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Energy Demand and Supply: Implications for Sustainable Development in Nigeria

[1]Jooji, Innocent Tyomlia, [2]Oguchi, Chinweuba Benjamin & [3]Okwara, Emmanuel Chukwuma
[1]*Department of Political Science and Diplomacy, Veritas University, Abuja*
[2]*Department of Economics, Veritas University, Abuja*
[3]*Department of Political Science and Diplomacy, Veritas University, Abuja*

Abstract

Energy is the life-blood of any nation. It is widely acknowledged as to have a significant positive relationship with consumption, investment, technological advancement, economic growth and development. This paper examined the demand/supply scenario in Nigeria given the projections for the period 2005-2016 (National Energy Commission of Nigeria), and its implications for the quest for sustainable development in Nigeria.. Apart from the commission, data is also sourced from other secondary sources such as books, journals, magazines, the internet etc. Being an analytical survey, the mode of analysis followed the IAEA model which led to the introduction of MAED and MESSAGE components. The result of the analysis indicates that, in spite of the abundant natural endowment of coal, crude oil, tar sands and other bituminous deposits, the demand for energy clearly is in excess of its supply. The paper went ahead to recommend the aggressive implementation of energy policies to ensure optimal exploitation and allocation of resources to meet the equilibration of demand and supply.Finally, it reached the conclusion that the disequilibrium in the energy demand and supply would jeopardize the Nations quest for sustainable development.

Keywords: *Energy demand, Energy supply, International Atomic Energy Agency (IAEA), National Energy Commission (NEC- Nigeria) and Sustainable development.*

Corresponding Author: Jooji, Innocent Tyomlia

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Background to the Study

The global economy remains fragile and volatile as the world is yet to recover from financial crisis. The growth rate for major economies has slowed and the European debt crisis still envelopes the global economy, just as emerging market countries are facing relatively heavy inflationary pressures. Also, capital markets are experiencing huge volatility while fluctuations in the global economy are growing more significant. These and other critical incidents have created unexpected changes in the global energy market. To begin with, the global energy consumption has witnessed declining growth rates. Guobao (2012), observes that, "in recent years, the growth of energy consumption in developed countries has been flat or decreasing". According to him, "developing countries led by the BRIC countries (Brazil, Russia, India and China), have seen decreasing energy consumption per unit of GDP, while total energy demand increases rapidly". Meeting such demand requires sound energy policies which are crucial as drivers of economic growth in an environmentally responsible way. Rising to the energy policy demand does not come by accident. It is arguable that while an energy policy could matter, however, the political process of compromise and negotiation unfortunately does not always produce an optimal energy policy. After all, energy rich countries like Nigeria are yet to take maximum advantage of these resources for the benefit of their economies. In contrast, some countries like South Korea prosper despite not having meaningful natural endowments of energy. Energy is the life-blood of economic activity. Without energy, we cannot build or run the offices, cities and factories which provide the jobs, services and goods that make people's lives more comfortable and secure. "Energy demands is expected to increase considerably in the coming years as a result of growing population and economic development" (EIA, 2007). Many people in the world over are currently experiencing dramatic shifts in lifestyles as their economies make the transition from subsistence to industrial or service base. "The largest increases in energy demand will take place in developing countries where the proportion of global energy consumption is expected to increase from 46 to 58 percent between 2004 and 2030" (EIA, 2007). Per capita consumption figures are, however, likely to remain well below those in organization for Economic Co-operation and Development (OECD) countries. Energy consumption in developing countries is projected to grow at an average annual rate of 3 percent from 2004 to 2020.

In industrialized countries where national economies are mature and population growth is expected to be relatively low, the demand for energy is projected to grow at the lower rate of 0.9 percent per year, from a much greater starting point. Energy consumption in developing regions was projected to surpass that in industrialized regions by 2010.According to EIA (2007), "about half of the increase in global energy demand by 2030 will be for power generation and one-fifth for transport needs---mostly in the form of petroleum-based fuels". However, while many countries are focusing on domestic energy security and lowering their dependence on carbon-based fuels, many developing countries are struggling to secure sufficient energy to meet basic human needs. In Africa, access to affordable and reliable energy is fundamental to reducing poverty, improving health, increasing productivity, enhancing competitiveness and promoting economic growth. Undoubtedly, the provision of electricity to countries in Africa will not only fulfill their needs but help advance towards sustainable development.

