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USE AND BENEFITS OF BIOFUEL IN NIGERIA

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Abstract
Energy is at the center of man's existence as well as the pillar of wealth creation. As such, modern society cannot critically address issues of development if such consideration is not based on the basis of effective energy planning and management that enhances optimal utilization, regular supply and availability of energy resources. As a result of the recent happenings in the oil industry, nations are moving towards a long-term availability of oil and gas from sources that are cheap, accessible and harmless to the environment without compromising the ability of future generations to meet their own need. Biofuel is a kind of fuel that is produced from renewable organic materials from plants and animals. These renewable organic materials are otherwise referred to as biomass. Biofuel has been identified as potentially reliable and renewable energy resource, and it is promising in this regard, which is as a result of its numerous and overwhelming environmental and socio-economic benefits including rural development, land and soil reclamation, rural employment, energy security and mitigation of greenhouse emissions. The aim of this study is to critically examine the potential uses of biofuel as well as the need for a legal framework in Nigeria. The study will adopt a doctrinal legal research method, exploring both primary and secondary sources of information to achieve its aim. The outcome from the study should be able to strengthen the potency of biofuel, improve the enforcement strategies and make reference for adoption of best practices.
Key words: Biofuel, Uses, Energy, Renewable, Sustainability

1. Introduction:

Ever since the discovery of fossil fuel in Nigeria there had been a lot of dependency on fossil reserves and because these fossil reserves are not infinite, studies have shown that someday it will be exhausted. The growing concerns over the depletion of fossil fuels, energy security considerations, and concern over global warming as spelt in the Paris Agreement have generated significant interest in renewable energy sources such as biofuel. The escalating petroleum prices mounts pressure on foreign exchange and has relatively slowed down the economic development of the country. These, amongst other contraints have necessitated the quest for diversification of energy sources using natural resources which is in its nature, renewable.

Biofuel is a kind of fuel that is produced from renewable organic materials that comes from plants and animals. These renewable organic materials are otherwise referred to as biomass. Biofuel is regarded as a renewable energy due to its ability to replenish naturally by circle of life.[4] This attribute makes biofuel an attractive alternative to fossil fuels which are developed over a long time span and extracted from deep under the ground using expensive and environmentally damaging processes and are also being consumed at a far faster rate than they are being produced. This points to the fact that sooner or later the planet's supplies of fossil fuels will be completely exhausted – especially if we continue to deplete them at the current rate.[5]

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[4] *T. M. Letcher, ed. (2020). "Chapter1: Introduction With a Focus on Atmospheric Carbon Dioxide and Climate Change". Future energy : improved, sustainable and clean options for our planet (3rd ed.). Amsterdam, Netherlands. ISBN 978-0-08-102887-2. OCLC 1137604985*
[5] https://www.petro-online.com/news/biofuel-industry-news/22/breaking-news/what-is-biofuel-definition-advantages-examples-and-uses/54731, retrieved on 11/08/2023 at 12: 28 pm

Biofuel can be produced from plants or from agricultural produce such as cassava, maize, sugarcane, palm oil, sorghum and so on, and can also be produced from domestic or industrial biowaste. Basically, biofuel is basically classified into primary and secondary biofuel depending on how they are produced. Primary biofuels are defined as organic materials that are deployed as energy source immediately, without any prior treatment or processing.[6] Examples of primary biofuels include timber, wood chips, pellets and other types of wood that are traditionally used for heating and for cooking purposes, especially in developing countries where no other fuel source is available. Primary biofuels can also be used to generate electricity, although this practice is not common.[7] Secondary biofuels refer to any form of biomass that is used to generate energy after it has been processed which include liquid biofuels that are becoming increasingly popular in the transportation sector, industrial processes as well as biomass plants. Bioethanol and Biodiesel are examples of secondary biofuels. The most common types of biofuel are bioethanol and biodiesel. Bioethanol is an alcohol produced by a process of fermentation of carbohydrates or starchy crops such as sugarcane, maize or sweet sorghum. In some cases cellulosic biomass derived from non-food sources, such as trees and grasses are being developed as feedstock for bio ethanol production.[8] Biodiesel on the other hand is produced from oils or fats using a method known as transesterification.[9] Bioethanol and Biodiesel can be used as a fuel for vehicles in their pure form (E100 and B100 respectively). Although, Bioethanol is usually used as gasoline additive to increase octane ratings and improve vehicle emissions, while Biodiesel is usually used as diesel additive to reduce levels of particulates such as carbon monoxide and hydrocarbon from diesel-powered vehicles. The United States of America happens to be the highest producer of Bioethanol[10] while Malaysia is popular for its production of Biodiesel.

