CHALLENGES OF SHALE GAS FRACKING IN NIGERIA: LEGAL, ECONOMIC, AND ENVIRONMENTAL PERSPECTIVE

By

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Abstract

The Petroleum Industry Act 2021, mentioned the word "fracking" under the interpretation section, as part of the meaning of upstream petroleum operations, without stating the meaning of fracking. Nonetheless, by virtue of the meaning of upstream petroleum operations under the interpretation section, fracking is impliedly provided for, under the Act. The implication is that, fracking technology can be used to extract petroleum in the frontier basins of Nigeria, without a robust regime. This article investigates the implication of the inclusion of fracking to the meaning of upstream petroleum operations under the interpretation section of the PIA 2021. It states the legal implication of the meaning of upstream petroleum operations under the interpretation section of the PIA 2021. It also investigates the National Oil Spill Detection and Response Agency (Establishment Act (NOSDREA) 2011, and the Oil Spill and Oily Wastes Management Regulations 2011, whether they are adequate enough to regulate fracking operations in Nigeria. It appears, the National Oil Spill Detection and Response Agency (Establishment) Act (NOSDREA) 2006, did not contemplate fracking. It also appears that, the Oil Spill and Oily Wastes Management Regulation (OSOWMR) 2011, was made to regulate water-based and oil-based wastes, fluids or cuttings only. Hence, it cannot also adequately regulate fracking flowback water, wastes, or fluids, which contains chemicals and other radioactive materials more hazardous than the water-based and oil-based drilling methods it was made to regulate. That is why, it is important to have a robust regime on fracking, that will adequately regulate all fracking operations in an environmentally friendly manner, while at the same time, increasing gas output in Nigeria. This is because, Nigeria has shale gas, and gas is more environmentally friendly than other fossil fuels. Therefore, it is imperative to look at the US, UK, and the Algerian fracking regimes in order to derive lessons from these jurisdictions, for purposes of repositioning the Nigerian oil and gas industry for the better.

Keywords: *Hydraulic fracturing; Fracking; Shale; Shale Gas; Gas Shale; Conventional; Unconventional; Oil and Gas*

1.0 Introduction

The word "fracking" is included to the meaning of upstream petroleum operations under the interpretation section of the Petroleum Industry Act (PIA), 2021.[1] However, the Act did not explain the meaning of fracking. Nonetheless, by virtue of the meaning of upstream petroleum operations under the interpretation section, fracking is impliedly provided for, under the Act. The implication is that, fracking for oil or gas can be done in the frontier basins of the country without a robust regime to regulate the practice. The challenge is that, although, shale gas fracking will revolutionize the industry and bring gas boom in

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[1] Petroleum Industry Act 2021, s. 318. Meaning of upstream petroleum operations under the interpretation section.

Nigeria,[2] it can also occasion health and environmental hazards emanating from fracking chemical, and other radioactive materials.[3]

Therefore, providing for environmental safeguards and fracking for more shale gas, in order to have gas in abundance, is very important for Nigerian economic evolution.[4] This is because, Compressed Natural Gas (CNG) centres, that will convert petrol driven vehicles into gas driven ones are established in Abuja,[5] and Kaduna.[6] Such conversion centres may cause gas price-hike in the country. Therefore, exploring, discovering, and fracking for more shale gas will help to keep low price of gas in Nigeria.[7] It is also important for Nigeria to frack for more shale gas because, gas emits less carbon, hence, more environmentally friendly compared to other fossil fuels.[8] However, a robust fracking regime is needed for purposes of regulating fracking operations for more gas production, in a manner that promotes environmental safeguards, and in support of economic progression.

Fracking has been used to extract oil from shale reservoirs in other parts of the world.[9] It is stated that fracking was used in the 1860s to extract oil from shallow wells, in places like New York; Pennsylvania; Kentucky; and West Virginia.[10] Studies has also shown that, in 1947, Floyd Farris of Stanolind Oil, first applied it at the No.1 Klepper well in the Hugoton Field, Kansas.[11] About one thousand gallons of naphthenic acid and palm oil (napalm), combined with gasoline and sand was used to stimulate natural gas from the lime stone formation to rapidly flow upwards.[12] Hence, in 1949, the Halliburton Oil Well Cementing Company secured a license to apply fracking, which increased production.[13]

But, the American Oil and Gas Historical Society (AOGHS) has credited it to John Wilkes Booth's Dramatic Oil Company as one of the earliest fracking attempts in 1864.[14] Studies have revealed that the United Kingdom and the United States of America have used fracking method to increase oil and gas production to boost their economy a long time ago.[15] Especially, the United States has recorded economic

[2] J M Golden and H J Wiseman, 'The Fracking Revolution: Shale Gas as a Case Study in Innovation Policy' (2015) [64] *Emory Law Journal*, 964.
[3] T Myers, 'Potential Contaminant Pathways from Hydraulically Fractured hale Aquifers (2012) [50] (6) *Groundwater*, 872.
[4] Using fracking technology to develop shale reserves in Nigeria may occasion the reduction of gas price.
[5] D Aina, 'FG Launches CNG Conversion Centre in Abuja' *PUNCH* (Abuja: 4 November 2023) 15.
[6] G Isenyo, 'FG Unveils CNG Conversion Centre in Kaduna' *PUNCH* (Kaduna: 5 November 2023) 13.
[7] Fracking increases production, hence will cause abundance, which will reduce demand pressure and price.
[8] R W Howarth, 'Methane Emissions from Fossil Fuels: Exploring Recent Changes in Greenhouse-gas Reporting Requirements for the State of New York' (2020) [17] (3) *Journal of Integrative Environment Sciences*, 69.
[9] C T Montgomery and M B Smith, 'Hydraulic Fracturing: History of an Enduring Technology' (2010) [62] (12) *Journal of Petroleum Technology*, 26.
[10] Leiter, (n12), 112.
[11] M Q Morton, 'Unlock the Earth: A Short History of Hydraulic Fracturing' (2014 [10] (6) *Geoscience Magazine* 2014) 76.
[12] D K String, 'A Fracking Good Solution to the Hydraulic Fracturing Regulation Conundrum' (2013) [48] (1) *Valparaiso University Law Review*, 417.
[13] D R Cahoy and Others, 'Fracking Patents: The Emergence of Patents as Information-Containment Tools in Shale Drilling' (2014) [19] (2) *Michigan Telecommunications and Technology Law Review*, 283.
[14] R Coffey, 'What is Fracking? Definition, History and Environmental Impact' (2021) *Treehugger*, 9.
[15] M Greenstone and Others, 'Fracking Has Its Costs and Benefits: The Trick Is Balancing Them' *Forbes*

benefits from the application of fracking technology.[16] Therefore, Nigeria can also share the fracking experience by having a robust legal framework.

2.0 Terminological Elucidation

2.1 Hydraulic fracturing or Fracking

Hydraulic fracturing, also known as fracking, is the combination of vertical and horizontal perforation into the earth's subsoil to access crude oil or natural gas in shale depositions.[17] It involves the administration of high-pressure injection of fracking fluids or chemical mixture primarily containing water; sand; and other proppants, with the aid of thickening agents into a wellbore.[18] The aim is to create cracks in the deep-rock formations to enable natural gas; oil; and brine flow more freely to the surface, through a well.[19] Fracking therefore, is a drilling technology for the enhancement of crude oil and natural gas production.[20] It has the potentials to revitalize depleted wells to reproduce in commercial quantity.[21]

2.2 Shale

Shale is a fine-grained sedimentary rock formed from mud mixed with flakes of clay minerals and tiny fragment (silt-sized) particles of other minerals, especially quartz and calcite.[22] It is characterized by its ability to split into tiny layers of less than a centimetre in thickness, most common sedimentary rock.[23] The term referred to as shale, is sometimes synonymously and broadly used for mud-rock instead of the remote sense of clay-rich fissile mud-rock.[24]

Shale may contain either crude oil or natural gas.[25] Deposit of crude oil or natural gas trapped in shale formation is referred to as unconventional reservoir.[26] Unconventional because, the crude oil or natural gas contained in the shale cannot be extracted with the old drilling method except with fracking.[27] Shale that is endowed with an unoxidized carbon may have darker colour.[28]

(Chicago October 20 2018).

[16] R F Aguilera and M Radetzki, Shale Gas and Global Market in T Hunter (ed) *Handbook of Shale Gas Law and Policy* (Intersentia Ltd 2016) 116.

[17] J G Speight, Handbook of Hydraulic Fracturing (New Jersey: John Wiley & Sons Inc. 2016) 19.

[18] H G Kozik and S A Holditch, 'A Case History for Massive Hydraulic Fracturing: The Cotton Valley Lime Matrix, the Fallon and the Personville Fields' (1981) [33] (2) *Journal of Petroleum Technology*, 229

[19] *Ibid*.

[20] W J Phillips, Hydraulic Fracturing and Mineralization (1972) [128] *Journal of Geological Society of London*, 337.

[21] A Chukwuemeka and Others, 'Oil Well Side-tracking in Mature Fields: Its Potentials for Increasing Recovery from Nigeria's Mature Fields (2017) [59] (1) *Petroleum Coal*, 39.

[22] H Blat and T J Robert, *Petroleum: Igneous, Sedimentary and Metamorphic* (2nd edn, Freeman, 1996) 281.

[23] S Boggs, *Principles of Sedimentology and Stratigraphy* (4th edn, New Jessy: Upper Saddle River Pearson Prentice Hall, 2006) 139.

[24] P Styles, Shales: Shale Gas and Hydraulic Fracturing in Tina Hunter (ed.) *Handbook of Shale Gas Law and Policy* (Cambridge: Intersentia Ltd 2016) 15

[25] P E Potter and Others, *Sedimentology of Shale: Study Guide and Reference Source* (New York: Springer-Verlag, 1980) 54.

[26] J P Riva, 'Oil Shale Geology' [2021] (4) (8) *Journal of Congressional Research Service*, 83.

[27] P A Charlez, *Rock Mechanics: Petroleum Applications* (Paris: Editions Technip 1997) 239.

[28] T Ferriday and M Montenari, 'Chemo-stratigraphy and Chemo-facies of Source Rock Analogues: A High-Resolution of Black Shale Succession from Lower Silurian Formigoso Formation' (2016) [1] *Stratigraphy and Timescales*, 123.

Shale rock contains oil or gas trapped in it, hence, requires the technique or technology called hydraulic fracturing to rich the formation underground before it could be extracted.[29] Shale also includes other hybrid systems such as tight oil because, it also requires forceful stimulation to fracture the rock matrix.[30]
Therefore, shale is an oil or gas-bearing rock, which requires the use of advanced technology called hydraulic fracturing to extract. Otherwise, it is not possible to extract oil or gas in shale.