Energy poverty remains a serious impediment to progress in most parts of the continent. Africa continues to face critical challenges related to its energy sector. These include a lack of access to modern energy services (especially in rural areas), poor infrastructure, low purchasing power, low investments and over-dependence on traditional biomass. Only about one-fifth of the sub-Saharan population has access to electricity. A recent Africa Infrastructure Country Diagnostic (AICD) study estimates that at current trends, fewer than 40% of African countries will reach universal access to electricity by 2050. However, Africa is endowed with vast renewable and non-renewable sources of energy. The United Nations Industrial Development Organization (UNIDO) estimates that the continent has the potential to develop 1,750 terawatt hours (TWTT) of hydropower and 14,000 megawatts (Mw) of geothermal power. It receives abundant solar radiation throughout the year. Recent studies have confirmed the availability of abundant wind energy resources along some coastal and inland areas. These endowments remain largely underutilized. For instance, "only 5% of the continent's hydropower potential has been exploited and the geothermal figure stands at 0.6%" (UNIDO, 2009). Inadequate power supplies take heavy toll on the private sector, and the economic costs of outages are substantial. Many African enterprises experience frequent outages, and in many such countries, backup generators represent a significant proportion of the total installed power capacity. When appropriate and adequate, renewable and environmentally sound energy resources and technologies stand as pillars of long-term poverty alleviation and sustainable development strategies. Africa needs to create incentives, institutional structures and regulatory frameworks that will attract investment and encourage the development of clean technology markets. Political will and leadership, with a commitment to clear strategic targets, predictable policy actions and a full mobilization of financing options, are keys to achieving energy access goals efficiently and effectively.

The problem

The incidence of poverty occasioned by energy crisis which has engulfed Nigeria for almost two decades has paralyzed industrial activities during this period. The nation's apex bank estimates that Nigeria consumed 8,771,863tonnes of oil per day which amounts to about 180,000 barrels of oil per day. Akinbami (2001), reported that "the total hydroelectric power potential of the country was estimated to be about 8,824 MW with an electricity generation potential in excess of 36,000 GW h". But while Onyebuchi (1989) estimated the "technical potential of solar energy in Nigeria with a 5%device conversion efficiency at $15.0x10^{14}$ KJ of useful energy annually", Chineke and Igwiro (2008) show that "Nigeria receives abundant solar energy that can be usefully harnessed with an annual average daily solar radiation of about 5.25 kwh/m^2/day". This varies between 3.5KW h/m^2/day at the coastal areas and 7KW h/w^2/day at the northern boundary. It gives an average annual solar energy intensity of 1,934.5 kW h/m^2/year, thus, over the course of a year (approximately 1,770 TW h/year) of solar energy falls on the entire land area of Nigeria. The big question then is, how does this energy supply meetthe demand and what implication does the demand/supply scenario have on the nation's quest for the 2030 sustainable development Agenda?

Objective of the Study

Broadly, this paper seeks to evaluate the implications of the demand and supply situation in respect of the nation's quest for sustainable development. Specifically, the papers attempts to:

i. Ascertain the demand for energy in Nigeria
ii. Determine Nigeria's energy supply
iii. Determine the demand/supply equilibrium scenario
iv. Examine the potentials for the realization of the SDGs by 2030 given such supply/demand equilibrium scenario.

Research Questions

As would be expected, a number of questions will guide this investigation. They include:

i. What is the extent the demand for energy in Nigeria?
ii. To what extent is energy supplied in the country?
iii. Do demand and supply for energy in Nigeria equilibrate?
iv. Given the demand and supply situation, is sustainable development realizable by year 2030?

Literature Review

Conceptual Review

Energy: Most dictionaries define energy as "the capacity to do work". By implication, energy is a more abstract concept than work. Work is certainly an important 'manifestation' of energy; indeed, the Industrial Revolution went into full swing in late eighteenth century when breakthroughs were achieved in converting other forms of energy into work. Work is not the only form of energy, heat is. Walker (1996), gives a more comprehensive view of energy as " a property of matter that can be converted into work, heat or radiation'. In economic terminology, "energy" includes all energy commodities and energy resources that embody significant amounts of physical energy and thus offer the ability to perform work.

Energy Demand: Often stated as "the demand for energy", in economics; it is preferably explained from the angle of the wishes to obtain desired services. Thus, energy is not derived from preferences for the energy commodity itself; rather, it depends primarily on the demand for desired services, availability and properties of energy conversion technologies, and costs of energy and technologies used for conversion.

