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Biofuels trade and sustainable development: An analysis of South African bioethanol

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CONTENTS

List of abbreviations and acronyms

Asgisa	- Accelerated and shared growth initiative of South Africa.
B20	- Blend of 20% biodiesel in petroleum diesel (BX, where X is a number 1-100, indicates the percentage of biodiesel in the blend)
bbl	- Barrel of oil (158.98 litres)
BEE	- Black Economic Empowerment
BFP	- Basic Fuel price
BFAP	- Bureau for Food and Agricultural Policy
B-JIC	- Biodiesel Joint Implementation Committee
BTT	– Biofuel Task Team (South Africa)
CDM	- Clean Development Mechanism
CEF	- Central Energy Fund
CO	- Carbon Monoxide
CO_2	- Carbon Dioxide
COMTRADE	- United Nations Commodity Trade Statistics Database
DDGS	- Dried Distillers Grain from Solubles
DEAT	- Department of Environmental Affairs and Tourism, Government of South Africa
DME	- Department of Minerals and Energy
DST	- Department of Science & Technology, Government of South Africa
E8	- Blend of 8% ethanol in gasoline (EX, where X is a number 1-100, indicates the percentage of ethanol in the blend)
EIA	- Energy Information Administration
ESKOM	- Electricity Supply Commission, South African State Owned Electricity Utility
EU	- European Union
EU-25	- 25 countries on the European Union post 2004 (including accession countries)
FAOSTAT	- United Nations Food and Agriculture Organisation, Statistical database of Member Countries.
GDP	- Gross Domestic Product
GEF	- Global Environment Facility
GHG	- Greenhouse Gases
GIS	- Geographical Information System
GM	- Genetically Modified
ICLEI	- International Council for Local Environmental Initiatives
IIED	- International Institute for Environment and Development
KZN	- KwaZulu-Natal
l	- l
LPG	- Liquid Petroleum Gas
m^3	- Cubic metre
MDG	- Millennium Development Goals
MPC	- Monetary Policy Council of South Africa
MTBE	- Methyl tertiary-butyl ether
NDA	- National Department of Agriculture, Government of South Africa
NEPAD	- New Partnership for Africa's Development
NGO	- Non-Governmental Organisation

NOx	- Nitrogen Oxides
NWA	- National Water Act
NWRS	- National Water Resource Strategy
OECD	- Organisation of Economic Co-operation and Development
PASASA	- Paraffin Association of South Africa
REEEP	- Renewable Energy and Energy Efficiency Partnership
RFA	- Renewable Fuels Association
RV	- Recoverable Value
SABS	- South African Bureau of Standards
SACU	- South African Customs Union
SADC	- South African Development Community
SafMA	- Southern African Millennium Ecosystem Assessment
SAFEX	- South African Futures Exchange
SASA	- South African Sugar Association
SASOL	- Suid Afrikaanse Steenkool en Olie (South African Oil and Coal)
SOx	- Sulphur oxides
StatsSA	- Statistics South Africa
SWOT	- Strengths, Weaknesses, Opportunities, Threats
UNDP	- United Nations Development Program
UNFCCC	- United Nations Framework Convention on Climate Change
UNEP	- United Nations Environment Program
UNCTAD	- United Nations Conference on Trade and Development
US	- United States
USA	- United States of America
US$	- American dollar
WHO	- World Health Organization
WTO	- World Trade Organisation
ZAR	- South African Rands

Executive Summary

- Interest in bioethanol is surging as countries (1) seek new ways to buffer their economies against soaring oil prices and the limits of mineral fuel energy, (2) reduce greenhouse gas emissions and (3) support their rural economies.

- Due to high overland transport costs and the imperative of meeting domestic objectives, most bioethanol is consumed in the country in which it is produced.

- Trade in bioethanol is increasing as industrialised countries confront the limits to which they can expand their bioethanol feedstocks, and as developing countries in the warm, humid sub-tropics begin to establish low-cost bioethanol sectors.

- South Africa currently imports crude oil and refined petrol.

- South Africa was hoping to develop a bioethanol industry based on the mandatory blending target of E8 by 2013, a target that could have been met from existing sugarcane and maize surpluses.

- In late 2007 the Government in South Africa committed to a target of two per cent of liquid fuel substitution supplied by all biofuels (boiethanol and biodiesel) by 2013. The Government also reduced the anticipated levels of support for growers and processors and requested that maize not be used as a feedstock in mandatory blending schemes, citing food insecurity concerns.

- A South African bioethanol industry has the potential provide a measure of imported fuel substitution and macro-economic stability, and advance rural development and racial transformation of the agricultural sector. Bioethanol, even at the scale of E8, is unlikely to reduce the absolute level of South Africa's greenhouse gas emissions, given the growing demand for petrol and diesel. Where biofuels replaced existing 'synfuels' produced by South African Coal and Oil (SASOL), which are particularly emissions intensive, the greatest emissions impact would be achieved.

- The ethanol that is currently exported from South Africa is a combination of bioethanol produced from molasses by the sugar industry and mineral ethanol that is a by-product of SASOL's 'synfuel' programme. This ethanol is used in industrial applications and not as fuel.

- The South African industry is not currently focused on the export market, although in theory there is nothing stopping South African producers of bioethanol from exporting their produce. Bioethanol producers will, in all likelihood, supply the market that offers the highest returns and greatest surety of demand.

- On a financial cost of production basis, South Africa has the ability to compete with the United Kingdom, the remainder of the European Union, the United States and Canada. This is in spite of the relatively large subsidies afforded to growers and producers of bioethanol in these countries.

- Once import duties and transport costs to the United States, Canada, and Europe are factored into the cost of production, South African growers do not have an incentive to supply these markets. South Africa's ability to compete would be enhanced if:

  i. the statutory price offered to South African producers were to decrease (below the proposed US$ 0.51 per litre),

  ii. the price paid for bioethanol in international markets were to increase,

  iii. South Africa's exchange rate was to weaken,

  iv. import tariffs or grower support in North America and Europe were to be reduced,

  v. South African growers were to capture significant efficiency gains through 'learning by doing',

  vi. South Africa were to receive preferential access to European markets via a bilateral trade agreement, or any combination of the above.

- At current prices South Africa is unlikely to be able to compete with Brazil, Thailand and Australia in terms of the costs at which it can produce bioethanol for international markets. However, South Africa, with its progressive environmental and social legislation may be able to comply with conditional trade requirements more easily than other developing nation bioethanol producers, and particularly those developing countries in Africa.

- The opportunity cost of the water that is used in bioethanol feedstock, especially sugarcane production (a litre of bioethanol from sugarcane requires an estimated 20 m^3 to produce in South Africa) is a further constraint on South Africa's bioethanol production capacity.

- South Africa has the legislative reach to avoid the potentially malign impacts of biofuel production including rapid expansion of the sector, food insecurity, environmental degradation, water profligacy as well as the use of bioethanol in the potable alcohol market. Deploying this legislative reach would be relatively easy where production was restricted to the local market and producers were required to register in order to receive fuel tax rebates. In contrast, the export of agricultural commodities from South Africa is relatively unregulated and an export oriented bioethanol sector would render the control of bioethanol's undesirable side effects more difficult.

- SADC countries might, especially with investment in processing capacity and bulk infrastructure from South African agribusiness, prove successful bioethanol exporters. A number of SADC countries enjoy preferential trade agreements afforded to least developed countries, that are not available to South Africa. In such instances, South Africa might also benefit from bioethanol imports from the region.

- Were South Africa to import bioethanol from other SADC countries it should seek to ensure that environmental degradation and food insecurity safeguards were applied to these imports. It is possible that a bioethanol-triggered investment in SADC's rural economies could enhance food security, through the provision of infrastructure, the transfer of skills, the supply of animal feed by-products and the reduced exposure to oil driven food price inflation.

1 Introduction

Decoupling economic activity from the consumption of fossil fuels is a prerequisite for sustained economic growth, if not survival. In the face of this challenge biofuels are once again being posited as a source of renewable transport fuel and global biofuel production is increasing.[1] In 2005, 48 billion litres of biofuel were produced globally.[2] In 2007, production is expected to reach 65 billion litres, 1.3 per cent of total liquid fuel consumption by volume.[3] The expansion of this industry is being driven by four factors - although the combination and relative emphasis of these factors varies across countries:

- Heightened demand for mineral fuels, most notably from China, and renewed concerns over the ability of existing sources to satisfy this demand at reasonable prices.
- Precarious supply of mineral fuels, arising from conflict in the Middle East and geo-political instability in other traditional oil producing regions.
- Concern about the radiative forcing impacts of emissions from mineral fuels (greenhouse gases), and the wider repercussions of a perturbed global climate.
- Efforts to bolster rural economies and support agricultural constituencies. In developing countries biofuel production is being touted as a boon for rural poverty alleviation efforts. In industrialised countries, although less clearly articulated, there is a sense that the growing demand for biofuel might provide farming constituencies with a fresh *raison d'être* and provide farmers with a reprieve from the current trend of reduced state support.[4]

Resurgent enthusiasm for biofuels is being countered by some ecologists who fear adverse environmental impacts associated with an expansion of land and water intensive fuel crops,[5] by some climate scientists who believe that the energy expended and the forest and soil carbon released in the production of biofuels will result in a net increase in greenhouse gas emissions,[6] and by certain economists who fear the poor will suffer as a result of less land and water being deployed for food production and more expensive food,[7] or who simply question the financial viability of a global biofuel industry.[8]

Up until now biofuel programmes have been focussed on meeting domestic demand and dependent on domestic support. Accordingly most biofuel has been consumed in the country of its production. There are a number of rationales for this approach. Many of the current major biofuel programmes have their origins in the fuel crises of the 1970s. Back then these programmes were motivated by nationalist policies aimed at promoting energy security,

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1 In the US President George W Bush used his 2007 State of the Union address to propose a mandatory target for the replacement of about a fifth of oil-based transport fuels by inclusion of 35 billion gallons of biofuel in the fuel sold by 2017. This is a sharp increase from the current production of 4.2 billion gallons by 97 ethanol refineries.

2 Coelho, 2005; F.O. Licht, 2006; Walter, *et al.*, 2007

3 Steenblik, 2007

4 Kojima, 2007; RFA, 2007

5 Earthwatch, 2006. McNeely, 2006, Biofuelwatch, 2007

6 Pimental & Patzek, 2005; Righelato & Spracklen, 2007

7 Browne, 2006; Sugrue & Douthwaite, 2007

8 Steenblik, 2007; New York Times Editorial, 19 September 2007

reducing import burdens and supporting national agricultural sectors. In addition the transport of biofuels from inland refineries to ports can be expensive and can undermine greenhouse gas (GHG) emissions benefits. The biofuel produced, therefore was almost exclusively consumed locally. The current wave of biofuel programmes shares many of these original characteristics. Most of the prominent programmes are dependent on fiscal support and focussed on domestic efforts to reduce transport sector pollution and dependence on increasingly expensive imported oil. Exporting biofuels would export these associated benefits, and dilute the public benefits accruing to fiscal allocations in support of domestic biofuel programmes.

The global biofuel industry is, nonetheless, emerging against the backdrop of increasing international trade and attempts in some quarters to liberalise the terms of this trade. It has been suggested that developing countries in the tropics could exploit favourable growing conditions and lower opportunity costs of land, water and labour to produce and supply biofuels to industrialised countries in the north[9]. Very little country specific analysis has been conducted, but biofuel trade almost certainly has the potential to amplify either the benefits or the negative impacts that are commonly associated with biofuels (Chichilnisky, 1994). This paper is forward looking and explores these issues from a South African perspective. South Africa does not yet have a significant biofuel industry and does not engage in biofuel trade. The focus is on the potential for bioethanol trade to and from South Africa to contribute to sustainable development. Sugarcane and maize, the two feedstocks that are most likely to be used in bioethanol production in South Africa during the initial phase, form the basis for analysis. It is assumed that production levels will remain close to E8, which is the level targeted by the industry. Accordingly South Africa will remain a small (by global standards) bioethanol producer and the extent and nature of trade will depend on comparative policies and prices in the South African and export markets.

- Section 2 of this paper describes South Africa's liquid fuel sector and the nature of petrol and diesel demand in South Africa.
- Section 3 introduces South Africa's bioethanol industry by examining potential feedstocks, processing capacity and emerging policy issues.
- Section 4 explores South Africa's potential to export bioethanol in terms of relative prices, market access, domestic support for a South African industry and ability to comply with international bioethanol standards.
- Section 5 analyses the sustainability implications of bioethanol exports from South Africa by assessing the potential macro-economic, environmental and social impacts of such exports.
- A key question arising from this study involves whether or not South Africa can rise to the economic governance challenge of drawing on its legislative instruments in a coherent fashion to ensure that a Southern African Development Community (SADC) bioethanol industry delivers on its potential. The factors influencing this outcome are discussed in Section 6.

[9] Coelho, 2006; UNCTAD, 2006; Johnson, 2007; Mathews, 2007

- Section 7 lays out a conclusion and recommendations arising from the study.

2 The South African liquid fuel sector

South Africans consume 0.7 per cent of global petrol, 0.4 per cent of global diesel and 0.3 per cent of global crude oil. The relatively low consumption of crude oil is due to the capacity, developed during years in economic isolation, to synthesise oil from coal. Thirty per cent of South Africa's liquid fuel requirement is synthesised in this way by the formerly state owned company, SASOL. A further eight per cent is derived from natural gas.[10]

Annual vehicle fuel consumption ranges between 20 and 25 billion litres. This accounts for one third of South Africa's total energy consumption by energy and seventy per cent by value. Expenditure on liquid fuels accounts for eight per cent of GDP (US$ 16.6 billion),[11] or US$ 41.44 per day on liquid fuels.

Just less than 65 per cent of South Africa's total liquid fuel consumption and 14 per cent of the country's total energy consumption is derived from imported crude oil. The bulk of South Africa's oil imports come from Iran, although imports from Kuwait, the United Arab Emirates, Saudi Arabia, and Nigeria are increasing as South Africa attempts to diversify its supply. South Africa has been caught out by the global dissipation of "sweet crude" (easily refined) supplies. Due to capacity constraints, South Africa is unable to make up this shortfall with synfuel or by refining crude oil, a situation that requires refined diesel and petrol to be imported at huge cost (currently at US$ 0.63 per litre but often much more on the spot market) in addition to its crude oil imports.

Table 1: South Africa's petroleum refining capacity from crude oil and synthetic fuel facilities from coal and gas feedstock

Refinery	Refining capacity (Crude) Mmt/yr	Location
Sapref (Shell and BP)	8.3	Durban
Calref	5.5	Cape Town
Enref	6.3	Durban
Natref (Sasol/ TOTAL)	4.2	Sasolberg
Sasol 1, 2, 3	-	
PetroSA	-	

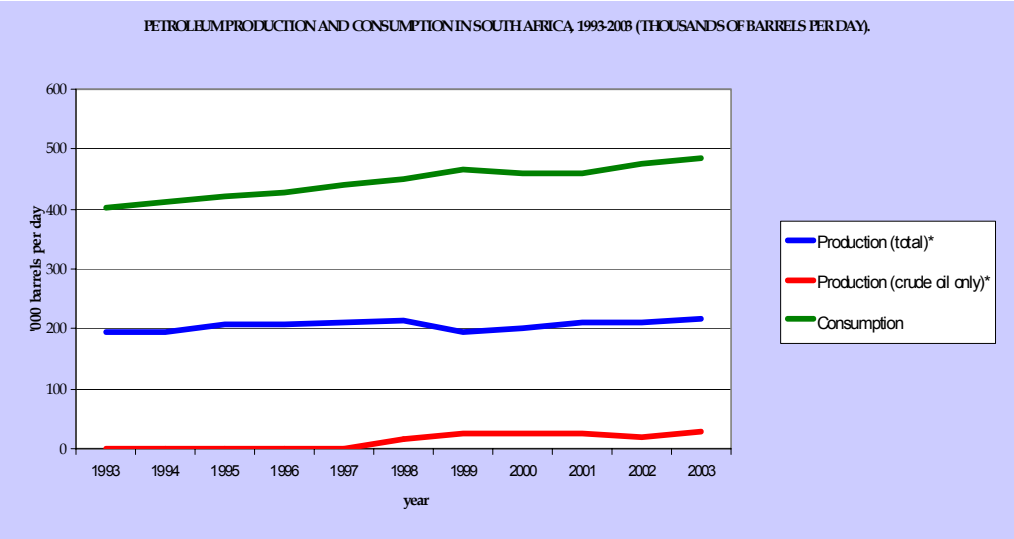
Source: Oil refining in Sub-Saharan Africa. CITAC, (2004). Cited in Wilson *et al*., 2005.

An historical summary of petroleum production and consumption in South Africa is shown in Figure 1.

[10] Wilson et al., 2005

[11] The South African currency (ZAR) is volatile. Throughout this document both ZAR and US$ prices are given for ease of reading. An exchange rate of 1 US$ to ZAR 7.24 has been applied to South African prices. Adjustments to quoted prices should be made if this exchange rate becomes unrepresentative in time.

Figure 1: Petroleum production and consumption in South Africa, 1993-2003 (thousands of barrels per day).



Source: DOE/EIA

Fuel imports cost South Africa an estimated US$ seven billion per annum and account for between 12 and 20 per cent of all South African imports; easily the most significant trade item. Dependence on imported oil, petrol and diesel is a feature of the country's economy. International oil price inflation drives domestic inflation in South Africa, and recent oil price hikes have forced a breach of South Africa's monetary policy, with inflation rising above the mandated upper limit of six per cent in the second half of 2007. This in turn has necessitated eight sequential interest hikes; monetary tightening that undermines economic growth and employment creation efforts. Recent oil price inflation has also been behind a widening of the current account deficit, leading to a 30 per cent depreciation of the South African Rand against the US dollar between the end of 2005 and mid 2007.[12] In contrast Brazil's exchange rate strengthened 16 per cent against the US dollar in the year to 2006, a phenomenon that has been attributed, at least in part, to the prominence of that country's biofuel sector.[13] The destabilising economic impact of South Africa's dependence on imported crude oil is a key motivation behind the country's drive to develop a biofuel industry.

As an Annex 2 signatory to the Kyoto Protocol, South Africa does not confront an emissions reduction target in the 2012 commitment period. But as a significant global polluter,[14] and the largest emitter of greenhouse gases (GHGs) in Africa, there is increasing pressure on South Africa – along with India, Brazil and China - to voluntarily reduce its emissions arising from

[12] World Bank, 2005, South African Reserve Bank, 2006, Monetary Policy Council June 2007, Budget Review, 2007

[13] Jose Domningos Gonzalez Miguez (Executive Secretary of the Ministry of Science and Technology in Brazil) personal communication.

[14] ESKOM – South Africa's State owned energy utility was recently identified as the world's biggest corporate emitter of greenhouse gases. A status it enjoys courtesy of its dependence (91%) on a low grade coal.

liquid fossil fuels. The transport sector accounts for 24 per cent of South Africa's total GHG emissions. The 30 per cent of transport fuel that is generated from coal by SASOL is a particular problem. The Fischer-Tropsch synthesis that is applied in this process is particularly energy intensive and accounts for roughly twice the GHG emissions, on a life-cycle basis, of imported crude oil. A 2002 Pew Centre study[15] of South Africa's transport sector concluded that under business as usual scenarios, vehicle GHG emissions would rise by 82 per cent between 2000 and 2020.

Currently the only significant substitute for mineral transport fuels is biofuel,[16] which includes bioethanol - a petrol substitute produced from the fermentation of starch based crops (maize, barley, wheat and cassava, sugarcane and sweet sorghum) to produce an alcohol and biodiesel - a diesel substitute produced from oil seed crops such as canola, sunflower, used cooking oil and animal fats. The refining of these oils involves a two step process: rendering and improving through esterification.

[15] Pew Centre for Climate Change(2002) Transportation in Developing Countries: Greenhouse Gas Scenarios for South Africa.

[16] Although the hydrogen economy is rapidly gaining momentum and likely to provide the dominant transport fuel in the future, the technology to make this form of fuel publicly accessible is not yet available.

3 South Africa's bioethanol industry

Bioethanol was a feature of South Africa's liquid fuel mix between 1930 and the late 1960's, but subsequent cheap and plentiful crude oil rendered the industry uneconomic. South Africa has been party to the recently resurgent interest in biofuels. Until December 2007, industry hopes had been focussed on the "Draft Industrial Biofuel Strategy", a document that was compiled following an extensive feasibility study. The strategy, which was approved by Cabinet in November 2006, prescribed a target of 4.5 per cent of liquid road transport fuel market penetration (3.4 per cent of total liquid fuel which includes fuel used in aviation, heating and cooking) by 2013 – roughly half of the renewable energy target.[17] To achieve this target, the draft strategy proposed statutory blending so as to ensure E10 blends in 80 per cent of petrol and B5 biodiesel blends in those regions that can supply biodiesel. This would have resulted in a net penetration of eight per cent and two percent in the petrol and diesel markets respectively.

In December 2007 the South African government undertook a significant and surprising retraction of its biofuel ambitions, mandating substitution targets of two per cent of liquid fuels for all biofuels, limiting the extent of fiscal support and moving to prevent the use of maize as a feedstock on food security grounds. If half the new target were supplied by bioethanol this would limit South Africa's bioethanol production to a meagre 58 kilotons per annum. It remains to be seen whether private sector initiatives, some of which have already sunk capital into production and processing capacity, will develop their own markets and surpass government goals. It is not yet clear how the private sector will react to this policy shift, what level of bioediesel and bioethanol respectively will be used to comprise the target, and whether or not market demand will result in the scaled down targets being surpassed by private sector efforts.

