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SUSTAINABLE OIL AND GAS ANDSUSTAINABLE GREEN ENERGY: WHY BOTH CAN BE BENEFICIAL TO NIGERIA?

Akachim M. Chizi-Boms*

Abstract

Nigeria has huge oil and gas deposits, the exploitation of which contributes massively to its economy. These are fossil fuels and although useful for human activities, have resulted in environmental pollution. To tackle this, there has been a call-in recent times to reduce its use to achieve lower carbon emissions; search for and utilize energy resources that are harmless to the environment, renewable and sustainable. Nigeria has expressed its commitment to the above initiative. This study therefore examined Nigeria's petroleum industry and its effects on the environment. This study appraised Nigeria's natural gas potentials and its quest to achieve sustainable green energy; measures in place and the benefits thereof. This study revealed that Nigeria is heavily reliant on oil for its energy needs and will be for some time before transitioning to green energy. It was discovered that there are challenges with green energy but Nigeria can benefit from the sustainability of both energy resources. This study recommended that practical commitment be given to the production of oil and more especially gas and utilization thereof to achieve energy security whilst awareness be made about green energy and the government work with private individuals and organisations to achieve this.

Keywords: Oil & Gas, Environment, Pollution, Green Energy, Aviation

*LL.B Hons (Kampala, Uganda), BL (Abuja, Nigeria); LL.M (Candidate) Rivers State University

1. Introduction

Nigeria is a country situated on the Western region of the African continent, home to 200 million people and is the most populous black nation. Having a GDP of about 440 billion U.S. Dollars in 2021,[2] Nigeria has one of the largest economies in Africa and is blessed with numerous natural resources some of which include gold, coal, oil and gas, zinc, iron ore, uranium, limestone and many others. Of crucial importance to the Nigerian economy is the exploration and production of oil and gas, Nigeria's foremost energy resource. The oil and gas industry is the country's most profitable economic sector and provides vast investment opportunities.[3] As at 2020, Nigeria had the largest oil and gas reserves in Africa, with about 37 billion barrels of crude oil and 5.5 trillion cubic metres of gas making it the ninth-largest in the world in terms of gas reserves.[4] Most of Nigeria's gas is untapped and the ones that are extracted are mostly flared or underutilized. The production of oil and gas in Nigeria whilst being of utmost benefit to the economy has created a number of problems for not only the environment but the host communities as well.

Oil and gas resources are mostly located, explored and produced in the Niger Delta region of the country. This region is located within nine coastal states is characterised by rain forests, swamps and marshy areas. These environments provide the local communities that habit this region food and is a source of livelihood to them. But with the advent of crude oil and gas exploratory and production activities by oil companies, the communities have suffered grave environmental pollution and degradation.[5] This has resulted in the deprivation of their livelihood and the right to live in the clean and healthy environment they once called home. Harmful substances from oil spillages have devastated ecological areas and nearby marine environment killing fishes and other living organisms. Host communities do not have a say and are left to wallow in extreme poverty and suffering, leaving them no choice but to resort to different means to make their voice heard.[6]

It is a fact that Nigeria has benefited economically from the production of oil and gas but it cannot be stated that Nigeria has achieved energy security. Energy security has been defined to encompass the availability, reliability, affordability and sustainability of energy resources.[7] Nigeria from its foremost energy resource has not been able to achieve availability, reliability, affordability and sustainability required thereof. Nigeria faces problems of fuel scarcity, electricity blackouts, pipeline sabotages, high petroleum prices and environmental degradation as a result of the factors such as corruption and mismanagement from the government, lack of political will, lack of state-of-the-art infrastructure, refining capacity and capability as well as an over reliance on international oil companies thereby letting them take advantage of the system resulting in energy insecurity.

Nigeria's underutilization of its gas potentials has also contributed to the very problem it faces. Even though Nigeria has one of the largest gas reserves in the world it has not benefitted from it because focus is not being placed on the full exploration and production of gas for general usage.[8] Gas is an energy resource that is less harmful to the environment than its counterpart crude oil[9] and is highly utilized in countries that have achieved great levels of energy security. Since environmental pollution, global warming and climate change is on the increase, countries are looking for and transitioning to safer and environmentally friendly energy resources such as wind and solar to utilize. Gas is therefore

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[2]https://tradingeconomics.com/nigeria/gdp; https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=NG Accessed September 24, 2022.

[3] International Trade Administration, Nigeria- Oil, Gas and Mining Sectors, 2021. https://www.trade.gov/country-commercial-guides/nigeria-oil-gas-and-mining-sectors/ Accessed September 24, 2022.

[4] Nigeria Oil and Gas Market – Growth, Trends, COVID-19 Impact and Forecasts (2022-2027). https://www.mordorintelligence.com/industry-erports/nigeria-oil-and-gas-market/ Accessed September 24, 2022.

[5] Oshienemen N. Albert and Others, Evaluation of the Impats of Oil Spill Disaster on Communitites and Its Influence on Restiveness in Niger Delta, Nigeria, *Procedia Engineering 212 (2018)* 1054-1061

[6] Nwogwugwu Ngozi and Others, Militancy and Insecurity in the Niger Delta: Impact on the Inflow of Foreign Direct Investment to Nigeria, *Kuwait Chapter of the Arabian Journal of Business and Management Review* 2 (1), 23, 2012.

