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# Ghana's biofuels policy: challenges and the way forward

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**Abstract**
Liquid biofuels have come up strongly as possible substitute to conventional fossils fuels and woodfuels apparently because of its perceived environmental benefit, sustainability and recent hikes in petroleum fuel prices. These have led most countries to include biofuels in their energy mix to mitigate climate change effect caused by petroleum fuels and also to ensure energy security. Ghana as a developing country has also identified the potential of biofuels in her energy mix by setting some targets in its Strategic National Energy Policy (SNEP). This paper analyses the implications of the policy as presented in SNEP. It also looks at programmes put in place to achieve the set objectives and the possible challenges that are likely to be faced in their implementation. The paper concludes by calling for strong governmental involvement in achieving the set objectives.


**Keywords:** Biofuels, Policy, Incentives.

## 1. Introduction

Worldwide production of liquid biofuels have seen an upsurge driven purely by hikes in oil prices, the desire to become energy independent and perceived environmental benefit associated with the use of biofuels. Production of ethanol and biodiesel, the two main liquid biofuels is reported to have exceeded 53 million liters in 2007 up by about 43 per cent from 2005 [1]. Brazil and the United States continue to be leading producers of ethanol with the latter overtaking the former as the leading producer globally but also the largest consumer. Europe on the other hand is the leading producer of biodiesel accounting for nearly 80 per cent of global production in 2004 [2]. Increases in production and advances in production technologies have been boosted by the direct involvement of governments in these countries. The European Union (EU) recently set a target of 10 per cent substitution of diesel and petrol with biodiesel and ethanol [3]. The United States on the other hand have set a target of producing 136 billion liters of biofuels by 2022. The setting of these targets by governments in these countries together with the provision of some incentives such as tax credits have led to increased production of biofuels in their respective countries. Sub Sahara Africa lags behind the rest of the world in terms of access to modern forms of energy. Woodfuels continue to dominate primary energy sources constituting about 65 per cent of total energy demand, whiles access to electricity is less than 20 per cent in rural settlement.
Ghana is no exception, even though access to electricity is about 54 per cent, only 20 per cent of rural dwellers enjoy electricity [4]. The economy is entirely dependent on imported crude oil which constitutes

about 30 per cent of the total energy demand. Woodfuels in the form of charcoal and firewood constitutes more than 70 per cent of primary energy sources whiles crude oil and hydro takes the remaining less than 30 per cent [5]. Consumption of petroleum products is growing at about 3 per cent per annum; this implies that by 2015 Ghana's petroleum demand will reach about 3 billion liters per annum. As shown in the Table 1 below, due to the price hikes in crude oil, import bills of crude oil have been rising tremendously. In 2007 import bills of petroleum products hit an all time high of $2 billion. This figure rose to about $2.3 billion in 2008 primarily due to hike in petroleum on the inhternational market and the strength of the national currency against the dollar. The ever increasing cost of crude oil on the international market is seriously affecting Ghana's balance of payment deficit. According to the Monetary Policy Committee [6], Ghana's balance of payment hit an all time high of $528.4 million in the first quarter of 2008 as compared to $335.1 million for the same period in 2007. This is largely due to the crude oil price on the international market which crossed the $100 per barrel threshold in the early part of 2008.

Table 1. Total cost of oil import in Ghana

| Year | Cost of oil imports (US$) |
|---|---|
| 2005 | 1,129,440,000 |
| 2006 | 1,646,160,000 |
| 2007 | 2,095,020,000 |
| 2008 | 2,349,220,000 |

*Sources: Energy Commission, 2006 and Bank of Ghana*

Ghana's transportation sector is highly dependent on the road sector resulting in high demand for diesel and petrol. Petrol and diesel constitute about 80 per cent of all petroleum products consumed in the country. Demand for diesel is growing at an annual rate of about 5 per cent. Climate change has been attributed to the combustion of petroleum derived fuels especially diesel and petrol which are used extensively as transportation fuels. The effect of climate change is believed to have been the cause of the recent draught which resulted in the energy crises that visited Ghana in 2006-2007. Also the subsequent floods in the northern and westerns regions of Ghana in 2007 have also been attributed to climate change. Ghana even though has struck oil in commercial quantities, production of the oil is yet to begin and the country is presently dependent solely on imported crude oil to meet its demand. In addressing energy security, climate change and balance of payment problems together with other problems such as high unemployment and low mechanized agriculture facing the country, biofuels come in handy as an alterative option for government to pursue which will in some way provide solutions to some of these problems.

