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A Critical Analysis of the Place of Energy Transitioning in Achieving Increased Access to Sustainable Energy in Nigeria

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Abstract. The place of energy in attaining socioeconomic growth and sustainable development remains undisputed. As hinted, its essentiality begins from job creation to economic development, and security concerns. Energy lies at the heart of country's core interests to drive rapid industrialisation and improve citizen's living standards among others. The extent of access to reliable electricity could either hinder or advance these interests. Inadequate access or unstable energy supply proves to be detrimental and counterproductive to any economy and nation. Amid global constraints towards achieving universal access to electricity; the paper interrogated global, regional as well as the government efforts in revitalising the failing energy system with positive outlook towards harnessing the renewable energy potentials of the country and integrating it into the Nigerian energy mix. The paper adopted the doctrinal research method of critically examining the primary and secondary sources. The paper found among others that there is a nexus between energy access and poverty confronting Nigeria. The paper argued that climate change and global warming significantly influenced modern energy choices, how it ought to be generated and deployed for electricity. Impliedly the overall goal, involve taking climate challenges into perspective whilst catering for the energy needs of people. The paper condemned protectionist ideas of advanced economies and suggested free market to drive the energy needs and access of nations. Doing so would require countries to embark on a transition scheme that is climate friendly and balances all three concerns of energy availability, accessibility and sustainability.

1. INTRODUCTION

Energy transitioning or decarbonisation are important and have become household names when it comes to the energy industry. Decarbonisation involves a three-step approach consisting of reducing consumption of fossil fuel, producing green electricity and switching to low carbon alternatives.[1] It can be suggested that access to reliable energy can be achieved through a departure from the existing system that relies heavily on fossil fuels to sustainable renewable energy sources.

In order to limit global warming to 1.5°C, greenhouse gas emissions need to be drastically reduced by 2040.[2] In keeping with this target, the 13th Agenda of the United Nations Sustainable Development Goal seeks to embark on restorative action against climate change by balancing the ecosystem and biodiversity in line with the Aichi biodiversity target.[3] This does not align with the current target as proposed by the United Nations Convention on Biological Diversity (CBD).[4]

However, the success of energy transition hinges on a robust policy framework, funding or investment, and access to technological innovation. In Nigeria, the prolonged use of fossil fuels has not yielded much benefit post privatisation. These losses have been associated with the failure of the Nigerian government to consider and improve the ratio of utilisation of renewable resources in Nigeria's energy mix; with efforts in this regard to be in consonance with the Paris Agreement on Climate Change, which seeks to revolutionise production techniques and energy system set-ups with emphasis on decarbonisation through systematic and people-oriented energy transition.[5]

Premised above, the federal government in 2005 embarked on a comprehensive reform and privatisation of the electric sector in Nigeria to break monopoly, rid it of corruption, inefficiency, improve funding and diversify energy sources to make energy reliable, accessible and sustainable. Although, it seems prolonged usage of fossil fuels in Nigeria after privatisation has not resulted in any immediate notable advantages. Also, the Nigerian government's lack of emphasis local technology to be adopted in raising the share of renewable energy sources in the nation's energy mix is blamed for the ongoing problems.

The goals of the Paris Climate Agreement (United Nations Climate Change Conference COP21), which call for revolutionary changes to manufacturing methods and energy system configurations, are in direct opposition to this oversight. As part of Nigeria's nationally determined contribution under the agreement, and intendment to make renewable sources the fodder feed of the off grid and on grid systems; completing flare out or reduction of gas flaring to the barest minimum by 2030. It is hoped that zero

[1] Middle East and Africa Energy Transition Readiness Index Report 2022, https://www.siemens-energy.com>home>stories>ene accessed 27 August, 2024; see also Green Hydrogen for the World, Siemens Energy https://www.siemens-energy.com> hydrogen-solution, accessed 27 August, 2024.
[2]The United Nations, Theme Report on Energy Access Towards the Achievement of SDG 7 and NET Zero Emissions (2021) 16.
[3]Department of Economic and Social Affairs, United Nations, Overview of the Sustainable Development Goal 13 https://unstats.un.org/sdgs/report/2022/ Date Accessed: 8th September, 2022
[4]Intergovernmental Panel on Climate Change, Sixth Assessment Report (2021) https://www.ipcc.ch/assessment-report/ar6/ Date Accessed: 8th September, 2022
[5] Hadyn Watters for CBC news, Key Points on the Paris Agreement on Climate Change, https://www.cbc.ca/news/world/paris-agreement-key-climate-points-1.3362500 Date Accessed: 24th September, 2022, See also the resolutions of the Conference of Parties (COPs) 28 and 29 <https://wmo.int/news/media-centre/cop28-concludes-historic-agreement-try-tackle-climate-crisis>, and https://table.media/en/europe/feature/cop29-what-the-resolutions-mean-for-climate-policy/ both accessed 8 December, 2024

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carbon or carbon neutrality will be attained in 2050.[6] But it cannot be glossed over that the financial requirements to implement these goals and transition are high and their probable effect on the on the already burdened national economy is far reaching.

The Climate Change Act was passed into law in November 2021.[7] The Climate Change Act seeks to provide necessary guidelines to realise Nigeria's commitment to reduce greenhouse gas emissions significantly in keeping with her declaration at the COP26.[8] To do this, it empowers the Minister of Environment to set a carbon budget taking the average global temperature into account. The law places responsibility at the feet of both private and public entities alike to create a sustainable and low carbon society. It establishes a National Council on Climate Change, headed by the President to mobilise the necessary funds for strategic climate change action.[9] In view of these, the Act expects that year 2050-2070 will mark her attainment of net zero greenhouse emission.

In spite of these concerted efforts, which have been geared towards increasing electricity access, the International Energy Agency stated that about 733 million people in the world, especially in Sub-Saharan Africa and Asia, still live without access to electricity.[10] In addition, the African continent accounts for 80% of the world's population living without electricity.[11] The IEA, in her Stated Policies Scenario Project, has taken a pessimistic view regarding the chances of the world meeting up with her 2030 target for improved energy access and this is reasonably so because of the lack of commitment to the goals by nations coupled with the lack of finances needed to make the necessary investment in the energy sector.[12]

As the discourse on energy accessibility, affordability and sustainability continues vis-à-vis the campaign for energy transition particularly transition from fossil to renewables, it becomes important to critically analysis the role of energy transitioning in achieving Nigeria's dream of increased access to sustainable energy for its citizens.

