

Biofuels in South Africa and The Tripartite White Paper



Sara Prins
2nd Biofuel Conference
19-20 March 2009 (Brussels, Belgium)

Your measure of excellence

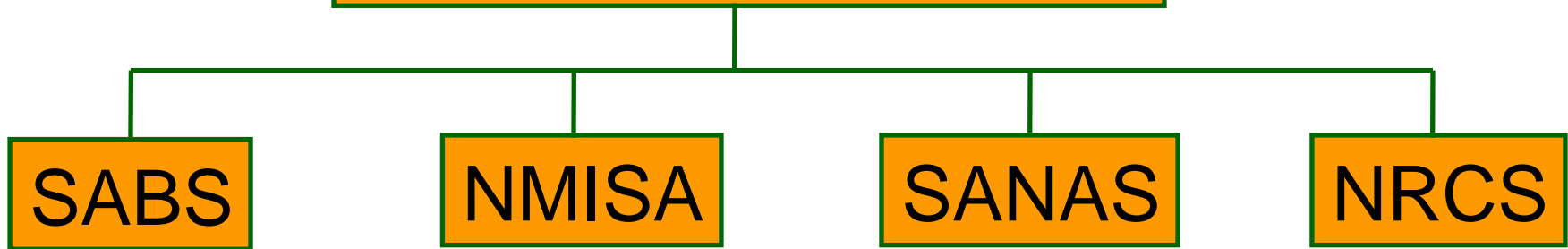
Overview

- History of Biofuels in South Africa
- The South African Technical Infrastructure
- Biofuel status in South Africa
 - National Biofuel Strategy
 - National standards
 - Feasibility
- The Tripartite White Paper
 - The South African Alignment
 - The NMISA FAME project
- The Regional Scenario
- The Road Forward

History of Biofuels in South Africa

- **1930's**
 - Vegetable oil powered heavy duty vehicles
- **1970's**
 - War in Middle East – global fuel crisis
 - Sunflower oil investigated in SA, chemical method to do a conversion to allow usage in diesel engines
- **1980's**
 - Crude oil dropped too much for biofuel to be feasible
- **1990's - now**
 - Climate change issues, Kyoto protocol... new drivers
 - Fears for sustainable fossil fuel supplies
 - World wide drive to alternative energy...
 - Government Biofuel Strategy Document and tax incentives
 - Energy intensive economy

Technical Infrastructure



The Department of Trade and Industry ‘revamped’ the Technical Infrastructure:

- The Standards Act, Act 8 of 2008 (SABS – documentary standards)
- The National Measurement Unit and Measurement Standards Act, Act 18 of 2006 (metrology – measurement traceability, reference materials/methods)
- The Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 Act No. 19 of 2006 (SANAS – accreditation)
- And the National Regulator for Compulsory Specifications Act, Act 5 of 2008 (legal metrology, conformance)

South African Biofuels in Government



- **The Department of Minerals and Energy**
 - Custodians of Biofuels in South Africa
 - Paper on Renewable Energy
 - Biofuel Strategy
- **Department of Trade and Industry**
 - Technical infrastructure supporting standards and trade policies
- **Department of Science and Technology**
 - Biofuels part of Corporate Strategy
 - Support research in related fields
 - Deployment of appropriate technology and the initiation of support for R&D activities (local production of biofuels for local users in public transport system)
- **Treasury**

Small biofuel plants:

 - Tax incentives: 40% rebate for bioethanol* and biodiesel
 - 100% rebate on <300 000 liter pa
 - Accreditation by SARS for tax rebates

South African Biofuel and its supporting Strategies

- Accepted Dec 2007
 - 4,5% market penetration (liquid road transport fuels) by 2013
 - Based on local production only
 - Tax incentives
 - Maize excluded
- November 2003: White Paper on Renewable Energy
 - 50% of SA's energy must be from renewable sources by 2013
 - Biofuels constitute 20-50% of renewable energy
 - Currently import 60% crude oil requirements
- Accelerated and Shared Growth Initiative South Africa
 - Special funding 2006-2009 to build infrastructure
 - Halve poverty and unemployment by 2014
 - Mainly transport and energy industries

Standards Development in South Africa

- **Issued:**
 - SANS 1935: Automotive Biodiesel Fuel
 - SANS 1598: Unleaded Fuel
 - SANS 465: Denatured Fuel Ethanol for Blending with Gasoline
 - SANS 342: Automotive Diesel Fuel
 - SANS 448:2007: Ethanol Gel for Cooking and other Burning Appliances
- **Under development:**
 - SANS 833:2008 Biofuel Production – Quality management system: Producer Requirements

