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# South Africa's Agrofuels Industry:





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The African Centre for Biosafety (ACB) is a non- profit organisation, based in Johannesburg, South Africa. It was established to protect Africa's biodiversity, traditional knowledge, food production systems, culture and diversity, from the threats posed by genetic engineering in food and agriculture. It has in addition to its work in the field of genetic engineering, also opposed biopiracy, agrofuels and the Green Revolution push in Africa, as it strongly supports social justice, equity and ecological sustainability.

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The ACB has a respected record of evidence based work and can play a vital role in the agroecological movement by striving towards seed sovereignty, built upon the values of equal access to and use of resources.

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## Acronyms

ACB	African Centre for Biosafety
CASP	Comprehensive Agricultural Support Programme
CEF	Central Energy Fund
DAFF	Department of Agriculture, Forestry and Fisheries
DoE	Department of Energy
EDD	Economic Development Department
EIA	Environmental Impact Assessment
IDC	Industrial Development Corporation
IDZ	Industrial Development Zone
NGP	New Growth Path
SABA	Southern African Bio-Energy Association
SAPIA	South African Petroleum Industries Association
SARS	South African Revenue Service

## Summary

This paper provides a brief overview of the biofuels industry in the context of the South African government's 2008 policy. Our key finding is that the large-scale biofuels industry has stagnated almost to the point of non-existence. There is, however, a growing impetus to address the shortcomings in government policy that has held the industry back. We provide an overview of the pilot project at the Cradock Bio-Ethanol Production Facility, which requires further monitoring. We have found that the bio-ethanol industry is waiting on the finalisation of an appropriate incentive scheme, as well as for the Minister of Energy to render it mandatory for fuel companies to purchase bio-ethanol and blend it into the fuel supply.

We also canvass the possible inclusion of maize as feedstock for bio-ethanol production. While taking cognizance of the pressure by the maize industry to include maize, we have concluded that the costs associated with such inclusion, considering food security and the environment are prohibitive.

Despite the important dangers attendant upon the establishment of a biofuels industry in South Africa, authoritative research on the matter is almost non-existent in the public domain. This paper attempts to contribute to closing this knowledge gap, and call for further inter-disciplinary efforts.

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# Introduction

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The most significant event in the history of agrofuels in South Africa was the publication, in December 2007, of the then Department of Minerals and Energy's "Biofuels Industrial Strategy". Shortly thereafter, the African Centre for Biosafety (ACB) released *Agrofuels in South Africa: Projects, Players and Poverty* (as part of its biosafety, biopiracy and biopolitics series). Presenting itself as a starting point for further research and elaboration, including by communities that would find themselves on the receiving end of agrofuels projects, the booklet provided: an overview of the policy context surrounding the agrofuels industry; the industrial scale agrofuels projects that were in the process of being developed and of the key concerns arising in the context of these developments. The booklet was released in 2008. The current paper represents a first attempt at providing updated information about recent developments relevant to the biofuels industry.

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We begin with an overview of the situation surrounding the biofuels industry in 2008. We provide an outline of the architecture of the biofuels policy process. A description of the Cradock Bio-Ethanol Production Facility provides us with an account of the issues holding back the development of the biofuels industry in South Africa. The inclusion of maize as a biofuels feedstock is an important issue and we discuss the potential prospects and pitfalls. We further present a discussion of bio-ethanol and the sugar industry. Finally, we include a discussion of the readiness of the oil industry to accept biofuels into the liquid fuels supply.

### I. The South African agrofuels industry in 2008

The key provisions of the Department of Minerals and Energy's Biofuels Industrial Strategy of the Republic of South Africa, 2007, included the following:

- The policy specifically excluded maize and *jatropha* as possible agrofuels feedstocks;
- The policy set a target of 2% penetration of biofuels into the liquid fuels supply within 5 years; This would entail the production of around 400 million litres of biofuels per annum;
- It was further recommended that a blending level of 8% for bio-ethanol (E2) and 2% for bio-diesel (B2) be achieved;
- A set of incentives was suggested to achieve this goal. A 100% fuel levy exemption along with a R4.20 per litre fixed margin price was suggested for bio-ethanol producers. A 50% fuel levy exemption with a fixed margin price of R4.88 per litre was suggested for bio-diesel producers. The policy document noted that bio-diesel producers were already registered at the South African Revenue Service (SARS) for a tax exemption, and that this registration would need to be extended to bio-ethanol producers;
- The policy did not provide for mandatory blending of biofuels into the liquid fuel supply, but recognised that blending could be mandated by the Minister of Energy in terms of the Petroleum Products Amendment Act;
- The policy noted that, like producers of any other petroleum product, biofuels producers would have to be licensed by the Petroleum Products Controller before they could begin their operations;
- An expressed aim of the policy was the incorporation of 'under-utilised' land, mainly in the former homelands, into mainstream agricultural production. Toward this end, the policy envisaged that support be provided by provincial departments of agriculture along with the Comprehensive Agricultural Support Programme (CASP) of the Department of Agriculture Forestry and Fisheries (DAFF), but only to previously disadvantaged persons in the former homelands;<sup>1</sup>
- Also, according to the Department of Energy's (DoE) 'Criteria for Licences to Manufacture Biofuels',

a licence would only be granted to a manufacturer if they commit, in writing or contract, to sourcing feedstock from emerging farmers in under-utilised areas. If feedstock was used from commercial farmers a detailed phase-in plan for substituting this feedstock with that from emerging farmers in under-utilised areas would have to be provided;

- The production of feedstock under irrigation would only be allowed in exceptional circumstances, when a detailed motivation was provided. Water already used for gainful irrigation would not be considered for biofuels production;<sup>2</sup> and
- Finally, according to the Biofuels Industrial Strategy, the Industrial Development Corporation (IDC) and the Central Energy Fund (CEF) were tasked with facilitating the implementation of the policy, with support from the provincial departments of agriculture. It was envisaged that the IDC and CEF would play a key role kick starting the infant biofuels industry. These state-owned enterprises could achieve this by investing in biofuels projects, as individuals or in partnership with other actors.<sup>3</sup>



http://farm5.static.flickr.com/4130/4999411483\_32f5b7e6fe.jpg

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When the ACB released its agrofuels booklet in 2008 (Agrofuels in South Africa: Projects, Players and Poverty), the government was still grappling with a number of issues pertaining to implementation. The fuel levy exemption scheme for bio-ethanol had not yet been implemented, and the South African Petroleum Industries Association (SAPIA) was concerned that 'the strategy failed to address certain key issues of the practical and economic implications of integrating biofuels into the fuels supply chain'.<sup>4</sup> The resolution of these issues, along with the mandating of blending and the inclusion of maize as an agrofuels feedstock, would be the most important pre-requisites for the bio-ethanol industry. As such, they represented a focal point for research in this paper.