2. EVOLUTION OF THE CONCEPT OF ENERGY SUSTAINABILITY, AFFORDABILITY AND ACCESSIBILITY: A GLOBAL OUTLOOK

The idea of Sustainable Energy is multifaceted and has lent itself to a variety of definitions. Notwithstanding, at its core lies the need to provide energy in such a way that does not jeopardise future generations abilities and capacities to generate energy as expressed by Kutscher, Milford and Keith.[13] In fact it can best be summarised by the phrase "Leave the campsite as you saw it."[14] But in a global context, the United Nations Sustainable Development Goal 7 (SDG 7)[15] hints at what sustainable energy is likely to consist of by making use of words like affordable, reliable and modern energy.[16] This therefore adopted the intergenerational equity theory of energy generation and consumption in its approach to sustainable energy realization. This theory places on every generation, the duty to use the planet with care and to hand it over to the next generation in the form it met it, if not better.

Initially, Sustainable energy was viewed strictly as a way to provide solutions to environmental concerns. At this time in history, concepts such as renewable energy and energy efficiency were not strange to the global scenes. To illustrate this, the UN's Framework Convention on Climate Change and the Kyoto Protocol of 1997 jointly address the role played by energy in improving atmospheric quality and reducing greenhouse gas emissions.[17] However, in recent times, the scope has been extended to cover crucial pillars for societal and economic development.[18] It was not until the early 2000s that the concept of sustainable energy development was given proper attention by the United Nation Development Programme's World Energy Assessment. Here, the concept was observed from a broader perspective to include diversified energy sources, energy access, and efficiency among other things.

In Spite of the recognition given by the United Nations Development Programme as seen above, the United Nations Millennium Development Goals Declaration of 2000 failed to give pride of place to energy. Seeing how much energy could have contributed to attaining the Millennium Development Goals (MDGs), such as energy access can further poverty alleviation and realise the MDGs. Unfortunately, the MDGs Commission on Sustainable Development failed to take any affirmative action to this effect.

Following, energy initiatives and agencies were established under the United Nations Framework. For instance, the UN's International Renewable Energy Agency (IRENA), which seeks to consolidate national government efforts towards obtaining, installing and utilising sustainable energy solutions and also, the United Nations Department for Economic and Social Affairs alongside other notable agencies, developed an indicator system contained in the Sustainable Development Guidelines and Methodologies Report 2001 which has become a crucial step for measuring and evaluating the progress rate for sustainable

[6] Extractive Industries Transparency Initiative, Nigeria: Pathways to Energy Transition https://eiti.org/documents/nigeria-pathways-energy-transitin (November 2021) Date Accessed: 24September, 2022. At COP 26, Nigeria has set 2060 as the deadline for its full attainment of zero net emission. See <https://unfccc.int/sites/default/files/resource/Nigeria_LTS1.pdf> accessed July 14 2023

[7] Adegbite Adeniji, Jumoke Fojemirokun and Abdulganiyu Mustapha, 'The Energy Regulation and Market Review: Nigeria', The Law Review (June 2022) https://thelawreviews.co.uk/title/the-energy-regulation-and-markets-review/nigeria Date Accessed: September 2022.

[8] International Labor Organization, Environmental, Climate and Sustainable Development Laws, https://www.ilo.org/dyn/natlex/natlex4.detail?p_lang=en&p_isn=112597&p_count=22&p_classification=01

[9] Date Accessed: 22nd September, 2022 International Union for the Conservation of Nature, A Review of Nigeria's Climate Change Act: Potential for Increased Climate Litigation, https://www.iucn.org/news/commission-environmental-economic-and-social-policy/202203/a-review-nigerias-2021-climate-change-act-potential-increased-climate-litigation Date Accessed: 22nd September, 2022

[10] International Energy Agency, Defining Energy Access: 2020 Methodology https://www.iea.org/articles/defining-energy-access-2020-methodology Date Accessed: 6 September 2022.

[11] International Energy Agency (IEA), United Nations Statistics Division, World Bank et Al, Tracking SDG 7 Progress Report 2022.

[12] International Energy Agency, Stated Policies Scenario (S.T.E.P.S) https://www.iea.org/reports/world-energy-model/stated-policies-scenario-steps Date Accessed: 6September 2022.

[13] Kutscher, C.F.; Milford, J.B.; Kreith, F. (2019). Principles of Sustainable Energy Systems: Mechanical and Aerospace Engineering Series (Third Ed.). CRC Press.

[14] A scout solagan for leaving the world or campsite better than you met it. It means to clean it up. https://www.linkedin.com/pulse/leaving-code-cleaner... accessed 27 August, 2024

[15] Sustainable Development Goal 7 seeks to ensure access to affordable, reliable, Sustainable and modern energy for all by the year 2030, Sustainable Energy for All SEforALL https://www.seforall.org>our>work>sustainable-devel... Accessed 27August, 2024.

[16] United Nations, Sustainable Development Goals, https://www.un.org/sustainabledevelopment/energy/ Date Accessed: 31st August 2022.

[17] United Nations, United Nations Framework Convention on Climate Change, New York 1992and the Kyoto Protocol to the UN Framework Convention on Climate Change 1998.