[7] Samuel C Dike, *Energy Security: The Case of Nigeria and Lessons from Brazil, Norway and the UK*, (Pearl Publishers 2015) 1, 29-31; Jonathan Ellkind, Energy Security: Call for A Broader Agenda, in C Pascual and J Elkind, *Energy Security, Economic Politics, Strategies and Implementations* (Brookings Institution's Press 2010).

[8] Ibid.

[9] Union of Concerned Scientists, Environmental impacts of Natural Gas, 2014. https://www.ucsusa.org/resources/environmental-impacts-natural-gas/ Accessed September 25, 2022.

a transition fuel which presents a lot of benefit to Nigeria and in its commitment to attaining lower carbon emissions and going fully carbon neutral in years to come.

Nigeria can meet its energy needs without an over reliance on crude oil.[10] Steps have been taken in recent times to reduce gas flaring and projects such as the Nigeria Liquefied Natural Gas project[11] and the West African Gas Pipeline project[12] have taken off to increase gas production and utilization and this is a very good initiative, but it cannot be stated that if Nigeria has the political will and practical commitment needed, crude oil cannot be explored and produced in a manner that is not harmful to the environment and in a manner that achieves energy security in addition to gas, with green energy on the horizon.

In this regard, green energy implies that energy resources are environmentally friendly and emit little to no pollution substances. From solar to wind to hydroelectric power, Nigeria has the environment and climate suitable to explore, produce and manufacture. Nigeria has high energy consumption capacity and so diversification of energy resources is greatly needed. Transition to green energy will not be easy for this country since it is a developing country but it can be done. There need not be total transition to green energy as fossil fuels are still much needed in industries and activities such as transportation affecting aviation and shipping activities more especially. This study therefore examines if and how sustainable oil and gas can be achieved and how Nigeria can benefit and make use of petroleum and green energy in a manner that is equally sustainable and harmless to the environment.

2. OIL AND GAS ACTIVIES AND THE NIGERIAN ENVIRONMENT

Crude oil was discovered in Nigeria in commercial quantity in Oloibiri, Bayelsa State in 1956 by Shell D'Arcy, after it was granted exploration license to prospect for oil throughout Nigeria by virtue of the of the Mineral Ordinance, 1914.[13] The initial output was about 5000 barrels which was considered a commercial discovery resulting in Shell's first export of crude oil from Port-Harcourt.[14] With time, the production levels increased and Nigeria reached its all-time peak of oil production in 1979 at the rate of about 2.4 million barrels per day.[15] As at 2021, Nigeria produced about 1.6 million barrels of crude oil per day.[16] Instrumental to Africa's oil and gas potential, Nigeria accounted for up to 29% and 21% of total oil and gas reserves respectively in 2018.[17] Currently, according to the National Petroleum Investment Management Services, there are about 500 oil fields in the Niger Delta with up to 55% of these onshore, while the remainder exists in shallow waters less than a depth of 500 metres.[18] Regarding gas, reports indicate that Nigeria holds more of non-associated gas in its reserves than associated gas, yet the latter accounts for more than half of the total gas produced every year.

Upon discovery of oil and gas in Nigeria, Shell acquired total ownership, management and control of the territory of Nigeria in the exploration and production of the resource since it had the necessary capital, expertise and infrastructure making it the sole concessionaire. The oil company enjoyed the massive financial benefits and advantages derived from the exportation of oil and gas to the detriment of the environment and the locals that resided therein. Since the locals were not very educated, had no rights to participate in the industry and to resource control, they were not able to confront the

[10]Mohammed Shaaban and J-O. Petinirin, Renewable Energy Potentials in Nigeria: Meeting Rural Energy Needs, *Renewable and Sustainable Energy Reviews* 29 (2014) 72-84.

[11]https://www.nigerialng.com/Pages/index.aspx/ Accessed September 25, 2022.

[12] The West African Gas Pipeline (WAGP) https://www.wagpa.org/the-wagp/ Accessed September 25, 2022.

[13] Section 6 (1), Mineral Ordinance, 1914.

[14] A.0.1 Gabriel, Oil Industries and Educational Development in Nigeria: 1937-1994, JOTASE (1994) VOL. 3 Nos. 1 & 2; Oloibiri Field January 1956 – Nigeria's First Commercial Oil, Energy Hub 2021.
https://energihub.com/article.php?slug=d1897db8 Accessed September 25, 2022

[15] M.D. Imobighe, The Impact of Oil Price Instability on the Growth Process of the Nigerian Economy, *Journal of Resources Development and Management* 14, 56-70, 2015.

[16] N. Sonnichsen, Oil Production in Nigeria 1998-2021, Statista 2022. https://www.statista.com/statistics/265195/oil-production-in-nigeria-in-barrels-per-day/ Accessed September 25, 2022.

