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Shale oil and its impact on Nigeria's economy

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Abstract

For some time now the price of Nigeria's crude oil which has been a major source of her revenue, has nose-dived. Several scholars, professionals and academics alike have been calling for proactive majors to enquiry into the the causes, so as to avert the imminent disaster, by charting a better course of action for the government.

It is in that regard, this study is carried out to identify one major reason for the fall in the price of crude oil. The shale oil on the other hand, is an unconventional oil produced from shale rock. The shale oil is also known as retort oil or light tight oil.

The sedimentary rock, where the shale oil is produced from, converts the organic matters in the rock (kerogen) to synthetic oil and gas.

This study is qualitative in nature, as such, the secondary method of data collection is employed. Relevant relatives were consulted, knowing fully well that, there exist a plethora of them.

The theoretical framework adopted is the determinism theory. This theory asserts that, for every action, is a consequence and vice versa. Everything that happens has a cause. From this study it is established that, the discovery of shale oil has a negative impact on the price of Nigeria's crude oil. Shale oil does what crude oil can do. If the patronage on shale oil increases globally, it invariably means that the price of crude oil in the market will fall. For the Nigerian government to come up with proactive measures to tackling the imminent doom that might happen due to the fall in price of crude oil, in the market, then the need for diversification is nonnegotiable.

Keywords: Shale oil, impact, determinism, cause, effect, Nigeria, crude oil

Introduction

Shale is a neo-fuel produced from oil shale rock fragment. It is also referred to as retort oil or light tight oil (Chian S. *et al*, 2016) ^[3]. The shale oil has great volume of hydrocarbon compounds viz olefin.

Shale oil exploration cum extraction process involves a plethora of stages viz pyrolysis, hydrogenation and thermal dissolution of oil shale. Fuel can be derived from raw shale oil through the process of direct burning.

The shale oil is an avalanche of unprocessed and unexplored hydrocarbon resources. It is also known as oil shale, containing cruel oil content.

The shale oil is an unconventional oil, and it is produced from oil shale rock, with certain qualities, and converts organic matters inside the rock, popularly known as kerogen, into synthetic oil and gas (wikipedia, 2023) ^[23].

The bye product can be used without further delay as a fuel or improved to meet refinery's feedstock requirements by including hydrogen whilst extracting impurities viz sulfur and nitrogen. This oil produced can be used as alternative cum supplement to fuel gotten from crude oil.

Sedimentary rock, where shale oil is gotten from, has great quantities of solid and insoluble naturally occurring organic matter, which includes Kerogen- where oil from shale can be extracted from.

There are two known methods of extracting of kerogen from oil shale- one is a cracking process termed retorting, which is used to break down the kerogen by heating it in absence of oxygen to release hydrocarbons with low molecular weight products viz nitrogen, oxygen and sulfur. This process is applied at factory site. Two is situ method, where the shale is made to undergo great heat underground, whilst the liquid kerogen is released to the surface (speight, 2011) ^[19].

On the other hand, crude oil in Nigeria was reportedly first discovered in a place called Oloibiri (present day Bayelsa State) in the Niger Delta area, in the year 1956. While oil exploration and production in the Southern region of Nigeria was said to have began in the late 1950s, full operations were halted in some areas like the Ogoni land to the early 1990s, as a result of community upheavals spearheaded by ethnic militias.

The Organization of Petroleum Export Countries (OPEC) places Nigeria's crude oil reserves at tenth position in the world, whilst thirteenth largest producer of crude oil, globally (USEP, 2023).

Nigeria is the second largest oil and gas in Africa. The crude oil which emanates from the Niger Delta basin comes in two forms, viz light, and invariably heavy- the lighter possesses about 36 gravity, whilst the heavier has 20-25 gravity (wikipedia, 2023) ^[24].

The determinism theory is premised on the principles of cause and effect. Determinism is a philosophical view where all happenings are caused by hitherto existing action(s) (wikipedia, 2023) ^[23].

Deterministic theories over the years of philosophy have metamorphosed from diverse, and at times overlapping motives cum basis. Indeterminism or nondeterminism, also known as randomness is the other end of determinism.