Biodiesel (I)

Property	Requirements	Test method ^a
Ester content ^a , % mass fraction, min	96,5 ^b	EN 14103
Density at 15 °C ^c , kg/m ³	860 – 900	ISO 3675, ISO 12185
Kinematic viscosity at 40 °C ^d , mm ² /s	3,5 – 5,0	ISO 3104
Flash point, °C, min	120	ISO 3679 ^e
Sulfur content, mg/kg, max	10,0	ISO 20846, ISO 20884
Carbon residue (on 10 % distillation residue) ^f , % mass fraction, max	0,3	ISO 10370
Cetane Number ^g , min	51,0	ISO 5165
Sulfated ash content, % mass fraction, max	0,02	ISO 3987
Water content, % mass fraction, max	0,05	ISO 12937
Total contamination ^h , mg/kg, max	24	EN 12662
Copper strip corrosion (3 h at 50 °C), rating, max	Class 1	ISO 2160
Oxidation stability, at 110 °C, h, min	6	EN 14112
Acid value, mg KOH/g, max	0,5	EN 14104
Iodine value, g of iodine/100 g of FAME, max	140	EN 14111
Linolenic acid methyl ester, % mass fraction, max	12	EN 14103
Polyunsaturated (> = 4 double bonds) methyl esters ⁱ , % mass fraction, max	1	-
Methanol content, % mass fraction, max	0,2	EN 14110
Monoglyceride content, % mass fraction, max	0,8	EN 14105
Diglyceride content, % mass fraction, max	0,2	EN 14105
Triglyceride content ^j , % mass fraction, max	0,2	EN 14105
Free glycerol ^k , % mass fraction, max	0,02	EN 14105, EN 14106

Biodiesel (II)

Total glycerol, % mass fraction, max	0,25	EN 14105
Group I metals (total of Na and K) ^k , mg/kg, max	5,0	EN 14108, EN 14109
Group II metals (total of Ca and Mg), mg/kg, max	5,0	prEN 14538 ^l
Phosphorus content, mg/kg, max	10,0	EN 14107

- SANS 1935: Automotive Biodiesel Fuel (2004)
- Based on European Standard EN1214
- Iodine level slightly higher as identified SA crops have higher levels
- SABS R&D to investigate 6 more oils

Economic Indicators / Feasibility

Table 1: Economic indicators – Baseline projections.

Item		2007	2008	2009	2010	2011	2012
Crude Oil Persian Gulf: fob	\$/barrel	63.22	60.79	57.01	53.44	51.41	50.33
Population	Millions	47.68	47.65	47.54	47.39	47.22	47.04
Exchange Rate	SA c/US\$	715.96	754.65	785.38	811.13	828.40	844.66
Real per capita GDP	R/capita	17600.81	18390.69	19233.4	20120.7	21042.24	22017.87
CPIF (Inflation)	Index ('00)	217.55	227.28	237.37	247.18	257.23	267.53

Source: Global Insight FAPRI Actuarial Society ARSA as quoted in the 2006 RFAP baseline.

Table 3: Plant profit calculations, 2006 average prices.