[17] Evaluating Nigeria's Gas Value Chain. https://www.pwc.com/ng Accessed September 25, 2022

[18] Crude Oil Reserves/Production, National Petroleum Investment Management Services.
https://napiims.nnpcgroup.com/Pages/Crude-Oil-Reserves-Production/ Accessed September 25, 2022

colonialists to protect their environment or to give them a share in the proceeds. Other companies such as Agip, Mobil, Safrap (now Elf), Texaco and Chevron joined in the exploratory and production activities later on.[19]

The clamour for control and resource ownership by Nigeria became evident and increasingly so with the desire for independence. After gaining independence on October 1, 1960, Nigeria enacted its Petroleum Act, `1969 which vested ownership and control of oil and gas resources in the Federal Government of Nigeria, giving the Minister of Petroleum the right to grant licenses and leases for the exploration and production of oil and gas.[20] Nigeria therefore gained the ability and right to participate effectively in the petroleum industry, having formed its own national oil company, the Nigerian National Oil Company in 1971, which later became NNPC and subsequently NNPC limited as is known today.[21] Nigeria was now able to participate through concessions, joint ventures, production sharing contracts as well as service contracts, with the international oil companies and also regulate the workings of the industry.

The vesting of petroleum resources in the Federal Government did not effectively address pollution even though it had the duty to protect the environment and had the right to compel the international companies to act in line with stipulates environmental standards and guidelines. Under the Constitution of the Federal Republic of Nigeria, it is the duty of the State to preserve and protect the environment and to not engage in activities that will affect the wellbeing of the community.[22] Various other laws such as the Petroleum Industry Act 2021, the National Oil Spill Detection and Response Agency Act 2006, the National Environmental Standards and Regulation Enforcement Agency Act 2007, enacted provided for the duties of oil companies and other participants to ensure that the environment is not subjected to pollution and where such inevitably occurs, there must be control and remediation. Environmental clean-ups are mandated in events of pollution and there is a responsibility to drastically control and reduce activities that result in pollution. It is imperative to state that whilst Nigeria has good environmental protection laws (not without lapses) as well as regulatory institutions, effective and efficient implementation is lacking. Reports indicate that currently and over the past few decades, there has been occurrences of severe environmental damage resulting from oil spills. It was estimated that between 1976 and 2001, there were about 6,800 spills totalling 3,000,000 barrels of oil and in 2006, there were 253 oil spills, in 2007, there were 588 oil spills and in 2008, there were more than 419 oil spills.[23] The damage is not only to the land but to the surrounding marine environment, the flora and fauna. Water systems in the region have been contaminated killing the marine life and making it unsafe for the people to use. Severe illnesses and health challenges such as cancer and lung diseases have been reported due to the presence of toxic waste, substances and materials. It has further been estimated that it would take up to 30 years or more for an effective environmental clean up to be made restoring the environment to its pre-pollution state.[24]

There have been consistent blame game involving who the perpetrators of these spills are. On one hand, it has been canvassed that most oil spills result from pipeline sabotage perpetrated by criminal groups and militants.[25] On the other hand, the host communities have blamed the oil companies and the government for having old and weak machinery that are susceptible to rupturing and damage.[26] It is the author's opinion that each of these stakeholders aforementioned are to be blamed, albeit in different proportions. The government being the regulator, chief law maker and stakeholder with the

[19] Charles Udosen and Others, Fifty Years of Oil Exploration in Nigeria: The Paradox of Plenty, *Global Journal of Social Sciences* Vol. 8, No. 2 2009: 37-47, 38.
[20] S. 1, Petroleum Act, `1969.
[21] https:www.nnpcgroup.com/who-we-are/
[22] S. 21, Constitution of the Federal Republic of Nigeria, 1999 as amended.
[23] Oshienemen N Albert and Others, Environmental Policies Within the Context of Compensation for Oil Spill Disaster Impacts; A Literature Synthesis, *Procedia Engineering* 212, 1179-1186, 2018.
[24] Paul A Onuh and Others, Artisanal Refining of Crude Oil in the Niger Delta: A Challenge to Clean-up and Remediation in Ogoniland, *Local Economy* 36 (6), 468-486, 2021.
[25] Freedom Onuoha, Oil Pipeline Sabotage in Nigeria: Dimensions, Actors and Implications for National Security, *African Security Review* 17 (3), 99-115, 2008.
[26] Akinola S. Akinwumiju and Others, Geospatial Assessment of Oil Spill Pollution in the Niger Delta of Nigeria: An Evidence-Based Evaluation of Causes and Potential Remedies, *Environmental Pollution* 267, 115545, 2020

majority participatory interests in joint ventures have not been so committed to fighting corruption and mismanagement amongst its officials, it has compromised standards and has not effectively and efficiently enforced or implemented the laws and regulations it enacted. The government, through NNPC, has failed to perform its obligations under the extant laws, existing joint ventures and contracts[27] and have not utilized oil proceeds well enough to provide better amenities for the host communities and environmental remediation in events of pollutions. Furthermore, the government has not been able to maintain the refineries built, leaving them in a state of despair and inactivity. The result of this is the exportation of crude and importation of refined petroleum creating fuel scarcity. As such, citizens are not able to fully enjoy from oil profits and are unable to afford petroleum products for their consumption.

