

DTI's biofuels experience, 2004 - 2010
Case study: Biodiesel from canola (rapeseed) project
in the Eastern Cape province of South Africa.

*African, Caribbean & Pacific Group of States Science &
Technology Programme*

Biofuels' Conference

hosted by Turner & Townsend
2nd – 3rd March 2011

Presentation by Andre Kudlinski
Department of Trade & Industry (DTI)

ACP S&T Biofuels Conference, 2-3 March 2011
AN OUTLINE OF THE PRESENTATION (1)

THE PROS and CONS of BIOFUEL PRODUCTION in SA

1. **The strategic, economic, social and environmental aspects of biofuel production in South Africa.**
2. **The South African National Biofuels Strategy (December 2007)**
 - Food security vs. biofuels' dilemma
 - Biofuel production as a tool for mass job creation and stimulating economic activity in economically-depressed areas of South Africa
3. **Bio-fuel production in SA from the Government's and the investor's perspective**
 - The SA production, market, exports, imports and trade balance of:
 - Crude oil and refined fuels
 - Feedstock for manufacture of bio-fuels: sugar cane, maize (corn), soybeans, sunflower, rapeseed (canola).

ACP S&T Biofuels Conference, 2-3 March 2011

AN OUTLINE OF THE PRESENTATION (2)

- Bio-diesel and / or ethanol?
 - Which feedstock? Which model: large commercial, medium or small (farmer co-ops, community-owned)?
 - The pros and cons from the Government's, investor's, oil industry and automotive industry's perspectives.
- Location of bio-fuel refinery and biofuel feedstock farming.
- Economic incentives for investment in bio-fuels in South Africa.
 - (DTI) Investment incentives; (Treasury) Fuel levy rebate.
- 4. South Africa biofuel projects, from 2004 to 2010.**
- Case study: "Phyto-Energy" canola biodiesel project in E. Cape.
- 5. Lessons learnt.**
- 6. Conclusions, questions and answers.**

ACP S&T Biofuels Conference, 2-3 March 2011

1. THE STRATEGIC, ECONOMIC, SOCIAL and ENVIRONMENTAL ASPECTS of BIOFUEL PRODUCTION in SOUTH AFRICA

Key drivers of the National Bio-fuel Programme

- ◆ Strategic considerations:
 - National fuel security (essential before 1994, due to oil embargo; reliance on imports of refined fuels since 2006),
 - The economic burden of imports of crude oil and refined fuels; their impact on South Africa's trade balance.
- ◆ Socio-economic policies, job creation, stimulating economic activity in economically-depressed areas of South Africa (such as the former homelands in Eastern Cape), economic assistance to the emerging farming sector.
- ◆ Environmental and public health considerations:
 - Global: Reducing fossil fuel-derived CO₂ emissions (S. Africa is a non-Annex 1 country in the UN FCCC / Kyoto Protocol, despite having one of the world's highest CO₂ emissions per capita).
 - Local: Reducing emissions of pollutants such as CO, SO₂, hydrocarbons, smog, particulates etc.

ACP S&T Biofuels Conference, 2-3 March 2011

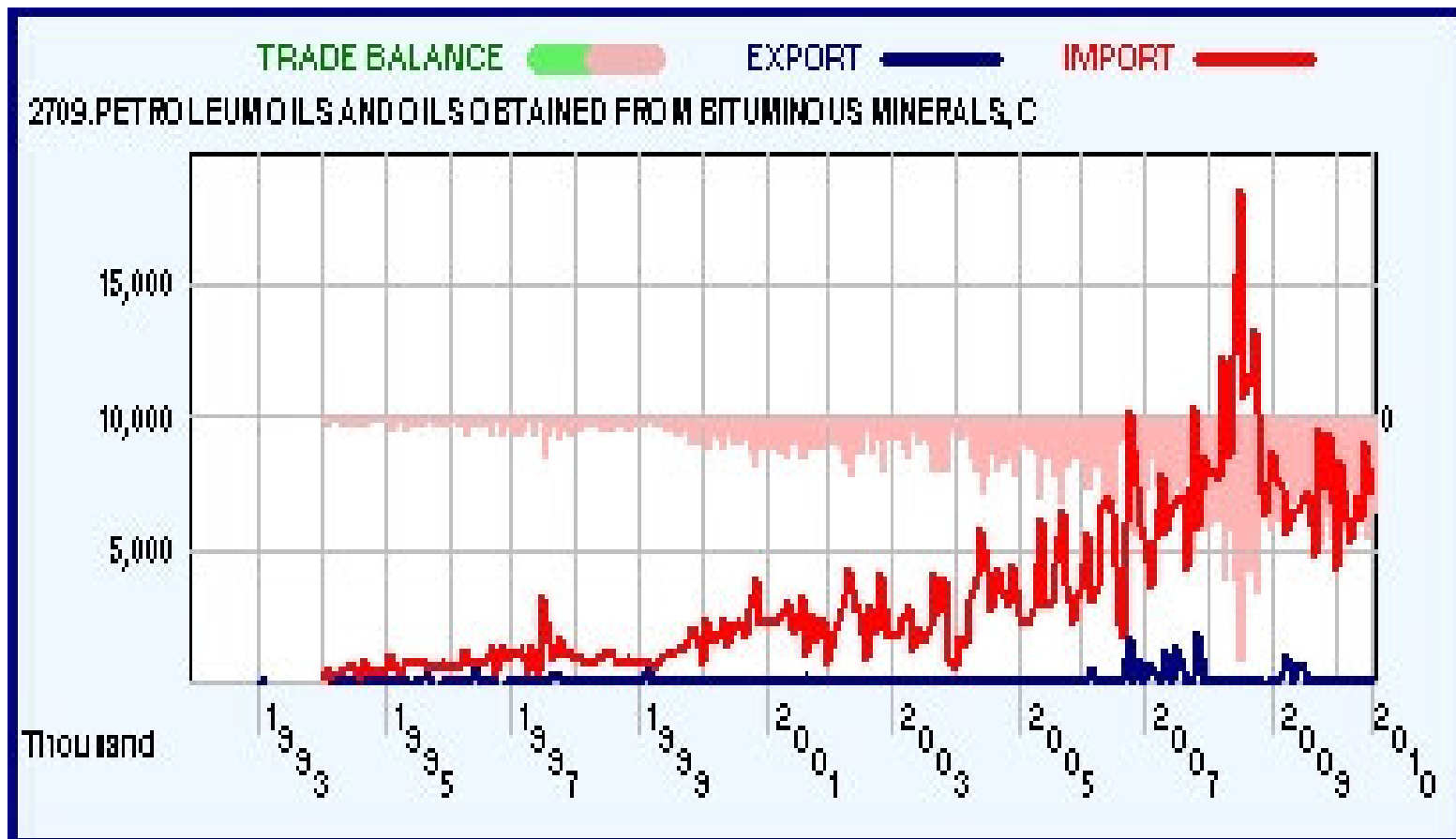
THE STRATEGIC, ECONOMIC, SOCIAL and ENVIRONMENTAL ASPECTS of BIOFUEL PRODUCTION in SOUTH AFRICA (2)

Key drivers of the National Bio-fuel Programme (continued)

- ◆ The “Biofuels Industrial Strategy for the Republic of South Africa” (December 2007)
 - Short-term focus (5-year pilot strategy); No mandatory blending; Forecast of 2% penetration / 400 million ltr. p/a.
 - Exclusion of maize as feedstock due to food security / food price considerations.
- ◆ Recognition of biofuels’ potential for job creation in:
 - DTI’s Industrial Policy Action Plan for 2010 - 2013 (IPAP-2): indicative target: 130,000 jobs in biofuels by 2020,
 - Department of Economic Development “New Growth Path” (launched November 2010),
 - Provincial strategies & programmes (e.g. ASGI-SA E. Cape).

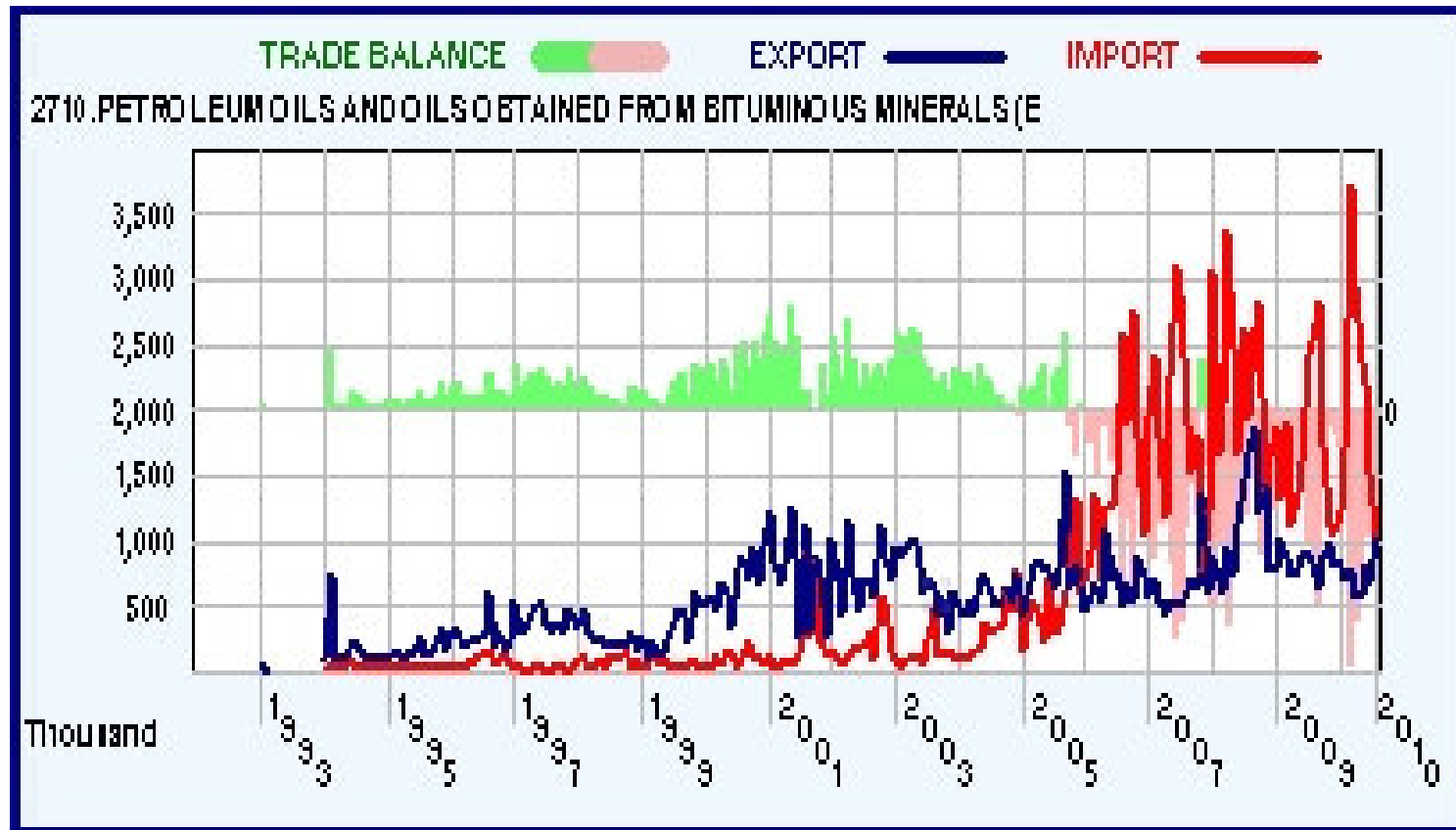
South Africa's trade balance: Crude oil (TH 27.09)