In 2008, a number of large-scale industrial developments were also on the cards:

- The East London Industrial Development Zone (IDZ) was involved in a biodiesel from canola project which was expected to begin production in 2010;
- The Coega IDZ, with Rainbow Nation Renewable Energy, was involved in a biodiesel from soya project which was to be in production by the end of 2009;
- The IDC, CEF and Sugar Beet RSA (Pty) Ltd were involved in an ethanol from sugar beet project in the Cradock area;
- J&J Bioenergy and the IDC were involved in various ethanol from sugar cane projects in Pondoland, which lies across the Eastern Cape–KwaZulu-Natal border;
- The IDC and CEF were considering ethanol from sugar cane projects on the Makhathini Flats in Zululand and at Hoedspruit in Mpumalanga;
- A biodiesel from soya and sunflower project, called the Mapfura-Makhura Incubator, was being pursued by a number of, mainly public, actors near Marble Hall, Limpopo; and
- The Mafikeng Biodiesel Company, a public-private partnership involving a range of actors, was working towards producing biodiesel from oil- bearing trees.

All of these projects were at varying stages of implementation in 2008. None had started producing biofuels. There is anecdotal evidence (from other researchers who have yet to publish) that none of these biodiesel projects have progressed. Furthermore, two key experts at the IDC, Rian Coetzee and Noel Kamrajh, did not consider the biodiesel industry in South Africa as viable in the foreseeable future, because South Africa is a net importer of edible oils, a substitute in the production of biodiesel.<sup>5</sup> As such, the IDC along with the CEF would focus on developing the bio-ethanol industry. Of the four IDC projects outlined above (in Cradock, Pondoland, Makhathini Flats and Hoedspruit, respectively) Coetzee and Kamrajh identified the Cradock Bio-Ethanol Production Facility as their pilot project, with the others all being put on hold.<sup>6</sup>

While the focus of this paper is the bio-ethanol industry, paradoxically, the bio-diesel industry was seemingly more advanced than the bio-ethanol industry in 2008. This appears to be a result of the implementation of the incentive scheme for bio-diesel production that predated the Biofuels Industrial Strategy of 2007. This stands in stark contrast to the non-implementation of the incentive scheme for bio-ethanol producers. The fact that South Africa imports most of its edible oils suggests a further important concern with the development of the bio-diesel industry. Presently, very little land is devoted to the production of feedstock for edible oils, and therefore bio-diesel, this means that scarce land may need to be appropriated, possibly from food production, to serve this purpose. In 2007 around 650 000 hectares of land was used to grow sunflower, soybean and canola – the three most prominent biofuels crops in South Africa. According to one estimate, producing 10% of South Africa's diesel from these crops would entail an increase in land used to 2 600 000 hectares, a 5.2 fold increase<sup>7</sup> representing 13.21% of arable land in South Africa.<sup>8</sup> Therefore, further research into the development of the bio-diesel industry is necessary.

### II. The Architecture of the Biofuels Policy Process

Despite support for the expansion of the biofuels industry in Minister Patel's New Growth Path (NGP), Patel's Economic Development Department (EDD) has not assumed a robust role in the implementation of the biofuels policy. The IDC, explicitly tasked with this function,<sup>9</sup> answers to the EDD. This represents the principal involvement of the EDD in the biofuels strategy.<sup>10</sup>

### Mandatory upliftment of biofuels would *require* oil companies to purchase all biofuels produced in South Africa for blending in the fuel supply.

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The Department of Energy (DoE) still plays a driving role in the policy process, but it is required to work through the Inter-Departmental Task Team on Biofuels. The CEF, DoE, DAFF, National Treasury, Department of Trade and Industry (DTI), Department of Water Affairs and Forestry (DWAF) and Department of Environment Affairs and Tourism (DEAT) are all represented on the task team.<sup>11</sup> Each can provide an official motivation to the task team if they want it to consider a change in, or review of, policy.<sup>12</sup> This power is crucial, as the DAFF is positioned to push for the inclusion of staples, such as maize, as possible feedstock for the biofuels industry



http://www.sciencephoto.com/images/showFullWatermarked.html/T122091-Growing maize for biofuel-SPL.jpg?id=841220091

The Minister of Energy also directly controls the mandating of upliftment of biofuels into the liquid fuels supply, as well as the fixed margin prices on biofuels, through s 2 (b) (ii) and s 2 (c), respectively, of the Petroleum Products Act 120 of 1977. The DoE must consult directly with the National Treasury as regards the fiscal incentives that will be provided to the biofuels industry.<sup>13</sup>

Representatives of the DoE confirmed that, at the time of writing, no steps have been taken to review the Biofuels Industrial Strategy. The government is still attempting to implement the original strategy.<sup>14</sup>

# III. The Cradock Bio-Ethanol Production Facility and Sugar Beet Farming Project

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The Cradock Bio-Ethanol Production Facility is the IDC and CEF's pilot project for bio-ethanol production. The hope is that the success of the facility will encourage the private sector to become more active in producing bio-ethanol for blending into the liquid fuel supply. The Cradock Facility seemingly represents the cutting-edge of the bio-ethanol industry in South Africa and deserves extended attention. The issues holding back construction of the Cradock facility also provide us with a good indication of what is needed, from the perspective of policy, for the bio-ethanol industry to get off the ground.