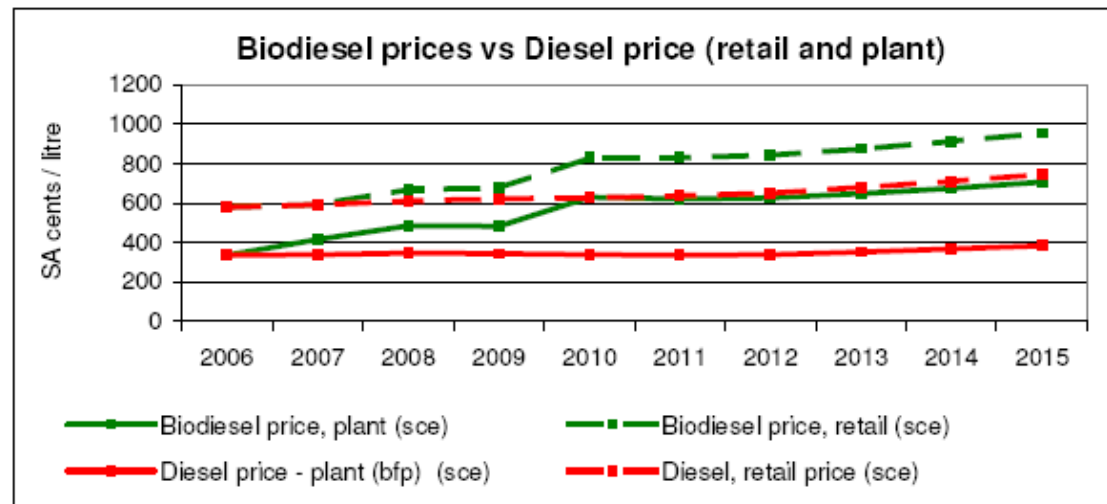
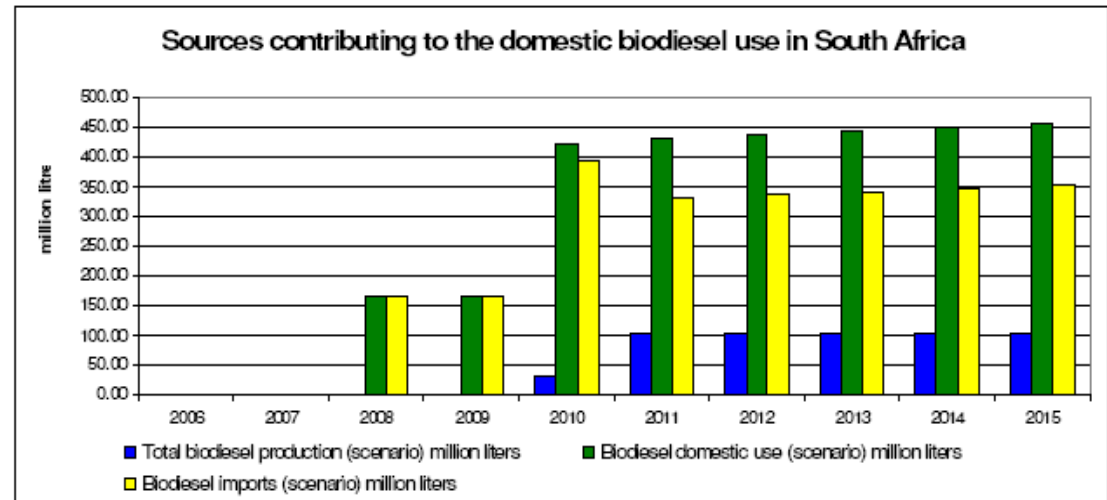
Commodity*	Cost of feedstock (R/ton)	Income from by-product (R/ton)	Income from sales (c/litre)	Total costs of production (c/litre)	Profit (c/litre)
Sugar cane (Eth)	193	-	312.91	165.59	-89.87
Yellow maize (Eth)	1310	1092	312.91	171.54	-101.80
Soybeans (BIOD)	1959	2076	336.45	212.67	-29.87
Sunflowers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

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

	Sugarcane-							Soy						
	Crude Oil price (US\$/bbl)							Crude Oil price (US\$/bbl)						
	40	52	64	76	88	100		40	52	64	76	88	100	112
6.20	-22%	-9%	3%	15%	27%	39%	6.20	-26%	-12%	2%	16%	30%	43%	57%
6.36	-20%	-8%	5%	17%	30%	42%	6.36	-24%	-10%	4%	18%	33%	47%	61%
6.53	-19%	-6%	7%	20%	32%	45%	6.53	-23%	-8%	6%	21%	36%	50%	65%
6.69	-18%	-4%	9%	22%	35%	48%	6.69	-21%	-6%	9%	24%	39%	54%	69%
6.85	-16%	-3%	11%	24%	38%	51%	6.85	-19%	-4%	12%	27%	43%	58%	73%
7.02	-15%	-1%	13%	27%	40%	54%	7.02	-17%	-1%	14%	30%	46%	61%	77%
7.18	-13%	1%	15%	29%	43%	57%	7.18	-15%	1%	17%	33%	49%	65%	81%
7.35	-12%	2%	17%	31%	46%	60%	7.35	-14%	3%	19%	35%	52%	68%	85%
7.51	-11%	4%	19%	34%	48%	63%	7.51	-12%	5%	22%	38%	55%	72%	89%
7.67	-9%	6%	21%	36%	51%	66%	7.67	-10%	7%	24%	41%	59%	76%	93%
7.84	-8%	7%	23%	38%	54%	69%	7.84	-8%	9%	27%	44%	62%	79%	97%
8.00	-6%	9%	25%	41%	56%	72%	8.00	-6%	11%	29%	47%	65%	83%	101%