2.3 Oil or Gas shale and Shale oil or gas

Many countries including India have developed their shale gas with robust policy.[31] Shale gas is natural gas produced from black shale-rock rich in organic matter, or self-generation and self-storage natural gas.[32] Gas or oil shale and shale oil or gas will be better understood through knowing what oil shale and shale oil are. Oil shale is a fine-grained elastic sedimentary rock composed of mud mixed with flakes of clay mineral and tiny fragments of other minerals especially quartz and calcite.[33] There is a difference between shale oil and oil shale though used interchangeably, just as there is difference in shale gas and gas shale.[34] Oil or gas extracted from shale deposit, after it has been processed, is referred to as shale oil or shale gas, while oil shale or gas shale is the shale rock reservoir, deposit or formation underground, containing a compound called kerogen used to make oil or gas.[35] Shale oil is one of the earliest produced oils from shale rock formation through a process known as pyrolysis.[36] Oil shale is a sedimentary rock containing various amounts of solid organic minerals that could yield petroleum products.[37] Due to the nature of their environmental depositions or reserves, oil or gas shales are given different classifications such as: marine; lacustrine; and terrestrial oil or gas shales.[38]

Oil or gas shale are fairly different from bitumen-carrying-rocks or petroleum reservoir rocks such as oil sands.[39] Oil sand is known to have originated from oil biodegradation yet to be mature through heat and pressure to transform the kerogen into petroleum.[40] Oil sand contains oil, which is still in the process of maturation, but is yet to exceed early meso-

[29] D M Javie, 'Components and Processes Affecting Producibility and Commerciality of Shale Resource System' (2014) [12] (4) *International Earth Science Journal*, 307.
[30] D M Javie, 'Shale Resource System for Oil and Gas: Part 1 in J Beryer (ed) (2012) [97] *Shale Reservoir: Giant Resources for the 21st Century*, 69.
[31] D Paul and Others, 'Shale Gas: An Indian Market Perspective' (2021) [11] (1) *International Journal of Energy Economics and Policy*, 126.
[32] Z Caineng and Others, 'Geological Characteristics and Resource Potential of Shale Gas in China' (2010) [37] (6) *Journal of Petroleum Exploration and Development*, 641.
[33] O L Omoregie, 'Prospective Shale Oil and Gas Development in Nigeria: The Two Sides of the Coin' (2017) [12] (1) *Ambrose Ali University Law Journal*, 70.
[34] G Elliot, 'The Difference Between Shale Oil and Oil Shale' *Street Wise Report* (California: 10 November 2010) 52.
[35] K Urov and A Sumberg, 'Characteristics of Oil Shales and Shale-like Rocks of Known Deposits and Outcrops' (1999) [16] *A Scientific-Technical Journal*, 1.
[36] I Dostrovsky, *Energy and the Missing Resources: A View from the Laboratory* (Cambridge: Cambridge University Press) 18.
[37] A Ots, 'Estonian Oil Shale Properties and Utilization in Power Plants' (2007) [53] (2) *Erngetika Lithuanian Academy of Science*, 8.
[38] A Hutton, 'Petrographic Classification of Oil Shale' (1987) [8] (3) (Amsterdam: *International Journal of Coal Geology*, 203.
[39] N Ted, 'Geoscientist' (2007) [17] (2) (London: *Geological Science of London*, 78.
[40] K Urov and A Sumberg, 'Characteristics of Oil Shales and Shale-like Rocks of Known Deposits and Outcrops' (1999) [16] *A Scientific-Technical Journal*, 1.

catagenetic.[41] Oil shale is different from oil-bearing shale and shale deposits containing tight oil. This is because, it is possible to produce tight-oil from a conventionally drilled well but not the same with shale, which must be drilled through fracking. [42]

It has been observed that, shale oil produced from oil shale is not the same as tight oil, though frequently called shale.[43] The difference between them is due largely to the chemical composition; mineral content; type; age; as well as depositional history.[44] However, it is argued that, oil shales are not geologically or geochemically different rocks, but more of economic terminology.[45] Extracting oil or gas from shale deposit, could be by mining the shale containing the oil or gas, and ship them elsewhere to a processing plant for heating to extract the oil or gas through a heating process known as *ex-situ*: or could be heated underground through a process referred to as *in-situ* pyrolysis.[46]
Various methods could be applied to increase efficiency in oil or gas shale extraction.[47] Oil shale could be used as low-grade fuel power generation; district heating; raw materials in chemical, and construction-material processing. [48] Oil shale is said to have been first used around the 3000 BC in Mesopotamia for road construction.[49] Britons of the Iron age is also reported to use oil shale to polish and transform it into ornaments.[50] Therefore, shale gas, is natural gas extracted from shale formation; while gas shale is the underground formation, or deposit, or rock containing gas.

2.4 Conventional and Unconventional Oil and Gas Reservoirs

Shale oil and gas deposition are significantly different from conventional oil or gas reservoir.[51] Conventional reservoir may require only vertical perforation into the earth to reach the pool underground because of the gathering quantity and high level of permeability.[52] On the other hand, Shale formation, deposit or reservoir, requires combined technology of vertical drilling, horizontal slanting, and application of stimulant chemicals.[53] These processes make fracking more expensive than conventional drilling.[54]

[41] W O'Neil, *Oil as a Strategic Factor: The Supply of Oil in the Half of 21ST Century and its Implication for the US* (CNA Corporation 2007) 94.
[42] R Enno and I Aarna, 'About Technical Terms of Oil Shale and Shale Oil' (2015) [32] (4) *A Scientific-Technical Journal*, 291.
[43] F C Schora and Others, 'Hydrocarbon Fuels from Oil Shale' (1976) [1] *American Institute of Chemical Engineers,* 325.
[44] N E Altun and Others, 'Oil Shale in the World and Turkey: Reserves, Current Situation and Future Prospects' (2006) [23] (3) *A Scientific-Technical Journal*, 23.
[45] A C Hutton, 'Organic Petrography and Oil Shale' (1994) [5] (5) *Energeia*, 89.
[46] M Koel, 'Estonian Oil Shale' (1999) *A Scientific-technical Journal,* 15; J T Bartis and Others, *Oil Shale Development in the United State: Prospect and Policy Issues* (RAND Corporation 2005) 73.
[47] T Laine and Others, 'Fixation of Chlorine Evolved in Pyrolysis of PVC by Estonian Oil Shale' (2006) [72] (2) *Journal of Analytical and Applied Pyrolysis*, 205.
[48] J Dyni, 'Geology and Resources of Some World Oil Shale Deposits' (2006) *Scientific Investigation Report,* 2005.
[49] R J Forbes, *A Short History of the Art of Distillation from the Beginning Up to Death of Cellier Blumenthal* (Brill Publishers, 1970) 41.
[50] I West, 'Kimmeridge Black Stone Oil Shale' (2006) *University of Southampton Press,* 97.
[51] Z Caineng and Other, 'Conventional and Unconventional Petroleum Orderly Accumulation: concept and Practical Significance' (2014) [41] (1) *Journal of Petroleum Exploration and Development*, 14.
[52] Z Caineng and Others, Theory, Technology and Prospects of Conventional and Unconventional Natural Gas' (2018) [45] (4) *Journal of Petroleum Exploration and Development*, 604.
[53] L M Petkovic, 'The Science and Technology of Unconventional Oils' (2017) *Science Direct,* 677.
[54] T Fitzgerald, 'Frackonomics: Some Economics of Hydraulic Fracturing' (2013) [63] (4) *Case Western Reserve Law Review*, 1337.

Nonetheless, fracking has the potential to extract oil or gas in shale formation, and can improve depleting wells to reproduce in commercial quantity.[55] Therefore, fracking reduces the tension created by the fears and worries about depletion of wells.

This is pivotal because, Nigeria also exercises some fears, having consistently exploited oil and gas in commercial quantity as far back as 1956.[56] Hence, there is the feeling that, there is the possibility that, the Nigerian oil and gas reserves may be setting in for the depletion stage.[57] This is orchestrated by the difficulty of discovering new conventional oil and gas reserves, and the maturity of the oil and gas fields globally.[58] As a result, many countries endowed with shale oil and gas resources around the world have long adopted fracking technology to increase production.[59] Therefore, Nigeria also need to transition into fracking with a robust regime by reviewing the PIA 2021 to contemplate fracking.

Algeria,[60] and Nigeria,[61] struck petroleum in commercial quantity in 1956. But Algeria has evolved more than Nigeria with respect to fracking regime. Discovery of gas in Algeria led to the establishment of Sonatrach, the State-owned petroleum company, in 1963, to manage petroleum activities in the country.[62] Sonatrach petroleum export revenue exceeded $63 billion in 2013, making it of the largest oil and gas revenue generating company in Africa.[63]

Algeria is primarily a gas producing country with the ninth largest gas reserves,[64] and the sixth largest producer in the world.[65] Algeria used to be a French colony, with the Saharan Petroleum Code governing petroleum activities. Upon independence in 1962, Algeria decided to remove itself from the hard grips of France's Saharan Petroleum Code and its depressing concession agreement.[66] Algeria now have a robust fracking regime to develop it unconventional reserves. Hence, it is important for Nigeria to do same, having discovered petroleum the same year.

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[55] H Rogers, 'Shale Gas: The Unfolding Story' (2011) [27] (117) *Oxford Review of Economic Policy*, 123.

[56] L Atsegbua, *Oil and Gas Law in Nigeria: Theory and Practice* (3rd edn, Lagos: Fifers Lane Publishers, 2012) 40.

[57] Depletion Stage is the Stage When Crude-Oil no Longer Flow in Commercial Quantity due to Limited Resource Underground.

[58] R A Kerr, 'The Next Oil Crisis Looms Large and Perhaps Close' (1998) [281] (5380) *Science*, 1128.

[59] K Robbins 'Awakening the Slumbering Giant: How Horizontal Drilling Technology Brought the Endangered Species Act to Bear in Hydraulic Fracturing' (2013) [63] (4) *Case Western Reserve Law Review*, 143.

[60] E Gailard and M Lebois, *Africa Upstream Oil and Gas: A Practical Guide to the Law and Regulation* in E G Periera and K Talus (eds), (Winchester: Globe Law Publishing Ltd 2015) 78.

[61] P Steyn, 'Oil Exploration in Colonial Nigeria: 1903 – 1958' (2009) [27] (2) *Journal of Imperial Commonwealth History*, 249.

[62] *Ibid*.

[63] M E Allaoui and C Tidjani, 'The Importance of Training Programmes in the Improvement of the Performance of Employees in the Petroleum Companies: The Case of Sonatrach Company' (2017) *Saudi Journal of Business and Management Studies*, 407.

[64] Gailard and Lebois, (n60).

[65] OPEC, Annual Statistic Bulletin 2014, 8.

[66] A Aissaoui, Algeria: The Political Economy of Oil and Gas (Oxford: Oxford Institute of Energy Studies 2001) 57.

