BIOFUELS AS A FUTURE SOURCE OF ENERGY FOR WOMEN IN RURAL SETTLEMENTS IN SOUTH AFRICA

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ABSTRACT

Gender issues continue to play a vital role in the development of policy for energy. Energy poverty creates a set of social problems that impact on the home and its occupants, with differing degrees depending on the circumstances. But no matter what the circumstances, energy poverty has an impact on the ability of home to be run affordably and efficiently and for the residents of the home to be able to use the home space as a place for local economic activity. Energy is a basic need for all people and the hardships of energy poverty need to be addressed through a number of the Millennium Development Goals. This paper looks at a particular energy supply, that which comes from biofuels. The needs of the rural poor in terms of energy supply is examined and biofuels are looked at terms of how this energy supply could become part of a pro poor strategy particularly among women. The issue of increasing oil prices is looked at and it is noted that South Africa, like the rest of the world is looking for alternatives. Biofuels seem an obvious one as they substitute directly for liquid fuels while still using the same machines/equipment that utilise liquid fossil fuels. There is an opportunity now to make the biofuels industry a pro poor process, if it is done correctly. However, if the biofuels sector is driven in the wrong way it could cause greater poverty, through competition for land and thus rising food prices, or through the increase in industrial agricultural processes in the quest for more liquid energy to fuel SUVs and to keep unsustainable lifestyles afloat. Recognizing that there are potential issues around the biofuels industry and working on a number of assumptions contained within this paper, EcoSasa has developed a proposal for how to develop the biofuels industry in a way that creates jobs in rural settlements, protects land from erosion and the impacts of poor industrial agricultural practice, stimulates additional local economic development within rural areas, as well as bringing energy to the most energy poor of the country, the rural communities and thus rural women. All of this can take place while at the same time making available the surplus biofuel product to other non rural areas, thus improving the energy security of South Africa. EcoSasa's proposal is that perennial crops be favoured over annual crops not only because they can be grown sustainably on non arable and marginal land, but also because their energy inputs/output ratio is far better over the lifetime of the crop than annual crops. Monocropping is discouraged to favour a food forest approach that enables small scale subsistence farmers to maintain household level food security as well as to develop other economic activities that contribute to sustainable livelihoods within these poor communities.

INTRODUCTION

Gender and energy

Energy provision, during the era of industrialization, focused on large scale, centralised, high power energy production from fossil fuels, mostly coal in the case of South Africa. It was top down and patriarchal in its approach and women have been, and continue to be, excluded from this sector. This is the core of the first economy, one based on production which mostly uses the grid and mass electrification as its energy source, although some

sectors use coal directly. It has doubtless been successful as an economic growth process and there is much evidence to show that large scale energy production and first economy economic growth are tightly linked[i]. Large numbers of people, both women and men are excluded from energy services that are provided through this top down system, but it is undoubtedly women, and in particular rural women who are most excluded. The first economy tends to ignore the second economy, the one dominated by women and run out of homes and in the streets where the energy component is small but critical. Of the 1.3 billion of the poorest people in the world, 70% of these are women. These people are energy poor, in that they have an absence of choice in the energy they access or use in their daily lives. Biomass plays an enormously important role in the lives of the rural poor in developing countries, in the form of wood for cooking and heating. But it is not just the poor in the rural areas that struggle. Centralised energy production is expensive and most poor urban households cannot afford to pay for electricity for most of their needs. A recent study by AFREPREN (Mapoko and Dube) confirmed this for other parts of Africa also, that energy services have been priced out of the reach of the poor. An alarming statistic is that poor households spend about 15-28% of their income on energy, which creates massive opportunity losses in the lives of these poor people as money they could use for education or improving the quality of their lives goes on providing for a basic need. But more importantly, the first economy is the beneficiary of this expenditure, the distributors of paraffin, coal and electricity, which is mostly owned by large energy providers with small gains for the small scale supplier. It is essentially a drain on the local economy; money spent on fossil fuel energy does not remain within the local community to contribute to the multiplier effect. It also means that in order to continue purchasing this energy, the poor must be able to secure income from this first economy in order to be able to purchase from it, and this is often not the case; most people in the second economy rely on social grants and many live below the bread line.