Energy Supply: As is the case with 'energy demand', the supply for energy in economics is explained in terms of the sources and potentials available for such resources. In Nigeria, there are two sources of energy, namely, the non-renewable energy sources which comprise petroleum, natural gas, coal and fuel wood as well as the renewable energy resources like hydro-power, solar, biomass and wind energy.

Supply/Demand Energy Equilibrium: This term evolves from the need to ascertain the appropriateness and adequacy of the quantity supplied when compared to the quantity demand. It is a construct meant for the ease of assessment and analysis of the demand/supply situation.

Sustainable Development: The World Commission on Environment and Development (1987) defines sustainable development as, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition has three spheres, dimensions, domains or pillars, i.e. the environment, the economy and society. The concept aims at maintaining economic advancement and progress while protecting the long-term value of the environment; it "provides a framework for the integration of the environment policies and development strategies" (United Nations General Assembly, 1987). Scholars before the late 20th century argued that, there need not be a trade-off between environmental sustainability and economic development. The key principle of sustainable development underlying all others is the integration of environmental, social, and economic concerns into all aspects of decision-making. "All other principles in the SD framework have integrated decision –making at their core" (Dernbach, 2003; Stoddart, 2011).

The Concept of Sustainability: Constanza (1992), views sustainability as "the relationship between dynamic human economic systems and dynamic, but slower, ecological systems in which: (a) human life can develop indefinitely; (b) human individuals can flourish (c) human culture can develop and (d) effects of human activities remain within bounds so as not to destroy the diversity, complexity and functioning of the ecological life-support system" Abrahamson (1997). The whole essence is geared towards an improvement in the quality of human life within the carrying capacity of ecosystems. Barbier (1987) quoted in Abia, believes the end should translate to "maximizing simultaneously, the biological system goals which include cultural diversity, institutional sustainability, social justice and participation". The idea is to promote a balance between these three interrelated systems and to maintain capital stocks like natural capital stocks as well as social capital stocks.

Theories of Environmental Sustainability

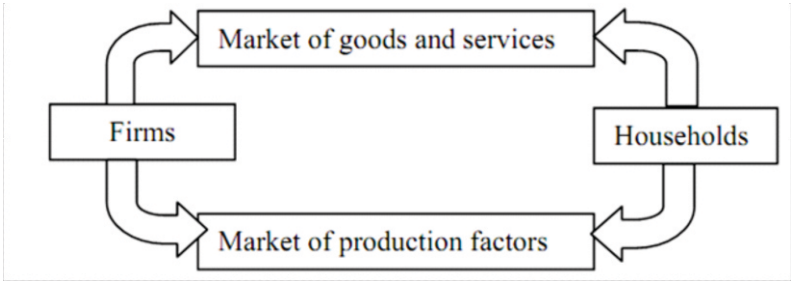
Environmental economics studies insights and additions which bind knowledge economy with the application of economic theory to environmental problems. The neoclassical vision of economics (Cozzi, Zamagni, S. 1989) of welfare (Varian 1990), identified with the willingness to offer the widest number of people, greater opportunities for consumption. Using the Solow model as an essential point of reference, economic development (as economic growth) is, identified with a level of consumption which is not decreasing over time and whose sustainability takes the form of constraints on the use of resources according to the rule of Hasrtwick –Solow (Solow, 1974).

Revision of the Neoclassical View

The neo-classical approach provides for a model of continuous growth considered closed and linear. Where the endogenous growth models are in alignment with the basic philosophy of the Solow approach (i.e. removing both the assumptions of decreasing productivity of capital and erogeneity of technical progress), leads both to deny that in the future, we have the process of convergence between the growth rates of the various countries, and to predict the tendency to continue expanding; there are no implicit mechanisms to stop (it was in fact, the diminishing marginal productivity of capital, which

has led to the arrest of growth unless it was offset by exogenous technical progress). For classical economists like Malthus, Ricardo, Mill, Marx, it is clear that the economic activity was conditioned by the environment. They believed in the role of the market as an indispensable basis for economic growth. The market would have, in fact, distributed merits and efficiency, generating wealth for all. The theoretical conclusion and confidence by the classics held only in the short-term context. In the long run, the economy would still be found in stationary state which coincides with the mere subsistence level by all. This is because of the full awareness of natural resources as a scarce and limited entity, or as a finite set of natural resources, causing a brake on growth. The point of view "pessimistic" of the classics in the long term is well expressed in the studies of Thomas Malthus and Ricardo who watched the constraints imposed by the environment in terms of scarcity of fertile land for cultivation.