[18] UNDP UNDESA, World Energy Council, World Energy Assessment, Energy and the Challenge of Sustainability, New York, 2002

energy across different areas or themes. Other Publications such as the World Energy Outlook by the International Energy Agency has equally generated awareness on the technological trends and policy systems that embrace the ideals of sustainable energy.[19]

In 2011, the former Secretary General of the United Nation, Ban Ki Moon set up a programme for sustainable energy with a vision statement 'Sustainable Energy for All Initiative' (SE for ALL). The goal of this programme is hinged on three pillars namely: Ensuring universal access to modern energy services; doubling the rate of improvement of energy efficiency and doubling the share of renewable energy knowledge global energy mix[20]

By analogy, the mandate of the SE for ALL initiative tries to attain a carbon neutral energy supply without compromising energy access. In Ban Ki Moon address, he made a call for action to realise a low-cost energy path, insisting forcefully that the ubiquity of mobile phones will make his vision realisable. Achieving these goals would help preserve national wealth, foster low carbon prosperity and empower vulnerable groups.[21]

In an attempt to give priority to energy's impact in the world; the year 2012 is remembered as the International Year for Sustainable Energy. Sustainable Energy was given an international stamp of approval by the declaration of the Sustainable Development Goals in 2015, of which Energy is the seventh point. This cuts across access to energy, renewable energy and energy efficiency.[22] Summarily, the concept of sustainable energy has now evolved from being considered as isolated from socio economic issues to an instrument to tackle environmental changes, health, and poverty and facilitate social welfare.

2.1. Energy Access

Similar to concept of sustainable energy, is energy access. There only exist attempts to define what energy access means rather than a generally accepted definition. To some, it means household access to a minimum level of electricity whereas others believe that it means access to modern energy that enables productive economic activity to thrive or for public service; [23] although these opinions appear similar, the former definition seems to suggest that energy access focuses on quantity rather than quality, while the latter definition appears to exclude households from due consideration. For the purpose of clarity, we will rely on the definition of energy access provided by the International Energy Agency, as follows:

a household having reliable and affordable access to both clean cooking facilities and to electricity, enough to supply a basic bundle of energy services initially and increasing level of electricity overtime to reach regional average. [24]

Although this definition is without its criticism, it brings certain factors to the fore. To begin with, it tries to suggest that there is a relationship between energy access and sustainable energy. This is corroborated by the United Nations Report on Energy Access, where it was defined as "providing sustainable and modern energy to meet end user's energy needs"[25]. Also, the IEA's definition narrows down on households as the yardstick or focal point instead of socio-economic institutions or public facilities. It is assumed that 1250kWh is appropriate electricity to be consumed by a household annually. In actual sense, as a result of the shortage of available data and absence of well-defined criteria, subsequent data alluded to consider whether or not households are connected to an electricity grid, standalone or mini grid systems. For clarification, grid connection means a household that is connected to a local network or grid extension which in turn relies on a centralised power source for power generation. Mini grids, on the other hand, are more localised and do not typically go beyond their service area.[26]

Statistics show that about 91% of the global population has access to electricity. However, the remnant of the global population resides in energy deficit regions especially Sub-Saharan Africa which posted only 51%.[27] This means that about 759 million people either lack electricity completely or are underserved by the existing infrastructure.[28] Admittedly, this is a sharp contrast from the expected progress or projections ahead of the 2030 target. No doubt, the constraints imposed by the COVID 19 have contributed to this drawback. Achieving these global goals would require a "paradigm shift in existing systems" such as energy source, generation, transmission and distribution requiring a minimum of 4% annual increase in electrification rates.

3. THE CURRENT STATUS QUO WITHIN AFRICA AND NIGERIAN AS REGARDS ENERGY ACCESS AND SUSTAINABILITY

North Africa posted a better energy accessibility of 95% than Sub Saharan Africa where Nigeria has been enlisted as one of the Sub-Saharan African Countries confronted with energy access deficit. In fact, available data shows that 92 million Nigerians do not have access to electricity, closely followed by the Democratic Republic of Congo with an estimated population of 72 million people.[29] These statistics show the inherent incapacity of the existing infrastructure that is largely dependent on fossil fuel and created a sense of urgency to provide creative solutions such as clean energy sources as a remedy. For instance, the effect of the appalling state of Nigeria's electricity performance[30] paints a mental picture of an existing energy crisis with extended tentacles

[19] Gunnarsdottir I, Davidsdottir B, Worrell E et al, Sustainable Energy Development: History of the Concept and Emerging Themes, Renewable and Sustainable Energy Reviews Vol. 141, May 2021, 110770. https://doi.org/10.1016/j.rser.2021.110770 accessed 27 August, 2024.

[20] Mr. Wu Hongbo, 2013, Keynote address at the Sustainable Energy for All Ministerial Panel, Abu Dhabi International Renewable Energy Conference, 15 January 2013 https://www.un.org/en/development/desa/usg/statements/mr-wu/2013/01/sustainable-energy-for-all-2.html, accessed 11 September, 2024

[21] United Nations, AVision Statement by Ban-Ki Moon,the SecretaryGeneral of the United Nations:Sustainable Energy for All, 1 November 2011.https://www.seforall.org>vision-st… accessed 28 August, 2024.

[22] Sustainable Energy for All, Sustainable Development Goal 7, https://www.seforall.org/sustainable-development-goal-7-sdg7 accessed: 6 September 2024.

[23] International Energy Agency, Defining Energy Access: 2020 Methodology https://www.iea.org/articles/defining-energy-access-2020-methodology Date Accessed: 6 September, 2024.

[24] ibid.

[25] The United Nations Secretariat of the High-level Dialogue on Energy 2021, Theme Report on Energy Access Towards the Achievement of SDG 7 and Net Zero Emissions (2021) 19 https://www.un.org>files>2021-twg_1-061921 accessed 28 August, 2024.

[26] ibid.

[27] Tracking SDG 7 Energy Progress Report, https://trackingsdg7.esmap.org/results?p=Access_to_Electricity&i=Electricity_access_rate,_Total_(%) Date Accessed: 8 September, 2024.

[28] The United Nations Secretariat of the High level Dialogue on Energy 2021, Theme Report on Energy Access Towards the Achievement of SDG 7 and Net Zero Emissions (2021) pg.19

[29] World Bank Group, International Energy Agency et al, Tracking SDG 7: Energy Progress Report 2022, 6.

[30] Ebhota, W. S., & Tabakov, P. Y. Power inadequacy, the thorn in economic growth of Nigeria. Inter-National Journal of Applied Engineering

to the living standards of citizens and other economic sectors like industrialisation, health care and education. Some experts believe that the situation came to be as a result of the imbalance in supply and demand along the value chain given the exponential population increase.

