AN APPRAISAL ON NATURAL GAS TRANSITION FOR EFFICIENT ENERGY SECURITY IN NIGERIA

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Abstract

Generally, energy is important for all three pillars of sustainable development: social, economic, and environmental well-being. The article examined the topic; "An Appraisal on Natural Gas transition for Efficient Energy Security in Nigeria". The research methodology adopted is the doctrinal research method. The aim of the article is to consider the challenges and prospects of natural gas transition to ensure efficient energy security in Nigeria. The objectives of the article include; the discussion of conceptual clarification of terms such as natural gas, energy transition, fossil fuel, and energy security; the examination of the national and international legal framework for natural gas; analyze the concept of natural gas as a substitute for petroleum to ensure efficient energy security; give comparative analysis of natural gas and other renewable energy transition measures available in jurisdictions like Norway. The article found that a transition to natural gas by Nigeria could be a veritable tool to solve the recurring challenges of Petroleum commercialization; the article further found that the Nigerian oil and gas laws are plagued with the challenge of adequate implementation that engender efficient energy security; the article also found that there is need for more legal reforms in the Nigerian Petroleum Industry to reflect Nigeria's attitude towards embracing natural gas as a substitute or transition fuel. The article gave a concise conclusion on the need for Nigeria to adopt the consideration of natural gas as the transition fuel for a more viable economy which will essentially promote efficient energy security. The article among others gave practicable recommendations on more enlightened ways Nigeria can embrace natural gas transition as a vital tool for economic growth and development in Nigeria through adopting a legal framework that draws on international best practices and energy laws of other nations.

Keywords: *Natural Gas, Domestic Gas, Fossil Fuel, Energy Security, Nigeria, Norway*

1.0 Introduction

It is trite knowledge that the Constitution of the Federal Republic of Nigeria 1999 (as amended), vests ownership of mineral rights in the Federal Government of Nigeria, covering all resources within Nigeria's territory, including its continental shelf and exclusive economic.[1] According to government statistics, Nigeria has approximately 206.53 trillion cubic feet (tcf) of proven gas valued at over $803.4 trillion, of which the estimated recoverable gas is 139.4 (tcf), and has the most extensive reserves in Africa.[2] However, although the country has the 10th largest proven reserves globally, the sector is largely underdeveloped as the production-to-reserves is approximately 1%.[3]

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[1] CFRN 1999 (as amended), Cap C23 LFN 2004

[2] Nigeria Energy, The Role of Gas in Nigeria's Energy Transition The "Decade of Gas", <http://www.nigeria-energy.com/>, accessed on 12th March 2025.

[3] *ibid*

No question, the energy sector is currently the main emitter of greenhouse gas emissions (GHGs) all over the world.[4] Therefore, the need to address climate change is the major driver for a transition from an energy sector dominated by fossil fuels to one based on renewable energy sources.[5] Future energy transitions will be driven by the demands of development combined with the constraints posed by climate change and energy supplies.[6] Basically, research suggests that the provision of energy services are not dependent on any one fuel or technology. Therefore, the demand for coal in the power sector is falling in OECD countries as the share of coal capacity is replaced by renewable and natural gas.[7]

Furthermore, the impact of energy consumption on the level of greenhouse gases (GHG) emissions is highly dependent on the primary energy mix.[8] It is indisputable that the global energy mix will need to be dominated by low-carbon sources by the end of next two decades. The role of natural gas in the ideal energy share in the near future may be crucial in optimizing the energy mix. Natural gas will be instrumental as a transition fuel and in dealing with the intermittency of the energy supply as the share of renewable in the global energy mix increases.[9]

Again, research shows that the share of natural gas in the global energy mix would be approximately 22%, even though the fossil fuel share of the world's total primary energy demand (TPED) decreases to 57%.[10] The transportation of natural gas, via liquefied natural gas (LNG), has also increase globally.[11] It has been anticipated that natural gas will be the second largest contributor to the global energy mix after oil by 2040, 80% of this projected growth coming from developing nations.[12]

According to the message contained in the Production-Gap-Report, the world needs to wind down fossil fuel production.[13] The report looks at the discrepancy between the planned fossil fuel production by different nations worldwide and what is seen as the needed reduction to achieve the temperature goal of the Paris Agreement (2015).[14]

2.0 Conceptual Clarification

i. **Natural Gas:** Natural gas is a mixture of hydrocarbons, mostly methane, and other gaseous substances such as carbon dioxide, nitrogen, hydrogen sulphide and, in some cases, helium.[15] The mixtures that are mainly composed of methane are called dry mixtures, whereas those mainly containing hydrocarbons such as propane and butane are called wet mixtures.[16] Before being

[4]United Nations Climate Change Conference, Marrakech 2016, <https://www.un.org>, accessed on 12th March 2025
[5] *ibid*
[6] *ibid*
[7] *ibid*
[8] *ibid*
[9] *ibid*
[10]IEA. World energy outlook. International Energy Agency; 2016, <https://iea.blob.core.windows.net>, accessed on12th March 2025.
[11]BP Statistical review of world energy June, 2017, <https://www.bp.com>, accessed 14th March 2025.
[12]IEA. World Energy Outlook. International Energy Agency; 2017, <https://iea.blob.core.windows.net>, accessed on 12th March 2025.
[13] Energies 2021, <https://doi.org/10.3390/en14175411>, or <https://www.mdpi.com/journal/energies>, accessed 8th March, 2025.
[14] *ibid*
[15] Natural Gas- Composition, properties, uses, <https://www.britannica.com>, accessed 10th March 2025.
[16] *ibid*