Figure 1



The Economic System is a Closed and Linear System

Unlike the classical, the traditional neoclassical economists in considering the economic system as a closed and linear system (Turner, K., Pearce, W., Bateman, I.), did not take into account, the binding connection between the economic system and the environment. The environment has only instrumental value. There are resources to be shaped and used in the production function to meet the market equilibrium. The unlimited exploitation of natural resources is commonly accepted as the price to pay for fuelling economic growth and provide employment.

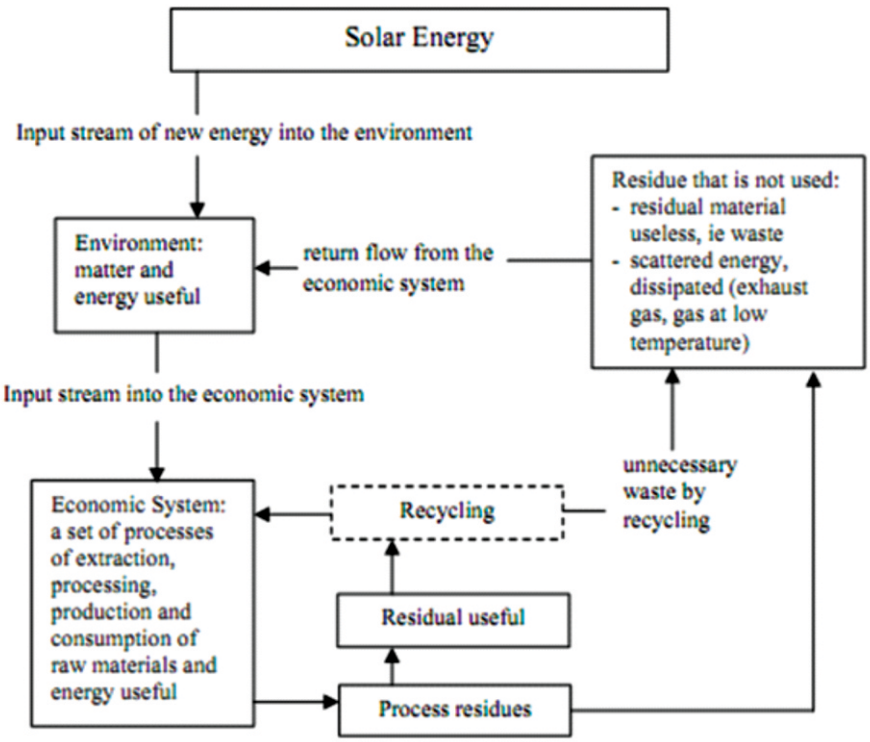
The Economic System as a Subsystem Open and Circular

The excessive trust towards perfectly substitutable resources through market mechanisms and technological progress, led to the general assumption of neoclassical to clash with the finite reality of the natural environment and to become aware that human communities are of a well-wider, which also includes, so to say, non-human (Daly & Cobb., 1990).

From this point of view, the traditional economy, the "real" (i.e., the economic system is made up of institutions, activities intended to produce and exchange goods and services using scarce resources to be allocated more efficiently among alternative uses to satisfy human needs (Turner, Pearch., Bateman, 2003) should be considered only as a part of a larger economy, the so-called "extended", which supports the entire global fabric of life: a kind of economy that takes into account the interdependent relationship between the environment and the economy.

The synthesis work of Boulding is formalized in the materials balance models with interrelationships between the economic system and the environment.

Figure 2



The economic system as a subsystem open and circular
A materials balance model
Source: elaboration of the neo-classical model

In the model, the economic system is open and circular, characterized by a set of extraction processes of matter and energy from the environment, then basic processing, production and consumption. Each of these processes makes at the end of its residues is no longer usable in the environment, and in its receptor bodies. "Such accounting shall be governed by the first and second laws of thermodynamics" (Musa, 2003), which highlight the environmental constraints that the system must take into account.