## 2. Energy policy

The government of Ghana has been pragmatic by coming out with an energy policy, the Strategic National Energy Policy (SNEP). The policy on the development of biofuels followed recommendations made by the Biofuels Committee set up in 2005 [7]. Among their recommendations were;

- 20 per cent of national gasoline consumption replaced with biodiesel by 2015
- 30 per cent of national kerosene consumption replaced with jatropha oil by 2015
- Removal of institutional barriers

SNEP [8] may have considered the recommendations too ambitious and therefore adopted the following target;

- 10 per cent penetration of liquid fuels by renewable and alternative fuel by 2015 expanding to reach 20 per cent by 2020
- To become self-sufficient in petroleum products by 2015 and net exporter by 2020

In order to achieve the target of 10 and 20 per cent substitution of liquid fuels by 2015 and 2030 respectively, a road map was drawn to introduce biofuels onto the market by 2008. B5 (a mixture of 5 per cent biodiesel and 95 per cent diesel) and E10 (a mixture of 10 per cent ethanol and 90 per cent petrol) was expected to be introduced onto the market by the end of 2008. Looking at development so far this target is not likely to be achieved (Reasons for this are discussed below). After the introduction of

 

B5 and E10 an ultimate blend of B10 and E85 are expected to be on sale by 2020. Even though these targets are laudable there is some ambiguity about them. It is difficult to tell whether the target of 10 and 20 percent penetration by renewable is for transport fuels or the total petroleum fuel consumption. The two scenarios are analysed and presented below.

As shown Figure 1 below in scenario one, assuming 10 per cent penetration of total petroleum products by renewables are achieved by 2015 and 20 per cent by 2020, then the country needs to develop the capacity to produce about 298,646,472 litres and 692,426,224 litres of biofuels respectively. On the other hand in scenario two, if the target is to meet 10 per cent of transport fuels in the form of diesel and gasoil by 2015 and 20 per cent by 2020 then the country requires a production capacity of about 160,002,455 and 336,328,377 litres of biofuels by 2015 and 2020 respectively. In both scenarios the country needs the deployment of sufficient large, medium or small scale production capacities to meet this demand.

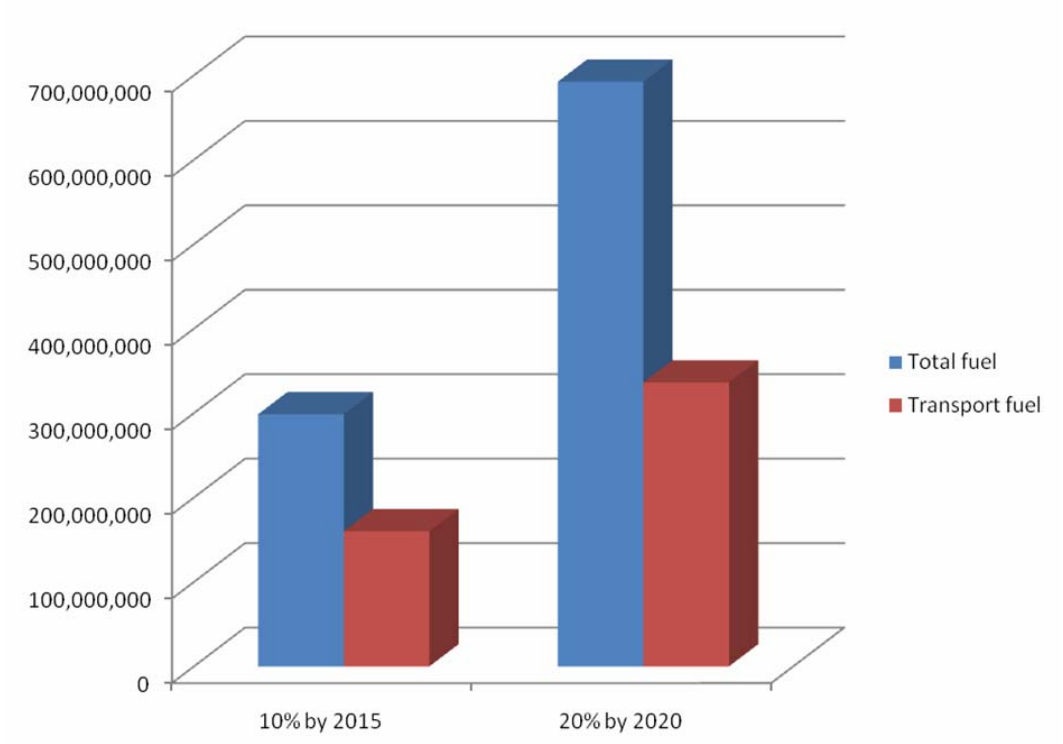


Figure 1. Production capacity of biofuels in 2015 and 2020 as a percentage of total petroleum product consumption and also total transport fuel consumption