As yet, very little biofuel is produced in South Africa, although investments in processing capacity have been made (see Appendix C). The industry is characterised by a wide range of often conflicting claims and speculative behaviour as stakeholders jostle for recognition, and attempt to shape policy to their benefit.[18] In seeking to meet the anticipated demand, the indication has been that the South African bioethanol industry will, in spite of Government efforts to prevent the use of maize as a feedstock, rely on locally cultivated maize and sugarcane in the initial period of development (see Appendix A for a detailed account of each sector).

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[17] In the days preceding the finalisation of this document the South African Cabinet agreed to target a two per cent mandatory blending of liquid fuels and moved to exclude maize as a feedstock. This late development does not alter the general conclusions of this document, and it remains to be seen whether or not private sector initiatives will seek to produce more biofuel than can be accommodated under the strategy necessitating exports or a higher level of uptake in the liquid fuel sector. See for example http://www.engineeringnews.co.za/article.php?a_id=123543

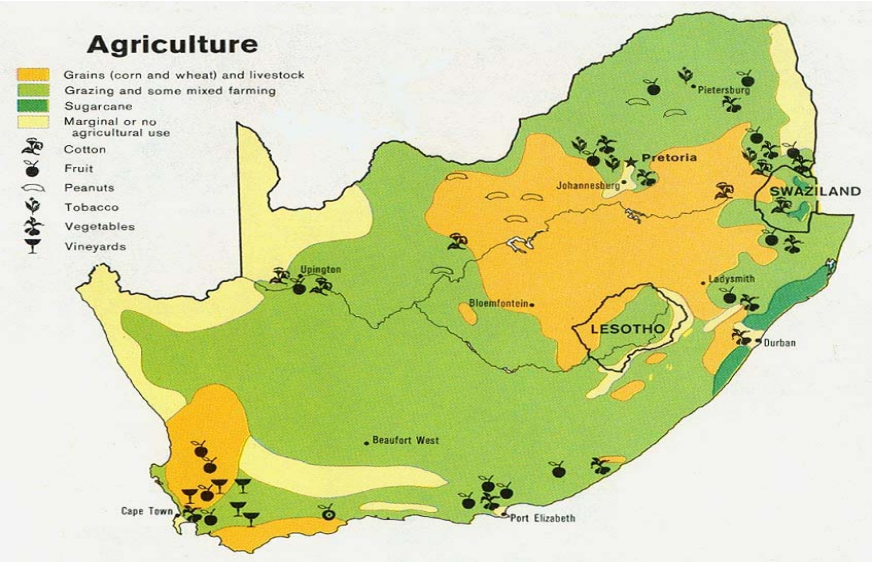
[18] In a recent biofuel symposium in Cape Town different presenters suggested variously that (1) South Africa has no, or very limited biofuel potential, and that (2) South Africa could become the "Saudi Arabia of biofuel".

3.1 Bioethanol feedstocks

Only 13 per cent of South Africa is considered arable, and much of this land is exposed to unreliable rainfall. However a strong agricultural sector was established during the apartheid era when the political dispensation guaranteed markets, provided State subsidies and ensured cheap labour. Since 1994, South Africa's first democratic government has reduced support for commercial agriculture from 18 per cent of farm receipts in 1992 to two per cent in 2005 and five per cent in 2007 (as measured by the OECD's Producer Support Estimate). During the same period The Marketing of Agricultural Products Act (1996) dismantled the statutory single channel marketing boards that had previously guaranteed markets for agricultural produce in favour of unregulated marketing in which produce is traded on the Agricultural Markets Division of the South African Futures Exchange (SAFEX).

The post-apartheid rationalisation has seen agriculture's revenue decline at an average rate of ten per cent per annum. Agriculture now represents less than 2.5 per cent of GDP and accounts for ten per cent of all employed people.

Figure 2: Map of South Africa's agricultural areas[19]



An ongoing agrarian reform programme has sought to establish a black commercial farming class through the provision of preferential access to land, water, grant funding and credit. With a few notable exceptions, one of which is provided by the sugar industry, these efforts have been piecemeal and slow. As a result the 25,000 commercial farmers in South Africa remain predominantly white. Aside from the commercial agricultural sector, an estimated eight million subsistence farmers on one million hectares of land struggle to support their

[19] Note the map does not capture the recent rapid expansion of sugarcane in the Inkomati basin north of Swaziland, an area that now accounts for a quarter of South Africa's sugarcane and in which sugarcane is irrigated.

livelihoods. The subsistence sector is characterised by inadequate infrastructure, high degrees of land degradation, low yields and low returns.

The two crops that are most likely to supply South Africa's bioethanol industry in its initial phase are maize and sugarcane. Maize is the country's most important staple food, accounting for 41 per cent of the average national calorie intake in 2004.[20] Local consumption of maize has, however, actually been decreasing at 0.4 per cent per annum, as access to the food market improves and more sophisticated alternatives become available.[21] South Africa does not have a large guaranteed maize surplus, but typically manages to export three million tons over and above the eight million tons that are consumed locally every year. South Africa's maize surplus is important to the food security of the Southern African region with its propensity for drought and famine. Assuming a ton of maize can produce 400 litres of bioethanol, the Draft Biofuel Strategy estimates that one fifth of the average surplus would be required to substitute four per cent[22] of liquid fuel consumption in 2013.

Maize farmers receive between US$ 80 - 160 per ton for their produce in commodity markets. If maize was converted into bioethanol and sold at the price that is recommended in the Draft Biofuel Strategy (US$ 0.51 per litre) it would be worth an equivalent of US$ 204 per ton.

In South Africa 430,000 hectares of sugarcane are cultivated, three quarters of which is suitable for harvest every year. In the 2005-6 season, 21 million tons of sugarcane was harvested yielding 2,5 million tons of sugar.[23] Prices for sugarcane and "recoverable value"[24] in 2005-6 were set by the industry at ZAR 173.59 (US$ 23.9) per ton and ZAR 1,389 (US$ 191.85) per ton, respectively. Unlike other agricultural sectors in South Africa, the sugar industry operates under the jurisdiction of the Department of Trade and Industry and has retained a measure of price support against imports. The industry further distinguishes itself by operating a successful small scale outgrower scheme. There are 23,471 small scale black growers (roughly half the total number of growers in South Africa) operating on land parcels that average eight hectares in size. Collectively these growers supply 11 per cent of the country's sugarcane under contract farming arrangements to one of the three major mills.

South Africa is the largest producer of sugarcane in the SADC region, but in 2006 for the first time produced less than half of SADC's sugar as Swaziland, Mauritius and Zambia increased their yields. In a typical year South Africa is able to export half of its sugar yield. If diverted to bioethanol production the surplus could produce an estimated 274 kilotons of bioethanol; enough to supply more than half of the 466 kilotons (E8) target that is proposed in the Draft Biofuel Strategy.

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20 FAOSTAT, 2007

21 BFAP, 2007

22 Four per cent would constitute the half of the E8 target that the draft strategy proposes be met with maize.

23 SAS, 2007

24 "Recoverable value"(RV) is the measure on which growers receive payments and is closely related to sucrose content. The average RV content for the South African crop ranges between 12 –13.5 per cent.

A ton of exported sugarcane returns roughly US$ 24 in revenue to South African growers. The same ton could earn US$ 41 for growers if converted into bioethanol, or substitute the need for US$ 45 worth of petrol imports (based on 80 litres of bioethanol per ton of sugarcane and 95 per cent of the prevailing basic fuel price being paid for ethanol).[25] (www.illovosugar.co.za/)

Once processing costs are included, it is unlikely that maize and sugarcane farmers in South Africa will receive significantly more for produce that they supply to the bioethanol industry than they do when selling it as food. Farmers typically receive the equivalent of US$ 0.45 per litre of bioethanol, when selling their produce as food in the domestic market. This should be compared to the US$ 0.51 – 0.53 per litre that is proposed in the Draft Biofuel Strategy.[26] Nonetheless farmers in both sectors are supportive of a local bioethanol industry on the grounds that it will expand, and possibly stabilise, their marketing options.[27]

3.2 The processing of bioethanol

3.2.1 The value chain

The E8 target posited by the Draft Biofuel Strategy is predicated on the sugarcane and maize industry each supplying 230 kilotons of bioethanol per annum. The processing facilities required for bioethanol production from maize and sugar are different.

South Africa already manufactures small volumes of bioethanol by fermenting molasses that is produced as a by-product of its sugar industry. This bioethanol is not used in fuel but as potable alcohol, in paints, inks and by the pharmaceutical industry. Between 50 and 70 per cent of this bioethanol is exported, predominantly to African countries and to Europe. Woods (2004) estimates that South Africa's molasses yield could substitute 0.91 per cent of the region's petrol by 2015. If a biofuel industry of any significant scale were to be created, however, sugarcane juice (which is a relatively more efficient source of bioethanol and which is capable of supplying larger volumes) would have to be used.

Ethanol Africa, the leading bioethanol from maize producer in South Africa, predicts that it will receive 490 litres of bioethanol from a ton of yellow maize. A USDA survey of 78 plants in the United States, however, suggests they may be overestimating their yields. The survey revealed an average of 394 tons of maize per litre of bioethanol produced.

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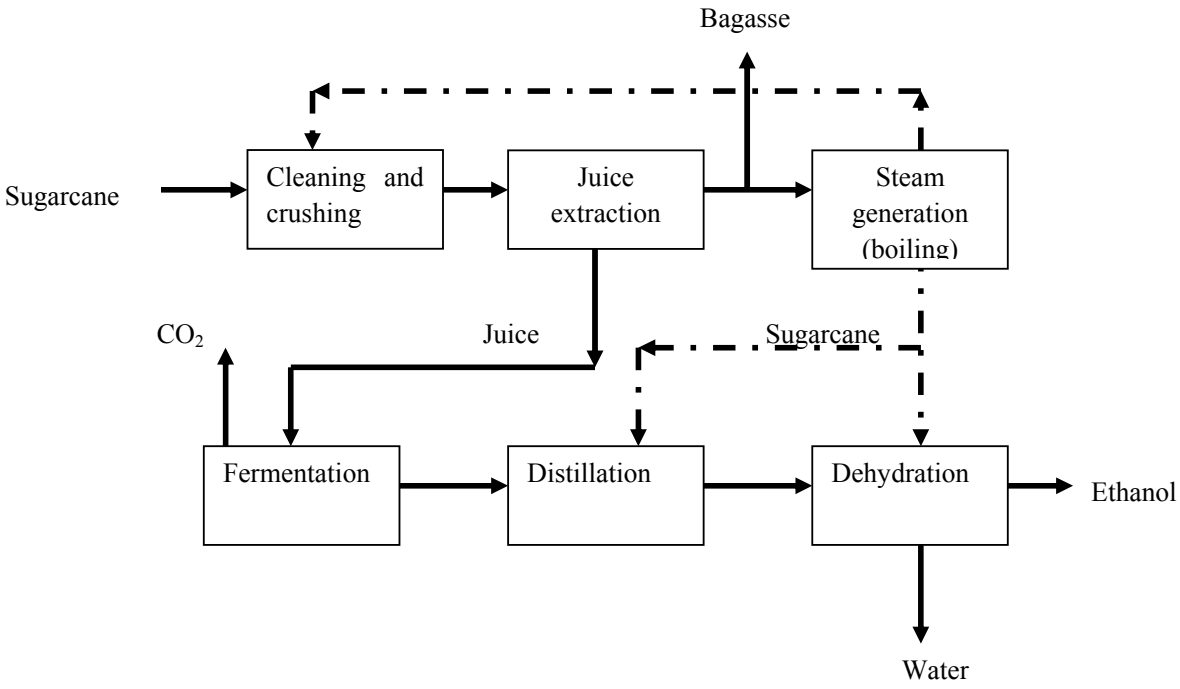
[25] These yields have been achieved in Brazil and Southern Africa according to the records of the, 'Policy Dialogue on Co-generation and Bioethanol for South Africa, (Partners 4 Africa) 21-23 June 2004 as published by WIP-Munich, Germany. In general South African producers get higher RV (sucrose) yields than their Brazilian counterparts, but the refining of ethanol in South Africa is currently less sophisticated.

[26] BT, 2006

[27] Dr John Purchase (a member of the South African Biofuels Association, a Presidential Advisor and a former member of GrainSA) personal communication.

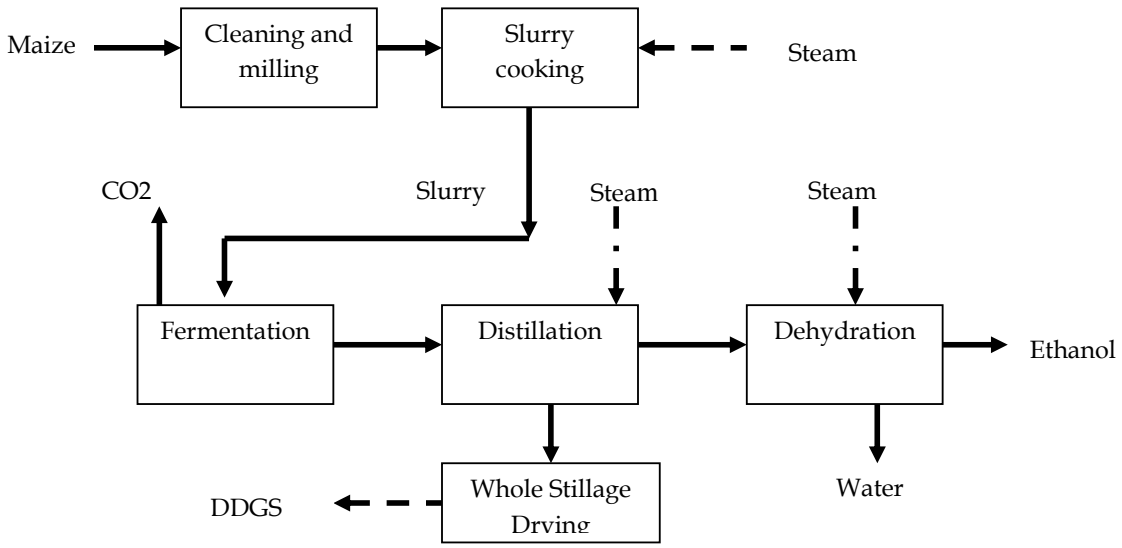
Meeting E8 in South Africa would require a more than ten-fold increase in South Africa's bioethanol fermentation capacity.[28] If new infrastructure was created to process this bioethanol, this would cost ZAR 1,4 billion and ZAR 1,8 billion (US$ 0.19 billion – US$ 0.25 billion) for sugarcane and maize, respectively.[29] In reality South Africa's sugar processing mills currently operate at between one fifth and half of their capacity[30] and both the sugar and the maize industry could easily convert existing processing capacity so as to manufacture bioethanol. The available capital is likely to halve the required investment estimates presented by the BTT, but private sector investors appear reluctant to incur this cost without government support for a large mandated market and levy waivers.

Figure 3: Stylised process diagram for production of bioethanol from sugarcane in South Africa.



[28] Peter Starling (managing Director of NCP Alcohol) quoted in the Mercury newspaper, 2007.
[29] BTT, 2006
[30] Van Rooy, personal communication

Figure 4: Stylised diagram for the process of production of bioethanol from maize in South Africa.



The respective bioethanol value chains for sugarcane and maize are presented in Tables 2 and 3 below showing expected gains to farmers, transporters, processors and retailers.

Table 2: Bioethanol from maize value chain.

Feedstock/ farming	Transport from farm to processing	Processing	Transport	Retail
Small-scale 0.75 tons per hectare (some much higher), 30% of feedstock supply.	Aim is for minimum transport costs between farmers and processing due to proximity.	Processors pay equivalent of US$ 0.35 – 0.38/ litre of bioethanol for maize feedstock. Processors responsible for feed preparation and purification.	Transport of bioethanol to ports can be expensive, typically by truck freight (10%-15%) of retail cost.	Processors sell to local retailers at 95% of basic fuel price US$ 0.60/ litre. Bioethanol = 70% energy of petrol. Retailers responsible for blending and quality assurances.
Large scale (commercial)3.2-4.0 tons per hectare, 70% of feedstock supply.		Production cost estimates (Bothaville) US$ 0.05/ litre.		Retailers sell to public (probably at local petrol price US$ 0.97)
Growers receive US$ 151/ ton of maize delivered (market price)		25% of maize feedstock value retrieved by processors in sale of by-products (DDGS provides US$ 0.10/ litre of bioethanol, carbon credits have potential to provide US$ 0.002/ litre).	Sea freight of bioethanol is inexpensive	Exported bioethanol is subject to potential duty of US$ 0.15/ litre

Up to 36% of the value of retailed bioethanol	Between 0-1% of retail value	Processors secure 8.6% of retail price, 18.5% if the retail price is included. Significant increases when petrol price increases.	Total transport between processing and retail 10%-15% of retail price	Retailers secure 45% of bioethanol value if they supply local market, 28% if bioethanol is exported.

Table 3: Bioethanol from sugar value chain.

Feedstock/ farming	Transport from farm to processing	Processing	Transport	Retail
Average yield 40 tons per hectare dryland, 110 tons per hectare irrigated	Growers located within 80 km of mill due to economics of sucrose production. Equivalent of US$ 0.02/ litre in transport costs	Processors pay equivalent of US$ 0.30/ litre of bioethanol for sugarcane feedstock. Processors responsible for feed preparation and purification.	Transport of bioethanol to ports relatively inexpensive as most mills located close to ports - 5% of retail cost.	Processors sell to local retailers at 95% of basic fuel price US$ 0.60/ litre. Bioethanol = 70% energy of petrol. Retailers responsible for blending and quality assurances.
11 per cent of crop currently provided by small-scale black growers.		Production cost estimates roughly 0.05/ litre		Retailers sell to public (probably at local petrol price cUS$ 0.97)
Growers receive US$ 23.90 per ton of cane. Equivalent of US$ 0.30 per litre of bioethanol.		US$ 0.025/ litre retrieved from sale of bagasse.	Sea freight of bioethanol is inexpensive	Exported bioethanol is subject to potential duty of US$ 0.15/ litre
Growers secure 29% of retail price of bioethanol	Transport between growers and mill accounts for 2% of retail price.	Processors secure 18.5% or retail price. 21.8% if sale of by-products is included.	Total transport costs between mill and retail accounts for 5% - 8% of retail value.	Retailers secure 45% of bioethanol value if they supply local market, 28% if bioethanol is exported and duties and freight is paid.

3.2.2 The costs of bioethanol production

Internationally the cost of producing a litre of bioethanol varies greatly as do reported estimates of these costs (see Table 4 for a range of estimates for various countries).

In order to compete with imported petrol on a cost basis, South African bioethanol would have to be cheaper than the "basic fuel price", an import parity price used to determine the domestic fuel price. In December 2007 the basic fuel price for 95

unleaded petrol was US$ 0.63 per litre. This is also the price that is paid to SASOL for its "synfuel". Levies and custom added another US$ 0.43 per litre to the December 2007 retail price. In order to compete unassisted with imported fuel, on an energy equivalent basis, South African bioethanol would, in December 2007, have had to be produced at ZAR 3.02 per litre (US$ 0.46), assuming that bioethanol provides 72 per cent of the energy of petrol.

The costs of producing dryland sugarcane (US$ 20 per ton) and maize (US$ 75 per ton) in South Africa can be very low,[31] creating the potential for cheap biofuel. Official estimates of the cost of bioethanol production range between US$ 0.41 per litre[32] (based on the Ethanol Africa Bothaville plant which has capacity for 190 million litres per year) and US$ 0.52 per litre which is presented in the Draft Biofuel Strategy, as the cost of sugarcane derived ethanol.

Based on these cost estimates, the ability of South African bioethanol to compete with imported petrol is contingent upon oil prices in excess of US$ 70 per barrel, maize prices below ZAR 1,100 per ton (circa US$ 150/ ton) and sugar prices below US$ 250 per ton.[33] There is a case, however, for expecting "learning-by-doing" to reduce processing costs over time. In Brazil, the cost of processing bioethanol has dropped by an estimated ten per cent a year over the past three years as a result of efficiency and scale enhancements.[34] Provided these gains are not offset by feedstock price inflation, they can be expected to enhance the viability of the industry.