Theoretical Framework

The Neo-Malthusian Theory of Sustainable Development

Daly (1977) presents the argument of many economists in the following manner:

> The close relationship that links population growth, economic growth, use of resources, and capacity to assimilate as the only sustainable path to development was characterized by economic growth and population anything, which leads to the deliberate creation of a situation of "steady state", before arriving at a situation of absolute physical scarcity of resources.

Daly explains the merit of the position as being that it would bring the attention on the limits of nature and subordination to critical review of the concept of indefinite neoclassical growth. The author (Daly), focuses his analysis on the differences between growth and development and on the purely quantitative character of the first one than the qualitative of the second. He proposes "development without growth" as the only possible path of development that can take into account the biophysical limits that nature imposes on human activities (hence the proposal for exceeding the GDP because it is considered merely indicator of growth and not of the development). In this vein, Daly speaks of steady state economy to be achieved through: (i) birth control (a kind of permits market of birth), (ii) maintaining the level of entropy below the limits of regeneration systems; (iii) redistribution of constant stock of wealth within a constant population. The most famous expression of this inescapable conclusion, is bound up in what is defined as the "Malthusian point of view" (Malthus, 1909), contained in "The Limits to Growth" (Meadows; Randers, Beherens, 1972 and 1981).

Generally, sustainability may be defined as "the practice of maintaining processes of productivity indefinitely---natural or human-made-by replacing resources used with resources of equal or greater value without degrading or endangering natural biotic systems" (Lynn and Eda, 2014). Sustainable development ties together, the concern for the carrying capacity of natural systems with the social, political, and economic challenges faced by humanity. It takes its roots in ideas about sustainable forest management which were developed in Europe during the seventeenth and eighteenth centuries. It was in response to the growing awareness of the depletion of timber resources in England that John Evelyn argued "sowing and planting of trees had to be regarded as a national duty of every landowner, in order to stop the destructive over-exploitation of natural resources". (Ulrich, 2007).

Following the publication of Rachel Carson's Silent Spring in 1962, the developing environmental movement drew attention to the relationship between economic growth and development and environmental degradation. In his 1966 influential essay – *The Economics of the coming Spaceship*, he identified the need for the "economic system to fit itself to the ecological system with its limited pools of resources" (Blewith, 2015). One of the foremost uses of the term sustainable in the contemporary sense was by the *Club of Rome* in 1972 in its classic report on the *Limits to Growth,* written by a group of scientists led by Dennis and DonellaMeadows of the Massachusetts Institute of Technology. In 1980, the International Union for the Conservation of Nature published a world conservation strategy that included one of the first references to sustainable development as a global priority (World Conservation Strategy, 1980) and introduced the term "sustainable development" (Sachs, 2015). Two years later, the United Nations World Charter for Nature raised five principles of conservation by which human conduct affecting nature, is to be guided and judged (World Charter for Nations, 1982). This culminated to release of the report – *Our Common Future,* commonly called the Bruntland Report in 1987 by the United Nations World Charter for Nature. This was the roadmap to the conveyance of the world summit on sustainable development which in turn resulted in the eight Millennium Development Goals later uploaded to the seventeen Sustainable Development Goals. Ever since, studies have and are still adding value to this landmark achievement. This study is one of them.

Empirical Literature

Stera (2010), conducted a study on the role of Energy in Economic growth. In his time series analysis, it was shown that energy and GDP co-integrate. Further still, the study explains that various mechanisms can weaken the links between energy and growth. The empirical literature cited in the studies underscored that energy used per unit of economic output has declined in developed and some developing countries due to both technological change and a shift from poorer quality fuels such as coal to the use of higher quality fuels, and especially electricity. Substitution of other inputs for energy and sectorial shifts in economic activity play smaller roles.

Li and Zheng (2012), studied the relationship of energy consumption and economic growth in China. In this study, the relationship was determined based on the VAR model using temporal series of China between 1990 and 2009, and also applying impulse response function and variance decomposition to portray the correlation between economic growth and energy consumption. The result showed that there exists a unidirectional causality from energy consumption to gross domestic product and energy consumption can observably promote the development of an economy.