Closely related to the proposed Cradock Bio-ethanol Production Facility is the Sugar Beet Farming Project. The Sugar Beet project is a joint venture between the IDC, the CEF, and Sugar Beet RSA (Pty) Ltd<sup>15</sup> (the latter being owned by the Eastern Cape Department of Agriculture and Rural Development)<sup>16</sup> which aims to introduce sugar beet as a crop into the Eastern Cape, and specifically, the Great Fish River Valley. The project is financed solely by the Eastern Cape Department of Agriculture and Rural Development.<sup>17</sup>

This will be the second commercial planting of sugar beet in South Africa. The first is operated by Silversands Ethanol in the North-West province. Silversands utilises sugar from sugar beet as a feedstock for its ethanol gel. The ethanol gel is not suitable for normal petrol cars because it only has an ethanol content of around 80%. It is, however, currently being used in some Johannesburg Metro Buses – diesel buses specially modified by Scania.<sup>18</sup> In contrast, the sugar beet produced at the Sugar Beet Farming Project will be processed, in the Cradock Bioethanol Production Facility, to make fuel-grade bioethanol, fit for blending into the national liquid fuel supply.

The Sugar Beet Farming Project will involve a core farming estate of some 6 000 ha, to be managed and owned by Sugar Beet RSA.<sup>19</sup> This 6 000 ha will provide about one third of the Cradock bioethanol production facility's feedstock. The balance of the feedstock, it is hoped, will be obtained from a further 12 000 ha to 18 000 ha of sugar beet crop<sup>20</sup> to be secured exclusively through contracts with existing commercial farmers. Alternatively, the balance will be provided in the form of grain sorghum sourced throughout the country.<sup>21</sup>

Around 1 200 ha have already been secured for the core farming estate. A further 3 000 ha are to be secured by June-July of 2011, with the balance expected to be secured by around April-May 2012. All this land has been, or will be, secured from existing commercial farmers.<sup>22</sup>

The IDC claims that 'the project has been specifically designed to facilitate linkages with the second economy through the establishment of [the] core estate with farming by emerging farmers.'<sup>23</sup> No beneficiaries have been identified for the project; it will remain the property of the Eastern Cape Department of Agriculture and Rural Development. Emerging farmers will be incorporated through training on the core farming estate. The requirement, in the 'Criteria for Licences to Manufacture Biofuels', that feedstock be supplied by emerging farmers in the former homelands has, therefore, apparently been relaxed.<sup>24</sup>

Large-scale sugar beet cultivation has not yet commenced, ostensibly because the bioethanol production facility first has to be constructed. Seeds are likely to be obtained from a variety of sources. The use of GM sugar beet is being discussed, however, at the time of writing; no permit had been issued for the growing of GM sugar beet in South Africa. The intention is to grow sugar beet

on a three-year rotation, to be followed by maize and lucerne. The crop will be ripe for harvesting between 6-12 months; an early harvest at 6 months will allow a second crop to be planted within the same year. The crop will be under irrigation for the entire year.<sup>25</sup> The project will involve upgrading the currently existing Fish River irrigation scheme.<sup>26</sup> In addition, the original commercial farmers from which land has been, or is being purchased are already in possession of the rights necessary to keep their land irrigated. These rights will pass to the core farming estate – apparently satisfying the condition, in the 'Criteria for Licences to Manufacture Biofuels', that irrigation for biofuels crops will only be approved in 'exceptional circumstances' where the water is not already 'gainfully employed'.<sup>27</sup>

The Cradock Bioethanol Production Facility is being implemented in partnership with the CEF and, via the Sugar Beet Farming Project, Sugar Beet RSA. The project is still at the basic engineering stage and the final figure for capital investment is currently unclear. The cost will be determined by the



http://www.monasette.com/blog/image/Feb1705/sugarbeet.jpg

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form of the facility. A rough estimate indicates an investment of between R1.4 billion and R2 billion.<sup>28</sup> One of the engineering options is a high technology system for dealing with CO2 emissions: CO2 will be used and re-used in three separate processes and then liquefied for sale to the soft drink industry, the result being a plant with minimal CO2 emissions.<sup>29</sup> At the time of writing, the IDC and the CEF are the only investors, though they are hoping to attract further investors. The facility will then be owned as a joint venture between the IDC and CEF, and any other investors that ultimately buy into the project.<sup>30</sup>

The project has received a license to produce bio-ethanol. The mandatory environmental impact assessments (EIA) has been completed and the project received environmental authorisation on 14 April 2010.<sup>31</sup> In 2009, a site for the plant was bought about 4km from the centre of Cradock, across

According to Noel Kamrajh and Rian Coetzee of the IDC, a R2 per litre incentive is necessary for the bio-ethanol industry in South Africa to be viable.<sup>34</sup> The Biofuels Industrial Strategy suggests that *'bioethanol producers...* should *receive* a 100% fuel levy exemption' (emphases added).<sup>35</sup> As bio-ethanol producers are exempt from fuel levies, this will be of little assistance to them.<sup>36</sup> Fuel levies are included in the pump price of liquid fuels,<sup>37</sup> if the fuel price were to fall; consumers would generally buy a similar amount of fuel as they did before. The reason being that there is no immediate substitute to liquid fuel and consumers would not be switching from a relatively more expensive commodity to the now less expensive liquid fuel. In other words, the fuel market is subject to price "inelastic" demand, the quantity of liquid fuel that people buy is relatively



http://www.itsgeneticallymodified.com/wp-content/uploads/2011/02/ SUGAR-BEET23.jpg

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unaffected by the price of fuel.<sup>38</sup> As such, if the fuel levy dropped – in proportion to the bioethanol blend as implied by the biofuels strategy – then consumers would generally just buy a bit more fuel and have more money to spend on other goods. Any exemption from the fuel levy will benefit motorists, not producers, and will not affect an incentive to producers.