Why gender and energy

Women and men have different roles in the energy system: women bear the main burden of providing and using biomass energy for cooking. A situation made worse by fuel scarcity and negative health and safety impacts

Women bear the invisible burden of human energy crisis – their time and effort in water pumping, agricultural processing and transport. They need modern and more efficient energy sources to improve their work and quality of life both within and outside the home

Women have less access than men to the credit, extension, land and training, necessary for improving energy access to support their livelihoods and income generation from micro enterprises

Women and men have different kinds of knowledge and experience of energy, either through their traditional roles, their new traditional roles or increasingly as professionals in the energy sector

Since women experience poverty differently to men, they may need different energy policies to help them escape energy poverty: new energy technologies can even have unintended negative consequences for women, as has happened in the past with other technologies

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Gender issues related to energy have largely been ignored for much of the industrialized era, when energy production became centralized and a big business in recent times. But gender issues are starting to make an appearance in policy debates in more recent times. Up to this point, the concept of gender neutrality was applied to energy service planning, assuming that women and men had the same needs for energy services

Such gender blind planning is now becoming exposed as unsustainable and attempts are being made to redress these issues.

It would be a mistake to think of the poor, or of women, as passive players in the top down, energy intensive development paradigm, or as inactive and economically unproductive. A recent survey done in South Africa showed that the informal sector in South Africa contributes 10% to the total retail sales with approximately 1.8 million people inputting at this level, or 12% of the labour force (UNISA Bureau for Market Research Feb 2004). Other reports indicate that the majority of informal sector enterprises are owned and operated by women and are usually survivalist and extensions of the households. But this is only a small fraction of the real value that women play in an economy, women are central in other reproductive, productive and welfare activities for example: keeping the population alive, providing nurturing and caring for the young, elderly and sick, but this input is largely unpaid for and so is never factored into an economy. This means that we need to redefine what we mean by ”household energy needs” and start to unpack the various roles that women are playing in the economy, their potential as human resources in assisting governments to achieve the Millennium Development Goals and the enormous opportunity that is being lost by essentially denying billions of women access to energy services that meet their actual needs, above and beyond the home. This paper looks at one source of energy, that from biofuels and how it could positively impact on the rural household economy and by extension, the livelihoods of women.

Why biofuels?

The industrialised world is heavily addicted to energy from fossil fuels. Our cities are designed around motorised vehicles, our homes are built using materials (including cement and steel) that take a lot of energy to make, our food is grown, processed and distributed using industrial farming methods that require large amounts of fossil fuel directly and indirectly and all homes need energy to survive, to cook, to keep warm and for lighting as well as entertainment.

There is an increasing realisation that this addiction is unsustainable and cannot be allowed to continue, Even if we were to ignore the serious consequences of global climate change caused by the burning of fossil fuels, the fuels themselves are a finite and rapidly depleting resource. The recent rise in oil prices was due to the increasing difficulties that oil companies are having in meeting global demand and it is widely accepted that at some point in the next thirty years the total amount of energy that humanity will be able to obtain from gas and oil combined will begin to contract. This will cause price increases far beyond those we have seen already. Some authorities, such as the Association for the Study of Peak Oil, (ASPO) think that the contraction will begin within the next five years.

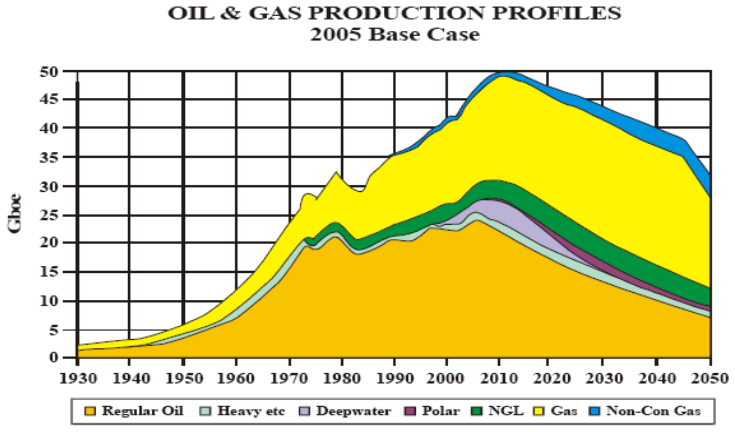

Fig. 1. The total amount of energy available to the world from oil and gas could start to decline within the next five years. Source: ASPO.

All energy prices, especially that of paraffin (an energy supply used in poor homes) but also including the price of coal, will be affected and South Africa will not be able to insulate itself from global trends. However, because there are no immediately obvious substitutes for the oil, the prices of liquid fuels are likely to rise most. These fuels are largely imported into South Africa with the exception of those made from coal by the SASOL liquefaction process.[ii].