Biofuel consumption vastly takes place in the domestic settings. They are usually used to heat water and food for domestic uses. Biofuel are also consumed as fuel for vehicles although they are usually used as a blend with petrol or diesel as most vehicles are not manufactured to run wholly on biofuel. The use of biofuel in the transportation industries is becoming increasingly popular as individual drivers, automotive manufacturers and national governments are becoming more cognizant of the need to improve the emissions ratings of their cars. Nigeria on the other hand is not left behind in the shift to a sustainable climate friendly source of energy, hence the Nigerian Biofuel policy and incentives, 2007.

2. The Use of Biofuel in Nigeria

Biofuel being a clean, sustainable and renewable source of fuel is also a reliable alternative to fossil fuel. This is attributed to the fact that they are made from natural resources that are easily replenished. The low emissions associated with their combustion equally makes it an attractive prospect for business owners and fuel users that are eco-conscious.[11]
Below are the most common applications of biofuel:

2.1 Heating and Cooking:

In developing nations and communities such as Nigerian rural areas and semi-urban communities, raw biomass materials that are yet to be processed or treated in any sort are used for heating purposes in homes especially in those communities where there is no alternative fuel source. These raw biomass materials are referred to as primary biofuel. A common example of primary biofuel is wood. Wood forms the most basic and ancient form of fuel that is derived from organic matter/biomass. Other

[6] *Ibid*.
[7] *Ibid*.
[8] https://www.petro-online.com/news/biofuel-industry-news/22/breaking-news/what-is-biofuel-definition-advantages-examples-and-uses/54731, Retrieved on 11/08/2023 at 12: 28 pm
[9] S. D. Romano and P. A. Sorichetti, Dielectric Spectroscopy in Biodiesel Production and Characterization, Green Energy and Technology, DOI: 10.1007/978-1-84996-519-4_2, Springer-Verlag London Limited 2011
[10] https://www.nationalgeographic.com/environment/article/biofuel retrieved on 11th August, 2023 at 2:13 pm
[11] https://www.petro-online.com/news/biofuel-industry-news/22/breaking-news/5-uses-of-biofuels/54813 last accessed on 21/08/2023 @3:35 pm.

examples of primary biofuel that are used for heating are charcoal and saw dust (wood flakes). These primary biofuels had been in use from time immemorial majorly for heating food and water and in some cases they are used for heating homes during cold season.
Furthermore, there are secondary biofuels which can equally be used for heating purposes although they have undergone the processes of refining. An example is biogas. Biogas serves as an efficient and eco-friendly substitute to the primary biofuels and can as well serve the same purpose of heating homes and can as well be used for cooking meals.

2.2 **Transport:**

Transportation sector is the most common sector where biofuel is utilized. It is common knowledge that in the nearest future, fossil fuel will extinguish, hence, the need for an alternative fuel source such as biofuel that vehicles can efficiently use. Studies have shown that vehicles are the major environment polluter,[12] and as such many transport companies, in a bid to make a contribution to a cleaner environment have opted to use bioethanol or biodiesel as their major source of fuel for their vehicles. Some vehicle engines are made to run on bioethanol fully (E100) or a blend of gasoline and bioethanol (E10 or E80). Put differently, bioethanol and biodiesel are used as a substitute and in some cases are used as additive to the conventional fuel for vehicles.
The use of biofuel in the transportation sector is increasingly becoming popular as automotive manufacturers, automotive users and the government are becoming aware of the necessity to improve the emission rating of their vehicles.[13] The advantage of the use of biofuel in the transportation sector is that it will not only boost fuel efficiency, it will also reduce emission to the barest minimum thereby contributing to a cleaner and safer environment.
Furthermore, aviation sector is another major harmful emissions contributor with its adverse effect on the climate. This is one of the reasons many airlines have been researching on how biofuel can be used in jet engines in order to curb the menace occasioned by the jet engine pollution. However, biodiesel which may have been a better alternative to jet fuel is found unsuitable for use in the aviation industry due to the unique properties of the jet engines.