Various researchers have expressed the view that the situation may be substantially more complex.

The National Treasury has offered four options for an incentive scheme to the DoE. However, officials have refused to elaborate on these options until a final decision is made.<sup>39</sup>

Currently, discussion regarding an incentive for bio-ethanol producers seems to revolve around the fixed margin price at which bio-ethanol is to be traded. Research into this issue has been commissioned by the DoE and they are expecting its completion by August 2011. Representatives at the DoE also suggested that upliftment would only be mandated once the incentive issue was finalised.<sup>40</sup>

Interestingly, the construction of the plant does not seem to depend upon the success of the Sugar Beet Farming Project. The plant will be capable of producing bio-ethanol from a number of different feedstocks. Initially, the plant is intended to produce bio-ethanol from both sugar beet and grain sorghum.<sup>41</sup> However, the plant will be viable with just grain sorghum as a feedstock. Grain sorghum was chosen as a potential feedstock for a number of reasons. First, grain sorghum, unlike sugar beet, can be transported over long distances eliminating a reliance on the local farming community to provide feedstock. It is hoped that the grain sorghum could eventually be sourced from the former Transkei. Second, with the demise of the sorghum beer industry, grain sorghum producers have unused capacity and will be able to provide the facility's feedstock requirements. Grain sorghum may well be the *preferred* feedstock. Currently, local farmers will not consider producing sugar beet, in the absence of price support, because production costs for sugar beet are too high. The IDC is currently researching ways to reduce production costs, as well as considering, in consultation with Treasury, the possibility of providing the farmers with some kind of incentive to grow.<sup>42</sup>

Interestingly, the processes in which maize and grain sorghum are used to produce bio-ethanol are essentially identical.<sup>43</sup> Therefore, the facility can readily be used to produce bio-ethanol from maize should the staple be included as a possible agrofuels feedstock.

The production facility is expected to produce around 100 million litres of bio-ethanol annually, along with around 75 000 tonnes of high-protein animal feed (a by-product of the ethanol production process). Animal feeding will most probably be set up near the production facility.<sup>44</sup> The production facility will employ around 167 people. It is expected that around 2 800 direct jobs will be created in the production of grain sorghum and a further 6 200 jobs in the production of sugar beet.<sup>45</sup>

Further Questions:

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- 1. How many indirect jobs could be created by the farming project and the bio-ethanol plant?
- 2. What is the involvement of community members and traditional authorities in the entire project?

# IV. On the (possible) inclusion of maize as an agrofuels feedstock

Maize is a staple in many people's diets. Therefore, the price of maize directly influences peoples buying choices. If the price rises, they spend less on other commodities and conversely, if the price drops they have more expandable income. The maize market exhibits price inelastic demand – the quantity of maize that people buy is relatively unaffected by changes in the price of maize. The result is that, with South Africa's relatively stagnant population growth rate, the domestic consumption of maize has remained at around 8.6 million tonnes.<sup>46</sup>

Farmers in South Africa produced 12.815 million tonnes of maize in the 2009/2010 season, the largest harvest in three decades. The result has been a surplus of around 4 million tonnes.<sup>47</sup> Typically, any surplus production above domestic consumption would be exported to international markets. South African maize, however, cannot compete on the world market because world maize prices have been depressed. This is largely due to the huge surpluses of heavily subsidised foreign farmers, mainly from the United States.<sup>48</sup> In addition, the traditional outlets for South African maize surpluses in Africa have also enjoyed excellent yields and have increasingly becoming self-sufficient.<sup>49</sup> Consequently, the domestic surplus has no place market.

In an effort to sell their excess maize, producers and traders, in competition with each other for buyers, bid down the domestic price of maize. The history of the South African maize market suggests that this continues until the domestic maize prices are equal to export parity prices or the price that a producer can expect to get if he exports his maize.<sup>50</sup> This means that a producer is compelled to sell her produce at a price determined, in effect, by heavily subsidised American

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Maize farming in South Africa is, therefore, a risky enterprise. Only the most wealthy and efficient producers, who utilise economies of scale, can survive.<sup>51</sup> Importantly, this seems to be one of the central causes of the increasing concentration of the South African maize industry in the hands of large-scale industrial producers, and the concomitant decline of the small farmer. In turn, with each step in the development of industrial agriculture we move away from (and even witness the formation of rural, class barriers resistant to) the realisation of small, local farming. Of course, there is also the many other social and economic ills attendant upon the concentration of capital.



http://www.traitgenetics.com/en/images/traitgenetics\_images/crops\_maize.jpg

Another, immediate consequence of the structure of the maize market is *volatility* in the price of maize and in the demand for labour. The low maize price is not static. The maize industry utilises its productive capacity in response to the price signal offered by the previous season. As we have seen, if a surplus is produced in a previous season then the price of maize falls. This results in maize producers cutting back on production in the following season; consequently, there is a reduced demand for labour and therefore less employment. The subsequent drop in domestic production pushes up the price of maize.<sup>52</sup>

The latter consequences are the basis for a central argument of the strong lobby, primarily consisting of GrainSA and the Southern African Bio-Energy Association (SABA) for the inclusion

of maize as a possible agrofuels feedstock. They argue that the problems, and problematic consequences, of the maize market can be resolved if maize is allowed as a bio-ethanol feedstock. This would create an alternative market for maize. Surplus production, over and above domestic consumption, could then be channelled into this market and the ill effects of the periodic surplus eliminated. Apparently, the maize industry has the capacity to produce around 12 million tonnes of maize without undue pressure on natural resources. This alternative market would also result in the creation and retention of more jobs.<sup>53</sup>