In their analysis, they estimate that 200 million people require about 31.2GW for optimum living. On the contrary, the installed capacity of 14.38 GW and supply of about 6GW is insufficient to meet this demand.[31] Others remain optimistic of Nigeria's ability to utilise her energy potential significantly citing her slow and steady progress as factors necessary to initiate the changes to sustainable energy sources. Nevertheless, Nigeria would still require a rigorous pursuit of renewable energy sources as a viable alternative to the current deplorable situation.[32] At this juncture, it is important to explore the efforts undertaken, including policies, legislation, government department and agencies, by the Nigerian Government so far in improving electrification across the country.

In recent times, the Nigerian Government launched an Energy Transition Plan, identifying itself with other countries, who have taken proactive steps to close the access gap and provide optimum services to the Nigerian population by 2060. The Energy Transition Plan draws its strategy under the following headings: Power, Cooking, Oil and Gas, Transport, and Industry. This would allow Nigeria to substitute her current energy system with a low carbon energy system, spearheaded by natural gas as a key player. To do this, Nigeria has professed commitment to deploy the necessary technology, investment, business strategies and policies[33]that priorities renewable energy sources over fossil fuel. It is estimated that about $1.9 trillion would be spent in realising these objectives. To finance the switch to sustainable energy sources, an existing $1.5 trillion and an additional "incremental fund" of $410 trillion will be utilised. Although, the dynamics of the Nigerian foreign exchange and her money value susceptibility to devaluation on the international market have left experts skeptical of her ability to achieve this goal.[34] Citing the technical expertise and the huge funds that will be required for implementation and the level of public acceptance needed, experts question its feasibility.

3.1. An Evaluation of the Energy Situation in Nigeria

It is stated that government-facilitated efforts to adopt off grid systems are not the only factors why focus has been diverted to that sector. Private consumers and industries, who have a need for a constant and reliable energy are already patronising off-grid alternatives such as diesel or fuel powered generators, solar panels, and fuel wood for rural dwellers. A typical example is the in famous "I pass my neighbour generator". In fact, studies have shown that Nigeria is one of the highest importers of generators worldwide.[35]

The frequent power cuts and unsuitable power supply have equally played a contributory role in this direction. A report by the World Bank indicates that Nigeria has the highest number of blackouts in the world of about 380 hours followed by Central African Republic which comes close behind with 290 hours. These statistics also reveal a corresponding impact in terms of value lost.[36] This report is also supported by the frequent collapse of the national grid system for the sixth time in 2022 and 206 times over the past nine years.[37] In the 2015 edition of the World Bank's Doing Business Report, it was reported that Nigeria ranked 187 out of 189 countries with regard to the ease of access to electricity;[38]and with the projected increase in population in the coming years, it only seems to get worse.

A comparative analysis between Nigeria and other African countries in terms of energy performance is dissatisfactory. According to a report published by the IEA in France on World Energy statistics, Nigeria was ranked least for her low performance in energy generation among a list of countries including Bangladesh, Brazil, Indonesia and South Africa.[39] The report featured a graph indicating the historical improvement since 1992. In a similar analysis conducted in 2017, Nigeria was ranked second to the last, just above Benin Republic, with an installed generating capacity of 10,480 mw. This is poor compared to countries having similar populations to Nigeria such as Japan and Brazil.[40]

In truth, every sector relies on energy resources to thrive. Conversely, absence of energy resources can be likened to a river without water. A wide variety of energy resources exist in Nigeria in substantial quantities. A study conducted in 2012 on the resource potential of Nigeria commented that Nigeria remains the "energy giant of Africa".[41] This is in view of her abundance in oil and natural gas which earned her the appellation as Africa's largest oil producer and the world's largest exporter of liquefied natural gas (LNG). It comes as no surprise that these natural resources constitute a formidable part of her economy, accounting

Research, Vol. 13, No. 16 (2018). 12602-12610. Cite using Oscola and be consistent

[31] Akuru, U. B., Onukwube, E. I., Okoro, I. O., & Obe, E. S. Towards 100% renewable energy in Nigeria. Renewable and Sustainable Energy Reviews (2017) Is this a journal article or a book? Please reference properly using OSCOLA

[32] Aliyu, A. S., Dada, J. O., & Adam, I. K. Current status and future prospects of renewable energy in Nigeria. Renewable and Sustainable Energy Reviews, (2015). Is this a journal article or a book? Please reference properly using OSCOLA

[33] The Guardian, Technology and Policy: Nigeria's Energy Transition Pathway, (May 2022) https://guardian.ng/news/technology-policy-nigerias-energy-transition-pathway-fg/ Date Accessed: 24th September 2022

[34] Premium Times, Nigeria, Analysis: Nigeria's Energy Transition Plan, Challenges of a Decade of Gas, https://www.premiumtimesng.com/news/headlines/553662-analysis-nigerias-energy-transition-plan-challenges-for-decade-of-gas.html Date Accessed: September, 2022

[35]The Nigerian Energy Support Programme, The Nigerian Energy Sector: An Overview on Renewable Energy, Energy Efficiency and Rural Electrification Page 36 Is this a journal article or a book? Please reference properly using OSCOLA

[36] World Bank, Enterprise Surveys enterprisesurveys.org https://data.worldbank.org/indicator/IC.ELC.OUTG?locations=NG Date Accessed: 9 July, 2022.

[37] Taiwo Adebulu, Insight: Nigerians bear brunt of Unstable National Grid Despite Multi-Billion Dollar Investiment in TCN, The Cable News, https://www.thecable.ng/insight-nigerians-bear-brunt-of-unstable-national-grid-despite-multi-billion-dollar-investment-in-tcn/amp accessed: 9 July, 2024

[38] Joseph Rebello and Camilla, Business Ready, World Bank Group, www.doingbusiness.org/data/exploreeconomies/nigeria accessed 8 July, 2024 see also World Bank's Doing Business Report 2020

[39] International Energy Agency, www.iea.org/statistics/topics/Electricity/ accessed: 5 July 2024. No serious academic paper should cite a website address simpliciter. Every academic source, including internet sources must have an author and a title before the publication details, such as the website address

[40] System Central Intelligence Agency: Country Comparison- Electricity: Installed Generating Capacity https://www.cia.gov/library/publications/the-world-factbook/rankorder/2236rank.html

[41] Sunday Olayinka Odeyepo, Energy and Sustainable Development in Nigeria: The Way Forward (2012) page 3. Is this a journal article or a book? Please reference properly using OSCOLA

for about "75% of the Government Revenue and 90% of her export earnings."[42] Nigeria boasts of 36.2 billion barrels of proven oil reserves and 187 trillion cubic feet of natural gas reserves according to the Organization of Petroleum Exporting Countries (OPEC).[43] Nigeria's natural gas reserves are ranked second to Algeria's. Combined with that of Libya, it is perceived to constitute two thirds of Africa's crude oil reserves.