Crude oil provides about 17% of SA's primary energy needs and natural gas about 2%. About 30% of SA's liquid fuels are made from coal and gas. SA consumes about 21 billion litres of liquid fuels annually and imports 20 million litres of crude oil. 11 billion litres are consumed as petrol and about 7 billion as diesel. Sasol makes liquid fuels from coal and Mossgas makes it from offshore gas

The poor in South Africa will be most affected by the price increases. Paraffin prices have already gone up and recently the SA Sunday newspapers reported that the poor are struggling to deal with increases in food prices as a result of increased fossil fuel prices[iii]. A recent report notes that every one cent increase in the fuel prices costs agriculture about 10 million rand and this rise has to passed onto the consumer. Where a 5% increase in food prices will mean the wealthy do without a new TV, it might mean that a poor family goes hungry. A report earlier this year showed that farmers are struggling to be profitable in the production of maize, the stable diet of almost 80% of all our population. South Africa is very dependent on oil imports as seen from the text box attached. Agriculture is one of the most dependent sectors as it uses liquid fuels in many direct on-farm processes and in its marketing activities and gas is needed for the production of fertilizers.

For these reasons, many countries are looking to the possibility of replacing imported liquid fossil fuels with biofuels. Brazil has led the way and is now almost self-sufficient with bioethanol providing most of its motorised vehicle fuel needs. South Africa is new to this game and a task team is busy preparing a strategy document for cabinet on the role of the ASGISA driven biofuels programme.

This paper concentrates on the production of liquid biofuels, but this does not imply that the other renewable energy solutions are not equally as important to the rural poor and it is likely that a mix of energy supply will provide the appropriate energy solutions over the next few decades, both for the poor and for the wealthy. If a biofuels production programme is developed carefully, with sustainable development indicators being used as markers all along the way, it has the potential to create employment and reduce rural poverty as well as helping with the looming liquid fossil fuel crisis. However, if SA make the mistake of using fossil energy intensive industrial agricultural processes to produce biofuels, it will not only fail to solve the energy crisis but add to the social and economic hardship in SA.[iv].

A quick summary of biofuels

Biodiesel and bioethanol are the two biofuels being used unceasingly worldwide. Bioethanol can replace petrol and biodiesel replaces diesel. It is beyond the scope of

this paper to review biofuels and there are many South African research papers dedicated to this study[vi]. What is important to understand for this paper is the following:

Biodiesel

- Some crops produce high yields of oils.
- Some of these crops are annuals, such as soya and canola,
- Some of these crops are perennials, like Jatropha, Moringa and the indigenous plums
- During the process of extracting the oil from the crop/seed, a protein cake is left behind and in most cases, with minor additions it can be used for animal feed. The exception is Jatropha but its bi-product makes an excellent fertilizer and soap.

Bioethanol

- Either the sugary or the starchy part of a plant can be used in a fermentation and distillation process to make ethanol
- The most common crops used for making bioethanol are maize, sugar cane, sugar beet and sweet sorghum
- Sugar cane is considered in this paper as a perennial crop

