Biofuels
a massive job creator

The world's oil resources are fast diminishing as prices rise. **Annie Sugrue** looks at alternatives and makes the startling claim that the biofuels industry could generate as many as 350 000 new jobs. Simultaneously it would create a cleaner environment and boost rural economies.

Anyone who has a car is aware of frequent fuel price increases and at about US$63 a barrel it is up 25% on average from last year's prices. But what most people don't realise is that the high cost of oil affects far more than the transport sector.

GROWTH IN DEMAND FOR ENERGY

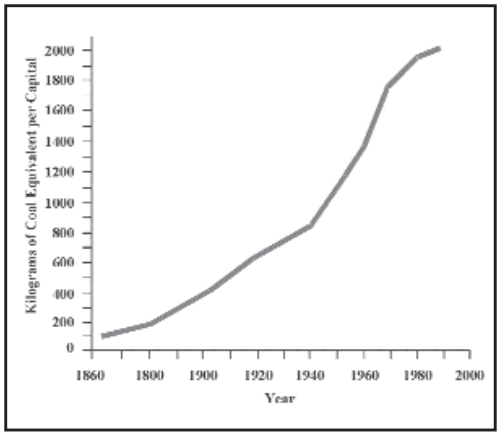
Everything in the modern world is made using fossil fuel energy (eg coal, oil, gas) in some form or another. From mining to felling, processing and manufacturing, most industry is energy intensive. Our cities are designed around the motor vehicle where highways and paved streets dominate. Nearly all of us need transport to work, places of study or for shopping – activities that were done by our feet in the past.

In the past 150 years, mankind's use of energy has grown enormously. A 40 litre fill up of petrol will give the same amount of energy as four years of human manual labour. This is why the world has become so dependent on fossil fuels because we can do so much more work so much more quickly. Yet many people in South Africa still have no access to modern energy services and use a mix of energy types such as biomass (wood, cow dung, grass), paraffin and also candles and coal. Even the poor that have access to electricity in their homes frequently cannot afford the bills and get disconnected from the service. Eskom reported that at the end of 2001, they were disconnecting 120 000 homes a month due to non payment.

Energy poverty is severe in Africa and in some measure it explains the inability for the poor to engage with the mainstream economy. If you need energy to be a producer of goods at any scale, then without energy you can't compete with goods from a globalised world that has access to this energy.

Most of us see food growing happily in the sunshine, certainly not as a huge user of the world's energy resources. We wrongly assume that most of the energy in food crops comes from the sun. But industrial agricultural processes use diesel in tractors, ploughs and other mechanised machinery and farms use other forms of energy as well, such as electricity for pumps, milking, heating and cooling. Other agricultural inputs are also high energy users, like fertilizers which are made by using natural gas. Add on the energy used to transport food to the markets and process it and it is no wonder that food prices are increasing alongside the oil price.

Fig. 1: The availability of cheap fossil energy has enabled increasing amounts of energy to be used by the average person



A recent report completed by the national Department of Agriculture conservatively estimated that the agriculture sector uses 12,5% of South Africa's energy. This is considerably more than the existing reports of 3 to 4%. Agriculture also uses 51% of all the available water in South Africa, for irrigation, in an already water poor country. A report by the IUCN (World Conservation

Union) stated that South Africa, while currently experiencing water scarcity faces absolute water scarcity by 2025 if it does not change its water usage patterns. This could mean that there will not be enough water for all of our needs, including the needs of rural areas, and to achieve the objectives of the Millenium Development Goals.

The world oil price has been rising, with a sharp drop recently which hopefully will stay with us for a while at least. The oil peak lobbyists, such as the Association for Peak Oil (ASPO) attribute the recent rises to global oil peak which ASPO believes will take place within the next five years. Oil peak happens when the world has used half of its conventional oil. Whether or not we are experiencing oil peak is irrelevant as there are other global pressures on oil such as a lack of oil refining capacity world wide and Middle East wars that are contributing to a market shortage. Most analysts believe that high oil prices are here to stay for some time if not permanently.

NEW ENERGY ROUTES

Some farmers are aware of this fact and are doing something about it. A recent report in *Engineering News* describes how a farmer, Jasper Van Zyl in the North West Province, is being assisted by Ivan Basson, a minerals processing and engineering consultant for Anglogold Ashanti, to grow energy crops like sunflowers and Soya on his farm. Van Zyl extracts the oil from the seeds and uses it for his motorised vehicles. He needs 80 000 litres and he easily gets that from his plants and he is selling the surplus to other farmers. Even better is that the seed cake left over when the oil is removed makes an excellent high protein feed for his livestock.

While these efforts by farmers are interesting, it is only a small part of the story. The biofuels (see box for different kinds of biofuels) industry is a fledgling one in South Africa. The South African cabinet has put together a task team to advise them on how to structure this industry and on the kind of support needed to achieve the objectives set out in ASGI-SA, the government macro-economic programme. ASGI-SA sets the objective of halving poverty and unemployment by 2014, merging the first and second economies, achieving a 6% growth rate and it has highlighted three key interventions to achieve this, one being biofuels.