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Industry is ready to produce bio-ethanol from maize upon the implementation of an incentive scheme and the acquisition of off-take agreements for biofuels – which could be achieved with mandatory upliftment. The Minister of Agriculture, Tina Joemat-Peterson, has expressed her support for a review of the biofuels policy in order to allow the maize industry to dispense with its surplus.<sup>54</sup> However, this does not mean that a review is on the cards in the immediate future. As mentioned, the DAFF has a representative within the Inter-Departmental Task Team on Biofuels. Any influence on the policy process will be through this representative, who must submit an official motivation for a review of policy to be considered. The fact that the Minister has expressed her support for such a review does not mean that the representative on the task team has been instructed accordingly. In the interim, the grain industry will try to export the surplus as South African maize becomes more competitive with the deterioration of the strong exchange rate and rise in global maize and crude oil prices.<sup>55</sup>

The extension of the bio-ethanol industry into the grain surplus is extremely worrying. It carries problems and risks that may well be prohibitive. It is clear that maize farmers can produce a surplus of maize to be fed into bio-ethanol production facilities. *If* production is kept consistent at the realistic total of 12 million tonnes, then this *will* outstrip consumption *only if*, population permitting, consumption is kept consistent at approximately 8.6 million tonnes. However, there are a number of realistic and unfavourable possibilities contained in this statement. At present, the most likely of these *possibilities* would be that production could fall below 12 million tonnes, due to drought or some other natural event that adversely affects yields. Proof of possibility: drought stress for 20 days during key points in the growth of a maize crop can reduce yields by up to 50%.<sup>56</sup>

So the pressing question is - What is to prevent the bio-ethanol industry from cutting into the maize supply traditionally used for domestic consumption? What will ensure priority for food rather than fuel? This problem will present itself even if domestic production does not drop and domestic consumption for food remains stagnant. The bio-ethanol industry could expand to the point where it requires more feedstock than the surplus can provide. The consequent domestic shortage of maize would increase maize prices, not periodically but permanently. However, in principle, the growth of the bio-ethanol industry could be regulated so that it does not have the *capacity* to cut into domestic consumption for food.

A *drop* in maize production makes the issue more complicated. To allow maize to be a feedstock for the bio-ethanol industry would mean the creation of bio-ethanol production facilities that rely on a relatively constant supply of maize. It is possible that the bio-ethanol industry could be denied feedstock during times of reduced maize production. However, the mechanisms required may be impractical and would rely on a high degree of political will and effectiveness. In addition, to deny the maize-to-ethanol industry feedstock would affect the very viability of the industry. The immediate interests of those involved in the industry, on the one hand, and ordinary maize consumers, on the other, would be decisively at odds. The outcome would have to be politically

mediated and would be extremely uncertain precisely for that reason. There are high-stake risks, in the arena of food security, attendant upon allowing maize to be used in bio-ethanol production.

Within the broader context, biofuels are only a miniscule part of the far-reaching structural solution to the country's, and the world's, many pressing problems – despite the techno-philes protestations to the contrary. At worst, biofuels are merely a misguided attempt at propping-up and perpetuating a system that is both fundamentally unjust and quickly failing us. For instance, research by Pimental and Patzek suggests that, in general, turning maize into bio-ethanol costs more energy than that provided by the resulting bio-ethanol, 29% more to be exact.<sup>57</sup> If this is correct, then this agrofuel has no environmental benefits. In fact, if we add the negative energy balance to all the environmental costs associated with large-scale industrial agriculture, (for instance those resulting from the use of chemical pesticides, herbicides, fertilisers and genetically modified (GM) crops), the use of maize to produce bio-ethanol begins to look like a veritable environmental nightmare. On the other hand, the problems in the maize industry are real, and production for bio-ethanol would seem to offer a solution. However, the costs, when we consider food security and the environment, may well be prohibitive.

### V. Bio-Ethanol and the Sugar Industry

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Sugar production in South Africa has dropped from a high of around 2.75 million tonnes in 2002-2003 season, to an estimated 1.91 million tonnes in the 2010-2011 season.<sup>58</sup> The drop in production is due to a convergence of factors including: the 2008 oil price spike; the recent recession and a persistent drought along the eastern stretches of the Great Escarpment. These conditions have now



http://www.virginmedia.com/images/sugarcane.jpg

shifted and the sugar industry expects production to increase progressively starting with an expected 2.2-2.3 million tonnes in the 2012-2013 season.<sup>59</sup>

Even at the height of sugar production, the industry estimated that sugar production could be expanded by 10% through increased growing in Mpumalanga and KwaZulu-Natal, the only regions in South Africa suitable for sugar cane farming. This kind of expansion, however, can only be achieved if sugar production is rendered more profitable and the sugar

industry is pushed to reinvest. This could be achieved through: preferential access to, currently fairly closed, European markets; electricity generation from bagasse or through bio-ethanol production.<sup>60</sup> The latter is the sugar industry's position in promoting the bio-ethanol industry. It supports mechanisms to support the bio-ethanol industry, so that emerging farmers, mainly in the former homelands, can extend the land area committed to cane growing.<sup>61</sup> It is not looking towards the inclusion of commercial farmers in the biofuels policy.

The mechanisms that the sugar industry is lobbying for include the implementation of an incentive scheme for bio-ethanol producers and the mandating of upliftment of locally-produced bio-ethanol into the liquid fuel supply. Representatives of the sugar industry are also concerned about the volatility of the oil price and the effects that this might have on the viability of the local bio-ethanol industry. The oil industry is capital intensive and can withstand high volatility in the oil price. The sugar industry, on the other hand, has higher labour costs and cannot easily withstand this volatility.<sup>62</sup> The sugar industry require something like a hedge fund, to be paid into when bio-ethanol profits are high and to pay out when profits are low, in order to sustain the industry. Representatives are also concerned about arbitrage of sugar products between saleable sugar production and bio-ethanol to the oil industry.<sup>63</sup> Some mechanism capable of stabilising the relative prices of sugar and bio-ethanol might be needed to secure a supply of bio-ethanol.

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#### Further questions:

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- 1. Does the sugar industry expect that the price of sugar will rise if a market for sugar is created in the bio-ethanol industry? Or is the sugar industry incapable of expanding production because this will make the price of sugar too low to cover costs and provide a return on investments?
- 2. How does the sugar industry manage production to avoid overproduction, as in the maize industry?
- 3. (Due to conflicting reports) Will the sugar industry begin producing bio-ethanol even if mechanisms are not put in place to deal with the volatility of the oil price and the volatility of the relative price of sugar respectively?

