BFAP

bureau for food and agricultural policy

Modelling the impacts of macroeconomic variables on the South African biofuels industry

March 2007

Foreword

The past year has witnessed huge developments in the global production and production capacity of biofuels. Given recent large carry-over stocks and resultant low prices of grains, individuals in South Africa as well as the government have proposed establishing a national mandate for biofuels.

Research at the Bureau for Food and Agricultural Policy has made significant progress since the first biofuels report and, as so many variables within the South African economy have changed drastically in the past year, it seems necessary that a follow-up report be published, this time emphasising the extensive role that various policies could have on the biofuels industry. Please note that this document is **not** related to the National Draft Strategy on Biofuels, but rather explores the impacts that alternative policies could have on the biofuels industry.

It is also worth mentioning that this is not a forecast, as the prime function of the partial equilibrium model that has been developed by BFAP is to show what the impacts of various policies could be on the industry. One should always remember the statement which Henri Theil, a great master of econometric modelling, made: "*Models are to be used not believed* "

The financial assistance of the Maize Trust and all other sponsors of the BFAP program is acknowledged and appreciated. The opinions expressed and conclusions drawn are those of the authors and are not to be attributed to the Maize Trust or any of the other sponsors. The Bureau for Food and Agricultural Policy takes full responsibility for any errors contained in the report.

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Table of contents

List of figures

List of tables

Executive Summary

The production of biofuel from agricultural commodities is the hot topic in most of the major economies around the world. The Kyoto Protocol has further sparked an interest in the preservation of the environment and has motivated various economies to actively work towards producing cleaner fuels from renewable resources.

While high carry-over stocks and the resultant low commodity prices have sparked a local drive towards the implementation of mandates on biofuel blends in the local fuel mix, the recent turnaround in both oil and commodity prices has left many individuals doubtful as to the economic viability of biofuel production without the financial support of state authorities.

This report discusses the economic feasibility of biofuel production in South Africa, without any form of government support, at 2006 prices. It then takes the analysis a step further and, with the help of a set of scenarios, discusses the different outcomes that could result from a range of policies.

A lack of government support of the local industry can seriously affect its economic viability, especially in the early stages of development. The report shows that the protection of the industry by means of trade policies will be crucial. In scenario 1 the implementation of a 30% ad valorem import tariff boosts the local production of ethanol by 382 %, in comparison to a scenario in which no tariff is applicable. The fuel levy tax exemption is another important tool that the government can use to support the local industry. In scenario 2 the fuel levy tax exemption mechanism is reduced to zero; as a result the local production of biofuels remains stagnant and is unable to expand further. This policy, combined with a no import tariff situation, can have a negative impact on the potential expansion of this industry. Various pricing options for both bioethanol and biodiesel are also discussed and the disadvantages identified.

In many of the now dominant biofuel producing nations, government support has played, and in most instances is still playing, an important role in developing the industry. It is therefore important that all potential role players in this infant industry meet and work towards a common representative and sustainable policy.

1. Introduction

The production of biofuels, bioethanol and biodiesel in particular, is on the increase globally. Countries that have signed the Kyoto Protocol have committed to making processes that usually contribute to global warming more efficient and less polluting. Countries that are not signatories of the Kyoto Protocol, such as the USA, are also experiencing expansive growth rates in their biofuels industry. In the USA, this is mainly driven by alternative government policies, such as the phasing out of the substance methyl tertiary (butyl ether, also known as MTBE) from the local fuel supply, and the Energy Policy Act (EPACT) of 2005, which sets out to enforce mandatory blending policies.

In South Africa, surplus maize production has led to prices trading at export parity levels with large carry-over stocks. The 2004/05 production season serves as a typical example, where maize prices decreased to export parity levels due to a large surplus. In this specific season, the strong exchange rate, together with average world prices, led to low export parity prices. In fact, the price of yellow and white maize decreased to levels where the majority of SA maize farmers could not produce economically. These large carry-over stocks have fuelled the debate to find alternative uses for the surplus maize. Other drivers, such as the government's commitment to comply with the framework of the Renewable Energy White Paper, in order to produce renewable energy of 10 000 GWh by 2013, of which a certain percentage needs to come from the production of biofuels, have automatically involved the government in the debate on biofuels. The preliminary target which the government aims to achieve is to replace 4.5% of the local petrol and diesel supply with biofuels by 2013. The prospects that a successful biofuels industry could create improved market access for black emerging farmers that produce suitable crops under contractual arrangements has also been much debated in government circles.

In 2005, the Bureau for Food and Agricultural Policy (BFAP) released a report that discussed the different means of producing bioethanol and weighed up the impact which a range of critical elements could have on bioethanol production plants in South Africa. The report made use of a scenario planning exercise to point out the critical factors that determine the economical feasibility of bioethanol production.

Over the past year, BFAP has developed the capacity to model the biofuels industry in a system of equations which interact directly with the relevant crop and livestock industries. The new BFAP sector model now has the ability to simulate the impact of various policy scenarios and macro-economic factors on the potential biofuels industry in South Africa.

In these simulations, the BFAP model takes the dynamic interaction between the field crops, livestock and government policy into account. The field crops are the source of supply and, as a result, their prices will influence the competitiveness and feasibility of the biofuels industry. The livestock sector acts as the uptake market for the by-product, which implies that the price at which the by-product sells is determined in the livestock market. Depending on how government structures the policy and incentive programme, the price of bioethanol and biodiesel can be mainly a function of the retail price of fuel. The flow diagram below displays graphically how the model reaches equilibrium and how the interaction between the different industries takes place.

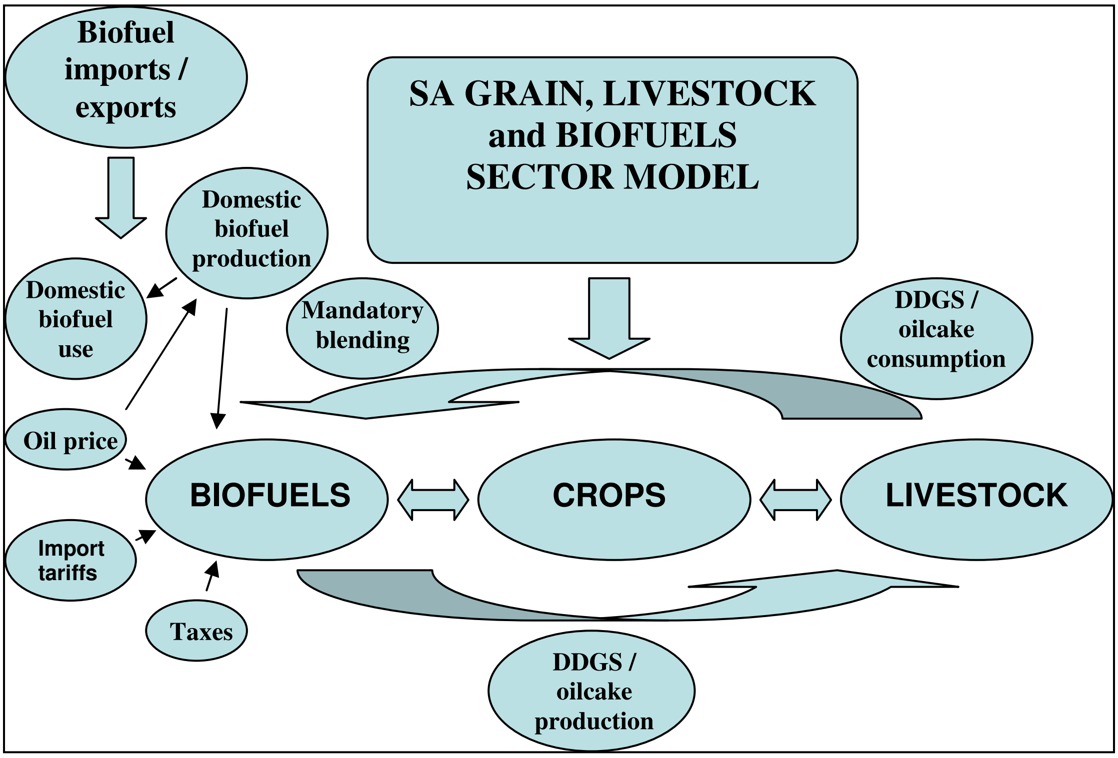

Figure 1: Modelling the interaction between the fuel, crop and livestock industries.

The biofuels section within the model is influenced by fuel taxes, import tariffs and a number of macro-economic factors, such as the oil price and the exchange rate. The demand and supply dynamics within each of the industries is solved until the model reaches equilibrium, in other words, until total demand is equal to total supply for every commodity in the model.

The by-products of bioethanol production from maize (Dried Distillers Feed with Solubles – DDGs) and biodiesel production from soybeans or sunflowers (oilcake) will compete in the feed market as alternative sources of protein. Therefore, this report includes both the bioethanol and the biodiesel market. Furthermore, bioethanol can also be produced from sugar and, therefore, sugar is also included in the analyses to compare how much bioethanol could come from maize and how much from sugar. Only commercial crops are currently taken into consideration in the BFAP sector model for the potential production of biofuels. Despite the inclusion of a number of related industries in the analyses, this report mainly focuses on the maize industry.

2. Current state of affairs

2.1 Market price movements of maize and crude oil

Political instability in the Middle East and a stronger demand for oil due to strong economic growth in both China and India have held oil prices at relatively high levels during 2006. The oil price reached new highs during July 2006 of around $75 per barrel (Oilnergy, 2007). The trend towards bioethanol production in the USA has remained extremely strong as a result of both higher oil prices and the MTBE producers not being granted liability protection from the Energy Policy Act of 2005. As a result, most US fuel companies are looking at bioethanol as a replacement oxygenate for MTBE and are attempting to make this change as soon as possible. In the European Union, the Biofuels Directive set "reference values" of a 2% market share for biofuels in 2005 and a 5.75% market share in 2010. The 2% target level for biofuels was not achieved and, as a result, the Commission has launched infringement proceedings in seven cases where Member States adopted lower targets without due justification (Council of the European Union, 2006).