3.0 Legal Evaluation of Shale Gas Fracking Regime in the Nigerian Petroleum Sector

3.1 Implication of the Meaning of Upstream Petroleum Operations Under the Petroleum Industry Act, 2021

The Petroleum Industry Act (PIA) 2021, did not robustly contemplate fracking. However, fracking is impliedly provided for, by virtue of the meaning of upstream petroleum operations under the interpretation section.[67] Implied provisions are provisions seen to have been provided under an Act, but which were not expressly or robustly documented under the same Act.[68] For instance, in *Australian Capital Television Pty Ltd v Commonwealth*,[69] and *Nationwide News Pty Ltd v Wills*,[70] the court states that, freedom of communication rights, are rights implied from the fundamental principle of representative government.

The reasoning of the court was that, since government officials are representatives of the people, the people have implied right to criticize government officials as their representatives, although not expressly stated.[71] From the expression of the court, it is easy to decipher that, certain provisions in a legislation may not be express, but implied. Hence, also applicable to the meaning of upstream petroleum operations under the interpretation section of the PIA 2021, with regards to fracking.

However, all laws are supposed to be prospective, open, and clear because, implied languages in a legislative drafting, could really mislead those the law is intended to guide.[72] That is why, legislative drafting requires plain and express language to avoid such ambiguities.[73] It is also the reason international law principle holds that, treaties or international agreements must be given literal interpretation devoid of common law rules of interpretation.[74] This is expedient for purposes of clarity, in order to circumvent the conflicts under the rules of interpretation.[75]

The implication of including fracking as part of the meaning of upstream petroleum operations without stating the meaning of fracking is that, all activities of upstream petroleum operations in the frontier basins of Nigeria means the same thing as fracking. It also means that, fracking activities in the frontier basins of Nigeria mean one and the same thing as upstream petroleum operations. This is where fracking is impliedly provided for, by the PIA 2021.

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[67] Petroleum Industry Act 2021, s. 318: meaning of upstream petroleum operations under the interpretation section.

[68] Implied provisions may not be expressly stated, but are recognized as having links to the enacted law. Hence, the Rights to using fracking technology in the frontier basins of Nigeria is implied by virtue of the meaning of upstream petroleum operations under the interpretation section of the PIA, 2021.

[69] (1992) 177 CLR 106.

[70] (1992) 177 CLR 1.

[71] Implied provisions, (n2).

[72] J Raz, 'The Rule of Law and its Virtue' (1977) [93] (195) *Law Quarterly Review*, 198.

[73] Legislative Standards Act 1992, s. 4 (3) (k).

[74] C Wigwe and V Wigwe-Chizindu, 'The Effect of the Elastic Interpretation of the Term: Adequate Safeguard in Article 1 (v) of International Monetary Fund (IMF) Articles of Agreements 1944' (2019) [10] (1) *The Journal of Property Law and Contemporary Issues*, 1.

[75] M M Gidado and S S Shikyil, *The Province of Legal Method* (Jos: Mono Expression Limited) 140.

In order to shed more light into the implication, it is important to reproduce part of the meaning of upstream petroleum operations under the interpretation section. It reads:

> Upstream petroleum operations mean the exploration for; appraisal of; development of and winning or obtaining of petroleum in Nigeria by or on behalf of a company on its own account for commercial purposes; petroleum exploration operations; the drilling of exploration; appraisal and development wells; all activities upstream of the measurement points; related to the winning of petroleum through wells or mining from petroleum reservoirs; drilling; fracking…[76]

In other words, since fracking is included to the meaning of upstream petroleum operations under the interpretation section of the Act, it is impliedly provided for. Therefore, fracking could be applied to extract shale oil and gas, as an upstream petroleum operations activity, in the frontier basins, as a result of the implied language used.

There is also an implied provision conferring power on the Commission to make regulations to govern fracking in Nigeria. This is because, section 7 (a)-(c) of the PIA 2021, provides that, the Commission should ensure the implementation of laws, regulations, policies and standards relating to upstream petroleum operations. Others include but not limited to, management of petroleum reserves; installations; exploration of oil and gas offshore, onshore, shallow water, and in the frontier basins of Nigeria.[77] This ordinarily places the Commission in a position to make regulations for fracking, being an upstream petroleum operation activity in Nigeria.

However, the Commission may not aver their mind towards making regulations for fracking because, fracking is not robustly provided for. Therefore, to resonate with the objectives of the PIA 2021, a robust and elaborate regime for fracking is a priority for an effective and efficient management of fracking operations in the frontier basins of Nigeria.[78] Implied provisions, as reflected under the interpretation section of the PIA 2021, with respect to fracking, does not portray a good legislative drafting.[79]

It is common practice that, express, or implied language used in a legislative drafting, could provide for, or confer power on a particular body.[80] This was stated by Lord Haldane in *Dundee Harbour Trustees v Nicol* that:

> It is now well settled that the answer to the question whether a corporation created by statute has a particular power depends

[76] Petroleum Industry Act 2021, s. 318. Meaning of upstream petroleum operations under the interpretation section.
[77] Petroleum Industry Act 2021, s. 7 (a)-(c).
[78] *Ibid*, s. 2
[79] Legislative Standards Act 1992, s. 4 (3) (k).
[80] A Hameed, 'Parliament Constitution: Legislative Disruption of Implied Repeal' (2023) [43] (2) *Oxford Journal of Legal Studies*, 429.

> exclusively on whether that power has been expressly given to it or can be implied from the language used.[81]

Therefore, the language used to give the meaning of upstream petroleum operations under the interpretation of the PIA 2021, indicates that, fracking is impliedly provided for. Again, the language used in section 7, which confers regulation making power on the Commission also indicates that, the Commission has implied power to make regulations for fracking. However, it is stated that, plain and expressly provided law makes ease of readers' understanding of the law.[82] This is important for the sake of those who would want to interpret and use the law in bad faith, in the expense of the public.[83]

Hence, justice Stephen, in *Re Castioni*, held:

> It is not enough to attain to a degree of precision which a person reading in good faith can understand; but it is necessary to attain, if possible, to a degree of precision which a person reading in bad faith cannot misunderstand. It is all the better if he cannot pretend to misunderstand it.[84]

Therefore, those operators who would want to misuse the inclusion of fracking to the meaning of upstream petroleum operations by fracking for shale gas or crude oil in the frontier basins, in an environmentally unfriendly manner, are the reason the PIA 2021, need to be reviewed to robustly contemplate fracking, with a corresponding regulation.

This is because, the implied provision failed to address key questions such as: what is fracking? what is shale? What area is restricted from fracking operations? What is the statutory distance between residential areas and fracking site? What is the statutorily approved depth into the subsoil for fracking operations, in order not to contaminate water aquifers? What are the measures to take in order to control fracking flowback water, wastes, or fluids? And how are fracking wastes to be disposed in order to prevent health and environmental hazard in Nigeria?

Globally, even in countries with robust regime for conventional oil, using fracking technology to extract oil or gas, especially in shale formation, is a fundamental topic that usually warrants specific robust governance.[85] That is why, a robust fracking regime under the PIA 2021, or under a specific separate legislation, with a corresponding regulation to mitigate the challenges of fracking chemicals pollution is pivotal.[86] Hence, express provision for fracking is pivotal in order not to make the operators and the Commission act ultra vires.[87]

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[81] (1915) A.C. 550.
[82] Legislative Standards Act 1992, s. 4 (3) (k).
[83] Acts Interpretation Act 1954, s. 14 (A).
[84] (1891) 1 QB 149 167-168.
[85] H J Wiseman, Handbook of Shale Gas Law and Policy in H J Wiseman (ed) *Hydraulic Fracturing in Shale Gas Operations: Risk and Response in Shale Gas Policy* (Cambridge: Intersentia Ltd 2016) 61.
[86] R Gold and T McGinty, 'Energy Boom Puts Wells in America's Backyards' (2013) *The Wall Street Journal*, 128.
[87] R Douglas and Others, *The Law of Harbours, Coast and Pilotage* (5th edn, London: LLP Ltd 1997) 22.

Therefore, although section 102 (1) of the PIA 2021, provides for a licensee or lessee engaged in upstream petroleum operations to conduct environmental impact assessment plan. And that, such licensee must be capable of environmental rehabilitation in case of degradation.[88]

However, these provisions cannot adequately govern fracking operations impliedly provided under the interpretation section of the PIA 2021. Hence, the need for a review of the PIA 2021, to robustly contemplate fracking in Nigeria. There is also an urgent need for the Commission to make a specific regulation for fracking operations in Nigeria.

3.1.2 Fracking Governance Under the National Oil Spill Detection and Response Agency (Establishment) Act 2006 (as amended)

The parent law governing oil pollution in Nigeria today, is the National Oil Spill Detection and Response Agency (Establishment) Act (NOSDRA), 2006.[89] In other words, pollution emanating from fracking wastes, fluids, or flowback water ought ordinarily to be regulated by the NOSDRA. This is because, it was enacted to handle environmental protection with a view to specifically handle pollution emanating from the oil and gas sector. Section 1 of the Act established NOSDRA with statutory objectives to amongst others things, monitor; regulate; coordinate; implement; and review National Oil Spill Contingency Plan.

The NOSDREA's general function are: to conduct surveillance and ensure compliance with all environmental preservation legislation in the petroleum sector. It also includes the detection, prevention, and management of oil spills, oily wastes as well as gas flaring amongst others.[90] Furthermore, section 7 (a) – (g) enjoins regional co-operation among member States of West African sub-region and the Gulf of Guinea, by combating oil spillage and pollution in the contiguous waters. It also includes the facilitation of the arrival and utilization of ingress and egress from Nigeria, of ships, aircrafts, and other modes of transport engaged in the response of oil pollution incidents among others. That is why, it could be said that, the NOSDRA has the power to safeguard Nigeria's environment from pollution emanating from the oil and gas industry, including pollution from fracking fluids or wastes.

However, it is impossible to effectively regulate fracking through the NOSDRA because, fracking is totally different from the conventional drilling method the NOSDRA was made to regulate. Therefore, it is important for Nigeria to have a robust legal framework for fracking. Such legal framework, will make Nigerian legislators and policy makers to understand whether the functions of the NOSDRA covers pollution emanating from fracking chemicals, being pollution incidental to upstream petroleum operations. It will also shed light to whose duty it lies to regulate fracking wastewater, whether the Commission or the NOSDRA.

The bottom line is that, the NOSDRA was not intended for fracking, hence cannot effectively regulate fracking flowback wastewater and fluids. Therefore, not even the regulations made under it can adequately regulate fracking operations in Nigeria. That is why, the PIA 2021, need to be reviewed in order to

[88] Petroleum Industry Act 2021, s. 102 (3) (b).
[89] National Oil Spill Detection and Response Agency (Establishment) Act 2006, s. 1
[90] *Ibid*, s. 6 (a) – (g).

adequately reflect fracking as a legal operation in Nigeria. This will enable the Commission to make regulations specifically for fracking.

3.1.3 Fracking Governance Under the Oil Spill and Oily Waste Management Regulation, 2011

The Oil Spill and Oily Waste Management Regulations (OSOWMR) 2011, was made pursuant to section 26 of the NOSDRA Act 2006. Regulation 2 (1) focuses on regulating facilities used for seismic survey operations; drilling; producing; gathering; storage; processing; refining; and distribution, amongst other activities.