Biodiesel Predictions

- Relative shortage of biodiesel feedstock in SA
- Expect the price of biodiesel to trade well above the wholesale price of fossil diesel
- Increases in price:
 - Mandatory blending (2008/9)
 - Increased levels of blending (2010/11)
 - 30% import tariffs (2012)
- Break-even US\$60/bbl



Biofuel Plants in South Africa

- **CEF and Sugar Beet Africa**
 - large-scale 90-million-litres bioethanol production plant in Cradock, Eastern Cape (sugar beet is abundant crop in Eastern Cape) to start construction in 2009, operational 2011
- **5 small manufacturers**
 - Savral Biodiesel
 - SATO Biodiesel
- **2 SARS accredited facilities**
- **Current biodiesel produced used for fleet, trucks, farming, marine**
- **No large-scale commercial biodiesel plant**



Shaval Biodiesel:
Transestification takes place in a 1400 litre vessel constructed from stainless steel

Alignment to the Tripartite White Paper

- Feedstocks: identified
- SA standards based on EU and USA standards
- Current blend limits
 - (No pump labeling required)
 - Bioethanol 5%
Fuel specification for blended gasoline addresses water content
 - Biodiesel 2%
Standard in place, but no commercial blending yet
- Task group for Production
- Task group for Quality System for Supply Chain Management
- National test laboratory
- Development of reference methods and CRMs

Background to the NMISA FAME project

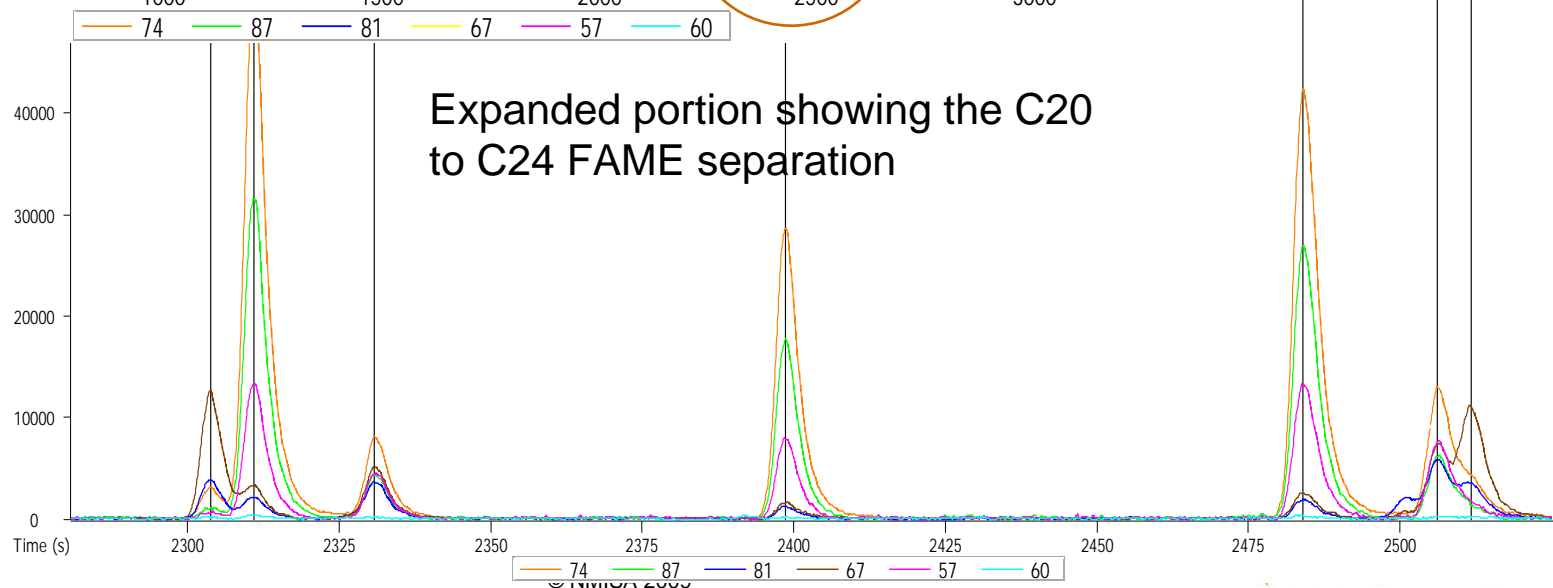
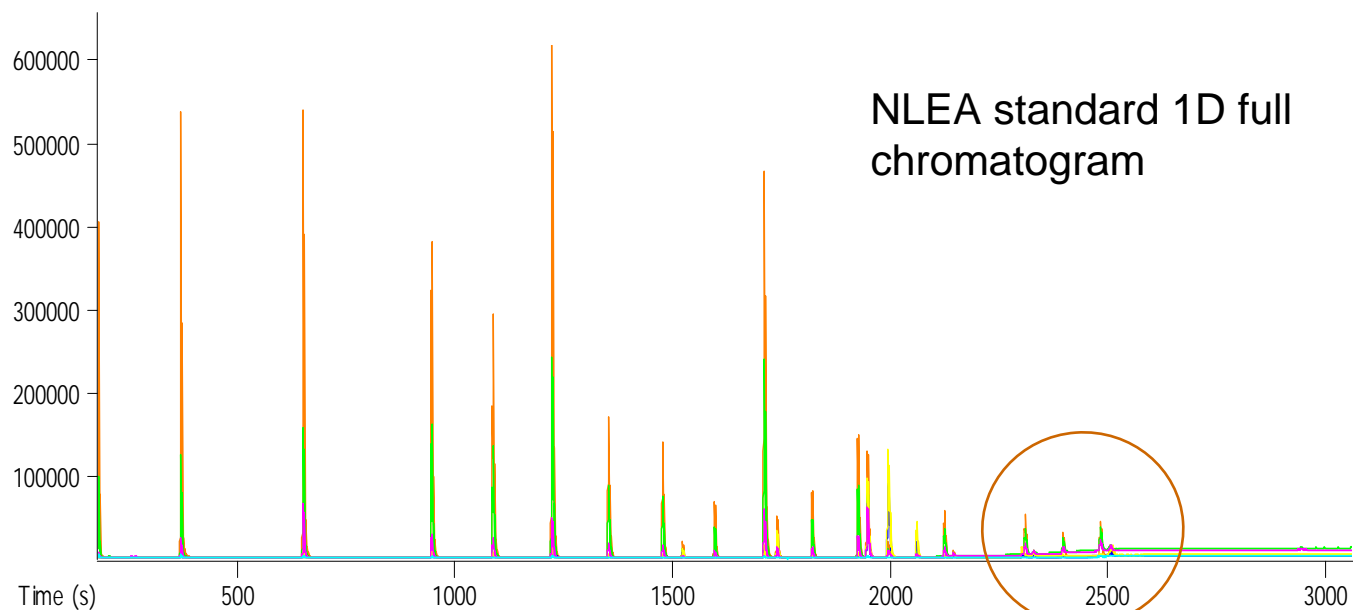