Furthermore assuming exactly 10 per cent of annual Consumption of diesel and gasoline separately are substituted with biodiesel and ethanol respectively by 2015 then 170 million and 81 million litres of biodiesel and ethanol respectively should be produced in the country. As shown in Figure 2 below, by 2020 Ghana should develop the capacity to produce about 430 million and 170 million litres of biodiesel and ethanol respectively. This will result in 8 and 17 per cent substitution of petroleum fuels with renewables by 2015 and 2020 respectively going by scenario one. Meanwhile the same will result in 12.56 per cent and 25.47 per cent substitution of petroleum fuels with renewables by 2015 and 2020 respectively going by scenario two.

 

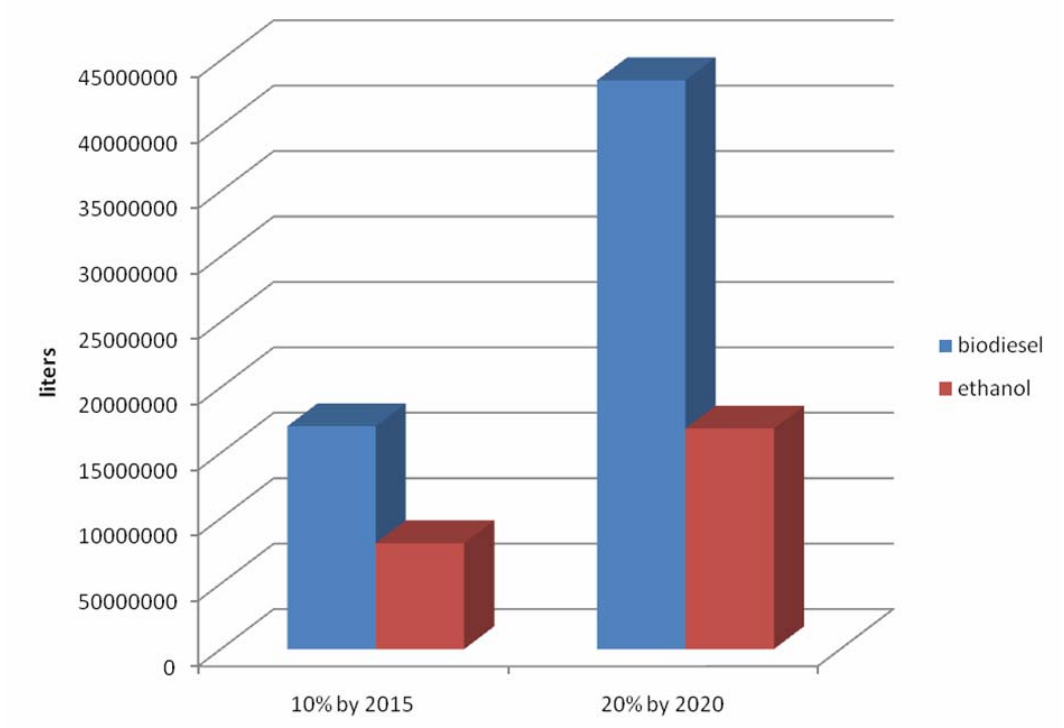


Figure 2. Biodiesel and ethanol demand as a percentage of total transport fuel consumption

**3. Policy implications**

Biofuels are generally produced from agricultural products hence the need to have sufficient feedstock to meet the demand. Ghana is blessed with many oil bearing food crops some of which are listed in table 2 below. Until recently cultivation of jatropha was not seen as an economic venture apparently because of the low end use of the oil in Ghana. The same can be said of coconut and palm kernel oils which even though extracted on small and medium scale are not put to large scale industrial use therefore affecting the quantities produced annually. Ghana being fortunate to lie within the $\pm 10^{o}$ north or south of the equator which is classified as a good place for palm fruit cultivation has taken advantage of this and cultivated about 240,000 ha of land with palm fruit under large, medium and small scale farms [9]. Though production levels of palm oil are not too impressive as shown in table 1 below, the country has a huge potential to produce more palm oil for both domestic and industrial use. Currently there is a Presidential Special Initiative (PSI) on palm oil which is expected to have about 300,000 ha of land cultivated with palm fruits. Already about 100,000 ha has been cultivated. Because of the direct involvement of government in the process, rapid success is being achieved. Ghana is a net importer of soybean even though the country produces about 50 MT with a potential to produce about 700,000 T annually [9].