2.3 **Lubrication:**

Every piece of machinery must be maintained and lubricated regardless of the industry or sector in which it is being used. This is to ensure that it runs smoothly and enjoys the expected lifespan. Historically, lubrication of machines has always been carried out by diesel-based or oil –based lubricants. These diesel-based and oil-based lubricants are products of fossil fuel which bring about adverse effect on the environment. Biofuels contain higher concentrations of cetane than fossil fuels, which makes them act more effectively as a lubricant in car engines. This means that the engine requires less maintenance over a longer period of time, increasing its durability and that of the vehicle as a whole. This makes it more attractive both in economic and environmental terms for the car owner and for the wider community.

2.4 **Oil Clean-Up Operations:**

Periodically, in the cause of oil extraction, distribution and storage, oil spillage may occur. Oil spillage though a sad occurrence is also an inevitable occurrence in the oil sector. Oil spillage can cause a devastating harm to the ecosystem which can lead to the death of plants, and animals including humans. Biofuel has been demonstrated to effectively address this problem. This is so because the methyl esters compound contained in biofuel is a powerful solvent that can serve as washing agent for contaminated shorelines.

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1 [12] https://azbigmedia.com/business/top-applications-of-biofuels/ accessed last on 15/8/2023 @ 1:02 pm

[13] https://www.petro-online.com/news/biofuel-industry-news/22/international-environmental-technology/first-sustainable-petrolnbspin-uk-comes-to-market/60906 accessed last on 15/8/2023@ 12:58 pm

3. Benefits of Biofuel:

Biofuel has been attributed much acknowledgement by environmental groups and commercial interest as a sustainable and renewable alternative to fossil fuel. These have not been refuted based on a good number of advantages of biofuel when compared to fossil fuel.[14] Below are the notable benefits of Biofuel:

3.1 Renewability:

Biofuel is said to be renewable because they are mostly produced from plants material (biomass) that can be cultivated and harvested with relative speed and ease than it takes fossil fuel to be created. This is to mean that the feedstocks or biomass for biofuel production are renewable because they can be replaced fairly quickly (with duration ranging from one planting season to perhaps one or two decades) without permanently depleting the earth's natural resources. By comparison, fossil fuel such as petroleum, natural gas and coal do not reproduce and as matter of fact may go into extinction. Put differently, biofuel is a renewable alternative energy source in that it can be produced from plants which can be re-grown from time to time unlike the fossil oil that has a limited source, from a specific material, and which will be exhausted or run out in the nearest future. Biofuel on the other hand are produced from a wide range of materials including crop waste, manure and other by-products. This wonderful feature of biofuel makes it an efficient step in recycling. Again, biofuel is much more renewable as new crops are grown and wastes materials also collected for its production as such, its production and use can be sustained indefinitely. Most of the sources of biofuel such as manure, corn, sugar cane, soy oil, palm oil, waste from crops and plants are renewable and are not likely to run out of stock at any time soon. This attribute makes the use of biofuel more efficient in nature.[15] Summarily, biofuel cannot be depleted when carefully used in appropriate applications and can provide a reliable and sustainable supply of energy almost indefinitely. This is in contrast with fossil fuels that are diminished by extraction and consumption.

3.2 Energy Security:

The role of energy in any given society is so vital that it is evidenced in the economic growth, progress, development, security as well as poverty eradication in any such society. This by implication is that any change in the security of energy has a proportionate effect on well-being of the society. This effect can either be positive or negative. Energy security is the capability to establish an efficient, sustainable, and affordable energy system that meets the demands of the people. Energy security can be said to be the link between national security and the availability of natural resources for energy consumption. Access to energy affects the provision and sustainability of human's basic needs and also contributes to a nation's economic growth, political stability, and the general development and security of other sectors (such as the agricultural and manufacturing sectors) of any given economies. Access to cheaper energy has remain indispensable to the functioning of modern economies in the midst of rapid energy demand growth. Population growth and economic expansion is the reason for the rapid growth of energy demand. This is the reason nations have resorted to ensure that their economies function without any sort of disruptions in energy supply by providing adequate, reliable and affordable clean energy.

