

in energy use has brought a significant negative impact on the cost competitiveness of the manufacturing sector in Nigeria thereby increasing cost of goods which has a negative effect on the cost of local goods. Furthermore Ronald (2010) opined that the key to increasing energy efficiency and reducing costs in sustained manner is having the right drivers through education, policy and legislation, financial incentives, and technological advances. These drivers need to be integrated with both management and technology of the business to drive down cost in a sustained manner. In essence energy efficiency means doing more with less energy and involves all aspects of energy production, distribution and end use. In recent years, energy efficiency has considerably gained in importance and has been recognized as one of the most cost-effective ways of meeting the demands of sustainable development. The energy conservation denotes doing without, possibly giving up amenities to save energy.

Nigeria is one of the developing countries in the world with abundant natural resources such as crude oil, coal, water, minerals including potential energy inclusive. Ironically, increasing access to energy remains the biggest, continuous and most pressing challenge to Nigeria's economic revival. Economic growth is a necessity for evolution from being a third world nation to a developed nation. For Nigeria today, the greater the economic growth, the better the chances of economic development. According to Uduma and Arciszewski (2010), with proper utilization of energy potentials to meet the expectation, the nation would experience an accelerated economic growth. Energy efficiency does not only involve cost reduction but enhance chance of revenue proliferation through greater productivity. It was agreed that ‘energy efficiency is the indispensable component of any effort to improve productivity’ and of course contribute to economic resuscitation. Energy efficiency should be the baseline for transition in Nigeria from the present economic retardation to a resource-efficient economic state (Adeyemo 2011).

For effective businesses to flourish, which is the backbone of any economy, it needs to meet a conventional level of standardization. A rational use of energy results in significant benefits in areas of cost savings and promoting efficiency. Standardization can contribute to better energy management by supporting the spread of best practices and providing end users with necessary tools for analysis and energy consumption patterns. Energy efficiency improvement has the potentials to produce benefits at all levels of the economy and the society.

2. Constraints to energy efficiency/conversation

Some of the constraints facing energy efficiency, planning and conservation promotions in Nigeria as highlighted by Sambo (2007) are:

- Lack of Adequate Institutional Framework
- Inefficient Energy Pricing Policies
- Lack of Capital to finance EC Programs / Projects
- Low Manufacturing Capacity

  Others are
- Poor History of Corporate Governance
- Lack of Detailed and Reliable Data; or Information Asymmetry
- Lack of Awareness on EE & C Benefits among Policymakers and End-Users
- Lack of Skilled Manpower to Identify and Implement Specific EC Measures

2.1 Lack of adequate institutional frame work: There is ineffective energy blue print for development of energy sector because of weak institutional framework. An energy blue print is a detailed plan policies or program of actions to be undertaken for the purposes of sustainable development, supply and efficient utilization of energy resource within an economy, and for use

2.2 **Inefficient energy pricing policies**: A major constraints to energy planning in Nigeria has been the presence of subsidies in the energy pricing structures. There is the belief that crude oil is a free gift of nature and hence domestic fuel must be cheap. The prices of both petroleum products and electricity have historically been subsidised and fixed by the federal government corporation. These heavily subsidized prices have not only promoted an inefficient pattern of end use, but have also prevented the recovery of capital costs, greatly discouraging investment in more efficient energy processes in general and more particularly the electricity.

In principle, long term sustainability demands that energy prices (petroleum product and electricity) reflect the full cost of producing and delivering energy including externalities, leading to more efficient decision by producers and consumers as put by James and Fredrich (2008). In the energy sector externalities represent the failure of the market and in many cases of the regulator to include all cost of energy generation into the energy price. This leads to under-pricing of energy produced from technologies that have negative environmental and social

impact and inefficient consumption. For example, associated gas from some oil fields are not developed for domestic market.

2.3 Lack of skilled manpower to identify and implement specific EC measures: In Nigeria, there is lack of knowledge about energy planning; their economic benefit, technical benefits, as well as lack of personnel with adequate technical, financial, economic, managerial and energy planning skill to design, identify and implement specific energy conservation measures, and policy programs (Itsekor, 2018). Dickson (2010) opined that the energy industry requires highly skilled labour. In the short run, the Nigeria government should assist the energy company in gathering information about Nigeria in diaspora who have these skills set that oil company are looking for. In the long run, they should improve and accelerate the training programme at Warri petroleum training institute in order to meet the goal or labour needs of the sector.