As stated earlier in this study, the international companies are complicit in environmental pollution because they take leverage of Nigeria's weak and mostly ineffective law and regulatory enforcement and also partake in corrupt practices with the government to the detriment of the host communities. Reports indicate that there have been cases of bribery between government officials and the international oil companies (IOCs) to secure confidential information or exploratory and production licenses.[28] Since judicial enforcement is also a bit loose, IOCs always have the money to pay fines and compensations and also go ahead to frustrate proceedings to prevent the affected communities from enforcing their rights. Lastly, we have the host communities. Being aggrieved due to the state of their environment and the fact that they have little to no access to profit nor participation in the industry, indigenes of these communities resorted to violent acts of militancy and pipeline sabotage which have caused adverse effects to the environment as well. It is a sad state in the Niger Delta region which leaves one wondering if the theory of Resource Curse is applicable to Nigeria.
It is therefore apparent that with the existence of the above Nigeria relies more on oil to meet its energy needs. Gas, on the other hand, has not been utilized fully as a better energy resource. Most of the associated gas produced have been constantly flared. Nigeria is reported to have contributed up to 25% share in the global gas flaring.[29] Gas flaring poses threats to the environment and has been capable of causing pollution if not channelled properly or safely.

The impact of oil and gas on the environment is one that is capable of causing more harm than good. Climate change, global warming, ozone depletion are some of the crucial issues that affect the environment as a result of human activities. The international community have pledged to take actions to drastically reduce carbon emissions, combat climate change and global warming in order to protect the environment. Developed countries are searching for and beginning to utilize alternative energy sources which are of less harm to the environment and are sustainable in the long term. Nigeria was not left out as it pledged its commitment to achieving the above by signing and ratifying relevant international treaties, conventions and protocols and drafting its own environmental protection laws such as the Climate Change Act 2021. This is a step in the right direction as Nigeria is capable, with the right government and infrastructure, of achieving sustainable green energy. Before Nigeria reaches this, however, a transition from over dependence of oil needs to be made and gas is best suited to be a transition fuel if effectively utilized.

3. TRANSITION TO SUSTAINABLE GREEN ENERGY IN NIGERIA: GAS AS A TRANSITION FUEL AND ITS EFFECTIVE UTILIZATION

It has been understood that as a result of prevailing challenges and problems highlighted, facing the oil and gas industry in Nigeria, the country has not been able to achieve energy security. Nigeria biggest energy resources are its oil and gas and in addition, hydro and solar resources. The main source of the country's electricity comes from gas accounting for up to 80% of the capacity in the

[27] S.C Dike (n. 6) Pg. 69.
[28] Chioma B. Achinike, Nigeria: Anti-corruption Overview in the Oil and Gas Industry, 2021. https://www.mondaq.com/nigeria/white-collar-crime-anti-corruption-fraud/ Accessed September 26, 2022
[29]https://www.google.com/amp/s/www.vanguardngr.com/2019/12/nigerias-gas-flaring-profile-drops-to-25-in-20-years/amp/ Accessed September 26, 2022.

country with the remainder generated from hydropower.[30] But since Nigeria has not utilized its gas potentials, citizens face challenges such as incessant power failures, fuel scarcity resulting from the government's inability to meet its domestic gas supply and delivery obligations. The international oil companies are also complicit in this giving reasons that there are lack of incentives and inadequate infrastructure to effectively produce and supply gas resulting in the flaring of gas.[31]

Natural gas is a better alternative to oil and is safer for the environment. The United States Energy Information Agency (USEIA) reported that burning natural gas for energy results in fewer emissions of nearly all types of air pollutants and carbon di-oxide[32] and as such is quite environmentally friendly if processed, transported and stored safely. It has also been acknowledged that although being a non-renewable energy resource and does not solve climate change crisis and global warming, natural gas is the most environmentally friendly fossil fuel because it burns cleaner and emits up to 60% less carbon dioxide than regular oil or coal-fired power plants.[33] Natural gas therefore presents a unique opportunity to Nigeria. As indicated earlier, Nigeria possesses more non-associated gas in its reserves than associated gas, yet the latter accounts for more than half of the total gas produced every year. From here, it is clear that two things are evident. Firstly, if the amount of gas flared is instead channelled and utilised more through the existence of state-of-the-art infrastructure, there would be an increase in the availability of energy resources. Secondly, it is apparent that attention needs to be given to non-associated gas in other to bring about an increase in its production. Since this was not envisaged or adequately provided for in the Petroleum Act 1969, the new Petroleum Industry Act 2021 which replaces the 1969 Act makes provision for the grant of licenses to engage in the processing, storage, transportation as well as distribution and supply of gas.[34] This is a step in the right direction as it will improve existing gas supply and also achieve security of supply whilst increasing revenue for the government from the exportation of natural gas, being one of the highest exporters of the energy resource. Public service obligations are imposed under Section 171 to ensure that in addition to security of supply and economic development, there is the existence of environmental protection as well as safety[35], as gas is less harmful to the environment when compared to petroleum. Nigeria is a fertile ground for the maximisation of gas potentials globally as a result of the fact that there has been a global energy crisis stemming from various factors such as the Corona Virus Pandemic of 2019 and the ongoing Russia-Ukraine military conflict. The COVID-19 Pandemic greatly reduced energy demand and affected the production of resources such as oil and gas globally whilst the Russia-Ukraine military conflict affected the supply of gas to Europe from its Nord Stream 1 and 2 pipelines creating an energy shortage.[36] Nigeria is therefore uniquely positioned to expand its gas production in order to supply to countries in need. It is of great importance that the government is committed to the full enforcement and implementation of the Petroleum Industry Act 2021 because if the law is not enforced, however good the provisions are, it will not be useful.