But Nigeria equally has an estimated 2 billion metric tonnes of coal reserves in Enugu State.[44] She is reputed to have lignite and bitumen reserves situated in the Niger Delta regions, Gulf of Guinea and Bight of Bonny. Research conducted by Chineke and Igwiro provides a fresh perspective of Nigeria's renewable energy potential. They claim that Nigeria has an average annual solar radiation of 5.25 KWh/m^2/ day with even higher solar radiation in the Northern regions. This is equivalent to 6.5 hours' worth of sunshine per day.[45] The presence of water bodies such as River Niger and Benue account for its hydro resource. All these facts speak to the quantity and wealth of resources that abound in Nigeria. If Nigeria is so blessed with an array of resources, why does Nigeria remain unable to harness these resources for beneficial energy supply? This brings us to the challenges faced by the Nigerian energy sector.

4. ENERGY PRODUCTION, DISTRIBUTION AND CONSUMPTION, WHAT ECONOMIC CHOICES EXIST?

Economics may be a branch of knowledge concerned with production, consumption, and transfer of wealth or the condition of a region or group as regards material prosperity.[46]It is also the production and consumption of goods and services which are used to fulfil the needs of those living and operating within the economy, which is also referred to as an economic system.[47] The economic system may be:

a. Market economy: which allow the supply of goods and demand to determine prices.[48] This market force will ultimately affect production and satisfaction of needs with scarce resources. This is what is termed rational allocation of scarce resources for improvement of welfare of both producers and consumers when prices are at per with supply, a state of equilibrium is reached. The opposite is when supply is more than demand, the price falls or where supply is short than demand, the prices hike because too many persons are chasing few goods.[49] Assuming the goods is energy. It is responsible to gives rise to huge profit which market forces dictate, it is however exploitative and anti-welfarism not to normally include energy along capital, land, labour and entrepreneurship as the factors to look upon in the production of goods and services to satisfy human needs and aggregate profit. The other types of economic structures are:

b. Mixed economies: mixed economies are markets with government interventions and regulations in certain sector to filling the gaps and create a sort of balance where producers stay in business but do not bug down consumers with high cost of goods and services.

c. Command-based economies: have a central political figure determining the prices and distribution of goods and services. Example include the socialist/communist economies. The economy is centrally planned to avoid common inequalities but this remains common feature of it.[50]

d. Green economies: These systems operate with the goal of cutting down carbon emissions, resorting to biodiversity, alternative energy sources which are renewable and more environmentally friendly than fossil fuel. By employing advanced technology, green economies focus on increased efficient production of energy and consumption while eliminating any adverse effect to the earth's environment and its resources.[51]

It was those four factors that Adam Smith in his book "Wealth of Nations" - 1776, advocated was responsible for choices of production and prices of goods and services. Although entrepreneurship was considered the controlling factor, the rest were of such importance that were required if the entrepreneur was to bring to bear his human ingenuity. But today, energy and technology are 'omnipresent'. It has taken over the means of production and displacing entrepreneurship. A fresh look at the factors of production, entrepreneurs will most likely consider energy and technology as equally important means of production. It is capital intensive and controls how to produce; energy and saves labour (energy) dissipation. Technology assist entrepreneur in efficient decision making and matching choices with production system that is most efficient to save cost, maximize output and profits.[52]

The relevance of technology in economics of energy is summed up as "better the conditions of perfect competition are approximated, the more the state of the economy will gravitate towards an efficient equilibrium"[53] Policy/law target the approximation of perfect competition to produce improved welfare for citizens and efficiency in service delivery and consumption. To realise this the choice is market governance or regulation, a sort of mixed market economy because market economy forecloses optimal efficiency[54] but law because it is future oriented and present ideal, it considers not just the present gains but the interest of future generations and the sustainability of energy by preserving the system. It is in this broad nature of law that

[42] The Nigerian Energy Support Programme, The Nigerian Energy Sector: An Overview on Renewable Energy, Energy Efficiency and Rural Electrification Page 24. Is this a journal article or a book? Please reference properly using OSCOLA Organization of the Petroleum Exporting Countries, Annual Statistical Bullentin,

[43] www.opec.org Date accessed: 8 of July, 2024

[44] Ajumogobia and Okeke, The Nigerian Energy Sector: Legal and Regulatory Overview (2015) 6, https://ajumogobiaokeke.com>publications, accessed 27 August, 2024

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[46] Backhouse, Roger E. and Steven Medema (2009) Retrospective: on the Definition of Economics, Journal of Economic Perspectives, Vol.23, No.1, 221-233.

[47] Will Kenton, What it is, Types of Economies, Economic indicators, updated August 20, 2024 https://www. investopedia.com accessed 27 August, 2024.

[48] ibid.

[49] ibid.

[50] Will Kenton, What it is, Types of Economies, Economic indicators, updated August 20, 2024 https://www. investopedia.com accessed 27 August, 2024.

[51] ibid.

[52] Stephan Meyer Intergenerational choice under uncertainty: The case of future energy technologies – Legal and Economic perspectives, springer international publishing AG. Part of Springer Nature 2018, K. Mathis, B. R. Huber (eds) Energy Law and Economics, Economic Analysis of Law in European Legal scholarship 5 https://doi.org/10.1007/978-3-319-74636-4-9; p.174.

[53] ibid.

[54] ibid. 175

economic choices find real expression in terms of the decision of production, distribution and consumption of energy.