2.4 Poor history of corporate governance of energy producing utilities and economic inefficiency: Adekoya (2011) opined that in most developing countries particularly Nigeria, the energy sector has been troubled by high technical losses, lack of cost recovery pricing, poor maintenance, low equipment reliability, high staff level, low productivity and corruption, This factors have resulted in the commercial un-sustainability of many energy projects for example the refineries and the power plant which would have serves as support industries for marginal oil fields are underperforming.

3. Energy Economy in Nigeria

The fact still remains that all developing petroleum countries in the world, Nigeria inclusive, since independence till 2023, considers energy as the mainstay of their economic growth and development. Energy plays a vital role in the Nigeria's international diplomacy and serves as central tradable commodity for revenue generation, which is the backbone of any stable government. Energy is an indispensable input in the area of Industrialization i.e., in production of goods and services in the nation's industries, agriculture, health, transport and education sectors. In summary, Nigeria is endowed with numerous primary energy resources. The Country is blessed with the world's tenth largest reserves of crude oil currently estimated to be about 37.2 billion barrels. The country has also been described as more of a natural gas island than oil with an estimated endowment in 2022 put at about 208 trillion standard cubic feet

This includes associated and non-associated reserves, placing Nigeria among the top ten countries with the largest gas reserves in the World (World Bank 2021). Other significant primary energy resource endowment in Nigeria include: Tar sands, coal lignite, small hydropower Potentials. In spite of the abundance of ample coal, crude oil and natural gas reserves which is being extracted, it has been forecasted that, these reserves may be depleted in years to come where exploration will be almost impossible. Therefore, it's imperative to begin implementing energy management, conservation and efficiency measures with critical research for alternative source of energy.

4. Methodology

The research is qualitative in nature. The methodological framework for the study comprised extensive literature review, and policy analysis. The literature review focused on energy policies and institutional issues in relation to energy efficiency across different regions of the world. The Nigerian government policy on energy efficiency was reviewed to discuss certain hitherto neglected strategies and mechanism with an overall orientation that gives general direction and chart the way forward for sustainable management of energy resources.

Relevant literature report from form Journals, text books, energy policies and relevant government agencies like the Nigeria National Petroleum Company (NNPC), Energy Commission of Nigeria (ECN), and documents from different multinationals operating in Nigeria were reviewed. Also, articles dealing on energy efficiency and sustainable development were consulted. The policy options that support energy efficiency were analyzed. Qualitative studies build rich descriptions of complex circumstances that are unexplored in literature (Marshal & Rossman, 2016).

5. Results and discussion:

5.1 Sources of Energy and Their Impacts

The energy resources which can be adapted by a man for his own use are those which result direct from the sun (solar energy) and from the earth (nuclear and geothermal). Direct sources such as the solar energy constitute the renewable sources and within the context, solar energy is defined and evaluated as the energy currently coming to earth from the sun. Indirect sources such as wind, biomass and so on are equally renewable sources of energy but limited to being of local rather than global value.

Energy is stored in many distinctive ways, Independent of the forms, energy sources are divided into two forms:

- Renewable- energy is the energy generated from natural processes and are continuously replenished. Renewable sources of energy can be recycled or recovered when used and are effective considering the impact of greenhouse gases contributing to global warming and climate change. This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed

- Non-renewable energy otherwise known as conventional energy or non-recoverable energy such as fossil fuels. The term alternative is used to contrast with fossil fuels according to some sources, alternative energy has less environmental effects, a

distinction which distinguishes it from renewable energy which may have less or no significant environmental impact.

5.2. Natural Gas Energy

Natural gas abounds either in association with crude petroleum or in unassociation form. In Nigeria, there are some liquidfied natural gas scheme such as the ones at Afam, Ughelli, Ogorode-Sapele for power generation to local industries. Nigeria proven gas reserves is placed at 209.5 trillion cubic feet. The natural gas sector holds significant potential. Nigeria has the largest natural gas reserves in the Africa continent and is among the ten most enriched nations in the world, the quantity of natural gas reserves in Nigeria is almost twice as much as the oil, and the horizon for the availability of natural gas is inevitably longer than that of oil. Natural and expected to last for more than a century as a domestic fuel and a major export. About 30% of natural gas is flared which implies a drastic drop from the 95% proportion flared before. The hitherto flared gas is being channeled into gas powered projects for rapid utilization and monetization with a view to maximizing value addition to the nation's natural gas resource. Gas flaring is due to inadequate infrastructure and other institutional problem. However, gas flaring is mitigated by monetization and utilization of the natural gas for industrial feedstock like cement industries, fertlizers, petrochemical and power industries which creates jobs and revenue generation there by alleviating povery in the country (Oruwari, 2022).