This theory is of the view that, within a paradigm, events are bound by causality. In that regard, any state of an object or event is obviously as a result of its prior states.

Conceptual Evaluation

Shale Oil

Oil shale happens to be one of the foremost sources of mineral oil used by humans. During the 10th century, Masawaih al-Mardini (Mesue the Younger), an Arabic physician first introduced a method of extracting oil from some form of bituminous shale (wikipedia, 2023) ^[24].

In similitude, it was said to have its first usage in Switzerland and Austria in the early 14th century. According to Ramirez-Corredores (2017) ^[17], shale oil is the result of the thermal reaction and decomposition of kerogen visible in oil shales.

To Chian *et al* (2016) ^[3], shale oil is an unconventional fuel gotten from oil shale rock fragment. Any technology to produce this oil includes the following process, mining, heat treatment- referred to as retorting- to get the oil, and oil upgrading.

Mining oil shale can be in two ways viz surface or in situ retorting. In the former, the oil shale is transferred to aboveground level. At that, the oil is broken and transferred into a reactor referred to as a retort. The temperature must have increased to about 400-500°C to decompose the kerogen and release the shale oil. In the latter, heat is applied directly to the rocks beneath the earth surface and the shale oil gotten is explored in a similar manner as petroleum exploration.

Zendehboudi and Bahadori (2017) ^[27] highlighted about six types and source of shale oil. Shale oil is known by various nomenclatures viz cannel coal, kerosene shale, bituminite,

gas coal, algal coal, wolongite schistes bitumineuse, torbanite and kukersite. Shale oil is classified on the bases of environment deposits, organic matter, and precursor organisms, where the organic matter emanates from.

In the words of Papvinasam (2014), shale oil is a fine-grained rock having sizeable volume of hydrocarbons. The global deposits of shale oil from which crude oil can be regained are estimated to be around 3trillion barrels (- 500 x 10⁹ m³). Shale oil deposits is present in the USA, Estoniesn, China, Germany, Israel, Russia and Brazil. Though the USA is owner of 68% of the world shale oil resources, Estonia in 2009 produced 80% of its oil needs from oil shale (Papvinasam, 2014).

To Speight (2012) ^[20], shale oil is a synthetic crude oil that is produced viz-a-viz retorting oil shale and is the pyrolysis product of the organic matter (kerogen) embedded in it.



Fig 1: Global oil share market

Oil Shale Market Analysis- 2030

From figure 1, global oil shale market is expected to hit 5.9 Billion by 2030, whilst growing at CAGR of 7.7% beginning from 2020 to 2030.

Crude Oil

Crude oil refers to a mixture of hydrocarbons existing in liquid state in natural beneath earth's surface reservoirs and stays in such state at atmospheric pressure after passing through surface separating facilities.

Crude oil is majorly a hybrid of straight and branched chain aliphatic hydrocarbons, ranging from gaseous methane to viscous tar-like compounds with up to 80 carbons (Encyclopedia, 2009). It is often referred to as black gold. Crude oil is oil in its raw cum unprocessed form.

Crude Oil in Nigeria

Historically, oil in Nigeria is said to have been discovered in a place called Oloibiri, present day Bayelsa State, in the Niger Delta, in 1956 (though it was in commercial quantities).

Following the ranking of Organization of Petroleum Export Countries (OPEC), Nigeria currently is ranked tenth largest crude oil reserves in the world, and is the thirteenth largest producer of crude oil, in the world.

In that regard, it is very clear and evident, crude oil exploration began in the Niger Delta area and spread up North (UNEP, 2023) ^[22].

Continently, Nigeria is the second largest oil and gas producer in Africa. There are two types of crude oil produced from the Niger Delta basin: light, and heavy - the lighter possesses about 36 gravity while the heavier possesses 20-25 gravity. Both types- light heavy are paraffinic and low in

sulfur.

Since the time of independence in 1960, the Petroleum Industry has remained the major source of income and revenue. Prior to this time, palm produce, colanuts, and cocoa were the major source of income to the country. The tide was dramatically turned, with the discovery of crude oil cum oil boom in the world.

