To What Extent does Nigeria's Biofuel Policy offer Fiscal Incentives?

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1. Introduction

Biofuels are liquid or gaseous fuels produced from biomass that are generally high in sugar (e.g. sugarcane and sweet sorghum), starch (e.g. corn and cassava) or oils (e.g. soybeans, and palms). Biofuel is used in the form of ethanol (73%) and biodiesel (27%), mostly as a transport fuel. The global production of biofuels has increased steadily from 16Billion litres in 2000 to around 122Billion litres (est.) in 2015 providing ~3.5% of total road transport fuel globally with higher shares achieved in countries, like Brazil, where biofuels provide around 25% of current road transport fuel demand ("Biofuels", 2018). In the US, biofuels in 2017 represented 5% of transport fuel demand ("Biofuels Explained", 2018). The interest in biofuels has been motivated by search for low carbon energy alternatives, increasing oil prices, and the pursuit of energy independence (Sorda et al., 2010). This context against which the interest in biofuels is stirred is part of the larger evolution of the global energy mix – referred to as energy transition. Characteristic of this energy transition is that it is driven by deliberate government policy and hence biofuels policy development arises out of a thoughtful process in attempts to displace liquid fossil fuels.

2. Overview of Nigeria's Biofuels Policy

In Nigeria, the government in August 2005, issued directive on Automotive Biomass Programme for Nigeria ("Nigerian Bio-Fuel Policy and Incentives", 2005) which had the objectives to facilitate an environment for the take-off of a domestic fuel ethanol industry. The aim was to gradually reduce the nation's dependence on imported gasoline, lower environmental pollution, create a commercially viable industry, and precipitate sustainable domestic jobs. Consequently, in 2007, the government gazette of the Nigerian Biofuels policy and incentives codified the intent and seriousness of government with the policy objective "…to firmly establish a thriving fuel ethanol industry utilizing agricultural products as a means of improving the quality of automotive fossil-based fuels in Nigeria.

The Policy shall link the agricultural and the energy sector, with the underlying aim of stimulating development in the agricultural sector." ("Nigerian Bio-Fuel Policy and Incentives", 2005)

The anticipated benefits of Bio-fuel policy include additional tax revenue for the government from the economic activities attributable to the industry, improved farming techniques, electricity co-generation and environmental benefits. To stimulate biofuels adoption, the Biofuels policy envisages a 2-stage process– a seeding phase followed by domestic ethanol production. Furthermore, during seeding, expected to be 5 – 10yrs, fuel ethanol is to be imported for blending up to 10% with gasoline to produce Ethanol 10 (E10[1]) until in-country capacity develops for domestic biofuels production. Consequently, to kick-start the biofuels industry and achieve the stated policy objective, some incentives have been provisioned. As such, this paper assesses the extent to which the fiscal incentives in Nigeria's 2007 Biofuels Policy could achieve the stated objectives.

3. Literature Review

The modern biofuels markets emerged in response to the two oil price hikes in the 1970s. Various countries responded with proposals for alternative fuels policies partly to defend interests of powerful agricultural and agro-industrial sectors as well as to achieve energy independence (Wilkinson, et al., 2013, The Economist, 2013). The two countries which created a biofuels ethanol market and a biofuels productive sector in this period were Brazil and the US, the former using sugar-cane and the latter corn, by use of obligatory mandates, tax exemptions, subsidies and favourable credit. The European Union (EU) adoption of biofuels was driven by commitment to the fulfillment of the Kyoto protocol targets using still the instruments of mandates and tax exemptions. Consequently, Brazil, the US and the EU are together responsible for 91% of global biofuels production amongst the more than 50 countries as at 2010 that had adopted biofuels targets and/or incorporated transport fuels mandates for biofuels development (Wilkinson et al., 2013; USDOE).

A cross–country biofuels policies survey indicates shared and contrasted objectives and tax/fiscal instruments – mandating minimum biofuel blend to reduce GHG emissions from transport fuel, specification of target crop for biofuel production, land use policy, pricing framework, tax incentives, waiver of duties. For example, Brazil taking advantage of global concerns for climate and environment, created the National Alcohol Program (PROALCOOL) in 1975, which leveraged Brazilian ethanol production through incentives and subsidies that were discontinued in the early 1990s. However, the

[1] The Policy also envisages the blending of biodiesel up to 20% with diesel to produce B20

subsidies are indirectly maintained by the Federal Law 8723/1993, which enforce the 20%–25% proportion of ethanol in gasoline (Shikida et al., 2014). In the USA, the policy view is of biofuels as a route to energy independence (The Economist, 2013) hence Federal policy incentivizes biofuel production using three primary tools: (1) offering tax credits to biofuel blenders; (2) imposing import duty on fuel ethanol; and (3) offering direct payments to producers of non-corn biofuel feedstocks and to biofuel manufacturing facilities toward purchasing biomass (Wilkinson et. al., 2013; Naveen & Andrew 2014).

The South African policy includes accelerated depreciation scheme for facilities manufacturing biodiesel as well as a 50% general fuel levy exemption. However, the objectives of the South Africa biofuels program were inspired neither by energy dependence nor concern with CO_2 emissions, but rather to promote rural development, alleviate poverty with a focus on non-cultivated lands (South African Biofuels Regulatory Framework, 2014; Wilkinson et al., 2013). The Indian Biofuels policy approach is based solely on non-food feedstocks to be raised on degraded or wastelands not suited to agriculture, or "surplus or damaged food feedstock" thus avoiding a possible conflict of fuel vs. food security. The policy further recognizes that appropriate financial and fiscal measures will be considered periodically, which include a minimum support price for feedstock prices, to support the development, promotion and differentiated sector utilization of biofuels. The policy has also prescribed fuel blend mandates from the current 2% ethanol blend achieved to increase to 20% by 2030 (National Policy on Biofuels, 2009; India National Policy on Biofuels, 2018).

A major plank of the Nigeria biofuels policy objective is to link the agricultural and the energy sector, with the underlying aim of stimulating development in the agricultural sector. However, a review of the US biofuels policy has shown that the tight linkage between energy and agricultural sector indicate that negative economic impacts are ominous (Naveen and Andrew, 2014). Similarly, Oshewolo, S. (2010) while commending the intent behind the Nigeria biofuels policy, warns that the pre-condition for the success of the program in Nigeria will be the security of food supply and the firming up of environmental standards especially given that the Nigeria biofuels policy envisages that ethanol for gasoline blending will be made from sugarcane, the costs of which are equivalent to roughly 55% - 65% of the final production costs of ethanol (Dias et al., 2010; Kojima et al., 2007).