Regulation 14 provides for the monitoring of produced water-based mud or fluids, oil-based mud or fluids, water-based drill cuttings, oil-based drill cuttings, drainage and well treatment fluids. This is to be done through a laboratory analysis, in order to determine the level of oil content. Regulation 30 prohibits the discharge of drilling mud; fluids; and well treatment waste on land or navigable waters. Where such discharge is due to well blow-out, the operator shall immediately take measures to prevent potential harmful impact.[91]

However, the OSOWMR monitors only produced water-based mud or fluids, oil-based mud or fluids, water-based drill cuttings, oil-based drill cuttings, drainage and well treatment fluids. This means that, the OSOWMR cannot adequately regulate fracking chemicals flowback wastewater, fluids or cuttings that contains environmentally hazardous radioactive materials.[92]

Therefore, fracking was not contemplated when the regulation was made. As a result, cannot adequately regulate fracking operations in Nigeria. For instance, a regulation targeted to govern fracking must state the depth into the subsoil permitted for fracking operations; the protection of water aquifers from fracking chemicals; the kilometres that is required for residential areas' closeness to fracking sites; prevention of air pollution from fracking chemicals; transportation and disposal of fracking flowbacks; prevention of sinkholes as a result of fracking; integrity of fracking assets amongst others.

Therefore, although the Regulation is intended to mitigate pollutions emanating from the oil and gas industry, it is intended for conventional drilling, and not shale fracking as reflected in the meaning of upstream petroleum operations under the interpretation section of the PIA 2021. Hence, a robust fracking regime and a corresponding regulation is still needed in Nigeria to effectively regulate fracking operations to minimize health and environmental hazards. This is because, unlike the water-based cuttings or oil-based mud contemplated by the OSOWMR, fracking flowback water is difficult to clean once it pollutes an area.[93]

Therefore, although Nigeria has good regulations on management of drilling waste,[94] there is no regulation on management of fracking fluids in Nigeria. This is because, the OSOWMR focused on regulating

[91] Oil Spill and Oily Waste Management Regulation, Reg. 29
[92] J Andrew and Others, 'Radium and Barium Removal Through Blending Hydraulic Fracturing Fluids with Acid Mine Drainage' (2014) [48] (2) *Journal of Environmental Science Technology*, 1334.
[93] J Fajfer and Others, 'Hydraulic Fracturing Flowback Chemical Composition Diversity as Factor Determining Possibilities of its Management' (2022) [29] *Environmental Science and Pollution Research*, 16152.
[94] Environmental Regulations for Midstream and Downstream Petroleum Operations in Nigeria 2022, reg. 15, 16, 17.

produced water-based mud or fluids; oil-based mud or fluids; water-based drill cuttings; or oil-based drill cuttings. These are not as toxic or hazardous as fracking wastes or fracking flowback water or fluids. That is why, the management and disposal of fracking fluids or flowback water or wastes, usually requires stricter regulations due to the toxicity of the fracking chemicals and radioactive materials. Therefore, it is important to have a robust fracking regime that will effectively regulate fracking operations in Nigeria.

3.1.4 Fracking Governance Under the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria

Pursuant to the power conferred on the expunged Department of Petroleum Resources (DPR), the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) was made. Part II (C) (2) (7) mentioned Hydraulic fracturing and acidification when it defines well treatment wastes as spent fluids that result from acidification and hydraulic fracturing operations to improve oil recovery. However, Part II (D) (2) (2) (1) (i) mentioned conventional recirculation system during water-based system. The mention of conventional system in the section above indicates that EGASPIN guidelines was not intended for shale fracking; neither did it contemplate modern day hydraulic fracturing. Again, Part II (E) (3) (7) specifically provides for the control of radioactive sources or materials. But it did focus only conventional well abandonment and logging. Hence, it did not contemplate shale gas or shale oil fracking. Under Part II (B) (1) (4), only water-based and oil-based drilling muds are allowed to be used in Nigeria. It means that, although the phrase ‘’hydraulic fracturing’’ was mentioned, fracking oil and gas from shale geological formations was not contemplated, since it recommends conventional water-based and oil-based drilling methods. That is why Part II (C) (2) (3) defines drilling fluids (mud) as suspensions of solid or dissolved materials in oil-based or water-based drilling used to maintain hydrostatic pressure control in a well. There is no express mention of unconventional shale fracking of oil or gas from shale formations under EGASPIN.

Therefore, although Part II (C) (2) (7) of EGASPIN defined well treatment wastes as spent fluids from acidification and hydraulic fracturing operations to enhance of oil recovery, it is oil or water-based fluids or wastes.[95] Again, EGASPIN provides that, all drilling activities must be carried out in a manner that shall not affect human and living organisms (fauna and flora) or the adjacent surface water.[96] Also, that, all wastes such as spent water-based muds or fluids; well treatment wastes; oil-based and water-based drill cuttings; brine; deck drainages or residues, shall be adequately treated to the satisfaction of the Director of Department of Petroleum Resources.[97]

However, it cannot adequately regulate fracking because, EGASPIN expressly contemplates only water-based and oil-based drilling methods in Nigeria. Hence, it did not provide for unconventional fracking. Thus, neither the Oil Spill and Oily Wastes Management Regulations and EGASPIN can adequately

[95] Environmental Guidelines and Standards for the Petroleum Industry in Nigeria, Pt II (C) (2) (3) (6).
[96] *Ibid*, Part II (C) (3) (1).
[97] *Ibid*, Part II (C) (3) (5).

regulate unconventional fracking in Nigeria because, they both contemplate management of only water-based and oil-based wastes.

Therefore, although EGASPIN has provisions that could partially regulate fracking, it was not intended to govern modern day hydraulic fracturing. Again, even if it had contemplated modern day fracking, it does not have the effect of law, hence difficult to enforce it. Hence, it is pivotal to robustly contemplate fracking under the PIA 2021, with a corresponding regulation from the Commission. This will create legal and enforcement quality of the regulation. Therefore, the Commission has a duty to make a regulation that will regulate unconventional fracking in Nigeria. But before that, it is imperative to review the PIA 2021, to robustly contemplate unconventional oil and gas fracking in Nigeria.

3.1.5 Shale Gas Reserves in Nigeria.

The advent of oil and gas exploration in Nigeria dates back to 1903, when the Nigerian Bitumen Corporation commenced exploration activities.[98] The pioneering efforts of the exploration ended abruptly due to the sudden outbreak of the First World War in 1914.[99] Shell-PB recommenced exploration in 1937 in Owerri, Imo State, and later expanded to other environs in the Niger Delta.[100] This led to the discovery of crude oil in commercial quantity in 1956.[101]

In order to discover more oil and gas fields, the exploration expanded to the Benue Trough, Nigeria.[102] This led to the discovery of oil and gas shale deposits in 1980.[103] However, shale oil and gas were not resources of interest to Shell-BP and the Federal Government of Nigeria at the time. They were not interested in shale oil and gas because, the technology to extract oil and gas from shale deposition was not advanced as today, and conventional oil and gas were also in abundance.[104]

As a result, Nigeria concentrated in drilling only the conventional oil discovered in commercial quantity. The discovery of petroleum in Nigeria made the country to obtain international recognition in the global petroleum industry.[105] Petroleum resources also become the centre of political system, and determinant factor for the foreign policy-making of the country ever since Nigeria assumed ownership of the resources.[106]

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[98] Steyn, (n61).
[99] D Daniel, 'The Economic Feasibility of Oil Shale Development in Nigeria: A Case Study of Abakaliki Shale Deposit' (2016) *Unpublished B.Eng. Project submitted to the Department of Chemical and Petroleum Engineering*, University of Uyo, Nigeria.
[100] P Steyn, 'Oil Exploration in Colonial Nigeria: 1903 – 58' (2009) [37] (2) *The Journal of Commonwealth History*, 250.
[101] *Ibid*.
[102] O A Ehinola, 'Biostratigraphy and Depositional Environment of the Shale Deposit in the Abakiliki Folt Belt: South-eastern Nigeria' (2010) [27] (2) *Energy and Environmental Research Group*, 99.
[103] *Ibid*.
[104] By the 1980s, conventional oil and gas were still in abundance, and the technology to extract oil and gas from shale reservoir is not very much available hence, shale oil and gas were abandoned.
[105] Atsegbua, (n56) 43.
[106] T I Monday and M Shalihu, 'Crude-oil and Politics of Nigerian Foreign Policy' ((2017) [7] (7) *Research on Humanities and Social Sciences*, 2224.

3.1.6 The Significance of Shale Gas Fracking and the Nigerian Gas Export Project

There is every good reason for Nigeria to embark on shale gas fracking. Shale gas fracking in Nigeria will enhance its Algerian-Niger Republic Saharan, and Moroccan gas supply chain to Europe.[107] It will also sustain its domestic gas supply chain.[108] Therefore, a robust fracking regime will again, encourage companies that specialized in fracking, and who might want to invest in the fracking business, have a template to operate upon. Most especially, a robust regime for fracking will help to minimize the health and environmental risks associated with unregulated fracking.

4.0 Fracking Legal Framework and Experiences in Other Jurisdictions

4.1 Fracking Practice and Experience in the United States of America

The US started fracking as far back as 1949, which, by the year 2013, about two million oil and gas wells, making about 95 percent of the wells were been hydraulically fractured across US.[109] About 45 percent of US crude oil production comes from fracking, while fracking also Smakes 67 percent of natural gas production.[110]

In the US, although Congress have power to regulate fracking activities under the Commerce Clause, of the US' Constitution,[111] the States however, have power to decide whether or not to have law on fracking at the State level. This means that the governors of the various States in the US have power to, or not allow fracking in the US.

The US oil and gas fracking industry has been visited by numerous challenges of protests over doubts about the safety of fracking technology.[112]

On the 16th day of September 2009, there were two chemical spills in Dimock, Pennsylvania from fracking operation at the Marcellus shale by Cabot Oil and Gas Corporations.[113] The spill was due to failure of pipe connections. It resulted to spilling about 8000 gallons of fracturing fluid containing chemicals into a nearby creek. As a result, government placed fine of $56, 650 on Cabot oil and gas corporation.[114] This was followed with an order not to carry out any other fracking operations until the spill is properly cleaned up.[115] Also, the Macondo blowout leading to loss of lives, was as a result of drilling equipment, well design, well construction and testing inadequacies.[116] This occasioned series of protest across the US.[117]

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[107] D Onyango, 'The Proposed Nigeria-Morocco Pipeline Could Provide Gas to Europe' (2022) *Journal of Pipeline Technology*, 75.
[108] Petroleum Industry Act 2021, s. 109; 110.
[109] C T Montgomery and M B Smith, 'Hydraulic Fracturing: History of an Enduring Technology' (2010) [62] (12) *Online Journal of Petroleum Technology*, 26.
[110] U.S Department of Energy, 'How Shale is Produced' 2013 Energy Report.
[111] Constitution of the United States of America, 1789 as amended, art 1, s.8, cl. 3
[112] I Urbina, 'A tainted Water Well and Concern: There May be More' *The New York Times* (3 August 2011).
[113] J Hurdle, 'Penn Charges Cabot with Natgas Chemical Spills' *REUTERS* (22 September 2009) 30.
[114] *Ibid.*
[115] J Hurdle, 'Pennsylvania Fines Cabot Over Drilling Spills' *REUTERS* (22 October 2009) 43.
[116] National Academy, *Macondo Well Deepwater Horizon Blowout: Lessons for Improving Offshore Drilling Safety* (National Academies Press, 2011).
[117] Urbina, (n109).