Assuming extraction efficiency of about 50 per cent and 100 per cent conversion of vegetable oils into biodiesel in all cases, seed requirement for soybean was found to be 1, 500, 000 T and 4,000,000 T in 2015 and 2020 respectively. As shown in Figure 3, seed requirement for jatropha, coconut and were found to be not too different. Palm oil and palm kernel oil had the lowest seed requirement to meet the national demand by 2015 and 2020. The other question worth considering is the land area required to produce these feedstock since all the various oil seeds have different yields per hectare. This is a very legitimate concern especially when the same piece of land used to grow food can be converted to grow energy producing crops. Published works on the yield of the various feedstock are very scarce for Ghana. What is available is published data on yields of the feedstock per hectare in other countries. It will be wrong to use these published data for purposes of comparison because it is a well established fact that yield of food crops depend largely on the soil conditions and farm practices employed. Also another factor like the number of time in year that seeds can be harvested in a year can also affect the choice of feedstock together with the availability of land and cultural practices employed.

Presently the country lacks the capacity to produce the large number of seeds required to produce the quantities of biodiesel needed. Presently palm oil production stands at about 800 000 T per annum. Even

 

though coconut production has remained quite stagnant at about 270 000 T per annum [10]. The same cannot be said of its conversion into vegetable oil in the country. Large scale production of coconut oil is almost nonexistent in the country hence the absence of data on it. The same can be said of palm kernel oil which is left to small scale industries to process. Production of sunflower and soybean is quite low as shown in table 2 below, ruling them completely out at least in the immediate future as a potential source of feedstock for large scale production of biodiesel. However, depending on the focus of government, the two vegetable oils can become potential feedstock later. Data on production of citronella, castor and neem seed oils are practically nonexistent together with used vegetable oils. In the interim, the choice of feedstock may readily fall on palm, jatropha, coconut and palm kernel oils.