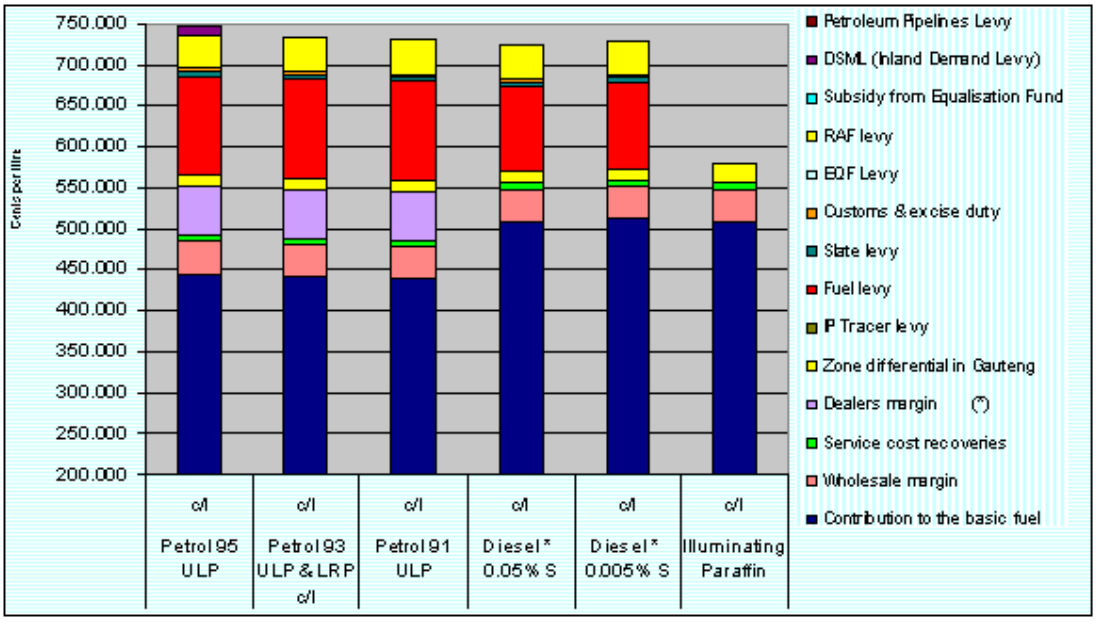
Most established bioethanol producing countries have relied on State subsidies to support their industries, and aspirant bioethanol producers in South Africa have lobbied government for the same support. The pricing of South Africa's liquid fuels is subject to a range of domestic and international levies which collectively comprise 41 per cent of the retail price (see Figure 5 below and Appendix D). By providing the bioethanol industry with exemption from certain fuel taxes, South Africa would forego fiscal revenue but support the emergence of a local industry with the ancillary benefits for rural development and fiscal stability. It is not in the South African Government's perceived interests to undermine its oil refining capacity by placing them under price pressure. The Biofuels Task Team estimated that if bioethanol producers were required to sell bioethanol to the petroleum industry at 87 per cent of the basic fuel price, profits of refiners would remain stable.[35] This makes the price paid to bioethanol processors as volatile as the international oil price. Adopting such an approach would have seen bioethanol manufacturers paid US$ 0.55 per litre in December 2007. When compared to the prices that bioethanol manufacturers would pay for feedstock in order to sustain farming activities (US$ 0.45 – 0.46 per litre) this provides an adequate profit margin for processors. Whether or not this would allow for the recouping of capital expenditure is less clear. More critically this profit margin would be cut if the international price of oil were to fall, making for precarious investments. In an attempt to support all players in the

[31] Cartwright et al., 2007
[32] Ethanol Africa personal communication
[33] There is of course a positive correlation between the price of oil and bioethanol feedstocks.
[34] Hamelinck et al., 2005; Miguez, pers. comm.
[35] BTT, 2006

processing chain the Draft Biofuel Strategy proposed that bioethanol be sold at 95 per cent of basic fuel price, US$ 0.60 in December 2007, but in its latest move the South African Cabinet opted only for a waiving of the fuel tax, which compromises 16 per cent of the retail price and did not stipulate a price at which bioethanol ought to be sold. The combination of reduced biofuel targets and limited fiscal support is likely to see some bioethanol producers, and particularly those using maize feedstocks, operate outside the domain of a State regulated market and pursue markets outside of South Africa.

The sale of bioethanol byproducts and emissions reduction certificates has the potential to boost the viability of the bioethanol value-chain, especially for processors. By-product revenue is included in the estimates above, but aggressive marketing of by-products could enhance their contribution. There is an equal danger, however, that the large quantities of by-product being produced internationally by bioethanol industries will deflate the value of these products and undermine their contribution to bioethanol viability.

Figure 5: Breakdown of petrol prices in South Africa, December 2007.



SEE ALSO APPENDIX D FOR DEFINITIONS.
Source: Department of Minerals and Energy (DME).

The registration of a UNFCCC Clean Development Mechanism (CDM) methodology for biofuels, could assist the viability of South African biofuels by facilitating carbon trading and access to the associated revenue.[36] The development of such a methodology is currently the attention of a strategic collaboration between the Food and Agricultural Organisation and the

[36] Bakker, 2006. It should be noted that due to high transaction costs, the Clean Development Mechanism (CDM) has proven generally cumbersome an unprofitable to date, especially for South Africa.

UNFCCC.[37] The collaboration aims to pave the way for future biofuel projects by submitting and attaining approval for a biofuel methodology. The BTT estimates that carbon revenue could return an additional US$ 0.015 per litre to bioethanol from sugarcane and US$ 0.002 per litre for maize-ethanol.

In total the BTT estimates that, based on E8, the sale of maize and sugarcane by-products (DDGs for maize, bagasse for sugarcane and the sale of realised carbon credits for both crops) could generate US$ 56 million and US$ 14 million respectively.

[37] Gustavo Best personal commuication

4 International bioethanol trade from South Africa

4.1 An international overview

Liquid fuels, mainly petrol, diesel[38] and jet fuel, make up about 40 per cent of world energy use, and account for 95 per cent of the energy used in transport. Crude oil is the chief source of this liquid fuel. Globally, 85 million barrels of crude oil are used daily, representing an expenditure of roughly US$ 7 billion. Biofuels became a feature of the international liquid fuel regime in the wake of the 1973 oil price shocks when a number of countries initiated national biofuel programmes in an attempt to ensure supply security and counter expanding trade deficits. In the face of recent pressures on mineral oil and growing concerns about global warming, the industry has received renewed attention in recent years.

Global biofuel production is expected to reach 60-65 billion litres in 2007. USA, Brazil and China are the greatest producers, although Germany achieved the highest rate of production growth in 2006.[39] Brazil alone accounts for 50 per cent of global bioethanol exports, and supplies half its domestic petrol requirements with bioethanol (or 1.5 times the total South African petrol use). In Brazil bioethanol accounts for over half the sugarcane crop and is blended as either E85, or E20-25 with mineral fuels.

Global bioethanol trade represents less than ten per cent of production. Traditionally bioethanol has been used in the country of origin but, as the industry expands, many commentators are calling for greater biofuel trade.[40] The case for biofuel trade is based on a number of rationales:

- Countries face great disparities in the cost of producing biofuels, creating the potential for gains from trade (see Table 4). Assessments of gains from trade should, but tend not to, include the opportunity cost (or scarcity value) of water, land and labour. Developing countries, many of which are located in the tropics, with their long growing season, relatively cheap labour and low opportunity cost of land and water, relative to industrialised countries, might be able to exploit comparative advantage in growing bioethanol (and biodiesel) crops and benefit from increasing biofuel trade[41]. The same trade could relieve the current fiscal burden on OECD countries that have undertaken to support domestic biofuel subsidies in an attempt to reduce vehicle emissions.

- Demand for transport fuels is greatest in countries that no longer have significant scope for expanding their agriculture. In contrast many developing countries have under-developed rural economies characterised by a lack of investment, unutilised land resources and low fuel consumption relative to their agricultural potential. For the time being, developing countries do not confront the need to reduce their transport sector emission of GHGs under the Kyoto Protocol.

[38] Both marine and road diesel
[39] Steenblik, 2007
[40] Pereira da Carvalho, 2004
[41] Johnson, 2006; Walter et al., 2007

- Industrialised countries are unlikely to be able to meet their biofuel or emissions reduction targets while relying on domestic supplies. The EU, for example, has established a biofuel target of 18.2 million tons of oil equivalent (5.75 per cent market penetration) by 2010. As of 2006, the EU consumed 5.38 million tons of oil equivalent (toe), up from 3.3 million toe in 2005,[42] mainly as biodiesel from rapeseed. Only a small portion of this was imported. However the region confronts shortages of land, labour, and most significantly processing capacity in attempting to reach its target.[43] In the interim the European Commission has proposed a new (and this time binding) target of ten per cent of total vehicle fuel by 2020, which assumes 20 per cent of biofuels will be imported.[44]

- Similarly, to comply with its target of 28.30 billion litres by 2012, the USA would have to devote over nine million hectares (roughly 33 per cent of all land cultivated with maize) of land to maize. Currently only 3.9 million hectares of maize is used in ethanol production (16 per cent of the total area). Whilst the required expansion is possible, it would more than likely push the price of USA bioethanol up to levels at which it would be rendered uncompetitive.

- Broader supply sources are required to meet expected demand. Fulton (2004) notes that the USA, EU-25 and China are likely, if the planned expansion continues, to reach the ceiling of their biofuel supply capacity between 2020 and 2030, given their respective available natural resources. Without imports these countries could confront fuel shortage crises. In Brazil, on the other hand, the production capacity would be just about 50 per cent of its potential in 2030,[45] creating the obvious potential for trade. Indeed, in the case that large scale production of bioethanol from cellulose was not feasible in 20-25 years, the only way to assure that fuel bioethanol could attain a USA target of ten per cent of the gasoline consumption is through trade.[46] Brazil, itself, has called for greater trade in the face of concerns about its own ability to meet future bioethanol demands without introducing supply side risks. Brazil has, in response, encouraged the development of bioethanol feedstocks in a number of countries including South Africa.[47]

- A globally diverse supply of biofuels, augmented by international trade, could mediate the impacts of supply side disruptions caused by localised drought, or pest outbreaks.[48]

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43 UNCTAD, 2006. To meet its 2010 target of 18 Mtoe, the EU would have to dedicate 6.8 million hectares of wheat or 2.9 million hectares of sugar beet to biofuel production. The current area dedicated to wheat is 22 million hectares and for sugar beet, 2.2 million hectares.

44 Garofalo, 2007

45 Walter et al., 2007

46 Forecasts from the World Energy Outlook form the International Energy Agency (IEA 2006 sit biofuels between 4-7% of global consumption in the transport sector in the next 20 years).

47 Miguez, personal communication, 2007

48 Steenblik, 2007

Table 4: Estimates of bioethanol production costs, excluding taxes and subsidies

Country/feedstock	Estimates and source	Estimates and source	Estimates and source
	Dufey, Vermeulen and Vorley (2007)	South African feasibility study, citing Brazilian ministry of mines and energy (2006)	UNCTAD (2006)
South Africa (sugarcane & maize)		US$ 0.45-0.46	US$ 0.41
Brazil (sugarcane)	US$ 0.25	US$ 0.23	US$ 0.27
Thailand (cassava)	US$ 0.27	US$ 0.29	
Australia (sugarcane)	US$ 0.38	US$ 0.32	
US (corn)	US$ 0.40 – 0.50	US$ 0.47	US$ 0.41
EU (wheat/beet)	US$ 0.51 – 0.80	US$ 0.97	US 0.61 & 0.68 respectively
China (sugarcane 2005)	US$ 0.53		
Chicago Bourse July 2007		US$ 0.55/ litre	

Source: International costs of production reflect 2006 prices and are sourced from a presentation made by NJ Moreira, Vice President of Mines and Energy in Brazil, as reported in the South African Biofuels Feasibility Study; Dufey, Vermeulen, Vorley, 2007; Chicago Bourse.

A number of private and public sector initiatives, aimed at developing future trade in biofuels, have begun to sink investments. As the authors of the article, The New Scramble for Africa point out, "When it comes to agrofuels, the road to Africa is paved with diplomats. A daily parade of foreign politicians stalks the continent negotiating agrofuel deals wherever possible. Europe, Japan and the USA are, of course, very active, working their agrofuel interests into the various multilateral and bilateral aid, trade or investment agreements they have on the go with African countries".[49]

Investments with the intention to promote trade are not restricted to north-south bilaterals, however. Brazil, largely by way of the state owned oil company Petrobrás, has forged deals for bioethanol imports and technology transfer with a range of African countries, from Senegal to Nigeria, Mozambique to Angola. India recently pledged US$ 250 million to a West African Biofuels Fund; and China has cemented a long term cassava supply channel from Nigeria for its domestic bioethanol distilleries.[50] On the back of these agreements, the volumes of traded bioethanol appear to be increasing. In 2005, the net amount of bioethanol imported by USA was estimated as 600 Ml, representing about five per cent of USA domestic consumption and ten per cent of all bioethanol traded. In 2006 the USA imported an

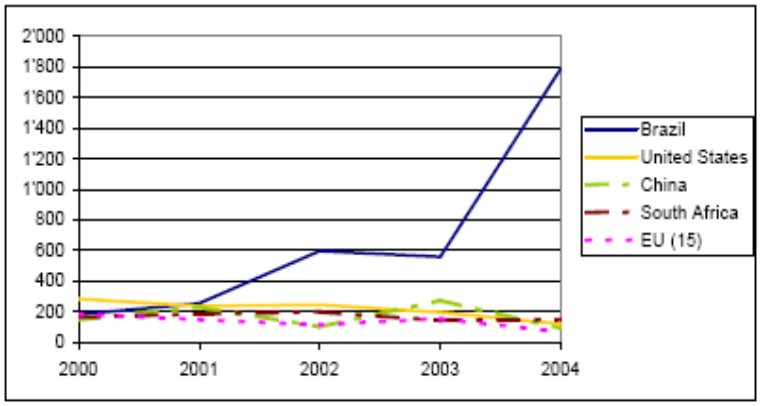
[49] http://www.grain.org/seedling_files/seed-07-07-6-en.pdf
[50] Licth, 2006

estimated 13 per cent of their bioethanol (see Figure 6). In 2005 the EU imported roughly 19 per cent of its total bioethanol consumption. Discerning how much of the traded bioethanol is used in fuel can be difficult, as the trade codes do not distinguish between fuel bioethanol and that used in industrial processes, but Licth estimates that 13 per cent of the 45 Gl of bioethanol produced globally in 2005, was traded.

4.2 South Africa 's bioethanol trade

COMTRADE data show that in 2004 the chief importers were the US (352,000 tons), India (337, 000 tons), Republic of Korea (223, 000 tons), Japan (160,000 tons), Sweden (134,000 tons), Jamaica (107,000) tons and The Netherlands (137,000 tons). The chief supplier of all these trades was Brazil, although Bolivia is recorded as exporting an additional 37,000 tons to The Netherlands.

Figure 6: Ethanol (80% plus strength) exports 2000-2004.



Source: UNCTAD calculations based on COMTRADE.

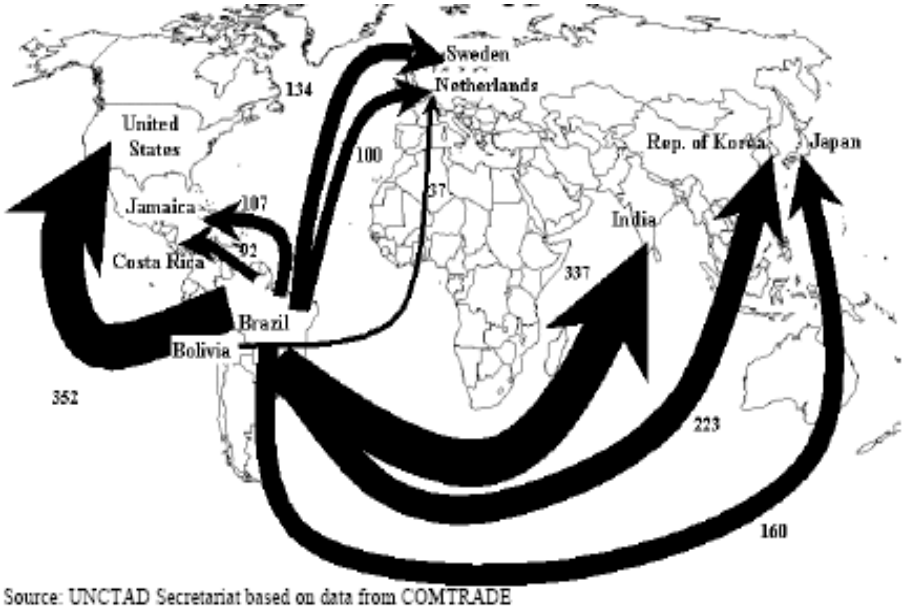
A number of commentators[51] have interpreted the United Nations Commodity Trade Statistics Database (COMTRADE) data showing South Africa exporting just under 200,000 tons of undenatured bioethanol (strength greater than 80% alcohol) throughout the period 2000 – 2004, as being an indicator of South Africa's significance as a bioethanol exporter. The reality, however, is that South Africa does not currently export bioethanol for use in the fuel market. The COMTRADE data are comprised of small proportions of the 40,000 tons of bioethanol that is manufactured from sugarcane molasses, and the ethanol produced by SASOL as a co-product of its Fischer-Tropsch process.

In both instances this ethanol is exported for use in the potable alcohol, pharmaceutical and paint industry. SASOL's high purity ethanol plant at Secunda in South Africa produces 115,000 tons of industrial ethanol annually. The product is marketed in Europe, the USA, the Far East, Africa (most notably Nigeria), the Middle East and the Asian sub-continent. The production of this ethanol is as a byproduct of synfuel processing, is energy intensive and

[51] see for example Coelho, 2005, and F.O. Lichts, 2006, Walter et al., 2007

associated with significant GHG emissions. Experimental use of this ethanol in motor vehicles encountered difficulties and has been discontinued.[52] The ethanol reported in COMTRADE data may, in addition, include small quantities of fortified wine and spirits that has been either incorrectly or illegally classified in an attempt to avoid the import tariffs that are levied on potable alcohol.

Figure 7: Main flows of ethanol in 2004 (in thousand tons). Flows under 25,000 tons are not shown.



Source: UNCTAD Secretariat based on data from COMTRADE

Apart from the industrial bioethanol produced by the sugar industry, there is currently very little bioethanol being produced in South Africa. Would be bioethanol manufacturers interviewed in the course of this study were awaiting a finalisation of the Industrial Biofuels Strategy and an indication of the level of support they could expect from the South African Government. As a result, they were unanimously focussed on the domestic market. The Strategy that was approved by Cabinet in December 2007 provides significantly less support than had been anticipated. To a certain extent the lack of Government support has been offset by rising oil prices and it remains to be seen to what extent private bioethanol manufacturers will pursue bioethanol manufacturing and marketing independently of State support. There are no restrictions on where South African producers of bioethanol may sell their produce and it is plausible to imagine that producers might export their bioethanol if foreign markets offer the greatest profits. Where South African bioethanol ends up is likely to depend upon:

- The price received in South Africa relative to the price available on export markets.
- Domestic policies supporting bioethanol production and export.
- Emergence of internationally accepted bioethanol standards with which South Africa can comply.

[52] Dr John Purchase personal communication

- Access to regional and international markets at prices that deliver a profit to South African producers.

4.3 Relative prices for South African biofuels

There is no legislation restricting the sale of bioethanol from South Africa. The relatively small volumes of bioethanol that are likely to be produced in the medium term will almost certainly be sold in the market that offers the highest price. On a purely financial basis, it makes sense for South African growers to export bioethanol if the price they receive once the bioethanol has been freighted and import duties have been paid, is higher than the price received in the domestic market. The domestic market price is likely to be linked to the basic fuel price, which itself is linked to the import parity price of petrol. The Basic Fuel Price is determined by exchange rates and the international oil price, and is highly volatile (see Figure 8). Based on a December 2007 crude price of ??? being determined by, but is currently US$ 0.64 per litre (based on a crude price of US$ 92.23/ bbl). In an attempt to support all players in the processing chain the BTT has proposed that bioethanol be sold at 95 per cent of BFP. Based on these figures, any country offering to pay South African producers more than US$ 0.60 per litre once transport and import duties have been paid might be considered a viable export partner. The transport component of export costs, most notably the transport to ports, has increased steeply in the past two years. The total transport component of the bioethanol export now represents between 10 and 30 per cent of the final price.[53] As such export viability is likely to depend greatly on the proximity of production plants to coastal export facilities and the ability to secure reasonably priced freight. Maize growers interviewed in the course of this research are, unlike their sugarcane growing counterparts, generally located in the hinterland. These growers considered the cost of transporting their maize or ethanol to the coast and then freighting it generally too high to be economic. For cane growers the logistic costs of ethanol export is less prohibitive, making it potentially more profitable as an export.

The Chicago Bourse provides the most reliable source of international ethanol (including non-crop sources of ethanol) prices.[54] According to the Bourse, ethanol was traded at US$ 0.62 per litre in December 2007. Based on what is known about the cost of production in other countries and regions (see Table 4 above), only the Euro-zone countries and the United Kingdom have the potential to provide a viable export market for South African bioethanol at current prices.

Southern African Development Community (SADC) countries, many of whom are dependent on fuel imports from South Africa, could provide a further viable market for South African bioethanol. Whether or not Europe will source its bioethanol from South Africa, or from countries such as Brazil, Guatemala and China, which are currently able to provide bioethanol more cheaply than South Africa, will depend on the export and import preferences between the respective countries. Brazil and Guatemala are, at present, the two chief origins for bioethanol imported into Europe.

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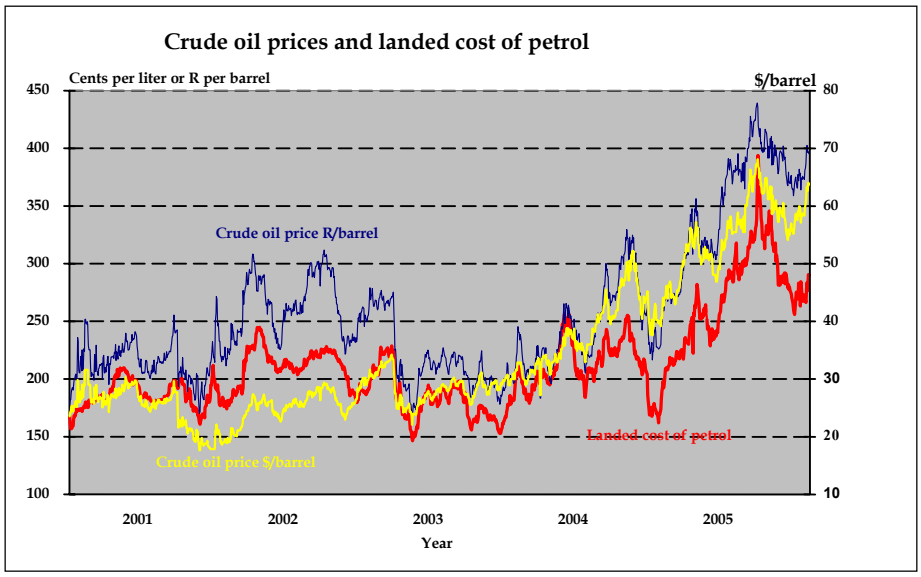
53 Dr John Purchase, personal communication

54 http://www.cbot.com/cbot/docs/85189.pdf

Figure 8: Relationship between the price of crude oil in US$ and South African Rands and the "landed cost of petrol" – the basic fuel price 2001 to 2005.