As a result of the protest across US, states such as New York, through executive order, ban fracking in 2010; Vermont in May 2012; Maryland banned fracking in 2017; and Washington, in 2019.[118] Propelled by the series of protests and ban of fracking across many states in the US, the federal government set up a committee to find out the environmental impact of fracking, as well as the effect of the ban on US economy, and come up with a report.

4.1.2 Report on the Effects of Fracking moratorium on the US Economy

Due to the protests and the corresponding banning of fracking by some states in the US, the US' government carried out investigation on the practice and safety of fracking. The report was submitted on January 2021. The main content of the report is divided into five sections. Each of the sections provides insights and analysis in support of the findings. It is pivotal, for purposes of comprehensive understanding, to reproduce the report overview and the findings.

Section II of the report was on the evolution of the United States Energy Markets since 2005, which states that in 2019, the United States produced 4.5 billion barrels of crude oil and 34.0 Tcf of natural gas, which represented increases of 137 percent and 88 percent, respectively, from 2005 levels.

The use of horizontal drilling coupled with hydraulic fracturing to develop low permeability oil and natural gas reservoirs has allowed the United States to reverse its dependence on oil and gas imports. For the first time in history, the United States became a net exporter of natural gas in 2017. In 2019, natural gas exports reached a record high of 4.66 Tcf exported to 38 countries.

The net imports of petroleum products, like gasoline and diesel, reversed direction from 2005 to 2019 with the United States becoming a net exporter of petroleum products in 2011 and increasing net exports to more than 1.1 billion barrels in 2019.

It further revealed that the increased domestic oil and natural-gas supply has put downward pressure on consumer prices for gasoline and natural gas. In 2019, gasoline and diesel prices were 40 percent and 38.3 percent lower, respectively, compared to 2012, and average end-user prices for natural-gas fell 24.3 percent in 2019 from 2008 levels.

The electric power generation sector has been the principal driver of domestic natural-gas consumption growth, accounting for 59.3 percent of the total natural-gas demand increase in 2019 from 2005 levels. A considerable shift has taken place in electric power generation, with natural-gas generating 38 percent of the nation's power in 2019 compared to 19 percent in 2005. The shift in the power generation fuel mix caused a significant reduction in NOx; SO2; and CO2 emissions, with emissions of these compounds tied to the electric power sector, falling about 76, 91, and 30 percent, respectively, below 2005 levels.

Like the UK, there was also a ban on fracking in the U.S. As a result, the U.S Government formed a committee to investigate the impact of the ban on the economy.[119] The report found that, by 2025, the U.S

[118] P Wood, 'Maryland General Assembly Approves Fracking Ban' *Baltimore Sun* (Baltimore, 27 March 2017).
[119] D Brouillette, Economic and National Security Impact Under a Hydraulic Fracturing Ban <https://www.energy.gov> accessed May 8 2023.

will lose about 7.7 million jobs; 1.1 trillion less in gross domestic product (GDP); and $950 billion less in labour income.[120]

Section III of the report was on Energy Market Impacts of a Hydraulic Fracturing Ban, 2021–2025. the report found that if a ban on high-volume hydraulic fracturing were to occur starting in 2021, natural gas production would decline, and the United States would reverse the trajectory that has led to it becoming a major global liquefied natural gas (LNG) exporter and once again become a net importer of natural-gas by 2025.

Crude oil imports would also rise by 2025, as United States crude-oil production would be removed from international markets and the United States would return to reliance on imports from foreign nations for the crude-oil inputs to domestic refineries.

The oil and natural gas price increases under a hydraulic fracturing ban scenario would be considerable. As of December 24, 2020, current prices are $48.23 per barrel for West Texas Intermediate (WTI) crude-oil and $2.68 per Metric Million British Thermal Unit (MMBtu) for Henry hub natural gas. With a ban on high-volume hydraulic fracturing, WTI crude-oil prices would peak at $130.20 per barrel in 2023 before stabilizing at $93.2 per barrel in 2025. By 2022, the national benchmark Henry Hub price would rise to $6.17 per MMBtu, a level not reached since 2008, and further to $8.80 per MMBtu in 2025.

Under a hydraulic fracturing ban, the high price of natural gas would significantly shift overall power generation and patterns of new builds by 2025. Power generation fuelled by natural-gas would fall from nearly 40 percent of United States electric power generation in the business-as-usual Base Case for 2021 to only 14 percent in 2025 under the hydraulic fracturing ban scenario.

Changes to the power generation fleet and fuel prices would increase average wholesale power prices across all markets from a low of $16.07 per megawatt-hour (MWh) in the Southwest Power Pool (SPP) to a high of $33.34 per MWh in the Electric Reliability Council of Texas (ERCOT).

Emissions of NOx, SO2, and CO2 rise in the first year of a hydraulic fracturing ban, and would increase 17, 62, and 16 percent, respectively, due to fuel generation mix changes where coal replaces natural gas.

Consumers across all segments of the economy would bear the impacts of a hydraulic fracturing ban through higher electricity and natural gas costs. Retail electricity costs would increase by more than $480 billion between 2021 and 2025, and retail natural-gas costs would increase by more than $400 billion between 2021 and 2025.

Consumers would face higher gasoline and diesel costs if hydraulic fracturing were banned. Annual average gasoline prices would increase over 100 percent to over $4.20 per gallon in 2022 and 2023, and annual average diesel prices would increase 95 percent to $4.56 per gallon in 2022. Higher prices for gasoline,

[120] D Brouillette, Economic and National Security Impact Under a Hydraulic Fracturing Ban <https://www.energy.gov> accessed May 8 2023.

diesel, and petroleum products would amount to $1.9 trillion in additional, cumulative costs from 2021 to 2025 across all sectors.

Section IV of the report focused on the Macroeconomic Impacts of a Hydraulic Fracturing Ban, 2021–2025, which reveals that the economy would experience a significant upset due to a hydraulic fracturing ban, derailing the recovery from pandemic-driven economic disruptions and increasing the risk of another recession in the early 2020s. Job losses, reductions in GDP, and lost wages and reduced labour income would significantly increase economic hardship for millions of Americans. With a high-volume hydraulic fracturing ban, the United States would see 7.7 million fewer jobs and a $1.1 trillion reduction to GDP by 2025 as decreased energy production has a direct impact on oil and natural-gas sector employment and increased energy costs negatively impact the economy more broadly as industries deal with the higher energy costs.

The domestic job losses and GDP reductions would be immediate and significant in 2021 relative to the Base Case, with 3.2 million fewer jobs (1.6 percent lower) and a $400 billion contraction to GDP (2.0 percent lower than otherwise projected).

Therefore, a hydraulic fracturing ban would have a contractionary effect on the wages and other compensation paid to American workers. By 2024, Americans would experience $667 billion in lost wages, $105 billion in lost fringe benefits (mostly health insurance and their employers' contributions to private savings), $49 billion in lost employer-paid contributions to Social Security and Medicare, and $188 billion in proprietors' income.

Section V bordered on the National Security Impacts of a Hydraulic Fracturing Ban, which detailed that, amid falling domestic crude oil and natural-gas supply, the analysis forecasts diminished US energy security due to increased reliance on Middle Eastern and Russian energy supplies. A decrease in LNG and crude oil exports would weaken geopolitical standing globally and take away an important diplomacy tool. Countries in Europe, Asia, and Latin America would be unable to source oil and natural gas from the United States and would turn to alternative producers. Furthermore, if options in the United States are limited, oil and gas companies would likely be keen to invest in oil and gas production in foreign countries.

Section VI focused on Further Potential Impacts due to hydraulic fracturing ban: The cost of products that are essential elements of everyday modern American life and the rely on domestic production of oil and natural gas; including fertilizers that increase crop yields; advanced light-weight plastics to improve vehicle fuel efficiency and safety; and life-saving medical products would be impacted.

Banning high-volume hydraulic fracturing, thereby drastically reducing domestic oil and natural-gas production, would have adverse impacts on renewable technology development both in terms of manufacturing costs and ensuring a reliable electricity grid. Many university endowments; education funding; and States and Local budgets are tied directly to oil and natural gas production severance taxes; fees; lease royalties; and State income taxes. Drastically reducing production volumes will decrease these taxes; fees; and royalty revenues and create significant budget gaps to be filled likely through increases in other taxes.

A critical analysis of the report reveals obviously where US' Government interest might rely especially concerning national economic grounds and job creation, as US may neither want to depend on oil and gas importation, nor allow the economy to dwindle down toward recession in the wake of threatening global economic challenges.

Another influence that appears a formidable force that may compel US to approve fracking again is the Russian invasion of Ukraine and the ban on Russian gas, which has caused a global hike on energy price in the international market that leads to fracking been seen as the solution to U.S energy scarcity.[121]

Acknowledging that the ban on Russia's gas is affecting the U.S oil and gas supply as one of the major importers from Russia, the Republican and Conservative are driving hard to see that the ban of fracking is reversed in the United States of America.[122]

4.2 Fracking Practice and Experience in the United Kingdom

The United Kingdom (UK) started fracking since in the early 1970s, with fracturing of the conventional oil and gas fields near the North Sea.[123] Hence, by 1980s, fracking has been applied in about 200 British onshore oil and gas wells.[124] Therefore, fracking is not new to the United Kingdom.[125] David Cameron, the former Prime Minister of UK said in 2014 that, fracking for shale gas in the UK have the potentials of meeting all UK gas needs for 30 years,[126] and that Britain is going all out for fracking.[127]

As a result, incentives packages were slated for communities within fracking sites.[128] The UK government was very decisive on fracking that it also offers incentives (lobby) to local councils to accept fracking.[129] The initiative to promote fracking in the UK propelled UK government to enact the Infrastructure Act 2015,[130] as an addition to the 1998 Petroleum Act,[131] which now provides for legal procedure to obtain license for hydraulic fracturing.[132]

Fracking technology did not attract much attention until licences were awarded for onshore shale gas exploration in 2008.[133] But fear of environmental concerns over fracking activated a wide protest against