The twin issues of food security and environmental impact are the thematic concerns shared in the literature on the biofuels industry in Nigeria and globally (Oshewolo, 2010; Agboola et al., 2011; Elijah, 2013; Elliot, 2015). Although Ayoola (2015) asserts that use of waste oil for the production of biofuels circumvents the threat to food security that first–generation biofuels production poses, an economic impact analysis of the method isn't provided by which to assess the economic merit of his process – a process for which Europe has 2billion litres of capacity (The Economist, 2015) supported by tax reductions, up to US$0.60 per liter of biodiesel blended in the European Union (Kojima et al., 2007). This paper therefore seeks to fill the gap in the literature on biofuels in Nigeria by providing an estimate of the impact of the fiscal incentives provided for in the policy.

4. Methodology

To answer the question posed by this paper, the fiscal elements of the policy will be identified, estimations of CapEx and OpEx will be made, and biofuel price scenarios considered. A spreadsheet economic model will be built on Discounted Cash Flow (DCF) basis to assess the fiscal benefit to the biofuels investor, the cost to the government and the consumer from the policy implementation. The analysis will view the fiscal cost to government and consumer from an industry wide perspective and from the view of a single investment in an integrated plantation and biofuels distillery while keeping an eye on the biofuels investors' returns and fiscal benefits.

5. Analysis

Recall the fiscal incentives contained in the biofuels policy, with the referencing, which are reproduced succinctly in Table 1:

Table 1: Incentives in Nigeria Biofuels Policy

S/N	Incentive	Reference
1	Exemption from the 66.67% rule on the cap on allowable capital allowance deduction	▪ Biofuels Policy Sec. 2(3) ▪ CITA 23(7)
2	A 10year Tax Holiday with option of 5year extension	▪ Biofuels Policy Sec. 4(1), Sec. 6(1)
3	10year Waiver of Import Duties	▪ Biofuels Policy Sec. 4(2), Sec. 6(3)
4	Exemption from Value Added Tax	▪ Biofuels Policy (Sec. 6(4))
5	Exemption from With Holding Tax (WHT) on interests and dividends	▪ Biofuels Policy (Sec. 6(2))

The policy, based on 35.60Million litres/day of gasoline consumption, estimated that 1.30Billion litres/annum of ethanol at 10% blend with gasoline will be required in–country, expected to increase to about 2.00Billion litres/annum in 12years. Based on the assumptions in Table 1, the fiscal impact of the biofuels industry is estimated as well as its economic performance.

Table 2: Assumptions to determine Fiscal Impact of Biofuels Industry

Industry Characteristics	**Unit**	**Value**
Plant CapEx	$ Millions	111.33
Plant Capacity	Million Ltrs/yr	10.00
Ethanol Mandate	Billion Ltrs/yr	2.00
CapEx Req'ment	$ Billions	22.27
Ethanol Mandate in Start Year	Billion Ltrs/yr	1.30
Ethanol Mandate in 12th Year	Billion Ltrs/yr	2.00
Ethanol Yield of Sugarcane	Ltrs/mt	42.00
Capacity Rampup Duration	Years	10
Fiscal Terms		
Tax Holiday	Years	10
Industry Lifecycle Duration	Years	20
Initial Allowance	%	95%
Annual Allowance	%	0%
Education Tax	%	2%
CITA	%	30%
With Holding Tax Rate (WHT)	%	10%
Value Added Tax (VAT)	%	5%
Customs Duty	%	20%
Cost Basis and Macroeconomic Rates		
Plant Capacity Util.	%	95%
Price of Ethanol	$/Ltr	0.67
Price of Sugarcane	$/mt	33.19
Feedstock as Pct of OpEx	%	55%
Escalation Ethanol	%	2%
Escalation Sugarcane (Feedstock)	%	2%
Discount Rate	%	10%
Financing Terms		
Debt as Pct of CapEx	%	70%
Interest rate	%	10%
Moratarium	Years	5.00
Loan Tenor	Years	10.00

5.1 Evaluation of Biofuels Industry – Impact on Government Receipts

The policy–granted waivers and exemptions are considered in view of their wider economy impact. To achieve Ethanol blend mandates of 2Billion Litres/annum, a $22.27Billion CapEx spend is estimated over a 10year period, which implies a customs duty waived estimated at $4.01Billion. VAT waived is estimated at $2.33Billion, while it is also expected that the government will subsidize ethanol imports during the seeding period (while capacity is been ramped up) at an estimated rate of 10% the cost of ethanol from a domestic distillery. Consequently, the cost of the subsidies is estimated at $0.84Billion.