distributed for use, natural gas is treated to eliminate carbon dioxide and nitrogen, which make it less flammable, and hydrogen sulphide, a corrosive and toxic gas, the result is mainly methane.[17]

ii. **Fossil Fuel:** Fossil fuel comprises coal, oil, petroleum, and natural gas products, the burning of which releases greenhouses gases (GHG) most commonly referred to as Carbon dioxide (CO_2) into the atmosphere.[18] Fossil fuel are the major energy source that are being used in the world today, but their over-consumption can lead to serious environmental issues such as air pollution, climate change, economic dependence and energy insecurity.[19] Fossil Fuels are energy resources derived from organic matter that has been substantially changed by geologic processes.[20] The major fossil fuels include coal, petroleum, and natural gas. Minor ones include peat and shale. Fossil fuels release carbon dioxide, nitrogen dioxide, sulphur dioxide, carbon monoxide and more, when burnt that can have severe consequences on the habitats.[21]

iii. **Domestic Gas:** Domestic gas is defined as gas utilized locally within the shores of Nigeria either for home, industrial and/or electric power use.[22] For industrial use, gas is used in value adding industries such as methanol, fertilizer and more, which are considered as domestic gas regardless of whether the end product is consumed locally or exported.[23]

iv. **Energy Security:** Energy Security means the uninterrupted physical availability on the market of energy products at a price which is affordable for all consumers.[24] Energy Insecurity on the other hand, is the loss of economic welfare that may occur as a result of a change in the price or availability of energy.[25] According to the International Energy Agency, energy security is the uninterrupted availability of energy sources at an affordable price.[26] It is trite that one of the most frequently quoted definitions is the availability of sufficient supplies at affordable prices.[27] Furthermore, another commonly used taxonomy is the 4 A's, "Availability" (physical availability of resources), "Accessibility" (geopolitical aspects associated with accessing resources), "Affordability" (economic costs of energy), and "Acceptability" (social and often environmental

[17] *ibid*
[18] Nigerian Fossil Fuel, <http://knoema.com/atlas/Nigeria/Fossil-fuel-energy-consumption>, accessed 7th March, 2025.
[19] *ibid*
[20] *ibid*
[21] Nigerian Fossil Fuel, <http://knoema.com/atlas/Nigeria/Fossil-fuel-energy-consumption>, accessed 7th March, 2025.
[22] The Government of The Federal Republic of Nigeria, The National Domestic Gas Supply and Pricing Policy, <https://nesgroup.org>, accessed 10th March, 2025.
[23] *ibid*
[24] European Commission, 2000: Towards a European Strategy for the Security of Energy Supply. Green Paper, Communication from the Commission to the European parliament, The Council, The European Economic and Social Committee and the Committee of the Regions, European Commission, Brussels, <https://eur-lex.europa.eu>, accessed 10th March 2025.
[25] D R Bohi and M Toman, 'Energy Security: Externalities and Policies' Energy Policy 1093, 1093, on legislative proposals in promoting energy security, (1993) 1.
[26] IEA at COP28: A Just Transition Through Inclusive Energy Infrastructure, Dubai, United Arab Emirates, 2023 12:45—13:45.
[27] D Yergin, Ensuring Energy Security, (Foreign Affairs, 2006), 85 (2): 69 – 82.

stewardship aspects of energy).[28] Therefore energy security is broadly defined as a situation of availability, reliability, affordability, and sustainability of energy resources.[29]

3.0 Legal Framework for Natural Gas

Constitution of the Federal Republic of Nigeria 1999 (as amended)

The Constitution of the Federal Republic of Nigeria 1999 (as amended) is the grundnorm from which every other institution or body of authority derive their validity and have a binding force on all authorities and persons throughout the Federal Republic of Nigeria,[30] and if any other law is inconsistent with the provisions of this constitution, the latter shall prevail and that other law shall to the extent of its inconsistency, be null and void.[31]

The supremacy of the constitution reflects on the management and control of oil and gas deposits in Nigeria. The Constitution provides expressly that: 'Notwithstanding the forgoing provisions of this section, the entire property in and control of all minerals, mineral oils and natural gas in, under or upon any land in Nigeria or in, under or upon the territorial waters and the Exclusive Economic Zone of Nigeria shall vest in the Government of the Federation and shall be managed in such manner as may be prescribed by the National Assembly'.[32]

Petroleum Industry Act 2021

The PIA is the current principal legislation regulation the Nigerian oil and gas industry. Gas operations are undertaken within the confines of the petroleum industry therefore a subject matter of regulation by the PIA. The PIA like the Constitution vested ownership and control of petroleum which includes natural gas on the Federal Government of Nigeria.[33]

The PIA makes provisions for gas operations in the Nigerian petroleum industry. The PIA provides that except with requisite license issued by the appropriate regulator, no one is allowed to carry out activities with respect to midstream and downstream gas operations with respect to the following: **e**stablish, construct, or operate a facility for the processing of gas, establish, construct, or operate a facility for the storage of gas; establish, construct, or operate a gas transportation pipeline; engage in bulk transportation of natural gas by rail, barge, or other means of transportation; operate a gas transportation network, establish, construct, or operate a terminal, jetty, or other facility for the export or importation of gas, engage in wholesale gas supply, engage in the construction or operation of petrochemical or fertilizer plants and more.[34]

The PIA further provides that except with relevant license appropriately issued, no one shall undertake the following activities with respect to downstream gas operations: retail trading, distribution or supplies