Source: Fanie Brink, GrainSA, 2005.

(Note the December 2007 basic fuel price is ZAR 4.45 per litre).

4.4 Access to regional and international markets

The trading of agricultural commodities is notoriously irrational, often reflecting influences that have little to do with price or comparative advantage. This is particularly true of bioethanol trade, which receives twice as much government support as biodiesel.[55] None of the countries currently supplying bioethanol for fuel have avoided the need to support their industries.[56] Support has multiple forms, including fuel tax reduction or exemption, mandatory blending, producer subsidies, subsidised access to water, electricity and credit, import tariffs and financial incentive programmes such as accelerated tax reduction. In 2006 the extent of government support for OECD countries producing bioethanol was estimated at US$ 11 billion, and this is predicted to rise to US$ 15 billion in 2007.[57] The most frequently cited rational for these subsidies is energy security although in reality it is very difficult to distinguish between long standing efforts aimed at supporting OECD farmers and support for biofuels.[58] Steenblik, for one, expresses doubt about the ability of biofuels to deliver on the wide range of fronts on which their benefits are alleged.

The prevailing government support for biofuel producers in industrialised countries distorts both the price and the international flow of bioethanol and deprives developing countries, such as South Africa, of the full benefit of bioethanol trade while limiting the extent to which their production capacity can develop. Trade distorting support for biofuels can be divided

55 Steenblik, 2007
56 Kojima et al., 2007 and RFA, 2007
57 Steenblik, 2007
58 Kojima et al., 2007

into two categories: (1) support for growers of crops including barriers to aspirant biofuel crop importers, and (2) support for retailers of biofuels including tariffs charged on biofuel imports.

Producer support for European agriculture averaged US$ 144 billion per annum, 34 per cent of all farm receipts between 2003-2005. Support for EU sugar beet growers, although scheduled for reform,[59] is particularly robust and was estimated to total US$ 3.75 billion in 2003.[60] South Africa confronts import duties in trying to sell lower priced sugarcane and sucrose in the EU, while EU exporters receive subsidies to cover the gap between the intervention price and lower world price when quota sugar is sold from the intervention stock.[61] In addition to general agricultural support, the 2 million hectares of energy crops in the EU receive a US$ 60.25 per hectare subsidy under the "non-food set aside scheme", a subsidy that accounts for a US$ 0.02 cents per litre benefit. In the USA, farmers receive an average of 20 per cent of their revenue in the form of State support.[62] Growers of corn for bioethanol almost certainly receive more than this average. The US bioethanol sector benefits from "subsidy stacking"– the use of subsidies from a range of sources.[63] In addition to the general agricultural support, growers of bioethanol crops qualify for a US$ 0.26 per litre Federal subsidy, while States such as Kentucky, offer growers an additional US$ 0.26 per litre. All biofuel farmers qualify for a US$ 0.048 per litre tax rebate on top of their direct support.[64]

Concerning support for biofuel retailers, the EU Directive 2003/96/EC creates the potential for a 100 per cent fuel tax exemption for EU biofuel producers – potentially an amount of R4.50 (US$ 0.621) per litre. Implementation of this directive has been varied. Germany initially applied a full exemption but later reduced it citing fiscal shortfalls, while Denmark provides no exemption. In France bioethanol/petrol blends are exempt from the "General Tax on Polluting Activities". Biofuel imported from South Africa would not, currently, qualify for these exemptions although this may be challenged under WTO guidelines.[65] The USA provides its bioethanol processors, who are particularly threatened by Brazil, with exemption from the Federal Excise Tax on motorfuels – a US$ 0.135 per litre benefit.[66] To prevent this windfall accruing to non-US taxpayers, bioethanol imports to the USA are liable for a US$ 13.5 cents per litre border tax in addition to the standard 2.5 per cent *ad valorem* border duty. Certain "least developed countries" in Africa (under the African Growth and Opportunity Act - AGOA) and the Caribbean (under the Caribbean Basin Initiative), Israel, Mexico and Canada are not required to pay the US$ 13.5 cents per litre import duty, but this group does

[59] In 2005, the Agricultural Council of the EU accepted an agreement that will be binding until 2015. The agreement entails a 36 per cent reduction of the guaranteed price offered to sugarbeet growers over four years beginning in 2006. Thereafter the intervention price system will be abolished and replaced by a reference price, coupled with a private storage system as a safety net in case the market price falls below the reference price.

[60] Pollard, 2004.

[61] Mitchell, 2004.

[62] OECD, 2006.

[63] Steenblick, 2007.

[64] Steenblick, 2007.

[65] Steenblick, 2007.

[66] Kojima et al., 2007.

not include South Africa. In addition, fuel distributors in the USA that blend ethanol with petrol qualify for an income tax credit which cannot be claimed on imported feedstock.

Similar barriers to ethanol imports are imposed by other countries.[67] See Table 5 below for a complete summary.

By way of comparison, South African bioethanol processors stand to receive a full fuel tax exemption amounting to US$ 0.17 per litre up to a level that will provide for a two per cent penetration of the liquid fuels market. Bioethanol imports to South Africa are currently duty free. Maize growers receive no protection against imports and typically receive a price that is determined by the import parity price of maize and the size of the South African harvest.[68] In general South African farmers receive very little State support. State support for South African agriculture dropped from 18 per cent to just over two per cent of farm revenue between 1992 and 2002, and now represents five per cent.[69] The South African agricultural sector is unregulated and unprotected by import duties.

South Africa's sugar sector is subject to industrial and not agricultural policy. The sugar sector is protected by an import duty that is imposed on non-SADC supplies and set at the Rand (ZAR) value of the difference between the "dollar based reference price" and the 20-day moving average of the London International Financial Futures and Options Exchange "No.5 white sugar" price.[70] The tariff is roughly US$ 70 per ton of sugar. Imports from SADC countries are subject to the 1998 Sugar Co-operation Agreement, which permits SADC surpluses to be sold tariff-free but in quotas that are scheduled to expand incrementally, with the view of achieving essentially free Southern African Customs Union trade in sugar after 2012.

Given the disparity between the level of support for the South African bioethanol sector and that received in potential export markets for South Africa, it is not surprising that the focus of the emerging bioethanol industry in South Africa is firmly on the domestic market. As a commodity analyst at South Africa's FinWeek Journal recently observed: "It wouldn't be practical to think that we could export ethanol profitably from SA to Europe or to any country where agriculture is subsidised, even on farms that are much more productive than SA's large areas of marginal agricultural land". If the South African industry is to mature and expand beyond the levels stipulated by policy, export markets will necessarily become important. Based on current production costs estimates South Africa could produce bioethanol at US$ 0.41 per litre. Once import duties and transport had been paid, the effective price of South African biofuels in the USA would be at least US$ 0.62 per litre, and in the EU US$ 0.77 per litre. A great unknown in these estimates is the cost of transport, the most significant component of which is transport from processors to ports. Transport costs have been factored

[67] Johnson, 2007 and Steenblik, 2007.
[68] Vink and Kirsten, 2002.
[69] OECD, 2006.
[70] Lorentzen et al., 2007.

into this analysis at ten per cent of retail value, but could range between 10 and 40 per cent.[71] As Table 5 suggests South Africa would struggle to compete in the bioethanol export market given current prices and import duties.

Table 5: Comparison of country production costs with the landed cost of South African bioethanol including duties and transport.

Country/feedstock	Import levies to country	Minimum landed price of SA bioethanol (10%-15% transport costs)	Production cost estimates range
South Africa Sugarcane and maize)	None		US$ 0.41-0.46
Brazil (sugarcane)	20% *ad valorem* (removed completely as of 1 January 2007)	US$ 0.46 - 0.50	US$ 0.23-0.27 (may be as low as US$ 0.18 in 2007)
Thailand (cassava)	25 % *ad valorem*	US$ 0.65	US$ 0.29-0.45
Australia (sugarcane)	5% *ad valorem* plus US$ 0.34	US 0.84	US$ 0.32-0.38
US (Corn)	US$ 0.135 plus 2.5% - in sum about 46% *ad valorem*	US$ 0.62	US$ 0.40 – 0.50
EU (wheat/beet)	US$ 0.262 in sum about 63% *ad valorem*	US$ 0.77	US$ 0.51 – 0.97
China (sugarcane 2005)	not known	not known	US$ 0.53
United Kingdom	US$ 0.36	US$ 0.86	US$ 0.70 - 1.05
Canada	9 % *ad valorem*	US$ 0.55	US$ 0.50

Source: UNCTAD (2006), Steenblik (2007).

4.4.1 Multilateral trade rules

Bioethanol is classified as an "agricultural commodity" as opposed to a "fuel commodity" and as a result is subject to the intricate, and regressive, conditions governing the World Trade Organisation's "Agreement on Agriculture".[72]

[71] Because bioethanol absorbs water and other impurities in pipelines it is best transported in dedicated pipelines or with dedicated freight fleets, both of which increase the cost.

In an attempt to overcome local shortages Brazil removed its 25 per cent *ad valorem* duty on imported bioethanol in January 2007, but the liberalisation of bioethanol trade has encountered opposition from certain environmental and poverty focussed agencies that fear natural resource degradation and food insecurity concerns.[73] To address this concern the EU is likely to require environmental certification of its biofuel imports. Relative to many other developing countries South Africa, which rewrote much of its policy post-1994, has sophisticated and progressive environment, water and industrial relations legislation. As a result South Africa might be able to show compliance with European conditions more easily than other countries, making it a preferred trading partner. This has been the case in the Fairtrade® market where the transparency and ease of monitoring on South African farms relative to other African countries, makes for easy and low-cost compliance with Fairtrade® criteria and has seen South Africa quickly develop a commanding presence.

4.5 Domestic policies supporting bioethanol production

The South African biofuel industry is emerging within the context the 1998 White Paper on Energy and the Renewable Energy Strategy, approved by the Cabinet in 2003. In spite of vested State interests, the 1998 White Paper acknowledges that benefits could be derived from the use of alternate transport fuels and renewable energies.[74] The Renewable Energy Strategy outlines a, "new energy regime"[75] and sets the target of generating 10,000 GWh of renewable energy by 2013.

The Biofuel Strategy, proposing a biofuel target of 3.4 per cent of all liquid fuel (4.5 per cent of vehicle fuel) by 2013, was set to become a crucial component of the Renewable Energy Strategy, potentially contributing two thirds of the renewable energy required. The scaling back of this target to two per cent of all vehicle fuel in late 2007, represents a significant dilution of this ambition. To meet the proposed target, the Government was to draw on the Petroleum Products Licensing System[76] to mandate E8 and B2 blends. Mandatory blending was to have provided a "captured market"[77] removing uncertainty for investors and permitting forecourt infrastructure to be used in retail. Mandatory blending is, however, a controversial

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72 Brazil's newly created bureau of energy, located in the Foreign Ministry, is planning a submission to the WTO to have bioethanol reclassified as a fuel commodity. Coseby and Tarasofskey, 2007.

73 Brown, 2006.

75 The State is a major shareholder in ESKOM and a shareholder SASOL. Vested interests in other State parastatals, most notably the telecommunications utility TELKOM, have hampered the liberalisation of utilities in other sectors.

75 The White Paper was a Constitutional requirement and highlights the overarching energy goals of the country as being: Increasing access to affordable energy services, stimulating economic development – encouragement of competition within energy markets, managing energy-related environmental and health effects and securing supply through diversity – increased opportunities for energy trade and diversity in both supply sources and primary energy carriers.

76 The Petroleum Products Amendment Act, (Act No. 58 of 2003) enables the Minister of Minerals and Energy to require that licensed wholesalers and licensed producers supply petroleum products made from "vegetable matter", and complying to certain specifications before they supply petroleum products made from other raw materials.

77 Dr John Purchase, personal communication.

policy instrument as it transfers risk from producers to tax payers and, by creating a bureaucracy dependent agricultural sector, which can in turn amplify risk.[78]

It remains to be seen how the South African government intends to allocate responsibility for meeting the revised target and whether or not it will seek to cap biofuel production at the targeted levels. A number of potential interventions, by which the local industry might be supported, exist. These include:

- Bioethanol that complies with agreed specifications will receive a 100 per cent fuel levy reduction, equivalent to 16 per cent of the current petrol retail price. This levy will accrue to retailers but should enhance the viability of the entire value chain. The biodiesel levy has been set at 50 per cent of the fuel levy. Forcing producers to register in order to qualify for fuel levy exemption facilitates regulation of bioethanol quality and growing conditions.[79]
- Certain government fleets committing to E85 (ethanol denatured with petrol) which may be used in dedicated or flexi-fuel engines.
- A producer's stabilisation hedge fund. If the oil price were below US$ 45/ bbl, biofuel producers would receive support. If the oil price were above US$ 65/ bbl, producers would pay in. The hedge available to producers would be catered for under the Central Energy Fund's (CEF) Act Equalisation Fund Levy. At the extreme low of US$ 35/ bbl this hedge would require State fuel price support of ZAR 0.012 per litre.
- Accelerated tax-depreciation write-off 50:30:20 per cent over three years, for investments in biofuels. This mechanism, which was approved by National Treasury in 2002, equates to roughly US$ 1.71/bbl crude oil.
- In September 2005 the National Treasury approved a Renewable Energy Subsidy Scheme, which is implemented by the Department of Minerals and Energy (DME). The Subsidy provides for US$ 0.024 cent (South African) per litre for bioethanol up to a maximum of US$ 2.85 million for bioethanoil and biodiesel in the 2006/7 financial year.
- In July 2006, the National Treasury released a Discussion Paper on Environmental Taxes for comment. The paper proposes extending this incentive to bioethanol, and that the basis for incentives be linked to overall externality benefits.
- Local governments, lead by the City of Cape Town, and acting upon the National Vehicles Emissions Strategy tabled in 2004, have drawn up air quality and climate change strategies. Cape Town, which is a member of ICLEI's Cities for Climate Change programme aims to introduce cleaner fuels through its Integrated Metropolitan Environmental Policy, and has converted some its municipal fleet to biofuel.
- The meagre support that has been retained for South African agriculture is reserved for black economic empowerment initiatives. Such initiatives are able to benefit from subsidised access to land (under the Land Reform for Agricultural Development Programme and Municipal Commonage Schemes), water (under the water allocation reform programme), credit (from the Industrial Development Corporation and the Land Bank), as well as direct grants for infrastructure (under the Consolidated Agricultural Support Programme and the Local Economic Development Programme). "Stacking" this

[78] Steenblik, 2007.
[79] BTT, 2006 and Makenete, 2007.

support and linking aspirant black sugarcane and maize farmers with the requisite technical expertise and markets could reduce the private cost of production and greatly enhance South Africa's competitiveness in international bioethanol markets.

Thus South Africa does have the policies and the budgets in place to support the development of a bioethanol industry capable of contributing to poverty alleviation and addressing important environmental concerns. The problem with much of the legislation is that is not implemented, or where it is implemented this has been done in a piecemeal manner and does little to remove uncertainty for investors or to crowd in private sector investment.

On the international front, South Africa has entered into two politically celebrated trilateral partnerships with Brazil and the United Kingdom, and India and Brazil. These agreements, defined by memoranda of understanding, are aimed at investment in production capacity and in knowledge transfers from Brazil to African countries including South Africa. The agreements make no reference to liberalising market access or to future trade agreements, and as such provide no basis on which to establish bioethanol trade.[80]

4.6 Emergence of an internationally accepted bioethanol standard with which South Africa can comply

Assuming public and private interests in South Africa can combine to create a viable bioethanol industry, international trade will further require standardisation of the terms, definitions and quality controls that are applied to bioethanol. Certain Brazilian exports of bioethanol have, in the past, been rejected by the EU on quality grounds.[81] The Fuel Quality Directive of the EU, responsible for EU fuel quality standards, currently imposes standards relating to hydrocarbon content and requires bioethanol to be processed with isobutylene to produce ETBE in order to make them less volatile. In addition, Brazil and the USA are currently working on an international standard for bioethanol that will facilitate its trade in international commodity markets.[82]

The South African Bureau of Standards (SABS) oversees standards that stipulate viscosity, colour and chemical composition specifications for petrol and diesel. The South African bioethanol industry confronts the choice of whether to adopt SABS standards or compliance with European or American standards that would be more exacting, but which would facilitate an export focused industry.

A key quality hurdle for South African bioethanol seeking to penetrate the export market revolves around the current practice of using MTBE (methyl tertiary-butyl ether). Whilst MTBE makes blending easier, and may present certain air quality benefits, there is a suggestion that inhaling MTBE fumes can cause cancer and other non-cancerous ailments and where petrol leaks through ground storage facilities, small amounts of MTBE can contaminate

[80] DME, 2007.
[81] BTT, 2006 and Miguez, personal communication.
[82] Dufey, personal communication.

large volumes of water. MTBE use is the norm in South African petrol and MTBE would feature in blended South African bioethanol. MTBE is, however, banned in the USA and Western Europe.

5 Sustainable development implications

Liquid fuels are an integral component of South Africa's economy. The country has just under nine million registered vehicles, eight million licensed drivers[83] and over 800 million litres of paraffin are sold every year, mainly to poor shack-dwelling households.[84] Inevitably changes in the types of liquid fuels used, and in the way that these fuels are provided, will have widespread implications. Establishing a bioethanol industry, whether on the back of international trade or a domestic effort, is expected to present economic and environmental benefits, but has the potential to create environmental risks, new concentrations of economic power and local food shortages. International trade in South African bioethanol could exacerbate these risks.

In a medium-sized and newly open economy in which economic governance has yet to gain traction, predicting the manner in which interventions and changes will feed through the system and impact upon people's lives is difficult. Below is an attempt to highlight both the financial and external costs and benefits that are likely to arise from a South African biofuel sector, and potential biofuel trade.

5.1 Macro-economic impact

The feasibility study that preceded the Draft Biofuel Strategy was based on the proposed bioethanol target of eight per cent of petrol consumption in 2013 – roughly 466 kilotons – without unduly damaging its environment or food supply. Whilst this target has been more than halved, and uncertainty now exists as to the way in which South Africa will go about its bioethanol industry, the study does provide an indication of the types (if not the scale) of impacts that are likely.

Applying a social accounting matrix (SAM) to the E8 scenario, the study found that South Africa's crude oil refining sector would suffer a small negative impact, but that this would be compensated by a positive impact on the biofuel refining and agricultural sectors. As with all SAMs caution is necessary in drawing inference from the results, but the estimates suggest that in conjunction with a biodiesel supply of B2, meeting a target of E8 would contribute 0.11 per cent or US$ 0.23 billion to South Africa's GDP. Crucially, since roughly 40 per cent of the costs in the bioethanol supply chain accrue to growers and a number of processing plants have established local operations (see for example Ethanol Africa in Bothaville in Appendix C) growth would take place in rural economies that are currently characterised by rising poverty. The ability to replace imports in this way could reduce the current account deficit by US$ 0.511 billion per annum. Since it is this deficit that is partially responsible for South Africa's exchange rate volatility and macro-economic uncertainty,[85] a biofuel sector could have a stabilising influence on South Africa's economy and enhance long term growth prospects.

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83 www.arrivealive.co.za
84 PASASA, 2007.
85 MPC, 2007.

An important consideration is whether the potential benefits outweigh the fiscal impacts arising from a fuel levy exemption or other supporting policies, especially as neither agriculture nor crude oil refineries typically return the tax breaks that they are afforded to the fiscus. The feasibility study estimates that fiscal shortfalls would be easily compensated by the estimated US$ 101 million increase in GDP arising from a successful biofuel industry, even without considering the additional GDP created by the emergence of a new industry.[86]

5.1.1 Gains from trade

The sum of South Africa's crude oil refining and oil synthesising capacity is insufficient to meet South Africa's demand for petrol and diesel. In 2006 South Africa was required to import 450,000 tons and 530,000 tons of refined petrol and diesel respectively in order to ?????.[87] Petrol imports alone cost US$ 280 million in 2006, and this need for imported refined fuel is increasing at three per cent to five per cent per annum.

An E8 bioethanol penetration would reduce the demand for imported petrol by seven per cent by 2013. Using a portion of existing sugar and maize exports to reach this target would forego an estimated US$ 190 million in agricultural exports,[88] but this loss would be covered by the estimated US$ 280 million (and rapidly increasing) saving of forex that is currently used to purchase imported petrol. An export oriented biofuel industry would continue to expose South Africa to the full vagaries of the mineral fuel market, and would export the environmental and health benefits associated with burning bioethanol as opposed to petrol (see Sections 5.2 and 5.3 below). On macro-economic grounds however, the industry should not rule out the possibility of exporting biofuel. Were export market prices to become higher than domestic prices, the current account benefits of exported biofuel could outweigh those of an import substitution strategy.

There is the additional suggestion that South Africa could import bioethanol from countries such as Brazil or Zambia. In such instances South Africa would benefit from a fiscal saving as well as the environmental benefits of biofuels relative to mineral fuels.