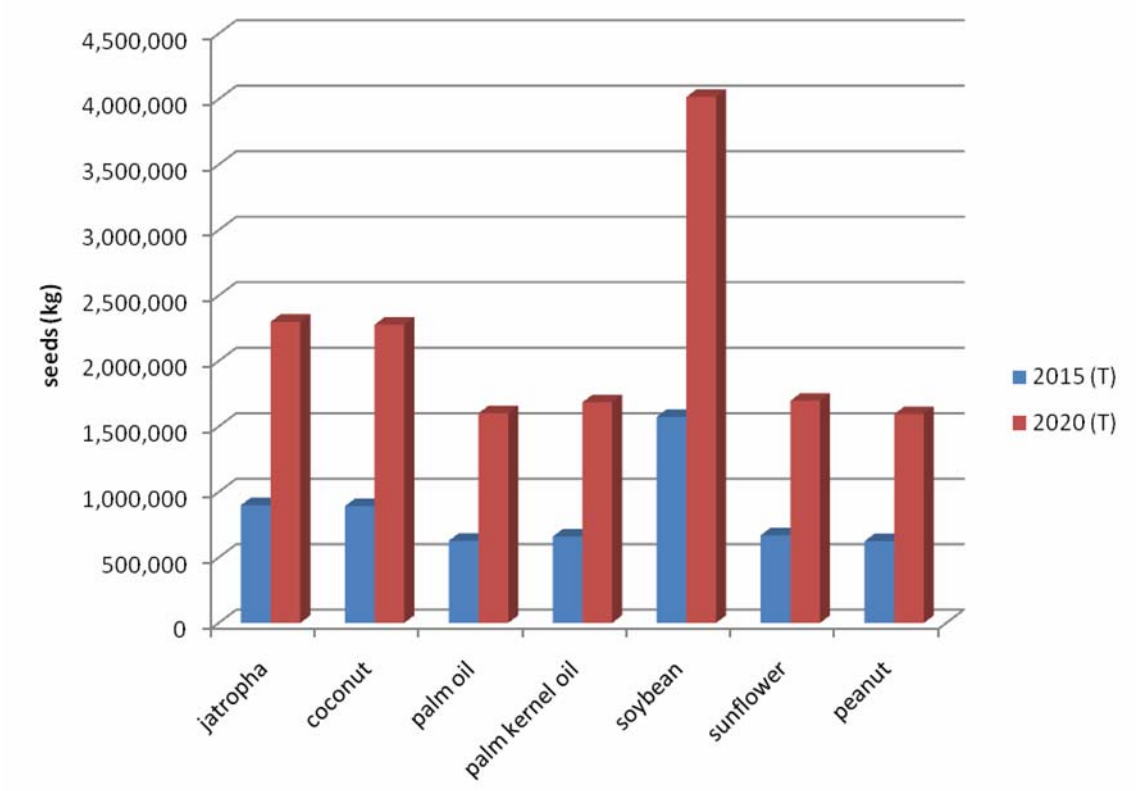


Figure 3. Feedstock requirement to meet demand of substituting 10 and 20 per cent of diesel consumed by 2015 and 2020 respectively

Table 2. Production levels of potential feedstock in Ghana

| Feedstock for biodiesel | Current production |
|---|---|
| Jatropha oil | 500 T |
| Coconut | 270 00 T |
| Palm oil | 800,000 T |
| Palm nut | 1040 M T |
| Soybean | 50 MT |
| Sunflower | 9, 262 kg |
| Used vegetable oil | - |
| Citronella oil | - |
| Castor oil | - |
| Feedstock for ethanol | |
| Maize | 1,100,000 T |
| Cassava | 900,000 T |
| Cane sugar | 900,000 T |

*Source: Duku, 2008*

 

On the other hand feedstock demand for the production of ethanol was estimated using a simple technique. Three of the major feedstock for the production of ethanol are readily available in the country. Assuming that 70 L of ethanol can be produced from one ton of crushed sugar cane and using the estimated demand for ethanol in 2015 and 2020 above, it was estimated that about 1,157,146 T and 2,408,262 T of crushed sugar cane will be required in 2015 and 2020 respectively. Also assuming that about 25.4 kg of corn can produce about 9.5 L of ethanol, the demand for corn assuming only corn will be used to meet that demand in 2015 and 2020 it was estimated that about 218, 000 T and 453,000 T of corn will be required respectively. These estimates are very conservative because other authors have reported higher alcohol yield from crushed sugar cane in the range of 80 L per ton as well as 13.25 L from 9.5 kg of corn. Estimate for cassava was carried based on the assumption that cassava contains about 32 per cent starch [11]. Also, it was assumed that the hydrolysis of starch to glucose goes to completion whiles the conversion of glucose to ethanol also goes to completion (The theoretical conversion of glucose to ethanol is about 97 per cent.). Based on these assumptions the demand for cassava for producing ethanol in 2015 and 2020 assuming further that only cassava will be used to meet this demand was estimated as 506,281T and 1, 053,614 T respectively.

As can be seen from Figure 4 below, in terms of feedstock requirement, about five times more sugar cane will be required to produce the same quantity of ethanol as compared to corn. However, it is very important to note that corn and cassava are food crops and are actually major staple foods in Ghana. They are used to prepare variety of meals and the country is heavily dependent on it. Though production levels of corn and cassava are quite high, almost all are consumed by humans internally. Therefore if it is intended to be used for ethanol production then the country will have to increase its production levels considerably in order not to create any food shortage or hikes in food prices on the market.