From January 2006 to November 2006 yellow maize was trading at an average of around R1127 per ton in South Africa, in response to a smaller total maize harvest of both yellow and white maize of 6.7 million tons (BFAP, 2006) caused by lower plantings.

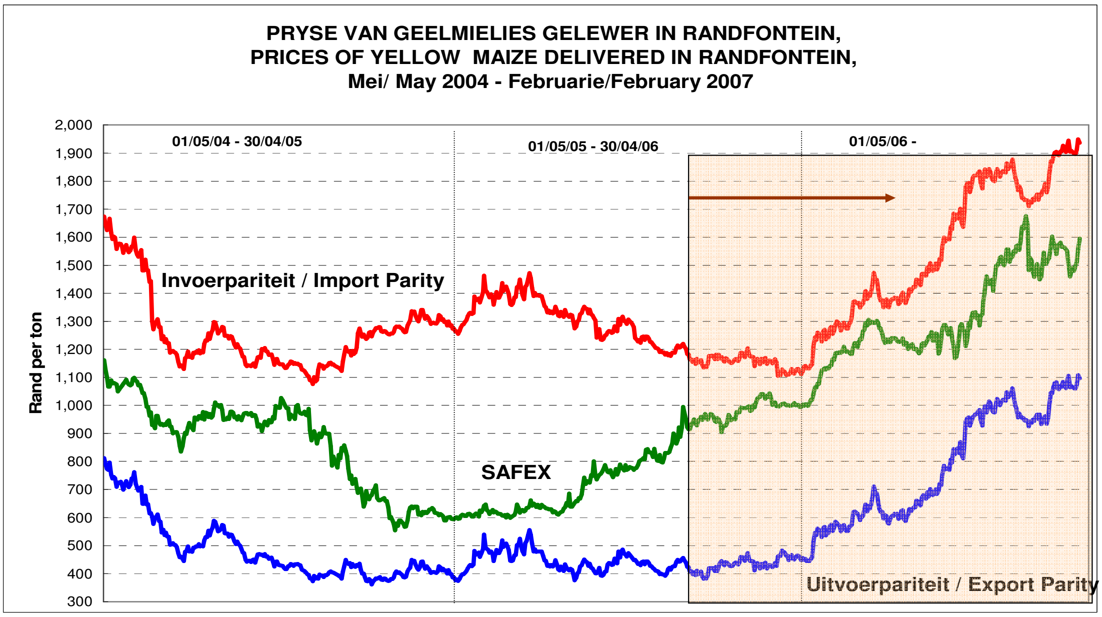

Figure 2: Prices of yellow maize delivered in Randfontein, May 04 – February 07.
Source: Grain South Africa, 2007.

The shaded area in Figure 2 represents the price movements for yellow maize from January 2006 onwards. The yellow maize price traded closer to export parity in 2005, but in 2006 it increased sharply, trading closer to the import parity level. Currently, prices are in an upward phase, and yellow maize is trading at the import parity level. During the second half of 2006 the import-export parity band also increased sharply, due to the rapid increase in the world price of yellow maize. In the USA an unusually strong demand growth in maize (corn) was triggered by booming ethanol production. This strong demand growth will keep the US maize balance tight even if the harvested area increases by 10% and an above average yield of 156 bushels/acre can be achieved. The expansion of the bioethanol industry in the US was therefore partly responsible for the higher world prices of maize (Oil World, 2007). In the previous report (BFAP, 2005) the high level of volatility in the maize price was identified as one of the crucial factors that will determine the economic sustainability of bioethanol production from maize. At the time of the first report, maize prices were at record low levels and the production of bioethanol seemed to be feasible. However, over the course of two years this picture has changed dramatically. This will be addressed further in section 2.2.

The South African petrol price, on the back of the price of crude oil, saw record high levels during 2006. In January 2006, a litre of unleaded 93 octane petrol sold for R5.39 at the pump in Gauteng, while a litre of unleaded 95 octane petrol sold for R5.29 at the coast. In August 2006, the same quantity and octane blend of petrol sold for R6.92 in Gauteng and R6.80 at the coast (SAPIA, 2007). As the local petrol price is directly dependent on the movements of the oil price, it becomes clear that the huge increases in the petrol pump price follow as a direct result of the increases in the international crude oil price. Figure 3 below displays the movements seen in the price of various crude oils.

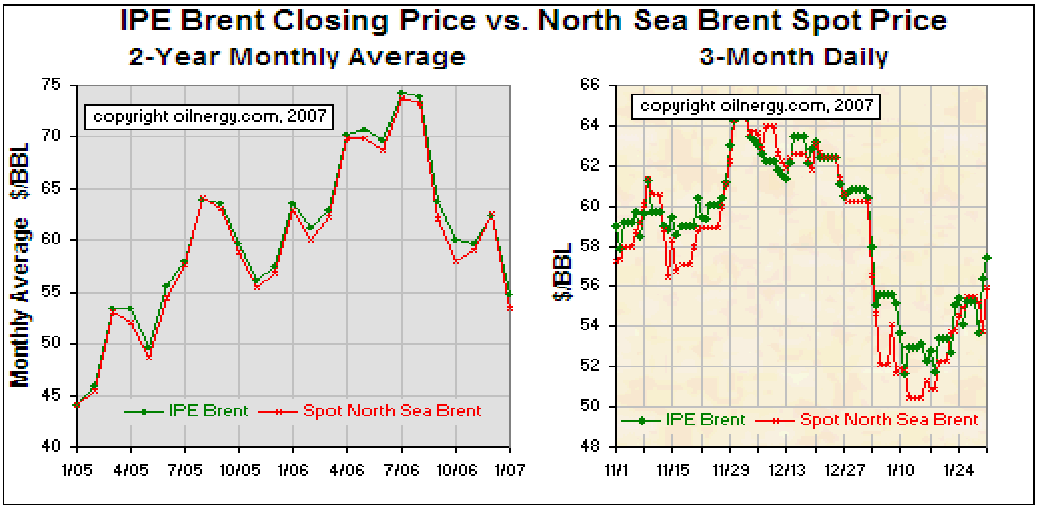

Figure 3: Recent movements in the various crude oil prices, 2004 – 2006.
Source: Oilnergy, 2007.

2.2 Plant profits

This section indicates the status on plant profits for the production of biofuels from various commodities, given current commodity prices (2006 averages) with absolutely no other support incentives in place.

Agricultural commodities that have been used in this analysis include sugar cane, yellow maize, soybeans and sunflower seed. The BFAP model only takes these commercial agricultural commodities into account but it is acknowledged that there are other commodities that could also contribute to the production of biofuels. A certain set of prices and costs have been used to calculate these potential profits. In Figure 4 below, the blue columns represent the profits/losses which a plant producing bioethanol may incur and the green columns are representative of profits/losses which are to be earned by biodiesel producers. Figure 4 clearly shows that under current market conditions, no commercial crop will yield a positive plant profit producing biofuels. Interestingly, there is not much choice between producing bioethanol from sugar or maize under current conditions.

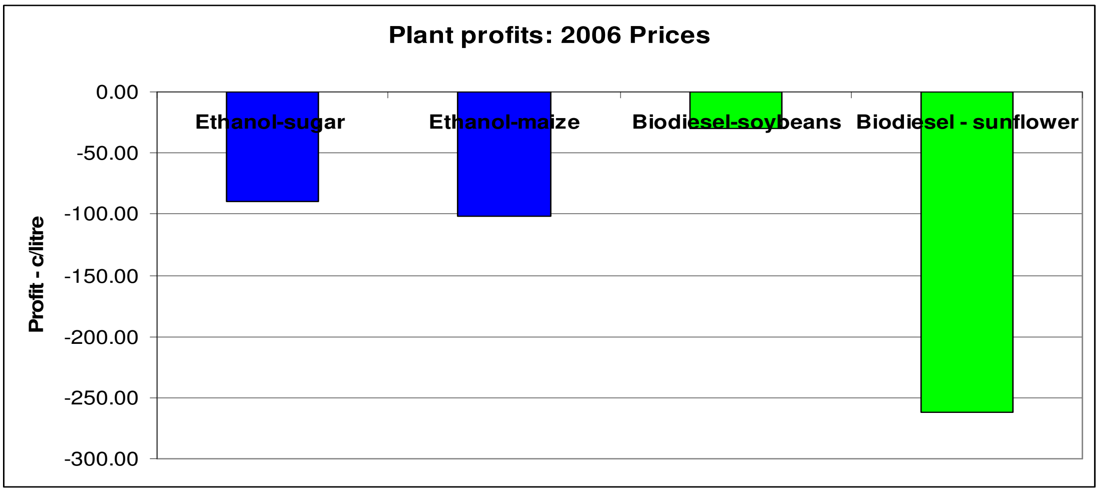

Figure 4: Bioethanol and biodiesel plant profits for various agricultural commodities.

Although the potential profit from selling soybean and sunflower oil into the human vegetable oil market is not represented in the graph, industry specialists argue that positive profits are obtained in this industry. The comparison between the fuel and human market is not very complicated. In the fuel market, the biodiesel from soybeans sells for 336.45 SA cents per litre at plant level whereas, in the human vegetable oil market, soybean oil is sold at plant level for approximately 529.47 SA cents per litre. In the case of sunflower seed, a similar situation occurs. Biodiesel from sunflower seeds sells at 336.45 SA cents per litre, while sunflower oil sells for 555.23 SA cents per litre in the human market. Even though the price at which sunflower oil is sold is higher than the price at which soy oil can be sold, the prices at which the by-products trade in the feed market create a more profitable environment for soybean producers. Apart from locking in positive plant profits, any form of incentive for the production of biodiesel will thus have to be structured in such a way as to ensure that vegetable oil sales will be diverted from the human market to the biodiesel market.