[28] B Kruyt and others, Indicators for Energy Security, Energy Policy (2009) 37 (6): 2166 – 2181.
[29] S C Dike, Energy Security: The case of Nigeria and Lessons from Brazil, Norway and the UK (Pearl Publishers 2015) 1; J Elkind, Energy Security: Call for a Broader Agenda, in C Pascual and J Elkind, Energy Security, Economics, Politics, Strategies and Implications (Brookings Institution's Press 2010) 121, 128, 129
[30] CFRN 1999 (as amended), s.1(1)
[31] *ibid*, s.1(3)
[32] *ibid*, s. 44(3)
[33] PIA 2021, s. 1
[34] *ibid*, s.125(1)(a)-(h)

of natural gas; establishment, construction or operation of a gas distribution network; or establishment, construction or operation of a facility for the supply or trading of natural gas.[35]

In line with midstream and downstream gas operations, the PIA provides for specific licensing regime that will help to regulate the operations. They include gas processing license, bulk gas storage license, gas transportation pipeline license, gas transportation network operator license, wholesale gas supply license, retail gas supply license, gas distribution license, and domestic gas aggregation license.[36]

The PIA provides an enforcement mechanism to help sustain its provisions with respect to gas operations in the industry. It provides that a person who undertakes gas operations as listed in the Act without requisite license, commits an offence and is liable to imprisonment for a term of: one year or to a fine prescribed by regulation, in the case of an activity requiring a permit; or six months or to a fine prescribed by regulation, in the case of an activity requiring a permit.[37] The PIA further makes provision for right of way relating to midstream and downstream gas operations.[38]

The United Nations Framework Convention on Climatic Change, 1992

It is trite that the United Nations Framework Convention on Climate Change, 1992, is the foundational climate agreement which has provided the platform for subsequent international climate agreements. Basically, the objective of the treaty is to stabilize Green House Gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.[39] The Convention provides an overall framework for inter-state efforts to deal with the challenges of climate change.[40] The Convention recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon-dioxide and other green-house gases.[41]

Kyoto Protocol 1997

The Kyoto Protocol was signed in 1997 as a protocol to the UNFCCC.[42] The Protocol commits its parties by setting internationally binding emission reduction target based on the premise that (a) global warming exists and (b) man-made carbon emissions have caused it.[43] The protocol derives its sustenance from Article 2 of the UNFCCC which states that the ultimate objective of the protocol is to stabilize the concentration of greenhouse gases in the atmosphere "at a level that would prevent dangerous anthropogenic (human) interference with the climate system."[44]

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[35] *ibid*, s. 125(2)(a)-(c)
[36] PIA 2021, ss. 129, 132, 135, 138, 142, 146, 148, 153
[37] *ibid*, s. 125(5)(a)(b)
[38] *ibid*, s. 127
[39] G I Malumfashi, G. I. Phase-out of gas flaring in Nigeria by 2008: The prospects of a multi-win project. Centre for Energy Petroleum and Mineral Law and Policy (CEPMLP), (University of Dundee, Scotland, United Kingdom 2007).
[40] A M Halvorssen, UNFCCC, the Kyoto protocol, and the WTO-brewing conflicts or are they mutually supportive. Denv. J. Int'l L. & Pol'y, (2007) 36, 369.
[41] The United Nations Framework Convention on Climate Change <http://unfccc.int/essential_background/convention/items/2627.php>, accessed on 2nd June, 2025.
[42] Text of the Kyoto protocol to the United Nations Framework Convention on Climate Change, <http://unfccc.int/kyoto_protocol/items/2830.php>, accessed on 2nd June, 2025.
[43] Kyoto Protocol to the United Nations Framework Convention on Climate Change, 31 ILM 849 (1992), <http://unfccc.int/kyoto_protocol/items/2830.php>, accessed on 2nd June, 2025.
[44] UNFCCC 1992, art 2.

The protocol places a heavier burden on developed nations under the principle of common but differentiated responsibilities, as it recognizes that developed nations are principally responsible for the current high levels of GHG emissions in the atmosphere.[45] It is trite that Nigeria became a signatory to the Kyoto Protocol on the 23rd October 1998, and ratified the Kyoto Protocol in 30th September 2004. Furthermore, Nigeria has been collaborating with the United Nations Industrial Development Organization (UNIDO) in accessing some projects targeted at reducing gas flaring such as the West African Gas Pipeline project and other gas utilization projects among others.[46] Basically, an important element of the Kyoto Protocol is its flexibility mechanisms such as the Clean Development, Joint Implementation, and Emission Trading Mechanisms, that enable nations to achieve their emission target by means other than reducing their domestic emission of greenhouse gases.[47]

Global Gas Flaring Reduction

The Global Gas Flaring Reduction Partnership, is a public-private initiative comprising international and national oil companies, national and regional governments, and international institutions.[48] The Partnership works to increase use of natural gas associated with oil production by helping remove technical and regulatory barriers to flaring reduction, conducting research, disseminating best practices, and developing country-specific gas flaring reduction programs.[49]The World Bank Group, in collaboration with the government of Norway initiated this global public/private partnership to facilitate gas flaring reduction with a view to reducing air pollution, save energy and money, reduce associated poverty, and boost shared prosperity.[50]

4.0 Natural Gas as Transition Fuel in Nigeria

Basically, natural gas is a key source of energy, and supplies around one-fifth of the global energy needs, compared with one-third from crude oil and one-quarter from coal.[51] It is clean burning, environmentally friendly and has a wide variety of uses, particularly for the Nigeria power generation which accounts for bulk of natural gas usage in the domestic sector of the economy.[52] Natural gas is considered the cleanest of all fossil fuels and a source of lower cost, sustainable fuel for power generation for industrial and commercial customers alike for economic development.[53]