The growing dependence on fossil fuel products in Nigeria along with the high prices tied with it is the most crucial challenge on energy security in Nigeria. The ever-increasing demand for fossil fuel products in Nigeria is inconsistent to the available oil in the market. Hence, biofuel as an alternative to fossil fuel becomes necessary for sustenance of national consumption as the natural resources needed for its production is practically available and accessible. Again, investing in the biofuel industry is highly recommended as it will enable sufficient oil supply and price stability. In other words, the

[14] https://www.petro-online.com/news/biofuel-industry-news/22/international-environmental-technology/first-sustainable-petrolnbspin-uk-comes-to-market/60906 Accessed last on 15/8/2023@ 12:58 pm.

[15] Y Kajikawa and Y Takeda, 'Structure of research on biomass and bio-fuels: A citation-based approach' (2008)75 *Technological Forecasting & Social Change*, 1349–1359.

introduction and use of biofuel will cure supply disruptions and supply-demand imbalances as their use does not affect their availability in the future; this is to mean that they are inexhaustible.

3.3 Sustainability:

In addition to the renewability and energy security attributes of biofuel is its sustainability or sustainable feature.

Researchers have shown that someday in the nearest future that the world will run out of fossil oil, and with that, our main source of energy will finish or be exhausted. In April 2008, an independent policy institute based in London carried out a study [16] titled 'Resource Depletion, Dependence and Development', which focused on some oil producing counties including Nigeria. The aforementioned study showed that Nigeria's oil and gas production will begin to decline from between 2021 and 2022 and went further to show that Nigeria's hydrocarbon export earnings would no longer support imports to the rest of the economy. The said study was conducted at a period that Nigeria was still growing its reserves long before Nigeria started dipping hands into its reserves. Alas, the production decline and its economic impact began to occur before the timelines given by the Chatham House.[17] The study also noted that by 2036, Nigeria will be domestically consuming all its oil and gas production, with emphasizes on the direction that Nigeria's dependence on oil and gas is not sustainable. In view of the above, there is every reason to feel concerned about Nigeria's oil and gas future. Experts in the oil and gas sector have sounded warnings about the dwindling activities in the sector which happens to be the sustainer of the economy of Africa's largest economy- Nigeria. From a sustainability perspective as originated from the Brundtland Report of 1987[18], biofuel has proven to be sustainable in nature as it has shown to increase energy security, reduce Green House Gas emissions, and improve air quality in the urban areas and in doing that, stimulates development in the rural areas without impeding the development of future generations. Put differently, biofuel is made from plants which are grown and can be re-grown over and over. Perennial crops do not even require replanting. The raw materials for the production of biofuel are sustainable as well as renewable in nature and can meet the needs of the present generation without compromising the ability of the future generations to meet their needs hence its sustainable feature. Summarily, sustainability in the use of natural resource for biofuel production is one that is economically viable, conserves the natural resource and also ensures social well-being.

3.4 Cost-Efficient:

Biofuels have the potential to be significantly inexpensive compared to gasoline and other fossil fuels. This is because as the demand for oil increases worldwide and oil supplies dwindles, more sources of biofuel will become obvious. Further to this is that the overall cost benefit of using biofuel is much higher. Biofuel is a cleaner fuel, this means that they produce fewer emissions on burning and can produce no emission when carefully produced. Again, biofuel is adaptable to current engine designs and perform well in most conditions. Consequently, it keeps the engine running for a longer time with less maintenance and brings down the overall pollution check costs.[19] With increase in demand for biofuels, they have a potential of becoming cheaper in future as well and so, the use of biofuels will be less of a drain on the wallet.

In Nigeria, the production and utilization of biofuel can help to reduce the over reliance on foreign nations/companies to refine our crude oil as biofuel can be produced locally thereby reducing the cost associated with the refining of crude oil. Biofuel being an eco-friendly source of fuel equally stands in not only as a more sustainable alternative, it is also cost-effective. A shift to biofuel will bring to the

[16] A study by the Royal Institute of International Affairs (The Chatham House), 2008.
[17] R Okere, 'New Administration and Quest for Energy Security', Guardian online paper, 2015 <http://guardian.ng/business-services/new-administration-and-gquest-for-energy-security/> Accessed on 6th July, 2024 @ 12:35 pm.
[18] World Commission on Environment and Development, '*Our Common Future'* (Oxford University press, New York, NY, USA. 1987).
[19] Conserve Energy Future <http://www.conserve-energy-future.com/advantagesanddisadvantages-of-biofuel.php> Accessed on 13th February, 2024 @ 2:47 pm.

barest minimum the nation's much reliance on fossil fuel and more jobs will be created which will keep our economy secured.