Molem and Neifor (2016), investigated the effect of energy consumption on economic growth in Cameroon –from 1980-2014. The energy resources used to test for the relationship were petroleum and electricity---using secondary time-series data. Applying the Generalized Method of Moments technique, the results obtained reveal that Gross Domestic Product (GDP), population growth rate and petroleum prices, have a positive relationship with petroleum consumption. Also, there is an established positive relationship between Gross Domestic Product (GDP), population growth rate, electricity prices and electricity consumption. Again, the study found a positive and significant relationship between petroleum consumption, electricity consumption, Gross Domestic Investment (GDI), population growth rate and economic growth. Gbadebo and Chinedu (2009), carried out a study which tried to answer the question, "Does energy consumption contribute to economic performance? Empirical evidence from Nigeria.covering the period 1970 to 2005. They investigated the relationship between energy consumption and the Nigerian economy. The energy sources used to test the relationship were crude oil, electricity and coal. By applying the co-integration technique, the results indicate that there exists a positive relationship between current period energy consumption and economic growth. With the exception of coal which was positive, a negative relationship was observed for lagged values of energy consumption and economic growth. The implication is that increased energy consumption is a strong determinant of economic growth having an implicit effect in lagged periods and both an implicit and explicit effect on the present period in Nigeria.

Shu-Chen (2014), studied the effects of financial developments and income on energy consumption. Extending Sadorsky (2010), the paper focused on non-linear effects of financial development and income on energy consumption. It utilized five alternative measures of financial development and adopted a panel threshold regression approach to re-examine the effect of financial development and income on energy consumption. The

analysis relied on the sample of 53 countries for the period 1999-2008, showing a single-threshold effect, stock market turnover were used as financial development indicators. Results show that, energy consumption increases with income in emerging market and developing economies, while in advanced economies, energy consumption increases with income beyond a point where the economy achieves a threshold level of income.

Gap in Literature

All empirical studies above failed to pay any attention on the supply/demand of energy situation in Nigeria with a view to assessing the nation's prospects in attaining sustainable development by 2030. This is the gap we intend to bridge.

Methodology

This study is an analytical survey of the energy demand/supply scenario in Nigeria using projections emanating from the National Energy Commission under the International Atomic Energy Agency (IAEA) regional project code-named, *a Sustainable Energy Development for sub-Saharan Africa (RAF/O/016).* The project entails capacity building for energy planning and the determination of the actual energy demand and the strategies for supply for each participating country over a 30 year time horizon. Given the difficulty associated with data sourcing, the study is restricted to information obtainable form this commission. Thus, data is obtained from secondary sources. Also, the Nigerian energy demand and supply projections (2005-2030), will be employed for purposes of our analysis. Specifically, the analysis adopts the following IAEA Energy modeling tools:

i. Model for the Analysis of Energy Demand (MAED)
ii. Model for the Energy Supply Strategy Alternatives and their General Environmental Impact (MESSAGE)

In modeling the Nigeria energy situation, four economic scenarios were developed and used as follows:

i. Reference scenario – 7% GDP growth
ii. High growth scenario- 10% GDP growth
iii. Optimistic scenario I – 11.5% GDP growth and
iv. Optimistic scenario II – 13% growth (based on presidential pronouncement for the desire to be among the first 20 economies by 2020)

The analysis revolves around electricity supply. It is adopted as the reference pivot as a lot of other resources can be used to generate its energy. Nigeria is a country that is blessed with a lot of such resources - such as coal, natural gas, oil and other renewable energy resources.

Research Question I: Energy Demand in Nigeria (2005-2030)
Table 1

Scenario	2005	2010	2015	2020	2025	2030
Reference (7%)	5,746	15,730	28,360	50,820	77,450	119,200
High Growth (10%)	5,746	15,920	30,210	58,180	107,220	192,000
Optimistic I (11.5%)	5,746	16,000	31,240	70,760	137,370	250,000
Optimistic II (13%)	5,746	33,250	64,200	107,600	172,900	297,900
Presidential pronouncement						

Electricity Demand Projections per Scenario, MW

The table above presents the demand projections for the various scenarios. This projection for 2005 represents suppressed demand as a result of inadequate generation, transmission, distribution and retail facilities. Projections for 13% GDP growth rate rose from 5,746MW in the base year of 2005 to 297,900MW in the year 2030. This implies the of raising the sum of US$484.62 billion (25 years period) to construct 11,686MW every year to meet the demand – a fund the country may not be able to generate.