(Monthly figures, January 1994 to November 2010 - SARS)



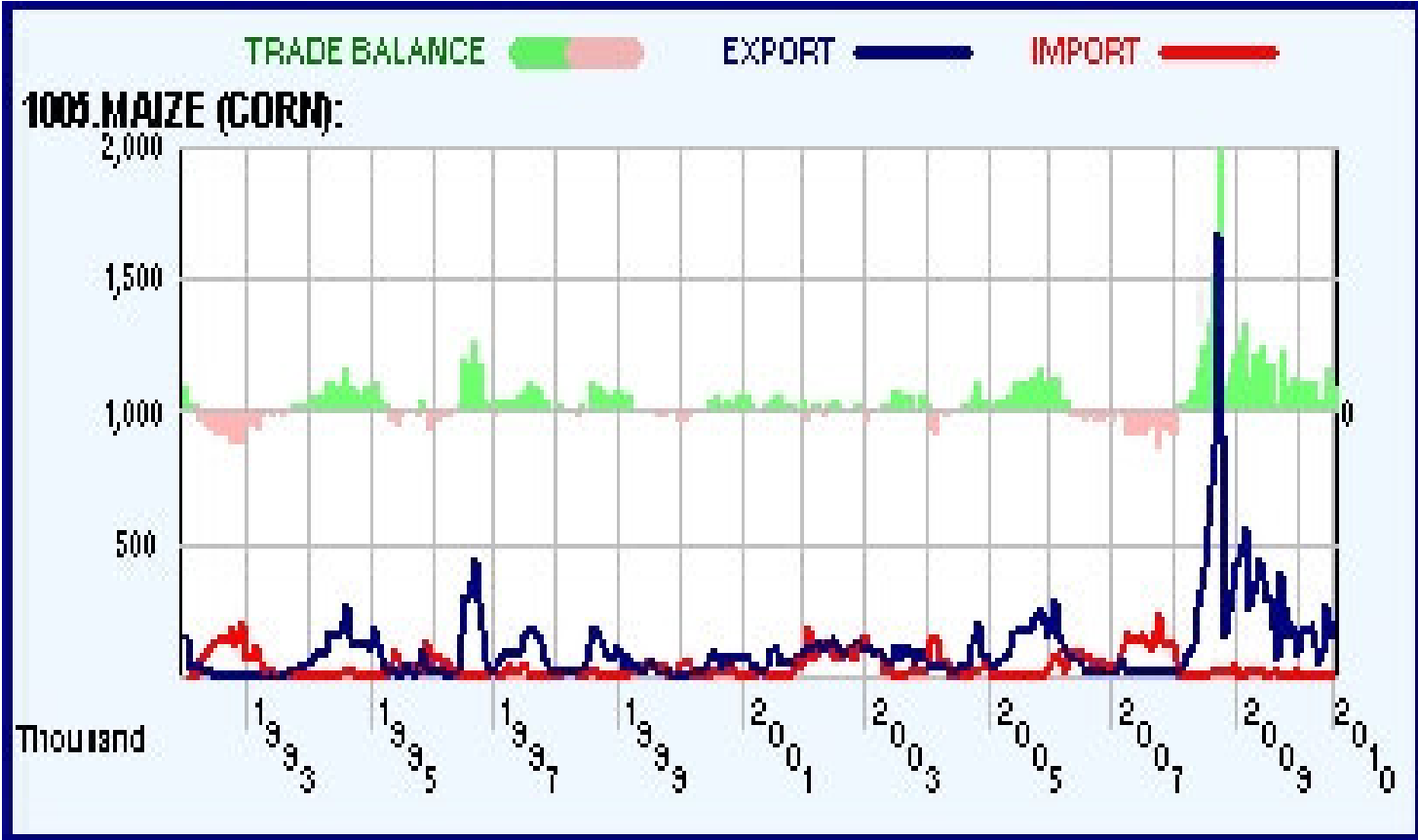
South Africa's trade balance: Refined fuels (TH 27.10)

(Monthly figures, January 1994 to November 2010 - SARS)



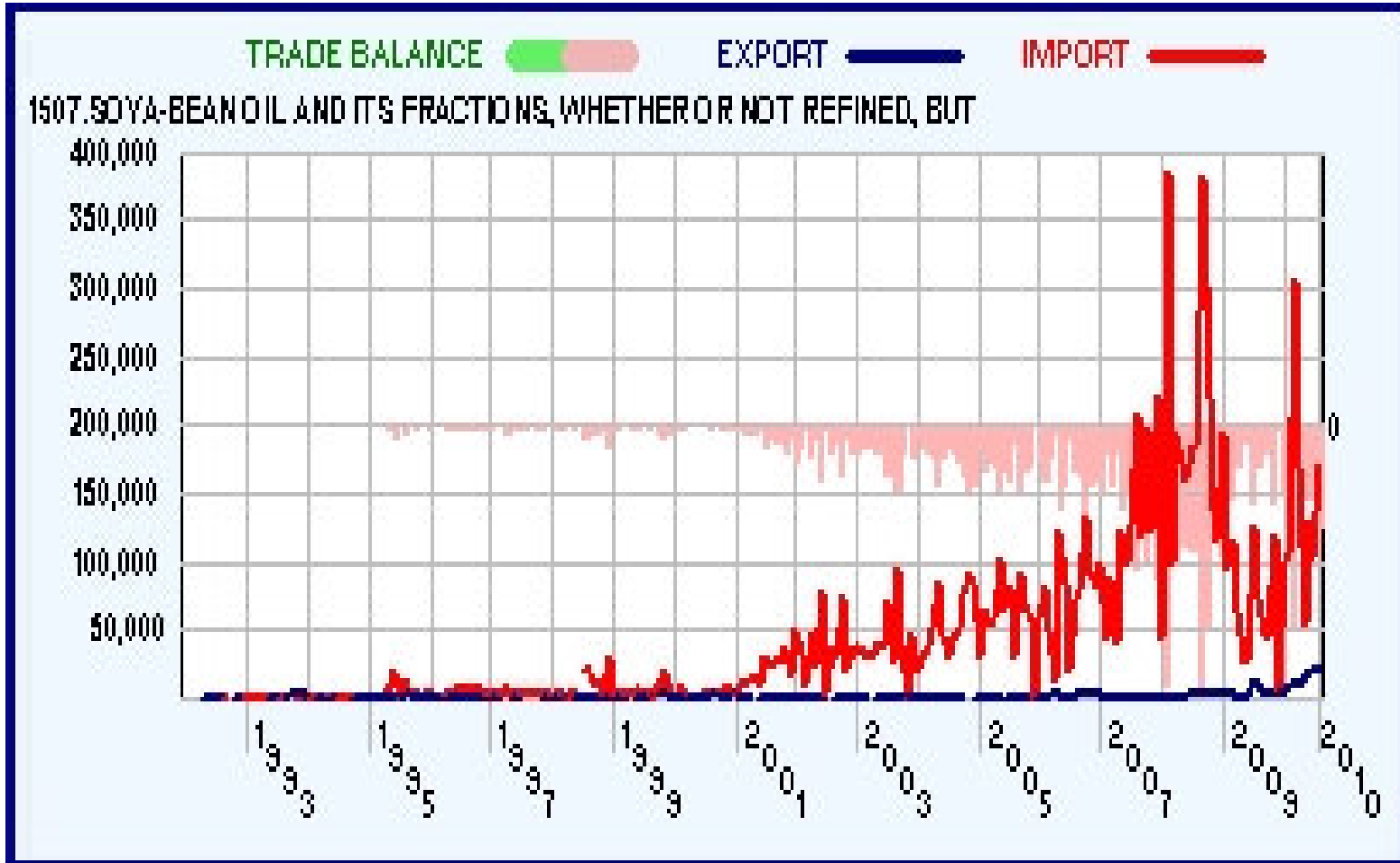
South Africa's trade balance: Maize (TH 10.05)

(Monthly figures, January 1992 to November 2010 - SARS)