Liquefied Natural Gas is therefore a valuable, safe and reliable energy resource. Although interest in Liquefied Natural Gas (LNG) was initiated in the 1960s, as a result of factors such as political instability, lack of political will or interest as well as lack of investors, it was not until 1989 that the Nigeria Liquefied Natural Gas, being a joint venture between NNPC (49%), Shell Gas B.V. (25.6%), TotalEnegies Gaz & Electricite Holdings (15%) and Eni International N. A. N. V. S. ar.I (10.4%),[37] was incorporated as a limited liability company, after which production from the first NLNG

[30] Charlotte Remteng and Others, Nigeria Electricity Sector, Energypedia. https://www.energypedia.info/wiki/Nigeria-Electricity-Sector/ Accessed September 26, 2022.
[31] S.C. Dike, (n.6) Pg. 9.
[32] Natural Gas Explained: Natural Gas and the Environment. https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php
Accessed September 26, 2022
[33] Ibid n. 8
[34] Part IV, Petroleum Industry Act, 2021.
[35] Ibid.
[36] How the Russia-Ukraine Conflict is Impacting Supply Chains, July 2022. https://www.google.com/amp/s/www.consultancy.eu/news/amp/7993/ Accessed September 27, 2022.
[37]https://www.nigeiralng.com/the-company/Pages/Shareholders.aspx. Accessed September 27, 2022.

operational train started in 1999 from its LNG plant in Bonny Island.[38] This development brought about a commendable increase in the production and exportation of natural gas in the country.

The West African Gas Pipeline Project is a natural gas pipeline project consisting of 678 km pipeline to transport gas in a safe, responsible and reliable manner from Nigeria's Escravos region through the West African countries of Benin Republic, Togo and Ghana.[39] It was incorporated as a limited liability company in 2003 and was registered in Nigeria, Benin, Ghana and Togo as a foreign company. It is a joint venture consisting of Chevron, NNPC, Shell, Takoradi Power Company Limited, Societe Togolaise de Gaz and Societe BenGaz S.A. as the shareholders. The Project is overseen by the West African Gas Pipeline Authority (WAGPA) which was established under the West African Gas Pipeline Project Treaty.[40] It is the expectation that the West African Gas Pipeline will greatly utilize gas potentials and as stipulated in the Treaty, "provide a new market for Natural Gas and expand sources of energy in the West African region as well as improve the balance of energy requirements and resources in the region."[41]

The Nigeria-Morocco Gas Pipeline Project is yet another 5,600 km gas pipeline transportation project that was recently approved between Nigeria and Morocco for the transportation of gas through pipeline from Nigeria along the coast of West Africa, through the North African region then terminating in Morocco.[42] The commitment of the two countries on the project was essentially brought to life by a Memorandum of Understanding which was signed between NNPC and Morocco's Office of Hydrocarbons and Mines. The Project is to begin in different stages which would take up to 25 years and is financially supported by the countries as well as the OPEC and the Islamic Development Bank of Saudi Arabia (IDB).[43] This project is therefore important as Nigeria seeks to utilize its gas that has in the past been extensively flared or left underdeveloped.

The above Natural Gas Projects involving Nigeria are laudable in bringing about a gradual increase production and supply of the resource since without these, there cannot be effective and efficient utilization of the resource as a transition fuel making the over dependence on oil linger. The Petroleum Industry Act 2021 therefore seeks to promote the expansion of Natural Gas potentials and with effective commitment from the government, IOCs and other stakeholders energy needs can be met without causing harm to the environment we live in and are dependent on for our survival and for the survival of our future generations.

4. ACHIEVING SUSTAINABLE GREEN ENERGY IN NIGERIA

The need for energy resources to be sustainable cannot be overemphasised. As human activities continue to increase, there will always be a need for the production and utilization of energy resources. Energy supply may emanate from fossil fuels such as oil and gas or from renewable sources such as solar, wind, water and geothermal energy. Green energy is therefore defined to mean energy that is compatible with the environment and cannot produce pollution.[44] For green energy to be sustainable, it is important that it is also renewable. Sustainability of energy resources envisages that it meets the needs of the present without compromising the ability of future generations to meet their own needs.[45] This means that energy resources should be accessible and utilized in a way that the society is able to meet its needs and express their greatest potential in the present, while protecting the diversity of the environment and natural ecosystems and maintaining them for utilization by future generations. Green energy not only preserves the environment but improves the health, livelihood and