5.1.2 Employment

Redressing unemployment in South Africa, which runs between 25 per cent and 40 per cent[89] is a national priority. The biofuel sector is known to be more labour intensive in absolute terms and per unit of capital investment than the crude oil sector.[90] The feasibility study that preceded the Draft Strategy estimated 40-45 direct jobs would be created per 100 kilotons of biofuel processing plant capacity. Whilst a vibrant biofuel industry has the potential to stimulate the agricultural economy, it should be noted that the propensity for agriculture to

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86 BTT, 2006.
87 SAPIA, 2007.
88 FAOSTAT, 2007.
89 See for example StatsSA, 2003; McCord, 2006; Noble *et al*., 2006.
90 BTT, 2006.

create employment has been repeatedly overestimated in South Africa.[91] The 55,000 new jobs predicted by the feasibility study seems improbable, especially as most bioethanol will not be produced from new maize and sugar crops. In the sugarcane industry intensified production techniques, arising from bioethanol feedstock supply, may actually lead to increased mechanisation of the harvest and reduced employment. In general it is more likely that a vibrant bioethanol sector will assist rural economies to arrest the current trend towards insecure employment and labour shedding. Crucially, employment created or protected is likely to be in rural areas that are currently subject to increasing unemployment and growing poverty.

5.2 Environment

A bioethanol based economic expansion in South Africa will require actions that bring the region's natural resource limits into stark focus.[92] The use of crops for biofuels and the expansion of cropping in order to supply biofuel crops, whether for the domestic or export market is expected to have both positive and negative impacts on South Africa's environment.

5.2.1 Greenhouse gas emissions

One of the motivations for introducing biofuels is the consequent reduction of GHGs emissions. The cultivation and processing of biofuels is not, however, carbon neutral. The production of fertilisers used in cropping is energy intensive and fertilisers themselves release nitrogen gases with potent radiative forcing potential. The Fertilizer Association of South Africa estimates that fertilisers currently account for 1.5 per cent of the country's emissions, and the agricultural sector as a whole accounts for 12.5 per cent of emissions[93] – a figure which includes losses of soil carbon.

No lifecycle analysis has been done on the emissions released in South Africa's biofuel sector. The following Brazilian and USDA figures are indicatively in the Draft Biofuels Strategy:[94]

- Sugarcane (based on Brazilian figures): on a lifecycle basis ethanol from sugarcane provides eight times the energy that is used in its cultivation, and saves 2.07 tons of carbon dioxide equivalent per ton of bioethanol produced. Assuming that bioethanol has 73 per cent of the energy content of mineral petrol, this represents an emissions saving of 1.45 tons of carbon dioxide equivalent per ton of petrol equivalent.
- Maize (based on USA figures): on lifecycle basis saves 0.32 tons of carbon dioxide equivalent per ton of bioethanol produced. Savings per unit of energy are 0.22 tons and fuel from maize represents a 30 – 60 per cent energy saving relative to the energy used in its cultivation.

[91] Lorentzen et al., 2007.
[92] Sachs, 2005; SafMA, 2005.
[93] FAOSTAT, 2007.
[94] BTT, 2006.

Sugarcane's relative GHG efficiency is due to the use of bagasse in generating the energy required by sugar refineries. A ton of cane in South Africa currently produces 30 kWh of energy from bagasse, although this could be increased to 200 kWh with better technology[95]. Maize would achieve similar reductions if it used solar, wind energy and animal waste to power the refining processes, but these technologies remain expensive in South Africa. As Miguez points out, Brazil's emissions gains are self perpetuating; the more bioethanol in the market the greater the opportunities for transporting cane without burning fossil fuels and the greater the availability of bagasse for cogeneration that can be used in agriculture and in processing.

The proposed target of two per cent of vehicle fuels would result in roughly 500, 000 tons of carbon dioxide equivalent being saved annually in South Africa.[96] Whilst any reduction in South Africa's emissions should be seen as positive, this figure represents less than 0.15 per cent of the country's current emissions and is less than the annual incremental increase in emissions. In terms of the reduction of greenhouse gas emissions, Johnson points out that replacing the synfuel created by SASOL could deliver significantly greater emissions reduction (as well as financial) gains than the proposed bioethanol target.

5.2.2 Water scarcity

Water scarcity is arguably a more pressing environmental issue in South Africa than climate change, although the two are clearly linked[97]. Water availability varies greatly across South Africa but at least 11 of the country's 19 catchments are critically water stressed[98]. Whilst on average the population of South Africa has access to 1,200 m^3 of water per person per year, roughly one fifth of the population survive on less than the 50 litres a day prescribed by the WHO as the essential minimum. Water scarcity combines with poor water quality to raise the level of water borne diseases and contaminants. These in turn inflict debilitating health impacts on South Africa's population, particularly in the context of the national HIV-AIDS pandemic.

In spite of this the value of water is inadequately appreciated and South Africa's overarching economic strategy, "Asgisa"[99], makes no mention of the value of the available water resource or how water constraints impact upon the economy. Agriculture accounts for 60 per cent of water consumption in South Africa and restricts the availability of water for alternative uses while providing returns in terms of employment and revenue that are 4 – 100 times lower than those in secondary and tertiary activities.[100]

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95 Otto, 2004.
96 Based on BTT, 2006.
97 Cartwright, 2007b.
98 NWRS, 2002.
99 The Accelerated and Shared Growth Initiative for South Africa (Asgisa) is the national economic growth initiative.
100 Lorentzen et al., 2007.

Dryland maize in South Africa requires roughly 1,100 m^3 of water per ton to produce. Assuming 400 litres of ethanol are received from a ton of maize, 2.75 m^3 of water is required to produce a litre of maize ethanol. In contrast sugarcane is extremely water intensive and is irrigated in the northern regions of the country. Based on the work by Lorentzen *et al*., a ton of efficiently farmed sugarcane requires 1,600 m^3 of water to produce. This figure can be tripled where irrigation is inefficient. Assuming 80 litres of ethanol can be processed from a ton of sugarcane[101] a litre of bioethanol from sugarcane would require 20 m^3 to produce.[102]

The 'opportunity cost' - the true economic value that should be taken into account in establishing comparative advantage – of this water depends on its alternative use, and ranges between US$ 0.02 per m^3 if used in agriculture[103] and roughly US$ 25 per m^3 if used in manufacturing.[104] Opportunity cost can be a difficult measure to estimate and apply, and very few countries consider the scarcity value of water in estimating biofuel production costs. But significantly, the South African economy is water constrained in all of the regions in which sugarcane and maize is produced. In addition the opportunity cost of water is considerably higher than in other SADC countries producing maize and sugarcane.

Table 6: Summary of previous estimates of economic returns to water.

	Agriculture	Horticulture	Sugarcane	Forestry & wood products	Sugar refining	Mining	Manufacture
Crafford *et al.* (2001)	US$ 0.17/m^3			US$ 0.11 /m^3		US$ 11.11 /m^3	US$ 25.00 /m^3
Farolfi & Perret (2002)	US$ 0.02/m^3						
Crafford *et al.* (2004)		US$ 0.44 /m^3	US$ 0.18 /m^3	US$ 0.26 /m^3	US$ 0.24 /m^3		
Lorentzen *et al.*, (2007)		US$ 0.24 /m^3	US$ 0.11 /m^3	US$ 0.07 /m^3			

Source: Adapted from Lorentzen *et al.*, (2007)

If bioethanol requires additional sugarcane plantings, or entrenches the use of water by sugarcane growers in catchments that are already water stressed, this will involve water that is

[101] Miguez, personal communication.

[102] Estimates include the water used in crop production only. It is assumed that the refining processes operate on "closed-loop" water systems and do not consume excessive water. Where this is not the case it is assumed that similar amounts of water are used in the processing of bioethanol from maize and sugar.

[103] Farolfi and Perret, 2002.

[104] Crafford et al., 2001 and Lorentzen et al., 2007.

legally reserved for international transfers, the meeting of basic human needs and the maintenance of hydrological habitats under the National Water Act (NWA,1998).

The exact economic contribution of bioethanol in South Africa remains to be seen, but Lorentzen *et al*., point out the imprudence of locking South Africa's scarce water resource into the agricultural sector with its low growth and employment prospects, relative to scenarios under which water is used in more profitable sectors. Water scarcity is likely to provide a definitive and constraining influence on South Africa's capacity to produce biofuel, and particularly bioethanol from sugarcane. It was precisely this constraint (in conjunction with the limited suitable and available land) that led the 2007 scoping study for the "Brazil: UK: Africa Bioethanol Partnership" to conclude that, "the potential for expanding sugarcane in South Africa is rather limited".[105]

Where the development of a bioethanol industry takes place under the aegis of the NWA, and in support of the Water Allocation Reform programme, the potentially adverse impacts highlighted above could be avoided. However, if a bioethanol industry undermined the authority of the NWA, or made water allocation reform more difficult or expensive to implement, the public benefits arising from bioethanol are likely to be eroded. Ensuring that feedstock cultivation remains proportionate with the availability of water and compliant with South Africa's water legislation may prove more difficult where bioethanol is exported and not subject to national registration.

5.2.3 Land use change and biodiversity losses

In addition to the 90 million hectares of cultivated land, South Africa also has under-utilised and unutilised land that could be brought under cultivation in order to meet growing bioethanol demand. A 2002 study established the availability of land resources for an additional 1.4 billion litres of biodiesel.[106] The Draft Biofuel Strategy estimates that three million hectares of arable land, out of a total of 15 million hectares of arable land and 84 million hectares of pasture land nationally,[107] is available in the former homelands for agricultural expansion. Bringing additional land under cultivation would affect the environment.

Soil tillage, nitrate run off and replacing traditional habitats with monocultures disrupts existing ecosystems and the biodiversity that has co-evolved with these systems. The fear is that a bullish export market will lead to injudicious cultivations that exacerbate existing land degradation, involve encroachment into unsuitable areas, expose farmers to high-risk ventures and imposes longer-term environmental risks on regional inhabitants. This risk is particularly acute in the case of sugarcane, which has already undergone a rapid recent expansion, some of it on unsuitable land[108] and where yields in Mpumalanga and on South Coast of KwaZulu Natal have begun to decline. Reducing the risk of land and biodiversity losses is the fact that

[105] E4tech, 2006.
[106] CSIR, 2002.
[107] FAOSTAT, 2004.
[108] Cartwright et al., 2007.

South Africa should be able to meet moderate (E8) targets by using existing maize and sugarcane surpluses. Were a viable export market to develop, however, it would prove very difficult to prevent expansion of the area under cultivation.

An expansion of agricultural lands should not proceed without due diligence with regards to habitat destruction, as is required by the National Environmental Management Act (107 of 1998) (NEMA) and the Convention on Biological Diversity (CBD). At the same time it should be noted that the indigenous vegetation of the former homelands, was a combination of grassland and thicket, but has long since been perturbed beyond recognition. In this sense the cultivation of ethanol crops is unlikely to cause the same extent of habitat disruption, biodiversity losses or GHG emissions, and should not be compared to, the deforestation of indigenous forests in Uganda,[109] Indonesia and to a lesser extent Brazil.[110],[111], [112]

5.2.4 Genetically modified crops

Genetically Modified (GM) crops occupy a controversial place in South Africa's public discourse. In reality less than five per cent of the maize crop is genetically modified and domestically grown sugarcane is not yet genetically modified.[113] Insect resistant genetically modified (GM) yellow maize has been introduced with some commercial success in Kwazulu Natal.

GM crops have the potential to increase the supply of bioenergy in South Africa where growing conditions are harsh and investment in agricultural infrastructure is low. On the other hand, concerns have been raised about the cross-pollination of crops and the effect of GM crops on human health, via the inevitable contamination of byproducts. In addition GM insect resistant crops produce the toxin *Bacillus thuringiensis* (bt), which could promote the development of super resistant pests and insects.

South Africa has the regulatory instruments to oversee a managed use of GM crops.[114] In May 1997, the South African Parliament passed the GMO Act. In November 1999, an Executive Council, Registrar and Advisory Committee have been appointed to oversee the implementation of the Act.

5.2.5 Air pollution

South Africa has committed to improving its air quality in the National Environmental Management: Air Quality Act (2004).

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110 When Uganda gained independence in 1962, 20 per cent of the country was forested; today the proportion is seven per cent.

110 The University of Leeds and World Land Trust recently released a high profile study showing that where deforestation takes place to cultivate biofuel crops, the net carbon balance can be negative.

111 Monbiot, 2004 http://www.monbiot.com/archives/2004/11/23/feeding-cars-not-people/

112 OECD, 2007.

113 GMO sugarbeet and sugarcane are under trial in the US. Brazil is also developing GM sugarcane varieties

114 The South African government has denied an application from a multi-million dollar project aimed at developing genetically modified sorghum. Africa Harvest Biotech Foundation International (AHBFI) is running the project, which is attempting to develop sorghum with additional iron, zinc, and vitamins.

Vehicle emissions, in conjunction with oil refineries and coal-fired power stations are the source of poor air quality in South Africa's major cities. Both Johannesburg and Cape Town suffer from brown haze for six months of the year caused by pollution and temperature inversions. In Cape Town more than half the air pollution is produced from vehicle emissions.[115] The problem is caused by a combination of ash and sulphur and nitrogen particulates (SOx, NOx). Bioethanol emits no SOx and reduced levels of carbon monoxide and hydrocarbons relative to petrol. Bioethanol combustion in engines releases less NOx than petrol combustion, but the use of nitrogen fertilisers in the cultivation of bioethanol crops negates any benefits. No official figures exist for South Africa but in the USA diesel ash causes 21,000 additional deaths per year via chronic respiratory illnesses.[116]

Collectively, biofuels could have a small but positive impact on South Africa's urban and peri-urban air quality. This impact would be lost where biofuels were not used for domestic consumption but for exports.

5.3 Social

The introduction of a biofuel industry is likely to benefit some people and disadvantage others. South Africa is a country defined by socio-economic disparity,[117] and it is important that the disadvantages and risks created by a biofuel industry do not further undermining food security, employment creation and environmental integrity, thereby exacerbating the problem. Ideally the poor would share in the direct benefits generated by biofuels, including revenue, employment and safer living conditions.

5.3.1 Food availability, price and access

Much concern has been raised over the impact of biofuels on food supplies, and particularly the availability of food for the poor. It is this concern that has seen the prohibition of maize as a feedstock in South Africa's biofuel strategy.

No less than the Governor of the South African Reserve Bank recently urged bioethanol efforts to focus on sugarcane and not maize as a feedstock in order to avoid staple food price inflation.[118] An OECD report in July 2007 claimed that the growing use of "cereals, sugar, oil seed and vegetable oils to produce the fossil fuel substitutes, ethanol and biodiesel, is underpinning crop prices and, indirectly through higher animal feed costs, also the prices for

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115 Haskins, personal communication. Craig Haskins is the former City of Cape Town official in charge of air pollution and climate change.

116 American Lung Association, 2007; http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=22542

117 South Africa has a Gini-coefficient of 0.59, as estimate by the United Nations. Other estimates range between 0.77 and 0.54.

118 Tito Mboweni, 5 August 2005: "That is something that we should be concerned about … the production of ethanol from maize. If I may just counsel against that. This is not going to help us." The Governor, who is mandated to focus on inflation, reflected popular opinion but failed to acknowledge the dynamics underlying South African food security or the nature of the South African bioethanol market.

livestock products".[119] Similarly a United Nations report stated, "Of particular concern is the potential impact on the poor through price increases in basic foodstuffs such as maize, sugar, palm oil and soy beans".[120]

In its crudest form this issue is structured as a trade-off between the worlds 800 million motorist (or South Africa's 8 million motorists) and the 815 million people estimated by the FAO (2005) to be food insecure.[121] The debate is understandably emotive, but frequently misrepresents the dynamics between access to food and the production of fuel. That the emergence of a global biofuels industry will make demands on the crop production sector seems obvious, but the issue of food security is too often confused with the concept "food production" – the physical yield of crops that is apportioned to the food market, and "food self-sufficiency" - the isolationist policy of supplying all the food consumed by a population, which when pursued undermines the welfare gains possible from comparative advantage based trade.

It is however "food security", the physical and economic access to sufficient, safe and nutritious food (as determined by food production, patterns of food trade and distribution as well as the ability to access food) that is relevant in any assessment of the impact of bioethanol on food. More precisely it is the impact of a South African bioethanol industry on the food security of the 14 million most-poor South Africans that should be assessed. The impact of increased demand for biofuels on food security is complex and difficult to predict. There is the potential for biofuel feedstocks to reduce the volume of crops that enters the food market, especially in the short term. At the same time increased demand for food and biofuel crops could trigger investment in agricultural infrastructure and production - supply responses that could increase the production of food even more rapidly than has been the case in the past 50 years, during which South African food supply has grown four-fold.[122]

More importantly, South Africa is increasingly well integrated into the regional and global food market. Where food shortages arise South Africa is able to draw on a wide range of potential food exporters in order to meet the deficit and ensure food security. As such food security impacts created by bioethanol and heightened competition for land and water resources, are more likely to manifest in food price inflation than in absolute food shortages.

In South Africa recent food price increases have been cited as a portent of what is to come if South Africa pursues bioethanol production.[123] Food price inflation was 9.5 per cent through the third quarter of 2007 - higher than broader consumer inflation. More specifically for the year ending December 2006 maize prices increased by 28 per cent and the sugar price rose by 12.6 per cent. Sugar price increases were indeed the result of Brazil having withdrawn sugar to support its bioethanol, but this was a temporary phenomenon. When supply responses

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119 http://www.busrep.co.za/index.php?fArticleId=3919355&fSectionId=552&fSetId=662

120 http://aspo.org.za/index.php?option=com_content&task=view&id=58&Itemid=34
UN Press Release, 7 May 2007. http://www.un.org/apps/news/story.asp?NewsID=22480&Cr=energy&Cr1=

121 Browne, 2006.

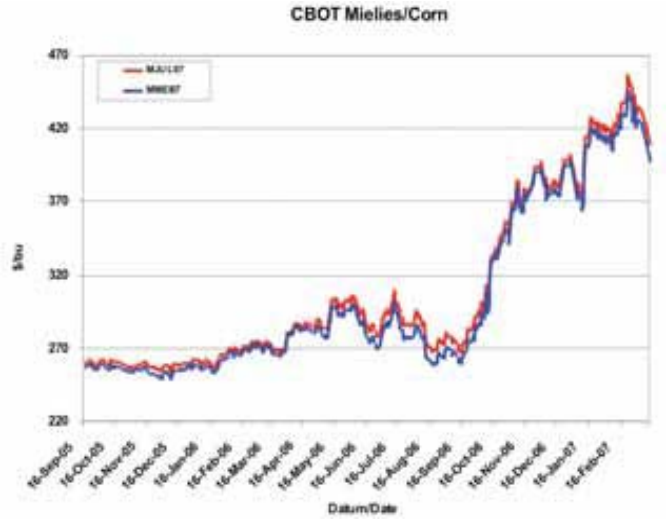
122 Vink and Kirsten, 2002.

123 Sugrue and Douthwaite, 2007.

were triggered in 2006/7 the sugar price inflation settled to 3.8 per cent.[124] The maize price increase was due to a low domestic harvest and to higher global commodity prices.

These increases should not be linked to the influence of South Africa's bioethanol sector, which barely exists. On the contrary, a major driver of recent food price inflation in South Africa has almost certainly been higher oil prices, and the embedded energy in food products.[125] In addition, global prices for a range of commodities are in an inflationary phase of their cycle as demand, most notably from China, increases. Maize prices have increased particularly quickly as they respond, from a very low base in 2005, to increasing consumption of meat and demand for animal feed.[126]

Table 9: Maize prices in South Africa 2005 to 2007



Source: Sugrue and Douthwaite (2007)

A number of factors combine to suggest that the risk to food insecurity arising from bioethanol production may not be as pertinent as some forecasts:

- South Africa's biofuel target of two per cent of vehicle fuels by 2013 can be produced with existing sugarcane surpluses. Indeed the Draft Biofuels Strategy estimated that South Africa could produce up to E8 with its maize and sugarcane surpluses, implying that initial international demand for South African bioethanol could be satisfied without any impact on domestic food security.

124 National Agricultural Marketing Board, 2007.
125 FAO, 2007; RFA, 2007.
126 OECD/FAO, 2007; RFA, 2007. In the USA the Food Commodities Index, which tracks a dozen agricultural raw materials used by food companies including wheat, barley, milk, cocoa and edible oils, show cost inflation of 21 per cent in 2006 - the biggest increase since the index started almost a decade ago. The UK's consumer price index showed annual food price inflation of 6 per cent in April 2007 - its highest level in almost six years, and well ahead of overall inflation of 2.8 per cent.