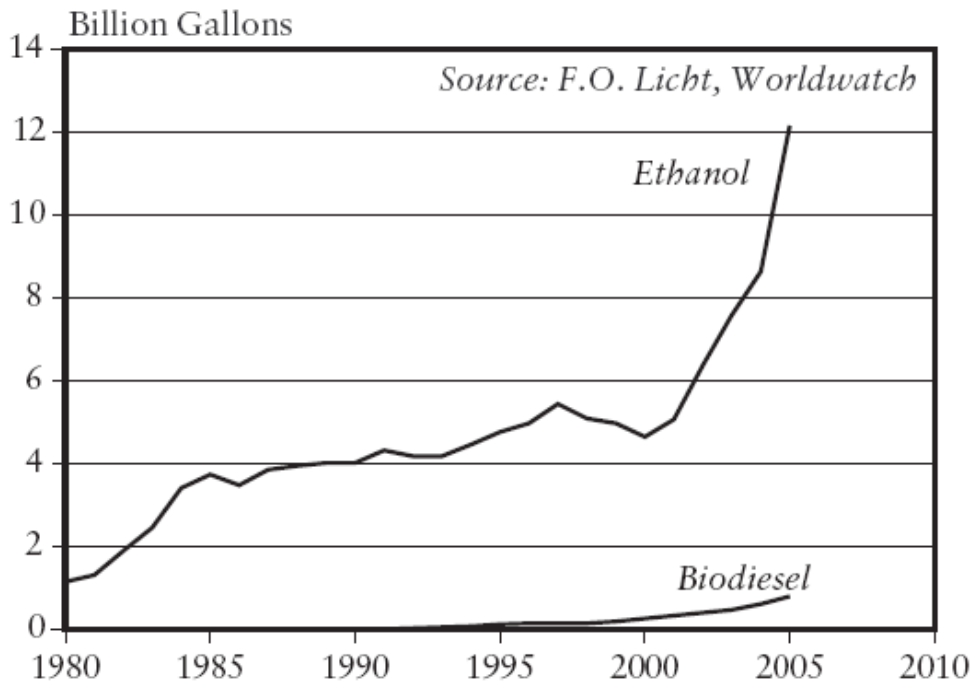

Figure 2: How biofuel production is talking off around the world.

Another process is being developed which breaks down plant cellulose into sugars which are then fermented and the alcohol produced is extracted by distillation. As this cellulosic-lignin technology is not yet commercially available, it is not considered in this paper[vii].

Not all crops are good for producing biofuels. The key factor is the energy input/energy output ratio. If the ratio is less than 1, then the process takes more energy to produce than biofuel than it delivers. If it is more than 1, the energy gain is greater than the energy cost. Sugar cane, for instance has a 1:8.3 energy in/energy out ration. This is excellent and is better than that for the production of gasoline itself. This net gain can be attributed to the accessibility of the sugars in the plant for fermentation, the perennial nature of its growth and the fact that the bagasse provides the energy for the production process. Maize on the other hand, under optimal conditions which we don't have in SA, gives a ratio of 1:1.3, so it should be ruled out as an energy crop[viii]. For every four units of fossil energy applied to growing and processing it, it would only deliver one extra one as fuel.

What could biofuels do for the rural poor

Renewable energy production could transform and speed up energy provision if it were chosen over fossil fuel driven solutions by developing governments. Although it is worrying that oil prices are increasing, it also presents an opportunity to develop our renewable energy resources and make SA a more self reliant economy, not dependent on import of liquid fossil fuels.

Renewable energy is a dispersed resource. You don't find it in wells in one country and absent in another. All countries, all places, have a renewable resource that can be utilized for making energy. Biofuels is a particularly interesting resource as the feedstock is produced in rural areas where poverty is the greatest. It is also produced in rural areas where the energy poverty is the greatest and if biofuels were produced sustainably they could provide the energy that is so desperately needed in these areas.

In the final section of this paper, we provide examples of how biofuels have been used to reduce poverty in Africa. The choice of energy crop is critical as some crops grow more easily and with less risk than others. Most rural households have access to about 1-3 hectares of land which they have a "permission to occupy (PTO) " type of land use agreement that allows them to grow and use the land for their own purposes. Using simple affordable apparatus, that can be used by uneducated people, the local women can extract and use the energy resource, in the first instance for themselves, their families, their homes, their businesses and in the second instance for sale to their local co-operative.

Designing a pro poor biodiesel programme for SA

The design of the programme proceeds from these facts and opinions:

- The energy input/output ratio of perennial crops is so much higher than annual crops that perennials should be preferentially grown for biofuel production
- Most perennial biodiesel crops can be grown on land that is non arable, as long as water can be provided. This means they do not compete with food growing and thus will have less potential to increase food prices through a competition for land use
- Perennial crops are easier for communities to grow as they require less care after the initial few years and less labour yearly with the exception of harvesting.

- Annual crop growing on communal land has proven difficult and, often, uneconomic. Perennial crops avoid many of the difficulties seen with annuals.
- Although it is hard to get rural communal farmers together to co-operate in a farming venture it is not impossible and there are pilots and examples/case studies that one can draw on
- Perennial crops stabilize soils preventing soil erosion and rehabilitating land
- Perennials allow a variety of crops, including annuals, to be grown together in a system of intercropping which has been shown to increase overall productivity of all plants within the system by as much as 30%. This diversity is important to a small scale farmer who does not want to lose her subsistence livelihood that the land offers while availing of the energy crops' benefits
- Biodiesel production lends itself to small scale processing and so it is more suitable as a crop for rural local economic development. Additionally, the farmer could use the vegetable oil directly in a diesel generator designed to take crude unprocessed oil and thus create other local economic opportunities from small scale manufacturing process. The generator could be run at night for heating, cooking and lighting.
- Biodiesel co-products can be used by the small scale farmer directly in his farm, as fertilizer, feedstock for livestock and even food and medicines for the family. Co-products can be the source of other small scale local industries. For instance the Moringa tree is almost totally usable, the leaves and foliage as greens in salads and for making relishes, the seed as a nut and the root as a substitute for horseradish.