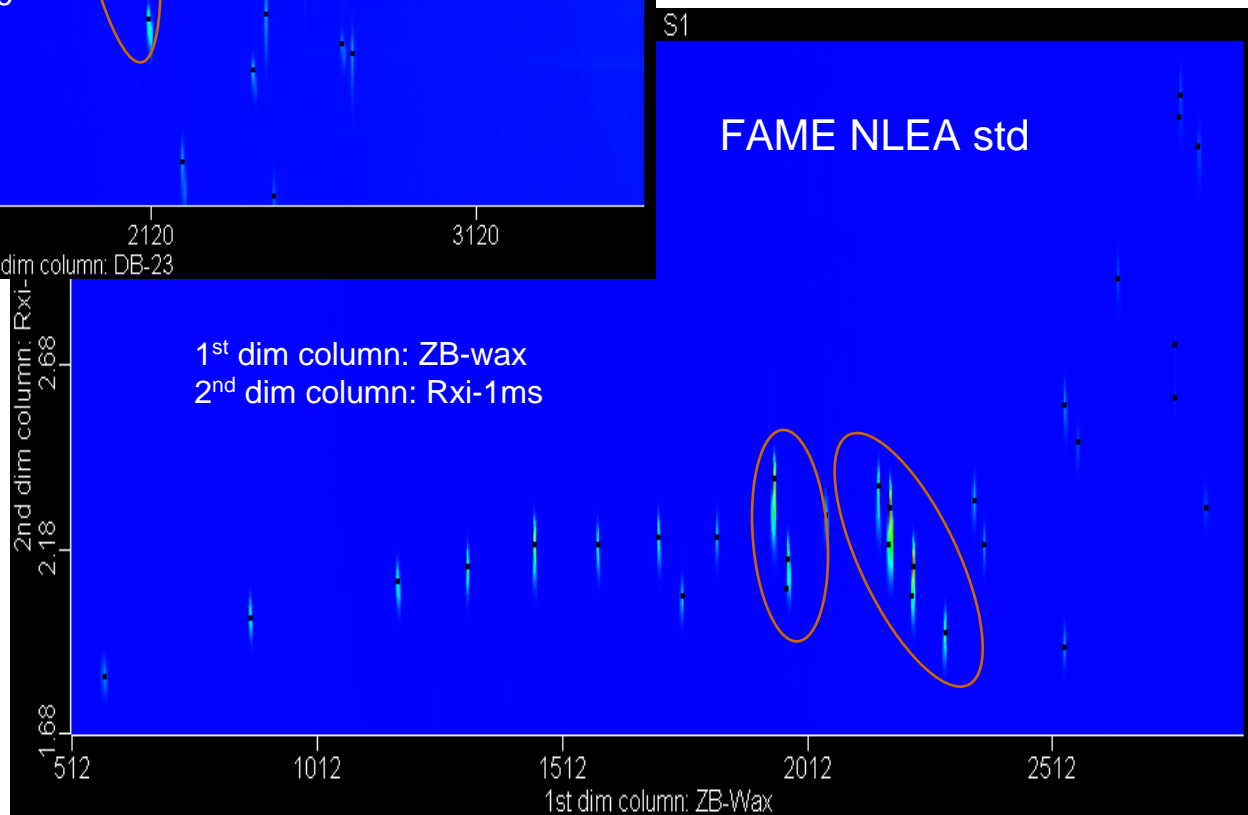
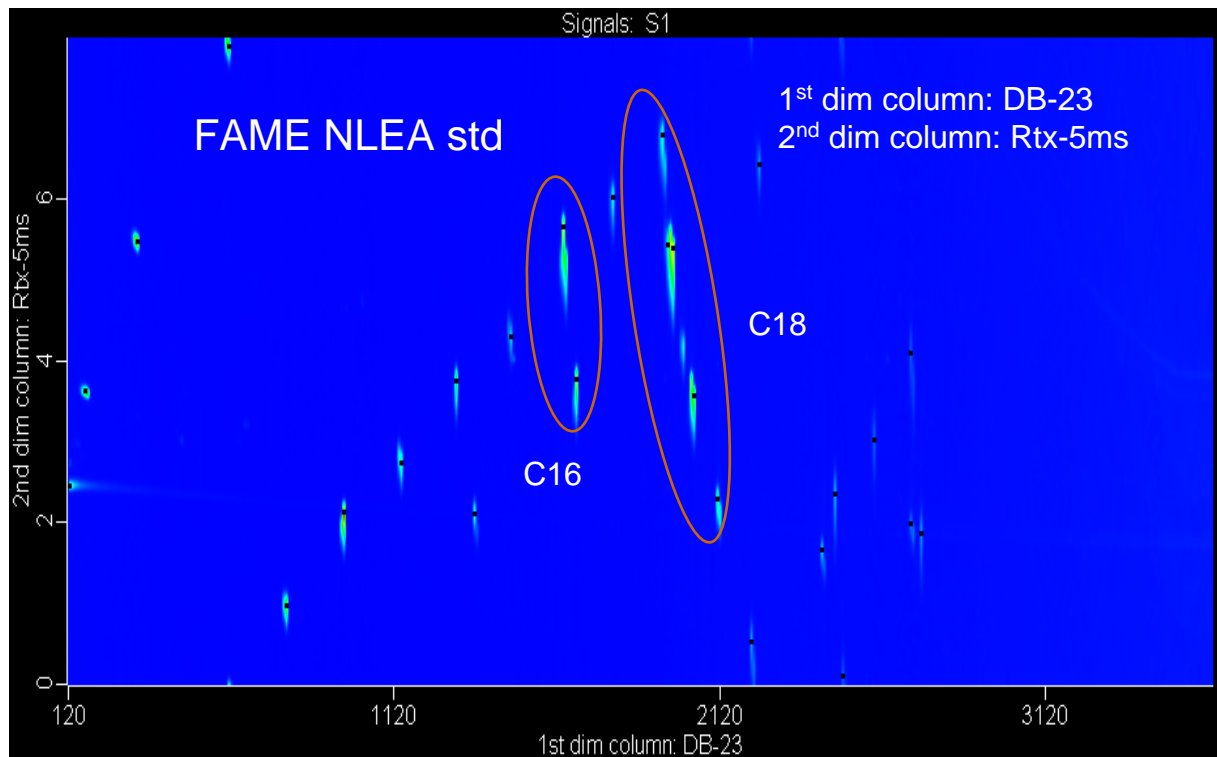
- Fatty Acid Methyl Esters analysis is important, both for the food industry and in the biofuels area, where these compounds form the major components
- In the biofuels market, the need to differentiate between *cis* and *trans* double bond isomers is not important as the naturally occurring FAMEs are almost exclusively *cis* double bonds
- With this in mind, analysis of FAMEs in biodiesel produced from plant material can be undertaken using GC-FID or GC-MS
- This allows for the determination of fatty acids differing by carbon number and unsaturated FAME isomers differing by the number and position of the double bonds in the compound