Nigeria's wealth was so much that, a former head of state, General Yakubu Gowon on a national telecast submitted that, the problem of the country was not money, or what have you, but what to spend the money on.

According to Wikipedia (2023) [23], statistics from February 2021 shows that the country's oil sector accounts for about 9% of her entire GDP.

In same vein, Nigeria happens to be the largest producer of oil and gas in the Africa, as well as, one of the major exporter of crude oil and petroleum products to the United States of America. Facts shows that in 2010, Nigeria exported over one million barrels per day to the United States, making 9% of the US total crude oil and petroleum products import and 40% Nigeria exports.

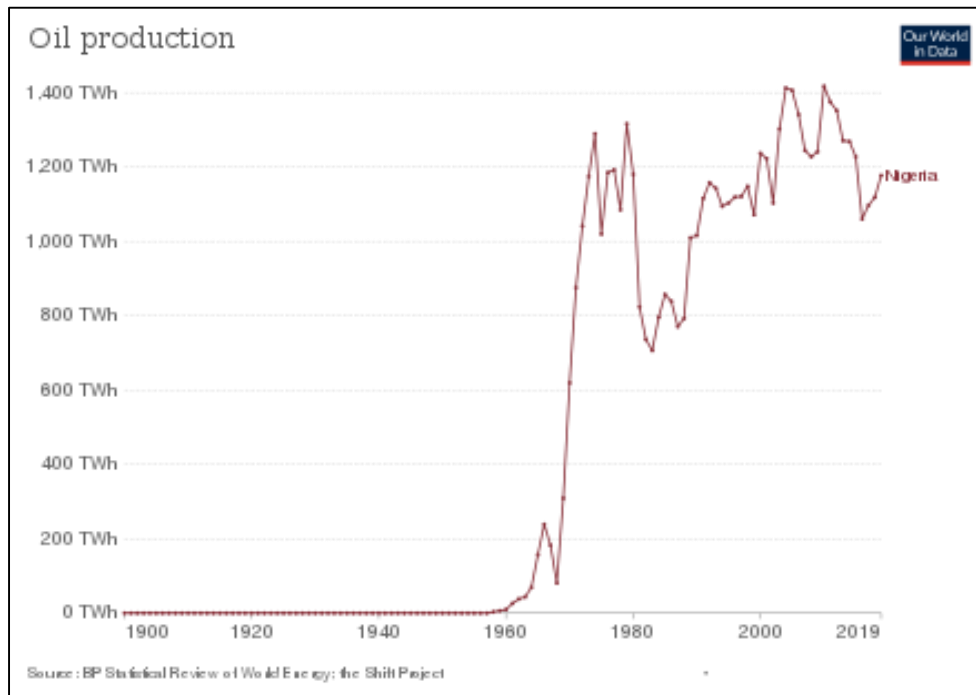


Fig 2: Oil production

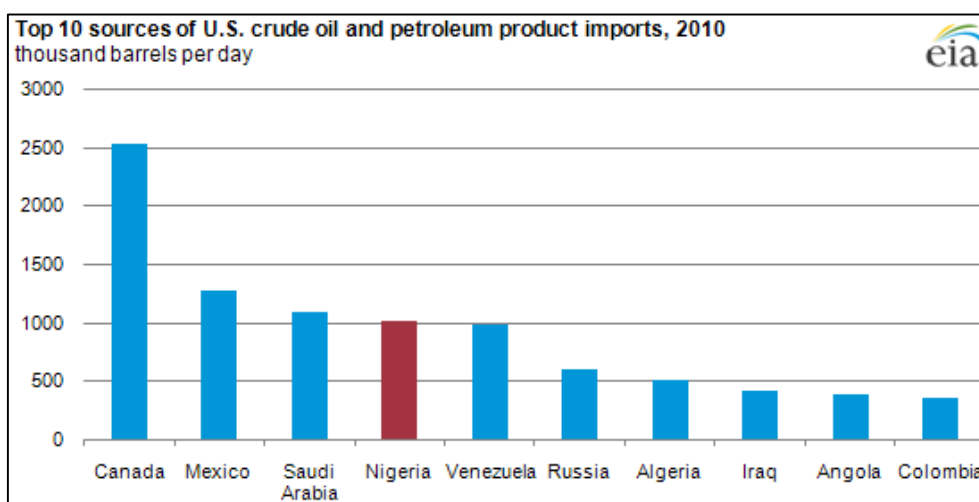


Fig 3: Energy information administration, 2023

Figure 3 shows that in 2010 Nigeria happens to be amongst the first 10 exporters of crude oil to the United States of America- fourth to be precised.