### VI. The readiness of the oil industry

Soon after the Biofuels Industrial Strategy was released in 2008, the oil industry raised concerns about the Strategy's failure to take into account the practical and economic implications of blending bio-ethanol into the liquid fuel supply. The list of concerns is extensive<sup>64</sup>:

- Adding small quantities of ethanol to petrol changes its vapour pressure making it more volatile. This can affect engine performance in high temperatures and altitudes. New fire fighting equipment would be needed at distribution points.
- The presence of water in the fuel supply system would cause the ethanol to separate out of the fuel and dissolve in water, called phase separation; this would cause the octane levels of petrol to drop. Normally water from condensation, for instance, would collect at the bottom of a tank where it can easily be removed. Tanks and piping would need to be upgraded to prevent water from getting into the system. (According to Rian Coetzee and Noel Kamrajh of the IDC, phase separation potential is very low up until a 10% bio-ethanol blend, and then is again very low after a 25% blend. So phase separation need not be a problem at this stage.)<sup>65</sup>
- If ethanol is separated out then it could be siphoned off for consumption. The ethanol would need to be de-natured in order to make it unpalatable.
- The linings and seals of storage tanks, transport tankers and pipe networks need to be checked for compatibility with ethanol.
- Ethanol consumption is about 34% higher than petrol. This might have implications on the amount of storage tank space required at distribution centres in the longer term.

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- The use of biofuels should not result in an increase, carried by the oil industry or the consumer, of overall production and distribution costs. This would require appropriate incentivisation and an appropriate biofuels transfer price at the producer's gate. (Whether this would be the case, given the currently proposed incentivisation, would depend largely on where the bio-ethanol is produced and where it needs to be transported to.)<sup>66</sup>
- The use of biofuels in the off-road and industrial sectors is neglected in the current policy, yet it would be easier and more cost-effective within this area.
- A continuity of supply of ethanol would need to be ensured given the technical challenges associated with the blending and distribution of blends, especially where bio-ethanol exceeds 2% of the blend.
- The quality of both bio-ethanol and bio-diesel blends would need to be ensured according to the relevant SANS specifications.
- There is a multi-product pipeline that carries diesel, petrol and jet fuel from Durban to Johannesburg. The pipeline is a key component of national fuel supply logistics and is vital for supplying jet fuel to Oliver Tambo International Airport. The products in the pipeline are segregated by interface mixtures, which minimise product mixing. The effect of transporting a 2% bio-ethanol blend and 5% bio-diesel blend with this pipeline would need to be explored.

The oil industry does not expect any major changes in infrastructure if the bio-ethanol blend remains below 2%. Beyond this point, significant changes in infrastructure would be required. SAPIA has noted that the development of the biofuels industry in the rest of the world has required large subsidies and it estimates that including biofuels in the fuel mix would add 10 to 15 cents per litre to the fuel price. The price will likely be passed on to the consumer in the absence of some kind of subsidisation.<sup>67</sup> At the time of writing, none of these issues, raised as early as 2008, had been comprehensively dealt with,<sup>68</sup> although DoE and the National Treasury were in consultation regarding the appropriate support mechanisms.<sup>69</sup>

#### Further Questions:

1. What mechanisms are required to ensure continuity of the bio-ethanol supply? How close are these mechanisms to being implemented? What are the constraints?

# Conclusion

We can conclude that the agrofuels industry in South Africa has not developed much since the release of the Biofuels Industrial Strategy. Much rests on the question of incentives for producers, support for the fuel company distributors and the mandating of upliftment by the Minister of Energy. Consultations with regard to all these issues are on going. The ACB has not neglected to bear witness to the dangers attendant upon the establishment of an agrofuels industry in South Africa.<sup>1</sup> Developments on the policy and industrial levels should be monitored and in-depth research undertaken, in order to pre-empt any unfavourable developments.

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# Understanding Sugar Beet

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# The establishment of sugar beet

Sugar beet is the most important of several cultivated varieties (including spinach beet, Swiss chard, beetroot and fodder beet) within *Beta vulgaris* ssp. *vulgaris*. The most likely ancestor of these cultivated beets is the wild sea beet, or *Beta vulgaris* ssp. *maritime*, a hardy plant that grows on sand dunes, sea walls and shingles around the coasts of the UK, Continental Europe and the Mediterranean. The Ancient Greeks cultivated the beet plant as a garden vegetable. At this stage, the plant was grown primarily for its leaves and probably resembled spinach beet or Swiss chard. By the end of the fifteenth century, the cultivated plant was grown throughout Europe, including within the United Kingdom. However, it was not until the seventeenth century that beet was cultivated as a crop. By this time, beetroot had appeared, fodder beet, the tops and roots of which were used as cattle fodder, had also been cultivated.<sup>1</sup>

A milestone in the history of the sugar beet industry occurred when Andreas Sigismund Marggraf, president of the Physical Class of the Berlin Academy of Science, showed that a sweet-tasting crystal (later called sucrose) obtained from beet juice was identical to cane sugar. At this stage the sugar content of the roots of red and white beets was very low, the amount of sugar that he obtained being around 1.6% of the roots' weight. As such, the large-scale extraction of sugar from beet was not seen as economically viable.<sup>2</sup>

It was Marggraf's student, Franz Carl Achard, that would begin to unlock the potential of sugar beet. He investigated the crop in more detail and found that roots with white skin, white flesh and a conical shape had the highest content of sugar. This form of beet was selected from the fodder beet variety, and would later be called White Silesian beet. In 1801, Achard opened the first beet sugar factory at Cunern in Lower Silesia. Although the amount of sugar extracted amounted to only 4% of the roots' weight, Achard demonstrated the possibility of Continental Europe producing large quantities of sugar, and thereby limiting the import of expensive sugar from British colonies. Others adopted Achard's methods and ideas. In 1802, a factory was opened in Russia; another was opened in 1805 by a friend of Achard's, Moritz Baron von Koppy. Koppy showed that sugar beet offered considerable benefits in a diversified farming system. It was a high value crop with by-products, such as tops and beet pulp, which could be used as fodder for cattle.<sup>3</sup>