Table 1 represents the prices that were used in the calculation of plant profits. All the prices are generated in the BFAP sector model under a combination of assumptions, for example, that bioethanol sells at 95% of the basic fuel price and biodiesel at 100%

of the basic fuel price (Department of Minerals and Energy, 2006). The macro-economic variables and world prices that were used for these calculations are presented in section 3.1, Tables 2 and 3.

Table 1: Plant profit calculations, 2006 average prices.

Commodity*	Cost of feedstock (R/ton)	Income from by-product (R/ton)	Income from sales (c/litre)	Total costs of production (c/litre)	Profit (c/litre)
Sugar cane (Eth)	193	-	312.91	165.59	**-89.87**
Yellow maize (Eth)	1310	1092	312.91	171.54	**-101.80**
Soybeans (BIOD)	1959	2076	336.45	212.67	**-29.87**
Sunflowers (BIOD)	2338	1505	336.45	170.47	**-262.27**

** Abbreviations of biofuels: Eth – Ethanol; and BIOD – Biodiesel.*

Due to the proprietary nature of the costs of production, only aggregated costs are provided in the Table. This includes variable costs and capital costs. These costs were collected from technology providers, financial institutions and refineries. Another important assumption is that these costs are representative for an "average sized plant" although it is possible that the costs structures for different sized plants will differ from the values presented in Table 1.

Technical factors with respect to extraction rates of ethanol, vegetable oil and by-products have been benchmarked by using data and norms received from industry roleplayers and international experience. Extraction rates of ethanol from sugar cane (76 litres per ton), maize (402 litres per ton), and of biodiesel from soybean (194 litres per ton) and sunflower seed (398 litres per ton) are applied in the model. DDGs from maize have an extraction rate of 304 kilograms per ton, soy cake 800 kilograms per ton of soybeans and sunflower cake 420 kilograms per ton of sunflower seed. There is some uncertainty regarding the quality of DDGs that will be produced and the level of uptake at a specific price, therefore an average quality of DDGs is assumed for this model.

While there are some by-products which could potentially add more value to the gross margins, it is difficult to determine a price series for these. In the case of the sugar cane to ethanol process, for example, bagasse should definitely be taken into account, due to its potential as a raw material for electricity generation. Carbon Dioxide ($CO_{2)}$ sequestration from the fermentation process could also be taken into account as this product also has a market value. In the maize to ethanol process, the value of $C0_2$, as well as gluten oil has also not been taken into account.

3. Baseline and scenario analysis

3.1 The baseline

A baseline is a simulation of the sector model under agreed policies and assumptions regarding macroeconomic variables, the weather and technological change. The baseline does not constitute a forecast, but rather presents a benchmark of what could happen under a particular set of assumptions. Inherent uncertainties, including policy changes, weather and other market disruptions, ensure that the future is highly unlikely to match baseline projections. A baseline can thus be looked upon as a "reference scenario" and can form part of the validation procedures. Many different reference scenarios can be developed under various assumptions, but the application and interpretation of a specific baseline (or reference scenario) will determine the significance of the baseline.

Macroeconomic assumptions are based on forecasts prepared by a number of institutions, such as Global Insight, the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri, ABSA and the Actuarial Society of South Africa (for projections on population). Tables 2 and 3 present the baseline projections for key economic indicators and world commodity prices in the model.

Table 2: Economic indicators – Baseline projections

Item		2007	2008	2009	2010	2011	2012
Crude Oil Persian Gulf: fob	$/barrel	63.22	60.79	57.01	53.44	51.41	50.33
Population	Millions	47.68	47.65	47.54	47.39	47.22	47.04
Exchange Rate	SA c/US$	751.75	792.38	824.63	851.67	869.81	886.89
Real per capita GDP	R/capita	17600.81	18390.69	19233.4	20120.7	21042.24	22017.87
CPIF (Inflation)	Index ('00)	217.55	227.28	237.37	247.18	257.23	267.53

Source: Global Insight, FAPRI, Actuarial Society, ABSA, as quoted in the 2006 BFAP baseline.

Table 3: World prices – Baseline projections

Item		2007	2008	2009	2010	2011	2012
Yellow maize, US No.2, fob, Gulf	US$/t	161.00	143.01	145.66	145.87	146.33	145.44
Wheat US No2 HRW fob (ord) Gulf	US$/t	178.17	177.05	180.26	181.84	184.00	185.58
Sorghum, US No.2, fob, Gulf	US$/t	177.55	177.66	180.93	182.09	183.61	183.74
Sunflower Seed, EU CIF Lower Rhine	US$/t	338.24	343.53	348.44	343.27	335.93	331.01
Sunflower cake (pell 37/38%) , Arg CIF Rott	US$/t	122.32	120.86	120.28	119.49	118.89	117.51
Sunflower oil, EU FOB NW Europe	US$/t	726.01	729.93	732.82	737.66	743.40	747.45
Soya Beans seed: Arg. CIF Rott	US$/t	328.30	343.84	343.82	340.34	335.77	333.66
Soya Bean Cake(pell 44/45%): Arg CIF Rott	US$/t	245.49	249.36	244.55	236.84	231.76	228.98
Soya Bean Oil: Arg. FOB	US$/t	648.43	684.69	698.42	712.77	714.35	716.18

Source: FAPRI, 2006, BFAP adjustments

3.2 New scenarios

The South African economy has, during the past two years, experienced increasing upward pressure on the rate of inflation. The Monetary Policy Committee (MPC) raised the repo rate by 50 basis points at its June, August and October 2006 meetings, the first change to the rate since April 2005. Even though inflation levels remain in the 3 to 5% target levels, recent economic developments indicate that there are significant risks to the inflation outlook (South African Reserve Bank, 2006).

Changes in macroeconomic factors, both locally and internationally, have a direct impact on the local economic environment, be it in the manufacturing sector, the agricultural sector or the financial sector. For example, a shock in the oil price has a direct impact on the local economic environment. The future of the biofuels industry in South Africa will be shaped by the economic and political environment that it has to operate in. The scenarios are designed to point out what the impact of changes in the macroeconomic environment will mean for the infant biofuels industry. Below we discuss some of the variables that will directly impact the biofuels industry.

Policy variables

Since the biofuels industry is still in an infant stage, it needs some form of government support so that it can start producing at economically feasible levels. Governments across the world have supported and are still supporting their local industries. Direct government support in Brazil has, for example, decreased from the levels in the late ‘70’s. The USA, on the other hand, has maintained levels of support that allow the industry to produce economically even at the current record levels of world maize prices. The Renewable Fuel Standards Act (RFS) has paved the way for even more support to come the way of American ethanol producers (RFA, 2006).

There are a number of ways in which a government can support the viability of the biofuels industry indirectly. These include, for example, provision of tax breaks, making the blending of biofuel into normal gasoline and diesel fuels mandatory, and introducing import tariffs to further support the viability and growth of this infant industry.

The model that BFAP uses is designed to simulate the possible effect of a number of these policy variables on the infant biofuels industry in South Africa. The model simulates the impacts which the policies will have on prices, production and changes in areas where the various biofuel crops are planted, as well as the production and price dynamics which will play a role in the fuel and by-product industries.

Price variables

The financial and economic success of biofuel production depends largely on a whole range of prices. The crude oil price and the resultant petrol and diesel prices will to a certain extent determine what ethanol and biodiesel will sell for. The price of feedstock used for biofuel production is another important price factor to consider, as it plays an important role in determining the price for which the biofuels plant purchases its raw material. The price of the plant’s by-products also determines the success which the biofuels plant could possibly achieve, as this implies an increase in potential profits in addition to the earnings from the fuel sales. The prices that determine the financial success of biofuel production are dynamically solved within the model.

Production variables

Price and production are so interdependent that a change in the one will have a resultant effect on the other. The speed at which this adjustment takes place depends on the speed at which adjustments can be made to production practices or the extent to which farmers are basing their decision to plant on future expectations. An increase in the area will, in most circumstances, result in increased production, which drives down the price. The adaptive expectation approach is applied in this model, where farmers base their decision to plant on the expected price, as well as the expected yield. Expected prices are an extrapolation of current price levels.

3.2.1 Scenario 1: South Africa's green revolution!

Scenario 1 represents a world in which the production of biofuel is the answer to South Africa's energy needs. In the government's paper on renewable energy, the government has set standards of achieving 10 000 GWh of renewable energy by 2013. The aim is to have biofuels account for 75% of this quota. The government implements an E10, 10% bioethanol blend, and a B5, 5% biodiesel blend, mandatory blending policy in 2008, as it is keen on achieving its 2013 renewable energy goals and expects that its policy on renewable energy will uplift emerging and small-scale farmers, if managed correctly.

The mandatory blending policies for bioethanol and biodiesel differ considerably in that the quantities of petrol and diesel consumed in South Africa are so different. In 2005, petrol consumption in South Africa amounted to around 11.1 billion litres, while diesel consumption amounted to around 8.1 billion litres (SAPIA, 2007). The bioethanol policy is gradually phased in, changing with 2% blending every year until a 10% blend is achieved. The biodiesel mandate is also systematically phased in from 2008 onwards, with a 2% blending mandate at first. This is then upgraded to a 5% mandate from 2010 onwards. The government is very conscious as to what is happening within the global biofuels industry and understands that it is nearly impossible for such an infant industry to survive without any support. The biofuels task team, therefore, recommends that the industry receives a tax break in the form of a reduction of 40% in the fuel tax for biodiesel and for bioethanol.