The proposed system

These assumptions have enabled EcoSasa to develop a pro poor biodiesel production process that contains the following components:

- Rural small scale farming communities are encouraged to grow perennial crops on marginal land, in association with other crops that will satisfy their own more direct household food needs. Monocropping is discouraged due its potential for disease proliferation and its limitation for the household livelihood.
- Small biodiesel facilities are strategically located close to the areas of biodiesel feedstock production, these service a number of different energy crop feedstock providers (the small scale farmers).
- The small scale farmers form themselves into co-operatives which purchase diesel generators that can run on crude vegetable oil. They use this apparatus for pressing the oil for the feedstock. The co-products are used both by the household as well as developed by the co-operatives to generate small businesses that add value to the co-products and sell them on to other markets
- The local biodiesel manufacturer collects the vegetable oil directly from the co-operative
- Many of these co-operatives have majority shares in companies that have outside investors that provide the necessary finance for the seeds, initial growing and the inputs for the first few years of the crop growing process.
- The co-operatives also have shares in the biodiesel manufacturing plant.

Benefits to the local communities

A recent independent research report by the sustainable energy and climate change partnership (SECCP) indicates that if SA were to replace 15% of its liquid fossil fuels with biodiesel and bioethanol that this would create 350,000 direct jobs in the industry and another 350,000 jobs indirectly[ix]. As these jobs are primarily located in rural areas the initiative would target the poorest areas and people. Bearing in mind that the majority of the farmers are women, this has a gender bias benefit in the right direction. These jobs are low skilled and the co-products provide an exciting additional source of job and livelihood development within the same communities.

Because there is likely to be a big squeeze in fossil fuels in the near future, rural areas are likely to be targeted for biofuel production. If the SA government puts in places strict criteria and processes for how this production is carried out, this could bring welcome development to the rural areas that have suffered from poor infrastructure and service delivery in the past. However, this will only happen if we guard against the ruthless overtaking of land and its potential by unscrupulous investors that sideline the land owners.

Assuming that monocropping is discouraged, the development upsurge in these areas will have other knock-on effects like assisting small-scale farmers to produce higher yields of other crops from their small plots of land. Polycropping has been show to increase yields in any event. This, coupled with access to energy and to other local economic development opportunities could result in a significant improvement in food security.

What is proposed is to established patches of "food forest" a type of permaculture promoted by Robert Hart but known for centuries in peasant communities around the world. The forest consists of seven layers

1. Large fruit and nut trees.
2. Lower trees
3. Layer of shrubs
4. Layer of herbs
5. Root layer
6. Ground cover layer
7. Vertical layer - climbing vines

In this way you avoid monocropping and encourage muticropping that benefits more than just the energy buyer but also the household and the local community.

Case studies

This is a new field in South Africa and thus case studies that have proven success are few. However, here are some examples within Africa that are clear winners.

Case study 1- A rural electrification scheme of D1 oils

Di Oil Plc is listed in the UK stock exchange and has successfully developed *Jatropha curcas* plantations in Zambia and Swaziland.

A 3000 ha D1 community project will grow enough feedstock to supply a D1 20 (the name of the operational facility of a D1 Oils biodiesel refinery). In the process, over 3000 jobs would be created. The energy resulting from the project would be equal to 6 mw of Electricity from the Biodiesel, and 4 MW from the Biomass. There is a substantial amount of glycerol as a co-product from the processing side which could also be converted to electricity and yield a further 1MW. Therefore the total electricity generated from the project could be about 11 MW of renewable energy. And this is all available in the local area for local people.

A D1 project is composed of a number of activities as follows:

- Growing
- Managing
- Harvesting
- Oil expelling
- Processing charcoal
- Processing Biodiesel
- Processing glycerol
- Processing Co-products

In Southern Africa, the approximate costs of developing a community out-growers program with sufficient trees planted to deliver enough seeds to support a D1 20 (managed up to the stage of processing) would cost approximately $1,500 000.