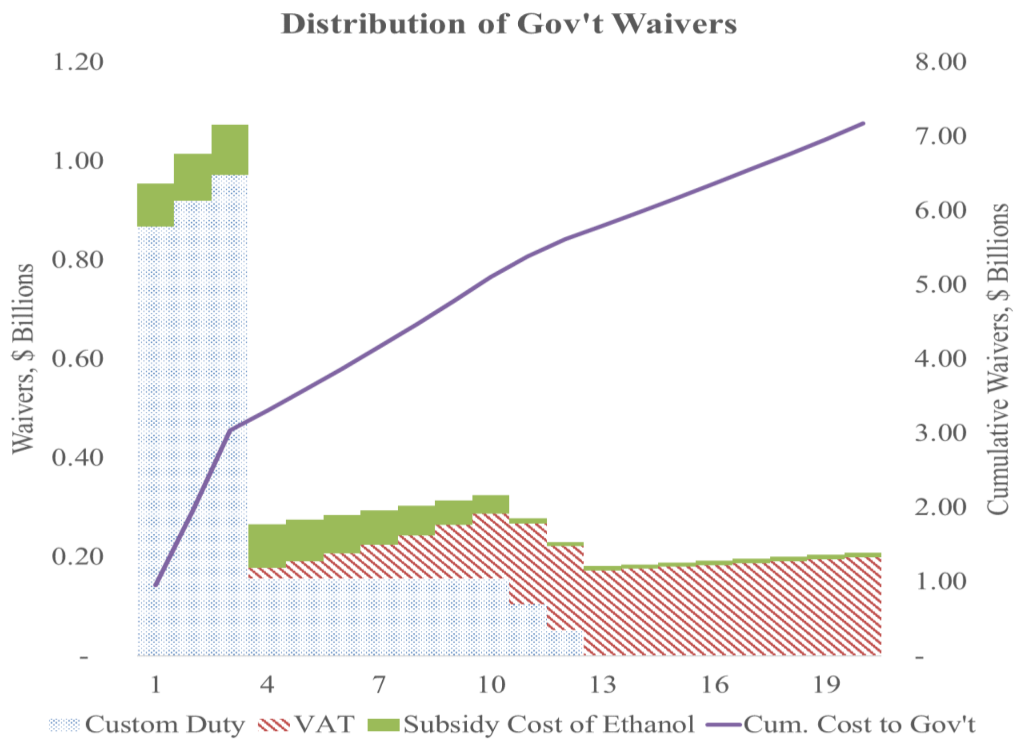

Figure 1: Distribution Profile of Waivers to Biofuels Industry – Customs Duty, VAT and Subsidy

Figure 1 shows that the twenty-year distribution of the waivers amounts to **$7.17Billion**. Customs duties, initially high, declines due to reducing CapEx spend as capacity is built. Whereas VAT waived increases as feedstock consumption and the resulting ethanol production increases. Also note that the subsidy bill on imported ethanol declines as domestic capacity ramps up to mandated volumes. Overall, the waivers are seen to decline in absolute terms over time with most of the waivers granted during capacity ramp-up due to the waiver on custom duties.

VAT on a relative basis increases and accounts for the highest proportion of waivers (>90%) granted to the biofuels industry at the latter period as can be seen in Figure 2. During the latter period, post the twelfth year, the waivers on custom duty drop off to 0% of all the waivers issued as investment in meeting the targets are considered to have wound down.

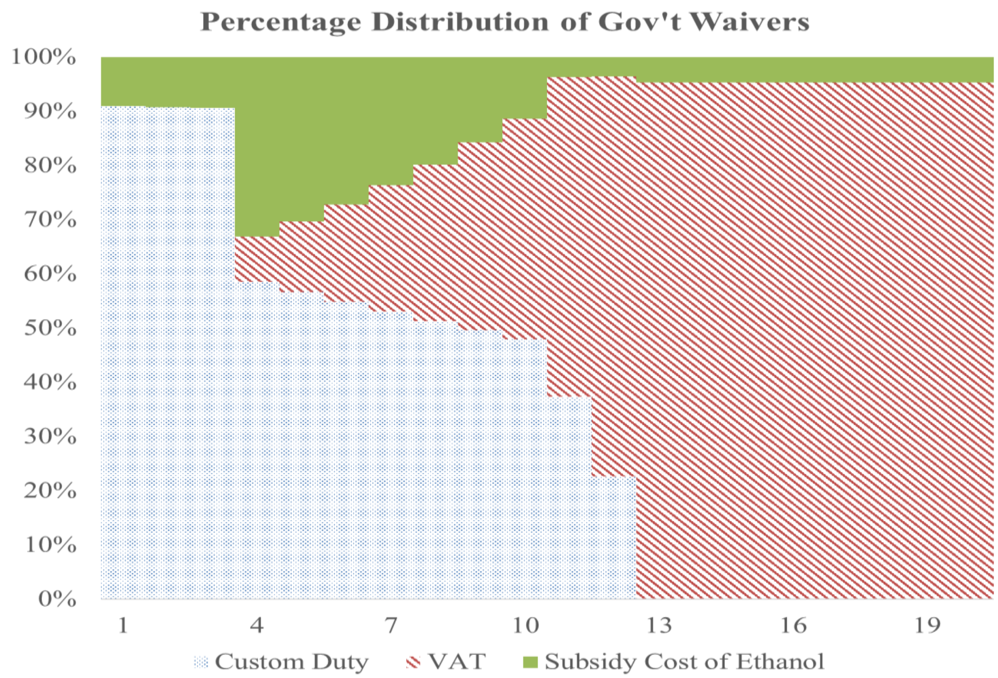

Figure 2: Percentage Distribution Profile of Waivers to Biofuels Industry - Custom Duty, VAT, Subsidy

Furthermore, the economic performance of the ethanol industry is examined based on the results shown in Table 3, where the fiscal assumptions made in Table 2 are maintained. It is seen that the biofuels Industry (based on ethanol production only from sugarcane) is not economically self-sustaining and therefore insufficiently profitable to be taxed even with waivers in place. For the industry to breakeven, it needs to be subsidized by at least $1.95/Litre over 20years, which will amount to $48.94Billion, besides the $7.17Billion in waived taxes and subsidy spend. A long-range bioethanol price of $2.66/Ltr is required by the industry to breakeven on NPV basis, which is ~4X the current ethanol prices of $0.67/Ltr assumed.

Table 3: Economics of Biofuels Industry in Nigeria with Waivers

Viability Indices	Unit	With Waivers
CapEx	$ Bln	22.27
Debt Issued	$ Bln	15.59
OpEx	$ Bln	63.94
Lifecycle Revenue	$ Bln	21.69
Lifecycle Volumes	Bln Ltrs	25.10
NPV0	$ Bln	(48.94)
NPV10	$ Bln	(20.23)
Taxes		
Ed. Tax	$ Bln	-
CIT	$ Bln	-
WHT	$ Bln	-
Total Gov't Take	$ Bln	-
Unit Viability Indices		
Revenue	$/Ltr	0.86
Debt	$/Ltr	0.62
CapEx	$/Ltr	0.89
OpEx	$/Ltr	2.55
GT	$/Ltr	-
Ind. Profit	$/Ltr	(1.95)

5.2 Evaluation of Biofuels Industry – Impact on Consumer Prices

Given the currently estimated price of ethanol to the industry of $0.67/Litre at which it is seen above that the industry performs poorly (NPV10 is **($20.23Million)**), the impact on the retail price of E10 shows that the consumer will pay ₦17.37/Litre above the current gasoline retail price of ₦145.00/Litre. For the industry to achieve a 10% Internal Rate of Return (IRR), the long-range ethanol price will have to be $2.66/Litre, four times (4X) the current estimate ethanol price of $0.67/Litre, and ~10X the current Import parity price of gasoline computed on an energy equivalence basis. The impact of ethanol at $2.66/Litre on E10 retail prices is for E10 to retail at ₦108.57/Litre above the current gasoline retail price. See Table 4 for illustration.