On the biodiesel side, the supply of feedstock seems to be the biggest concern for the South African biofuels industry. The past five years' averages indicate that South Africa has produced 686 thousand tons of sunflower seed and 245 thousand tons of soybeans, but consumed an average of 717 thousand tons of sunflower seed and 258 thousand tons of soybeans. This means that South Africa is, on average, a net importer of both of these commodities. World soybean prices could also be expected to follow an upward trend as the European Union and countries such as the US and Brazil start increasing their biodiesel capacity, which in turn goes hand in hand with a reduction in exports and a potential supply squeeze on the international market.

On the bioethanol side, ethanol prices rise as the demand has to be satisfied and there are just not enough plants producing ethanol. Internationally, the developed countries are moving towards a biofuel blend in their local transport fuels. This increase in the world demand for ethanol leads to a steady increase in the price of ethanol on the world market and, as a result, an increase in the South African ethanol import parity price. On top of the increase in the import parity prices, the financial survivability of the local industry is further supported by the introduction of import tariffs (30% on ethanol and 30% on biodiesel) in 2011. The local industry only starts to make a real contribution to the mandatory requirements of ethanol once the import tariffs are in place. The local biodiesel industry struggles to remain competitive compared to the local vegetable oil market. Biodiesel will only be produced from vegetable oil where full tax concessions are applicable (such as on-farm usage). The bulk of the volume of vegetable oil produced locally will still be consumed in the human market.

3.2.2 Scenario 2: A green but bleak future

The government recognises the potential of increasing employment opportunities and productivity in the agricultural sector if the biofuels industry is supported. In fact, the government regards this as one of the key areas in order to achieve a 6% growth rate in the agricultural sector. In order to achieve this potential, the government reduces the fuel tax by 50% for both the biodiesel and bioethanol. However, the Department of Trade and Industry is also focussed on keeping in good standing with the WTO and, as a result, does not implement a protective import tariff for the biofuels industry. Large investment companies are reluctant to invest in the local biofuels industry because they are of the opinion that the local industry will not be able to compete over the long run.

After establishing the tax reduction, the government decides to implement a national mandatory blending policy. The government then decides to phase in an ethanol mandatory blending requirement, starting with 2% in 2008 and increasing gradually to

8% in 2011. The government, furthermore, decides to implement a biodiesel mandatory blending policy, starting off with 2% in 2008 and keeping it constant.

In this scenario, it is assumed that the 50% fuel tax reduction only applies to locally produced biofuel and not to any imported fuel. In 2011 the government abolishes the reduction in fuel taxes, as it argues that the mandatory blending policy is more than enough incentive to start producing biofuels economically.

4. The output

The combination of external shocks in the form of policies and macroeconomic variables are introduced in the model and a new equilibrium is simulated for each of the scenarios. Equilibrium is reached when supply equals demand for each of the commodities in the model. The output from each scenario can be seen as the specific deviation from the previous state.

4.1 Scenario 1: South Africa's green revolution!

In summary, Scenario 1 implies that the government implements a mandatory blending policy, a fuel levy reduction of 40% and an import tariff of 30% for both bioethanol and biodiesel.

4.1.1 Scenario 1: The ethanol industry

The mandatory blending policy for ethanol is gradually introduced in the model for 2008 onwards, growing with 2% annually until the eventual mandatory blending level of 10% is reached. The model indicates that in the first year, 2008, all ethanol which is required to satisfy the local market will be imported. Ethanol production is likely to commence from 2009 onwards, when the first maize and sugar to ethanol plants come into production. No bioethanol is produced until a mandatory blending requirement is introduced because plant profits are negative under baseline conditions where no policies or incentives are introduced. In the long-run, more ethanol will be produced from sugar than from maize.

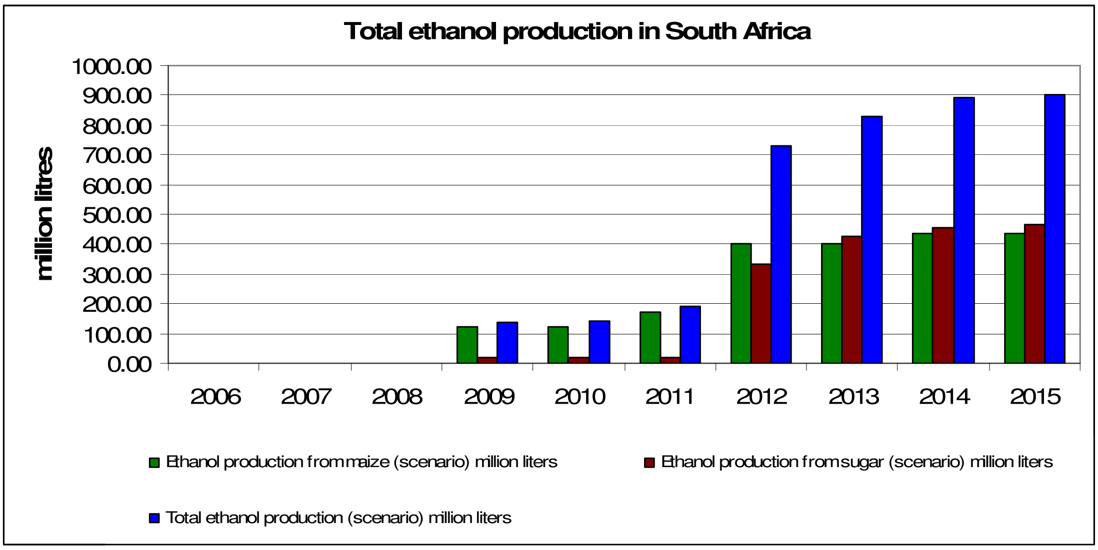

Figure 5: Scenario 1: Total ethanol production in South Africa

Ethanol imports continue to play an important role in the fulfilment of the mandatory blending requirements. It is only in 2012 that local ethanol production finally exceeds imports of ethanol. Imports continually decrease, but still play a role in satisfying local demand. It is projected that by 2015 just over 900 million litres will be produced locally of which 464 million litres will be produced from sugar and 437 million litres from maize.

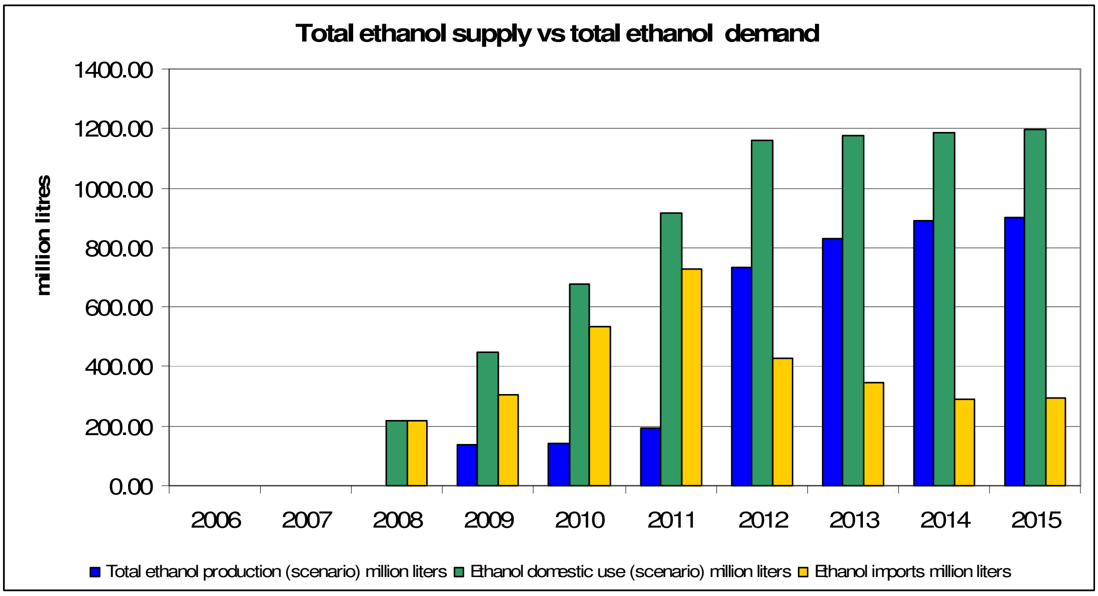

Figure 6: Scenario 1: Total ethanol supply versus total ethanol demand

As mentioned previously, the ethanol price is solved in a dynamic system of equations. Figure 7 shows how the price could be affected, given the assumptions of the scenario. The ethanol price is compared to the price of petrol at wholesale levels. The bioethanol price calculation method, as mentioned in the draft strategy, proposes a different methodology in determining the bioethanol plant prices. The draft proposes that the price of bioethanol is set at 95% of the basic fuel price, giving oil refineries a 5% margin to recover any additional costs which they may incur due to the mandatory blending policies. The pricing system will further give an advantage to producers that are located within the country's interior as the pricing system makes use of the current system determining the location differential. The proposed pricing system further allows for the fuel levy exemption to be added, but maintains that a cost occurring due to logistics be subtracted. The price that the biofuel producer in the northern Free State receives is represented by the blue line in the figure below.