Brazil is the world leader in biofuels as it is now fuel self sufficient through the production of bioethanol from sugar cane. In the US the maize/corn industry is heavily subsidised by the government and there is zero tax payable on biofuels. In fact most countries have stimulated the biofuels industry through removing tax levies on this fuel. But many, such as Germany, are reconsidering this as the industry matures, finding the cost to the fiscus too high. The biofuels industry, as seen from the graph on page 52 is taking off all over the world.

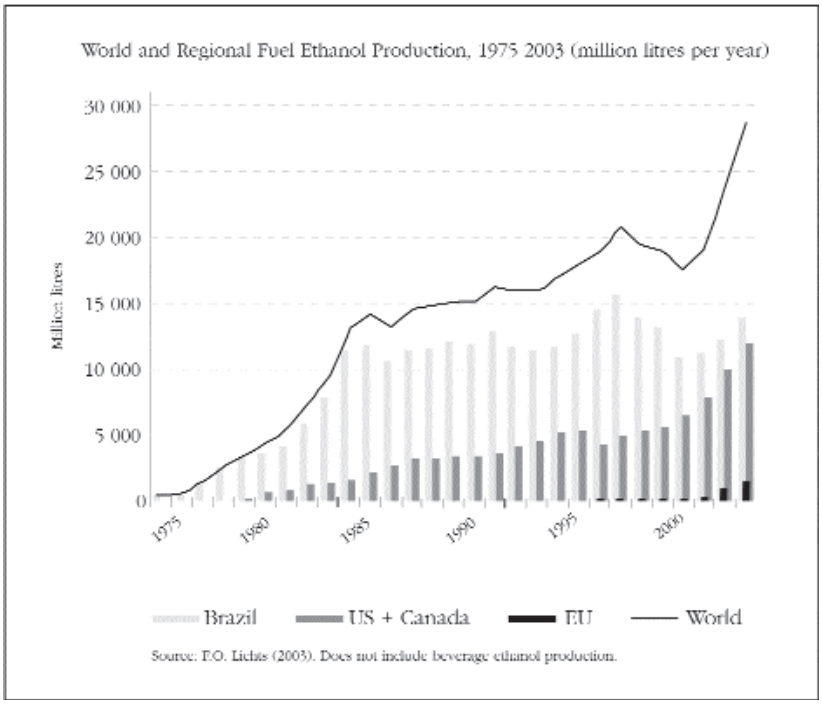
RENEWABLE ENERGY AND JOB CREATION

An independent study commissioned in 2003 by the activist organisation Earthlife Africa compares traditional forms of energy production to renewable sources of energy. It shows that you get a lot

THE TWO MAIN BIOFUELS USED TODAY ARE BIOETHANOL AND BIODIESEL

- Bioethanol is distilled alcohol fermented from biological sources, eg potatoes, sugar which can be blended with gasoline. Commonly bioethanol is blended at 10% concentration with gasoline giving what is called an E10 blend. A flexi fuel vehicle has been developed in Brazil that can take any concentration of bioethanol from 0-100% but these cars are not yet available in South Africa. 75% of all new car sales in Brazil are flexi fuel vehicles and Brazil is producing 3,5 million flexi vehicles per year and exporting 1 million of these.
- Biodiesel is made from vegetable oil through a simple chemical process that removes the glycerine. Some old engines can use vegetable oil directly and were in fact designed originally to use this fuel. But modern engines have been adapted to use petrodiesel and some of the modern parts, in particular the rubber parts, cannot tolerate the chemical composition of vegetable oil. This means the engines require a reasonably inexpensive conversion to work effectively with vegetable oil. Biodiesel can be blended with petrodiesel and used in modern engines at any concentration. However, most modern cars only provide a warranty at a 5% blend (B5) but this is slowly changing as confidence increases in the chemical processes.

Biofuels are being seen as an ecological alternative for fossil fuel derived motor vehicle fuel, but they can be used for other stationary purposes as well. Bioethanol can be mixed with a gel to make an ethanol gel that can be easily used by households for cooking and heating. Biodiesel can be used in engines that can drive electric generators or used for cooking and heating.



more jobs when you invest in the biofuels industry than if you invest in fossil fuel energy production.

The most startling figures from the study come from job creation within the biofuels industry. If we substitute 15% of South Africa's gasoline/petrol with bioethanol we will create 62 000 jobs. And if we substitute diesel with biodiesel we create a whopping 288 000 jobs making a total of 350 000 jobs. These are only direct jobs and the study also estimates that in total the number of jobs, with indirect employment, could be as much as double these figures. It is of note that a sophisticated economy like Germany created 150 000 jobs through its renewable energy programme, driven through political will and subsidies.

As we have seen, there is a global move towards biofuels. Energy security is an obvious reason for this move. Declining world oil reserves has caused jitters in all developed economies as well as the emerging ones. South Africa could adopt a biofuel strategy for reasons of higher political priorities, such as job creation. If done properly, biofuels could stimulate growth in areas which have traditionally not grown, namely in rural areas where regeneration is badly needed.