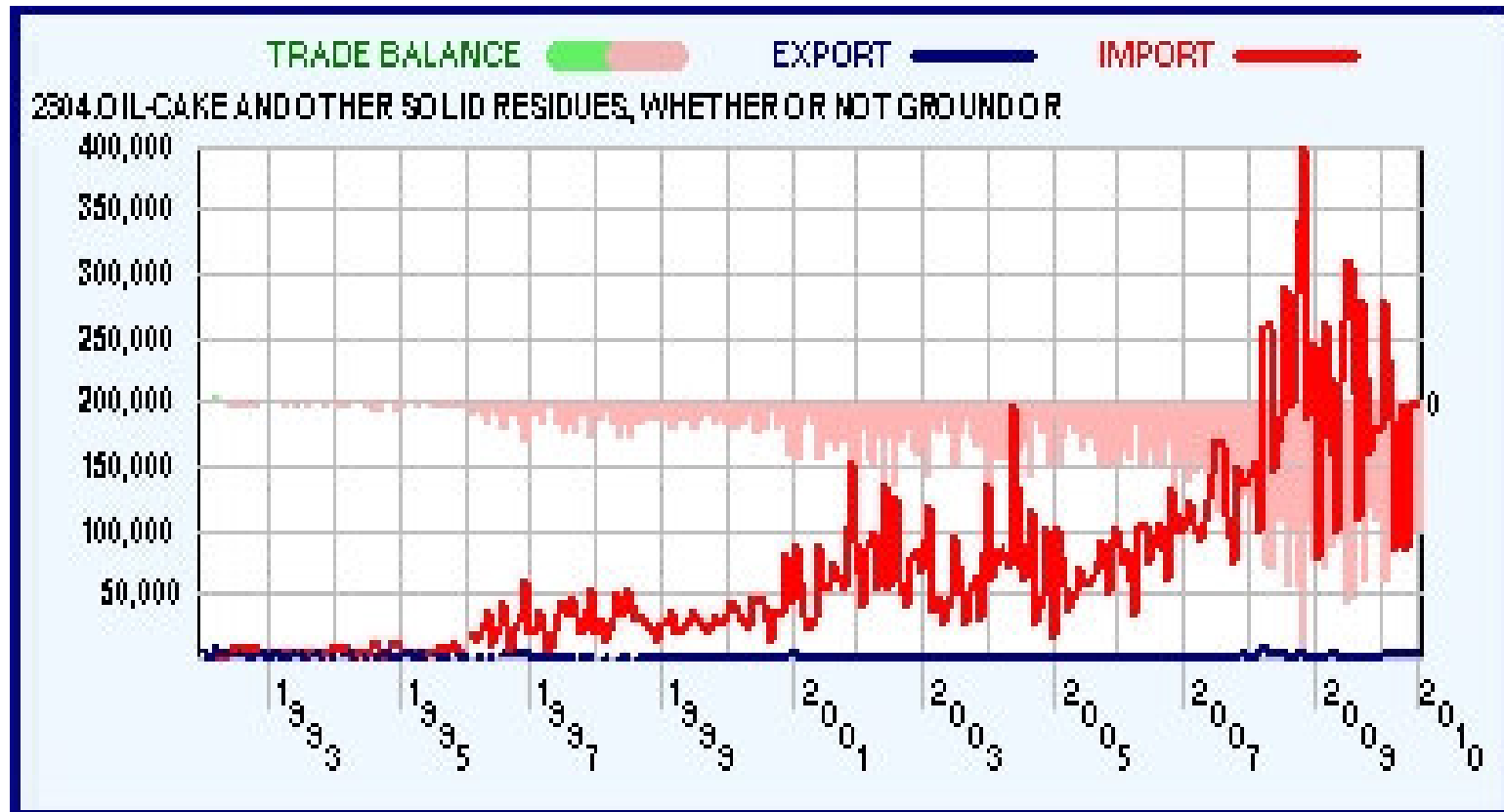
South Africa's trade balance: Soy oil (TH 15.07)

(Monthly figures, January 1992 to November 2010 - SARS)



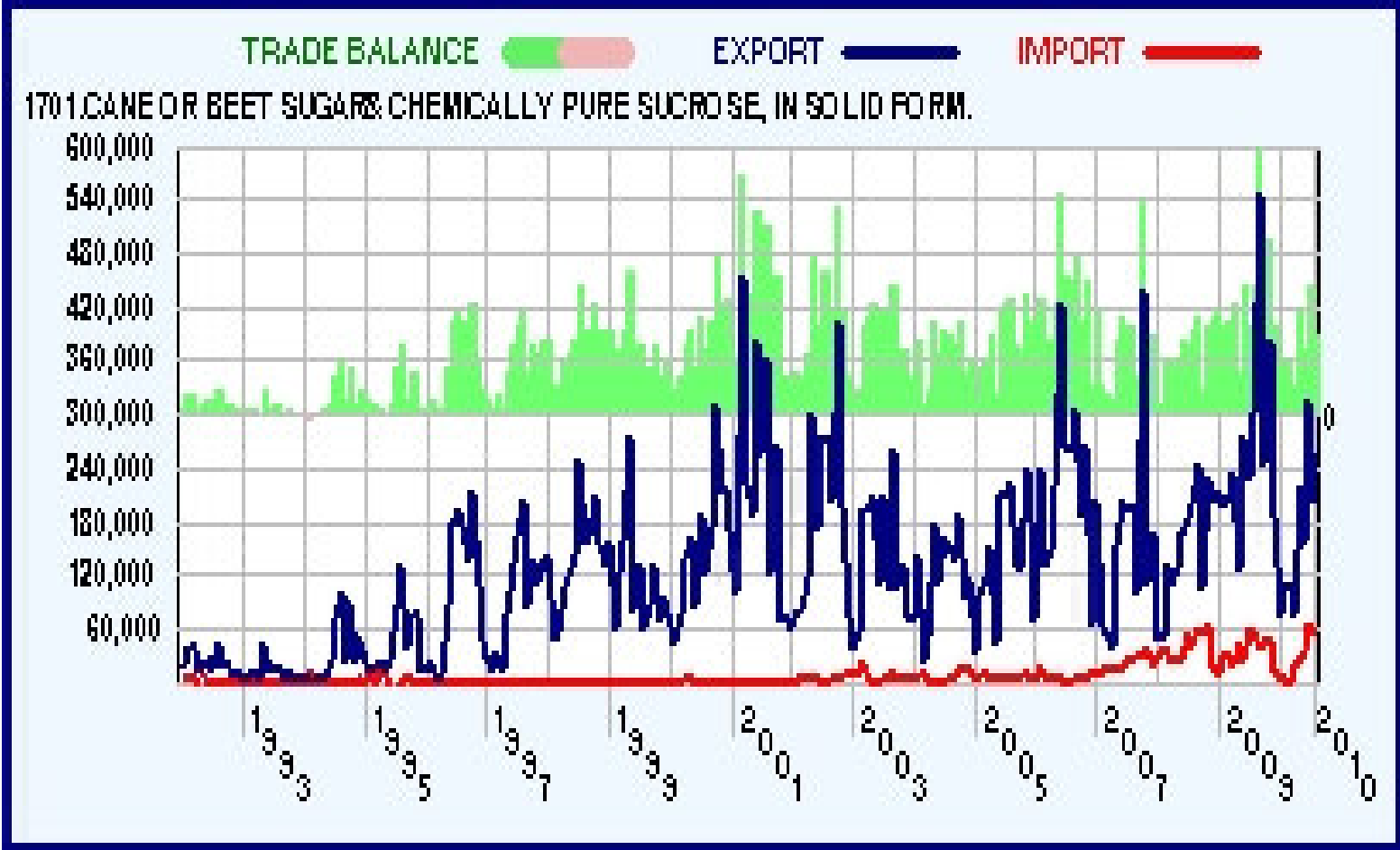
South Africa's trade balance: Soy oil meal (TH 23.04)

(Monthly figures, January 1992 to November 2010 - SARS)



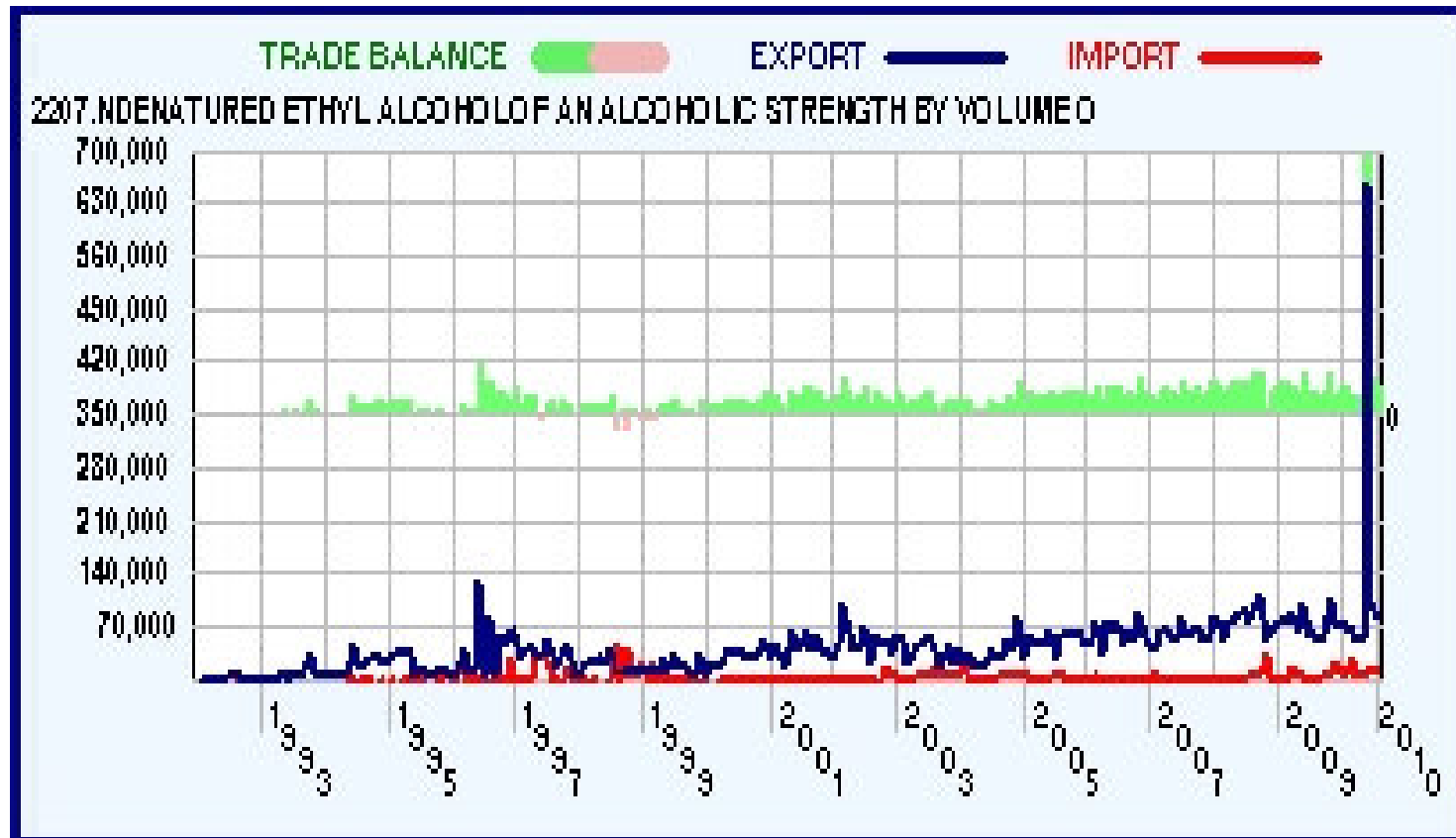
South Africa's trade balance: Sugar (TH 17.01)

(Monthly figures, January 1992 to November 2010 - SARS)



South Africa's trade balance: Ethanol (TH 22.07)

(Monthly figures, January 1992 to November 2010 - SARS)



Bio-diesel and/or Ethanol?