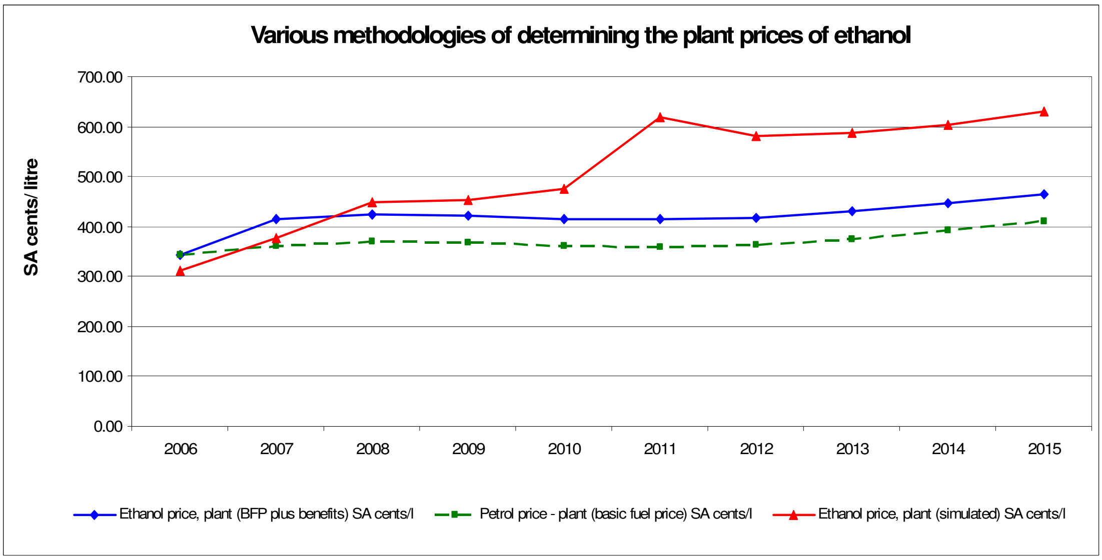

Figure 7: The basic fuel price, the simulated ethanol plant price and the proposed ethanol plant price

The ethanol price receives its first boost when the mandatory blending policy is implemented in 2008, which creates a demand for the product. The ethanol price then moves in relatively close proximity to the petrol price until a tariff of 30% is introduced in 2011, raising the import parity price for ethanol. The effect of the import tariff is transmitted to the plant prices and these rise by a certain percentage. As the ethanol prices increase one would expect the biofuel plants to become more profitable.

As the sale of the by-product plays an important role in the economic feasibility of an ethanol plant, it is of the utmost importance that the price variations of these products and its limits within the South African feed industry are well understood. The following graph indicates how the DDGs, yellow maize production and the DDGs prices move together over time.

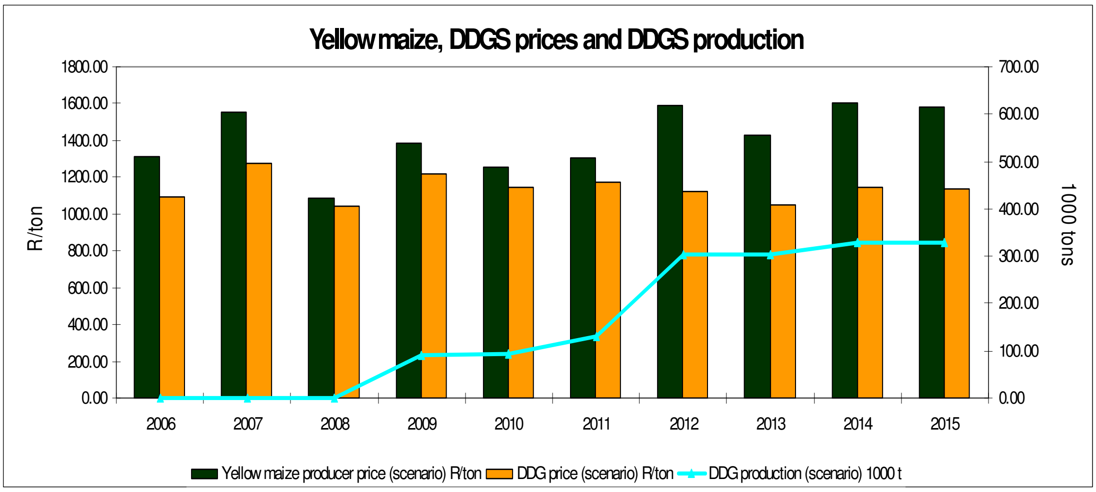

Figure 8: Scenario 1: DDGs production, Yellow maize and DDGs prices

After consulting with industry experts in the feed industry it was determined that average quality DDGs will be demanded at competitive prices up to a level of approximately 300 000 tons, after which prices could come under pressure. In scenario 1, DDGs production levels are at approximately 330 000 tons. At these levels, the model projects DDGs prices to start trading at a discount compared to the projected yellow maize prices. The yellow maize price increases as the production of biofuels drives up the demand for yellow maize. As previously mentioned, consumption levels and the prices at which DDGs will trade in the local market are still uncertain and various modelling approaches can be used to enrich the debate.

Figure 9 illustrates the impact of biofuel production on the local white and yellow maize prices. White and yellow maize prices increase by an average 12 and 18% respectively over the long-run (2012-2015). It has to be mentioned that these projections are simulated under normal weather conditions. The model projects a net increase in total consumption of maize of approximately 650 000 tons per annum. Under normal weather conditions, South Africa can easily produce a surplus of 650 000 tons and only a moderate increase in prices can be expected. However, under drought conditions, it can be expected that the local maize industry will move to an import parity scenario much faster if maize is used for the production of ethanol. The total area planted under yellow maize is projected to increase by an annual average of 176 000 ha for the period 2012-2015, partly at the expense of the area planted to other field crops. The net increase in the total area planted to field crops is in the order of 140 000 ha.

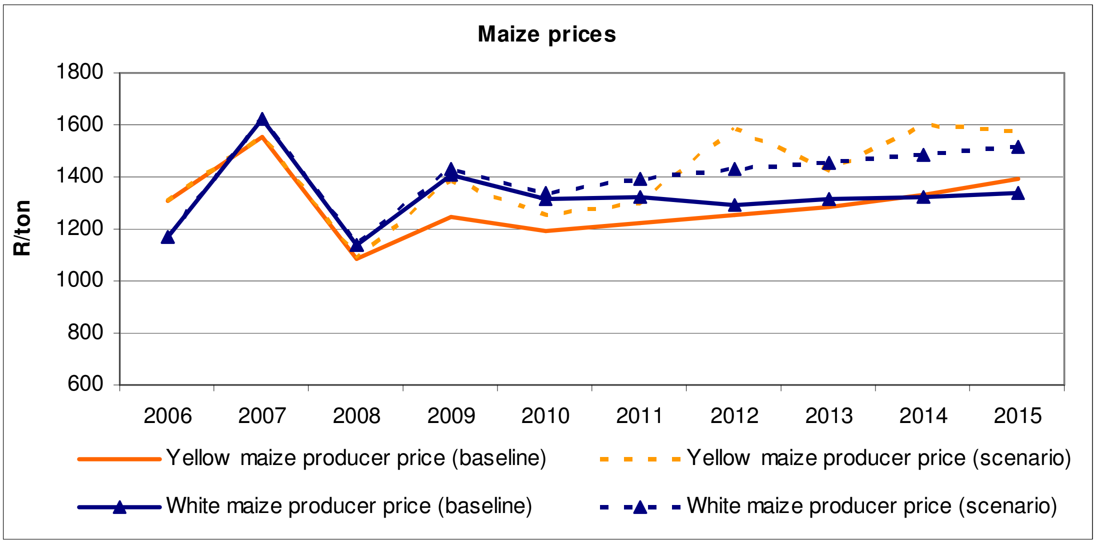

Figure 9: Scenario 1: White and yellow maize SAFEX prices

Table 4: Yellow maize balance sheet – absolute change from baseline

		2012	2013	2014	2015
Yellow maize area harvested	1000ha	101.5	237.4	154.0	211.3
Yellow maize average yield	t/ha	0.0	0.0	0.0	0.0
Yellow maize production	1000 tons	378.1	893.8	585.5	811.2
Yellow maize feed consumption	1000 tons	-487.6	-266.3	-396.8	-312.8
Yellow maize human consumption	1000 tons	-17.3	-7.1	-13.8	-9.7
Yellow maize ethanol use	1000 tons	996.1	998.4	1084.6	1086.9
Yellow maize domestic use	1000 tons	491.2	725.0	674.0	764.4
Yellow maize ending stocks	1000 tons	-11.1	174.7	117.4	186.2
Yellow maize exports	1000 tons	-6.8	-2.8	-5.3	-3.6
Yellow maize imports	1000 tons	34.4	13.9	26.5	18.3
Yellow maize producer price	R/ton	337.0	139.1	268.4	189.3

Table 4 presents the absolute changes from the baseline in a balance sheet format for yellow maize. This table clearly illustrates the strength of the partial equilibrium framework that is applied in the BFAP sector model to simulate for dynamic market equilibrium over time. The interaction between industries is also taken into account. For example, white maize prices increase because the area planted under white maize will decrease as the area under yellow maize expands.

4.1.2 Scenario 1: The biodiesel industry

The mandatory blending policy, as in the case of biodiesel, is slowly phased in from 2008 onwards. The blend is kept constant at 2% up until 2010 and increased to 5% from then onwards.

As South Africa produces relatively small quantities of oilseeds compared to starch crops. Figure 10 below illustrates what the domestic use of biodiesel will consist of in terms of imports and local biodiesel production.