5.3 Solar

All the energy that can be obtained from fossil fuel is insignificant when compared with the amount of energy the earth receives from the sun in a year. The increasing interest in developing and improving solar energy system can be associated to:

- The energy source is not only available everywhere but decentralized and clear to use
- Viable in number of ways such as for water heating both domestic and industrial, drying of products, space heating and cooling, water pumping, thermal electricity conversion, waterdistillation and desalination and photovoltaic conversion.

Nigeria is endowed with estimated average of 6.25 hours daily sunshine ranging 3.5 hours at the coastal areas of the country and 9.0 hours in the northern part of the country. Nigeria receives about 5.08 x 1012 kWh of energy per day from the sun, and if solar energy appliances with just 5% efficiency are used to cover only 1% of the country's surface, then 2.54 x 106 MWh of electrical energy can be obtained from solar energy and this amount of electrical energy is equivalent to 4.66 million barrels of oil per day which means an appreciable increment to the national grid. Therefore, solar energy technology can be developed effectively with the availability and accessibility of this important natural source of energy (Adeyemo, 2001)

5.4 Hydropower

Basically, this involved the harnessing of flowing water to generate power or perform work. By the beginning of 20th century, the development of hydro electricity was well underway and accounted for 40% of world electric power. In Nigeria, hydroelectripower (HEP) had been generated on the escarpment of the JOS Plateau in 1925. Hydropower is often associated with localities that have a relatively large volume of water of relatively steady flow, but occassionaly, met with water fall. The other source is through dams which must have terrains large volumeof water that can be impounded behind the dam

Nigeria also has massive hydro-electric potentials. We have seven river basins resources endowed land in the following areas, chad, cross river Hadejia, Jamaare, Benue consisting of upper and lower Benue and Sokoto respectively. Even the small-scale Basins Upper, lower Benue and Cross River possess hydropower potentials estimated to be about 734.2 MW. According to Oyedepo (2012), PHCN Appraisal has estimated that, Nigeria's outstanding total exploitable hydro potential currently stands at 12,220 MW. If harnessed an incremental of about 300% will be witness. Now imagine additional 12,220 MW It will surely accelerate economic activities thus give rise to stability (Sambo, 2015). National Metrological Services has shown that total actual exploitable wind energy reserve at 10m height, may differ from 8 MWh/yr in Yola to 51 MWh/yr in the mountain areas of Jos Plateau and it is as high as 97 MWh/yr in Sokoto which are indications of wind energy potential (Manoha & Adeyanju, 2009).

However, in Nigeria, heavy reliance has been on hydro-electricty programmes due mainly to its anticipated advantages which include:

- A contmously reliable and renewable elctricty supply source
- Non polluting and permission of conversion of the country non renewable fossil fuel resources. This in turn ehances energy exports and of course, aids foreign cash earnings.
- Hydro flexibility, which aids low operating and maintenance cost. This in turn provides optimum water utilization.

5.5 Coal Energy

Coal: A fossil fuel formed from the compression of plant deposit which have been overlaid by sand and mud of immense thickness. Given that the plantlife on earth which becomes trapped by sediments and reappers as coal is small the rate at which it is formed is very slow. This is a non-renewable energy source because its creation takes millions of years. The energy in coal comes from the energy stored by dead organisms containing carbon deposits that lived millions of years ago, when the earth was partly covered with swampy forests. Nigeria is endowed with 22 mines of coal resources which have a total proven capacity of 2.7 billion tones. And is the first energy resource to be exploited in Nigeria. It then immediately became the power of the country but its relevance began to drop immediately after oil discovery. The level of significance attributed to coal by the nation began to drop very quickly and today it is insignificantly used as an energy resource. In many countries which use coal as an energy resource like United States, increased coal consumption reflects the increasing output of industry, transportation, and even agriculture. Coal resources in Nigeria is sub bituminous with low sulphur and ash content and that makes it attractive force to so many African countries like Ghana, Egypt as well as European countries which definitely show interest in the partnership. Strategic exploitation of this will witness an unprecedented industrial revolution which will spur gross economic activities.