[38] Ibid.
[39] https://www.wagpco.com/
[40] West African Gas Pipeline Project Treaty, Done at Dakar, Senegal January 31, 2003.
[41] Ibid.
[42] https://www.gem.wiki/Nigeria-Morocco_Gas_Pipeline/
[43] North Africa Post, Nigeria-Morocco Gas Pipeline: OPEC Fund to Contribute $14.3 million to Phase II of Feasibility Study, 2022. https://northafriapost.com/57317/nigeria-morocco-gas-pipeline-opec-fund-to-contribute-14-3-million-to-phase-ii-of-feasibility-study Accessed September 29, 2022.
[44]https://www.twi-global.com/technical-knowledge/faqs/what-is-green-energy/ Accessed September 28, 2022
[45]S.O. Oyedepo, Energy and Sustainable Development in Nigeria: The Way Forward, *Energy, Sustainability and Society* 2012, 2:15, Pg. 11.

wellbeing of the people globally. Reports indicated that about 156 countries have enacted laws regulating the renewable energy sector and renewable energy systems are quickly becoming efficient and cheaper to afford and access.[46]

Before the discovery of fossil fuel, energy resources although utilised on a small scale was green. For example, windmills and biodegradables like firewood were utilized for domestic and few industrial uses. Ancient African kingdoms relied on natural materials for its energy needs as well as transportation, cooking, housing and so on. But upon discovery of oil, these resources became less utilized as population increased and industrial activities skyrocketed. War also had an influence on the rapid production and utilization of fossil fuels for military vehicles, ships and aircrafts. With "civilisation" and colonialism, the invention and use of technology increased and the need to modernise among African states expanded. However, the utilization of these fossil fuels created massive environmental damages and pollution. Increased environmental degradation became a problem globally. Water channels, rivers and lakes were constantly polluted with harmful and toxic industrial waste products and with the effects of wars and military conflicts, many regions and cities became uninhabitable.

Seeing the effect the above had on the environment, countries began to express commitment to environmental protection, combating climate change and global warming. International agreements were entered into and international documents were drafted to that effect. The Stockholm Declaration on the Human Environment 1972 was the first international document to recognize the right to a clean and healthy environment as well as the need to preserve and protect the environment and was made pursuant to the first United Nations (UN) Conference on the Human Environment which was held at Stockholm, Sweden from June 5 – 16, 1972. The United Nations Environment Programme (UNEP) was also created in this period.[47] In 1987, the Vienna Convention for the Protection of the Ozone Layer was a framework convention that was signed laying down principles concerning the reduction of activities which were harmful to the Ozone layer. The Montreal Protocol was signed in 1987 pursuant to the Vienna Convention to combat the depletion of the ozone layer and was successful in mandating most States that ratified it to do so.[48] It was then in 1992 that the UN Framework Convention on Climate Change (UNFCCC) was made and was ratified by 197 countries calling on State Parties to protect the climate system for the benefit of the present and future generations of mankind. The Convention established an annual forum known as the Conference of Parties (COP), where Parties came together to engage in international discussions aimed at stabilizing the concentration of greenhouse gases in the atmosphere.[49] These meetings resulted in the creation of important documents and agreements on the environment which were the Kyoto Protocol and the Paris Climate Agreement. The Kyoto Protocol to the UNFCCC was adopted in 1997 and entered into force in 2005 becoming the first legally binding climate treaty that required countries to reduce greenhouse gas emissions[50]; whilst the Paris Climate Agreement which was adopted by 196 Parties at the COP 21 in Paris in December 2015, entered into force in November 2016, having the goal of limiting global warming to below 2 degrees Celsius and aiming to reach global net-zero emissions.[51] Within these conventions and treaties, it is clear that an increase in the production and utilization of green energy sources will lead to environmental protection and preservation.

As indicated prior in this study, Nigeria expressed its commitment to reducing carbon emissions and utilizing green energy resources. Nigeria is blessed with most renewable energy resources including wind, solar and hydropower which although lower than gas, generates power for households, offices, hospitals and other places. The promotion of renewable energy power generation is provided for under Electric Power Sector Reform Act in order to achieve equitable regional access to electricity.

[46] REN21, Renewables 2022 – Global Status Report, (Renewable Energies): 44

[47]https://www.unep.org Accessed September 29, 2022.

[48]Including Nigeria.

[49] Conference of Parties (COP) https://unfccc.int/process/bodies/supreme-bodies/conference-of-parties-cop Accessed September 29, 2022

[50] What is the Kyoto Protocol? UNFCCC https://unfccc.int/kyoto_protocol/ Accessed September 29, 2022.

[51] The Paris Climate Change Agreement | UNFCCC https://unfccc.int/process-and-meeting/theh-paris-agreement/ Accessed September 29, 2022.

Generally, the National Energy Policy 2001 envisaged the optimal utilization of the nation's energy resources for sustainable development. From solar to biomass, wind and hydropower, the objectives of the policy was to diversify energy resources for consumption with the aim of reducing air pollution as well as greenhouse gas emissions.Nigeria has ratified majority of the aforementioned treaties and has its own environmental laws which it has enacted.[52] In 2021, Nigeria enacted its Climate Change Act wherein it provides a framework for achieving low greenhouse gas emission, inclusive green energy and sustainable economic development through the formulation and implementation of actions, programmes and policies to that effect.[53] Sustainable green energy is therefore achievable in Nigeria if the government is committed to ensuring that systems, incentives and measures are put in place to facilitate investment in green energy. Apart from hydro power which is supplied by the government, other existing green energy sources such as solar are mostly supplied and distributed by private entities making it expensive to purchase by most average Nigerian homes. As such the need to diversify energy resources is fundamental and paramount to achieving energy security as well as sustainability.