Table 4: Impact Analysis of Ethanol Prices on E10 Blend Retail Prices

	Units	Symbols	Based on \$0.67/Ltr EthOH[2]	Based on \$2.66/Ltr EthOH
Pct Gasoline	%	**A**	90%	90%
Pct Ethanol	%	**B**	10%	10%
Ex. Rate	N/$	**C**	305.50	305.50
Ex-Depot Gasoline	$/Ltr	**D**	0.44	0.44
Ex-Depot Ethanol	$/Ltr	**E**	0.67	2.66
Ex-Depot Ethanol (GEE)[3]	$/Ltr	**F = 1.50*E**	1.01	3.99
Ex-Depot EthOH-Gasoline Blend	$/Ltr	**G = (A*D) + (B*E)**	0.49	0.79
Ex-Depot EthOH-Gasoline Blend	N/Ltr	**H = G*C**	150.65	241.85
Retail Margin	N/Ltr	**I**	11.72	11.72
Retail EthOH-Gasoline Blend	N/Ltr	**J = H + I**	162.37	253.57
Retail Gasoline	N/Ltr	**K = (D*C) + I**	145.00	145.00
Difference from N145	N/Ltr	**L = J - K**	17.37	108.57

Figure 3 shows the Ex-depot[4] price of gasoline and ethanol at which the E10 achieves price parity with the current retail gasoline price of ₦145.00/Litre.

[2] EthOH is Ethanol
[3] Gasoline Energy Equivalent (GEE) – EthOh contains 67% Energy Content of Gasoline
[4] Ex-depot gasoline price refers to the price of gasoline at the depot gate and is computed here as per the PPPRA template. PPPRA is Petroleum Product Price Regulatory Agency. For Ethanol, this analysis assumes for simplicity that the Ethanol depot is within the battery limit of the Ethanol distillery. Although it may be understood that the policy envisaged, by NNPC participation in blending and distribution, that the ethanol depots may be situated outside the distillery. Hence Ex-depot Ethanol price is the same as the price Ex-distillery.

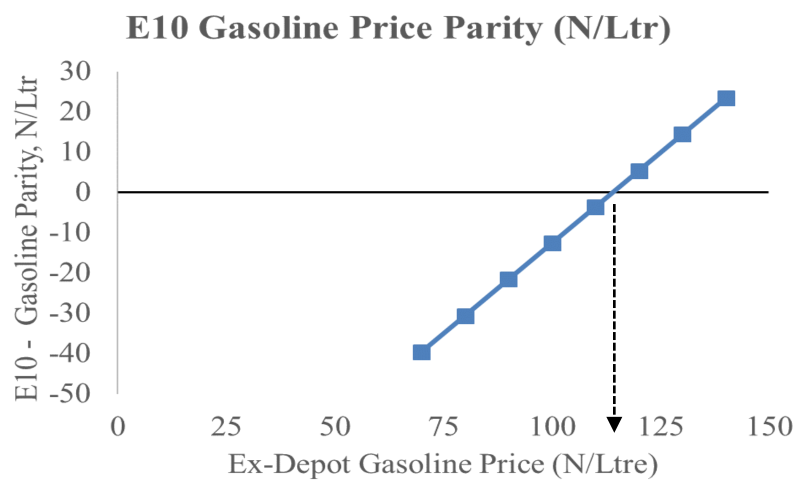

Figure 3: Ex-Depot Gasoline Price to Achieve E10-Gasoline Parity is ~N114/Litre

Keeping Ethanol Price at $0.67/Litre, Fig. 3 shows that the Ex-depot price of gasoline for E10 to be at parity is ₦114.00/Litre, lower than the current Ex-depot gasoline price of ₦133.28/Litre (see D in Table 2).

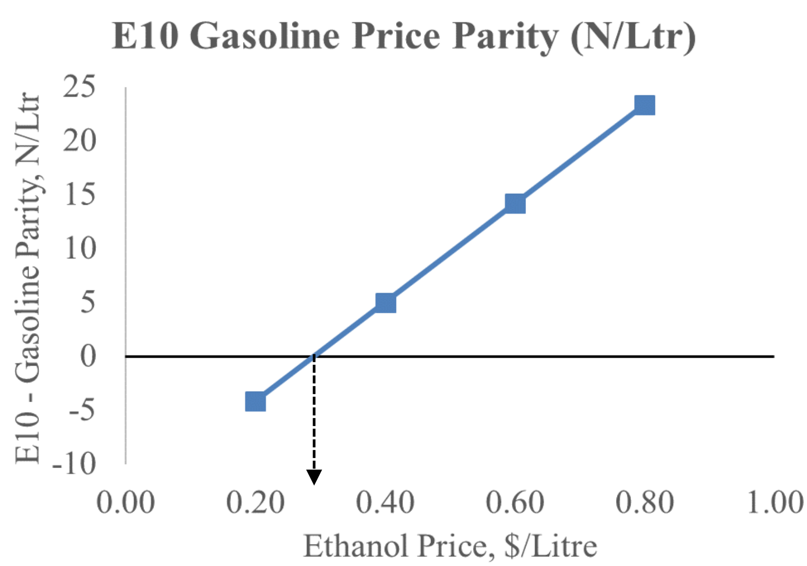

Figure 4: Ex-Depot Ethanol Price to Achieve E10 -Gasoline Parity is ~$0.29/Litre

However, the ethanol price for E10 parity with gasoline keeping Ex-depot gasoline price at ₦133.28/Litre is $0.29/Litre. This latter observation implies that ethanol price will have to be 57% less than current ethanol prices for E10 gasoline parity to be achieved which will worsen the biofuel industry economic performance (NPV10 sinks to **($24.09Million)** from **($20.23Million)**) and increase the industry support required from the government from **$48.94Billion** to **$61.24Billion** over a 20year period. The huge industry intervention required as shown is just as Kojima et al. (2007) have noted: that countries with low or negative taxes on petroleum fuels would find it difficult to launch commercially viable biofuel markets because biofuels have historically required large tax reductions to compete with petroleum fuels.