There is a question of economic importance to be answered here, is ignorance of future choices a source of uncertainty to production and consumption? Should policy makers pay attention to reasons for intervention in the market such as consumer's lack of self-control, ignorance to choose rightly, lack of fund to purchase needed services including energy. Economic choices are to be rational and objective, there is often verdicts of irrationality and choices or preferences made are to be viewed as such. But the reality is that looking back out present choices at a later time; it will be considered a mistake. This is the concept of hyperbolic discounting as against exponential discounting which is time consistent.[55]

One thing is that preferences exist as choices in energy production, distribution and consumption, for instance in Germany, electric transportation was federal government strategic goals to become the lead market for electric transportation by 2020. To achieve this, government made direct funding intervention[56] and tax[57] incentives to drive production and consumption. In another instance, the United States of America (USA) wants to put one million electric vehicles on the road in 2020; Also, China and Japan are doing the same already.[58] The objectives of these countries are achievement of sustainable energy and environment.

The other thing to be mentioned here is market risk and/or political risk. The efficiency of energy depends on how it was produced and time spent on refuel or recharge. For instance, renewable energy, nuclear energy versus fossil energy. One may compare the weight of batteries and fueled tank, or average time required to refuel a tank or fully change a battery or the season in which solar works optimally and when it will not be a reliable source of energy. Or even the economy of cost of consumption on consumers. All these will suggest the nuisance for potential buyers of a multipurpose vehicle for long distance travel.[59]

Market risk does not itself signify market failure but it is an inherent contradiction of a perfect market. It includes consumer acceptance of goods, reliability, long range, quick refueling, recharging and pricing[60] while political risk may include government policy summersault for instance Malabu oil block and Nigerian government cancellation of the sale of oil block after deal was reached in 1998 and concluded in 2011.[61]

Mayer has argued that some dubious state intervention accounts for market failure and resembles a command economy. If you take German Government policy of electric car intervention and tax incentive to push Germans to buy and use electric cars, instead of allowing same to compete with combustible fossil powered engines is a violation of free market economy it assuredly professes and denies consumers power of choice of preference. The soundness of this policy of German and by extension Europe and advanced technologies to ban combustion engine by 2030 is not clear.[62] The point being made is that, the law as a neutral master should not be called in aid to one technology against another but, the economics of satisfaction from goods based on reliability, durability, ease of refueling energy and pricing be allowed to inform choices of consumers and not government instinct to drive into extinction a particular means of energy by labeling it as environmentally unfriendly just to sell a new technology at a disequilibrium price. This is not in any way to argue against inclusion of renewable energy sources in the energy mix of nations. It is to pursue sound market autonomy by allowing demand and supply to drive any market.

This policy is even most unfair on Nigeria and other oil exporting economies who sell oil to fund her national budget. These countries account for the world's poorest economies and therefore world most poor and vulnerable people who have been played out by international oil companies and host countries in the international politics and interpretation of United Nation's notion of ownership of natural resources and control and the right to self-determination.

It therefore seems, and perhaps one should think that energy efficiency means different things to economically and technologically advanced countries and the developing countries. Whereas in developed countries with functional industries, their emissions does not result in adverse effect on climate to justify closure of such industries, it is developing countries fossil energy and major source of budget funding that should be technically outlawed because it damages the environmental and causes climate change and in order to reverse the trend and preserve the earth for future generation, to justify research and development in energy efficient cars riding by electricity whether powered by batteries or solar were sponsored by state funds against combustion engine. Who told them that, that is what the future generation wants? We think keeping options open for the present and future generation will present each with equal opportunity to preferences particularly if you consider that 80% of world energy is supported by fossil energy.[63]

It has not been disputed that fossil energy is not efficient and reliable. The major complain is that it emits CO^2 to the atmosphere. There is already technology to capture CO^2 or even reduce its burning by high combustion engine lubricants. So why the ban on fossil combustion engines? What is the economic justice of this new policy on oil producing nations? There may be some other reasons other than what is being said now, like sale of new technology and impoverishing oil producing nations etc.

4.1. Energy Production, The Economics and Law Involved

Oil and gas production cost applies differently for any country. Factor that may affect the cost of the product include if country is oil and gas producer, self-sufficiency in local refining of petroleum or non-shipment of refined product, holding capacity etc. For Nigeria, marginal production cost for Deep water is N30.00 per barrel while onshore is N15.00 only per barrel.[64]

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[55] ibid.

[56] Richlinie Zur Fordering des Absatzes von elektrisch betriebenen Fahrzeugen (umweltbonus) (Finding Guidelines for the support of the marketing of Electric vehicles (Environmental Bonus)J. 29 June 2016, Bundersan Zeiger Amtlicher Teil (Federal Gazette Official section) pp. 8,17, 1 July 2016 B1.

[57] Sec. 3d. Kraftfahrzeugsteuer gesetz (Kraftsta) (Motor vehicle Tax Act), 26 September 2002, BGBI. 1@ 3818, last amended by Gesetz (G); 23 December 2016, BGBI 1@3234 art. 19 para 8 (Ger.)

[58] Giz gumbutt (2016) pp 34-53; see also Berger (2015)

[59] ibid. 180

[60] Ibid.

[61] Malabu OPL 245 with a signature bonus of $20 million being a one-time assignment fee to Nigerian Government, www.thecable.ng accessed April 11, 2020

[62] Decision 'Energiewende-reten, verk-erhswende einleiten" [save the Energy Revolution, start a Transportation Revolution"] of the Green Party's 40th Federal Assembly, November 2016, at p.6, available at https://www.gruen.de/fieadmin/user-upload/Dokumente/BDK_2016_muester/EV-01 Energiewende_retten_verkehrswende_einleiten.pdf) accessed 3 March 2017 and Retrieved April 12, 2020.

[63] Fossil energy – client earth.org>fossil-f... accessed April 16, 2020

[64] https://knoema.com>vyronoe>cos... accessed April 16, 2020. No serious academic paper should cite a website address simpliciter. Every academic source, including internet sources must have an author and a title before the publication details, such as the website address

Nigeria sell oil at the international market price and later repurchase the refined products, and bear the cost of shipment to land the products in Nigeria and consequently discharge same into tank farms and further truck the products to major distributers and retailers all at additional cost.