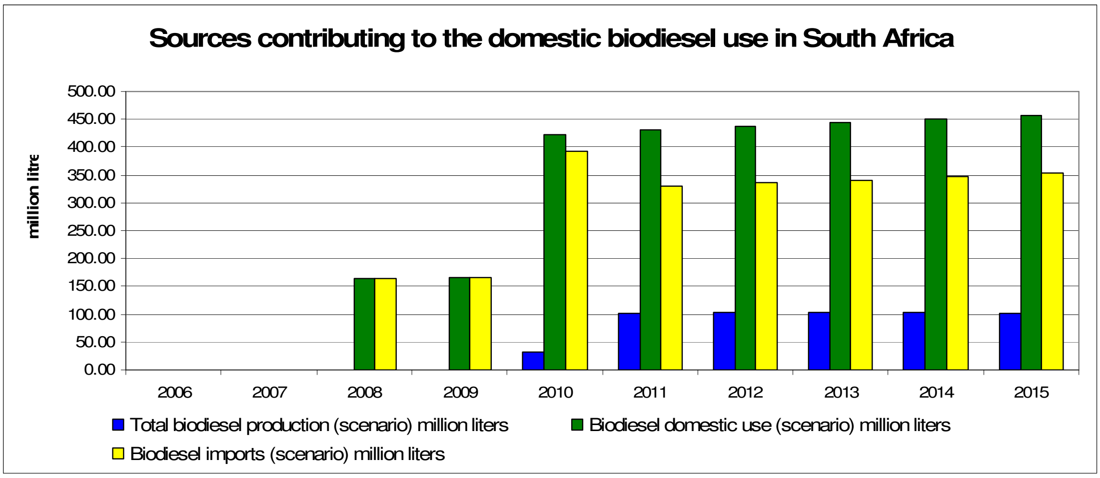

Figure 10: Domestic biodiesel use composition in South Africa

As indicated by the yellow bars, imports make up the largest chunk of the domestic biodiesel use. These levels of imports decrease as the import tariff of 30% comes into existence in 2011. This again gives the local biodiesel industry a slight boost, but not enough incentive to expand the industry. Only limited production of biodiesel (mostly for own use) is projected. The reason for this is that the policies and the incentives are not sufficient to divert vegetable oil away from the human market to the biodiesel market.

Figure 11 applies a similar methodology to what has been discussed previously. The red line represents the simulated plant price for biodiesel, the green line is representative of the basic fuel price and the blue line contains the assumptions as set out by the draft policy, namely that biodiesel will sell at 100% of the basic fuel price, will receive an advantage based on the location differential and on top of that receive the percentage of the fuel levy exemption as is allocated to it in this scenario. As in the case of the price for bioethanol, a cost is deducted to cover the logistics involved.

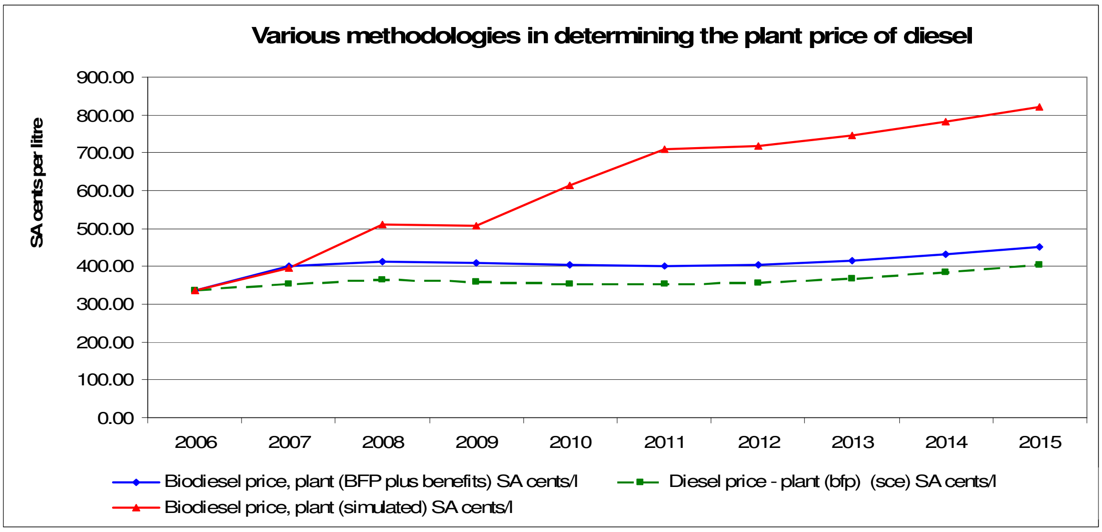

Figure 11: The basic fuel price, the simulated biodiesel plant price and the proposed biodiesel plant price

Figure 11 shows a relatively similar picture as in the case of ethanol. The price of biodiesel receives its first boost when the mandatory blending policy comes into play in 2008. This means that due to the shortage of locally produced biodiesel in South Africa, biodiesel is sought in the international market. This causes the price at plant levels to rise. The increase in the mandatory blending level in 2010 and the introduction of the import tariff of 30% in 2011 boosts the local price of biodiesel even more and it moves to almost 250 cents per litre above the basic fuel price. The proposed biodiesel price remains relatively static as the direct incentives to the biodiesel producers don't increase with anything other than the inflation rate.

The biodiesel which is produced in South Africa has its source mainly in soybeans and partly in sunflower seed after the 2011 tariff introduction. The figure below shows how the imports of soybeans and the cake production of soybeans move in tandem, these being represented by the red lines and the green columns. The sunflower seed net imports, represented by the blue line, show a slight increase from 2010 onwards, this corresponding to the increase in mandatory blending levels and the introduction of the tariff in 2011.

It should however be mentioned that all of the scenarios take only the simulated biofuel prices into account. This means that in most cases biofuel production is made possible by the high price which the ethanol producer receives for his product, which in turn is based on feedstock prices, availability etc. A lower price, as indicated by the proposed fuel price, could seriously dampen local biofuel production incentives and as a result cause a serious shortage within the local market.

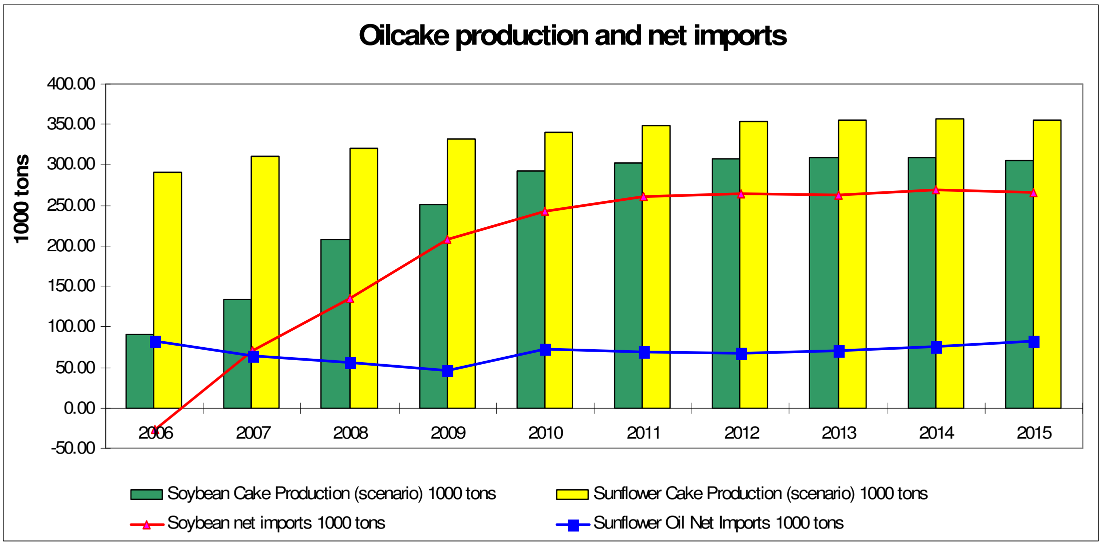

Figure 12: Oilcake production and net imports

4.2 Scenario 2: A green but bleak future.

Scenario 2 differs slightly from scenario 1 in that the government implements a mandatory blending policy of E8 and B2, a fuel levy reduction of 50%, but no import tariffs. Scenario 2 assumes that the government is under the impression that the industry does not require additional support and decides to abort the fuel levy tax exemption in 2011.

4.2.1 Scenario 2: The ethanol industry

The mandatory blending policy for ethanol is introduced on a year-by-year basis from 2008 onwards. A 2% mandatory blend is imposed in 2008 and this increases to an 8% level in 2011. The mandatory blending policy remains constant from then onwards. Figure 13 displays how much ethanol is produced from maize and sugar, respectively.

Sugar contributes a relatively constant supply to ethanol production, increasing very slightly from 2011. From 2012, when the ethanol mandatory blending requirement comes into full force, both sugar and maize contribute significantly to the mandate.

Maize does, however, always contribute more to ethanol production than sugar. This is not the case in the first scenario, where more ethanol is produced from sugar. The answer lies in the volumes of local production. In the first scenario, just 900 million litres of ethanol are produced locally, compared to 469 million litres in the second scenario. In the first scenario, an import tariff on ethanol is used to protect the local industry, which makes the production of ethanol very lucrative. The higher level of demand for yellow maize increases yellow maize prices to such an extent that it becomes more profitable to produce ethanol from sugar. In the second scenario, less maize is demanded and prices increase only moderately, which makes the production of ethanol from maize more profitable.