[121] R Leber, 'America Cannot Solve its Gas Price (Or Russia Problem) with Drilling' *Vox* (5 March 2022).
[122] *Ibid*.
[123] R Mair, 'Shale gas extraction in the UK: A review of hydraulic fracturing' (2012) *The Royal Society and the Royal Academy of Engineering*, 19.
[124] *Ibid*
[125] S Weiss, 'What Is Fracking? Your Need To-Know Guide To Fracking In The UK' (2019) *Journal of Environmental pollution* <https://www.wired.co.uk> accessed 10 March 2022.
[126] P Wintour, 'Fracking Opponents are Being Irrational, Says David Cameron' *THE GUARDIAN* (London, 14 July 2014) 78.
[127] A Vaughan, 'Fracking Incentives will Give Councils Contradictory Roles' *THE GUARDIAN* (London, 13 January 2014) 97.
[128] F Harvey and D Carrington, 'Fracking Communities Should Get Incentives, Says Minister' *THE GUARDIAN* (London, 18 March 2013) 140.
[129] F Noble, 'UK Offers Local Councils Incentives to Accept Shale Gas Drilling' *REUTERS* (London, 13 January 2014).
[130] Infrastructure Act 2015, s.50.
[131] Petroleum Act 1998, s. 4 (a).
[132] BEIS, 'Guidance Note on Fracking: Developing Shale Gas in the UK' *BEIS publication*, 2019).
[133] *Ibid.*

fracking in the UK.[134] Especially, its impact on the local communities.[135] The protest led to placement of temporary moratorium on fracking in the UK.[136] However, the UK government is reviewing its laws to relax the moratorium because of the oil boom in the US as a result of fracking. The reviewed version of the UK's petroleum law is filled with lots of incentives to encourage host communities and the public to accept fracking.[137]

The fracking moratorium placed by UK government in November 2019 was on grounds that it was difficult to predict tremors associated with fracking technology.[138] As a result, fracking companies were to decommission already hydraulically fractured fields by 2022.[139]

However, because of the EU's sanction on Russian oil and gas, the UK government is forced to reconsider fracking as the solution to ease oil and gas scarcity in the country.[140] This will lead to the lifting of the 2019 moratorium on fracking in the UK.[141] This is because, although some are opposed to fracking, shale gas is seen by many countries as the future source of affordable energy, with the estimated potentials reserves capable of adding about 7299 trillion cubic metres to the conventional gas in the global market.[142]

4.3 Fracking Practice and Experience in Algeria

The Algerian petroleum industry has evolved tremendously through innovations and better legal framework for the industry. These include Law 05-7 enacted in April 2005, which was later amended by the Ordinance 06-10 of 2006; and Law 13-01 of 2013. It is referred to as the Hydrocarbon Law, that gave Sonatrach the major shareholding in all petroleum exploration and production activities in the country.[143]

Algeria has contemplated fracking into its petroleum laws for shale development. The term "unconventional hydrocarbon was for the first time introduced into the new Hydrocarbon Law of 2013. It defines the concept of unconventional hydrocarbon and provides incentives. The law thus initiated a favourable regime for unconventional hydrocarbons than for conventional hydrocarbons. Article 5, Hydrocarbon Law 2013, provides for five different unconventional hydrocarbons depending on their formation, existence and characteristics.

These include:

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[134] J Cooper and Others, 'Shale Gas: A Review of the Economic, Environmental and Social sustainability' (2016) [4] *Energy Technology*, 772.
[135] J Cooper and Others, 'Social Sustainability Assessment of Shale Gas in the UK: Sustainable Production and Consumption' (2018) [14] *Energy Technology*, 1.
[136] *Ibid*.
[137] The Crown, 'Autumn Statement 2013' (London, HM Treasury 2013).
[138] J Lawless, 'As Ukraine War Squeezes Energy, UK Looks Again at Fracking' *A P News* (5 April 2022)
[139] A Reid, 'Unconventional Gas in Scotland' (2013) *SPICe Briefing*, 68.
[140] Cooper and Others, (n19).
[141] J Lawless, 'As Ukraine War Squeezes Energy, UK Looks Again at Fracking' *A P News* (5 April 2022).
[142] J Cooper and Other, 'Economic Viability of UK Shale Gas and Potential Impacts on the Energy Market up to 2030' (2018) [215] *Applied Energy*, 577.
[143] J Entelis, *Algeria: Democracy Denied and Revived* in North Africa's Arab Spring ed (London: Routledge 2014) 161.

1. compact reservoirs with average matrix permeability equal to or less than 0.1 millidarcies or that which can only be produced from a horizontal well or by multi-stage fracturing;
2. Clay or Shale formations with little or no permeability that can only be produced from horizontal well or multi-stage fracturing;
3. Geological formations containing hydrocarbons of which the viscosity exceeds 1000 centipoises or density but lower than 15degree Celsius American Petroleum Institutes (API);
4. High pressure and high temperature reservoirs of which the pressure and temperature meet the following criteria: bottom-hole pressure equal to or greater than 650 bars, bottom-hole temperature above 150 degrees Celsius;
5. Natural gas or coal bed methane (CBM) located in the micropores of coal beds located deep underground that have either not yet been mined or incompletely mined. Coal bed methane absorbed into the solid matrix of coal through a process known as adsorption. This natural gas distinguishes itself by the use of unconventional extraction methods such as a decrease in pressure.

Algeria again contemplates the peculiarities of fracking under the Executive Decree 13-436 of 2013. Article 8 provides that "the geological subdivision takes into consideration the intrinsic characteristics of the petroleum target revealed through the prospecting or exploration for hydrocarbons", including "the nature of hydrocarbons it contains". Article 6 is in relation to the delineation and breakdown of the mining estates into zones, and defines the prospecting, exploration and production perimeters as supplement to Article 8.

The Decree also differentiates between the three types of geological formations: conventional reservoir; unconventional reservoir; and other complex entities. As a result, the perimeters for unconventional reservoir are larger than the conventional ones during national calls for tenders. Again, Law 13-01 of 2013 which modifies the Hydrocarbon Law differentiates the duration of contracts between unconventional and conventional reservoirs. Article 35 of the Hydrocarbons Law as modified in 2013, did extends the duration for exploration and production phases for unconventional to 11years as opposed to 7years for conventional reservoirs.

Concerning production phase contract, it was extended to 30years for unconventional oil and 40years for unconventional gas as opposed to 25years for the production of conventional ones.

4.3.1 Algerian Fracking Tax Regime and Regulators.

There is also a tax regime for unconventional hydrocarbon in Algeria. Law 13-01 introduced a more favourable and advantageous tax regime for the unconventional hydrocarbon production. Article 83, Hydrocarbon Law (as modified in 2013), gives a lesser tax rate for unconventional hydrocarbon-related operations. The tax rate for unconventional hydrocarbon-related activities is reduced under the law to 5percent as opposed to 23percent for conventional hydrocarbon-related operations.[144]

[144] Hydrocarbon Law (as modified in 2013), art. 85.

Article 11 provides for, and vests power on the Council of Ministers to have regulatory control over all matters relating to unconventional hydrocarbon activities. All hydrocarbon exploration and production operations must be approved by a decree of the Council of Ministers.[145]

The Hydrocarbon Law (as modified in 2013), also introduced other bodies with responsibilities in addition to the Council of Ministers. These include the National Agency for the Valorisation of Hydrocarbon Resources been acronymized as (ALNAFT); and the Hydrocarbon Regulatory Authority (HRA).[146] The HRA is directly responsible in ensuring compliance with regulations concerning hygiene; industrial safety; environment; and risks management amongst others.[147] On the other hand, the ALNAFT's duty include: assessing petroleum resources; promotion of investment; granting of prospecting permits; initiation of calls in respect of competitive bidding in conjunction with Sonatrach. Therefore, the ALNAFT is an upstream activities-based body hence, responsible for the monitoring of chemicals relating to fracking processes in Algeria.[148]

4.3.2 Algerian Fracking and Environmental Protection Awareness

Article 17 of the Hydrocarbon Law (as modified in 2013) provides for the HRA to use specialized monitoring companies to manage the risks from fracking chemicals activities to safeguard the environment. Article 18 also provides for environmental impact study for all the petroleum fracking operations. This makes Algeria's petroleum law one of the best in Africa having robustly provided for fracking and in particular, environmental concerns from fracking activities.

Algeria has an express and robust regime for fracking, It is also important to note that while Algeria has fracking tax regime, there is no spelt out tax specifically for fracking in Nigeria. Algeria has a specific body that regulate fracking. But it is implied that the Commission may regulate fracking in Nigeria having impliedly added fracking to the interpretation section of the PIA 2021. This is because, fracking is an upstream petroleum operation activity, and the Commission regulates upstream petroleum operations. Therefore, Nigeria has a lot to learn from the Algerian fracking regime.

4.4 South African Fracking Plan and Experience

The South African energy source used to be 90percent dependent upon coal, and it is running out of coal-energy. Hence, it has decided to go into shale gas fracking to sustain its energy.[149] Pursuant to the South African Mineral and Petroleum Resources Act of 2002, the Department of Mineral Resources proposed the Petroleum Exploration and Exploitation Regulation 2013, to regulate the South African petroleum industry.[150]

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[145] *Ibid*, art. 23.
[146] *Ibid*, art. 13.
[147] Hydrocarbon Law (as modified in 2013), art. 13.
[148] *Ibid*.
[149] H R Bohlman and Others, 'Regional Economic Effects of Changes in South Africa's Electricity Generation Mix' (2018) *Economic Research Southern Africa Working Paper 756*, 1-20.
[150] G Chapman and Others, 'The Governance of Shale Gas Production in South Africa' (2016) [23] (1) *South African Journal of International Affairs*, 69.

Regulation 29 (1) provides for the disclosure of fracking fluid. Hence a fracking firm must reveal the fluids and its status, whether hazardous or non-hazardous substances; material safety data; volume of fracking fluid, and its chemical additive; trade name of the additive and its purpose in fracturing process; possible risk of each chemical on the environment; and required remediation in case of any pollution.

Regulation 31 (1) (a) is to the effect that each chemical ingredients and additive characteristics must be identified in other to mitigate environmental and health risks. Regulation 31 (3) (b) further requires for the training and development of relevant employees on procedures to effectively handle fracking chemicals. Regulations 23 (1); 49 (1); and 6 (1) - (10) requires that before fracking operations take place, the risk of potential fracking-connected seismicity must be assessed and a report on it be submitted to the proper authority. Regulation 36 requires the submission of any post-fracking report to the designated authority. This is South African established regulations for fracking.

However, South Africa is a water stressed region.[151] Main-while, the Karoo oil and gas discovery is of shale rock formation, requiring huge amount of water.[152] Fear of water stress caused fracking opposition.[153] Hence, fracking in South Africa also met series of protest leading to a moratorium.[154] The protest was due to fear of ground-water contamination emanating from fracking chemicals.[155]

Nonetheless, the South African government has lifted the moratorium and approved fracking for the development of its shale oil and gas.[156] Therefore, Nigeria need not sit back without reconsidering a robust regime on fracking to revolutionize the country's petroleum sector. Hence, a robust regime on fracking in Nigeria ought to commence by reviewing the PIA 2021, or through a separate legislation and an uncompromised Regulation on fracking.