3.5 Job Creation:

The production of plants material and other feedstocks for biofuel production and their conversion to fuels for vehicular and machine use creates new opportunities to the key players in biofuel industry. These key players include the farmers (especially those in the rural communities) and forestry workers who are able to diversify into energy crop production and processing of agroforestry wastes. Job opportunities is also created for the engineers, scientists and construction workers who build and operate advanced biofuel bio-refineries. Biofuel also creates markets for companies to market and distribute biofuels products as well as the companies that research and develop innovation process technologies in biofuel industry. The United States of America, National Corn Growers Association reports that the economic output of the "renewable fuels industry" is estimated at $184 billion and supports over 852, 200 jobs and generates about $14.5 billion in local and state tax revenue annually.[20] Additionally, biofuel are produced locally, its production will create employments more especially in rural areas where the crops required for its production are grown. Considering that most of the energy crops required for biofuel production are cultivated and harvested manually, this will present an opportunity for more persons especially the uneducated youth and in so doing will also empower them with the necessary skills to be experts in agricultural practices.

3.6 Environment-friendly:

Biofuel when spilled are much safer than fossil fuels. This is because biofuel are biological molecules meaning that they are degradable. Bacteria and other organisms that naturally live in the soil and water are able to use biofuel molecules as energy sources and break them down into harmless byproducts[21]. This means that even though concentrated biofuel spill can kill things like plants and smaller animals, they will not persist in the environment and cause further damage or make an area uninhabitable for long periods of time. In addition to this great feature of biofuels is that it can be produced in ways that completely eliminates sulphur which is a component of acid rain. In other words, biofuels can be carefully produced which will ensure that contaminants (including nitrogen) is as low as possible, giving them an edge over fossil fuels because it is easier to avoid contamination in the production phase than to remove contaminants during refining[22]. Additionally, Biofuels could drastically reduce exhaust pipe emissions and the depletion of ozone layer. They can also be used as desirable replacements to toxic octane and cetane enhancers in gasoline and diesel respectively.[23] Furthermore, pure biodiesel and ethanol are both biodegradable without any harmful effect as such any amount of it blended with gasoline will result in pollution reductions.

3.7 Easier to source:

The raw material or biomass needed for the production of biofuel is always and widely available. Biomass is widely available because the society produces a lot of waste thereby making it easier to source. They are infinite as our society consistently produces waste such as garbage, wood and manure. Almost every sector of the economy including agriculture, forestry, colleges/universities, hotels, sports venues, hospitals and even correctional facilities, produce waste that can be converted to biofuel. Every State of the federation has one or more locally generated biofuel feedstocks which can be obtained from agriculture, forest and urban sources like liquid and solid wastes. Most of these wastes like food and plant waste are biodegradable. Biomass can be sourced from anywhere that plants or animals can live. In other words, the availability of biofuel is effectively unlimited as they are produced from renewable

[20] https://www.etipbioenergy.eu/sustainability/societal-benefits-of-biofuels Accessed last on the 4th of August, 2024 @8:37 am.

[21] Biofuels, 'Advantages of Biofuels', <http://www.biofuel.org.uk/advantages-of-biofuels.html> Accessed on 13th February, 2024 @ 2:31 pm.

[22] *Ibid*.

[23] A Galadima, *et al*, 'Biofuels in the Quest for Sustainable Energy Development' (2011) 4(3) *journal of sustainable Development*, 10-19.

sources. Biofuel is produced from different sources ranging from wastes from animal to plants such as algae and other plants that are specifically planted for the fuel. They are easily grown and produced through a simple method like fermentation.

3.8 Reduction of so much Reliance on Fossil Fuel:

Over-reliance or over-dependence on oil has slowed down the development of alternative fuels. Households and corporate bodies have over depended on fossil fuel for their day to day activities and their energy needs are still growing rapidly. To ensure a greater energy security for the nation there is the need to diversify energy supply mix. The development of alternative fuels like biofuel from energy resources that are locally available will help to reduce much reliance on fossil fuel.