The scenario on the table is presented clearer on the histogram below: -

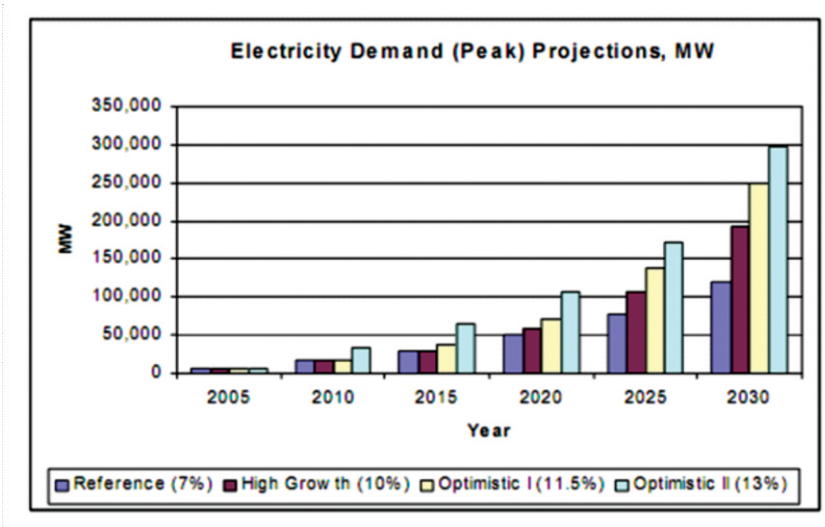


Figure 1: Electricity Demand Projection

Research Question 2: Energy Supply projection
Table 2

Scenario	2005	2010	2015	2020	2025	2030
Reference (7%)	6440	15668	28356	50817	77450	136879
High Growth (10%)	6440	15861	30531	54275	107217	192079
Optimistic I (11.5%)	6440	15998	31235	71964	117371	276229

In adopting the projected demand for energy as an input, the MESSAGE model was used to compute the total energy supply. The energy system dynamics are modeled by a multi-period approach. It is an optimization model which selects the optimal in terms of selected

criterion mix of technologies able to cover a country's demand for various energy forms during the whole study period. Such selection is from the set of existing and possible technologies.

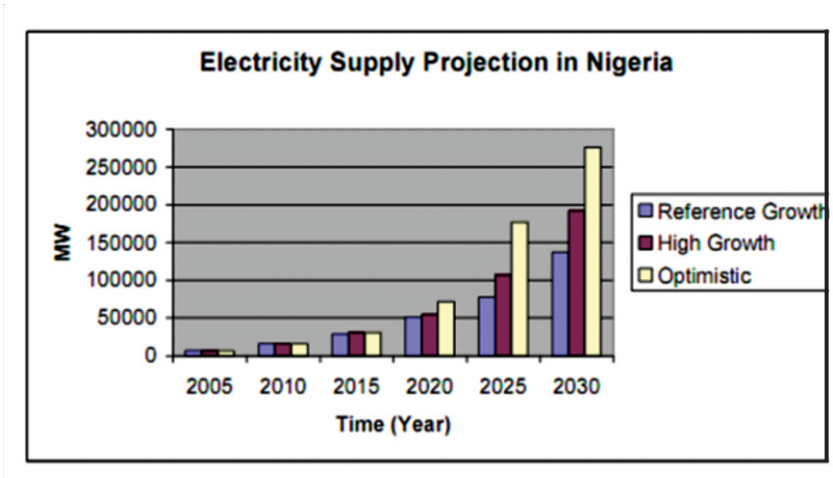


Figure 2: Electricity Simply Projection, MW

MESSAGE takes into account, demand variations of various final energy forms during the day, week and year, as well as different technological and political constrains of energy supply. This energy and environmental impact model, enables the user to carry out integrated analysis of the energy sector development and its environmental impacts. Its application results ina least-cost inter-temporal mix of primary energy, energy conversion and emission control technologies for each scenario. As was the case in adopting MAED to compute energy demand, scenarios like-reference (7%), High Growth (10%) and Optimistic I (11.5%), are also used. The result of the projection for electricity supply is as presented on table 2 above.