Theoretical Underpinnings

Theories are set of axioms, maxims aphorisms premises cum ideas relevant for the explanation, interpretation, prediction

and description of connections between and among phenomena. It is a supposition or a system of ideas, motivated to explain phenomena, especially one premised on patterned and consistent principles that is isomorphic to the study.

Determinism in social science is predicated on the principle that, all events or happenings in the universe, even human decisions and actions, are causally inevitable. Universal

determinism asserts that, nothing happens from the aloof, it must be planned. Determinism believes that, in a scenario where an individual or government alike, makes a certain decision or performs a certain action, it is irrational to assume that such actions was without a cause. In that regard, every action is well planned.

In other words, it is never true that people could have decided or acted the other way round than they actually did (Britannica, 2023) ^[2]. Determinism negates the principles of freewill and libertarianism. Nothing happens by chance. Everything on earth is as a result of another.

Causation or causality is the basic premise of determinism. However the cause and effect must be isomorphic.

Shale oil is used for petroleum, gas and etcetera, as well as, crude oil in the global market. This makes both oil substitutes to each other. As such, there is a nexus between the shale oil and crude oil.

It is in that regard, this study was carried out. The United States of America happens to be the major buyer of Nigeria's crude oil. Meaning that, whatever decisions and/or actions taken by her government vis-a-vis oil, would have adverse effects on Nigeria's crude oil. The United States of America is one of the major users of shale oil in the world. This suggests that, so long they make more investment on shale oil, the demand on Nigeria's crude oil would consistently nose-dive.

Although, shale oil has been in existence for a long time, its relevance cum importance was less felt, until recently, around 2013 or so when some nations of the world, including USA, decided to invest on it.

It is a known fact that, when two commodities can be used to serve same purpose, an increase in the demand for one, say X, would invariably lead to a decline in the demand for the other, Y.

By and large, it is not out of place to submit that, the discovery or better still, recent demand cum relevance on shale oil in the world market, especially the US government, is a major cause for the decline in the demand cum price of crude oil, leaving Nigeria at the receiving end, as her income and revenue largely depends on it.

Methodology

This work is qualitative in nature, as such made ample use of secondary method of data collection. Every data obtained is secondary. Therefore, both the historical and content analysis is fully exploited. This study relied majorly on hitherto works by authors, scholars and academics alike, viz relevant Journals, Articles (published and unpublished), books, and other relevant literatures, were consulted and perused.

Impact of shale oil on global economy

Shale oil has contributed a great deal to world's economy without equivocation. Most governments, the USA as a major beneficiary of its wealth. Shale has provided options for countries that hitherto depended on crude oil for most meet their engineering needs- petroleum, diesel, kerosene, gas and etcetera. By 2030, global Oil Shale Market is expected to hit \$5.9billion (GOSM, 2023).

Shale oil extraction process

Shale oil is extracted by pyrolyses, hydrogenation, or thermal dissolution of oil shale. The pyrolyses of the rock is operated in a retort, stationed either above sea level or by the rock formation itself. As of 2008, most shale oil extraction

operations by the industries, was preceded by the mining of the rock, dismantling and transportation to a retorting facility, even though series of experimental technologies perform the process in place (Insitu). The temperature at which the kerogen decomposes into useful hydrocarbons differs with the time-scale of the process; in the above-ground retorting process decomposition begins at 300°C (570°F), but proceeds spontaneously and completely at higher temperatures. Decomposition takes place most quickly at a temperature between 480 and 520°C (900 and 970°F) (wikipedia, 2023) ^[24].

