POSSIBLE FUTURES FOR BIOFUELS IN AUSTRALIA – WHERE DOES MAIZE FIT?

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Abstract
This paper examines the possible futures for maize in Australia for the production of ethanol by examining the competitive forces, and possible government policies that will shape the market place for ethanol and its feedstocks in Australia. There are considerable risks for investors in ethanol plants based on starch from grain. These risks include the competitive pricing of other fuels such as petrol and diesel, future exchange rates, the cost of feed stock inputs, the possibilities of changes in government policy, and competitor technologies for the production of ethanol. The grain based ethanol industry faces two essential paradoxes for its future. In order to be successful the industry needs low grain prices to keep its cost of production down and an excise holiday to keep its competitors at bay. Paradoxically if it is successful then grain prices will rise and the excise holiday will disappear, therefore rendering the industry unsuccessful. Given all of the uncertainties involved with these risks it is impossible to accurately forecast returns on investment but potential investors and lenders need to carefully assess the structure of their investments in order to manage these risks.

Introduction
As a futurist I do not make predictions of the future because such a path is littered with all the bodies of those who have tried before me. Instead I seek to examine all the possible futures and look for ways to decide when one or other of these possible futures might be eventuating. In order to do this it is necessary to examine trends, possible future drivers, and the possible actions of various stakeholders in order to create a story that can be understood. For the purposes of this paper I have examined:

• The cost of producing ethanol from maize in Australia.
• Increasing attention on the production and effects of greenhouse gases by the public and politicians.
• The cost of producing ethanol from competing grains in Australia.
• Possible competing technologies for ethanol production in Australia.
• The value proposition of the ethanol industry to its customers.
• The political responses to calls for ethanol production in Australia

In examining these issues I have come up with two basic scenarios:

1. That biofuel ethanol will continue to be a marginal business in Australia.
2. That biofuel ethanol will become a significant business in this country

Within each of these scenarios there are obviously a number of sub-scenarios where we can look at different possibilities.

1. Biofuel ethanol continues to be a marginal business in Australia

Biofuels are currently a marginal business in Australia with the Task Force on Biofuels report putting the recent annual volumes of ethanol at 23 million litres. The prime reasons for this are as follows.

Competing fuels such as petrol and diesel have been much cheaper and may continue to be much cheaper

If we look at two grains that could be used to produce ethanol in Australia then we see the following:

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1 Report of the Biofuels to Taskforce to the Prime Minister (August 2005). Based on the production grant figures from Department of Industry, Tourism and Resources.
Sorghum

The production of ethanol from sorghum was priced at 36 cents per litre in the Australian Bureau of Agricultural and Resource Economics (ABARE) Biofuels report based on the following assumptions:

• Sorghum at A$152 a tonne delivered to the refinery gate.
• Production of 380 litres of ethanol from a tonne of sorghum.
• The sale of dried distillers grains with solubles (DDGS) at $220 a tonne at the refinery gate.
• Assumptions on exchange rates and oil prices at varying times over the next few years.

It is important to note that because the energy content of ethanol is lower than that of petrol the equivalent cost of production is approximately 54 cents per litre of petrol. The assumption in relation to the number of litres of ethanol produced from a tonne of sorghum is reasonably accurate but there are possible problems with the other two assumptions:

• It is unlikely that sorghum prices would remain at A$152 a tonne delivered to the refinery gate if there was significant demand for sorghum for ethanol plants. This leads to a Catch 22 situation where ethanol from grain can only be successful (ignoring the mandating of ethanol by the government) if prices stay down but if grain based ethanol is successful its cost of production will rise.

• DDGS has been sold in the last few months in Australia at prices equivalent to A$120-$130 at the refinery gate. This price matches almost exactly the price in the US for DDGS through 2004. These prices will vary with grain and protein prices but $220 a tonne seems wildly optimistic given the current market signals. At these levels the offset from the sale of this “waste” product is considerably lower than in the ABARE calculations. The price of producing ethanol is 1c a litre higher for every $11 per tonne of reduced price for DDGS. If DDGS is sold at $130 a tonne then the calculated price of ethanol production rises to 44 cents a litre under the ABARE calculation method.