The system is said not to be efficient as landing cost of oil in Nigeria prior January 31, 2020 was N141.07 per liter but in January, 2020, it dropped to N92.89 per liter.[65] The system thrives on the subsidy regime which is now unsustainable because of corruption and has been removed[66]. The huge difference is accounted for by the cost of shipments and storage and trucking to retailers.

Further, the slight reduction in pump price of premium motor spirit (PMS) above economically speaking resembles market economy but the Nigerian oil industry is heavily regulated and there is visible government presence that tally with the mixed and command economy. Furthermore, local refining is good economic choice the law should enforce. It will not only make for self-sufficiency in petroleum products; it will create employment and result in the best use of by-products of crude oil and boost local industries and pharmaceuticals.[67]

The preference to source petroleum from outside Nigeria is not only expensive, it can be explained by hyperbolic discounting as irrational, yet it is a present choice fueled by politics and corruption and consistently pursued blindly by Nigerian leaders against the benefits offered by local refining. But it is not only in the areas of oil production that Nigeria makes irrational economic choice, you can see this in electricity generation, distribution and transmission. For instance, Nigeria with an estimated population of 194,748,265million in 2018[68] produces 3000-3700 MW of 5,900MW[69] of installed capacity and leaves over 90 million people without connection to the national grid.

The industries are worse hit with cost of production of goods in Nigeria being very high. The direct effect is high cost of living for Nigerians and low economic activities because of constant black out. The cumulative effect is poor living standards of Nigerians and high cost to secure energy to power home and industries. There is also poor distribution of power as Nigerians are not largely metered. Most consumption of power is paid on estimated billing system. The evil pang left by the 2005 power sector reform is to retain one monopoly company: the Transmission Company of Nigeria (TCN) to transmit electricity to the 11 Distribution Companies (DISCOS) across the country.

Currently, the TCN can only wheel out about 5,000 MW. So, unless government increases the transmission capacity of TCN, it cannot meet the power needs of Nigeria which targets to increase its capacity to 20,000 MW in the next five years. It is expected that when the Mambilla station comes on board with its 3000MW, it will stabilise power supply in Nigeria.[70] But government policy on port revenue generation target set for custom saw 907 containers of various equipment imported for 126 transmission projects seized by customs for port charges and demurrage. These are clear examples of how government intervention in the economy turns into market risks and policy summersault.

4.2. Energy Efficiency as an Economic Tool Promoted by Law

The notion of economic efficiency seem to be a tool for comparison of legal rules to institutions in which they operated and is not available as a universal standard.[71] Institutions, it should be noted operate in different environment and cost which influences their output and where there are more than one function or legal solution pursued, there will be multiple levels of efficiency to be attained.[72]For instance, the reforms of 2005 of power sector in Nigeria is a legal instrument used to break the monopoly of National Electric Power Authority which first became a Power Holding Company of Nigeria (PHCN) before it was finally unbundled in 2005 into 6 Generating Companies of Nigeria (GENCOS), 11 Distributing Companies of Nigeria (DISCOS) and the Transmission Company of Nigeria (TCN).

Reason for the 2005 reform was to remove political risk from electricity market and reassure investors of the sanctity of contract, assure consumers that they will derive value from services of DISCOS. When these services are reliable and satisfying it becomes rated in terms of economic performance; and such are said to be efficient. Spiller and Tommasi were of the view that only countries with institutional framework that reduces political risk can improve performance of electricity sector.[73] Although different approaches were adopted because countries have different goals it seeks, to achieve but the overall electric power sector reforms have followed these frameworks:

(a) Privatization of state-owned utilities
(b) Vertical separation of competitive segments from regulated segments
(c) Horizontal restructuring of generation segments
(d) Designation of an independent system operator;
(e) Creation of wholesale and auxiliary services markets;
(f) Promoting access to the transmission network;
(g) Unbundling of retail tariffs

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[65] https://www.vanguard-ngr.com>. accessed April 12, 2020. No serious academic paper should cite a website address simpliciter. Every academic source, including internet sources must have an author and a title before the publication details, such as the website address.
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(h) Arrangements of supplying customers when retail competitions is not in place;
(i) Creation of independent regulatory agencies;
(j) Transition mechanisms[74].

They agreed that where these models were followed, reforms were largely successful.

Although, Joskwo had further argued that the reforms resulted in implementation of basic legal and political infrastructure upon which the energy reform proceeded and thrived; he suggested that performance should be compared on alternatives like wholesale competition and access to network. But Joskwo's and Spiller and Tommasi postulations are better in theory than in real world.

History is replete with reform failures and lack of political will for successive government to follow through. In Nigeria for instance, which followed the above model, in 2005 when it broke the monopoly of NEPA, created a transition company PHCN which was unbundled in 2013. The Electric Power Sector Reform Act (EPSRA) created a regulatory agency the National Electricity Regulatory Commission (NERC), created 6 GENCOS; 11 DISCOS and 1 TCN. It also created the Nigerian Bulk Electricity Trading (NBET) Plc. Electricity markets whether wholesale and retail have been created including a market operator; market-based tariff is being charged consumers and there is consumer access to networks and NERC for complaint but generation target have not been achieved talk more of transmission. From 2013 to date, consumers are reaped off by DISCOS as estimated billing persist and the number of households using prepaid meters are negligible. It is hard to see how institutional environments have changed. The DISCOS task consumers to buy poles, wire to be connected and still charge consumers utility bills. When step down transformers is bad, consumers are charged utility bills just as in the time of NEPA continuously for three months, when in fact, there was no power supplied[75]. The community have to buy the transformer and paid DISCO over N600, 000.00 only to fix it. So, in Nigeria, it seems nothing has changed in terms of attitude of the DISCOS as a monopoly only in theory. It seems further, that countries like UK, USA and others in Europe where these models had worked enjoy better culture of questioning and accounting for every service/energy and measurement.