Hydrogenation and thermal dissolving (reactive fluid processes) explore the oil using hydrogen donors, solvents, or a host of these. Thermal dissolution includes the application of solvents at heightened temperatures and pressures, increasing oil output by breaking the dissolved organic matter. Different methods produce shale oil with varied properties.

Properties

The properties of raw shale oil differs based on the arrangement and components of the parent oil shale and the technology used for extraction. Just as conventional oil, shale oil is a complex mixture of hydrocarbons, and is characterized according to the bulk properties of the oil. It usually possesses large quantities of olefinic and aromatic hydrocarbons. It can also possess significant quantities of heteroatoms (Wikipedia, 2023) ^[23].

An ideal shale oil make up includes 0.5-1% of oxygen, 1.5-2% of nitrogen and 0.15-1% of sulfur; some deposits contain more heteroatoms than others. Mineral particles and metals are visible as well.

Shale oil contains polycyclic aromatic hydrocarbons, which are carcinogenic. The US EPA concludes that raw shale oil possesses a mild carcinogenic potential, comparable to some intermediate petroleum refinery products, whilst upgraded shale oil has lower carcinogenic potential, as most of the polycyclic aromatics are said to have been cracked by hydrogenation. The World Health Organization classifies shale oil as a Group 1 carcinogen to humans (Wikipedia, 2023) ^[24].

Relevance cum Advantages of Shale Oil

Shale oil has enormous advantages to a verse and dynamic world of ours. However, we would like to focus on just a few that are relevant to this study.

First, it provides a possible substitute for crude oil. The utilization of shale oil as an alternative for crude oil provides a diverse set of benefits. Chief amongst them, shale oil can undergo refinement processes that produce a wide array of fuels, viz diesel fuel, gasoline, and liquid petroleum gas (LPG). In that regard, it furnishes a way to supplement the current supply of crude oil.

Also, it preserves natural resources. Shale oil extraction produces a residual substance, popularly known as spent shale, having minerals and char. During combustion, the char creates shale ash. Strikingly, the spent shale and ash contains properties that make them appropriate for use as building materials, viz cement and bricks.

By so doing, applying these byproducts in construction work offers a better sustainable waste management approach whilst preserving precious natural resources.

It creates energy independence. Utilization of oil shale for energy production enriches countries possessing significant

oil shale deposits with the opportunity to reach energy self-sufficiency. In that regard, producing oil domestically, would reduce the expenses of such countries, as they will circumvent the need to import oil from foreign nations, attendantly reducing their reliance on costly foreign oil sources. Attendantly, this can turn into tremendous cost savings for these countries vis-a-vis foreign exchange and energy expenditure.

Countries that Buy Shale Oil

There are a lot of shale oil deposits that need more exploration to ascertain their abilities as reserves. However, some that have undergone the whole exploration process and are classified as reserves, include the Green River deposits in western region of United States, the Tertiary deposits located in Queensland, Australia, some deposits in Sweden and Estonia, the El-Lajjun deposit in Jordan, and deposits in France, Germany, Brazil, China, and Russia. It is envisaged that these deposits would yield at a minimum least 40 liters (0.25 bbl) of shale oil per metric ton of shale, using the Fischer Assay.

A conservative estimate in 2016, put the overall world resources of oil shale equivalent to yield of 6.05 trillion barrels (962 billion cubic metres) of shale oil, with the United States accounting for more than 80% of the world total resource, making her the largest in the world. Comparatively, the world's proven oil reserves are estimated to be at 1.6976 trillion barrels (269.90 billion cubic metres) (Wikipedia, 2023) ^[24].

Determinants of Oil Prices in the world

Crude oil affects nearly all of contemporary hydrocarbon society, regardless of the pendulum swinging to green energy (Gyari, M. *et al*, 2017) ^[7].

According to the BP Statistical Review of World Energy (2016), oil retains its relevance as world's leading fuel, accounting for 32.9% of global energy consumption. Crude Oil is an invaluable source of energy in the world affecting the development and activities of nearly all governments and its people, alike.

To Gyari, M. *et al*, (2017) ^[7], the following are factors that accounts for the pricing of crude oil in the world.