Corn

Corn ethanol production costs are given in Table 1.

Table 1. Cost of ethanol production from corn

<table>
<thead>
<tr>
<th></th>
<th>Annual</th>
<th>Per Gallon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shelled Corn</td>
<td>$17,000,000</td>
<td>$0.68</td>
</tr>
<tr>
<td>Other Raw Materials</td>
<td>$1,600,000</td>
<td>$0.06</td>
</tr>
<tr>
<td>Denaturant</td>
<td>$600,000</td>
<td>$0.03</td>
</tr>
<tr>
<td>Utilities</td>
<td>$4,000,000</td>
<td>$0.16</td>
</tr>
<tr>
<td>Labor, Supplies, and Overhead Expenses</td>
<td>$3,100,000</td>
<td>$0.13</td>
</tr>
<tr>
<td>Depreciation of Capital</td>
<td>$2,800,000</td>
<td>$0.11</td>
</tr>
<tr>
<td>DDG Credit</td>
<td>-$7,100,000</td>
<td>-$0.29</td>
</tr>
<tr>
<td>Total Production Cost</td>
<td>$22,000,000</td>
<td>$0.88</td>
</tr>
</tbody>
</table>

Source: NREL study TP-580-28893 - Determining the cost of producing ethanol from corn starch and lignocellulosic feedstocks.

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2 Christopher Short and Damien Riwoe (July 2005) Biofuels an Assessment of their Viability, - Prepared for the Prime Minister’s Biofuels Taskforce and listed as Appendix 3 in that report.

3 DDGS is the product that is left when the starch is removed from the grain for the ethanol process and is used primarily as a feed ingredient for livestock. Its protein and energy levels vary depending on the grain that is used as feedstock for the ethanol plant and also varies considerably between plants using the same grain feedstock. Co-locating feed lots or dairies with the plant would increase the refinery gate price.


5 These costs are US$/US gallon and a US gallon is only 3.785412 litres.
This report is in 1999 dollars and provides similar figures to the more detailed figures available in a very large USDA survey. If we convert these figures into Australian dollars at the current exchange rate then we get a cost in Australia of 31.5 cents per litre. However it is critical to note that the cost figures are critically dependent on two main factors — the cost of grain into the mill and the price paid for the by products that are produced from the process:

- **Cost of grain.** In the model above the corn is costed in at US$1.94 per bushel or A$103 per tonne at current exchange rates. The USDA long range price for corn is US$2.45 per bushel or A$132 per tonne. Every A$10/tonne move in the grain price in Australia would move the ethanol production price by approximately 2.5 cents per litre depending on yields. At an Australian price of A$180 per tonne this increases the above costs from 31.5 cents to 50 cents per litre.

- **By product sales.** A bushel (56 pounds) of corn produces about 10.2 litres of ethanol and about 7.84 kg of DDGS. Therefore at a price of A$131 per tonne for the dried distillers grains this provides an offset of approximately 10 Australian cents per litre. This matches the calculations done above on current DDGS prices in Australia.

The ABARE calculations provided a threshold price of 38 cents per litre for ethanol in Australia. This is the price that ethanol needs to be sold for to be competitive to petrol given the assumptions in oil prices, exchange rates and excise rates. If the cost of production is above this threshold price then the production of ethanol becomes a very poor business proposition.

**The biofuels industry has not come up with a convincing value proposition.**

A value proposition is a convincing argument to your customer that buying your product will add value to them, either financially or emotionally. To date the ethanol industry in Australia has not been able to convince its customers of a value proposition that makes sense. This is evidenced by market failure — nobody is producing and selling ethanol in any great volume.