Using biofuels for local economic development comes with the added benefit of reducing energy poverty in about 30% of the population that has no access to modern energy services, the rural poor. In this way, it can be a truly developmental project.

FACE OF A BIOFUELS STRATEGY

Firstly, it would take as its departure point the need to address energy poverty in the rural areas. The strategy would identify ways these farmers can use their land to produce biofuels for example, and then use the biofuels to produce energy for their use like mechanical or electrical energy.

Biodiesel production lends itself more easily to this process because of the accessibility of micro scale biodiesel refining plants at a relatively low cost, around R6 000 for a micro system.

By supporting small scale farmers to grow energy crops that do not require a lot of farming inputs, like tilling, sowing or fertilizers, we ensure that the farmers are also practising sustainable methods that do less damage to the environment as well. This would lead us to choose perennial crops like the shrub Jatropha Curcas, the Moringa tree as well as indigenous plums as all of these grow in South Africa and have a high oil content.

Algae, although still only being grown on a pilot scale seems to also have great potential as a biodiesel crop with all the benefits of perennial crops but much higher yields of oil per hectare. The Moringa tree, currently licensed for growth in South Africa unlike Jatropha, has the advantage that every part of the plant is edible or usable, whereas Jatropha seed cake, is poisonous, but makes an excellent soap and fertilizer.

By designing the system correctly household subsistence farming remains which is essential for the food security of the rural poor. The oil from the shrubs can be used directly in diesel engines that can be hooked up to electricity generators or the power can be used for doing

RENEWABLE ENERGY VERSUS FOSSIL FUEL EMPLOYMENT POTENTIAL

TECHNOLOGY	JOBS/TWH (TERRA WATT HOURS)
Biodiesel	16 318
SWH (solar water heaters)	8 733
Bioethanol	3 770
Biogas	1 341
RETs (Renewable energy technologies)	952
Coal	700
Gas	130
Nuclear	70

work like carpentry, sewing, milling or even welding goods for sale. The case study in the box below uses the Mali multi functional platform.

We should not forget bioethanol. There is no difference between bioethanol and what we drink as a spirit. Small scale distilleries are also not expensive and we can find them in most villages making African beer. Apart from sugar cane, most bioethanol feed stocks are annuals and require annual planting and harvesting which uses up a lot of energy. The energy balance (see box on right for explanation) for maize, using figures from the US where yields are higher, is 1:1.3. This means that you get 30% more energy out than you put in. This is not a great return. Sugar cane on the other hand gives a 1:8.3 ratio based on Brazilian models, an excellent energy balance. Bioethanol can be turned into an ethanol gel which, when high quality products are used is a safer fuel than paraffin.

The community can use the energy they produce in various pieces of equipment. This allows a rural community to take part in meaningful economic activity and to engage with the first economy because people have greater production capability.

People can generate electricity for lighting and use the energy directly for heating and cooking.

Communities are also sure to make a surplus and so they start to contribute to the energy security of the nation.

Local cooperatives can form joint ventures, on a socially just basis to set up small scale biodiesel production facilities. Estimates for buying small facilities vary but a figure of R2 million is a departure point. Smaller facilities strategically located within areas where the small scale producers are growing energy crops would be best. Here there is less need for high capital intensive infrastructure to support the facility. These cooperatives can become biodiesel suppliers for the local region or sell it to other areas or nearby towns.

The benefits to the communities are obvious. Local energy security, self reliance in modern energy services, rural regeneration, and supply of biodiesel to larger more industrially based economic nodes for motor transport and other machinery, to name a few uses. The outcome is integrated sustainable local economic development that has created sustainable livelihoods as well as jobs and a far higher quality of life.

If South Africa promotes an industrially based biofuels sector, it will entrench the inequalities of the past. It will enrich people who already have capital and make the rest poorer. The choice is there to make, I certainly know which one makes sense.

The Mali Folke Centre in Mali has been working with local rural communities in developing plantations of Jatropha curcas. They have worked hand in hand with the GTZ (German international cooperation for sustainable development) and have been utilising a United Nations Development Programme led technology, a multifunctional apparatus called the Mali platform, which can run on crude jatropha oil.

The platform not only generates electricity for the whole community but powers water pumps, crushes the oilseeds from the shrub and also provides energy for a welding and carpentry shop.

The waste heat from the engine, supplemented by solar panels, can go to a small cold store, a milk pasteurisation unit, a crop drier, a communal laundry and, possibly, a bath house.

We could adapt this model

from Mali. We could set up an energy cooperative to run the platform and buy the oilseed from the farmers and sell the oilcake for fertiliser if Jatropha is grown, or 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 see the additional co-products of soap making as more of an economic benefit even than the energy (www.malifolkecentre.org).

ENERGY BALANCES

To get the energy balance of a crop, you measure all the fossil energy used to produce the crop and then work out the energy equivalent potential of the crop itself. The ratio between the two is the energy balance. A ratio of 1:1 means that you use the same amount of energy that you get out, a positive balance is necessary to make the process worthwhile.

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