5.6. Electricity Energy

Electricity a secondary energy produced from conversion of some sources such as coal, natural gas, oil, nuclear power and other natural sources, which are primary sources. The energy sources in making electricity can be renewable or non-renewable, but electricity is neither renewable nor non-renewable. According to Barnes (2007) electricity is a vital energy for economic growth; its generation has been used to empower human technology engines for more than a decade and its supply has become indispensable part of human life. This energy is a necessary condition for growth and sustainability of any economic nation, developing or developed.

In all ramifications, electricity consumption increases productivity, which translate to economic momentum building. A significant population of Nigerians today has no access to this energy; the majority of urban areas where there is supply also consume half of its capacity. With an increased population coupled with diversification of economic activities, energy demand is rising rapidly, but electricity supply remains relatively stagnant. According to Davidson (2022), the inefficiency as well as inadequate facilities to boost the supply has also been a major cause of the increasing gap between demand and supply of this energy. Electricity consumption have diverse impact in socio economic activities of any nation and consequentially the citizens standard of living. The essence of this energy in a nation is one so pertinent that electric generating sets is owned by most Nigerians. This shows that electricity is not only important for fueling economic activities and economic growth but a necessary tool for the attainment of sustainable and comfortable life (Dayo, 2008).

There are no doubt that comprehensive and unreliable power remains a major concern to the entire Nigerian sectors: the commercial, industrial and more specifically domestic one. Numerous and unpredictable reduction of power, which occur virtually every day and most often impacts the economy negatively from equipment malfunctioning makes production of goods and services more exorbitant. Because of this fundamental problem, industrial enterprises have been compelled to install their own electricity generation and transmission equipment, thus catapulting their operating and capital costs. Virtually, all businesses in Nigeria, small, medium or even large, rely mostly on generator for electricity to power their businesses. According to Oruwari (2020), the Nigerian electric power sector is constrained by several factors such as high technical losses, poor maintenance culture, corruption, non payment of debt, unreliable equipment among others, which contributes to the commercial unsustainability of power supply.

Prudent and rational use of energy has been professed as a measure to enhance consumption of electricity. Engineers and scientists have also advocated the potential rational energy use depending on scientific knowledge and technology. This will aid energy conservation and sustainability (Doyle et al., 2005). Towards this end, the long-term technical potential for rational use of energy could be driven by various efforts. Among these efforts, increasing energy efficiency is paramount. The inability for the energy sector to efficiently meet the demand of populace has been detrimental to our economic growth as well as stability as a nation. No doubt that the sector is facing lots of inconveniences from poor funding to operational and technical problems. If the energy sector is fixed, Nigeria will be among the first twenty economies in the world, which has been a Century vision bemoaned by the inadequate energy system in the country. In almost all the developing nations, its only Nigerian cities like of Abuja, Lagos, Port Harcourt, kano and Onitsa have a closing time which is attributed to lack of electricity and these are our economic power houses.

Energy efficiency provides another option for meeting air quality goals in that combustion volumes are reduced proportionately with fossil fuel consumption. Energy Efficient electricity management will be a vital force in driving growth in the energy, manufacturing and social sector because its benefit does not only affect factors of Production but also capital accumulation. The fact that we want to survive economically, this important energy sector most be integrated; electricity production should become an economic policy and an uncompromised state emergency declaration is needed.

We are specifically associated with electricity generation transmission and use. Almost all primary energy consumed is ultimately released to the environment as heat. Because of their

low efficiecy power station emits very large quantities of heat to the environment, which may give rise to problems of thermal pollution. The effects of power station cooling on the environment are diverse and not fully understood. They include the following:

- Change of fish species as a result of higher temperatures
- Disturbance of fishbreeding patterns.

5.7. Petroleum Energy

The most significant source of energy all over the world. The rate of growth in the consumption of oil could be traced to the increase in the rate of industrilisation and civilization. The energy crisis which first surface in the wake of the year 1973 resulted in the quadrupling of oil price price by Organisation of Petroleum Exporting Countries (OPEC). In Nigeria, crude oil has been a major economic growth determinant. For decades, crude oil has claimed the supreme position in the export list of the country. Nigeria is one of largest oil producing countries with average revenue of 822.65 Billion Naira revenue from 2010 to 2016, with a proven reserve of 35.2 billion barrels.