According to research, Nigeria's earning from natural gas has increased substantially as a result of sustained growth in the Liquefied Natural Gas (LNG) project and measured by the employment and other socioeconomic benefits it creates.[54] Nigeria's gas is characterized as one of the best qualities in

[45] *ibid*
[46] West African Gas Pipeline project, <http://law.ucalgary.ca/files/law/2014-olayinka_legal-and-institutional-imperatives-for-designing-a-regionalemissions-trading-scheme.pdf >, accessed 2nd June, 2025.
[47] Kyoto Protocol 1992, art 6, 12, 17
[48] G Adeniji, Approaches to Gas Flare Reduction in Nigeria, GGFR Global Forum, London (2020), <https://journals.ezenwaohaetorc.org>, accessed 2nd June, 2025.
[49]World Bank Program on Gas Flaring Reduction, <http://www.worldbank.org/en/programs/gasflaringreduction>, accessed 2nd June, 2025.
[50] *ibid*
[51] D Jacobs, The Global Market for Liquefied Natural Gas, Reserved Bank of Australia Bulletin, September Quarter 2011, 17 - 27, <www.rba.gov.au/publications/bulletin/2011/sep/pdf/bu-0911-3.pdf>, accessed 9th March 2025.
[52] *ibid*
[53] *ibid*
[54] *ibid*

the world, and ostensibly the most important export-oriented product to stimulate economy growth, environmental preservation and sustainable development.[55]

It is trite that the necessity for safer, cleaner and environmentally friendly aspect of natural gas has led to a structural shift in the world energy/crude consumption and demand.[56] However, the radical development and shift in the world energy market does not wholly reflect the activities in the Nigerian gas industry as there seems to be little commitment by the Government to link the gas sector with the rest of the economy, save for the now inclusive provisions of the Petroleum Industry Act, 2021.[57] Thus, for many years, the oil and gas producing communities of the Niger Delta bore the pains and the discomfort of the natural endowment being flared, which put extra pressure on their immediate environment and means of livelihood of the local people.[58]

The first gas supply for power generation started in 1963, through uncoordinated attempt, leading to the establishment of facilities within producing fields for relatively small but steady off takes.[59] The initial efforts at gas utilization involved supply to the National Electric Power Authority (NEPA) at Afam Power Station, NEPA Delta Power Station, Ughelli, five private industries in Aba as well as the old Port Harcourt Refinery.[60]

These gas projects were executed by Shell between 1964 and 1966. Apart from the uncoordinated attempts, the first major gas pipeline system did not come up until 1978 when the Nigerian National Petroleum Corporation (NNPC) and Shell implemented the gas supply to NEPA Sapele station, quickly followed with the execution of 2 gas pipeline projects: Aladja Systems and Oben-Ajaokuta in 1981 and 1983 respectively.[61]

These projects with a combined system capacity of 270 million standard cubic feet/day were designed to deliver gas to the Steel Complex at Ajaokuta.[62] In 1985, a Gas Division was created in NNPC to ensure the realization of the government objectives for gas utilization and monetization.[63] In furtherance with a clear vision for commercialization, focused growth and development of the gas industry, a subsidiary company, the Nigerian Gas Company Ltd (NGC) was created out of the NNPC in 1988.[64] The NGC is now shouldering the responsibility of the control and further development of the network of domestic gas infrastructure in Nigeria.[65]

Additional gas systems were constructed between 1985 and 1987 to supply gas to NEPA at Afam, IGIL and other industries at Aba, and the National Fertilizer Company of Nigeria (NAFCON) fertilizer plant

[55] *ibid*
[56] I O Stanley, Gas to Liquid Technology: Prospect for Natural Gas Utilization in Nigeria. Journal of Natural Gas Science and Engineering (2009), 190 – 194.
[57] Petroleum Industry Act 2021
[58] M O Edino and Others, Perception and Attitudes towards Gas Fla ring in the Niger Delta, *The Environmentalist* (2010) 30 (1), 67 – 75.
[59] B Omiyi, Shell Nigeria Corporate Strategy for Ending Gas Flaring. In: Seminar on Gas Flaring and Poverty Alleviation, Oslo, Oslo: Shell Petroleum Development Company of Nigeria Ltd (2001), 2 – 13.
[60] B Omiyi, Shell Nigeria Corporate Strategy for Ending Gas Flaring. In: Seminar on Gas Flaring and Poverty Alleviation, Oslo, Oslo: Shell Petroleum Development Company of Nigeria Ltd (2001), 2 – 13.
[61] J E Gaius-Obaseki Gas Development in Nigeria: An Overview. Petroleum Training Institute (PTI), Warri, (1996).
[62] *ibid*
[63] *ibid*
[64] *ibid*
[65] *ibid*

at Onne.[66] These systems, although non-integrated, together with the Aluminum Smelting Company of Nigeria (ALSCON) constitute the backbone of the Eastern Gas supplies. The ALSCON project entails a total of about 117 kilometres of gas pipelines of various sizes traversing three Eastern States in Nigeria (Rivers, Abia and Akwa-Ibom) with a system capacity of 450 million standard cubic feet/day to form the basis of a fully integrated network in the East Delta. As at 2007, the Nigerian network included 3,071 kilometres of dry natural gas pipelines, 124 km condensates (wet gas) and 156 km of pipelines of liquefied petroleum gas - LPG.[67]