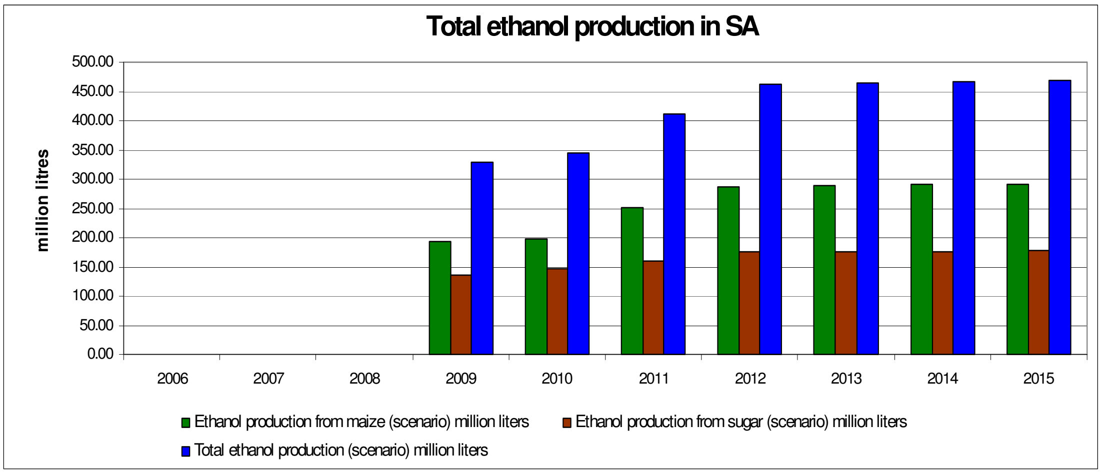

Figure 13: Total ethanol production by crop in SA

All of the ethanol that is to be blended into the petrol mix in 2008 is imported. Thereafter, imports decline slightly as the first local ethanol production facilities come into play and then imports increase as the sugar industry does not increase its contribution to the total ethanol. From 2012 onwards local ethanol production and ethanol imports contribute equally in order to satisfy the local demand for ethanol. Figure 14 illustrates this more clearly.

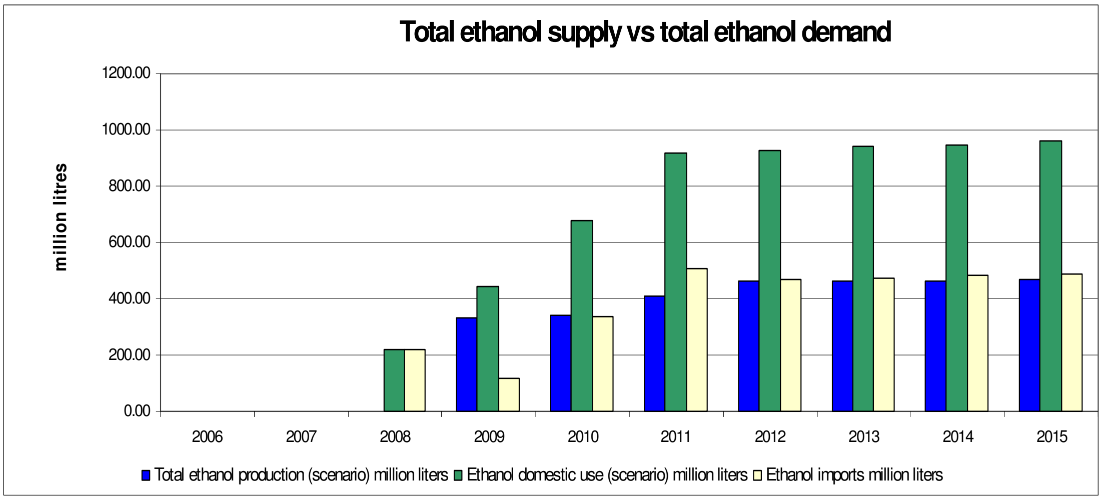

Figure 14: Total ethanol supply versus total ethanol demand

The ethanol price (Figure 15) is boosted quite significantly when the first mandatory blending policy of 2% is put into place in 2008. The price then steadily rises as the blend ratio increases and eventually levels off in 2011. The reduction in the fuel levy puts a damper on the increase in the simulated ethanol plant price and decreases the proposed ethanol price to the basic fuel price. This could possibly be too low a price at which ethanol could be produced economically. The reduction in the fuel tax levy levels off the simulated plant price and in the same instance causes the proposed ethanol price to converge with the basic fuel price. At a basic fuel price and no tax levy incentives, ethanol producers could struggle to become profitable.

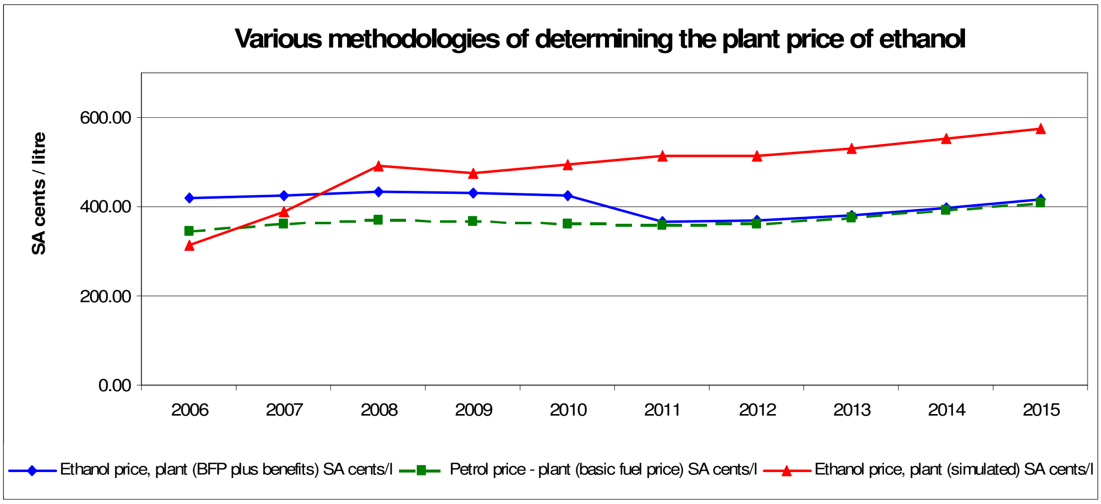

Figure 15: The basic fuel price, the simulated ethanol price and the ethanol price according to the proposed methodology

As the domestic ethanol industry uses both maize and sugar as a feedstock for ethanol production, and since almost half of the ethanol is imported in a refined form, the production of DDGs is significantly lower than if most of the ethanol were to be produced from maize.

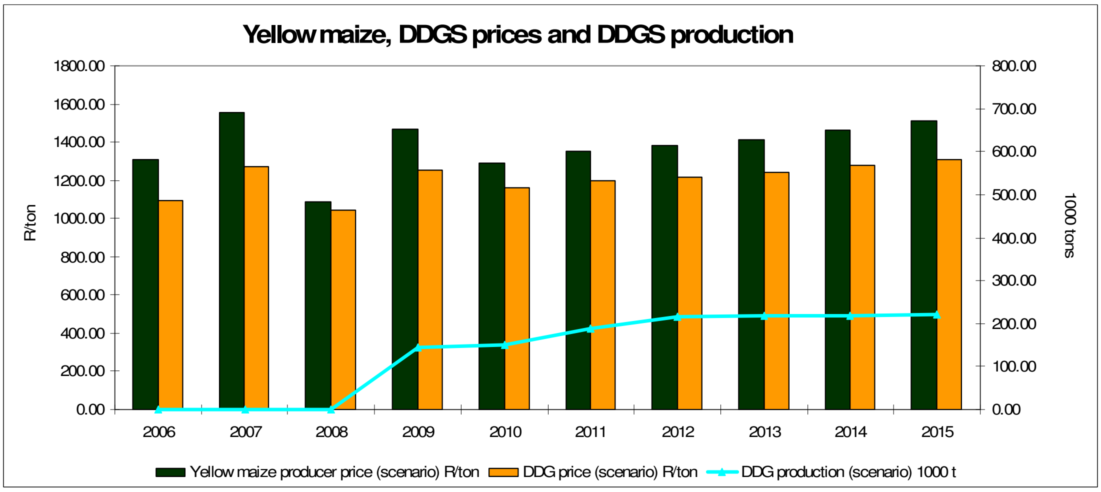

Figure 16: DDGs production, yellow maize and DDGs prices

With lower DDGs being produced, the price of DDGs actually moves closer to the producer price of yellow maize. The production of DDGs levels off at around 200 000 tons from 2012 onwards. The white and yellow maize prices are projected to increase over the long-run by 7% and 11% percent respectively and the area planted under maize is projected to increase by approximately 100 000 ha.

4.2.2 Scenario 2: The biodiesel industry

The government implements a mandatory blending requisite of 2% for biodiesel and keeps this constant from 2008 onwards. It has also implemented a 50% fuel tax levy reduction which is due to expire in 2012. No import tariff on biodiesel is levied.

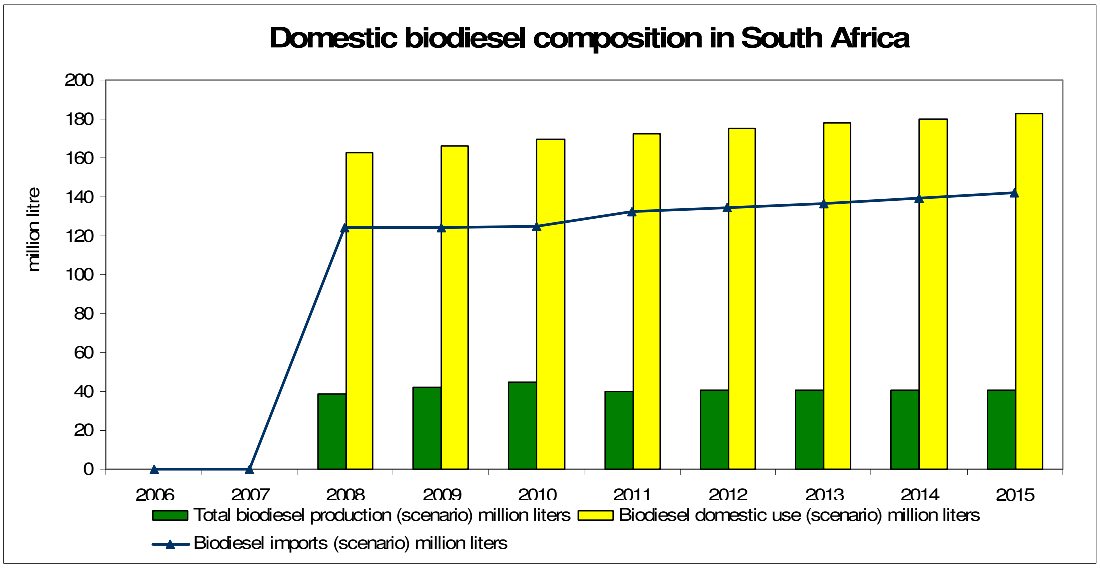

Figure 17: Domestic biodiesel composition in South Africa

The situation has not changed significantly from scenario 1. The majority of the biodiesel used in the South African fuel mix is still imported and a mere 40 million litres per annum are produced locally. The imports of biodiesel remain relatively constant, but indicate a slight rise in 2011, when the fuel tax levy is reduced.