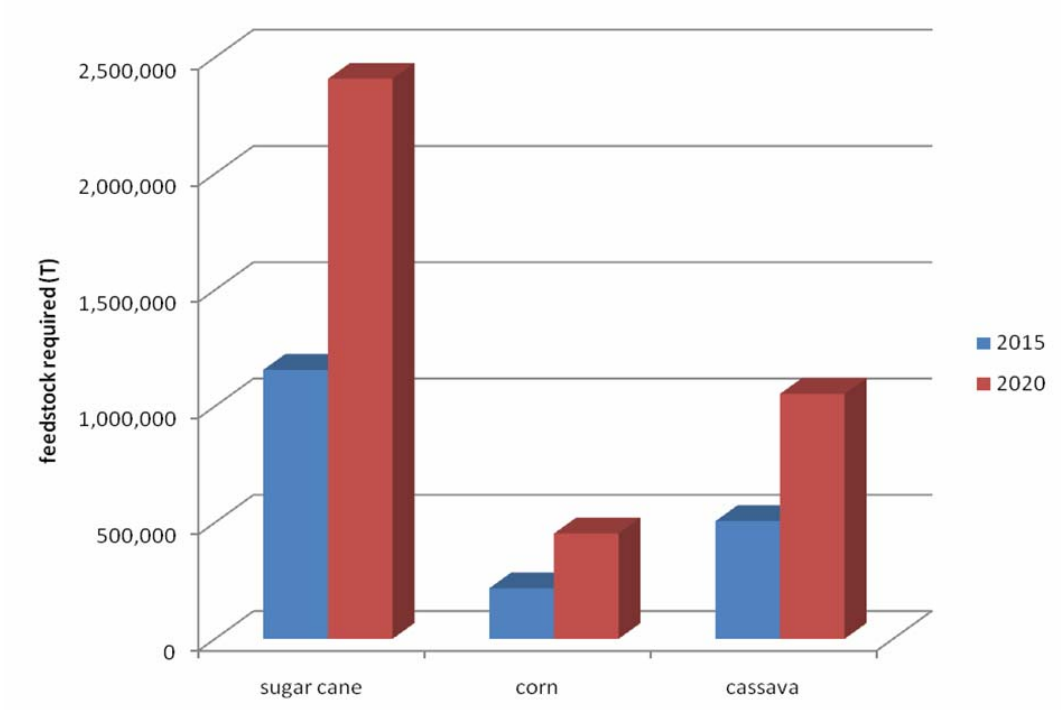


Figure 4. Feedstock requirement to meet demand of substituting 10 and 20 per cent of petrol by 2015 and 2020 respectively

**4. Policy response**

Development of feedstock for biodiesel and ethanol production: Two years after the publishing of SNEP no concrete steps have being put in place especially by government to meet the set objectives and targets. As stated earlier, B5 and E5 were expected to be introduced voluntarily onto the market by 2008 however was not done. The basic reason is that the standards and the regulatory mechanisms have not been developed. Industry players at present therefore do not produce to any specific standards. According to [12] 27 ISO and 17 ASTM standards have already been adopted by the Energy Commission (EC). In addition four local standards have been prepared however all these have not been published. Since the

 

standards have not been published it will not be fair to comment on them however it is important that it is pointed out that it is dangerous to adopt foreign standards without any modifications especially for biodiesel. The main reason is that standards are developed for a specific feedstock; for instance, ASTM D6751 was developed using soybean as the feedstock for producing the biodiesel (Also EN 14214 was developed using rapeseed oil as the feedstock for the production of biodiesel). This is significant because vegetable oils differ in most cases significantly in their fatty acid composition. This will make biodiesel produced from different feedstock likely to be different, affecting quality significantly. Zimbabwe is working closely with ASTM International to develop specific standards for biodiesel produced for jatropha feedstock [13]. The Zimbabwean experience is important because as already pointed out Ghana's major potential feedstock may not include soybean at least for now. Any production of biodiesel will most likely come from jatropha oil, palm oil and palm kernel oil which the government is promoting.

## 5. Challenges and way forward

Generally renewable energy sources are more expensive to produce than conventional sources. Biofuels are no exceptions. It is more expensive to produce biofuels in general than the production of petroleum derived fuels. To bring parity between the cost of producing biofuels and the cost of producing petroleum derived products some authors have suggested the removal of all subsidies on petroleum derived fuels whiles others have argued for the introduction of subsidies and incentives on biofuel production. Many governments have heeded this call by introducing tax breaks, reduction in excise and import duties and grants to boost the production of biofuels and the prices of biofuel competitive in their respective countries. The United States (US) for instance has outlined key policies intended to boost the production of biofuels. A policy on blended biofuels fuels called 'splash and dash' has been instituted. The policy permits companies to claim tax credit on blended biofuels they produce and even export with even a small percentage of conventional fuel. This policy is intended to offset the difference in production cost of biofuels and conventional petroleum fuels thus making biodiesel cheaper in some cases and more competitive to produce. According to [14], it is estimated that between US$200 million and US$300 million is spent annually to sustain this programme.

The Energy Policy Act [15], also spelt out key incentives to boost the production of liquid biofuels to achieve the set target of 1, 000, 000, 000 gallons annual production by 2015. An amount not exceeding of US$ 100, 000 is to be given as grant to each company to support bio-based product marketing and certification. An additional amount not exceeding US$ 500, 000 is also to be given as grant to support regional bio-economy development. The Energy Policy Act goes further to propose a US$ 5, 000, 000 grant for each fiscal year from 2006 - 2010 to support pre-processing and harvesting demonstration to add value to feedstock and reduce the cost of processing at biorefineries. Additionally a grant of US$ 1,000,000 has been proposed for each fiscal year from 2006-2010 to support education and outreach programmes geared towards promoting the use of biofuels and providing training and technical assistance programmes for feedstock producers.