The NGC owns and operates most of the major gas pipelines in Nigeria with a capacity of more than 2.5 billion cubic feet per day.[68] The network includes the Alakiri-Obigbo-Ikot-Abasi Pipeline (Eastern network) and the Escravos-Lagos Pipeline System - ELP (Western network), which feeds the commercial nerve-centre of Lagos, fuels the main power station at Egbin, near Lagos as well as gas supply to the WAGP (Ghana, Togo and Benin Republic).[69]

The Escravos-Lagos Gas Pipelines (ELP) was commissioned in 1989 with a system throughput of 1100 million standard cubic feet/day.[70] It is the biggest gas pipelines project executed to date in Nigeria, dedicated to domestic consumption in the country and also serve as the gas corridor' to Lagos and the WAGP project. Furthermore, the ELP is the only source of supply from the Niger Delta to the industrial and utility sectors of the domestic market in Lagos.[71]

The design concept of this system has envisaged the implementation of extension projects such as the gas supplies to the West African Portland Company (WAPCO) Plants at Ewekoro and Sagamu in Ogun State, PZ Industries in Ikorodu, and City Gate in Ikeja Lagos. The WAPCO gas supply systems were commissioned in 1993 and 1994 respectively and represent a modest beginning of commercially oriented gas pipeline projects.[72]

The Oben - Ajaokuta - Geregu gas pipeline system forms the backbone of the Northern Pipeline gas system, supplying gas to Ajaokuta Steel Company since 1983 and more recently to the Geregu NEPA Plant and Dangote Obanana Cement Plant on the same axis.[73] According to NGC (2009) these projects consist of 1,250 kilometres, 18 metering stations and 16 compressor stations with design capacity of more than 2.5 billion standard cubic feet of gas per day.[74] There are other dedicated pipeline infrastructure owned and operated by the LNG and the NNPC/SPDC/Total JV. [75]

On the domestic gas usage, Oando has been actively involved with the completion of 99 kilometre of natural gas distribution pipeline in the Lagos area, 124 kilometre of supply pipeline to the Cement plant

[66] *ibid*
[67]NNPC Joint Venture Operations, (2015), <http://www.nnpcgroup.com/NNPCBusiness/UpstreamVentures.aspx>, accessed 11th March 2025.
[68] *ibid*
[69] NNPC Joint Venture Operations, (2015), <http://www.nnpcgroup.com/NNPCBusiness/UpstreamVentures.aspx>, accessed 11th March 2025.
[70] *ibid*
[71] *ibid*
[72] J E Gaius-Obaseki Gas Development in Nigeria: An Overview. Petroleum Training Institute (PTI), Warri, (1996).
[73] *ibid*
[74] *ibid*
[75] *ibid*

in Calabar with over 90 industrial customers to the gas network.[76] Another active player in the domestic gas supply chain is Shell Nigeria Gas (SNG).[77] The company promotes gas development in Nigeria through pipelines distribution in the Lagos environs of Agbara, Ota and Igbessa (Ogun State) as well as in Aba (Abia State) with more reliable and cleaner alternative fuel for industrial processes and power generation. It operates approximately 80 kilometers of gas transmission and distribution pipeline networks.[78] Government has a social responsibility for orderly development, growth, and utilization of natural resources.[79] The goal of developing the gas pipeline infrastructure is therefore, to address the socioeconomic, environmental and sustainable development needs of the people. Notwithstanding efforts to develop the Nigerian gas industry, however, serious obstacles and challenges abound.[80]

5.0 Energy Security Challenges in Nigeria

Enhancing energy security in Nigeria will require a far sighted and cooperative approach. Two particular issues loom large in this respect: the threat of global warming and its links to the use of fossil fuels; and, the lack of access to clean, healthy and affordable energy, including electricity, of a significant number of the world community's poorest members. Despite being a major player in the global oil industry, Nigeria's energy sector is plagued with inefficiencies and setbacks.[81] These issues affect the energy security of the nation, which result in the individual challenges faced by different energy resources in Nigeria.[82]

The challenges facing Nigeria's energy sector are numerous and complex. Despite being a major player in the global oil industry, Nigeria's energy security is hampered by inefficiencies and corruption across various sectors. Nigeria's most controversial energy resource (petrol), is also marred by inefficiencies and corruption. The security of petrol as a resource is in the hands of a small group of elites who make decisions regarding its distribution in their own interests, rather than the interests of the general public. The natural gas sector has similarly been affected by availability and affordability issues that discourage average citizens from demanding Liquefied Natural Gas. Kerosene supply has been controlled by major middlemen and unlicensed personnel in the petroleum sector, resulting in increased prices for consumers.[83]

Other challenges include corruption tendencies that hinder the implementation of effective policies, insecurity, and external forces that negatively impact energy security. Nigeria's mono-cultural system has encouraged a heavy dependency on oil and gas, with the country's budget tied closely to fluctuations in oil prices. Environmental pollution in the energy zone has also led to social unrest in the oil regions,