- The co-product of bioethanol produced from maize (dried distillers grain from soluble) (DDGS) and molasses from sugarcane can be used as animal feed. Bagasse from sugarcane provides a source of co-generated energy. Additional supply of bioethanol co-products could deflate the cost of animal protein production in South Africa and reduce demand for energy.
- Unlike Europe or the USA, South Africa has unutilised and under-utilised land that, provided rainfall is adequate or water can be legally provided, could be brought under cultivation to increase supply. Bioethanol triggered investment, could go some way to overcoming the structural constraints that impede small-scale black agriculture, and food supply in the former homelands. Where this has been successfully achieved (such as in the wool and sugarcane sector) significant supply-side capacity has been unlocked. As Jeremy Wakeford of the University of Cape Town's School of Economics points out, "The best way to help people and secure food supplies is to teach more productive farming techniques and ensure they become more than mere subsistence farmers by being part of the biofuels boom."
- The efficiency gains likely to follow from a more intensive agricultural sector are expected to have a deflationary effect on the supply of agricultural goods and food in general.
- The removal of butane from petrol in order to facilitate blending can be used in the LPG sector and would become cheaper in the light of supply from the bioethanol sector. Use of LPG is higher among poor rural households than it is in urban affluent households that tend to be connected to the grid.
- Imported petrol is one of the key drivers of food price inflation. Substituting this import with locally produced bioethanol will remove this inflationary pressure.
- Concentration of market power and anti-competitive behaviour have been a source of food price inflation in the past but has recently been the focus of South Africa's increasingly vigilant Competition Commission. There is some evidence that food market competition is increasing, as is access to the food market.[127] One indicator of this trend is the erosion of South Africa's long-standing rural-urban bias in food prices. The price of a loaf of bread in rural areas is currently US$ 0.025 above that in urban areas, but this disparity has been decreasing steadily over the past four years. Interestingly it is market concentration that has driven Mexico's tortilla price up by 400%, and not demand for biofuels, as is so frequently suggested in the popular media.[128]

As such the trade-off between the all important concept of food security and bioethanol production need not be as direct in South Africa as critics such as Brown imply. This should not detract from the fact that a domestic bioethanol industry could undermine the ability of some of South Africa's poorest people to access sufficient food at affordable prices. This risk could become acute during the periodic agricultural droughts that inflict the country, when low production in conjunction with demands from bioethanol processors might push prices up. South Africa's poorest population cohorts spend 62 per cent of their income on food (51

[127] Vink and Kirsten, 2002.
[128] http://www.crikey.com.au/Politics/20070131-Biofuels-demand-sparks-Mexicos

per cent if they live in cities and towns) and maize price increases have a dramatic impact on their welfare. The problem could be more acute in those SADC countries that rely on the export of South African food surpluses to maintain their own food security.

The key to avoiding these adverse localised food security impacts within South Africa is to ensure increased agricultural productivity, and to marshal the opportunities and revenue streams that are generated by an emerging bioethanol sector in favour of the poor.

5.3.2 Poverty, welfare and small farmers

By deploying its regulatory influence over land, water, trade and financial support the Government in South Africa has the ability to influence the location and the extent of bioethanol crop production, and to ensure that some of the employment and revenue streams that are generated accrue to people that would otherwise be adversely affected by the growth of the sector. South Africa's land redistribution and restitution programme aims to transfer 30 per cent of arable land to black people by 2012. To date the transfer has been too slow, but a further feature of the programme has been the inability of those households that have acquired to access agricultural commodity markets. The emergence of a new, highly regulated, market for biofuels provides the opportunity to extend market opportunities to land reform beneficiaries and other emerging black farmers, particularly as it seems that bioethanol processors will rely on contracted growers, and not the market, to procure their feedstock. Contract farming arrangements, as used by the sugar industry, permit the transfer of capital, extension services markets to small-scale rural growers, and provide a good basis for rural development efforts. Relative to the option of allowing existing commercial farmers to monopolise the biofuel industry, such an approach will require additional effort especially for the Department of Agriculture and Land Affairs. The required effort can be justified by the political priority of establishing a stable and profitable black commercial farming class.

As a minimum, the securing of tenure rights for poor rural households should accompany any expansion of the bioethanol industry in order to ensure that rising land prices benefits, and does not further marginalize the poor.[129]

5.3.3 Health and safety

Bioethanol is less flammable than paraffin and petrol and can be used in a gel form as an illuminating and cooking fuel. Bioethanol gel does not offer the same emissions reduction benefits as liquid bioethanol, but does remove the danger created by the use of illuminating paraffin for lighting and cooking in South Africa's rural and informal peri-urban settlement. Liquid paraffin is a major cause of human burns and of shack fires in South Africa. Although official figures on shack fires in South Africa are not available (it is not a distinct cause of death in the records), every year "many thousands" of people are harmed by paraffin and paraffin burns, most of them children.[130] The Paraffin Association of South Africa estimated

[129] Dasgupta, 1992; Chichilnisky, 1994.
[130] SAPAFA, 2007.

that in 2006 in the Cape Town Unicity alone, shack fires cost the local government ZAR 13 million (US$ 1.79 million).

Bioethanol gel would also provide benefits, relative to paraffin, in terms of indoor air quality. Indoor air pollution is closely related to respiratory illness in women and children and a causal factor in the poverty of South Africa's poorest households.

There is a danger that bioethanol will find its way into the potable alcohol, where it would have intensely adverse health implications for those that consumed it. To avoid this happening it has been proposed that bioethanol producers be registered and that bioethanol be denatured on site and stored with a bittering agent. This measure would not, however, be easily enforceable where fuel was being sold into the into the export market, and outside of domestic regulatory reach.

6 A SADC-wide approach to trade?

This study shows that unless prices or international trade rules are altered South Africa has very little incentive to sell its bioethanol to its traditional export markets in Europe and the USA.

As an alternative, it has been suggested that South Africa might benefit from a SADC focus for its bioethanol.[131] South Africa is committed to increasing regional trade within the Southern African Customs Union (SACU). Within SACU maize trade is essentially duty free, while increasing quotas of duty free sugar trade aim to render sugar trade duty free by 2012. No SADC country currently imposes any border duty on the importation of bioethanol and South Africa already exports petrol and industrial ethanol to a number of SADC countries.

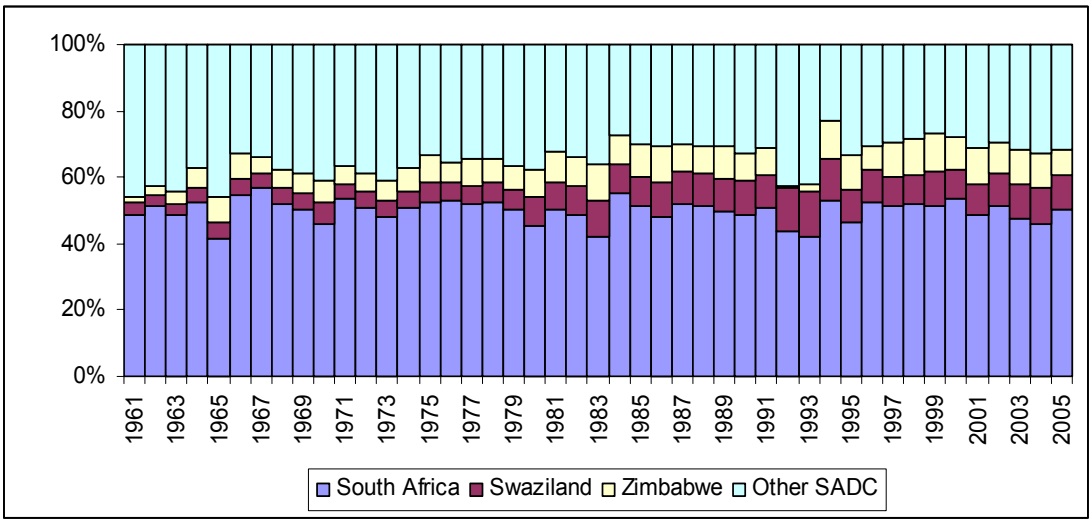
The rationale for such exports, however, confronts many of the same counter-arguments that have been presented for international exports. Such trade would run the risk of undermining the regulatory influence and control that South Africa could exert on a local market by requiring producers to register for a fuel tax rebate. Bioethanol exports could lead to an injudicious expansion of the industry with commensurate implications for food price inflation, prudent water governance and biodiversity losses. Exporting bioethanol to SADC countries would involve the loss of the positive externalities associated with burning bioethanol as opposed to mineral fuel.

A more prudent approach may see South African companies investing in SADC countries in order to produce bioethanol. Bioethanol from other SADC countries might be imported to South Africa which consumes 80 per cent of SADC's petrol, and could also be exported. This approach, which appears to be receiving speculative investment from South African companies, would be consistent with South Africa's policy aim to lead to an economic integration of SADC countries.

On the positive side, some SADC countries have both "ACP" and "least developed" status (see Appendix E) and qualify for preferential access to the EU and US markets. This access could sway the viability of bioethanol production. The opportunity cost of land and water in SADC countries is considerably less than it is in South Africa, particularly in those countries that straddle the inter-tropical convergence zone where precipitation is high.[132] Labour too, is generally cheaper in South Africa's regional neighbours. South Africa's three sugar processing companies already have investments, based on these favourable attributes and the associated comparative advantage, north of South Africa and could extend these to develop a bioethanol sector. A concerted effort by South African companies, motivated by the incentive of biofuel export revenues, to invest in agricultural production in these countries could overcome existing infrastructure and technology constraints and create local employment and enhance the productive capacity of the agricultural sector in general.

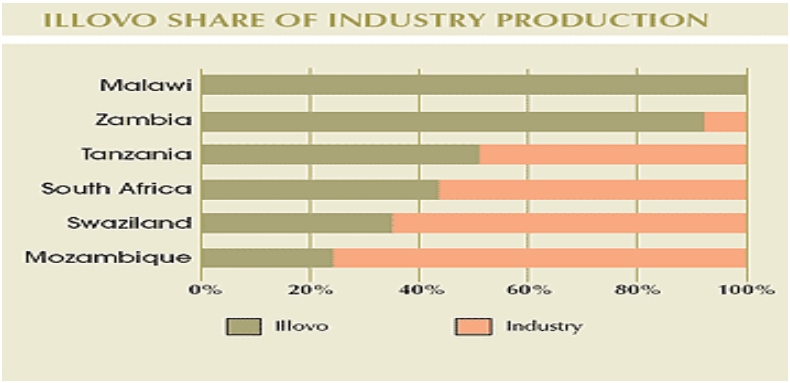
[131] Johnson, 2007; E4Tech, 2006.
[132] Turton, 2002; Lorentzen et al., 2007.

Figure 10: Relative shares of SADC sugar production.



Source: FAOSTAT.

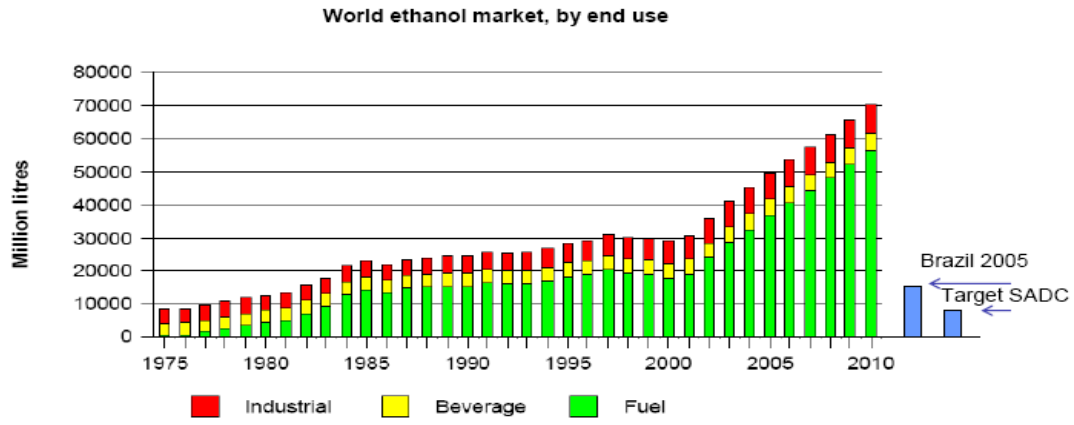
Figure 11: Illovo's share of industrial production in SADC countries.



Source: www.illovo.co.za

Even without investment in processing capacity, South African companies operating within SADC may benefit from exporting sucrose to European sugar retailers and bioethanol processors (although the process of converting refined sucrose to bioethanol is relatively costly). Over the next few years African, Caribbean and Pacific "ACP" and "Least Developed Country" SADC members will be granted phased-in tariff-free access to the EU markets under the Everything-but-Arms (EBA) Initiative. This process is expected to be completed before full SADC liberalisation kicks in by 2013. Because of the scheduled reduction in the EU sugar market intervention price, SADC sugar producers from places like Zambia, Mozambique, Swaziland, and perhaps even Zimbabwe are likely to replace the less competitive Caribbean producers in their sugar exports to the EU.

Figure 12: World ethanol market by end user



Source: FO Lichts

For maize based ethanol, the great disparities in production costs across SADC countries (see Figure 16) creates the potential for welfare enhancing intra-SADC trade.

Such a SADC-wide approach is not without its risks. Most SADC countries experience periodic food insecurity and are dependent on South Africa for food exports in times of shortfall (see Figure 14). In most SADC countries, the challenge of managing the food-fuel balance is greater than in South Africa and the legislative capacity is less. In these countries, even more than in South Africa, there is a risk that a burgeoning bioethanol industry will accentuate food shortages, particularly in times of drought. In 2006 an estimated 12 million people in the SADC countries experienced life-threatening food shortages, necessitating a net maize import to the region of 2.8 million tons.[133]

The often-cited notion that food security risks are specific to the use of staple crops, such as maize, in feedstocks is not always true. A booming sugarcane based bioethanol industry would attract investment and resources away from maize, for example, and impact on production across a range of alternative agricultural products including maize.

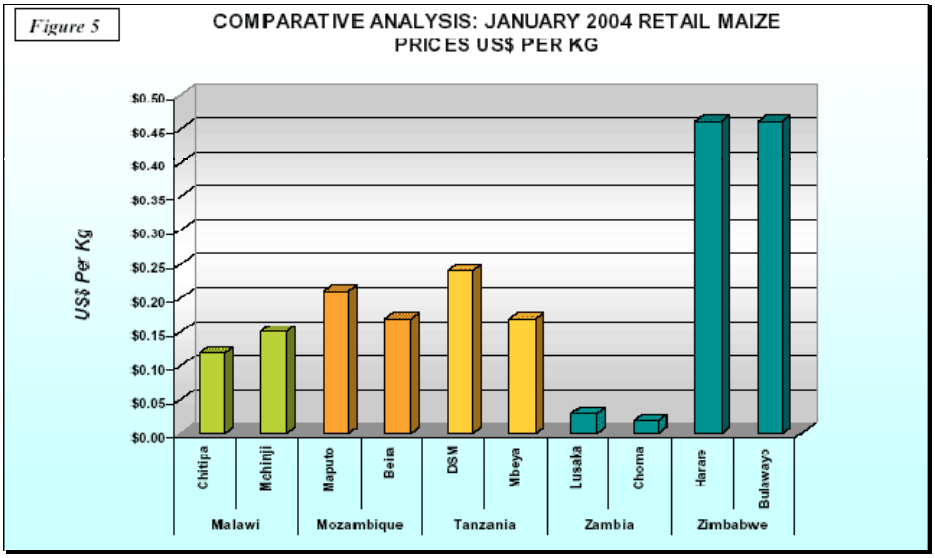
It would also be more difficult to monitor environmental impacts in many of these countries than in South Africa.

Ideally SADC countries would not compete on their laxness of the legislation they impose on agribusiness, and the commitment to develop bioethanol in the least developed SADC countries would be preceded by the type of research and institution building that would enable the sustainable development of this sector. In the past, however, it has not been uncommon for agribusiness corporations to undermine weak governments and the development of robust

[133] NDA, 2007 http://www.fao.org/giews/workstation/page.jspx

policy in SADC countries so as exploit natural resources and maximise their share of the export opportunities.

Figure 13: Different retail process for southern African maize



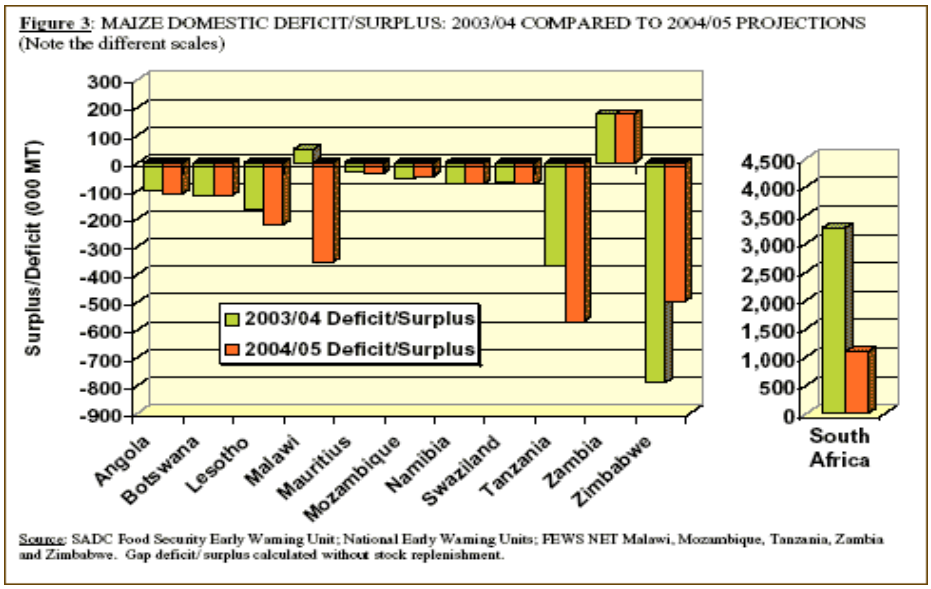
Source: FEWS NET Malawi, Mozambique, Tanzania, Zambia and Zimbabwe

A further danger of a SADC-wide approach to bioethanol trade is that unsophisticated SADC economies would become overly reliant on bioethanol production, at the expense of a diverse set of secondary and tertiary economic activities. Were farmers in a small developing country such as Swaziland, in which innovation is typically slow, to become dependent on the production of sugarcane feedstock for bioethanol exports, they would find themselves in a precarious position if the market suddenly switched to second generation cellulosic bioethanol, or if OPEC kept oil prices artificially low so as to undermine the development of the biofuel industry.[134]

A number of SADC, and other countries, appear to have taken cognisance of the potential and risks associated with a SADC-wide ethanol industry. The Brazil: UK: Southern Africa Bioethanol Partnership was originally intended as a trilateral partnership with South Africa, was expanded due to South Africa's limited potential relative to the obvious potential of the region. The partnership aims to conduct due diligence and transfer Brazil's experience as the global bioethanol leader to SADC countries. The partnership supports the diversion of sugarcane to bioethanol, the increase in sugarcane yields and the expansion of sugarcane cultivations as a means of establishing the regional industry.[135]

[134] Mathews, 2007.
[135] Study undertaken on behalf of OST by E4tech (UK) Ltd. (2006)

Figure 14: Food surpluses for southern African countries 2003 to 2005



7 A sustainable way forward: conclusions and recommendations

7.1 Conclusions

The study set out to explore the potential for bioethanol trade from South to contribute to sustainable development. Contrary to inference drawn by a number of authors, South Africa does not export bioethanol for fuel. The ethanol that is often included in bioethanol trade analyses is, in fact, a by-product of South Africa's oil from coal initiative and from the sugar industry. Neither type of ethanol is used as a transport fuel.

During December 2007 the South African Cabinet scaled back the country's bioethanol ambition and proposed a mandatory blending target of ten per cent vehicle fuel by 2013 – a move that has yet to manifest in industry reaction. The anticipated benefits of a South African bioethanol industry include rural employment (although not on the scale projected by the Biofuels Task Team), current account benefits and economic growth, but sceptics have drawn attention to the food insecurity threat and potential loss of natural environments that could be created by a burgeoning South African biofuel industry.

Given the small scale of South Africa's emerging bioethanol industry relative to global demand, and the unregulated nature of bioethanol transactions, it is likely that the bulk of bioethanol produced in South Africa will end up in the market that provides the greatest returns to manufacturers and retailers. Whether or not this is an export market will depend on relative prices, trade regulations, import barriers and transport costs as well as quality considerations. Emerging South African bioethanol policy proposes to pay local manufacturers US$ 0.60 per litre for their bioethanol. Once transport costs and import tariffs have been paid it is unlikely that any of United States, Europe, Canada or Australia will be able to offer a more attractive price than this. In Brazil, India, Thailand and Indonesia where import tariffs are not prohibitively high, the cost of local production is significantly lower than that in South Africa. There is some potential, however, for export markets to absorb that bioethanol that exceeds the relatively small quota that is mandated for local consumption.

In order for bioethanol trade from South Africa to become attractive to local producers, trade legislation applying to bioethanol would have to be relaxed or South Africa would have to remove or lower its supportive statutory price and the cost of production in South Africa would have to decrease. Alternatively South Africa should seek to invest in the productive capacity of other SADC countries, many of which have preferential access to the EU and US markets and enjoy lower opportunity costs of labour, land and water. Where such investment unlocked the productive capacity of SADC countries, it could off-set potential conflicts between food and biofuel production.

The overarching conclusion of this study is that the development of a bioethanol industry in South Africa could make a positive, but circumscribed and fairly limited, contribution to South Africa's development. This conclusion is based on the prediction that the benefits of having bioethanol (including insulation against oil price volatility, an improved current

account balance, climate change mitigation and investment and employment in rural communities) are likely to become more important and valuable in the future, especially relative to the alternative of increased fossil fuel combustion.

South Africa has the institutional and legislative architecture to ensure that small-scale farmers benefit from feedstock production, that biodiversity is protected, that water profligacy is avoided, that quality control is upheld and that GMO crops are used safely. The head of South Africa's Biofuel Association, Andrew Makenete articulates an example of how this could work when he says, "If it is a key criterion of a licence that biofuel producers must source feedstock from emerging farmers, then the biofuel industry can immediately create a market for the rural poor".[136] Deploying this architecture may prove more difficult where the industry adopts an export focus, especially where importing countries place little emphasis on supporting South Africa's domestic priorities. Private transactions between South African bioethanol manufacturers and international bioethanol brokers would make it difficult to manage the scale and the nature of the industry - most critical in this regard is the water consumed by sugarcane feedstocks. In addition it would leave South Africa fully exposed to the vagaries of liquid fuel imports and would export any positive environmental and health benefits arising for the use of bioethanol as opposed to petrol.