Summarily, the biofuels policy will cost the FGN **$4.01Billion** in forgone duties, **$2.33Billion** in forgone VAT, and import subsidies of **$0.84Billion** thus yielding an estimated total of **$7.17Billion** over a 20year period. Furthermore, over the same period, the government will have to bear a subsidy burden of **$48.94Billion** to allow the biofuels industry breakeven.

From the consumer end, at the current prices of gasoline and ethanol, the E10 blend will cost the consumer **₦17.37/Litre more** than the current gasoline price of ₦145.00/Litre if unsubsidized. Allowing that the government will subsidize the consumer, at the policy assumed gasoline consumption level of 35.6Million Litres/day this will translate to an annual consumer subsidy burden of **$739Million per annum**.

5.3 Evaluation of Integrated Biofuels Plant Project

The extent of the fiscal incentives offered by the biofuels policy is now considered from the perspective of a biofuels plant integrated with a sugar cane plantation. It will be recalled that one of the stated benefits of the biofuels policy is to deliver energy benefits, specifically co-generation benefits – where an ethanol distillery also produces electricity for sale to the power grid. Consequently, this analysis will consider the integrated biofuels plant project under the following production cases shown in Table 5:

- Case 1: Production of Ethanol, Animal Feed, and CO_2
- Case 2: Production of Ethanol, Animal Feed, CO_2, Refined Sugar, and Electricity

Table 5: Details of Production Cases for Integrated Project

	Units	Scenario No. 1	Scenario No. 2		
Plantation CapEx	$ Million	130.99	130.99		
Plant CapEx	$ Million	151.75	203.51		
Products				**Quantity Produced**	**Units**
Ethanol	Binary	1	1	51.87	Million Ltrs/yr
Yeast	Binary	1	1	63,000	Mt/yr
CO2	Binary	1	1	2,000	Mt/yr
PW Sugar	Binary	0	0	108,030	Mt/yr

Refined Sugar	Binary	0	1	108,030	Mt/yr
Electricity	Binary	0	1	64	MW

Figure 5 and Figure 6 show the price history of refined sugar and ethanol respectively – which are key products from a biorefinery – that form the basis for the choice of ex-distillery ethanol price of $0.67/Litre, and refined sugar of $427.60/mt.

Figure 5 details the assumption where electricity from the co-generation facility is priced at $0.20/kWhr and the sugar cane yield per hectare is 65mt/Ha.

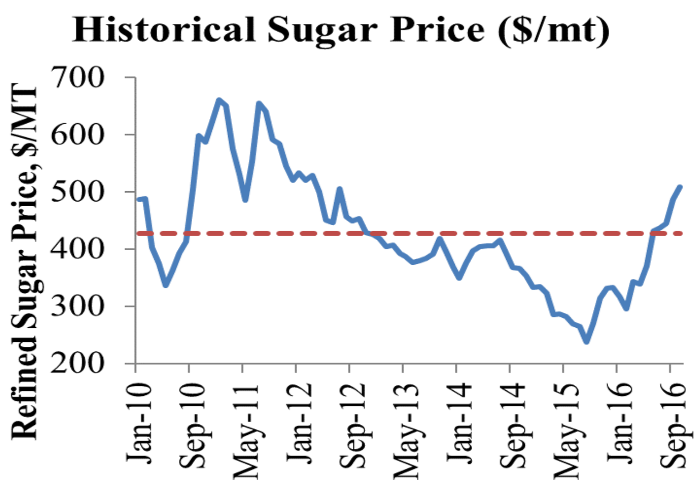

Figure 5: Historical Price of Sugar[5]

[5] Sugar Price is from International Sugar Agreement (ISA) daily price, raw, f.o.b and stored at greater Caribbean ports

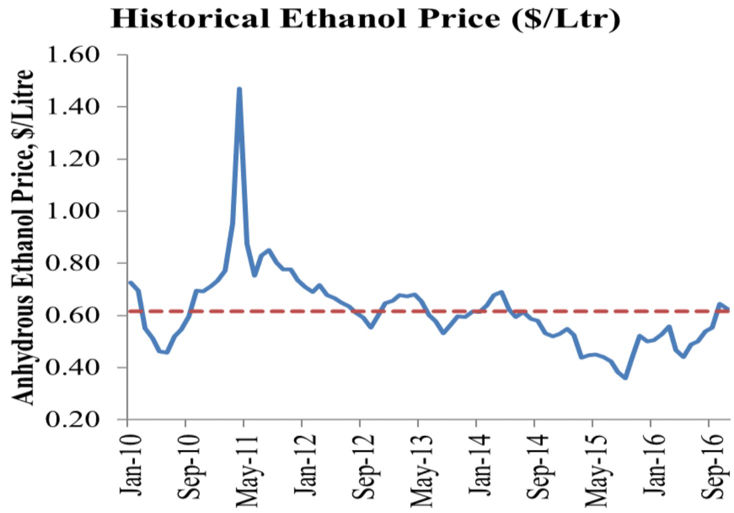

Figure 6: Historical Price of Ethanol[6]

Table 6: Assumptions for Integrated Biofuels Project

[6] Ethanol Price is referenced to Sao Paulo and sourced from CEPEA

Project Details	Units	Values
Project Start Year		2017
Capacity Rampup Duration	Years	6
Industry Lifecycle Duration	Years	25
Discount Rate	%	15%
Capacity Utilization	%	100%
Qty of Sugar Cane	Million mt	1.24
Production		
Ethanol	Million Ltrs/yr	51.87
Yeast	Million mt/yr	0.063
CO2	Million mt/yr	0.002
PW Sugar	Million mt/yr	0.108
Refined Sugar	Million mt/yr	0.108
Electricity	MWhr	408,593.21
Product Prices		
Ethanol	$/ltr	0.67
Yeast	$/mt	400.00
CO2	$/mt	40.00
PW Sugar	$/mt	384.80
Refined Sugar	$/mt	427.60
Electricity	$/kWhr	0.20
OpEx - Biofuels Plant	**Units**	
Feedstock Price	$/mt	33.19
Feedstock as % OpEx	%	55%
Annual OpEx	$ Million	38.39
OpEx - Plantation		
Startup OpEx (first 6 years)	$ Million	2.00
Post-Ramp up OpEx	$ Million	38.00
Land Lease	$ Million	0.07
Conversions		
SugarCane Yield/Ha	mt/ha	65.00
Ethanol Yield/mt SC	Ltrs/mt	42.00
Sugar Yield	mt Sugar/mt SC	0.09
Electricity Consumption	kWhr/Ltr	2.93
Financing Assumptions		
Debt as Pct of CapEx	%	55%
Interest rate	%	6%
Moratarium	Years	6.00
Loan Tenor	Years	15.00

The fiscal assumption scenarios under which the integrated biofuels project is evaluated is shown in

Table 7.