[76] *ibid*
[77] *ibid*
[78] Shell Petroleum Development Company (SPDC), Harnessing Nigeria Gas 2011, <http://wwwstatic.shell.com/static/nga/downloads/pdfs/briefing_notes/gas_flaring.pdf>, accessed 9th March, 2025.
[79] *ibid*
[80] *ibid*
[81] D M Orazulike D M, Energy security in Nigeria: Challenges and prospects, *International Journal of Energy Economics and Policy*, (2012) 2(4), 228-238.
[82] A A Ahmad and B O Odetokun, Energy Security in Nigeria: Challenges and Prospects, *Journal of Arid Zone Economy* (2023) 1(1) 101 – 111; 2992–4952, <https://bit.ly/JazeIssue3; https://resources.jaze.com.ng/index.php/jaze/login)>, accessed 10th March, 2025.
[83] D M Orazulike D M, Energy security in Nigeria: Challenges and prospects, *International Journal of Energy Economics and Policy*, (2012) 2(4), 228-238.

with political effects manifesting in the form of vandalism, kidnapping, trade unionism, and cartels in oil and gas.[84]

The inefficiency of the nation's refinery capacity has further compounded these issues. The refineries available are underutilized, which means there is a looming threat of resource importation, even for Nigeria's own resources. This situation has led to fuel shortages, parallel market activities, and increased prices. his has put the nation in a state of economic dis-equilibrium, with the energy sector being a significant contributor to the overall instability of the Nigerian economy.[85]

6.0 Improving Energy Security by Enhanced Utilization of Natural Gas

Due to environmental concerns and other complexities surrounding the production and use of crude oil as an energy source, the world is shifting emphasis from oil to gas as alternative energy source. Nigeria cannot be left out, more so given her abundant natural gas reserves. Experts in the petroleum industry in Nigeria have told us that the nation is blessed with over 100 trillion standard cubic feet (SCF) of natural gas reserves, which is equivalent to three times Nigeria's crude oil reserves.[86]

The gas reserves are about equally distributed between the two, associated and non-associated categories, they say. But gas utilization has not been optimized, it is far from occupying its appropriate level in the nation's energy mix, both domestically and internationally. Aside underplaying the potentials of natural gas, there exist a continual flaring (burning away) of this physical resource at the oil wells. Besides the huge financial loss to the nation that this represents, it constitutes a serious environmental hazard. There is every need in harnessing this resource for economic development, and reducing wastage of associated gas by enunciating appropriate policies.[87]

7.0 Natural Gas Transition Challenges in Nigeria

The Petroleum Industry of Nigeria is facing series of interlinked challenges which includes:

1. The legal and policy regime as well as the fiscal incentives to promote gas development and utilization in Nigeria has not resulted the desire outcome, but left in its wake dire social and economic consequences.[88] Again, weak enforcement, over centralization, inadequate capacity and lack of political will to enforce existing regulations affect the growth needed in the gas sector.[89]
2. The dual role of the government as a regulator as well as operator in the oil and gas production activities implies that it must meet its cash call obligation under the JV agreement in order to

[84] D M Orazulike D M, Energy security in Nigeria: Challenges and prospects, *International Journal of Energy Economics and Policy*, (2012) 2(4), 228-238.
[85] A Cherp and others, Energy and security. In: Global Energy Assessment: Toward a More Sustainable Future. Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, (Cambridge University Press, Laxenburg, Austria, 2012) 325–383 (Chapter 5), <www.globalenergyassessment.org.>, accessed 11th March 2025
[86] E Tsegha, Assessing the Challenges and Opportunities in the Oil and Gas Industry, Academic Journal of Interdisciplinary Studies, Rome-Italy (2013) 2, 12.
[87] *ibid*
[88] U J Orji, Moving from Gas Flaring to Gas Conservation and Utilization in Nigeria: A Review of the Legal and Policy Regime, John Wiley and Sons Ltd, Oxford, UK (2014), 1.
[89] UNDP, Niger Delta Human Development Report, Abuja, (2006), 35-90, <www.undp.com>, accessed 9th March, 2025.

influence gas development. Government share in the JV should reflect serious commitment to tackle environmental degradation and socioeconomic conditions.[90]

3. Rising populations and economic growth are increasing demand for energy services. Providing access to modern energy for the roughly 6 million people in Nigeria who are currently unserved will require new power capacity and infrastructure expansion in countries with limited means of financing the required investments.[91]
4. Energy systems are not resilient to future economic and environmental shocks. A massive shift from a highly centralized energy sector to increasingly decentralized energy production brings new participants into the energy value chain including citizens who can both produce and consume energy.[92]
5. Decarbonization pathways also suggest increasing competition between existing gas suppliers as they seek to secure markets between now and 2030. Gas is already facing strong competition from energy efficiency and price-competitive renewable energy, and the potential role of gas in the energy transition remains contested.[93]
6. Key issues that emerge include the credibility of natural gas as a lower-carbon fossil fuel. The emissions associated with gas are typically lower than those for oil and especially coal, and this should, in theory, mean that coal and oil leave the energy system first and that natural gas declines at a slower rate.
7. Lack of a strategy for decarbonizing gas systems. As previously mentioned, a strong case exists for gas to be a bridge to a lower-carbon energy system but there is little detail of the length or destination of this bridge. While gas will struggle to compete with renewable energy in new markets, there may be potential to displace coal and higher-carbon power sources with natural gas where infrastructure is already in place.[94]
8. Hydrogen and alternative gases pose obstruction to natural gas becoming a transition fuel. Therefore, if natural gas is to have a role as a bridge fuel, then there needs to be a clear strategy in place to ensure the phasing-in of hydrogen gas – including biogas and blue and green hydrogen as well as the phase-out of natural gas.[95]

8.0 Prospects for Natural Gas Transition in Nigeria[96]

To meet these existing natural gas transition challenges, a major transformation of the Petroleum Industry is required in Nigeria as follows:[97]

1. To support the transition process in Nigeria, there is need for enhanced international cooperation which is essential in facilitating the sharing of experiences and access to clean energy research and technology, including renewable energy, energy efficiency, and advanced hydrogen and biofuel technologies.