In 1806, Napoleon banned imports of British goods into Continental Europe and consequently Europe suffered a severe shortage of cane sugar. In 1811, Napoleon published a first edict declaring that 32 000 ha of beet be sown in France and in other countries under French administration, in order to compensate for the shortfall in the availability of sugar. Over 40 beet sugar factories were constructed in that year. In 1812, Napoleon published a second edict declaring that 100 000 ha of beet be sown. As a result, 334 beet sugar factories were licensed in that year. Only around half of them, however, started producing sugar. Napoleon was ousted by 1814, the continental blockade was

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removed, and beet sugar was not competitive in face of the subsequent in-flux of cane sugar from the West Indies.<sup>4</sup>

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The beet sugar industry only survived in France. Due to a duty on imported cane sugar, the French industry slowly grew between 1820 and 1839. It also grew in efficiency. Sugar extraction was improved using new machines, mainly imported from England, such as the steam engine, presses and juice pumps. With these new improvements, the beet sugar industry spread throughout continental Europe, gradually replacing the cane sugar industry. All major sugar-producing countries in Europe eventually introduced bonuses and protectionist import duties on cane sugar to support domestic sugar production. Eventually, a tax on beet sugar provided the impetus for the pursuit of improved efficiency by beet sugar producers. Through the progeny system of breeding the sugar content of beet was increased to 18-20% by 1880, with sugar extraction rates increasing correspondingly. Industrialisation further increased the efficiency of beet processing.<sup>5</sup>

Due to these latter developments, during the second half of the nineteenth century production of beet sugar began to exceed consumption in France, Germany and Austria. Competition between cane sugar and beet sugar on the international market became more intense, and by the end of the nineteenth century beet sugar production outstripped cane sugar production. However, in 1901, an international agreement was reached stating that no subsidies would be paid for sugar beet production and no import taxes would be imposed on cane sugar. As such, by 1914 cane sugar again accounted for half the world's sugar consumption.<sup>6</sup> Although the liberalisation of the market for sugar has been partially reversed since World War One (when the value of a supply of sugar, independent of the freedom of sea routes, was realized) the market share of cane sugar has continued to grow.<sup>7</sup> Today beet sugar accounts for just a quarter of the 144 Mt of sugar produced annually.<sup>8</sup>

# The political economy of sugar beet in the present

Sugar beet is now grown in around 50 countries including much of Europe, the USA and Canada, Uruguay and Chile, Morocco, Algeria, Tunisia and Egypt, Turkey, Iraq, Iran, Pakistan, Syria, China and Japan. The crop is also currently being extended into Australia, India and South Africa. Despite the extension of the crop into subtropical climates, sugar beet is still essentially a crop grown in temperate regions. The distribution of the contemporary beet sugar industry is largely determined politically, that is, by protectionist policies and preferential international agriculture and trade agreements.<sup>9</sup>

The costs associated with beet sugar production outstrip those of cane sugar production in almost every case. For example, in Germany and Poland in 1999 it cost around  $\in$ 70 and  $\in$ 38 respectively to produce 100kg of beet sugar. Alternatively, in South Africa, Australia and Brazil it cost  $\in$ 22,  $\in$ 18 and  $\in$ 14 respectively to produce 100kg of cane sugar. Germany's high production costs are due primarily to high employment- and land- costs, as well as demanding environmental and social regulations. Poland's high production costs are due primarily to low efficiency, with 5.5 tonnes of sugar being produced per hectare to the 10 tonnes per hectare being produced in Germany. Australia makes up for its high labour costs, in 1999 standing at  $\in$ 10.7 per hectare to South Africa's  $\in$ 0.60 per hectare, with high efficiency, at 13.7 tonnes of sugar produced for every hectare of crop, and low land costs. South Africa and Brazil make up for their relatively low efficiency, in 1999 at 6.2 and 7.9 per hectare respectively, through low labour and land costs.<sup>10</sup> This indicates that any liberalisation of the international trade in agricultural products, through the WTO and GATT processes, will likely have far-reaching consequences for national beet sugar industries.

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Aside from protectionist policies, the success of sugar beet has also rested upon the breeding of new varieties of sugar beet, especially disease-resistant varieties, and the development of systems of cultivation, harvesting and processing, which have enabled the crop to be grown economically in a range of climates and soil types. Economically, the most important improvements have been labour-saving developments.

Monogerm seeds eliminated the labour-intensive work of thinning and singling sugar beet plants. New selective herbicides eliminated the need for hand weeding. In addition, mechanical harvesters have meant that the crop no longer needs to be topped and harvested by hand. These kinds of developments have meant that, to use the UK as an example, average labour requirements declined from 300 labour hours per hectare in 1954, to 50 hours in the late 1970s, and in some cases 20 labour hours per hectare today. This was the greatest reduction in labour requirements experienced by any agricultural crop over the period." In 1999, the average labour in Germany was 24 labour-hours per hectare, while in Poland it was 180 labour-hours per hectare. This compared to 35 labour-hours per hectare in Australia's sugar cane fields, 200 labour-hours per hectare in Brazil's and 400-500 labour-hours per hectare in South Africa's. The high labour requirements in South Africa were due, in part, to the fact that cane cultivation occurs largely on slopes that inhibit mechanisation, and that also inhibit irrigation contributing to an exceptionally long maturation period of sometimes up to 2 years.<sup>12</sup>

### The agronomics of sugar beet

The sugar beet crop can be grown successfully on almost all soil types, including clays, silts, sands and organic soils. Sugar beet does relatively well in soils with high salinity. Production can be limited on soils that are excessively wet during sowing and harvesting times, but this issue can be resolved using artificial drainage. The pH of soil must be near neutral, an issue that is also easily resolved.<sup>13</sup>