However, as a member of the Organization of Petroleum Exporting Countries (OPEC), Nigerian oil attracts important patronage from Global market simply because Nigerian oil is of high quality and most environmentally friendly relative to oil from other countries. Nigeria's export blends are light, sweet crudes and have low sulphur contents of 0.05 - 0.2%. The local consumption of oil in the country is low. With only 3 of 4 refineries at work in Nigeria there is inadequate capacity to meet the increasing demands for petroleum products. Nigeria's four refineries have a total capacity of 445,000 barrels of oil per day but these refineries are currently unable to meet domestic demand of 300,000 barrels of oil per day. This is as a result of inadequate maintenance and a general declining technical inefficiency causing incessant shortages, hoarding and long queues at petrol filling stations (Itsekor, 2018). The effect of oil as an energy source is obvious and the impact is mostly experienced in the economic accounts. Petroleum as an energy oil resource contributes significantly to economic growth due to global recognition. For this energy to be efficient, infrastructural development needs utmost consideration to effectively enhance supply and appreciable domestic consumption which will not only translate to expressive revenue generation but accelerated socio-economic advancement in the country.

In spite of the indispensability of this sector, lots need to be tapped from the source. Government and other stakeholders need to work tirelessly across the upstream and global market, in both exploration and retrieval, so that our future discoveries will be a significant addition to present reserves and support the oil industry for a long-term future of this country. This will add more energy to the existing contribution made by this prominent source.

5.8 Biomass

Biomas refers to plant and animal materials which can be converted into into energy by means of biological or thermochemical process. Currently, biomass provides about 6% of the world's energy needs. Uses of biomass range from the conversion of woods and agricultural residues by burning to produce heat, steam and electricity to the fermentation of sugar cane and grains to produce acohol fuels. Demaki (2007) submitted that biomass is favoured because it results in a cleaner environment and can provide the means to recycle the waste. The major set back of this source is the energy losses associated with the conversion.

5.9. Relevance of Energy to Economic Development

The role of energy as a strategic resource in the Nigerian economy is discussed below under the following headings:

Underpins industrial growth: In Nigeria fossil fuel, which is a source of energy is used in powering industrial plant and providing transportation system. The society today depends on increasing use of natural energy source such as petroleum and natural gas. Cambell and Price (2008) submitted that in the contemporay world, the economically significant natural source of energy are coal, crude oil, natural gas, falling water and to some extent, nuclear fuel. To achieve economic progress and attain military security, every nation must progressively supplement and replace human energy with energy derived from different energy sources. Energy combined with technology speed up human force (e.g., motor fuel for cars, electricity for household appliances), thereby playing a crucial role in pre- and post-industrial and then IT societies. For other essential needs such as space heating and cooking, the transition has been from local biomass (e.g., firewood, agriculture waste) to industrialized fuels (e.g., LPG, natural gas) and also electricity.

Enhances productivity: To achieve economic progress and attain military security, every nation must progressively supplement and replace human energy with energy derived from the sources of energy such as crude oil, natural gas and others. Petroleum and natural gas as sources of energy also serves in rapidily increasing amount as feedstock for gigantic petrochemical industry that produces a vast range of plastic materials, chemical and pharmaceutical products.

Assist in fulfilment of basic social need (Comfort, nuturtion, health and education): Electricity for domestic use helps to provide convenience in the home, cooking heating and aircondition. Also useful in certain area of medical therapy and educational facilities.

Government reveunes: Today, petroleum industry forms a large segment of every developed country or economy. The energy industry significance in the countries of the world varies according to the degree to which a country is either an importer or an exporter of petroleum. The oil revenue of major oil exporting countries like Nigeria accounts for 70% to 90% of government income.

Global access to reliable energy services such as renewable energy sources that are complementary with economic actors' incomes has a strong potential for positive socio-economic development in many areas such as:

- Technological innovation and employment generation
- Increase sources of revenue generation.
- Rural depopulation.
- Reduces dependence on Import by enhanced patronage of domestic product.

Energy insecurity is an impediment to economic and social development of any nation by creating a structural barrier and supplemental costs at both micro and macro level (Davia, 2008). More so, energy is required to meet basic human needs. Energy, especially electricity, provide several social benefits, which are in direct correlation with economic growth such as:

- Agricultural and industrial development especially in rural areas;
- Conducive environment for comprehensive education because of power availability, which can be an attractive force to so many classical tutors.

• Access to electricity, energy, efficient fuels and cooking appliances reduce domestic pollution that causes so many diseases.