Approach to FAME project

- The NMISA and LECO Separation Sciences decided to establish a GCxGC-FID screening method for the analysis of a FAME standard (Restek NLEA FAME Mix, cat 35078)
- Most laboratories do have access to GC-FID (although probably not GCxGC)
- A GC-TOFMS method was also developed in order to identify the individual FAMES in the specific standard
- Column considered was a ZB-Wax (highly polar) for the GC-FID/ TOFMS analysis and for the GCxGC-FID analysis, a Wax in the 1st dimension and an Rtx-5 in the 2nd dimension was used and also a DB-23/ Rtx-5 was used
- The chromatograms for the GCxGC separation using both a Wax and DB-23 are shown
- Samples from Thailand (*Jatropha Curcas Linn* & Palm Oil) and SA were compared
- Results were quantified using the NLEA standard

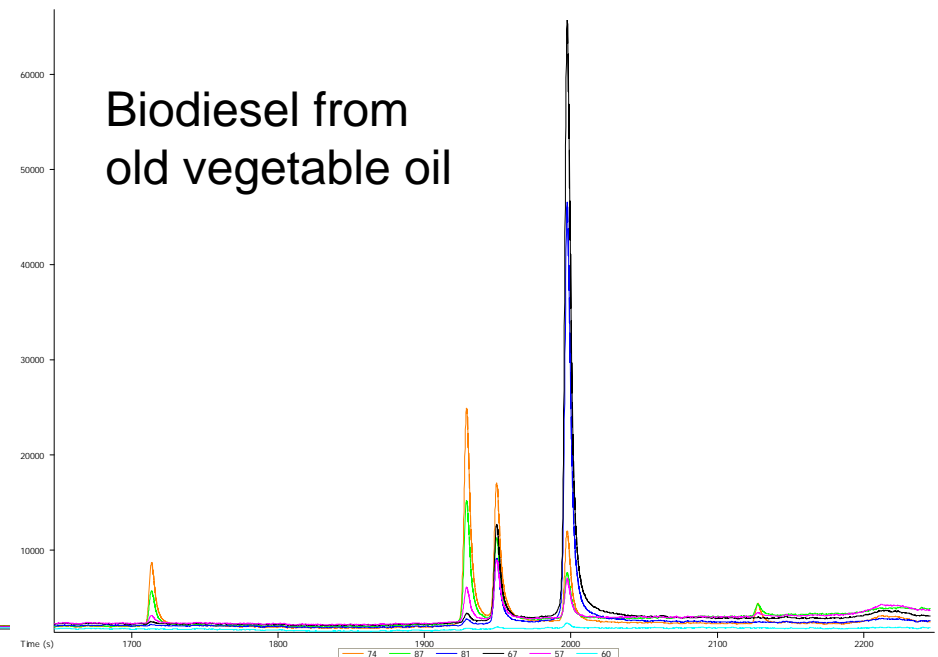
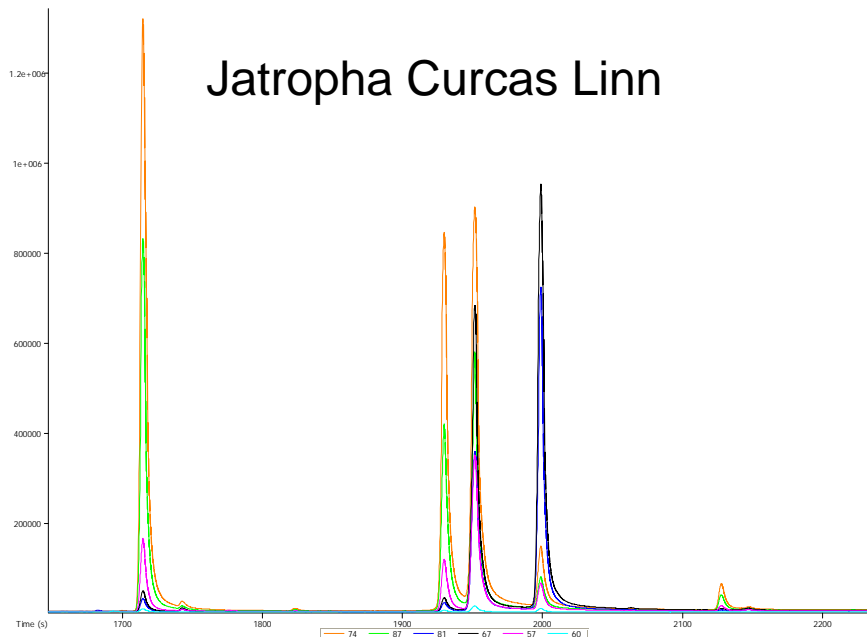
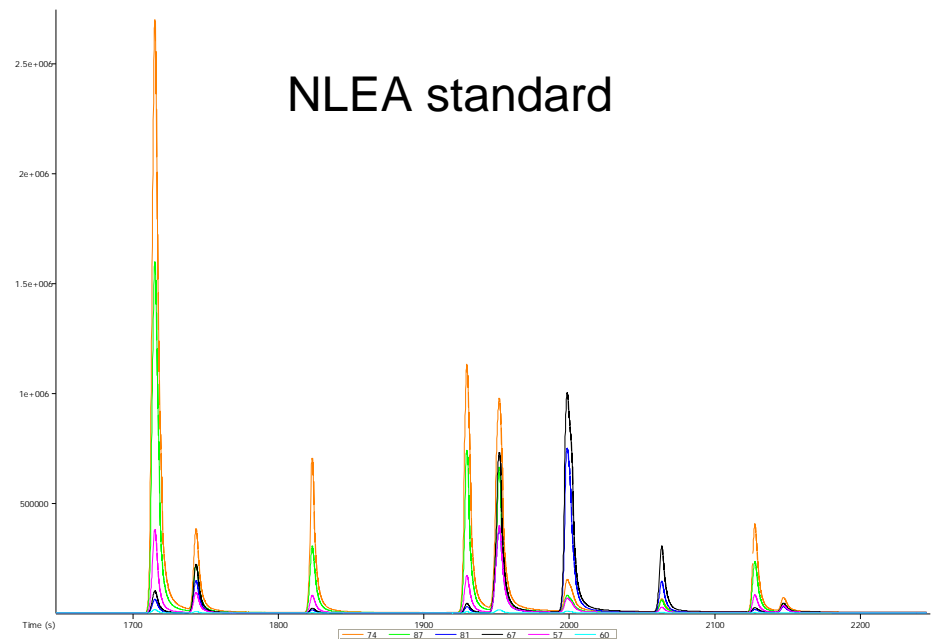
GC-TOFMS (and GC-FID) analysis





Fingerprinting?

- The NLEA standard was used to quantify the FAME compounds in the Thailand and SA biodiesel samples
- Below is an example of the C16 and C18 GC-TOFMS results obtained for two of the samples



SABS Biodiesel Assessment

- Samples from 26 small manufacturers were analysed
- 2 of the participants were SARS accredited
- Results still being processed, and will be published in near future

The Regional Scenario: SADC

- 14 countries, 220 million people
- SADC discussed regional strategy in 2008
- Need for close regional cooperation
 - Industry
 - Agricultural
 - Financial
 - Technical services
 - Challenges
- Landlocked countries have higher fuel prices
- Typically smaller markets
- Different concerns to EU, USA, and different support structures



The Road Forward

- Ensure alignment of SANS with the recommendations of the Tripartite White Paper
- Accessible, easy and affordable QC methods for especially small biofuel producers
- International comparison (all parameters) between NMIs to establish comparability and identify areas that require analytical support
- Range of CRMs – especially for biodiesel
- Mine rehabilitation for biofuels (vs nuclear energy...)
- Improved communication between all stakeholders in SA

Conclusions

- South African biofuel industry (especially biodiesel) still in infancy stage
- Lack of incentives, no farming subsidies
- Adopted national standards for bioethanol and biodiesel
- Reference methods under development to characterise different types of biofuels based on the 26 FAMES (fingerprinting)

the energy challenge

***there is no single solution, and great skill
is needed to find the optimum mix of
solutions for different circumstances***

thank you