While diseases, weeds and pests do pose a threat to crops, they can usually be kept under control relatively easily. Weeds are generally dealt with using selective herbicides.<sup>14</sup> Monsanto has developed GM sugar beets that are resistant to its own Round Up herbicide. Highly refined sugar is a chemical pure substance. It contains neither proteins nor DNA and so does not contain the transgenes, which apparently pose severe health threats.<sup>15</sup> Nevertheless, in August 2010 a California district judge banned the use of GM sugar beet until the appropriate environmental impact statement (EIS) had been conducted, expressing concerns that the GM sugar beet might contaminate the sugar beet of organic farmers, as well as other beet crops. The EIS is only due for May 2012. In the interim the USDA has unilaterally, though partially, deregulated the use of GM sugar beet when it sits on 28 February 2011.<sup>17</sup>

Diseases and pests are dealt with in a number of ways. Fungicides are used to control diseases such as powdery mildew and rust. Conventional breeding has given rise to a number of disease-resistant varieties that are able to defend against diseases such as curly top and rhizomania. Efficient insecticides have been developed to protect against the major arthropod pests. Recently, pesticide application technology has resulted in a 60% reduction in the quantity of pesticides utilised to protect the crop, also including a 95% reduction in insecticide use. Diseases and pests are also guarded against through judicious crop rotation practices.<sup>18</sup> A three-year rotation is considered the

minimum length for an acceptable rotation, while a four or five-year rotation is desirable to reduce the prevalence of diseases.<sup>19</sup>

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The dominant factor influencing yield in temperate climates is the amount of radiation intercepted. The yield is greatly influenced by the extent of coincidence between leaf area growth and seasonal trends in radiation.<sup>20</sup> To ensure this coincidence, it is important that farmers facilitate the growth of leaf area early on. This requires the provision of enough nitrogen to prevent them from suffering restriction: possibly as much as 5kg of nitrogen per hectare per day from when plants have four or five leaves until the time that the canopy is complete. After this period of rapid canopy growth, the plants can usually acquire enough nitrogen from the soil.<sup>21</sup> Continued application of nitrogen after this point can even serve to partition biomass to the growth of tops at the expense of the root and sugar yield.<sup>22</sup> Sugar beet is very effective at absorbing nitrogen from the soil, meaning that little nitrogen will then move into the groundwater after harvest time.<sup>23</sup>

To ensure maximum radiation interception, and therefore maximum sugar yield, it is also important that no gaps are left uncovered by the plants' foliage. This generally means a population of 75 000 per hectare. After this point sugar yields usually fail to increase because placing the plants closer together leads to leaves overlapping early, even when cover is only 10%, and so individual plants receive less light and produce further leaves more slowly, thereby eroding the benefit to radiation interception of having additional plants.<sup>24</sup>

Maximising yield also requires that the plants receive sufficient water. There is, however, no simple relationship between yield and rainfall without irrigation. Exceedingly wet years as well as dry years can reduce yield. Water consumption is related to a number of factors including radiation, wind, humidity and air temperature. In general, water consumption can range from 350mm in temperate areas to 1000mm in arid areas.<sup>25</sup>

The dominant factor influencing yield in temperate climates is radiation interception, this is largely because plants spend little time in bright sunlight and their canopies are not light-saturated for long. In these conditions, it is imperative to increase radiation interception. Nearer the equator canopies are generally light-saturated so the dominant factor influencing yield is most often the availability of water.<sup>26</sup> As such, in temperate climates sugar beet is generally sown in early spring, or from when base temperatures consistently rise to above the 3°C that germination requires and when soils are not so wet that the process of sowing risks the creation of a cloddy seedbed underlain by a compacted layer. It is imperative to avoid late sowing as this will directly affect the total amount of radiation interception and, therefore, crop yield.<sup>27</sup>

Sugar beet is a biennial plant: it grows vegetative structures during its first year, goes into dormancy over the next winter, and begins flowering in its second spring or summer (known as 'bolting'). During bolting nutrients from the plants roots are used in the production of flowers and seeds. Ultimately, this means that bolting occurs at the expense of sugar production and therefore yield. Consequently, sugar beet is best harvested before bolting occurs. Sugar as a proportion of the root's dry matter generally reaches a maximum by the middle of the last month of summer. The root continues to grow with a constant percentage of sugar through early autumn, if soil moisture and rainfall permit. In fact, the crop will keep growing as long as environmental conditions allow, but environmental conditions generally become less favourable.<sup>28</sup>

In practice, in temperate climates, sugar beet can be harvested any time after the middle of the last month of summer. Actual harvesting decisions will often be affected by contingent conditions, such

as when a processing factory wishes to start operating and whether the soil has become too dry and hard to harvest without risking damage to the roots or wear and tear on machinery.<sup>29</sup>

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Certain agricultural developments, also involving Syngenta's development of a breed of tropical sugar beet,<sup>30</sup> have resulted in the extension of sugar beet into subtropical climates. It is grown in areas not suitable for sugar cane production. Sugar beet is often treated as a winter crop in some areas. It is generally sown in early- or mid-autumn and harvested, 6 to 7 months later, in spring.<sup>31</sup> In many subtropical climates, sugar beet has some important advantages over sugar cane in that it uses 30-70% less water; it has a shorter growing season and can grow in saline and alkaline soils.<sup>32</sup>

In the Fish River Valley of the Eastern Cape, it is expected that sugar beet will be grown on a threeyear rotation, to be followed by maize and lucerne. The crop will be ripe for harvesting within 6-12 months, an early harvest at 6 months will allow a second crop to be planted on that piece of land in the same year. The crop will be under irrigation for the entire year.<sup>33</sup>

Sugar beet degrades quickly after harvesting so must be forwarded to the processing plant within 48 hours of being harvested.<sup>34</sup> It is suggested that it been grown within 50 km of a processing plant.<sup>35</sup>

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