SA sales of refined petroleum products, 2005 to 2007
[millions of litres] (SAPIA).

Volumes in millions of Litres	Jan to Dec 2005	Jan to Dec 2006	% Change 2006/2005	Jan to Dec 2007	% Change 2007/2006
PETROL	11,165	11,279	1	11,558	3
DIESEL	8,115	8,708	7	9,757	12
JET FUEL	2,180	2,269	4	2,392	5
ILLUM	761	738	-3	697	-6
PARAFFIN					
FUEL OIL	489	476	-3	470	-1
BITUMEN	305	314	3	334	6
LPG	550	605	10	635	5
SUM OF ABOVE	23,565	24,389	4	25,843	6

Bio-diesel and/or Ethanol (2)?

Arguments in favour of biodiesel in South Africa:

- SA diesel consumption growing at 7% per year vs. petrol 1.5%. Shortfall of local diesel production 3.5 M tons in 2012.
- Lower investment costs of a biodiesel refinery vis-à-vis bio-ethanol plant of the same capacity; shorter investment cycle.
- The energy efficiency for biodiesel (energy output to input ratio) better than of fermentation-derived ethanol (\Rightarrow Energy Balance),
- Can be used as “neat” (100%) and blended with mineral diesel,
- Safe (flash point $> 120^{\circ}\text{C}$, lower CO emissions) make bio-diesel excellent fuel for underground mining,
- Almost unlimited export market (the EU / Germany),
- The food vs. fuel dilemma largely avoided, as oil cake (protein concentrate) is used as animal feed (SA imports 90% of oil meal).
- Canola and soybeans can diversify SA farming (maize almost a mono-crop in SA) and reduce cyclical pattern of harvest & price.

Bio-diesel and/or Ethanol (3)?

Arguments against biodiesel in South Africa:

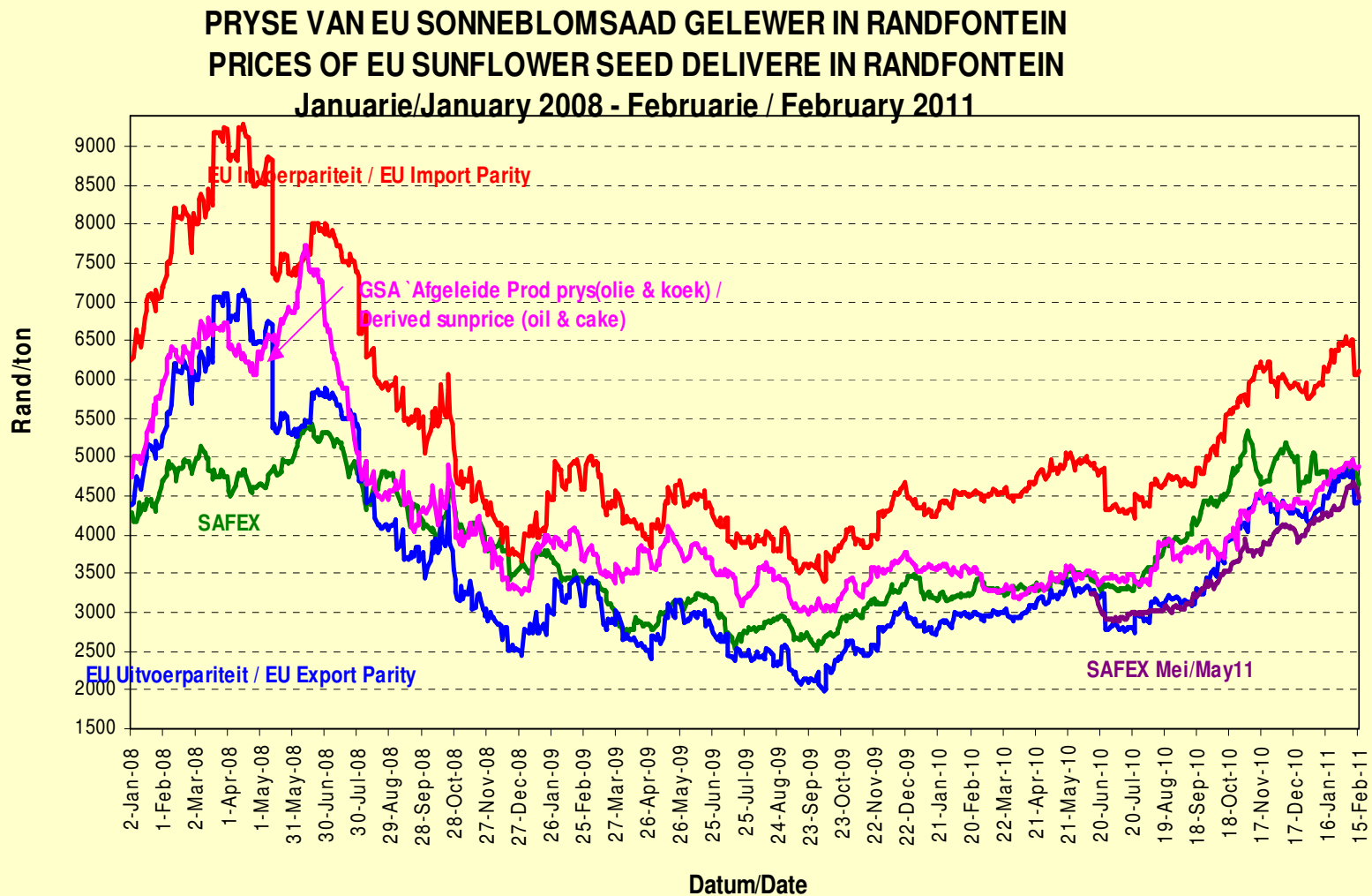
- Lower yield per hectare of oil from soy, rapeseed / canola or sunflower vis-à-vis ethanol from sugar cane or sugar beet.
- South Africa is a net importer of oil seeds and edible oils; at the current prices of crude oil, conversion of edible oils to biodiesel requires much higher incentives than currently available.
- It will take several years before local farming can meet demand for feedstock for soy and rapeseed / canola (current soybeans production in SA: 400,000 tons and canola 30,000 tons).
- At the same time, SA is a net exporter of maize and sugar (feedstock for ethanol production); converting surplus maize & sugar to ethanol could help keep the prices sustainable.
- Global over-supply of glycerol
- Quality of biodiesel from small producers is difficult to enforce / control; health & safety risks associated with methanol.

Bio-diesel and/or Ethanol (4)?

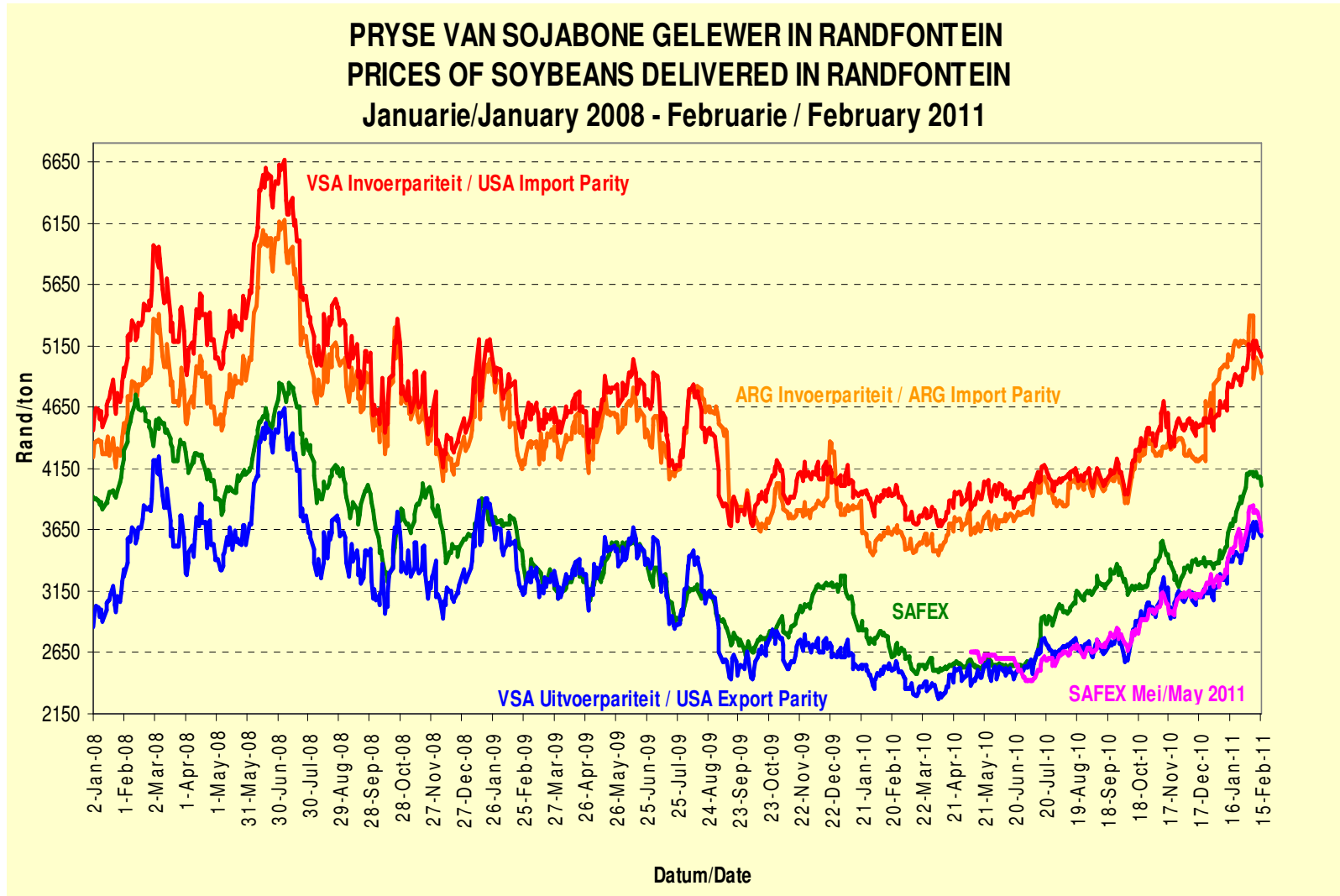
Arguments against mandatory blending of ethanol in South Africa:

- For a 2% - 7% ethanol blend (E2 – E 7) the gain in octane number (RON) is almost nil; at the same time, disproportional increase of vapour pressure (RVP), propensity to absorb water, corrosiveness.
- To keep fuel RVP within specification, refineries would have to find alternative market for the volatile / low-boiling fractions (C3 – C4).
- For 10% ethanol blend (E10), octane number (RON) \nearrow by 1 unit;
- SA vehicles are not “Flexi-fuel” ready i.e. \Rightarrow higher blending possible only for a dedicated car fleet.
- Higher production cost of ethanol in SA, vis-à-vis Brazil and the USA (import tariffs needed).
- Risks of ethanol “leaks” into illegal alcohol market; Treasury / Customs & Excise objections to the concept of small-scale ethanol producers (farmer co-ops).

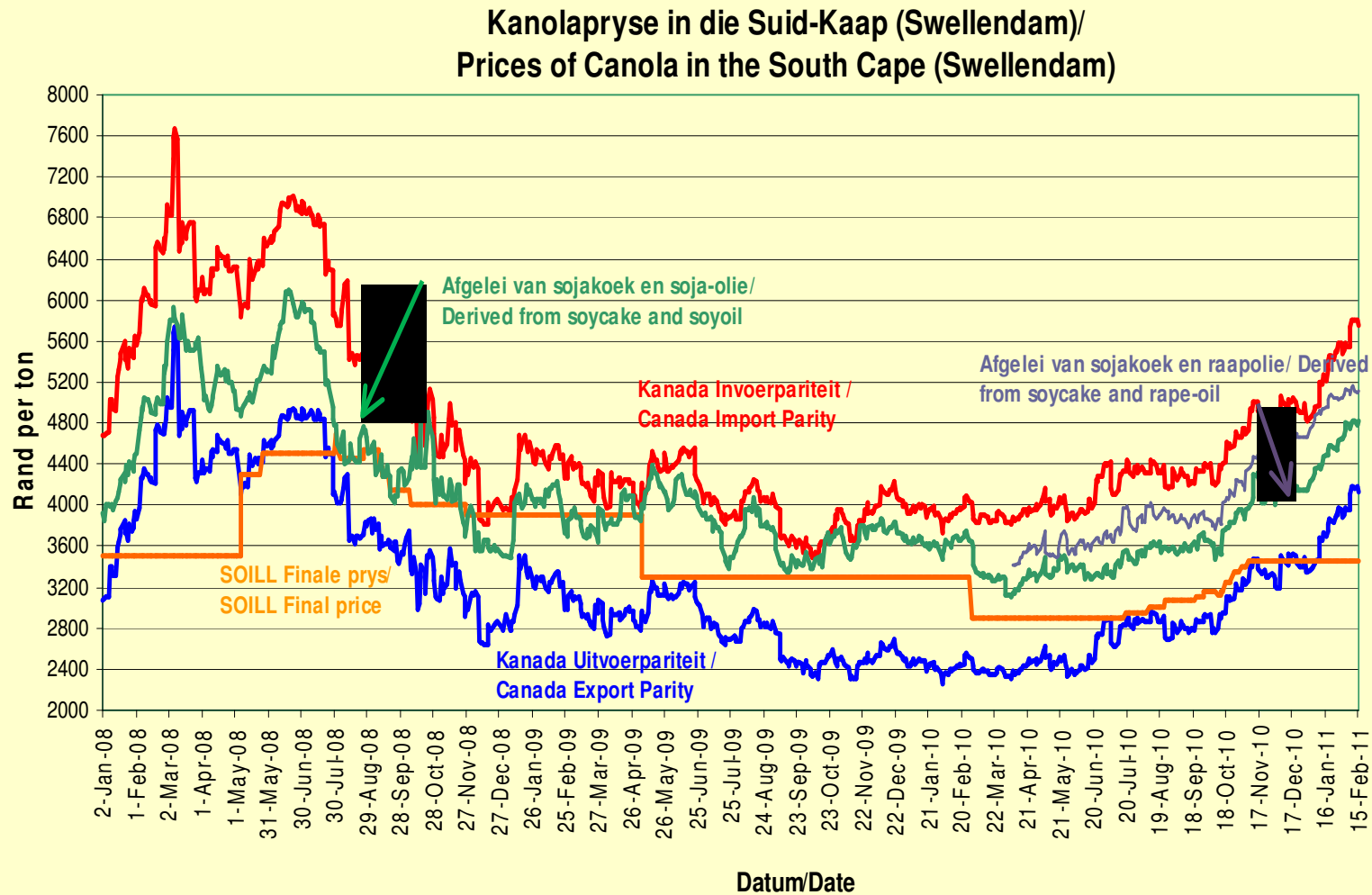
SA prices of biofuel feedstock: Sunflower (SAFEX) (January 2008 – February 2011)



SA prices of biofuel feedstock: soybeans (SAFEX) (January 2008 – February 2011)



SA prices of biofuel feedstock: canola (SAFEX) (January 2008 – February 2011)



SA AGRICULTURE BIO-FUEL PRODUCTION POTENTIAL CONSTRAINTS & NATURAL LIMITS

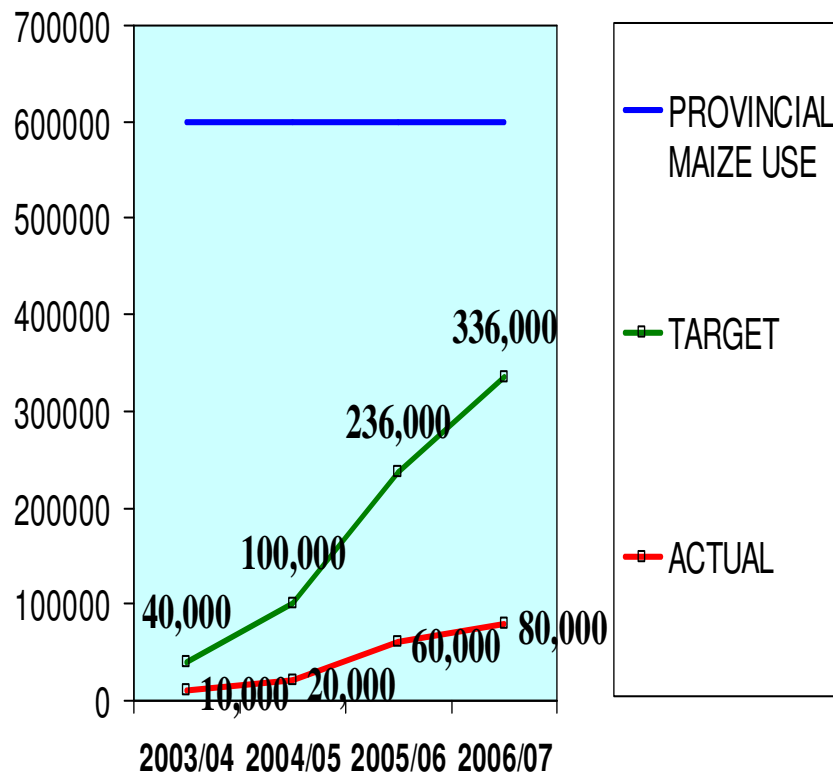
Crop		SA harvest 2003 – 2006				Max.	Biofuel equiv.	Mineral fuel equivalent	
		(thousands of tons)				Harvest	(Million litres)	(Million litres)	
		2003	2004	2005	2006	(th. tons)		Petrol	Diesel
Maize	Yellow	6,366	5,805	6,541	3,538	6,541	2,590 EtOH	1,684	
	White	3,026	3,677	4,909	2,356	4,909	1,945 EtOH	1,264	
Wheat		1,540	1,680	1,905	1,971	1,971	715 EtOH	465	
Sorghum		220	373	260	98	373	145 EtOH	94	
Barley		240	185	225	190	240	85 EtOH	55	
Sugar cane	Cane	23,013	20,419	19,095	21,052	23,013	1,956 EtOH	1,271	
	Sugar	-2,763	-2,419	-2,335	-2,507	-2,755	(1,733) EtOH	-1.126	
	Molasses	-720	-670	-660	-700	-720	(204) EtOH	-133	
Sunflower		656	651	614	595	656	309 B-diesel		286
Soy		127	217	263	400	400	94 B-diesel		80
TOTAL BIO-FUEL PRODUCTION POTENTIAL							EtOH 7,436 MI B-diesel 403 MI	4,833	366

THE SOUTH AFRICAN BIO-FUEL PRODUCTION POTENTIAL

- SA food and feed crops (10-year maximum):
 - ◆ Maize 15 M tons; ◆ Sugar cane 23 M tons;
 - ◆ Wheat 2 M tons; ◆ Sorghum 0.4 M tons;
 - ◆ Barley 0.25 M tons; ◆ Sunflower 0.65 M tons;
 - ◆ Soybeans 0.4 M tons; ◆ Canola 30,000 tons.
- The conversion of South Africa' entire current production of food and feed crops to bio-fuels would bring about 8.25 billion litres of ethanol and 400 million litres of biodiesel, equivalent to 5.35 billion litres of petrol and 370 million litres of diesel (i.e. 45% of South Africa's petrol and 3.5% of diesel consumption in 2009).