The next stage of costs are the harvesting labour and capital costs, working capital, processing the seed into oil and seedcake, processing oil to Biodiesel and seedcake

A simple biodiesel manufacturing facility that can be located in any small space

into the various products such as organic fertilizer, charcoal briquettes. All of these activities are income generating and create jobs. Such projects have been successfully achieved in Southern Africa.

Case study 2 – Biodiesel production by the Mali Folke Centre

The Mali Folke Centre in Mali (www.malifolkecentre.org) has been working with local rural communities in developing plantations of *Jatropha curcas*. They have worked hand in hand with the GTZ and have been utilizing a UNDP led technology, a multifunctional apparatus called the Mali platform which can run on crude *jatropha* oil. The platform can not only generates electricity for the whole community but powers water pumps, crushes the oilseeds and provides energy for a welding and carpentry shop. The waste heat from engine, supplemented by solar panels, could go to a small cold store, a milk pasteurisation unit, a crop drier, a communal laundry and, possibly, a bath house. If we were to adapt this model from Mali, an energy cooperative could be set up to run the Platform and would buy the oilseed from the farmers and sell the oilcake for fertiliser if it is *Jatropha* being grown and animal feedstock if it uses other sources of oil. In the Mali Folke Centre they have converted their Toyota pick up to run on *Jatropha* oil. Women are the main beneficiaries of the project and they have cited the additional co-products of soap making as more of an economic benefit even then the energy.

Case study 3 - Mafikeng biodiesel model[x]

Mafikeng Biodiesel is attempting to consolidate 60 000 ha of communally owned land in Mafikeng in the North West province. It is a company owned 25% by government (20% through Northwest Invest, an arm of the provincial government and 5% through the Mafikeng Industrial Development Zone), 45% by the tribe as landowners and 30% by the private sector. A considerable effort has already gone into convincing the rights-holders of the soundness of the project and the absence of risk to them.

The 20% owned by Northwest Invest will be sold to an investor after the development stage. Money obtained through the Clean Development Mechanism set up under the Kyoto Protocol will be used to pay for seeds and for planting. Meanwhile, the government has funded the nursery which will be used to develop *Moringa, Jatropha, Papia Capensis,* and *Ximenia caffra*. About 13,000 part-time jobs will be in place when the project has been fully developed.


Jatropha Curcas

Case study 4 – The farmers are doing it already

Let us not leave this only to wealthy farmers that have the wherewithal to do this. We can and should be helping our poorer subsistence farmers to also benefit from this growing industry.

Consultant advises farmers on biodiesel production

Ivan Basson, a minerals processing and engineering consultant for AngloGold Ashanti in the Klerksdorp area, is assisting farmers to turn a profit on crops like sunflower and soya, which are suitable for the production of biodiesel. Basson has designed a cost-effective processing plant and chemical process that enables farmers to turn their sunflower and soya crops into biodiesel at a profit.

Engineering News visited Basson and farmer Jasper van Zyl on the farm Boskop, on the outskirts of Wolmaransstad, in the North West province, to see the plant in action. The plant produces sufficient diesel for Van Zyl's annual farming requirements of 80 000 l of diesel, as well as oil-seed cake to feed his cattle. The plant also enables Van Zyl to supply other farmers in the area with cheaper diesel, as well as oil-seed cake for cattle feed.

The biodiesel that is produced is bright yellow, is odourless and contains no sulphur. Basson says that he hopes to assist more farmers in the area to build biodiesel plants. The technology behind the process is available on the Internet; however, Basson has tweaked the production process and the chemical catalyst required to enable the manufacturing of a quality product.

He believes that biodiesel is currently the most viable biofuel option for the farming community, as it involves a relatively simple process and does not require the significant capital investment associated with the production of bioethanol.

Reproduced from Engineering News,

[i] www.feasta.org
[ii] World Energy council (2003). South African Energy Profile, Saneri
[iii] SA Sunday Times, metro section July 16th 2006
[iv] Douthwaite R, Sugrue, A, (2006) . Energy use in South African Agriculture and its Future Supply. NDA draft paper
[v] Wilson S.G., Mathews M., Austen G., Von Blotnitz H., (2005) A review of the status of biodiesel related activities in South Africa", a report prepared for the city of Cape Town with support from the British High commission"
[vi] F.O licht. www.agra-net.com. (2006) World ethanol and biofuels report: South Africa approaches biofuels
[vii] www.iogen.ca
[viii] National Resource Defense council and climate Solutions (Feb 2006). Ethanol: energy well spent.
[ix] www.earthlife.org