The South African government contemplation of fracking is clear indication that Nigeria can through a rich and concise legal framework, also successfully move into the fracking transition.

4.5 Brazilian Fracking Plan and Experience

Brazil is not left out on the fracking migration trend, as it has announced its plan to develop its shale reserves.[157] Some are with the opinion that it is important for laws and regulations to place a requirement directing the shale oil and gas development and production companies to disclose the amount and types of chemicals used on a particular oil field.[158] Others have added that there should be a preliminary hazards

[151] D W Oliver and Others, 'Making Effective Use of Groundwater to Avoid Another Water Supply Crisis in Cape Town South Africa' (2019) [27] *Hydrogeology Journal*, 828.
[152] J De wit, 'The Great Shale Debate in the Karoo' (2011) *South African Journal of Science*, 201 – 207.
[153] P Hobbs and Others, *Shale Gas Development in Central Karoo: A Scientific Assessment of Opportunities and Risks* in R Scholes, P Schreiner, G Snyman-Van der Walt and M de Jager (eds) (Council for Science and Industrial Research 2016) 97.
[154] M Jorritsma, 'Don't Frack with our Karoo' (2012) (3) *Journal of South African and American Studies*, 3 – 9.
[155] S Blaine, *Fracking Chemicals will put Karoo Water at Risk: Says UK Envoy* (DBFM Publishers, 2014) 27.
[156] S Artel, *South Africa Lifts Moratorium: Citizens Alarmed by U.S Fracking Examples* (Johannesburg: AlterNet, 2012) 24.
[157] F Pierry, 'Q&A: Brazil to Offer Incentives for Shale Exploration' *Argus Midea Group* (Brasilia, 11 January 2022).
[158] L Alexis and Others, 'Disclosure of Hydraulic Fracturing Chemical Additives: Analysis of Regulations' (2013) [23] (1) *New Solutions*, 167.

assessment test on the chemicals before use.[159] It is argued that, some of the chemicals that are given a compound name contain many kinds of chemicals hazardous to the environment, which is not revealed by the chemical industry.[160] Irrespective of the many opinions surrounding fracking, Brazil's government appears to have concluded that shale development is acceptable in the country.

Whatever is the case, the contemplation of fracking by Brazilian government, increases the hope that Nigeria can through a robust fracking regime, also delve into the fracking trajectory successfully.

4.6 Saudi Arabian Fracking Plan and Experience

Triggered by the discovery of oil by the Anglo-Persian Oil Company in the mountain of north-western Persia in 1908, and the high demand of oil during World War 1, Saudi Arabia decided to explore for oil.[161] In 1923 oil exploration concession was signed in Saudi Arabia.[162] As a result, crude oil was first struck in Saudi Arabia on March 3rd 1938 at a depth of 1,440 metre at the Dammam oil field, in what is now modern day Dharan.[163] Saudi Arabia is said to possess 17 percent of the world's proven petroleum reserves, with oil and gas sector accounting for about 50 percent of the gross domestic product (GDP), and 70 percent of export earnings.[164]

The Middle East is the world largest possessors of oil and natural-gas trapped in carbonate formation.[165] Carbonate formation holds 60 percent of world crude oil and 40 percent of the world gas reserves.[166] And Saudi Arabia is rated as the fifth largest holder of shale gas reserves in the world.[167] As a result, the Saudi Aramco awarded $10 billion contract for the development of shale in the Jafura gas field with a view to assuming third position in the world on natural gas production by 2030.[168]

It is important to also add that, concerning the Saudi Arabia's estimated oil and gas reserves, some critiques hold the opinion that Saudi Arabia has been exaggerating its reserves over the years in order to create importance for itself in the global oil and gas power.[169] The critique was premised on the ground that in 1989, Saudi Arabia claimed to have a proven reserve of 170 billion barrels. And a year later, without discovery of new oil fields, the official estimate increased by 51. 2 percent to 257 billion barrels.

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[159] Y Abid, 'Reflection on Shale Gas Fracking Assessment and Management in the United States' (2020) [11] (1) *Washington Journal of Environmental Law and Policy*, 8.

[160] T S William and others, *Comparison of Chemical-use between Hydraulic Fracturing, Acidizing and Routine Development* (PloS ONE, 2017).

[161] M Q Morton, In the Heart of the Desert: The Story of an Exploration Geologist and the Search for Oil in the Middle East (Green Mountain Press, 2006) 89.

[162] *Ibid.*

[163] National Geographic, 'March 3 1939: Oil Discovered in Saudi Arabia' (2022) <https://www.nationalgeographic.org> accessed June 4 2022.

[164] OPEC, Saudi Arabia <https://www.opec.org> accessed 4 June 2022.

[165] A Zaleski, 'Technology for Saudi Fracking Boom Moves Closer to Reality' (2015) *CNBC LLC*, 12.

[166] *Ibid*.

[167] M Glackin, Saudi Arabia's $100bn Plan to Become Largest Shale Gas Producer Outside of the US' *ARAB NEWS* (1 December 2021).

[168] *Ibid*.

[169] S Watkins, 'Is Saudi Arabia Exaggerating its Oil Production Potentials?' *Oil Price* (4 July 2022).

Shortly after that, it increased again to over 266 billion barrels and 268 billion in 2017 with constant pumping of an average 8.192 barrels of oil per day (bpd) since 1973.[170] Therefore, using 1989 estimation of 170 billion barrels reserves of crude oil officially claimed, and acknowledging that Saudi Arabia has constantly pumped such barrels of crude oil since 1973 without new oil field discoveries means that, Saudi Arabia has pumped and removed about 95, 682, 560, 000 barrels of crude oil from its fields. However, instead of the reserve going down, Saudi Arabia keep claiming increase of its oil and gas reserves which critique sees as "mathematical impossibilities".

The critique of Saudi Arabia's oil reserve exaggeration appears to be correct based on the fact that Saudi Arabia's national oil and gas company ARAMCO has awarded a contract contemplating developing its shale oil and gas by employing the oil industry's globally trending technology (hydraulic fracturing) to increase production capacity.[171] Although it is focused on shale oil and gas development, it may be that Saudi Arabia is actually running low in production of conventional crude oil, and requires fracking to increase production to sustain its balance and claims.

Whether Saudi Arabia's oil and gas reserves claim is exaggerated or not is not an issue. What is in issue is the fact that Saudi Arabia is equally delving into hydraulic fracturing to develop its shale gas endowment to increase production. It shows that the oil and gas industry is globally transitioning into hydraulic fracturing, and Nigeria can through a robust fracking regime, delve into the fracking trajectory successfully.

4.7 Comparison of Fracking Regime Between Nigeria and Other Jurisdictions

Under the common law of England and Wales, all mines and minerals under the soil of a portion of land belongs to the landowner.[172] However, the decision of the court in *R v the Earl of Northumberland*,[173] changed the common law practice. The court ruled that, minerals such as gold; silver; and presumably, oil and natural gas under the earth belong to the Crown. Hence, the pronouncement of the court influenced the Petroleum (Production) Act 1934,[174] concerning ownership of minerals in the UK. The statute gave the Crown power to determine the terms and conditions over oil and gas as it deemed fit.[175] Consequent to that, the Petroleum Act 1998 also vests ownership of petroleum in the Crown (His or Her Majesty) in the United Kingdom.[176]

Therefore, ownership of petroleum in the United Kingdom is vested in the Crown pursuant to section 1 (1) of Petroleum (Production) Act 1934, and section 2 (1) of the Petroleum Act, 1998 The United Kingdom Petroleum Act 1998, did not provide for fracking. However, fracking is robustly provided for under the Infrastructure Act 2015 as a separate legislation.[177]

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[170] S Watkins, *The Great Oil Price Fixes and How to Trade Them* (Amazon Inc, 2015) 120.
[171] Glackin, (n164).
[172] T Hunter and S Latta, Shale Gas Licensing in The United Kingdom in T Hunter (ed), *Handbook of Shale Gas Law and Policy: Economics, Access, Law and Regulation in Key Jurisdictions* (Intersentia Ltd 2016) 172.
[173] R v Earl of Northumberland (1568) Plowden 310.
[174] Petroleum (Production) Act 1934, s. 2 (1).
[175] *Ibid*, s. 2 (2)
[176] Petroleum Act 1998, s. 2 (1).
[177] Infrastructure Act 2015, s. 43, 50.

On the contrary, there is no separate robust regime for fracking in Nigeria. And under the PIA 2021, fracking may only be implied by virtue of the meaning of upstream petroleum operations under the interpretation section.[178] With regards to ownership of petroleum both conventional and unconventional is vested in the Federal Government of Nigeria. There, is a convergence between Nigeria and the United Kingdom with respect to ownership of conventional petroleum. However, petroleum in shale deposits, which requires heat and distillation before extraction is not vested in the Crown, in the United Kingdom.

Therefore, while ownership of petroleum both in conventional and unconventional (shale) deposits is vested in the federal government in the case of Nigeria, unconventional (petroleum in shale deposit) is not vested in the Crown, in the United Kingdom. This is the point of divergence between the UK and Nigeria, with respect to ownership of petroleum in shale composition or formation.

In order to understand the rights to petroleum vested in the Crown, it is important to know the meaning of petroleum in the United Kingdom.

Section 1 of the Petroleum Act 1998 provides: In this part of the Act "petroleum" means-

(a) Includes any mineral oil or relative hydrocarbon and natural gas existing in its natural condition in strata; but
(b) Does not include coal or bituminous shale or other stratified deposit from which oil can be extracted by destructive distillation.

Section 2 of the Act vests petroleum in the Crown. It provides:

(1) Her Majesty has the exclusive right of searching and boring for and getting petroleum, to which this section applies.
(2) This section applies to petroleum (including petroleum in Crown land) which for the time being exists in its natural condition in strata in Great Britain or beneath the territorial sea adjacent to the United Kingdom.

Looking at section 1, which explains the meaning of petroleum as relative hydrocarbon existing in its natural strata, exempting bituminous shale or other stratified deposits; and section 2 (2), which vests only petroleum existing in its natural condition in strata in the Crown shows that, petroleum in shale is not vested in the Crown in the United Kingdom.

Another similarity between Nigeria and the United Kingdom is the creation of institutions to handle the petroleum sector. What the Commission,[179] and the Authority,[180] are for Nigeria, the Oil and Gas Authority (OGA); and Department for Business, Energy and Industrial Strategy (BEIS) are for the United Kingdom petroleum sector.[181]

[178] Petroleum Industry Act 2021, s. 318.
[179] *Ibid*, s.4 (1).
[180] *Ibid*, s. 29 (1).
[181] Energy Act 2016, s. 1 (1).

The difference though, is that, while the Energy Act did not allow OGA to make orders; rules, regulation; or any other subordinate instrument in the United Kingdom,[182] the PIA 2021, allows the Commission,[183] and the Authority,[184] to make regulations for the upstream, and the midstream and downstream petroleum operations in Nigeria respectively.