6. Conclusion

From the above document analysis and Literature reviews, it's obvious that there is direct relationship between energy consumption and economic growth. The supreme position of energy as an instrument to national economic growth cannot be overemphasized, and for effectiveness there is urgent need to intensify effort in energy diversification for optimal economic growth. Energy is the vital backbone of any economy. Research and development backed up by energy efficiency will be beneficial to Nigeria and world at large. Increased investment, especially in infrastructure will be needed to foster increased energy production. The private-public partnership project could be carried out to see the increase in provision of energy.

Nigeria almost has all the means to increase its energy security for the present and future development of economic growth with renewable source of energy such as water, wind, geothermal, solar energy, ocean waves, tides, and biomass. The estimated draft by National Energy Master Plan (2007), shows that Nigeria has approximately 37.2 billion barrels of crude reserve, 2.7 billion tons of coal, average daily solar radiation of 6.25 hours between 3.5 hours at the coastal and 9.0 hours in the northern part of the country. Daily, 5.08 ×1012 KWh of energy is received from the solar radiation. Therefore, if electrical appliances with 5% efficiency are used to cover on 1%, then 2.54×106MWh of electricity can be produced which is equivalent to 4.66 million bpd.

Also, Nigeria has seven river basins (hydroelectric potentials) and estimated to produce 734.2 MW but currently stands at 12,220MW. It's estimated that biomass can contribute to 144 million tons per year. Nigeria is currently consuming approximately 43.4×109 Kg of fuel wood per year with an average daily consumption of 0.5-1.0Kg of fuel fire wood per individual. Biomass can contribute about 37% demand of energy in Nigeria for economic growth if utilized appropriately. Wind distribution depends on the location of a state with average production of 8MWh/yr in Yola, Adamawa state, 51MWh/ yr in Jos, Plateau state, and 97MWh/yr in Sokoto state.

7. Recommendations

Regarding energy efficiency for sustainable development, the following recommendations are made to improve economic activities in Nigeria.

7.1. Increased Funding

There should be an increased funding, supervision, and commitment to different energy projects by the governmmet. Also, there should be appropriate financing to support indigenous investment in the energy sector like electricity. Energy sector is capital intensive and requires significant investments to ensure a desirable energy delivery. An effective public and private sector partnership will certainly overcome investment problem in the system. Adequate financing will ensure effectiveness in the energy sector.

7.2. Research Development

There should be an intensified national effort in training, research, and development with a view to generating energy using various solar, wind and other renewables resources. That implies an energy mix to obtain the best form of energy for the nation. Research and development into renewable sources of energy could be fostered and this could enhance economic growth.

Increase in energy supply in addition to optimal production and utilization in an energy deficient nation like Nigeria will have a direct positive influence on national economic security.

7.3 *Provision of infrastructure*. Basic engineering infrastructure is one of the significant trends developed nations use in their economic stabilization. Enhancing infrastructural operations will inevitably increase production, consumption and economic growth. Also, there should be effective measure to ensure security of energy infrastructure.

7.5. Promote Energy Efficiency, Conservation and Management
Inadequate knowledge in energy is very detrimental to economig development of any nation. Public awareness and consistent orientation on energy efficiency standards and its overall effect on the citizens will help in energy conservation. Orientation in areas of buildings and use of the right domestic appliances in consumption power and counseling on use of lower energy consuming appliances will help save more energy that could be channeled for other Purposes. The government should enlighten the populave on the issue of energy efficiency.

7*.6. Right Energy Pricing Policies*
There should be right pricing of energy to ensure adequate return on investment for entrprenuers. When energy is not well priced the consumers may misuse it and the venture may not be sustainable or profitable for investors in energy projects like electricity generation, distribution, and consumption. Its use is directly correlated with healthy and efficient economic growth. Inefficiency in the energy sector cripples industrial sector; lack of electricity affects our life in all ramifications.

7.7. Diversification of Energy Sources
Nigeria should diversify her energy sources instead of overdependence on crude export for revenue generation. Oil is responsible for the nation's microeconomic volatility because of the adverse effect of halting major economic activities. Other sources of energy such as coal and tar sand will go along way to complement the energy drive from Petroleum.

7.8 Liberalization and reform of the energy sector
Developing and implementing a program for the participation of private sector in the various energy sectors.

7.9 *Capacity building*
Ensure the participation and involvement of indigenous engineers and applied research groups in the execution of on-going and future energy projects right from feasibility studies with the objective of establishing local capacity in the long run.

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