SA AGRICULTURE BIO-FUEL POTENTIAL CONSTRAINTS & NATURAL LIMITS

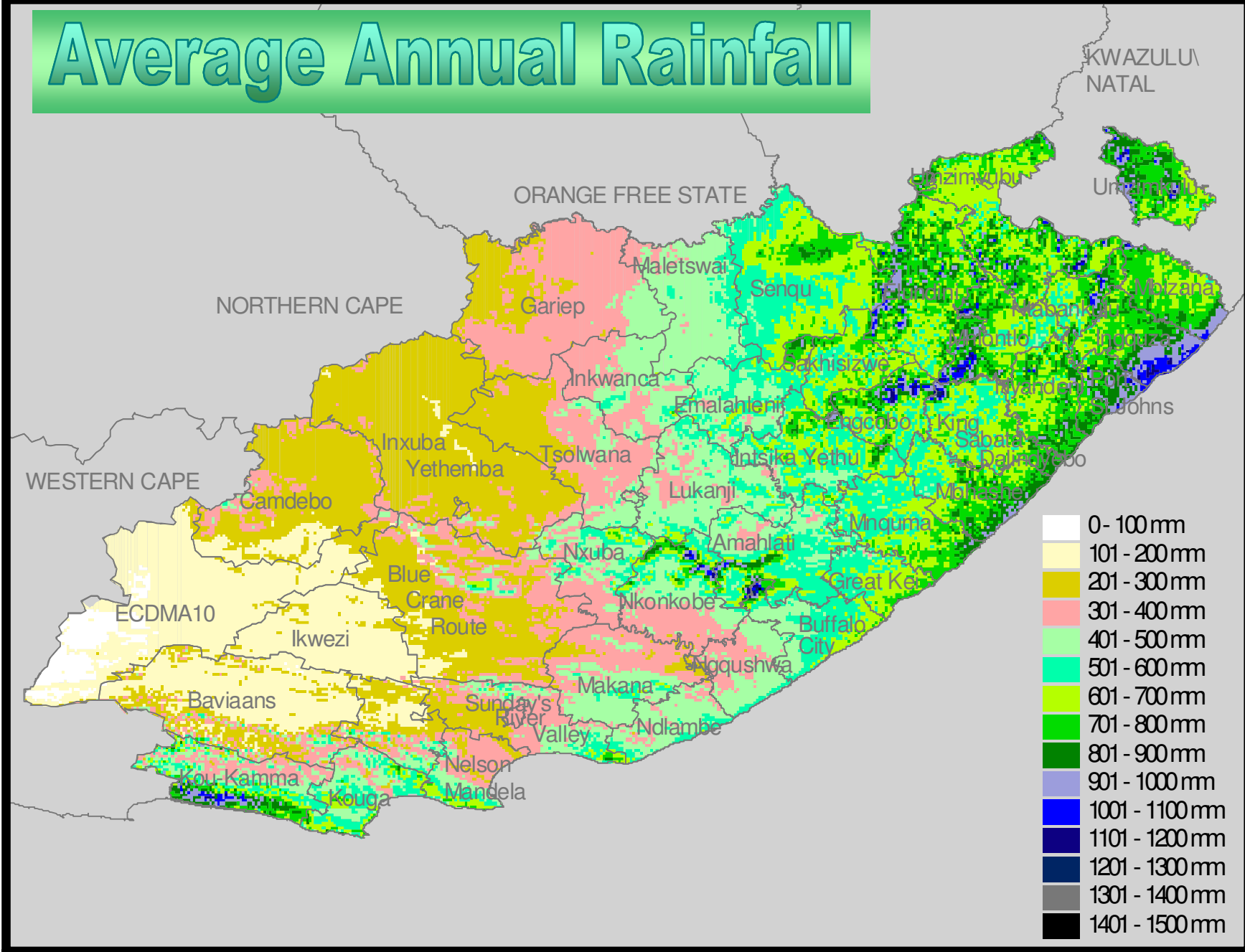
Eastern Cape agriculture's bio-fuel production potential



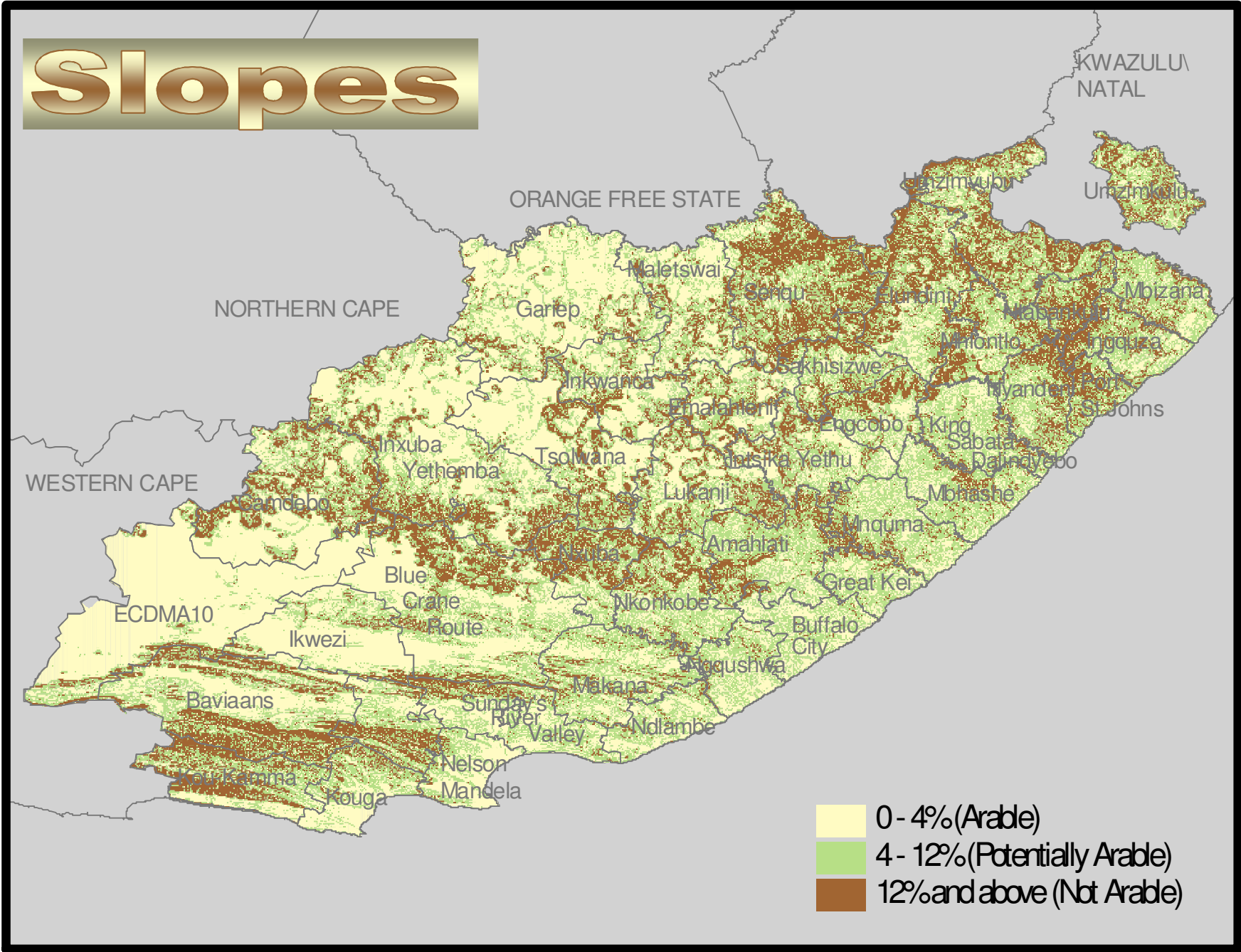
EASTERN CAPE STATISTICS

- ❑ Population: 4.5 million
- ❑ 4 500 commercial farms on 12 million hectares
- ❑ 65,000 agricultural workers (14% of SA total)
- ❑ E. Cape province maize consumption: 600,000 tons
- ❑ E. Cape province maize production: 80,000 tons (13.5% of consumption)

Average Annual Rainfall



Slopes



Maize Potential in Eastern Cape Province

Map: 600 000 ha

➤ >500 mm Rain Nov.- April

➤ >600 mm soil depth

➤ < 6% slope

➤ Suitable soil types

Effectively 250 000 ha

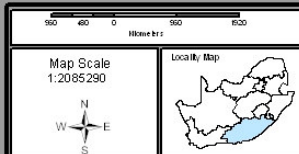
Legend

- Major Towns
- Local Municipalities
- Maize Potential
- Actual Lands

Criteria for Maize Potential :
 Rainfall (Nov - Apr) \geq 500 mm
 Depth: \geq 600 mm
 Avg Slope: \leq 6 %
 Broad Soil Patterns = Aa,Ab,
 Ac,Ad,Ae,Ea,Fa,Fb,Fc,Hb,Ia