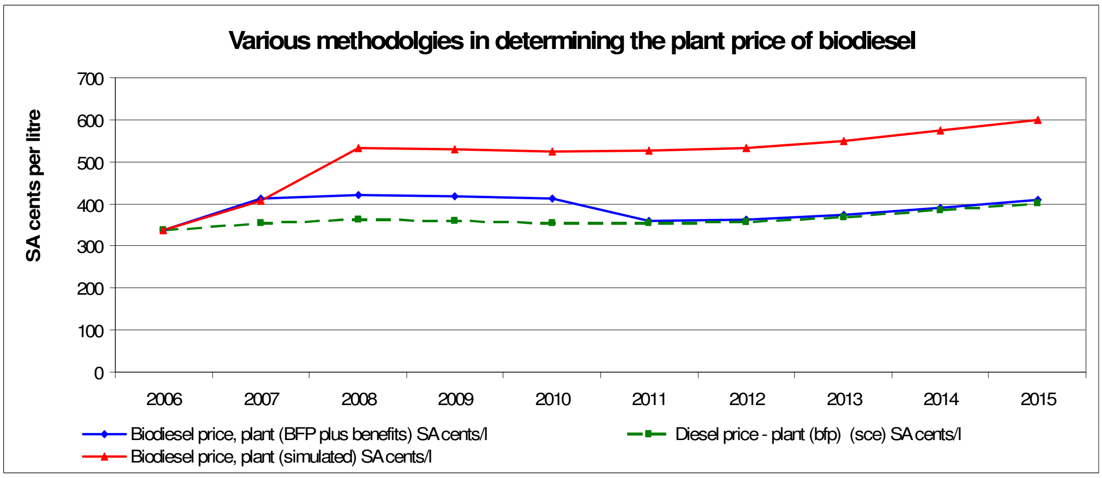

Figure 18: The basic fuel price, the simulated biodiesel price and the biodiesel price according to the proposed methodology

The biodiesel price increases relative to the diesel price once the mandatory blending levels are enforced in 2008. Once the fuel tax levy is reduced in 2010 the proposed biodiesel price is barely higher than the basic fuel price, which in turn could make the production of biodiesel completely unprofitable. Even the simulated biodiesel price indicates that the profitability of the biodiesel industry could come under pressure if the fuel tax levy is discarded.

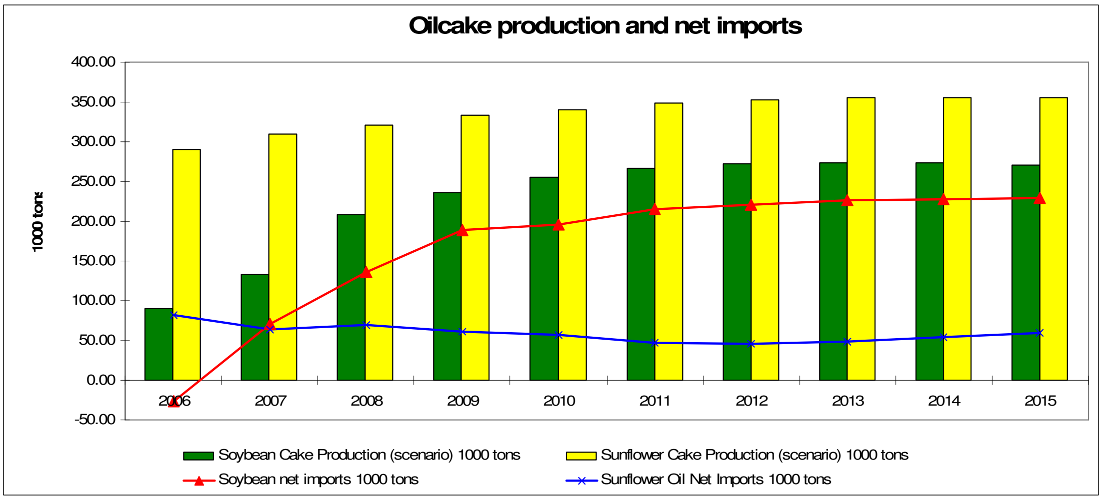

Figure 19: Oilcake production and net imports

Soybean imports and soy cake production increase at the exact same rate from 2007 onwards. Sunflower cake and sunflower oil imports, on the other hand, follow directly opposite trends. The sunflower cake production increases at first and then stays relatively constant.

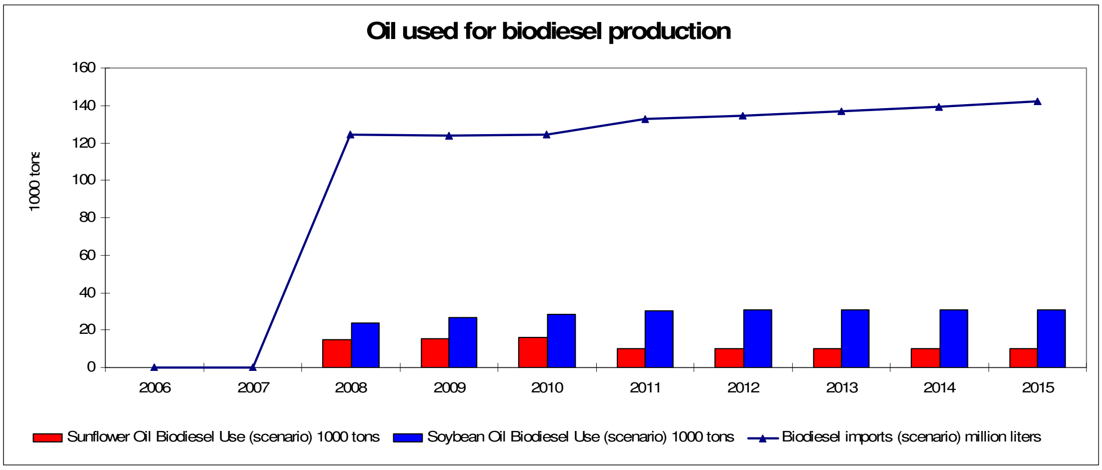

Figure 20: Source of oil used for biodiesel production

Figure 20 shows that the amount of sunflower oil that is used for biodiesel production decreases over time, while on the other hand the amount of soya oil that is used for biodiesel production increases from 2008-2010 and then remains relatively constant. The imports of biodiesel increase slightly over time in order to fill the gap left by the reduction in sunflower oil which was used for biodiesel production. One major constraint of this exercise is that biodiesel is currently not traded on the world market like ethanol. The model simulates that imports will satisfy the domestic requirements for biodiesel. However, it is uncertain whether this will actually be a realistic scenario in the future.

5. Conclusion

The aim of this document is to point out how important government policies are when it comes to establishing a new agriculture-dependent industry. Partial tax exemptions, decisions on import tariff levels and mandatory blending requirements are just a few of the tools available to the government. These tools can be used to further the growth of the industry and make it competitive worldwide.

The scenario, "South Africa's green revolution" represents a scenario in which the government lends enough support to the industry over an extended period of time, with the aim of making it a worthwhile initiative. The results in terms of ethanol production look rather promising, with ethanol imports being reduced as the industry finds support in the form of an import tariff of 30%. Maize prices increase and the total area planted under field crops increases, which are likely to have a positive impact on the rural economy. Ethanol prices jump significantly as the import tariff comes into effect, which might not be in line with the government's long-term view. What needs to be kept in mind is that if ethanol prices are fixed at 95% of the BFP, for example, then it might not be enough of an incentive for the agricultural sector to participate.

"A green but bleak future" represents a situation where the emphasis is to get the industry going, but then to have them stand on their own feet and be economically feasible and internationally competitive. No import tariffs, lower blending mandates and a complete reduction of the fuel tax levy benefit after four years provides only limited support to the industry, and limits its' scope for expansion. The local production and imports of ethanol make up the total domestically required quantity in a 50:50 ratio, thereby reducing the total quantity of DDGs produced to just over 200 000 tons in 2012. Even though the price of ethanol does not jump by such a large amount, it is still higher at retail level than the price in scenario 1. The plant prices show the opposite effect, meaning that the scrapping of the fuel tax levy has, in this case, been passed on to the consumer.

To summarize, government policies will determine the success of the biofuel industry and whether it will boost the rural economy or invite foreign biofuel producers to come and stake their claim on this infant industry. A self-sustaining industry might be a long-term goal, but in a country with highly volatile prices in a highly deregulated market, as well as erratic weather conditions, the government will carefully have to consider the incentives, the costs and the welfare effects of a biofuel industry.

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