In total US$250,000,000 has been set aside to provide incentives for the development of liquid biofuels. As already pointed out, the main purpose of these incentives is to boost the production of biofuels by giving biofuels a competitive edge over conventional petroleum derived products producers.

The European Union (EU) on the other hand encouraged the production and usage of biofuels by allowing individual member countries to institute measures such as tax exemptions, financial assistance to companies, and establishing compulsory rate for oil companies [16]. According to the Council Directive 2003/96/EC (2003), individual countries may grant tax exemption on biofuels so long as it does not constitute overcompensation between the production cost of the biofuels and that of conventional fuels. To this end EU countries like Germany, UK, France, Austria, Spain, Italy, Czech Republic and Portugal among others have instituted some form of subsidies in the form of tax reduction to boost their biofuel production.

It can be seen from table 3 the level of support given by governments of individual EU countries to the development of their biofuel industry.

South Africa which is by far the most developed nation in SSA realising the need for subsidies to enhance the development of the biofuel industry has announced a comprehensive package in its Renewable Energy Strategy to this effect. A Fuel Levy exemption of up to 40% has been granted by the National Treasury for biodiesel. Also the National Treasury has approved a Renewable Energy Subsidy Scheme of 16.7 c/l for bioethanol and 27.3 c/l for biodiesel up to a maximum of R20 million [18].

 

Additionally, the National Treasury is considering the imposition of Environmental Tax as a way of enhancing the development of the biofuel industry.

Table 3. Biofuel incentives in some countries

| EU country | Tax reduction |
|---|---|
| Germany | $ 2.30 per litre of biofuel |
| UK | € 0.33 per litre of biofuel |
| France | € 0.33 per litre of biofuel |
| Spain | Zero tax |
| Czech Republic | $ 383 per ton of biofuel |
| Italy | $ 40 per litre of biofuel |
| Poland | 45 cents per each litre of biofuel in blends containing from 2 per cent to 5 per cent biofuels |
| | 54 cents per each litre of biofuel in blends containing from 5 per cent to 10 per biofuels |
| Austria | Pure biofuels are exempt from mineral oil tax |
| Estonia | No excise duty on biofuels used as transport fuel |

*Source: Adapted from [17], 2005*

The government of Nigeria has also recognised the need for subsidies to enhance the development of the biofuel industry. The Renewable Energy Master Plan of the Republic of Nigeria proposes zero import duty tax on Renewable Energy Technologies (RETs) in general. A Renewable Energy Fund (REF) has also been proposed to help provide subsidies and incentives for RETs in general. Source of funding may include 0.1 per cent of money accruing from the export of crude oil [19]. Since officially Nigeria exports about two million barrels of oil per day this fund is likely to accumulate a substantial amount of money for the development of RETs in general.

In spite of the apparent need for the introduction of subsidies and incentives to boost the production of biofuels SNEP fell short of proposing any form of subsidies and or incentives after setting the targets. In order to meet the set target by SNEP it is very obvious that just like many other governments, the government of Ghana must as a matter of urgency consider granting any form of subsidy to prop up the production of biofuels. It is true that the country may not be in the position to march the levels of subsidies granted by rich nations however it also true that if the country means real business then some form of incentives and subsidies must be granted by government no matter the cost. Subsidies in the form of tax reduction and exemptions as well as other forms of incentives like guaranteed loans for potential businesses should be immediately considered.

To start with, all forms of tax on biofuels production equipment should be removed. Farmers in the cultivation of feedstock should enjoy the same incentives enjoyed by cocoa farmers which have seen the production of cocoa nearing 800,000 T from a paltry 400,000 not long ago. Like Nigeria the setting up of a fund this time specifically to support biofuel production may be essential. The fund may be named the Biofuel Development Fund (BDF). This fund can be financed through the imposition of additional tax on refined petroleum products or setting aside one percent of all future revenue accrued from the export of crude oil which the country is likely to produce by 2010 or both. Also new tax regimes should be announced to reward the final users of biofuels in order to encourage its use and acceptance. Depending on the price of crude oil on the international and the production levels as shown in table 4 below, if implemented, the BDF is likely to bag between US$ 5 million and US$ 28 million per annum. The South Africa model of considering the imposition of environmental tax on petroleum diesel may be quite useful in this regard and may be replicated in Ghana.