**The government is not prepared to mandate the use of biofuels although it has given considerable support to the biofuels industry through capital grants and excise holidays/tariff protection.**

If we look at the maize industry in particular, the production of ethanol from maize has thrived in the USA over the last few years with reports indicating that up to 10% of the total maize crop is now dedicated to ethanol production. Recent indications from the USA are that investment in maize based ethanol plants continues to gather pace, with some people wondering if the volumes used will start to impact on other value adding industries such as the pork and poultry industries. This success has been almost completely due to government intervention in the industry through subsidies and mandating the use of ethanol in petrol. Assistance to the automotive manufacturing industries has also led to a large number of people owning vehicles that can run on up to 85% ethanol even though they may not even know it.

It is highly unlikely that this level of assistance will be given to the Australian industry given the level of debate that has already occurred, and the conclusion of the Prime Minister’s Biofuels Taskforce. However considerable assistance in the form of capital grants and excise holidays has been given (see below for further discussion).

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6 Shapouri, Gallagher and Graboski (1998) USDA 1998 Cost of Production Survey. The NREL study uses 2.85 litres of ethanol produced per bushel of corn while the USDA study shows lower yields of approximately 2.63 litres per bushel.

7 I have used an exchange rate of 0.7381 for these calculations.

8 2004 National Distillers Grain Marketing Surveys – USDA-NASS

9 USDA Agricultural Baseline Projections to 2014 (Feb 2005) show that 1.37 billion bushels of corn were predicted to be used for fuel and alcohol use in 2004/2005.

**Investment in biofuels refineries is a long run capital investment and to date the risks of investment have outweighed possible returns.**

If you are going to invest in an ethanol plant that uses grain as its feedstock in Australia then you need to know the following:

- The long run production and price of the feedstock. The ethanol industry faces a conundrum in that for it to be successful grain prices need to remain low enough for the cost of ethanol to be competitive but if the industry is successful then demand for grain will drive up the feedstock price. The relationship between feed grain prices supplies and demand is very tight on the East coast of Australia with shortages predicted in coming years. It can be argued that increased demand will result in increased production but this will only occur through price signals above the current levels or this change would have already occurred. Existing users of feed grains have significant sunk costs in their existing operations and will remain significant competitors for the feedstocks.

- The long term government policy. Current government policy is an excise holiday/tariff barrier at an equivalent of 100% of the petrol fuel excise until 2011, and then 50% from 2015 with a phase in between the two dates. Industry advocates argue this is not a tariff barrier or a subsidy but if you are a foreign producer of ethanol you pay the full excise so it is definitely a tariff protection measure as well as a subsidy against other products in the market place. What is little understood is that the excise holiday is only in regulation and can be changed at any time. There are two plausible scenarios where this could occur. Firstly if the ethanol tariff is put on the table as part of trade negotiations where significant trade concessions for Australian agriculture can be gained there will be immense pressure on the government to abandon the arrangements. Secondly, if the ethanol industry becomes very successful the excise holiday will cost the government more and more money. An excise holiday on a potential 350 million litres of production is a long way from a real excise holiday on 1.5 billion litres. At those levels of production it would cost the government around $286 million a year (04/05 dollars) until the excise starts to phase in and $143 million a year after the excise is at half rate in 2015. In such a situation the government would be under intense pressure to cancel the excise holiday, both to save money but also on the basis that it was in place to assist the development of an industry would be then fully developed and larger than a lot of existing industries.

- The supply risks in the area where your plant is to be located. The risks of drought, local supply issues, price of grain feedstocks and transport costs over a 10-15 year period have to be considered. You can consider these on an historical basis but there is still uncertainty going forward given issues of climate change, both local and global.

- Who is going to be your competitor in the ethanol business? There are probably two key possible competitors. The first of these is the Brazilian sugar industry. It is difficult to get accurate cost of production figures for Brazilian ethanol due to subsidy issues but Table 2 shows the official export prices.