Table 7: Fiscal Assumptions

Fiscal Assumptions	Units	Waivers	No Waivers
Tax Holiday	Years	10	0
Initial Allowance	%	95%	95%
Annual Allowance	%	0%	0%
% Ass. Profit as CA Recovery	%	100%	66.67%
Education Tax	%	2%	2%
CITA	%	30%	30%
With Holding Tax Rate (WHT)	%	10%	10%

The integrated project is evaluated by adhering to the principles of Transfer Pricing Regulations, where sugar cane produced by the plantation is transacted with the biofuels plant on an arm's length basis recognizing that the biofuels plant feedstock can be sourced from out growers as envisaged by the policy just as well as the out growers can supply feedstock for some other Agro-Allied industry purpose.

5.4 Economic Viability Indices

Key economic viability indices will be used to measure the extent or quantum of the fiscal incentives granted by the biofuels policy. The impact to both investor and government for the integrated project performance is judged with respect to the indices described below.

Net Present Value (NPV): Refers to the Present Value (PV) of future Net Cash Flows discounted at a given hurdle rate. A project is considered viable if its NPV discounted at the investor's hurdle rate, D%, exceeds zero (ie NPV @ D% > 0). Generally, the higher the NPV, the more favourable the project is considered. NPV computed by Eq. 1

$$\boldsymbol{NPV = \sum_{t=0}^{N} \frac{NCF_t}{(1+D)^t} \ldots\ldots Eq. 1}$$

Internal Rate of Return (IRR): This refers to the discount rate, D in Eq. 2, which makes the NPV of all cash flows from a project equal to zero. IRR calculations rely on the same formula as NPV does.

$$\boldsymbol{IRR = \{D | NPV = 0\} \ldots . Eq. 2}$$

Government Take (GT): An important metric that measures government receipts from the integrated biofuels project. For the project it is computed as the sum of government inflows which include

Education Tax (ET), Corporate Income Tax (CIT), and With–Holding Tax (WHT) on interests. Value Added Tax (VAT) and Customs Duties (CD) are excluded in this computation. GT is given as:

$$\boldsymbol{GT} = \sum_{t=0}^{N} \boldsymbol{ET_t} + \boldsymbol{CIT_t} + \boldsymbol{WHT_t} \quad \ldots .\boldsymbol{Eq.3}$$

6. Results of Economic Analysis

The integrated biofuels plant economics is reported in Table 8 and Table 9 for both Case 1 and Case 2 respectively considering the impact of fiscal waivers.

Table 8: Economic Indices of Integrated Biofuels Project (Equity) – Case 1

	Unit	**With Waivers**	**Without Waivers**
CapEx	$ Mln	282.74	282.74
Debt Issued	$ Mln	155.51	155.51
OpEx	$ Mln	2,969.68	2,969.68
Lifecycle Revenue	$ Mln	2,598.52	2,598.52
Lifecycle Qty of SC	Mln mt	23.47	23.47
IRR	%	na	na
NPV0	$ Mln	(500.10)	(515.87)
NPV 15%	$ Mln	(190.18)	(193.66)
Ed. Tax	$ Mln	1.70	2.47
CIT	$ Mln	-	0.96
WHT	$ Mln	-	14.05
Gov't Take (GT)	$ Mln	1.70	17.48
GTPV 15%	$ Mln	0.10	3.58
Project Life	Years	25	25
Time to Payout	Years	0.00	0.00
Payout Year		**0**	**0**

The NPV15 of Integrated Project under Case 1 is **($190.18Million)** with waivers and **($193.66Million)** without waiver while Gov't Take (GT) under Case 1 with waivers is **$1.70Million** and without waivers GT is **$17.48Million**, a difference of **$15.78Million.** This result implies that under Case 1 where only Ethanol, Animal Feed, and CO_2, are produced the project is unviable to equity investor even with the waivers thus showing the inefficacy of the Government waivers to transform the unviable project to one that is viable at the given cost – price structure of the project.

Table 9: Economic Indices of Integrated Biofuels Project (Equity) – Case 2

	Unit	With Waivers	Without Waivers
CapEx	$ Mln	334.50	334.50
Debt Issued	$ Mln	183.97	183.97
OpEx	$ Mln	2,997.30	2,997.30
Lifecycle Revenue	$ Mln	5,888.70	5,888.70
Lifecycle Qty of SC	Mln mt	23.47	23.47
IRR	%	29%	25%
NPV0	$ Mln	2,259.97	1,879.83
NPV 15%	$ Mln	247.30	164.71
Ed. Tax	$ Mln	31.65	58.64
CIT	$ Mln	449.25	785.58
WHT	$ Mln	-	16.81
Gov't Take (GT)	$ Mln	480.90	861.04
GTPV 15%	$ Mln	30.62	113.21
Project Life	Years	25	25
Time to Payout	Years	7.38	7.18
Payout Year		**2024**	**2024**

Under Case 2, NPV15 with waivers is **$247.30Million** while without waiver it is **$164.71Million**. GT with waivers in place is $380.14Million less than without waivers at $861.04Million. Recall that Case 2 includes the production of Refined Sugar and Electricity in addition to Ethanol, Animal Feed, and CO_2 production as per Case 1. The viable economics that results from the inclusion of refined sugar and electricity from the biofuels plant is also reported by Dias et al. (2010) who have verified that selling of surplus electricity produced as by-product of bioethanol from distillation positively impacts the economics.