7.2 Recommendations

Based on the findings of this study the ability of bioethanol trade to contribute to sustainable development in South Africa could be greatly enhanced by adhering to the following steps:

- Ensuring that land and water tenure for poor and marginalised people is secure prior to bringing land under bioethanol crop production. In this way the chance of these people being incorporated in the emerging industry is enhanced. Similarly, in this way, any appreciation of land and water values arising from bioethanol related demand, will benefit poor and marginalised people as opposed to further disenfranchising them.
- Prior to proceeding with crop production in a particular basin, the "human" and "ecological" water reserve should be secured as is required by the National Water Act (1998).
- Identifying the potential for agricultural intensification and identifying suitable (low ecological impact) land for expanded production is a necessary prerequisite for government support to the sector. It is not possible for Government to stipulate where private sector biofuel initiatives establish themselves, but effective public sector support (including infrastructure) for growers in suitable rural areas would incentivise private sector refining capacity in these areas and limit ecological impacts.
- Ensuring that bioethanol producing companies comply with broad based black economic empowerment and Basic Conditions of Employment Act legislation prior to issuing them with supply contracts, fuel levy rebates, or preferential access to international markets is

[136] http://www.mg.co.za/articlePage.aspx?articleid=303720&area=/breaking_news/breaking_news__business/

not only a policy requirement, but would permit the industry to fulfil its socio-economic potential.

- South Africa possesses sophisticated water, biodiversity, agricultural and social legislation. Significant challenges remain for South Africa in terms of policy implementation, but the ability to meet these challenges will determine the extent to which bioethanol production and trade contributes to sustainable development.
- Exploring the potential for production of bioethanol in other SADC countries in concert with developing the South African industry could yield great benefits for South Africa. Such an approach would allow South Africa to divert its land and water from agriculture into sectors and activities that are currently water restricted but capable of generating more employment and revenue than agriculture. In pursuing a regional rationalisation of Southern Africa's biofuel industry in this manner, South Africa should be cautious not to export environmental degradation or food insecurity to these countries.[137]
- It is important that bioethanol remains part (and not the whole) of a comprehensive South African renewable energy effort. It would, for example, be disproportionate for bioethanol to contribute the 30 per cent of South Africa's renewable energy target, as is implied by the Draft Renewable Energy Strategy.
- Current oil prices in excess of US$ 90 per bbl enhance the viability of bioethanol production and trade, but a hedging facility in which producers pay into a stabilising fund when the oil price is above a certain level and draw from this fund when the oil price is low would contribute to stable and sustainable production and trade.
- Maintaining an active biofuel research component is important. Using sugar and maize in the initial stages of bioethanol production should not prohibit exploration of new crops such as jatropha, sunchoke (injulin sugar), jojoba, diatomic algae and oil palm as well as new technologies. The so called "second-generation" biofuel production technologies, such as syngas production from the gasification of biomass (the "biomass-to-liquid" process), and cellulosic bioethanol[138] are not yet financially proven but may well become established in the near future. The South African industry should be capable of moving with technological progress as it takes place. This should include transitions to hydrogen and fusion technologies.
- South Africa should, in the early stages, pursue the potential for "emissions reduction" revenue arising in tandem with bioethanol trade. It is not possible to claim emissions reduction revenue once an industry is established as the reductions are a part of the "business as usual" baseline.

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[137] This regional approach is supported by "Farming for Energy for Better Livelihoods in South Africa" (FELISA), which is described as both a "concept and a project". It encourages the cultivation of all energy crops but has an initial focus on biodiesel and specifically palm oil which it claims has a comparative advantage in the tropics. (Dar-es-Salaam, June 2005, De Keyser and Hongo).

[138] Cellulosic bioethanol enables the production of ethanol from starchy or woody plant matter. GHG savings for cellulosic bioethanol are slightly greater than for regular bioethanol and feedstock costs would be significantly lower. Currently the high costs of cellulose enzymes are an inhibiting factor in the production of cellulosic bioethanol but these costs are likely to fall as the technology develops.

8 Reference List

Bakker, S (2006) CDM and Biofuels; can the CDM assist biofuel production and deployment. ECN Netherlands (October).

Biofuelwatch (2007) Agrofuels: towards a reality check in nine key areas (June 2007). www.biofulewatch.org.uk

Brown, L.R (2006) Starving the People to Feed the Cars. Washington Post 10 September, 2006.

Bureau for Food and Agricultural Policy (BFAP) (South Africa) (2006). Based at, Department of Agricultural Economics, University of Pretoria.

Cartwright, A; Von der Heyden, C and Perkins, R (2007) Sugarcane cultivation on ecologically sensitive sites in Southern Africa: profitability and conservation issues. The Sugar Journal, International Society of Sugarcane Technologists.

Cartwright, A (2007b) A Water Scarcity Risk Typology. Working Paper for the World Wildlife Fund's Freshwater Team (Godalming, United Kingdom).

Chichilnisky, G (1994) North-South Trade and the Global Environment, American Economic Review, 84, pp. 851-853.

Coelho, S.T. (2005) Biofuels – advantages and Meeting on the Developing Countries'

COMTRADE – United Nations Commodity available at http://comtrade.un.org

Cosbey, A & Tarasofsky, R (2007) Climate Change Competitiveness and Trade. A Chattam House Report (June).

Crafford, J; King, N, Malubani, T, Anderson, H & De Wit, M. (2001) Water resource Accounts for South Africa 1991-1998. CSIR, Environmentek, Pretoria.

Crafford, J; Hassan, R; King, N; Damon, M; De Wit, M; Bekker, S; Rapholo, B and Olbrich, B. (2004) An Analysis of the Social, Economic, and Environmental Direct and Indirect Costs and Benefits of Water Use in Irrigated Agriculture and Forestry: a case study of the Crocodile River Catchment, Mpumalanga Province. WRC Report No. 1048/1/04.

Crafford, J; King, N, Malubani, T, Anderson, H & De Wit, M. (2001) Water resource Accounts for South Africa 1991-1998. CSIR, Environmentek, Pretoria.

Dasgupta, P (1992) The Control of Natural resources. Harvard University Press, Cambridge.

Dufey, A (2006) Biofuels production, trade and sustainable development: emerging issues, International Institute for Environment and Development, London.

Dufey, A (2007) International Trade in Biofuels. IIED Briefing Paper (February).

E4Tech (2006) 'Brazil: UK: Africa Partnership on Bioethanol', scoping study E4tech (UK) Ltd. United Kingdom: OST

Earth Policy Institute (2006). World Biofuels Production - 2006. Available at www.earth-policy.org

Enrsting, A and Boswell, A (2007) Agrofuels: towards a reality check in nine key areas. Biofuel watch (June) www.biofuelwatch.org.uk

Farolfi, S and S Perret (2002) Intersectoral Competition for Water in Rural South Africa: analysing a case study through standard environmental economics approach. Paper presented at the XXX1X Convegno SIDEA – Firenze (12-14 September, 2002).

F.O. Licht (2006) World Ethanol & Biofuels Report.

Food and Agricultural Organisation (FAO) (2006) The state of food insecurity in the world: Eradicating Hunger - taking stock ten years after the World Food Summit. Rome: FAO.

Food and Agricultural Organization of the United Nations (FAO) (2006). Food Outlook – Global Market Analysis 2006; 1.

Food and Agricultural Organization of the United Nations (FAO) (2007). FAOSTAT. http://faostat.org

Fulton, L. Recent biofuels assessments and two new scenarios. Paper presented at the IEA Seminar Assessing the Biofuels Option. Paris; 2004.

Goldemberg, J. (2002) The Brazilian energy initiative-support report. Paper Presented at the Johannesburg 2002 World Summit for Sustainable Development.

Greene, N (2004) Growing Energy; how can biofuels help end America's oil dependence. NRDC Report (December).

Health Effects Institute 2000 Health Effects Institute, Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Morbidity, Health Effects Institute, July 2000.

Hoekman, B, Ng, F, Olarreaga, M. Eliminating Excessive Tariffs on Exports of Least Developed Countries. Policy Research Working Paper 2604. The World Bank: Washington; 2001.

Johnson, F (2007) Bioenergy and Sustainability Transition; from local resources to global commodity. DRAFT for WEC 2007. Stockholm Environment Institute – Climate and Energy Programme (September).

Johnson, F & Rosillo-Calle, F (2007) Biomass, Livelihoods and International Trade. Challenges and Opportunities for the EU and Southern Africa. SEI- Climate and Energy Report (April).

Kojima, M, Mitchell, D & Ward, W (2007) Considering Trade Policies for Liquid Biofuels. Energy Sector Management Assistance Programme. The World Bank Group. Washington.

Koplow, D (2006) 'Biofuels: At What Cost? Government Support for Ethanol and Biodiesel in the United States', report prepared by Earth Track Inc. Geneva, Switzerland: The Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD).

Lorentzen, J, Cartwright, A and Meth, C (2007) The Impact of Trade Liberalisation on Rural Livelihoods and the Environment Land Governance, Asset Control, and Water Access and Use in the Incomati River Basin in Mpumalanga, South Africa: A Case Study of Sugarcane Production Past, Present, and Future, A WWF/ World Bank Study.

Macedo et al (2004) Assessment of Greenhouse gas Emissions in the Production and Use of Fuel Ethanol in Brazil, NIPE/INCAMP.

Martines-Filho, J., Burnquist, H.L., Vian, C (2006) Bioenergy and the Rise of Sugarcane Based Ethanol in Brazil. Choices - a publication of the American Agricultural Economics Association 21(2).

Martinot E. (2006) Biofuels Global Market and Policy Overview. World Biofuels Symposium – China 2006. Beijing.

Mathews, J (2007) Biofuels: what a biopact between the north and south could achieve. Energy Policy, 35 (7), pp. 3550-3570.

McCord, A. (2004) Policy Expectations and Programme Reality: The Poverty Reduction and Labour Market Impact of Two Public Works Programmes in South Africa", Working Paper No. 8, Overseas Development Institute (ODI), London.

Mpumalanga Director General (MDG) (1997). Nkomazi Irrigation Expansion Programme: Environmental Audit. Director General's Office (June 1997).

McNeely, J (2006) Biofuels Green Energy of Grim Reaper. Cited Biofuels: what a biopact between the north and south could achieve. Energy Policy, 35 (7), pp. 3550-3570, in Mathews, J (2007).

Meth, C (2004) What has happened to poverty in South Africa as unemployment has increased?" (Version 5), Draft manuscript, School of Development Studies, University of KwaZulu-Natal. September 2004.

Monbiot, G (2004) http://www.monbiot.com/archives/2004/11/23/feeding-cars-not-people/

Monetary Policy Council of South Africa (MPC) (2007) Statement at the announcement of an increase in lending rates. June 2007.

National Biofuel Task Team (BTT) (2006) An Investigation into the Feasibility of Establishing a Biofuels Industry in the Republic of South Africa. Final Report (October). Biofuels Task Team (BTT) (2006).

National Water Resources Strategy of South Africa (NWRS) (2004). Department of Water Affairs and Forestry (Pretoria).

Noble, M; Bita, M; Barnes, H; Dibben, C; Magasela, W; Noble, S; Ntshongwana, P; Phillips, H; Rama, S; Roberts, B; Wright, G and Sibogile Zungu (2001) *The Provincial Indices of Multiple Deprivation for South Africa 2001*.

Organisation for Economic Co-operation and Development (OECD) (2006) 'Agricultural Market Impacts of Future Growth in the Production of Biofuels, Directorate for Food, Agriculture And Fisheries', Committee for Agriculture, Working Party on Agricultural Policies and Markets. Paris: Organisation of Economic Commerce and Development.

Organisation for Economic Co-operation and Development (OECD) (2007) Agricultural Outlook 2007-2016. A Joint OECD-FAO Report. Available at www.oecd.org/dataoecd/6/10/38893266.pdf

Otto, A (2004) Renewable Energy Cogeneration Opportunities in Southern Africa. Workshop on Co-generation and Bio-ethanol for Southern Africa. Durban, 21-23 June.

Paraffin Safety Association of Southern Africa (PASASA) (2007) www.paraffinsafety.org

Pereira de Carvalho, E. 2004. "Brazilian Sugar and Ethanol Market, 2004." UNICA Presentation, Sugar Dinner, March, New York.

Peskett, L, Slater, R, Stevens, C and Dufey, A (2007) Biofuels Agriculture and Poverty Reduction. DfID Working Paper (March).

Pimental, D. & Patzek, T.W. (2005) 'Ethanol production using corn, switchgrass, and wood; biodiesel production using soybean and sunflower' Natural Resources Research 14 (1): 65-76.

Renewable Fuels Association (RFAa) Building New Horizons. Ethanol Industry Outlook, 2007. http://www.ethanolrfa.org/objects/pdf/outlook/RFA_Outlook_2007.pdf

Renewable Fuels Association (RFAb) (2007) http://www.ethanolrfa.org/resource/facts/food/

Righelato, R & Spracklen, D. (2007) Carbon Mitigation by Biofuels, or by Saving and Restoring Forests. Science 317 (5840). pp. 902.

Sachs, J. D. & Warner, A. M. (1995) Natural Resource Abundance and Economic Growth. NBER Working Paper (W5398). Cambridge, MA: National Bureau of Economic Research, December.

Sachs, Jeffrey D. & Andrew M. Warner, 1995. Natural Resource Abundance and Economic Growth. NBER Working Paper (W5398). Cambridge, MA: National Bureau of Economic Research, December.

South African Sugar Association (SASA) (2007) available at www.sasa.org.za

Southern African Millennium Assessment (SAfMA) (2005) Nature Supporting People: the South African Millennium Ecosystem Assessment (Summary for Decision Makers). http://www.millenniumassessment.org/en/subglobal.safma.aspx

Sugrue, A & Douthwaite, R (2007) Biofuel production and the Threat to South Africa's Food Security. Wahenga Brief, April (11).

Statistics South Africa (2003). *Census 2001,* Pretoria: Statistics South Africa.

Steenblik, R (2007) Biofules - at what cost? Governmenmt Support for Ethanol and Biodiesel in Selected OECD Countries. Global Subsidies Initiative (September).

Steven, P (2004) "Aid like this is fatal" The Times, London, 27 September 2004.

Turton, A (2002) Water Demand Management for Southern Africa. Analytical Paper.

Turton, A, S Moodley and R Meissner (2002) An Analysis of The Role of Virtual Water in Southern Africa in Meeting Water Scarcity: an applied research and capacity building project. Report for the Group for Environmental Monitoring.

UNCTAD (2006) Challenges and opportunities for developing countries in producing biofuels. United Nations Conference on Trade and Development. UNCTAD/DITC/COM/2006/15.

Vink, N & Kirsten, J (2002) Pricing Behaviour in the South African Food and Agricultural Sector. A report Commissioned by the National Treasury.

Walter, A; Rosillo-Calle, F; Dolzan, P; Piacente, E; Borges da Cunha, K (2007) Sustainable Bio-energy Trade, Securing Supply and Demand. Market evaluation, fuel ethanol. IEA BioEnergy Report, deliverable 8 (January).

Woods, J (2004) Sugarcane Resources for Energy Production in Southern Africa. Workshop on Co-generation and Bio-ethanol for Southern Africa. Durban, 21-23 June.

World Bank (2005) The Vulnerability of African Countries to Oil Price Shocks: The Case of Oil Importing Countries" World Bank Energy Sector Management Assistance Programme, Report 309, August 2005.

Appendix A: South Africa's maize and sugarcane sectors

Maize production

Maize is the country's most important field crop and the staple food of the population, accounting for 41 per cent of the average national calorie intake in 2004.[139] In South Africa, maize can be produced on lands that receive more than 350 mm of precipitation per year. Three provinces, the Free State, North West, Mpumalanga are responsible (almost equally) for the country's maize production with KwaZulu Natal supply an additional three per cent of South Africa's maize harvest.

Maize is grown by an estimated 9,000 commercial growers in South Africa, who collectively employ over 100,000 workers and account for roughly 25 per cent of South Africa's cultivated land. A further one million households, located in the former homelands, grow maize for domestic consumption. Although production varies greatly (between 1.6 million hectares and 4.8 million hectares) in accordance with price, on average maize has contributed US $0.62 billion (0.11 per cent) to South Africa's GDP over the past five years.

A great range in yields is evident across South African maize growers. The key distinction is between "commercial" (predominantly white) farmers who produce an average of 3.2 tons per hectare, and the subsistence sector (comprising historically disadvantaged black growers on small parcels of land) in which the average maize yield is less than 0.75 tons per hectare. Raising the productivity of the maize sector, and particularly the "subsistence" yield would have a significant impact on some of South Africa's poorest people and is the focus of State extension efforts.

The South African maize industry was deregulated alongside other agricultural industries, in 1997. Producers may sell to whomever they wish and prices are determined by supply and demand. There is no direct financial support of South African maize farmers. Most commercial maize growers in South Africa sell their maize on the futures market (up to ten years in advance) although a degree of spot market sales and contracted cultivation also takes place. With regards to exports the only levy for which South African growers are currently liable is that required by the Perishable Products Exports Control Board (PPECB) – US$ 0.22 per metric ton. The importing of maize to South Africa is subject to a levy of US$ 4.35 per ton.

Due to the deregulated marketing of South African maize, in most years South Africa also imports small quantities of maize. In the past three years imports have been purchased from the United States, Argentina and Kenya. During the same period, exported maize has been sold to Japan, Iran, Kenya, Venezuela, Zimbabwe, Zambia, Mozambique, Angola and Malaysia according to FAOSTAT.

[139] FAOSTAT, 2007

Figures A1 and A2: The area under maize cultivation in South Africa and the corresponding annual maize harvest. As can be seen the cultivated area varies in accordance with price. Yield varies with cultivated area and rainfall.

Figure 2: Area under Maize Cultivation in South Africa – 1923/4 to 2004/5

Figure 3: Maize Yield in South Africa – 1923/4 to 2004/5

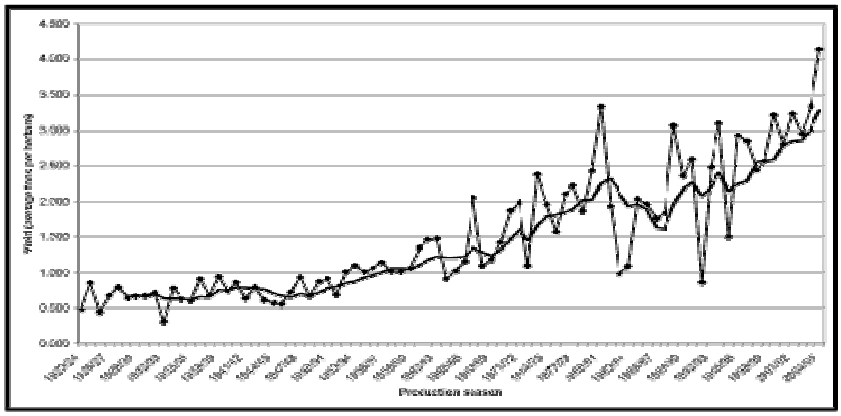

Table A1: Official crop yields and forecasts for South African commercial agriculture 2005 to 2007

	Area planted 2006/2007 (Ha)	Area planted 2005/2006 (Ha)	Yield 2005/2006 (tons)	Contribution to the total yield
Maize (yellow and white)	2 551 800	1 600 200	6 618 000	95%
Sugarcane	-	428 372 (of which 330 515 was harvested)	21 052 266 (2 500 504 tons of saleable sugar)	100%

Source: Department of Agriculture, Crop estimates Committee, 2007. South African Sugar Association, 2007

Table A2: Official crop yields and forecasts for South African subsistence agriculture 2005 to 2007

	Area planted 2006/2007	Area planted 2005/2006	Yield 2005/2006 (tons)	Contribution to the national yield
Maize (white and yellow)	345 266	432 246	317 056	5%

Source: Department of Agriculture, Crop Estimates Committee, 2007

Sugarcane

Sugarcane is grown in three provinces on the eastern side of South Africa, Kwazulu Natal, Eastern Mpumalanga (where sugarcane is irrigated and there have been a great number of recent plantings) and the northern reaches of the Eastern Cape. Nationally 430,000 hectares of sugarcane is cultivated, three quarters of which is suitable for harvest every year. In 2005/6 21 million tons of sugarcane was harvested yielding 2.5 million tons of sugar.[140] Prices for sugarcane and "recoverable value"[141] in 2005/6 were set by the industry at ZAR 173.59 (US$ 23.9) per ton and ZAR 1,389 (US$ 191.85) per ton respectively.

Unlike other agricultural sectors in South Africa, the sugar industry operates under the jurisdiction of the Department of Trade and Industry and has retained a measure of price support against imports. The industry further distinguishes itself by operating a successful small scale outgrower scheme. There are 23,471 small scale black growers (roughly half the total number of growers in South Africa) operating on land parcels that average eight hectares in size. Collectively these growers supply 11 per cent of the country's sugarcane under contract farming arrangements to one of the three major mills. The sugarcane outgrower scheme, while struggling to engage the poorest of the poor and frustrated by a lack of access to land and water, represents a celebrated commitment to broad based black economic empowerment.