### Table 2. Brazilian exports for petrol and ethanol

<table>
<thead>
<tr>
<th>Year</th>
<th>Gasoline</th>
<th>Ethanol</th>
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<tbody>
<tr>
<td></td>
<td>Quantity (1000 kl)</td>
<td>Average price (US$/kl)</td>
</tr>
<tr>
<td>2002</td>
<td>2,338</td>
<td>177.56</td>
</tr>
<tr>
<td>2003</td>
<td>2,641</td>
<td>207.40</td>
</tr>
<tr>
<td>2004*</td>
<td>1,466</td>
<td>280.45</td>
</tr>
</tbody>
</table>

Source: Brazilian Ministry of Industry and Foreign Trade

*January-November 2004
The price of US$213.22 per thousand litres in 2004 equates to just under 29 cents Australia per litre. This price will be affected by the price of sugar, and the exchange rate, but it is clear that Brazil is a significant competitor. Some people believe that the world price of sugar is going to be driven by the price of oil determining what ethanol will sell for, which will drive back into the demand supply situation for sugar and determine its price.

The second major potential competitor is the production of ethanol from cellulose and hemicellulose which are the key building blocks of plant life (biomass). What many people do not understand is that these compounds are just complex arrangements of sugar, and that if you can access those sugars then you can make ethanol and other products from them. What is also little understood is that this has been technically possible for a long time; it has just been more costly than other types of ethanol production. The difference between the use of grain for producing ethanol and the use of biomass is that it is possible to have large reductions in the costs of biomass ethanol because the process is a much larger percentage of the overall costs.

There have been large leaps in the cost reduction process over recent years. For example research funded by the National Renewable Energy Laboratory has achieved reductions in the enzyme cost in on method of production from A$5/US gallon to US10 cents/US Gallon. A company called Iogen in Ottawa is now shipping small commercial quantities of ethanol made from wheat straw to Shell. The Rocky Mountain Institute (RMI) has carried out an analysis of the potential for State of the Art technologies for producing ethanol from biomass, and conversion of those figure into Australian dollars gives a possible cost in Australia of 19 cents pre litre for ethanol. How optimistic those figures are, and how long this takes to be commercially feasible is still a question which is very much up in the air, but the possibility of a competitor with significant cost advantages over grain based ethanol needs to be considered when examining investments.

- What will the long run exchange rate be because the currency has a large effect on the price of competing fuels due to our export parity policy. The exchange rate makes a huge difference to the price of petrol locally due to our policy on pricing
- The long run price of the major competing fuel – oil. Now if I knew the answer to that question I would not be telling anyone else, but consider the following:

When ABARE did its revised analysis of a biofuels industry in 2004 it made the following statement:\footnote{Andrew Dickson and Chris Short (April 2004) Revised assessment of biofuels industry viability (ABARE)}:

In recent years the price of crude oil has been at historically high levels and for much of 2008 oil prices were above US$100 a barrel in world average trade weighted terms (or around US$30 a barrel on a West Texas Intermediate basis). However, the price of crude oil fluctuates regularly reflecting the interaction of global business cycles and ad hoc global developments. ABARE’s current forecast is for a gradual easing in oil prices over the short and medium term (Ball, Johnston, Wells and Haines 2004). On a world average trade weighted basis, world crude oil prices averaged US$77.74 a barrel in 2008 and ABARE forecasts prices to average US$83.31 a barrel in 2004 and US$72.50 a barrel in 2005.

Over the medium term ABARE forecasts world oil prices to ease further to settle around the US$71 level in the period from 2008 – 2015 (in 2004 dollars). This is equivalent to around US$24 a barrel in West Texas Intermediate terms. This assessment largely reflects the potential for Iraq to increase output significantly over the medium to longer term and the increased availability of non-OPEC capacity, for example, from the Gulf of Mexico and Kazakhstan.

The current outlook for world oil prices presented by the International Energy Agency is also for world oil prices to ease to around US$71 a barrel in the period to 2010 before rising moderately thereafter to around US$115 a barrel by 2020 (IEA, 2002).
When RMI wrote its book “Winning the Oil End Game” last year it used US$26 per barrel for its forward view based on International Energy Agency forecasts.