Note that in Case 2, the waivers only serve to enhance the project value to the equity investor which is already positive under the no-waivers scenario (NPV15 of $164.71Million, IRR of 25%). Figure 6 shows comparison of GT profile between Case 1 and Case 2 to more deeply reveal the impact of waivers both in tax dollars received and the timing of receipts.

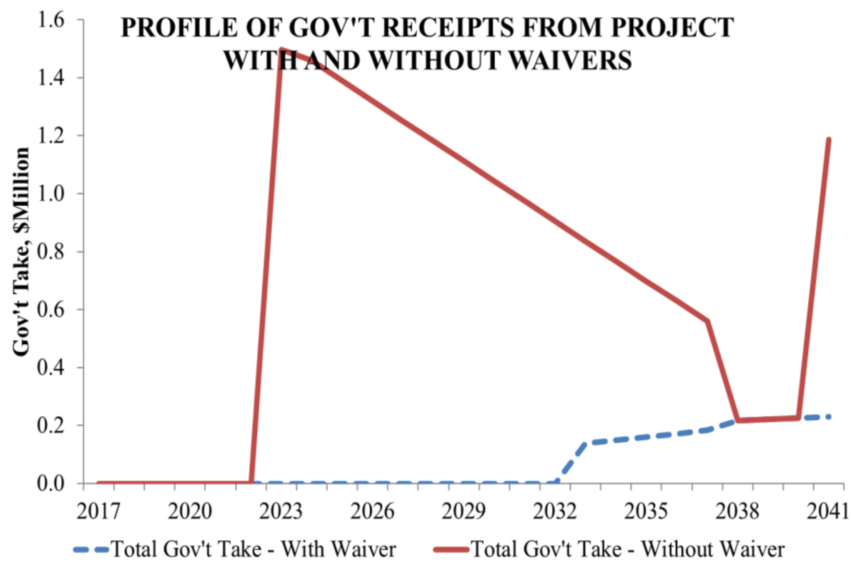

Figure 7: Profile of Gov't Receipts under Case 1

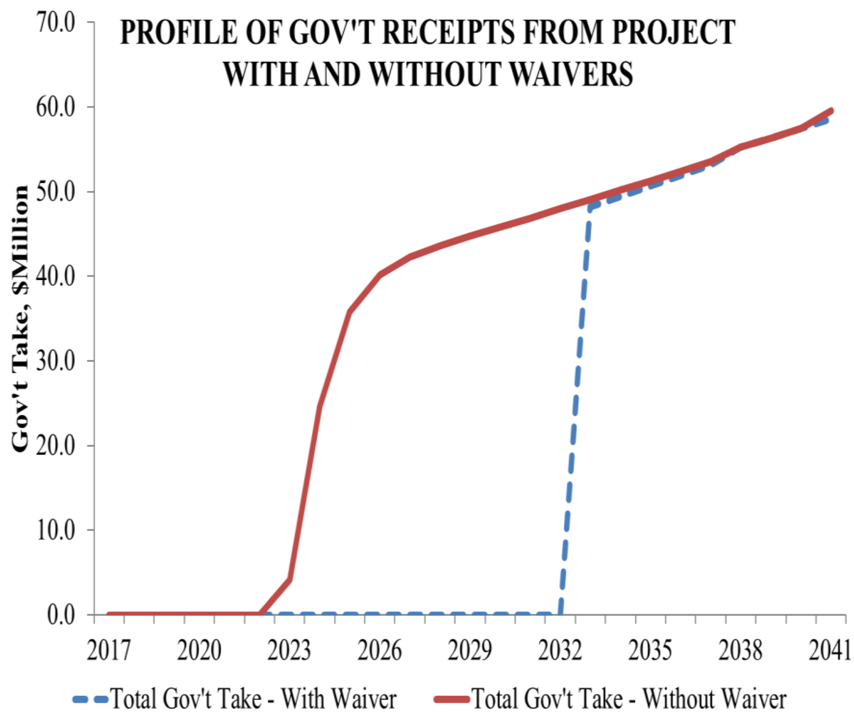

Figure 8: Profile of Gov't Receipts under Case 2

From the profiles above, it is seen that with waiver, the commencement of GT is delayed by 10 years in both cases relative to the commencement of GT without waiver. This delay in tax receipts occasioned by the waiver in both cases serve to even depress government take further when viewed from a present value perspective. Consider Case 2 where GT with waivers is $480.90Million in undiscounted terms, while in discounted terms amounts to $30.62Million, which is about 6% the value in undiscounted terms. In Case 1, with the waiver, GT is much lower than without waiver, even after taxes begin to flow. This contrasts with Case 2, where once GT (with waivers) commences, the level rises to the level it would be without waivers. Furthermore, in Case 1, GT without waiver declines from 2024 to 2037 which is due to WHT imposed on reducing interests paid by the investor and constitutes most of the inflow to the government under this case; the lack of taxable income against which to charge the CIT enables the bulk of tax receipt to be the WHT on interests. The spike at the end of the profile is due to the later stage availability of taxable income on which the CIT rate is applied.

A breakdown of the source of revenue to the integrated project under Case 1 and Case 2 is shown in Table 10 below:

Table 10: Revenue Contribution of Products from Integrated Biofuels Plant

Revenue Source	**Case 1**	**Case 2**
Ethanol	57.89%	18.49%
Yeast	41.98%	13.41%
CO2	0.13%	0.04%
PW Sugar	0.00%	0.00%
Refined Sugar	0.00%	24.58%
Electricity	0.00%	43.48%

Under Case 1 Ethanol contributes ~58%, Animal feed ~42% and CO_2 sales less than 1% to the revenue while under Case 2 sales from Electricity contribute ~44%, followed by Refined Sugar ~25%, then Ethanol at ~19% and Animal Feed at 13%. For the economically viable Case 2, the revenue distribution shows that the viability of the integrated biofuels project relies more on Electricity sales and Refined Sugar than on Ethanol. This implies at least two things:

- Given the poor record of payments for electricity supplied in Nigeria, the fact of 44% revenue derived from electricity is a high risk to the project;
- The biofuels project receives waivers effectively to refine sugar, an activity with its own set of fiscal incentives as contained in the Nigerian Sugar Master Plan (National Sugar Development Council, 2011).