In the United States however, there is an individual ownership of petroleum, if the petroleum is in his or her property or land. It means that petroleum in shale deposit can also be owned by an individual, if it is on his or her property or land. On the other hand, power to make regulation for fracking is conferred on the State government. Therefore, although the United States' Congress, pursuant to the Commerce Clause in the Constitution, have power to regulate oil and gas on Government land, fracking is exempted from all Federal Statutes.[185]

This is because, the actual regulation of oil and gas including fracking and its process is largely the responsibility of the State.[186] Therefore, every State has the statutory power to either allow or prohibit fracking in the United States of America.[187] Hence, while ownership of petroleum resources is vested in the Government of the Federation in Nigeria, and in the Crown in the United Kingdom, individual could own petroleum in the United States.

It is important to note that, while only an Act of the National Assembly and the House of Lords can provide for petroleum operations in Nigeria and the UK respectively, States have power to make laws to regulate petroleum operations, including fracking operations, in the US.

As a result, the oil and Gas Conservation Act (OGCA) is the primary statute for oil and gas development in the State of Colorado.[188] The Act established, and gave power to the Colorado Oil and Gas Conservative Commission (COGCC) to regulate petroleum operations, including fracking in the State of Colorado.[189]

Due to the fact that control and regulation of petroleum is the responsibility of the States, the then Governor of New York David Patterson, issued an executive order to ban fracking operations in 2010.[190] Therefore, States such as Louisiana; Texas; and Pennsylvania among others have different petroleum laws and governing institutions.[191]

[182] *Ibid*, s. 2 (5).
[183] Petroleum Industry Act 2021, s. 4 (3); s.6; s.7; s. 8; s. 9; s. 106 (2).
[184] *Ibid*, s. 32; s. 106.
[185] R L Kosnik, The Oil and Gas Industry's Exclusion and Exemption to Major Environmental Statutes (2007) <https://www.earthworksaction.org/pubs/PrtoleumExemption1c.pdf > accessed 15 May 2023.
[186] W J Brady, Hydraulic Fracturing Regulation in the United States: The Laissez-Faire Approach of Federal Government and Varying States Regulations (Colorado: Grimshaw & Harring P.C 2015) 20.
[187] Ibid.
[188] Oil and Gas Conservative Act, s. 30.
[189] Ibid, s. 34 (2) (d).
[190] Brady, (n183).
[191] Ibid.

4.8 Evaluation of Fracking Pollution litigations and the Lesson for Nigeria

Fracking is known to have serious environmental and health risks if not properly managed and well regulated.[192] There are many reports over ground-water; rivers and air contamination and poisoning emanating from fracking activities.[193] Therefore, without a robust regime, fracking for shale oil or gas in the frontier basins, might cause pollution that will lead to litigations.

Lack of robust regime could warrant the court to dismiss the suits for want of merit because, it is difficult to prove causation of ground-water contamination or air poisoning emanating from fracking. Hence, in *Evenson v Antero Resources Corp*,[194] a class action alleging that the defendants drilling and exploration activities exposed their properties to hazardous gases and fracking chemicals was brought before the court. The plaintiffs' cause of action bothers on negligence; medical monitoring; among others. But the Denver County District Court in Colorado dismissed the suit, stating that, the plaintiffs failed to plead injury to their properties because their claim was based on speculation.

Lack of robust regime will also cause the courts in Nigeria to be faced with the difficult task of assessing the right of parties in a situation where the cause and extent of environmental harm is not ascertained.[195] What would have guided the reasoning of the courts to an extent is express provision of fracking under the PIA 2021, or in a separate legislation with fracking regulations.

The absence of it will cause serious health challenges to Nigerians and its environs. As a result, it will give rise to protests and consequently, litigations that will inevitably impede and hamper the progress of shale oil and gas, or fracking operations and production. This will also create misunderstanding between the oil and gas operators and the local host communities that may culminate into oil and gas facilities vandalization.

In the United State case of *Matter of Wallach v Town of Dryden*,[196] the court ruled that the local authority have the right to ban fracking activities in order to preserve their community, small towns, character, health and environment from destruction. This was in accordance with the municipalities' home rule authority to regulate land-use in adoption of the zoning ordinances. The court decision was however, made possible because in the U.S, local authority have power over land.

However, in Nigeria where land is under the power of the state, and oil and gas under the control of Federal Government,[197] it will be impossible for the court to arrive at such decision. There is however, a contrary court ruling on the same subject matter. In the case of *State Ex. Rel. Morrison v Beck Energy Corporation*,[198]

[192] J E Johnson and Others, 'Wastewater Disposal Wells and Fracking: Environmental Injustice in Southern Texas' (2016) American Journal of Public Health, 192.
[193] R Nathaniel and Others, 'Impacts of Shale Wastewater Disposal on Water Quality in Western Pennsylvania' (2013) [47] (20) Environmental Science Technology, 11849.
[194] (2011) No. 5118/CV.
[195] M Nakamichi, 'The International Court of Justice Decision Regarding the Gabcikovo-Nagymaros Project' (1998) [9] (2) *Fordham Environmental Law Journal*, 337, 364.
[196] (2014) N.E 3d, N.Y Slip Op. 04875.
[197] Constitution of the Federal Republic of Nigeria 1999 as Amended, s. 44 (3).
[198] (2015) No. 485/CV/OH.

the Supreme court of Ohio held that local authorities do not have the power to make ordinances that borders on oil and gas production matters. The court emphasized that such power rest solely with the state, therefore, the Home Rule Amendment to the Constitution of Ohio never granted municipalities powers to enact their own separate laws concerning oil and gas schemes. This decision therefore, invalidated the previous court decision. It is very vital to note that the court in the later decision did not invalidate the power of local municipalities over land, its decision is based on power to make laws bordering on oil and gas, which the court emphasized, it solely rests with the state.

Again, in *Yanke v Fayetteville Gatherings*,[199] was a fracking suit brought against the defendant company at the Faulkner City Circuit Court, Arkansas. The plaintiff alleged that fracking activities of the defendant's company caused air pollution and contamination affecting their health. Based on that, they claim monetary compensation. The parties settled, and the suit was dismissed.

Also, in *Berry v Southwestern Energy Co*,[200] the claimants sued for abatement of nuisance due to natural gas compressor station located approximately 1,650 feet from their residential home.
They alleged that fracking has polluted the atmosphere, ground-water and soil. The parties again settled out of court and the suit was dismissed.

Similarly, in *Ginardi v Frontier Gas Services*,[201] a class action was filed on behalf of Arkansas residents who lived or owned properties within one mile of any gas compressor or transmission station. The class action alleged nuisance, negligence, trespass and claiming strict liability. The company equally settled out of court and the District Court dismissed the suit. In another development in *Kay v Peak Water Systems*,[202] plaintiffs who owned land within three miles of disposal wells operated by the defendants claim that fracking fluids and other oil-field wastes migrated horizontally under their properties after being injected vertically into the disposal wells. They instituted a suit for trespass against the defendants. The company settled the plaintiffs and the case was closed.

Therefore, in order to minimize the rate of litigations that are likely to emanate from fracking operations in Nigeria, there should be a robust regime. This will enable the Commission to make a regulation on it. It will also give the court a template upon which to use in decision making in respect of fracking litigations.

5.1 Summary of Findings

The PIA 2021, impliedly provides for fracking by virtue of the meaning of upstream petroleum operations under the interpretation section. However, it is not robust enough to govern fracking. Also, the NOSDRA Act 2006 and the Oil Spill and Oily Waste Management Regulation 2011 (OSOWMR), made to govern pollution in the petroleum industry, contemplates only water-based fluids or oil-based fluids, water-based

[199] (2013) No. 23CV/79.
[200] [2011] No.1CV/0045.
[201] [2011] No.4CV/0420.
[202] [2013] No.4CV/487.

cuttings and oil-based cuttings at the upstream operations. Therefore, cannot adequately regulate fracking flowback wastewater, cuttings or fluids, which contains radioactive materials. Nigeria has shale-gas deposit yet untapped; and have also established centres to convert fuel driven cars to gas driven ones in Kaduna and Abuja. Therefore, without fracking for more shale gas, there will price-hike in gas. And fracking without a robust regime will also cause health and environmental hazards.

The United Kingdom, the United States of America and Algeria, have all reviewed their laws to robustly contemplate shale-gas fracking. Again, ownership of petroleum in the United Kingdom is vested in the Crown except oil in shale deposit requiring distillation to extract. In Nigeria, both shale and conventional oil or gas is vested in the Federal Government.

Contrary to that of the UK and Nigeria, there is private and State ownership of conventional and unconventional petroleum in the United States. Whereas the central government enact Acts to govern oil and gas in the United Kingdom, Algeria, and Nigeria. In contrast, power to make laws on oil and gas in the United States of America is vested in the States.

5.2 Conclusion

Fracking was not robustly contemplated under the Petroleum Industry Act, 2021. However, by virtue of the meaning of upstream petroleum operations under the interpretation section of the PIA 2021, fracking is impliedly provided for. As a result of the implied provision, fracking operations can be carried out in the frontier basins without a robust regime. And such fracking operations without a robust regime, might cause health and environmental hazards.

Also, it is pivotal for Nigeria to go into shale gas fracking with a robust regime. This is because, Nigeria has shale gas yet to be discovered and tapped, and gas is more environmentally friendly than other fossil fuels. Again, Nigeria has established centres for the conversion of petrol driven cars into gas driven ones. Converting petrol cars to gas propelled ones will naturally occasion price-hike in gas. To prevent gas price-hike, fracking for more shale gas in a priority. A robust legal framework for fracking is important because, the Oil Spill and Oily Wastes Management Regulations 2011, only contemplates water-based and oil-based wastes or fluids. Hence, it cannot adequately regulate fracking flowback, wastewater, fluids or cuttings, which contains chemicals and other radioactive materials capable of occasioning health and environmental hazards. Hence, a robust regime on shale gas fracking will create gas abundance and minimize the environmental challenges associated with fracking.

5.3 Recommendation

1. Shale gas fracking is trending globally, and centres for the conversion of petroleum-driven cars into gas-driven ones have been established in Kaduna and Abuja. It will cause price-hike of gas in the country. Hence, fracking for shale gas will help reduce the price of gas. However, a robust fracking regime is needed to regulate shale gas fracking in Nigeria. This is because, the PIA 2021, only impliedly provided for fracking by virtue of the meaning of upstream petroleum operations under the interpretation section of the Act. It also implies that shale oil or gas can be fracked in the frontier basins of Nigeria without a robust regime. Although more shale gas will improve the economy, while

combating climate change because, gas is more environmentally friendly compared to other fossil fuels, a robust fracking regime is needed to safeguard the environment. This is because, the Oil Spill and Oily Waste Management Regulations 2011 cannot adequately regulate fracking operations.

Hence, it is recommended that, the PIA 2021, should be reviewed to robustly contemplate fracking for shale oil and gas, with a corresponding regulation. Review of the PIA 2021, and a corresponding regulation in Nigeria, will help the country to extract more gas in an environmentally friendly manner for export and domestic supply.