South Africa is the largest producer of sugarcane in the SADC region, but in 2006 for the first time produced less than half of SADC's sugar as Swaziland, Mauritius and Zambia increased their yields. In a typical year South Africa is able to export half of its sugar yield. This surplus is a component of South Africa's food security and an important foreign exchange earner. If diverted, however, the surplus could produce an estimated 274 kilotons of ethanol; enough to supply more than half of the 466 kilotons (E8) target that is proposed in the Draft Biofuel Strategy.

[140] SASA, 2007

[141] "Recoverable value"(RV) is the measure on which growers receive payments and is closely related to sucrose content. The average RV content for the South African crop ranges between 12 –13.5 per cent.

As a substitute for crude oil imports, sugarcane is potentially far more valuable than as a food export. A ton of exported sugarcane returns roughly US$ 24 in revenue to South African growers, whilst the same ton could earn US$ 41 for growers if converted into bioethanol and US$ 45 in petrol imports (based on 80 litres of bioethanol per ton of sugarcane and 95 per cent of the prevailing basic fuel price being paid for ethanol).[142] (www.illovosugar.co.za/ Sugar production is resource intensive and in recent times the industry has been criticised for not returning revenue and employment that is commensurate with its consumption of South Africa's water in particular.[143] Sugar production multipliers of 1.28-1.91 are usual,[144] significantly below the average for agriculture (1.49-2.13). The multiplier for sugar refining is given as 1.21 - 2.43. The opportunity of producing bioethanol is being eagerly reviewed by the South African industry as a means of increasing the returns on their activity.

[142] These yields have been achieved in Brazil and Southern Africa according to the records of the, 'Policy Dialogue on Co-generation and Bioethanol for South Africa, (Partners 4 Africa) 21-23 June 2004, as published by WIP-Munich, Germany.

[143] DDG, 1997; Lorentzen et al., 2007; Cartwright, 2007.

[144] Crafford et al., 2004.

Appendix B: Country production of ethanol including non-biofuel ethanol 2006.

Country and '000 gallons	Country and '000 gallons
Austria 2.6	Denmark 4.9
France 251.0	Germany 202.2
Hungary 17.2	Italy 42.9
Poland 66.1	Spain 122.5
Sweden 30.4	U.K. 74.0
Other European Union 84.0	
European Union 897.6	
Russia 171.7	Switzerland 2.2
Turkey 17.2	Ukraine 71.3
Other Europe 63.4	
All Europe 1,223.5	
Egypt 7.9	Kenya 4.5
Malawi 4.0	Mauritius 2.4
Nigeria 7.9	South Africa 102.4
Swaziland 4.6	Zimbabwe 6.6
Other Africa 19.8	
All Africa 160.1	
Canada 153.2	Costa Rica 10.6
Cuba 11.9	Guatemala 21.1
Jamaica 6.5	Mexico 13.2
Nicaragua 7.7	Panama 4.2
U.S.A. 5,276.9	Other North & Central America 25.1
North & Central America 5,530.4	
Bolivia 18.5	Brazil 4,491.4
Colombia 74.0	Ecuador 11.6
Argentina 44.9	Other South America 50.2
South America 4,690.6	
China 1,017.2	India 502.0
Indonesia 44.9	Iran 7.9
Japan 29.9	Korea, South 15.9
Pakistan 23.8	Philippines 22.2
Saudi Arabia 52.8	Taiwan 2.6
Thailand 93.3	Other Asia 26.4
Asia 1,838.8	
New Zealand 4.2	Australia 39.4
Other Oceania 2.1	
OCEANIA 45.7	
WORLD 13,489.2 gallons	

Source: Steenblik (2007)

Appendix C: Key actors in South Africa's emerging biofuel industry

A number of private and public sector players are currently active in the emergence of South Africa's biofuel (bioethanol and biodiesel) sector.

Government

From Government the lead department is Minerals and Energy, supported by the Department of Water Affairs and Forestry and the Department of Environmental Affairs, which is responsible for Environmental Impact Assessments (EIAs).

The Department of Agriculture, is a member of the Biofuels Association but has been relatively inactive on biofuels. However, agriculture and Land Affairs minister Lulu Xingwana, speaking during the national assembly during the debate on her budget vote, stated that steps would be taken to ensure that crop production would not come at the expense of food security.

"We will ensure that biofuel crop production will not be at the expense of food security, but seek to stimulate the creation of 50 000 jobs, economic opportunities, and new entrepreneurs, especially in communal areas," she said.[145]

She has also stressed her hope that biofuels will assist with rural regeneration on a number of occasions. For example, *"Bio-fuels - if done in the right way - will offer potential for growth in the agriculture sector and should also assist emerging farmers. We are engaging with emerging farmers to see how this programme can benefit them."*[146]

Parastatals

The Industrial Development Corporation and the Land Bank, both parastatal financing institutions, are members of the Biofuels Association.

In March 2007, it was announced that the (IDC) and its partners were looking to invest R3.2 billion in two biofuels projects, with first production set for early 2009. The projects will be based in the Eastern Cape and Mpumalanga. The projects are at the detailed engineering study level and due for completion by September 2007 with construction likely to start in January. The IDC was likely to take a 49 per cent stake in both projects, with 25 percent

[145] Business Report, 20 May 2007. http://www.busrep.co.za/index.php?fSectionId=&fArticleId=3838763 Speech available at: http://land.pwv.gov.za/Documents&Publications/Publications/07Budget_Minister.pdf

[146] Media statement by the Minister for Agriculture and Land Affairs, Ms Lulu Xingwana at the Ministerial Lekgotla held at Kopanong Conference Centre, Benoni ,4 November 2006 http://www.info.gov.za/speeches/2006/06110610451001.htm

warehoused for empowerment and community groups. The remaining 51 percent interest will be taken by the CEF and outside partners, who are yet to be selected. In total, IDC plans the following projects (the final three are mooted but not yet as advanced as the first two).

Eastern Cape	Sugar beets	90million litres
Mpumalanga v	Sugar cane	100 million litres
Pondoland, which spans KwaZulu-Natal and the Eastern Cape.	sweet sorghum and sugar cane in	150 million litres
Ogies, Mpumalanga	Maize to be bought from local farmers	150 million litres
Makhathini, KwaZulu-Natal	Cassava	100 million litres

The project leader, Noel Kamrajh has said that the IDC's strategy would allow a mandate for blending ethanol into petrol at a maximum level of eight per cent. This required the production of one billion litres of bioethanol a year and could contribute 1.3 per cent to GDP. These were sufficient incentives to kick-start the biofuels industry, according to Kamrajh. Kamrajh said that for the IDC's biofuels projects to succeed, there needed to be a 100 per cent fuel tax rebate.[147]

The IDC has made more progress in expressing their willingness to finance these schemes than the Land Bank. The parastatal research agency has partnered with the Department of Science and Technology in conducting research in the past.

Industry Groups

South African Biofuels Association

SABA is a non-profit organisation, aiming to facilitate the establishment of a viable biofuels industry in Southern Africa. It promotes the sustainable production and use of quality biofuels in Southern Africa. As a partnership organization to the agricultural industry, science and technology as well as the liquid fuel sectors, SABA provides information and expertise to role-players in the private, governmental and educational sectors who are interested in pursuing biofuel initiatives. The focus of SABA is promoting the public awareness of the

[147] http://www.busrep.co.za/index.php?fSectionId=566&fArticleId=3752734

advantages of biofuels, the implementation of standards for the industry and their products, as well as the development of a business environment conducive to the biofuels agri-industry.[148]

SABA members include biofuels producers (such as D1 Oils Africa, De Beers Fuel and Ethanol Africa), equipment and technology suppliers (such as Shaval BioDiesel, Praj Industries, Lurgi SA and Thyssen Krupp Engineering), academia (such as Wits University), agricultural producer associations (such as Grain South Africa, the South African Cane Growers' Association and the Southern African Confederation of Agricultural Unions), financial institutions (such as Absa and Standard Bank), government departments (such as the Department of Minerals and Energy), and State-owned organisations (such as the Central Energy Fund). Absa Agribusiness GM Andrew Makenete is Saba president, Grain South Africa GM Dr John Purchase heads the association's biomass committee, Lurgi SA's Marc Otto the technology and equipment committee, and Louis Dreyfus Africa CEO R. Burdairon the services committee.[149]

South African Sugar Association

SASA is comprised of growers and processors in the sugar industry. Whilst SASA exists primarily to promote the interests of the South African sugar industry through its respective marketing, research and extension arms it has recently become an advocate of the country's bioethanol potential

Grain South Africa

Grain SA, like SASA, primarily aims to lobby the interests of the country's grain industry to government and to support its members with information and research. Grain SA has become a vocal advocate of the bioethanol from maize industry, and Government support for this industry, in the belief that this could offer its producers some reprieve from low and volatile maize prices.

Private Sector

Ethanol Africa

In the private sector, the main companies are Ethanol Africa (Johan Hoffman) which established the first ethanol processing plant in South Africa in Bothaville in the Free State and now has three plants.

Ethanol Africa is a private limited company, registered in SA. The current shareholders of Ethanol Africa include Sterling Waterford Holdings, an Environmental Finance group responsible for product development in the carbon credit market; Ecofields, a South African agriculture grouping supporting the development of the SA Biofuel industry, and Grain

[148] http://www.saba.za.org/index.jsp?page=mission
[149] http://www.engineeringnews.co.za/article.php?a_id=95234

Alcohol Investments, an investment vehicle representing over 100 farmer groupings in the maize producing areas of South Africa.

Ethanol Africa's plants use maize, corn and sorghum. Ethanol Africa claims it can produce 420 litres of ethanol for 1 ton of maize. Ethanol Africa claims that South Africa could plant 4,500 hecatres of maize if the bioethanol market were to develop and that they aim for an average yield (for yellow maize) of 4.1 tons per hectares which is considerably above the national average of 3.1 for yellow maize commercial farmers. The company believes that the key to the future of South Africa's ethanol from maize production lies in high yielding drought resistance cultivars and has invested in genetically modified cultivars that fit this description. Ethanol Africa is also interested in investing in feedlots in neighbouring countries.

The company blends its oils at its own depots rather than at existing syncrude refineries and supplies directly to fuel forecourts. Local blending ability is essential for reducing transport costs. Ethanol Africa believes biofuels are already transforming rural economies in South Africa and cite the 100 per cent house price increases around their plants in Bothaville in the past year as evidence. They also believe that their plants have crowded other industry into the region and as such are providing the catalyst for local economic development.

D1-Oils

Another company active in the sector in South Africa is D1-Oils South Africa,[150] whose CEO is Dimitri Popadopalous, a subsidiary of the multinational by the same name.

D1-Oils plc is a UK-based global producer of biodiesel. It claims to be building a global supply chain and network that is sustainable and delivers value from "earth-to-engine". Its operations cover agronomy, refining and trading, and says it is "pioneering the science, planting and production of inedible vegetable oils; we design, build, own, operate and market biodiesel refineries; and we source, transport and trade seeds and seedlings, seedcake, crude vegetable oils and biodiesel".[151]

The company cites the following biofuel yields from their trial cites in South Africa.

Crop	**Biofuels per hectare**
Soya	374
Sunflower	850
Canola/ Rape	1,100

[150] http://www.d1africa.com/southAfrica.php
[151] http://www.d1plc.com/index.php

Jatropha	1,300 –1,500 but no byproducts
Palm oil	4,000 litres but difficult to establish in South Africa and the oil solidifies in cold climates

D1-Oils claims that the ability for farmers to receive higher prices for their land under alternative uses including game farming and housing developments will make securing enough feedstock for the local industry difficult unless the price increases dramatically.

D1-Oils claim that in their company the cost of feedstock (crops) make up 60 to 70 per cent of the cost of their biodiesel. D1-Oils have experimented with palm oil but found that the long lead before a full harvest (seven years in South Africa) makes the cultivation of this crop difficult to finance.

Biodiesel SA

Biodiesel SA[152] was established in 2001, and has invested R350,000 in a biodiesel processing plant in Pietermaritzburg and have already produced 60,000 litres of prototype diesel for distribution "to an expectant market". The company's CEO Daryl Melrose said, "We have been experimenting and testing the biodiesel for the past five years and through our research and development, have come up with a commercially viable formula".

Biodiesel SA have been involved in a Jatropha trial in KZN. The company believe that South Africa should adopt EU quality standards that are strictest and engine manufacturers will be happy to honour warrantees. Biodiesel have supported and lobbied for a mandatory five per cent blend with EU standards, although given that South Africa uses different feedstocks to Europe this standardisation is controversial and not unanimously supported. Biodiesel SA's CEO stressed that the industry should not be seen as a challenge to the fossil fuel industry. "The fact of the matter is that biodiesel is produced in limited quantities and that it is highly unlikely to ever meet the growing demand for fuel," he said.[153]

ThyssenKrupp

This German based company plans to invest R 3 billion in building large biofuels plants and canola cultivations in the Eastern Cape.

[152] http://www.biodieselsa.co.za/index.htm
[153] http://www.biodieselsa.co.za/now-on-sale.htm

SASOL/Central Energy Fund/Siyanda Biodiesel

SASOL, the Central Energy Fund and BEE partner Siyanda Biodiesel[154] are working on a proposed 100 000 ton-a-year biodiesel plant. SASOL expected to decide in December 2006 whether to build the plant fed by soya beans, which was to cost at least $30 million.

SASOL said that should the venture proceed, it would own 37.5 per cent, 6.5 per cent would go to the state-owned Central Energy Fund and Siyanda Biodiesel would take 26 per cent. The plant might be located in Newcastle, Sasolburg or Secunda.[155]

When announcing the project, Sasol Nitro MD Bernard Klingenberg said that the technology bids were far higher than anticipated, negatively impacting the project economics, which might hold back project approval. "Together with Lurgi [global technology company], we are investigating opportunities to lower capital costs and improve efficiencies. Lurgi AG will only be given the go ahead for construction of the plant once its viability has been proven," says Klingenberg.

De Beers Fuel

De Beers Fuel claimed it planned to set up plants across South Africa to convert algae into fuel and ethanol. However, the company went insolvent, after having been exposed as a scam by the investigative television programme, Carte Blanche.

Louis Dreyfus Group

Louis Dreyfus Africa, part of the Louis Dreyfus Group, a global bulk commodities merchandiser, has recently established a vegetable-oil trading operation in La Lucia, north of Durban, to trade in the south African market and supply the biofuel industry.

Shailendra Mishra, team leader of the vegetable-oil trading operation, said South Africa produced vegetable oil from sunflower seeds, and it also imported about 400,000 tons of vegetable oil a year. Louis Dreyfus' new, mainly import-based business, is to trade in vegetable oil as well as provide "supply and offtake" solutions to the developing biofuel industry. Louis Dreyfus Africa trades in southern and eastern Africa, specialising in merchandising, distributing, importing and exporting agricultural commodities

Louis Dreyfus Africa CEO Remi Burdairon said: "This recent development represents a strategic addition to our existing trading operations portfolio in the region".[156]

[154] http://siyanda.com/prod.htm
[155] http://www.busrep.co.za/index.php?fSectionId=&fArticleId=3574784
[156] http://www.businessday.co.za/articles/companies.aspx?ID=BD4A311931

Appendix D: Break-down of the elements of South Africa's Basic Fuels Price

International influences

Free-on Board (FOB) values: These are petroleum product prices quoted on a daily basis by export orientated refining centres situated in the Mediterranean area, the Arab Gulf and Singapore.

Freight: This is the cost to transport refined petroleum products from these export refining centres to South African ports. The freight rates used in the BFP calculation are based on freight rates published by London Tanker Brokers Panel on 1 January each year. These freight rates are adjusted on a monthly basis in line with the so-called Average Freight Rate Assessment (AFRA) which is a function of risks and supply and demand of ships transporting refined petroleum products internationally.

Demurrage: Petroleum products are loaded into ships at ports in the Mediterranean area, Arab Gulf and Singapore and these products are discharged at South African ports. Demurrage rates are published by the World Scale Association Limited. In calculating the demurrage cost, the total demurrage time is limited to 3 days.

Insurance: An element of 0.15 percent of the FOB-value and freight to cover insurance as well as other costs such as letters of credit, surveyor's and agent's fees and laboratory costs.

Ocean loss: A loss allowance factor of 0.3 percent to be calculated on the sum of the FOB, Freight and Insurance values for products is applicable to provide for typical uninsurable losses during transportation of fuels.

Cargo dues (Wharfage): The South African harbour facilities are utilised to off-load petroleum products from ships into on-shore storage facilities. The cost to utilise these harbour facilities is based on the tariff set by the National Ports Authority of South Africa.

Coastal Storage: This is to recover the cost of providing storage and handling facilities at coastal terminals. In 2002, the typical international storage rate was assessed as US$ three per ton or 2.5 SA cents per litre per month. The BFP only makes provision for 25 days and the initial value when BFP was implemented amounted to 2.083 c/l. This element is adjusted on an annual basis by the increase in the Producer Price Index (PPI).

Stock Financing: Stock financing cost is based on (i) the landed cost values of refined petroleum products, (ii) 25 days of stockholding and (iii) the ruling prime interest rate less 2 percent.

The BFP, quoted in USD/barrel or USD/ton is converted to US cents/litre by applying the international conversion rates (for example, barrels to tons, tons to gallons and gallons to litres) and is then converted to South African cents/litre by applying the applicable Rand/US Dollar exchange rate.

To arrive at the final petrol pump price in the different fuel pricing zones (magisterial district zones), domestic costs, imposts, levies and margins are added to the Basic Fuel Price (BFP).

Domestic influences

Inland transport costs: Refined petroleum products are transported by road, rail, pipeline and by a combination thereof from coastal refineries to inland depots.

Delivery costs: This element compensates marketers for actual storage and handling costs of refined petroleum products at depots and for the distribution costs thereof from the depot to the end user.

Wholesale margin: The margin is a fixed maximum monetary margin. The formula used to determine the wholesale margin is based on a set of Guidelines, namely the Marketing-of-Petroleum- Activities Return. The level of the margin is calculated on an industry average basis and is aimed at granting these marketers a benchmark return of 15 per cent on depreciated book values of assets, with allowance for additional depreciation, but before tax and payment of interest. Should the industry aggregated margin be between 10 and 20 percent, no adjustment is made to the margin, if it is below 10 percent or above 20 percent, the margin is adjusted to a level of 15 percent.

Retail profit-margin: The retail profit margin is fixed by the DME and is determined on the basis of the actual costs incurred by the service station operator in selling petrol. In this cost structure, account is taken of all proportionate driveway related costs such as rental, interest, labour, overheads and entrepreneurial compensation.

Equalisation Fund levy: The equalisation fund levy is normally a fixed monetary levy, determined by the Minister of Minerals and Energy in concurrence with the Minister of Finance The levy income is mainly utilised to equalise fuel prices. The levy is currently zero.

Fuel tax: A fuel tax levied on petrol and diesel. The magnitude of this levy is determined by the Minister of Finance.

Customs and Excise levy: A levy collected in terms of an agreement by the Southern African Customs Union.

Road Accidents Fund levy: A Road Accidents Fund levy is applicable on petrol and diesel. The magnitude of this levy is determined by the Minister of Finance. The income generated from this levy is utilised to compensate third party victims of motor vehicle accidents.

Slate levy: The Basic Fuels Price (BFP) of petrol, diesel and illuminating paraffin is calculated on a daily basis. This daily calculated BFP is either higher or lower than the BFP reflected in the fuel price structures at that time. If the daily BFP is higher than the BFP in the fuel prices, a unit under recovery is realised on that day. When the BFP is lower than the BFP in the price structures, an over recovery is realised on that day. An under recovery means that

fuel consumers are paying too little for product on that day, whilst in an over recovery situation, consumer are paying too much for product on that day. These calculations are done for each day in the fuel price review period and an average for the fuel price review period is calculated. This monthly unit over/under recovery is multiplied by the volumes sold locally in that month and the cumulative over/under recovery is recorded on a Cumulative over/under recovery account (referred to as the "Slate Account"). A Slate levy is applicable on fuels to finance the balance in the Slate account when the Slate is in a negative balance.

Demand Side Management Levy on 95 unleaded petrol: A DMSL is applicable on 95 unleaded petrol consumed in the inland area. This levy was implemented into the price structure of 95 unleaded petrol in January 2006 when 95 unleaded petrol was introduced into the inland market for the first time. Most vehicles in the inland market do not require to run on 95 unleaded petrol and the unnecessary use thereof in the inland area would result in "octane waste" with negative economic consequences. A DSML was introduced to curtail the demand thereof in the inland area.

IP tracer dye levy: To curtail the unlawful mixing of diesel and illuminating paraffin, an illuminating paraffin tracer dye is injected into illuminating paraffin. An illuminating paraffin tracer dye levy was introduced into the price structures of diesel to finance expenses related thereto.

Petroleum pipelines levy: The annual budget of the Petroleum Pipelines Regulator is approved by the Ministers of Minerals and Energy and of Finance. In terms of the Petroleum Pipelines Levies Act, 2004 (Act No 28 of 2004), a levy of 0.19 c/l was implemented into the price structures of petrol and diesel on 7 March 2007.

Appendix E: Table of trade groupings in sub-Saharan Africa

SACU	SADC	ACP	Least developed country
	Angola		
Botswana			
	Congo (DRC)		
Lesotho	Lesotho		Lesotho
	Madagascar		Madagascar
	Malawi	Malawi	Malawi
	Mauritius	Mauritius	Mauritius
	Mozambique	Mozambique	Mozambique
Namibia	Namibia		
South Africa	South Africa		
Swaziland	Swaziland	Swaziland	
	Tanzania	Tanzania	Tanzania
	Zambia	Zambia	Zambia
	Zimbabwe	Zimbabwe	

Source: Godfrey *et al.* (2003), United Nations

Appendix F: Acknowledgements