Given the focus of ethanol in the economic viability of the integrated biofuels projects, attention will be paid to the price of ethanol with respect to how it impacts on the extent of government take sacrificed due to waivers (Forgone Government Take, or Government Waivers) where Forgone Government Take (FGT) is defined as:

$$FGT = GT_1 - GT_2 \ldots\ldots Eq.4$$

Where GT_1 is Government Take without waivers, and $GT_2$is Government Take with waivers. Figure 9 shows how FGT varies with ethanol price under both Case 1.

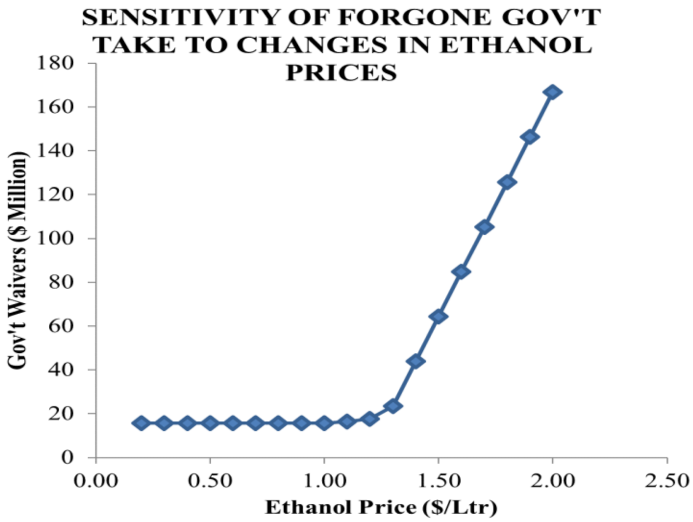

Figure 9:Impact of Ethanol Prices on Forgone Gov't Take - Case 1

While the Forgone GT under Case 2 is shown in

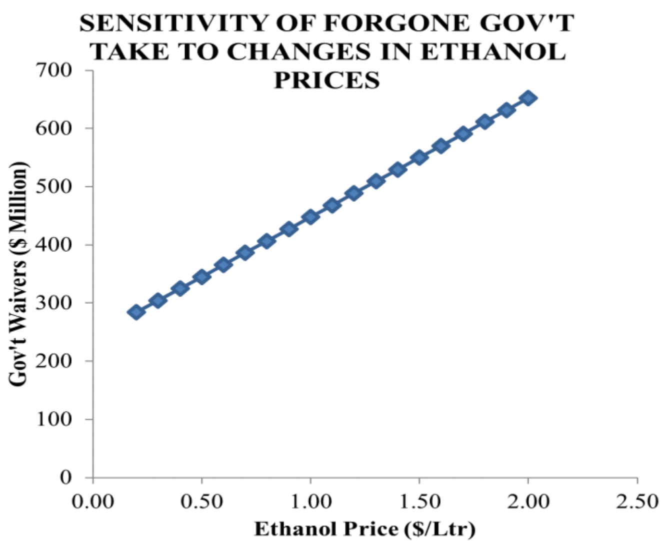

Figure 10:Impact of Ethanol Prices on Forgone Gov't Take - Case 2

For Case 1, the extent of government waivers remains constant at $15.77Million for ethanol prices up to $1.00/Litre and beyond $1.30/Litre the extent of waivers increases by $20.47Million for every $0.10/Litre increase in ethanol prices. This profile indicates there is a minimum ethanol price required for government waivers to increase with increasing project profitability (read ethanol prices). However, for Case 2, over the price range considered government waivers increase with the ethanol price due to the support provided by the other sources of project revenue. These profiles emphasize that government waivers are stagnant below a certain profitability threshold.

7. Conclusion

The Nigeria biofuels policy seeks to firmly establish a thriving fuel ethanol industry by utilizing agricultural products thus linking the agricultural and the energy sectors, with the underlying aim of stimulating development in the agricultural sector. To achieve the establishment of a thriving fuel ethanol industry, the policy set forth some fiscal incentives to stimulate private sector involvement. Most of the literature surveyed on the biofuels industry in Nigeria focused on the environmental and food security aspects of the policy drawing on experiences from other climes. The concluding points below will summarize the key findings of the paper:

1. The 2Billion Litres/annum ethanol blend mandate requires a 10year estimated $22.27Billion CapEx spend. This implies waivers and subsidies of **$7.17Billion** over a twenty-year period;
2. The biofuels industry (based on ethanol production only) is not economically self-sustaining and thus requires **$48.94Billion** (with the waivers in place!) subsidy over 20years for the industry to breakeven;
3. At the current ethanol price of $0.67/Litre, the retail price of E10 will be **₦17.37/Litre** above the current gasoline retail price of ₦145.00/Litre and **₦108.57/Litre** above the current gasoline price for the industry to achieve a 10% IRR;
4. The ethanol price for E10–gasoline parity is $0.29/Litre, a price 57% less than current ethanol prices, which will worsen the biofuel industry economic performance;
5. This analysis also considers an integrated biofuels plant project under the following production cases:
    a. Case 1: Production of Ethanol, Animal Feed, and CO2
    b. Case 2: Production of Ethanol, Animal Feed, CO2, Refined Sugar, and Electricity
6. Under Case 1, the project is unviable to equity investor even with the waivers thus showing the inefficacy of the Government waivers to transform the unviable project to one that is viable. Gov't Take (GT) with waivers is $1.70Million and without waivers is $17.48Million;
7. Under Case 2, NPV15 with waivers is **$247.30Million** while without waiver it is **$164.71Million**. GT with waivers in place is $380.14Million less than without waivers at

$861.04Million. The waivers in this Case 2 only serve to enhance the project value to the equity investor which is already positive under the no-waivers scenario (NPV15 of $164.71Million, IRR of 25%);

8. The economically viable project derives 68% of its revenue from electricity sales (44%) and refined sugar (24%) which implies that the project is exposed to the high risk of non-payment in the Nigerian electricity market and receives waivers effectively to refine sugar, an activity with its own set of fiscal incentives;

The extent of the biofuels fiscal incentives as prescribed in the policy has been highlighted, exposing the impact the introduction of biofuels to the fuel mix will have on consumer spending, illustrated the inefficacy of the waivers under the industry cost–price structure and the possible misdirection of the biofuels policy.

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