1. Supply and Demand

Whilst supply refers to the quantity of goods that the producer cum seller is willing and ready to sell at a given price within a period of time, demand has to do with the request on a good, backed up by the willingness cum readiness to pay for it, at a given price within a period of time.

The fundamental law of demand and supply affects oil prices. *Ceteris paribus*, as demand increases (or supply decreases) prices tend to go up, and vice versa.

In same vein, when the demand for crude oil products skyrockets, prices moves up to balance supply levels. On the other hand, high prices encourages production, as supply increase with an attendant decrease in the demand of oil and its products.

When hitherto existing nations importing crude oil, reduce their demand due to alternative (in this regard, shale oil), crude oil price would fall in the global market.

2. Production

According to Gyari, M. *et al* (2017) ^[7], the oil economy was controlled by seven western companies, "Seven Sisters".

They had their footage all over the world, and were responsible for significant oil field developments. They comprised of the Anglo-Persian Oil Company, Gulf Oil, Standard Oil (a California based Company), Texaco, Royal Dutch, Shell Standard Oil of New Jersey and Standard Oil Company of New York. During the 1970s, following the oil crises cum political developments, oil production became more of a national agenda to a great extent.

In recent times, multinational companies are in charge of a very little percentage (5%) of global oil, reserves however remained key actors in the oil market and development of the petroleum industry.

The middle eastern countries are the largest producers of oil, having the largest reserves. Developed countries viz Russia and the United States also produce at a very high rate, regardless of their lower reserves.

3. Consumption

Consumption of crude oil is a function of the demand for refined oil products. There are regional discrepancies on consumption rates, as the developed OECD countries viz Denmark, Germany, United Kingdom and Luxembourg accounts for about 50% of world demand.

Recently, China's economy has played key role to oil consumption, with consumption rates exceeding the second largest importer of liquid fuels, the United States in the late 2013.

In this wise, Gyari M. *et al*. (2017) ^[7], citing EIA, forecasted that, China would release about 3 million more barrels per day in 2020 when compared to 2012, and would be responsible for about one-quarter of global demand growth at the given time frame.

4. Organization of Petroleum Exporting Countries (OPEC)

The extant body is a permanent intergovernmental organization, established at a conference in Baghdad on September 14th, 1960 by the following members, Iran, Iraq, Kuwait, Saudi Arabia and Venezuela.

Nigeria became a member in 1971, Libya in 1962, and by 2015 has 13 member countries (Gyari, M. *et al*, 2017) ^[7]. OPEC is the regulatory body for its member states. It accounts for an estimated 42% of global oil production and 73% of the world's "surest" oil reserves, making it a key player on global oil prices.

5. Other Energy Sources

The relevance of crude oil price on other energy sectors like renewable energy and vice versa is not sacrosanct (Gyari, M. *et al*, 2017) ^[7]. Factors like legislative regulations, competitive substitutes and varying regional impact are to be considered. It is in their view, the dependency on crude oil has nose-dived in the face of increasing changes cum continual drop in the capital costs of other energy technologies.

In this regard, it is overtly correct to assert, shale oil as a substitute to crude oil has reduced the dependency on the latter, drastically.

Conclusion/Recommendations

Nigeria as a country is, for sometime now, a quasi-monotonous economy, and this is based on her over dependence on crude oil, since discovery in commercial quantities in Oloibiri (present day, Bayelsa State). Oil in its regard, is a

very veritable source of economy to any nation, globally. Also, there is no gainsaying that, since the emergence of crude oil in the state, her fortunes have increased, making her almost likened to an overpampered child. However, following the rise in demand of shale oil in the world, with the United States and China, having largest reserves, the demand on crude oil has fallen, with the attendant consequences of debt, economy retardation, inflation and what have you on the Nigeria economy.

For any nation to survive in the current world economy, it must be ready to diversify her economy, welcoming private sector partnership and what have you.

It is in that regard that this study looked into one major cause of fall in demand cum price of Nigeria's crude in the world. Having established that, shale oil is a major cause of fall in price of Nigeria's crude oil, it is wise for the government to take proactive measures to cushion further damages as well as set the nation ahead for global relevance cum power.