[90] *ibid*
[91] *ibid*
[92] *ibid*
[93] *ibid*
[94] UNDP, Niger Delta Human Development Report, Abuja, (2006), 35-90, <www.undp.com>, accessed 9th March, 2025.
[95] *ibid*
[96] *ibid*
[97] E Tsegha, Assessing the Challenges and Opportunities in the Oil and Gas Industry, Academic Journal of Interdisciplinary Studies, Rome-Italy (2013) 2, 12.

2. Massive efforts will be needed to increase energy efficiency and productivity, facilitate changes in consumption patterns and lifestyle choices, and expand renewable energy for power supply and direct use within and across regions.[98]
3. Regional collaboration on integrated power markets and investment in regional integration of energy infrastructures is emerging in several parts of the world and needs to be strengthened. In this regard, South–South cooperation can play a significant role, especially in the exchange of experiences and best practices.[99]
4. There is a need to change and expand the electricity sector infrastructure to allow for increased use of variable sources, system flexibility, and electrification of new services, mainly for transport.[100]

9.0 Best Practices for Natural Gas Transition: The Case of Norway

Natural Gas Transition of Norway

No question Norway exemplifies a country that is highly dependent on oil and gas revenues, with nearly all the petroleum produced being exported. The country is ranked as the world's third largest exporter of natural gas.[101] Norway has also been described as 'the odd country', because of its unique position concerning energy.[102] Domestic consumption of gas in Norway is low. According to research, more than 95% of the gas produced in Norway is exported.[103] Where crude oil is included, petroleum exports amounted to approximately 47% of the total value of Norway's export of goods in 2016. [104]

Norway is a petroleum exporting country that, simultaneously, is at the forefront of implementing ambitious climate policy measures.[105] As one of the world's largest exporters of energy and capital, Norway has a significant stake in the energy transition, as well as considerable influence over it. Factors such as the price of oil in a declining global market and the role of gas in a decarbonizing Europe will shape Norway's energy relations in the coming decades.[106] The country has expanded its oil and gas exploration through several licensing rounds into the Arctic, with no major changes in the framework conditions for the petroleum industry.[107]

With the world striving to meet decarbonization targets in line with the Paris Agreement, the global oil market will shrink considerably.[108] One obvious implication of this is that there will be increasing

[98] *ibid*
[99] *ibid*
[100] *ibid*
[101] Ministry of Petroleum and Energy; Norwegian Petroleum Directorate. Exports of Oil and Gas, <https://www.norskpetroleum.no/en/production-and-exports/exports-of-oil-and-gas/>, accessed on 9th March 2025.
[102] *ibid*
[103] *ibid*
[104] E Moe, Renewable Energy Transformation or Fossil Fuel Backlash: Vested Interests in the Political Economy; (Palgrave Macmillan: Hampshire, UK, 2015), p. 186.
[105] SEI; IISD; ODI; E3G; UNEP. The Production Gap Report: 2020 Special Report, < http://productiongap.org/2020/report>, accessed on 4th March 2025.
[106] *ibid*
[107] *ibid.*
[108] IEA, World Energy Outlook, 'Sustainable Development Scenario', (2019), p. 673, <www.iea.com>, accessed 4th March 2025.

competition between existing oil suppliers to secure their share of remaining supply, and to prevent their assets from becoming stranded or left undeveloped.[109]

The second reason is the availability and affordability of alternative technologies, especially EVs. The carbon intensity of different oils may also affect their competitiveness over time. A possible advantage for Norway is that the bulk of its reserves are dominated by light oil, which has a relatively low-carbon footprint although new reserves such as the giant Johan Sverdrup field are comprised of heavier oil and so will change the relative composition of Norway's oil production over time.[110]

The growing profile of fugitive emissions presents a potential competitive advantage for Norway, given its reputation for best practice in upstream emissions mitigation and tight infrastructure.[111] Methane is a far more potent GHG than CO2 and in some cases – where there is significant methane leakage from already energy-intensive LNG, for instance – gas can have similar emissions to coal.[112]

The overarching goal of the petroleum policy in Norway is to facilitate profitable production of oil and gas in a long-term perspective.[113] Hence, the aim is to ensure the 'highest possible value creation through good resource management.[114] Norwegian oil covers approximately 2% of the global demand, and it generates 'large amounts of revenue and results in tens of thousands of jobs in Norway'[115]. This therefore, places the overall goal for Norwegian petroleum policy in accordance with the imperative of ensuring economic growth. Ensuring state revenues from oil and gas activities is framed as synonymous with securing the welfare state in Norwegian petroleum policy because it is a fundamental underlying principle that the petroleum resources are the property of the people.[116]

The petroleum tax system and the State's Direct Financial Interest (SDFI) ensure that a large part of the value creation from the petroleum activities accrues to the state.[117] The management of petroleum resources has been based on the principle that it should benefit the Norwegian society and population since the beginning of exploration and production on the Norwegian Continental Shelf. This principle forms the logic of what has become recognized as *'the Ten Oil Commandments'*.[118]

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[109] *ibid.*

[110] N Coleman, 'Norway's Johan Sverdrup giant breathes life into declining North Sea', S&P Global Platts, 2019, https://www.spglobal.com/platts/en/market-insights/latest-news/oil/100719-norways-johan-sverdrup-giant-breathes-life-into-declining-north-sea>, accessed 9th March, 2025.