If you compare these forecasts to what has happened in the 18 months since these publications were finished, and the wide range of current forecasts then it is easy to be wise in hindsight. I do not highlight these forecasts to criticise the authors. In both cases the authors have made it clear that the figures that they have used were assumptions for their models, not predictions. What these figures do highlight however are two key points:

√ The inherent uncertainty of making investment decisions in this area.
√ That everyone should be far less certain of the current forecasts of higher prices especially as the IEA has just issued its fourth downgrading of forecast oil demand in 12 months.

2. Biofuels become a significant business in Australia

There are four basic situations where I believe that there will be significant ethanol sales in Australia:

1 Oil price moves higher than current prices and stays there for an extended period.
2 The government mandates the use of ethanol for political, health or environmental reasons.
3 The production of ethanol from biomass becomes commercially feasible at costs of production well below the cost of grain based ethanol.
4 The government opens up the country to imports of ethanol from other countries.

In addition there is a possibility of the development of a biorefinery industry based on maize or sugar where products such as plastics are made from organic feed stock as is already occurring in the USA. The story in each of these possible scenarios is fairly straightforward if the conditions described occur.

So where does maize fit?

I do not have any technical expertise in maize production systems and costs but a few conclusions are fairly logical:

• If a grain based ethanol industry is to develop then maize will have to compete as a feed stock against other grains. This is a complex question of costs of production on farm, the suitability of mixed grain inputs into plants, and the value of the by products produced from maize rather than other grains.

• It is unlikely that irrigation water will be used to produce energy crops rather than food because of the pure economics of the process. Therefore maize will have to be produced from dry land operations for energy crops.

• In the long run maize will have to be supplied at costs that allow ethanol to be competitive. While this may not occur in the short term, eventually long run economics will come to bear.

• If the production of ethanol from biomass becomes commercially competitive then maize farmers have an opportunity to value add their corn stover.

12 www.oilendgame.com
13 It is unlikely that there will be enough maize in one site to supply a large scale plant
Conclusions

My view of a grain based ethanol industry is that it is a highly risky proposition based on the high number of uncertainties presented in this paper. The industry may be artificially boosted by the returns available while the full excise holiday is in place. At the recent Australia Bioenergy Conference, Martin Jones from CSR expressed the view that there will not be any extra capacity built post 2011 when the excise starts to phase in.

Therefore my advice to potential investors and maize growers is that you need to carefully consider your risks. In order to do this you need to ask the following questions:

• Does the proposed or existing ethanol plant have long term sale contracts in place for their products that are locked in for volume and price, that are legally enforceable, and with a party that has the financial strength to give you confidence?

• Do the owners and operators of the proposed or existing ethanol plant have the financial strength to withstand a significant financial shock such as a drought, a significant reduction in oil prices, or a significant run up in grain prices?

• Do the owners and operators of the proposed or existing ethanol plant have a track record of success in business and the demonstrated operational, financial, and marketing expertise to give you confidence?

• Do proposed contracts to supply grain to a plant give you sufficient confidence for the financial risks that you are undertaking.

• Can you as a maize producer supply grain at a long run cost that is competitive with other feed grains?

It needs to be stressed that none of the views expressed here are predictions, they are merely a strategic overview of the possible risks. The fact that these risks exist does not mean that the industry cannot be successful. On the other hand people tend to discount risk if a project is successful and pillory people who fail where there was a reasonable risk reward relationship. In my view neither of those positions is reasonable. I am also well aware that there are a number of potential projects occurring in the industry as I write this paper and that by the time I present at the conference significant developments may have occurred. The full story will be played out over a number of years and I am happy to come back in six years time and debate the issues again.

Disclaimer: I have investments in the pork industry and therefore have a commercial interest in the overall outcome of feed grain prices. The merits of the arguments need to be debated, not the personal financial investments of individuals.