Shale oil is oil gotten from rock, and it is found in Nigeria also. According to Finelib (2017), Nigeria has an oil shale deposit of premium economic value which is found in Imo (Okigwe) and Abia states, respectively. It would not be out of place if the Federal government partners with organized private sector in refining and be a major producer cum exporter of shale oil.

References

1. British Petroleum. 2015 in review. BP Statistical Review of World Energy Journal. 2016;65:1-43.
2. Duignan B, et al. Determinism. Encyclopedia Britannica. 2023. Retrieved from www.britannica.com on, c2023.
3. Chian SL, Lim SK, Yeap KH, Lai KC. A review of shale oil production methodologies and its impact to global energy and economy. Research Journal of Applied Sciences, Engineering and Technology. 2016;13(7):555-568.
4. Erude SU, Orogun OC, Iyama JO. Age falsification and public perception in Nigeria. Journal of Public Administration and Social Welfare Research. 2023;8(1):16-28.
5. Fagbohunlu B, Ikwuazom C. Overview of the Nigerian Petroleum Industry Bill. Hogan Lowells; c2012. Retrieved from www.wikipedia.org on 23 May, 2023.
6. Finelib. Important information on oil shale endowed states in Nigeria; c2017. Finelib.com. 2017. Retrieved on 10 June, 2023.
7. Gyari M, Amarfio EM, Marfo SA. Determinants of global pricing of crude oil: A theoretical review. International Journal of Petroleum and Petrochemical Engineering (IJPPE). 2017;3(3):7-15.
8. Howden. Where does crude oil come from? Howden; c2023. Retrieved from www.howden.com on.
9. Kallis G, Sager J. Oil and the economy: A systematic review of the literature for ecological economists. Elsevier Inc. c2016;1-24.
10. NBS. Review of the Nigerian economy. National Bureau of Statistics. c2010;65.
11. NGS. Shale oil. National Geographic Society. 2023. Retrieved from education.nationalgeographic.org on, c2023.
12. Ogru OR. A review of the Nigerian petroleum industry and the associated environmental problems. The Environmentalist. 2001;21(2):11-21.
13. Oil Shale. American Association of Petroleum Geologists. Retrieved; c2023.
14. Oil Shale (PDF). Colorado School of Mines. Retrieved on; c2023.
15. OPEC. Organization of Petroleum Exporting Countries. 2017. OPEC webpage. https://www.opec.org/opec_web/en/. Accessed; c2023.
16. Papvinasam S. The oil and gas industry. Gulf Publishing, London; c2014;1-39.
17. Ramirez-Corredores M. The science and technology of unconventional oils: Finding refining opportunities. Elsevier Inc. c2017;677-693. Retrieved from www.sciencedirect.com on 23 May, 2023.
18. Reinsalu E, Aarna I. About technical terms of oil shale and shale oil (PDF). Oil Shale: A Scientific-Technical Journal. 2015;32(4):291-292.
19. Speight J. Handbook of industrial hydrocarbon process. Elsevier Inc. c2011;203-238.
20. Speight JG. Shale oil production process. Gulf Professional Publishing, London; c2012;123-138.
21. Ugwukah AC, Obinna I, Ohaja MA. A historiographic assessment of the petroleum industry and its impact on the Nigerian economy. IISTE. 2016;36(1):11-27.
22. UNEP. Crude oil in Nigeria. United Nations Environmental Programme; c2022. Retrieved from www.unep.org on 23 May, 2023.
23. Wikipedia. History of oil shale industry. Wikipedia. c2023. Retrieved from en.m.wikipedia.org on 24 May, 2023.
24. Wikipedia. Oil shale reserves. Wikipedia. c2023. Retrieved from en.m.wikipedia.org on 28 May, 2023.
25. World energy outlook. International Energy Agency (IEA), OECD; 2013;424. ISBN 978-92-64-20130-9.
26. World energy resources (PDF). World Energy Council. c2013;2-46.
27. Zendehboudi S, Bahadori A. Shale oil and gas handbook. Elsevier Incorporations; c2017;193-230. Retrieved from www.sciencedirect.com on 25 May, 2023.