[111] Norwegian Climate Risk Commission (2018), Climate risk and the Norwegian economy, Official Norwegian Reports NOU 2018: 17, p. 24, <https://www.regjeringen.no/contentassets/c5119502a03145278c33b72d9060fbc9/engb/pdfs/nou201820180017000engpdfs.pdf>, accessed on 9th March 2025.

[112] *ibid*

[113] Ministry of Petroleum and Energy. An industry for the future—Norway's petroleum activities, Meld. St. 28 (2010–2011) (p. 6), <https://www.regjeringen.no/contentassets/19da7cee551741b28edae71cc9aae287/en-gb/pdfs/stm2010201, 10028000en_pdfs.pdf >, accessed on 9th March 2025.

[114] Ministry of Petroleum and Energy. Utbygging og drift av Johan Castberg-feltet med status for olje- og gassvirksomheten, Prop.80 S (2017–2018),(p.35), <https://www.regjeringen.no/contentassets/358428f8785c4057a9cc143ed221ec75/no/pdfs/prp201720180080000dddpdfs.pdf >. accessed on 9th March 2025.

[115] *ibid*

[116] *ibid*

[117] *ibid*

[118] Exploration for and exploitation of subsea natural resources on the Norwegian Continental Shelf, White Paper No. 76 (1970–1971).

The state owns all subsea and subsoil petroleum resources within the territory, the exclusive economic zone and on the Norwegian continental shelf.[119] The Storting (Parliament) has the primary legislative power in Norway, passing laws, state budgets and confirming government petroleum policy through adopting formal proposals and discussing policy white papers.[120] The King in Council approves the award of production licenses, the appointment of operators and development plans.[121] Much of the powers afforded to the King in Council through law are delegated to the Ministry of Petroleum and Energy.[122]

Almost all-natural gas transportation is done through the Norwegian upstream gas pipeline network, predominantly owned by the Gassled joint venture, which consists of Norwegian continental shelf production license holders and other long-term investors. State-owned Gassco AS is the operator of the upstream gas transportation network and of Gassled and administrates the transport capacity rights.[123]

The oil from the Norwegian continental shelf is normally sold ex-platform and is either transported by pipeline (approximately 20%) to onshore terminals in Norway or the United Kingdom, or loaded offshore on to shuttle tankers (80%) and sold globally. The natural gas is normally sold ex-platform and transported by pipeline to either the United Kingdom or the European continent to large-scale customers.

Basically, oil and gas trading in Norway are regulated by general applicable law (for instance Competition Law and Marketing Law), and each licensee is responsible for selling its own share of oil and natural gas production from the production licence.[124] Thus, there is no joint sale of petroleum from the production license. The joint operating agreement stipulates procedures relating to oil lifting and natural gas lifting and balancing. Natural gas sales are contingent on booking of transport capacity in the existing gas pipeline network.[125]

An of the important enabler of natural gas as a transition fuel is its low carbon content ant its low emission potential increases even when integrated with efficient technologies such as CCGT and CCHP. It is therefore trite that that the electricity sector in Norway is almost 100% hydropower. Hence, hydroelectricity is the dominant source of Norwegian energy consumption, and heating.

10.0 Conclusion

Generally, as the demand for energy services change so do the need for fossil fuels and the conversion technologies employed to meet those demands. Again, with the increase population globally and the expansion of economic activity, energy consumption continues to increase which raises concerns for energy. Faced with the challenges of climate change, reduced petroleum resources, and the prospects of underdevelopment, it is reasonable to conclude that there is need for implementation of more

[119] Advokatfirmaet Simonsen Vogt, Wiig AS logo. Oil and Gas in Norway. Toggle Navigation. Global, Norway June 7 2018, accessed 8th March 2025.
[120] Advokatfirmaet Simonsen Vogt, Wiig AS logo. Oil and Gas in Norway. Toggle Navigation. Global, Norway June 7 2018, accessed 8th March 2025.
[121] *ibid*
[122] *ibid*
[123] *ibid*
[124] *ibid*
[125] *ibid*

proficient energy transition. No question, the present demand for petroleum has proved difficult to sustain. Therefore, alternative forms of energy resource must be considered in Nigeria.

Furthermore, as countries respond to climate change, carbon emissions will be an increasingly important consideration in the selection of resources to meet the demand for transportation, heating, cooling, lighting, and other needs, it is only proper for Nigeria to embrace current global energy trends. It is trite that in many countries and regions, energy transitions measures are already in progress and being expanded and scaled up. Moreover, expanded innovation in technologies, business models, and market solutions are continuously being adopted by states to improve the existing options and fill the gaps for compliance to sustainable development goals and decarbonized energy systems by 2050.

11.0 Recommendations

In the light of the above submission we make the following recommendations:

1. The need for improved foreign and local investment in the Nigerian gas sector through gas gathering, transmission, adequate gas transportation and distribution infrastructure, to give appropriate attention to existing gas value chain in Nigeria.
2. Adequate legal reforms, improved policies, and strengthened regulatory/institutional framework are required to deal with the problem of energy insecurity, gas pricing and transportation in Nigeria in order to enhance gas utilization.
3. It is essential to establish both medium and long-term integrated energy planning strategies, defining decarbonization targets, and adaption of policies and regulations to shape energy systems that boost sustainable development in Nigeria.
4. The government must take active steps to towards discussions on and execution of energy transition decisions in Nigeria by engaging all stakeholder, communities, and public/private partnerships that will help the implementation of the energy transition measures.