The report by Sambo further reveals available resources for electricity generation in Nigeria as follows:

Table 3
Energy Availability in Nigeria

Type/form	Location	Deposit	Inferred
Coal of sub-bituminous grade	22 fields spread over 13 states of the federation	Proven reserves 639 million tonnes	Inferred reserves about 2.75 billion tonnes
Oil-low sulphur light crude	Niger Delta, Anambra and Chad Basins, offshore continental shelves and deep water offshore terrains	34-36.5 billion barrels	68 billion barrels by 2030
Natural gas		187.44 trillion std cubic feet in 2005	

Source: Report by Sambo--------Energy Commission (Nigeria)

The report further presents data on New and Renewable energy supply /sources as follows:

Table 4

Energy Source	**Capacity**
Large Hydropower	11,250MW
Small Hydropower	735MW
Solar Radiation	3.5-7.0 KWh/m^2-day
Wind	2-4 m/s (annual average) at 10m height

Source: Energy Commission of Nigeria Master plan

Demand/Supply Scenario (Equilibrium) in Nigeria

Research Question 3: To what extent do the energy demand and supply in Nigeria equilibrate?

The extent to which energy demand and supply in Nigeria are in equilibrium provides the answer as to how much the energy needs of the citizens of the country are met in the present generation. To obtain this result, tables one (1) and two (2) above are integrated into table five (5) as follows:

Table 5

Energy Demand/Supply Equilibration

Scenario		**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Reference (7%)	Demand	5746	15,730	28,360	50,820	77,450	119,200
	Supply	6440	15,668	28,356	50,817	77,450	136,879
High Growth (10%)	Demand	5746	15,920	30,210	58,180	107,220	192,000
	Supply	6440	15,861	30,531	54,275	107,217	192,079
Optimistic I(11.5%)	Demand	5,746	16,000	31,240	70,760	137,370	250,000
	Supply	644o	15,998	31,235	71,964	117,371	276,229
Optimistic II (13%)	Demand Supply	5,746	33,250	64,200	107,600	172,900	297,900
Presidential pronouncement							

Source: A merger of Demand and Supply projections from Sambo (2008): National Energy Commission, Abuja.

Table 5 above clearly reveals that the demand for energy in Nigeria is hardly met except for a few scenarios. The implications are obvious and worrisome as discussed in the following chapter.

Research Question 4: The 2030 UN Sustainable Development Agenda: how realistic for Nigeria?

Energy is the life-blood of any economy or society. Inadequate supply of energy often slows down the pace of development in terms of industrialization, technological advancement, business and commerce, which translate to low income, poverty and standard of living. A situation whereby the energy needs of a nation are not met translates to not meeting the needs of the people – i.e. the essence of sustainable development. This is to say that the situation has the implication of the non-realization of the goals of sustainable development (UN 2030 Agenda).

Findings

The results of this investigation include:

i. Nigeria has a huge natural deposit of energy resources like coal, natural gas, crude oil, etc.
ii. The availability of these natural deposits do not translate to automatic supply of the energy commodities
iii. The inability of energy supply to meet its demand in the country indicates that such resources are yet to be properly managed to attain optimal exploitation, distribution, and allocation.
iv. Apart from the data projections of the national energy commission, studies in this area would have been very difficult.

Conclusion

In 1987, the Brunt land Commission Published its report *Our Common Future,* in an effort to link the issues of economic development and environmental sustainability. In doing so, the report provided the oft-cited definition of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations General Assembly, 1987). This definition underscores the importance of ensuring the realization of the welfare of the generality of a people---which brings into focus, the issue of energy consumption (demand) and availability (supply). As energy is fundamental for socioeconomic development and poverty eradication, access to modern energy services constitutes an enormous challenge to most African countries like Nigeria. Onyedepo (2015), submits that "60% to 70% of the Nigerian population does not have access to electricity". This assertion is in collaboration with the findings of this paper in which the MAED model introduced by the IAEA adopting MAED and MESSAGE were used to analyze data from the National Energy Commission of Nigeria to reveal the inability of supply mechanism (chain) to meet the energy demands of the citizenry. This is disturbing as it portends a gloomy future for the country with obvious implications for the realization of the UN 2030 Agenda. Thus, except certain aggressive policy measures are emplaced, the goals of sustainable development will remain elusive even by the year 2050. Studies, Li and Zheng (2012), reveal that; "there is a unidirectional causality from energy consumption to gross domestic product and energy consumption can observably promote the development of the economy". All hands, hearts and heads must come together in this direction.

Recommendations

Following the findings above, some recommendations shave been outlined. These include:

i. Genuine and serious efforts should be made by government to ensure effective and efficient exploitation, allocation, and distribution of the available energy resources to put the nation on the path of sustainable development.
ii. Serious attention should be given to the issue of availability to stimulate and encourage further research in this area.
iii. There is urgent need for a revisit of the energy policy.

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