Table 4. Projected oil Revenue for Ghana (US$, millions)

| Production/day | US$60/bl | US$80/bl | US$100/bl |
|---|---|---|---|
| 60,000 | 502 | 607 | 837 |
| 100,000 | 837 | 1,116 | 1,395 |
| 200,000 | 1,674 | 2,232 | 2,790 |

*Source: Adapted from[20].*

 

## 6. Conclusion

Recent hikes in crude oil prices points to the fact that the era of cheap petroleum products is over. Diversification is essential to ensure energy security and also preserve the environment. The publishing of SNEP by the government is very laudable however; the target on biofuels in SNEP needs to be clarified as soon as possible to ensure smooth implementation of the policy.

Feedstock required to meet set target in both scenarios where target is geared towards transportation fuels and total petroleum consumption in the country are quite enormous. Government needs to put in place very pragmatic measures if intended targets are to be met. A comprehensive national programme for feedstock production must be rolled out immediately through governmental agencies and major stakeholders. Proper land zoning should be carried out to avoid conversion of farm lands for food cultivation into the cultivation of energy production crops. In the case of biodiesel production, palm oil and jatropha can be promoted as possible feedstock, however since the quantities of feedstock may increase with time, others like sunflower, soybean can be considered in the long term. On the other hand, sugar cane can be promoted vigorously as possible feedstock as compared to corn or cassava since these are staple foodstuff.

Government as a matter of urgency should introduce incentives and subsidies to boost the cultivation of feedstock and the production of biofuels. To start with, all taxes imposed on imported machinery for both agricultural purposes and manufacturing must be removed with immediate effect. Also, a Biofuel Development Fund must be set up to provide soft loans for the cultivation of feedstock and the production of biofuels.

In effect government must be seen playing a leading role in helping to achieve the set objectives. Leaving the private sector alone will not yield the desired result.

## References

[1] REN21, Renewables 2007 Global Status Report, REN21 Secretariat, Paris, 2007.
[2] Schnepf, R., European Union Biofuels Policy and Agriculture: An Overview. CRS Report for Congress, 2006.
[3] Wetlands International, Biofuels in Africa, An Assessment of Risk and Benefit for Africa Wetlands, Wetlands International, 2008.
[4] Brew-Hammond, A., Energy: An African Perspective, A lecture Delivered at Yale University, New Haven, Connecticut, 2008.
[5] Energy Commission, Energy Statistics 2000-2008, 2009.
[6] Monetary Policy Committee, Press Release, Bank of Ghana, 2008.
[7] Energy Policy Act of 2005, Public Law 109-58-August 8, 2005
[8] Energy Commission, Strategic National Energy Plan 2006-2020 and Ghana Energy Policy, Main Version, Energy Commission, 2006.
[9] Duku, M. H., Status of Biofuels Development in Ghana. ICS-UNIDO-MPOB, Workshop on Biofuels from Palm Oil: Emerging Technologies and their Assessments, Kuala Lumpur, Malaysia, 2007
[10] Lartey, R. B. and Acquah, F., Development of National Capability for Manufacturing of Activated Carbon from Agricultural Waste, The Ghanaian Engineer, 1999.
[11] International Starch Institute, Cassava, International Starch Institute, Denmark, 2008.
[12] Asser, C., Renewable Energy Resource Situation, Biofuel Bridge to the Future and Trend, Workshop on Biofuels; R &D& technologies for Sustainable Development in Africa, Accra, 2007.
[13] ASTM , From Earth to Engine, Biofuel, Zimbabwe and International Standards, Standardization news. http://www.astm.org/SNEWS/MJ_2008/chiwozva_mj08.html, 2008.
[14] REUTERS, EU wants Quick end to US Biodiesel Incentives, REUTERS, 2008.
[15] Energy Policy Act of 2005 (2005), Public Law 109-58-August 8, 2005.
[16] Official Journal of the European Union, Directive 2003/30/EC of the European Parliament and of the Council of 8 May, 2003 on the Promotion of the use of Biofuels or other Renewable fuels for transport, 2003.
[17] RFA , The Importance of Preserving the Secondary Tariff on Ethanol, Renewable Fuel Association, 2005.
[18] DME, Draft Biofuel Industrial Strategy of the Republic of South Africa, Department of Minerals and Energy, 2006.
[19] ECN, Renewable Energy Master Plan, Final Draft Report, Energy Commission of Nigeria, 2005.

 

[20] Baah-Wiredu, K., Bawumia, M., Mensah, S., Starr, M. and Oku-Afari, K., The Republic of Ghana, A Presentation at the Investor Feedback Forum, 18th April, 2008, London, 2008.