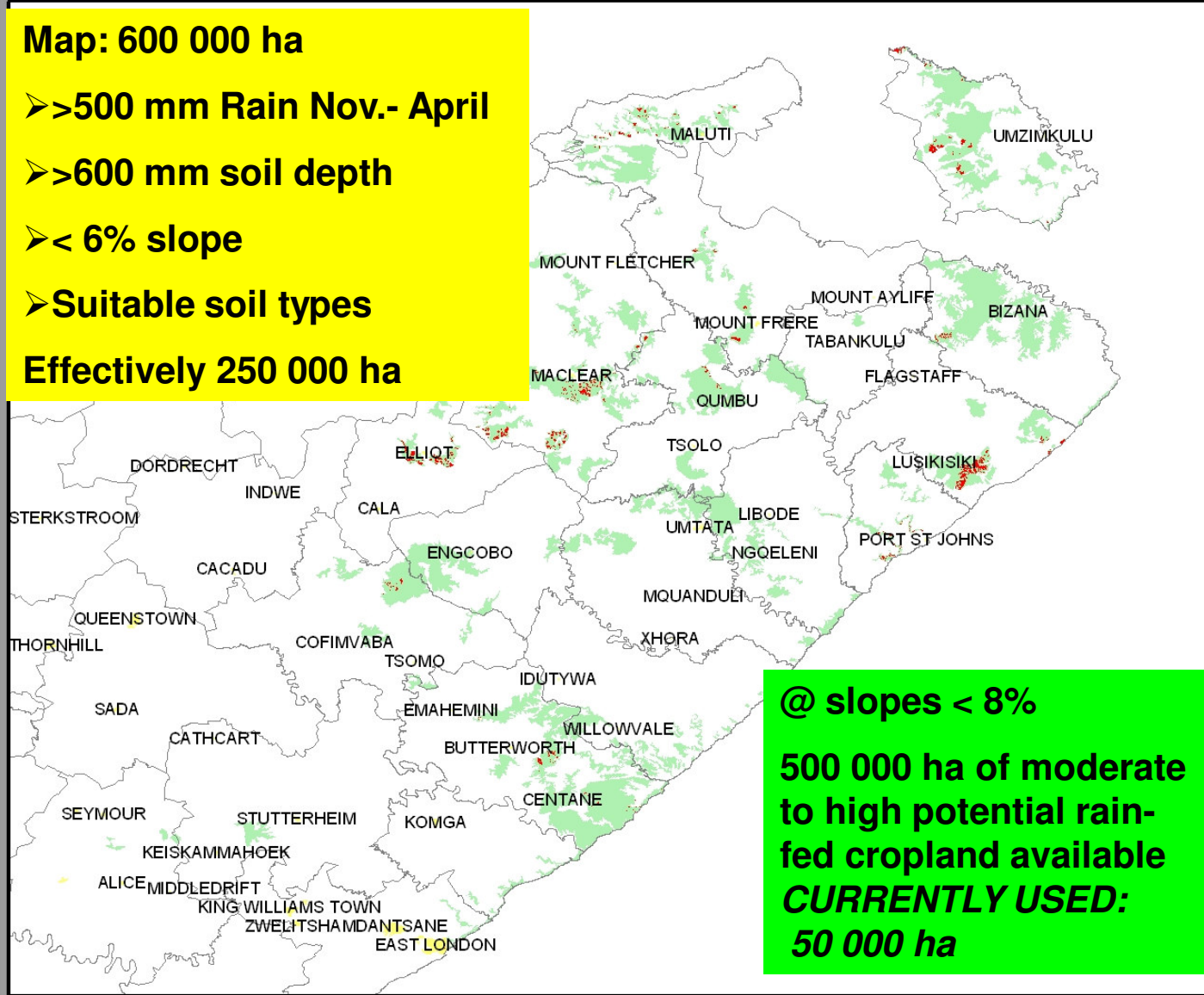
Date: April 2003

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Map produced by:
 Department of Agriculture

J Raath
 PO Box 131
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 5880
 South Africa



@ slopes < 8%
500 000 ha of moderate to high potential rain-fed cropland available
CURRENTLY USED:
50 000 ha

DTI INVESTMENT INCENTIVES: EIP - MIP (1)

Enterprise Investment Programme – Manufacturing Investment Programme (EIP – MIP)

- Launched July 2008. Will remain available until 2014.
- An investment incentive to stimulate investment growth, in line with the National Industrial Policy Framework (NIPF).
- ***Aim:*** To enhance the sustainability of manufacturing investment projects by SME's and to support medium-size investment projects in manufacturing *that would otherwise not be established without the grant.*
- Qualifying projects with Capex R 5 million to R 200 million are eligible for EIP-MIP tax-free investment grant of between 30% and 15% of their qualifying investment costs, calculated on a regressive (sliding) scale, payable over two years.
- Grant max. R 30 million / project.

DTI INVESTMENT INCENTIVES: EIP - MIP (2)

The principle is to use the EIP - MIP incentive to:

- Fill funding gaps where there is not sufficient equity for capitalization of the project;
 - Fill funding gaps where cash flows cannot support more third party debt;
 - Influence location of the project in favour of RSA in case where the investor is considering other countries for locating the project
 - Satisfy the company's internal investment evaluation criteria (IRR or NPV).
- ⇒ **The applicant must demonstrate how the EIP - MIP grant is necessary for the project to proceed.**
- ⇒ **Projects are expected to explore other sources of funding before seeking the EIP - MIP funding.**

DTI INVESTMENT INCENTIVES: TAX INCENTIVES (1)

- Tax incentives (“Investment & Training Tax Allowance” under Section 12i of the Income Tax Act)
- R 20 billion in tax allowances currently available (= R 5.6 billion of tax forgone).

Objective: To increase the competitiveness of manufacturing sectors by promoting / incentivise investment in advanced technologies (new products), equipment and skills.

- Greenfield investment projects (>R 200 M),
- Brownfield / expansion investment projects (>R 35 M), and substantial upgrade projects (re-capitalization / replacement of aged / old technology equipment).

Information and on-line application on DTI website:

- EIP-MIP <http://www.thedti.gov.za/teo/eip.htm>
- “12 i” <http://www.thedti.gov.za/teo/12i.htm>

DTI INVESTMENT INCENTIVES: TAX INCENTIVES (2)

- Criteria (scoring system) to determine the status of projects:
 - (a) Energy efficiency (index: MWh energy consumed per R 1million value added); Benchmarked against applicant's current index (improvement) and industry average,
 - (b) Other environmental considerations (cleaner production etc.)
 - (c) Technology innovation, new products,
 - (d) SME linkages,
 - (e) Employment creation (direct jobs per R 1 million capital investment), and
 - (f) Training (training expenditure as % of wage bill).

NB: To qualify for the incentive, the project must score a minimum of 2 points for (e) + (f).

Biofuel projects in SA

<p>Solid biofuels (wood pellets / granules)</p>	<p>4 projects completed: <ul style="list-style-type: none"> ◆ Biotech Fuels (Howick, KZN), ◆ EC Biomass (Coega), ◆ Sabie and ◆ Richards' Bay; Total capital cost > R 500 M</p>	<p>1 project in liquidation, 3 struggling / in financial difficulties, despite DTI incentives and IDC involvement (Reasons: logistics & freight cost).</p>
<p>Liquid biofuels: Ethanol</p>	<ul style="list-style-type: none"> ◆ Ethanol Africa (maize-to-ethanol) project in Free State. ◆ IDC / CEF sugar beet and sorghum to ethanol (Cradock). 	<p>Project dormant (cancelled?) At post-feasibility stage</p>
<p>Liquid biofuels: Biodiesel</p>	<ul style="list-style-type: none"> ◆ Sasol / CEF soy biodiesel, in Newcastle (R 700 M) ◆ Phyto-Energy (canola) (€ 200 M) ◆ Rainbow (soy) (\$ 200 M), both in Coega / Port Elizabeth 	<p>Project cancelled At post-feasibility stage, struggling to raise capital.</p>
<p>Methane capture from landfills</p>	<ul style="list-style-type: none"> ◆ Alberton (East Rand) (by NECSA). ◆ Cato Ridge (Durban) 	<p>Operating Operating</p>

BIOFUEL PROJECTS – RECIPIENTS OF DTI’s ECONOMIC INCENTIVES

Wood granules (pellets) plants – Biotech Fuels in Howick (KZN)
(capital cost R 175 million)



CASE STUDY: “Phyto-Energy” canola (winter rapeseed) biodiesel project in Eastern Cape (1).

- Investor: a German-Swiss company Phyto-Energy.
 - ▶ Field trials of winter canola in the former homelands Ciskei and Transkei started in 2005, by Phyto-Energy jointly with the East. Cape D o Agriculture. Mixed results, but confirming the potential to harvest 2.5 to 4 tons of canola/ha, under dry-land conditions.
 - ▶ Project summary:
 - 1 million ton/year canola crushing plant + 400,000 ton biodiesel refinery, plus 550,000 ton canola oil cake. 2 trains (200,000 ton biodiesel each);
 - Location: Coega IDZ, Port Elizabeth.
 - A network of silos in canola-growing areas (8 silos).
 - Biodiesel exported to the EU, oil cake and glycerin for SA domestic market.
 - Project capital cost: 200 million Euro.

CASE STUDY: “Phyto-Energy” canola (winter rapeseed) biodiesel project in Eastern Cape (2).

- ▶ **Summary of feasibility study results** (by KPMG, March 2009)
 - *Refinery*: Gross revenue (when operating at full capacity) 585 million Euro (5.85 billion Rands)/annum.
 - Net revenue 250 million Euro/annum,
 - IRR = 49.6%, RoI = 675% over 10 years,
 - *Canola farmers*: Gross revenue R 3.3 billion / annum (1 million tons of canola @ 3,300 Rand/ton).
- ▶ **Project benefits:**
 - 25,000 jobs in agriculture, 125 jobs in the refinery (plus 250 during construction phase), 150 jobs in logistics.
 - Forex earnings 400 million Euro/year from exports of biodiesel to the EU,
 - Forex savings 150 million Euro/year through substituting imports of 550,000 tons of oil cake / protein concentrate.
 - Thanks to crop rotation (winter canola followed by summer crops / maize) the project will not affect food security of the farming communities involved in the project.