5. IS THE EXISTENCE OF SUSTAINABLE PETROLEUM POSSIBLE?

The expansion of green energy usage is fundamental to the protection of the environment and the preservation of the ecosystem for the present and future generations. Countries have projected increased transition to green/renewable energy from 2030 – 2050,[54] and in doing so have acknowledged the existence of the principle of common but differentiated responsibilities. This principle explains that developed countries have the highest emission rates and as such have higher responsibilities to cut carbon emissions and increase the utilization of green energy. The principle also takes into consideration the fact that most third world countries do not have the capacity to transit to clean energy at the same rate as developed countries. This means that in efforts to bring about sustainable energy, third world or developing countries will still be heavily reliant on fossil fuels. Additionally, many countries utilize fossil fuels for industrial and transportation activities which renewable energy sources may not be able to cater for on a large scale.

Commercial aircrafts for example make use of jet fuel produced from oil in the transportation of individuals and cargo over regional and long distances. Although calls for the boycott/banning of commercial aircrafts have been made by environmental conservation groups and climate change activists since they contribute to carbon emissions,[55] it is not feasible to totally ban commercial aircrafts since aviation makes up one of the highest and largest means of transportation. Inasmuch as there is the existence of sustainable aviation fuels (SAFs) to replace conventional jet fuel, it is very expensive to manufacture costing up to at least 50% more than conventional jet fuel.[56] This will affect the affordability of flights for the average Nigerian therefore affecting the development of the industry in the country. The importance of commercial aviation cannot be ovestated more especially in Nigeria as the aviation sector in the country continues to expand.

The maritime sector through shipping as one of the largest transportation means also makes use of fossil fuels in transportation of people and cargo. Amongst others, it is apparent that petroleum is important for not only our energy needs but for other human activities that affect our survival. The question therefore is if and how petroleum can be made sustainable. The answer to this lies in understanding that if the correct precautionary measures are put in place in the exploration and production of oil, environmental pollution will drastically reduce. Most oil pollution activities in the

[52] Electricity Sector Reform Act, 2005.
[53] Section 1, Climate Change Act, 2021
[54] IRENA, Global Energy Transformation: A Roadmap to 2050, IRENA 2018. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Apr/IRENA_Report_GET_2018
Accessed September 29, 2022
[55] Damien Gayle, Activists Subjert Poster Sites to Shame Aviation and Ad Industries, 2022. https:www.google.com/amp/s/amp.theguardian.com/environment/2022 Accessed 29 September, 2022.
[56] Jaopo Prisco, Green Jet Fuel is Here – So Why are Airlines not using it? CNN Travel, CNN, 2022. https://www.google.com/amp/s/www.cnn.com/travel/amp/saf-jet-fuel-green/index.html Accessed September 29, 2022.

Niger Delta stem from the lack of implementation of environmental standards provided for in our legislations, policies and regulations to prevent, control and reduce pollution.

Good governance is the key to achieving this because as Solomon Ekokoi suggests, issues relating to good governance, accountability and transparency are very central to the sustainable management of Nigeria's oil wealth.[57] Adejala further suggests that the government should use its leverage to strengthen the preventive and safety requirements for all drilling activities and that the use of modern technology in exploration activities be made compulsory.[58] Certainly, if the government of Nigeria is committed to ensuring that stakeholders in the petroleum value chain undertake exploration and production activities in line with internationally recognised standards, the industry will in addition to boosting revenue, cater for the host communities largely and ensure that the environment and the ecosystem they live in is not compromised. It is therefore a recommendation that Nigeria incorporates practices of countries that have achieved some level of petroleum sustainability such as Brazil, Norway, the United States[59] as well as Qatar, taking into consideration Nigeria's ethnically diverse nature. If the above is implemented, then Nigeria will be achieve a petroleum industry that is inclusive, will cater for the needs of the present as well as the future generation taking into consideration the need to conserve the environment.

WHY THE DUALITY OF SUSTAINABILE OIL AND GAS AND SUSTAINABLE GREEN ENERGY IS POSSIBLE AND BENEFICIAL TO NIGERIA?

This study has discussed the importance of transitioning to green and renewable energy in Nigeria in order to make sure that the environment is protected and preserved while human activities progress. The purpose of this study overall is to show that Nigeria can utilize both petroleum and green energy in an environmentally friendly manner that is also sustainable, affordable, accessible and reliable. It has been explained that diversifying energy resources reduces over dependence on fossil fuels. Gas as a transition fuel is the catalyst to achieving this but as discussed earlier the production and utilization of crude oil is imperative as far as human activities go. Nigeria can therefore benefit from the underlying advantages sustainable petroleum and green energy. The following points buttress this:

First, petroleum is still much needed in the global market. With the increased production of cars, heavy duty machinery, aircrafts and ships, it is clear that the need for oil is high.[60] Although global crude oil demand reduced as a result of the COVID-19 pandemic, increase in daily demand will continue. Nigeria has one of the largest oil reserves and with implementation of best practices in the industry and in relation to the environment, the achievement of sustainable petroleum will not be farfetched.