Work ethics may be another reason. It seems, if workers earn the right wages from their labour, they will plan to buy and use the right amount of energy needed and insist on the right measure for what is paid for. Therefore, prepaid meter is the right option and NERC is advised to vigorously enforce it to give Nigerian electricity consumers value for their money. This in economics is equilibrium, where energy paid for is equal to energy demanded and supply. The same if enforced will curb energy thief and leakage and cause DISCOS, GENCOS and TCN to be efficient and even scale up their capacities.

The other way law impacts economics of energy is legal transplant from one country to another to cause desired change in the energy sector. This can be seen exemplified in the electric sector reform borrowed from USA[76], sustainable development goals and Paris convention of United Nations in respect of climate change actions of less greenhouse gas emission into the atmosphere[77].

5. ENERGY TRANSITION AND ACCESSIBILITY

In the past, energy transition basically refers to the systematic trans-generational movement and or growth and development of energy from one stage to another. Just like technology which moved from the stone age to the agrarian era to the industrial revolution stage to the era of information technology and commerce to artificial intelligence era and then the era of autonomous machine, energy has also evolved from one stage to another[78]. However, the evolvement or transition of energy which is the focus in this study is that occasioned by climate change and the need to urgently save the human environment from total collapse as result of the depletion of ozone layers occasioned by human activities including industrialisation, the exploration/generation, transportation/transmission, refining, distribution and end-use of oil and gas.[79] Moving to a more sustainable energy system requires changes in all these areas, including the introduction of renewable energy, energy efficiency measures, adaptation of network regulation and so on.[80]

As pointed out earlier, today, the energy world is going through a number of fundamental transitions, but the commonly discussed and the one significant to this study is the transition towards a more sustainable energy system.[81] For energy transition researchers who focus on this area of transition studies, 'sustainability transitions are long-term transformational processes of established industries, socio-technical systems and societies to more sustainable modes of production and consumption'. Sustainability transitions or sustainable development is the 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.

It is the position of this study that every effective transition programme must have not just the environmental interest or dimension, but also the socio-economic dimensions. For example, the 1992 Rio Declaration while encouraging nations to do all to protect the environment also made provision for the socio-economic advancement of the countries. It encourages states to cooperate towards promoting an open international economic system which allows growth and sustainable development in all nations to better address the degradation of the environment.[82]

The above accounts for the position of the parties at COP 28 which was directed at energy transition in an orderly and equitable manner. It includes accelerating efforts globally towards net zero emissions energy systems and transitioning away from fossil

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fuels in the energy systems. The new resolution from COP28 is considerably tougher than the first draft which caused consternation among many of the delegates at the conference. Although not legally binding, it is the first time in almost 30 years of UN climate summits that countries have agreed to transition away from fossil fuels.[83] Certain key point decisions were reached at COP 28 which are considered critical to the global drive for energy transition. One of such decisions was the one targeted at fast-tracking a just, orderly, and equitable energy transition. A rapid decarbonisation of the energy system according to the parties, is the key to keeping the goal of 1.5^{o}C within reach. This requires accelerating clean energy transition both from the demand and supply side, while such transformation should be orderly, just and equitable and also account for energy security.[84]

It was also agreed that while demanding energy transition, the focus should be on people, lives and livelihoods.[85] The parties agreed to triple renewable energy capacity globally and to double the global average annual rate of energy efficiency improvements by 2030.[86] Rapid phasing down of unabated coal use and limiting the permitting of new unabated coal power generation was also agreed upon by the parties. To this end, each party state is to accelerate efforts towards net zero emissions energy systems, utilise zero and low carbon fuels well before or by around mid-century. It was taken that transitioning away from fossil fuels in the global energy systems, beginning in this decade, in a just, orderly and equitable manner is the way to achieve net zero by 2050 in keeping with the science.[87]

For the first time, a decisive action was taken against methane which ranks ahead of oil and gas in terms of emission, but has not been half attacked as much as oil and gas. In particular, methane is to be phased out by the year 2030. Parties agreed to accelerating zero and low emissions technologies, including, inter alia, renewables, nuclear, abatement and removal technologies, such as carbon capture and utilisation and storage particularly in hard to abate sectors, and low carbon hydrogen production, so as to enhance efforts towards substitution of unabated fossil fuels in energy systems.[88] If Nigeria must achieve its dream of energy accessibility and sustainability, it must be intentional in its policy and legal framework in the energy mix and create enabling environment for investors in the renewable energy sector.

6. CONCLUSION

Energy sustainability and access is at the foundation of clean environment. It is to emphasize production of energy in a more environmentally friendly way while meeting the energy needs of all. This paper therefore recommends that to attain its lofty dream of energy accessibility, affordability and sustainability, Nigeria must through an intentional policy and legal framework promote a systematic energy transition agenda which include the creation of a conducive environment for foreign investors in the nation. The federal government should also ensure in the meantime, that extant technologies and carbon capture facilities are deployed in the oil and gas sector while the transition is ongoing.

7. RECOMMENDATIONS

It will be hazy to determine energy efficiency only by functionalism or performance as there are complementarities and competitions in the institutional environment – governance, politics, cultural elements, regulations, and even market forces. Carrying on a healthy dialogue will see whether energy efficiency will happen fast or later or not all. In Nigeria for instance, there is poor perception of energy economics and energy mix. This has resulted in the high cost to repurchase refined petroleum and heavy reliance on oil and gas while other alternative sources now termed clean sources of energy are in abundance in Nigeria. Further, economics of energy and law dealt with cost of production of energy and the trade aspects of it suggesting that the efficiency in production and use of energy is why the law regulates same.

Also, economics of energy production from the part of most governments to producers comes in the form of incentives and tax cut of production of the target commodity. For instance, production of ethanol and biofuel may not be environmental protection but policies on tax incentives, consumption mandates exist with political decision supporting their production or if you consider electric car production in Germany. So, law wisely used can direct energy economics and achieve efficient use of energy and at optimum pricing of energy. The way the law achieves this is by establishing the legal framework/policy upon which energy production, economics and trade aspects are carried on, including detection of infraction and enforcement.

In another breath of logic, it is submitted that if 89% of CO^2 emissions come from fossil fuel and industries, it would be right that both ought to be outlawed for causing such damage to earth and its resources[89] any discriminatory decision will not be rational exponentially.

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