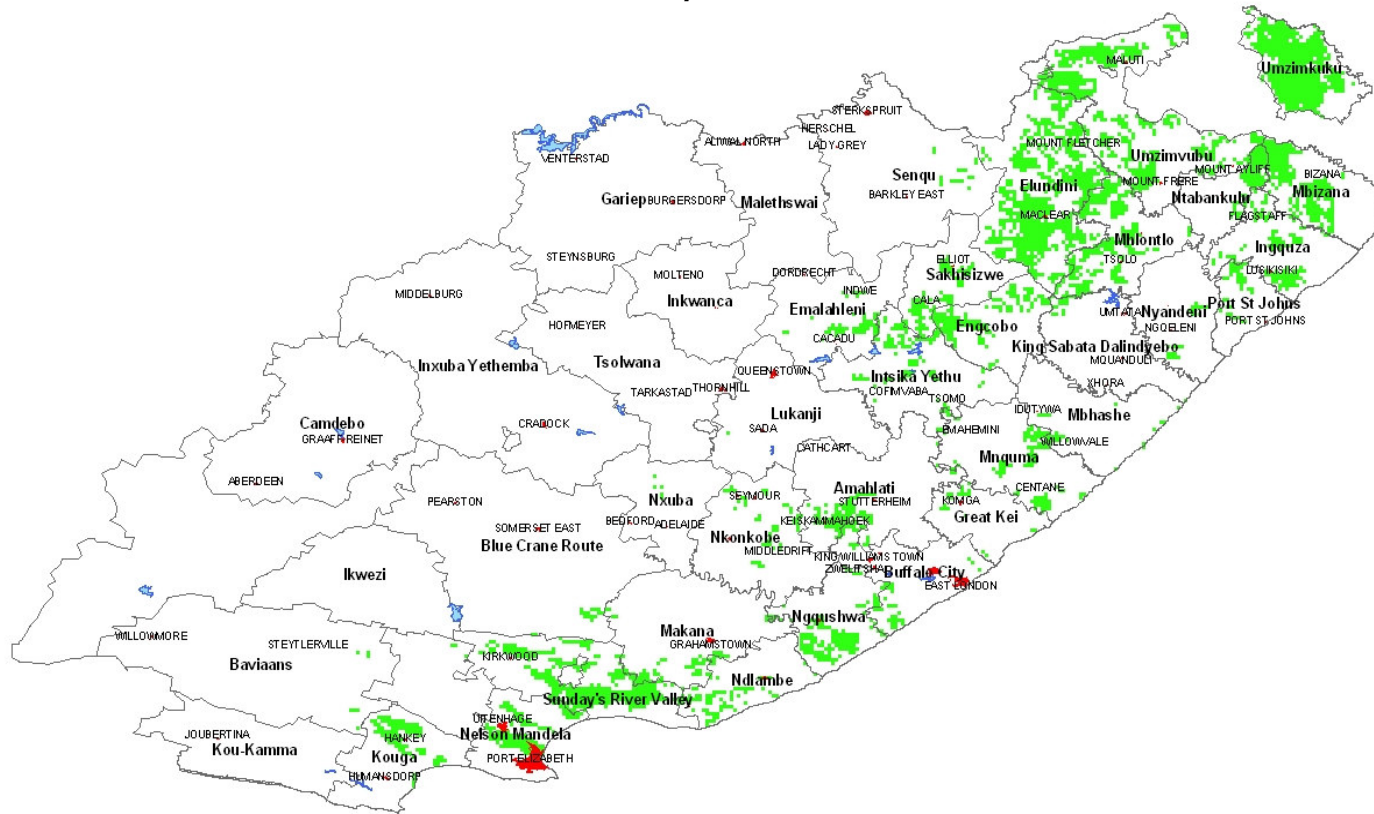
CASE STUDY: “Phyto-Energy” canola biodiesel project in Eastern Cape (3) – LESSONS LEARNT

- ▶ The project is highly profitable if biodiesel is exported to the EU; it becomes not feasible, or only marginally feasible if the biodiesel is sold in South Africa, at the current level of crude oil prices / SA refined fuels' prices / SA incentives (50% rebate on fuel levy).
- ▶ Feasibility study completed, debt finance for the construction of the refinery is available, but the investors are struggling to raise funds to finalize the basic engineering and the environmental impact assessment (EIA) ⇒ bring the project to financial closure.
- ▶ Project (the canola farming part) perceived as risky; limited interest / appetite for risk among SA fuel companies and SA financial institutions.
- ▶ Project supported by DTI's grant under the offset (NIP) programme.

Canola Dryland Potential in Eastern Cape Province

The map shows: c. 600 000 ha @ slopes < 12 %

Estimated c. 300 000 ha @ slopes < 6 % ??



Legend

- Dams
- Major Towns
- Local Municipalities

Canola

- Suited

Criteria from ARC:

- Rainfall April - October (mm): ≥ 200
- Avg Max Temperature Jun - Sept ($^{\circ}\text{C}$): ≤ 25
- Soil Categories: 1,2,3,5,6,7
- Average Soil Depth (mm): ≥ 400
- Average Soil clay percentage: ≥ 10
- Average Slope (%): ≤ 12
- Average pH: ≥ 4.8

Date: June 2004

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Meters

Map Scale

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Locality Map



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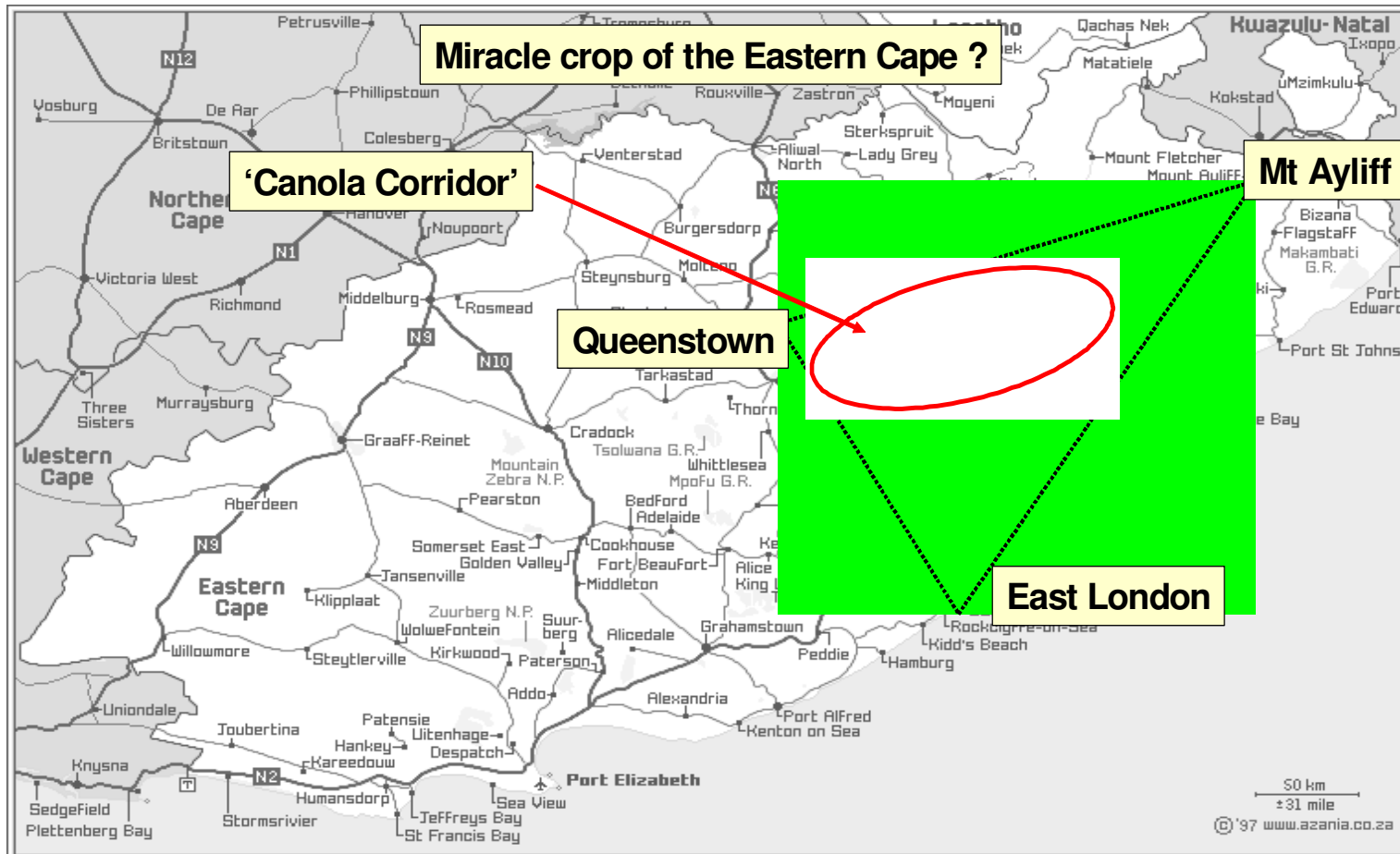


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The Eastern Cape “Canola triangle”

(details: Phyto-Energy (Germany) and KPMG (JHB))



Canola field trials in Eastern Cape

(Ugie / E. Cape, 2005 – canola harvest 1.8 tons/ha)



MOVING FORWARD: SOLUTION TO THE PROBLEM

- Review of the 2007 National Biofuels Strategy requested by the Cabinet of Ministers.
 - Not a single commercial-scale liquid biofuel project has materialized in SA in 2008 – 2010 despite record-high prices of crude oil,
 - SA incentives do not seem to be sufficient to attract investment in biofuels (case study – Phyto-Energy)
- Looking beyond biofuels - adding value to by-products
 - Sugar cane: converting biomass (bagasse) to electric energy – subject to favourable feed-in tariffs (potential for adding 1,200 MW to the national grid).
 - Corn cobs: conversion to furfuryl aldehyde?
 - Soy meal: conversion to food-grade protein concentrate ?
- The promise of 2nd generation biofuel technology
 - Cellulosic ethanol, biomass-to-liquids, algal biodiesel....WHEN?

CONCLUSIONS, QUESTIONS



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