Second, green energy also affects the environment. It has been alleged that although there is far less pollution relative to green energy resources such as solar energy, transportation and installation of solar systems contribute in the emission of greenhouse gases.[61] Additionally, toxic materials and hazardous substances such as hydrochloric acid, sulphuric acid, hydrogen fluoride, among others, are used in the manufacturing process of solar photovoltaic systems and this can affect the environment.[62] It has also been suggested that the electricity source chosen for the manufacturing of photovoltaic (PV) cells has a significant effect on the overall environmental impacts of solar electricity.[63]

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[57]Solomon Ekokoi, Sustainable Management of Nigeria's Oil Wealth: Legal Challenges and Future Directions, *Afebabalola University: Journal of Sustainable Development Law and Policy, Vol. 7: 2: 2016*, Pg. 169.

[58] Adelaja Odutola Odukoya, Oil and Sustainable Development in Nigeria: A Case Study of the Niger Delta, *Journal of Human Ecology (Delhi, India) 2006*, Pg. 257.

[59] S.C. Dike (n. 6)

[60] Jude Clemente, Three Reasons Oil Will Continue to Run the World, Forbes 2015. https://www.forbes.com/sites/judeclemente/2015/04/19/three-reasons-oil-will-continue-to-run-the-world/

[61] Aris Vourvoulias, Pros and Cons of Solar Energy, August 2022. https://www.greenmatch.co.uk/blog2014/08/05-advantages-and5-disadvantages-of-solar-energy Accessed September 29, 2022.

[62]Didem Tali, Negative Effects of Solar Energy, 2019. https://sciencing.com/negative-effects-solar -energy-6325659.html Accessed September 29, 2022.

[63] D. Beloin-Saint-Pierre and Others, Environmental Impacts of PV Systems: Effects of Energy Sources used in Production of Solar Panels, In Proceedings of the 24th European Photovoltaic Solar Energy Conference, 21-25 September 2009, Germany ISBN 3-936338-25-6, pp. 4517-4520.

Furthermore, with recycling problems the volume of discarded panels can pose a risk of damaging proportions[64] since mass manufacturing of solar panels demonstrates a socio-environmental threat owing to their End-of-Life waste which is projected to be in millions of tons by mid-century as predicted by the International Renewable Energy Agency.[65] This recycling problem is also existent among other renewable technologies such as wind turbines and electric-vehicle batteries and so in order to maximise green energy usage all the above need to be considered and taken care off substantially.

Third, biofuels are expensive. It has been suggested that recently, biofuels are expensive when compared to fossil fuels. Biofuels are liquid or gaseous renewable transport fuels produced from biomass and are regarded as one of the most viable options for reducing carbon emissions in the transport sector.[66] Biofuel made from feedstock such as vegetable oils, cereals, used cooking oils as well as animal fats which have experienced price hikes. Reports indicated that biofuel costs are presently 70% to 130% higher than petrol and diesel in Europe.[67] Sustainable aviation fuels are biofuels which, as indicated in this study, are very expensive to manufacture.[68] The aviation industry in Nigeria is not yet well equipped with the financial capacity to handle biofuels and as such, fossil fuels can be better utilized to transport people and cargo pending when Nigeria is economically buoyant enough to accommodate biofuel.

Fourth, Nigeria's gas potentials create a partway to achieving sustainable utilization of fossil fuels. This study discloses that natural gas is a better alternative to oil, having less environmentally damaging properties. With the initiation of pipeline projects earlier mentioned in this study, the opportunity to make increase natural gas use presents itself being a cleaner and economically beneficial fuel. A country like Nigeria with a massive population requires high energy consumption that gas can provide so when there is a diversification of energy resources the country can benefit from all resources and can be able to achieve sustainable energy.Admittedly, the side effects of renewable/green energy discussed in this study is not comparable to the damage that fossil fuel has done and can continue to do in Nigeria if not explored, channelled and distributed in an environmentally friendly manner.

CONCLUSION

The environment belongs to us and it is our responsibility to protect it. This study makes us understand that petroleum and green energy can be utilized to achieve sustainability and the government should begin to display the commitment and will necessary.

[64] Atalay Atasu and Others, The Dark Side of Solar Power, Sustainable Business Practices, Harvard Business Review 2021. https://hbr.org/2021/06/the-dark-side-of-solar-power/ Accessed September 29, 2022.

[65]IRENA and IEA-PVPS, End-of-Life Management: Solar Photovoltaic Panels, IRENA and IEA-PVPS: Sydney, Australia, 2016 in H.F. Yu and Others, Global Challenges and Prospects of Photovoltaic Materials Disposal and Recycling: A Comprehensive Review, *Sustainability 2022, 14, 8567*. https://doi.org/10.3390/su14148567

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[67]Transport and Environment, Biofuels twice as expensive as petrol and diesel in most cases, June 30, 2022. https://www.transportenvironment.org/discover/biofuel-are-twice-as-expensive-as-fossil-fuels/ Accessed September, 2022.

[68] Pg. 13, n. 73.