Furthermore, biofuel is such a fuel that can be produced domestically and as a result can reduce Nigeria's much reliance on the importation of fossil fuel. With the introduction of biofuel, there will be the tendency of reducing the much reliance that is placed on fossil fuels. As crude oil is being priced down, the need for alternative energy solution becomes imperative. Biofuel as a reliable alternative stands a better chance to reduce the nation's dependency on fossil fuels.[24] If Nigeria embraces the production and utilization of biofuel, the nation's over reliance on imported fossil fuel products will reduce and Nigeria may become less vulnerable to the adverse effects of supply disruptions. Invariably, reducing the demand and over reliance on petroleum could also reduce its price and generate economic benefits for the local consumers.

3.9 Reduction of Green House Gases (GHGs) Emission:

A simple way to describe the activity of biofuel on the environment is that biofuel is produced from plants that take up carbon dioxide from the atmosphere when they grow and return it to the atmosphere when they are combusted. As such there is no net increase in atmospheric carbon. This is in contrast to fossil fuel that uses carbon sources that have been stored in the ground millions of years ago and release same in atmosphere thereby contributing to "man-made" climate change.

Furthermore, it is common knowledge that fossil fuel emits carbons and toxins into the atmosphere and to stem these harmful gaseous emissions, people around the world are to embrace biofuels, such as ethanol or biodiesels, to power their homes, offices, cars and industries. Biofuel can help in reducing to the barest minimum the amount of carbons and toxins released into the atmosphere thereby making them safer alternative to preserve atmospheric quality.[25] Biofuel produces fewer harmful emissions at the point of combustion, whether used in a power plant, or burned in a vehicle engine. This is because they are sourced from organic feedstock and any emission associated with the combustion of biofuel is relative to what is obtainable in the natural world.

4. Conclusion:

Generally, biofuel serves the same purpose as its fossil fuel counterpart. It is the best and a wonderful option because of the obvious reason that it is limitless, eco-friendly and sustainable.

Biofuel invention in Nigeria will present an opportunity for Nigeria to produce its own renewable energy resources in commercial quantity at a cheaper rate which will not only meet the country's needs locally but can be exported to other countries thereby enhancing the country's foreign exchange. Biofuel by its nature is renewable and the materials needed for its production are grown locally and at all season. Its production will aid in combating greenhouse emission issue that is a great concern to the globe as biofuel is ecological friendly. Furthermore, a healthy supply of alternative energy source will help to combat petroleum low pricing and reduce over-dependence on fossil fuel, especially in the transport sector. Of course with a supportive regulatory framework, biofuel benefits and utilization can be actualized even faster. However, no fuel source is perfect, which means that biofuel also has its own shortfalls but the benefits outweigh the problems.

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[24]Conserve Energy Future, 'Overview of Fossil Fuels', < http://www.conserve-energy-future.com/fossilfuel.php> Accessed on 14th February, 2024 @ 5:51 pm.

[25]Green Living <http://greenliving.lovetoknow.com/Advantages and Disadvantagees of Biofuels> Accessed on 13th February, 2024 @ 2:13 pm.

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5. **Recommendations:**

5.1 There should be a political will power on the part of the Government to move from the conventional non-renewable energy source to biofuel which is a sustainable renewable energy source.

5.2 Biofuel markets should be created through mandates, incentives for blending of biofuel with the conventional fuels. In fact, making it mandatory for biofuel to be blended with the conventional fuel throughout the Federation.

5.3 There should be a clear and well defined energy crops that the Government will promote for biofuel production such as sugar cane, palm oil and corn, etc.

5.4 Residual biomass from food production for biofuel production should be promoted.

5.5 The Federal and State Government must play a vital role of disseminating information on biofuel energy resources availability, its benefits and opportunity to the general public in a bid to raise public awareness. This exercise by the Government will help build confidence and acceptance of biofuel technology. Furthermore, creating awareness of the benefits of biofuel energy source by the government (the Federal and States inclusive) and organized private sector, will entice private and public bodies to invest in biofuel industry

5.6 That a viable/coherent legal and regulatory framework be enacted so as to entrench the right and conducive legal environment for the enhancement and development of the biofuel.