Department of Agriculture and Food
Government of Western Australia

ETHANOL PRODUCTION FROM GRAIN

MAY 2006

DISCLAIMER

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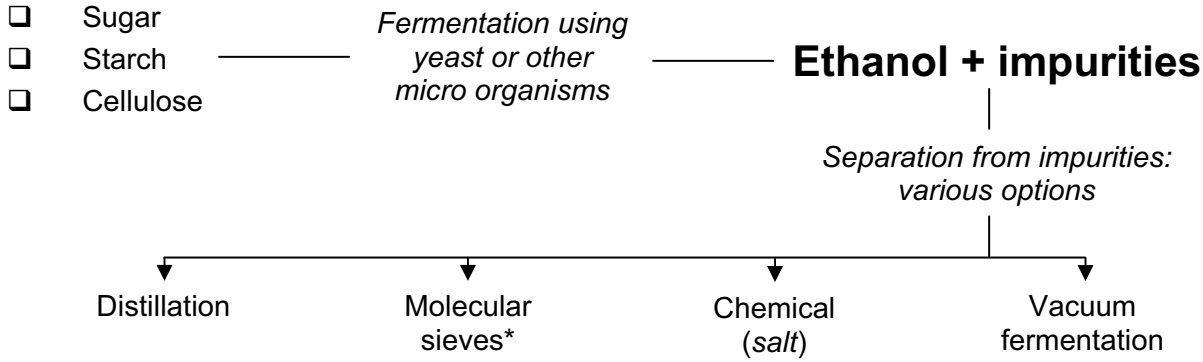
1. ETHANOL PRODUCTION PROCESSES

The process of producing ethanol can be schematised as follows:



* Today, almost all ethanol plants use molecular sieves for dehydration. This technology alone reduces energy use by 10 per cent per litre of ethanol produced.

Two methods are currently used to produce ethanol from grain: wet milling and dry milling. The adjectives 'wet' and 'dry' describe the method, not the product. The different methods affect both the profitability and logistics.

Dry mills produce ethanol, distillers' grain and carbon dioxide (Figure 1). The carbon dioxide is a co-product of the fermentation, and the distillers' dried grain with solubles (DDGS) is a non-animal based, high protein livestock feed supplement, produced from the distillation and dehydration process. If distillers' grains are not dried, they are referred to as distillers' wet grain (DWG).

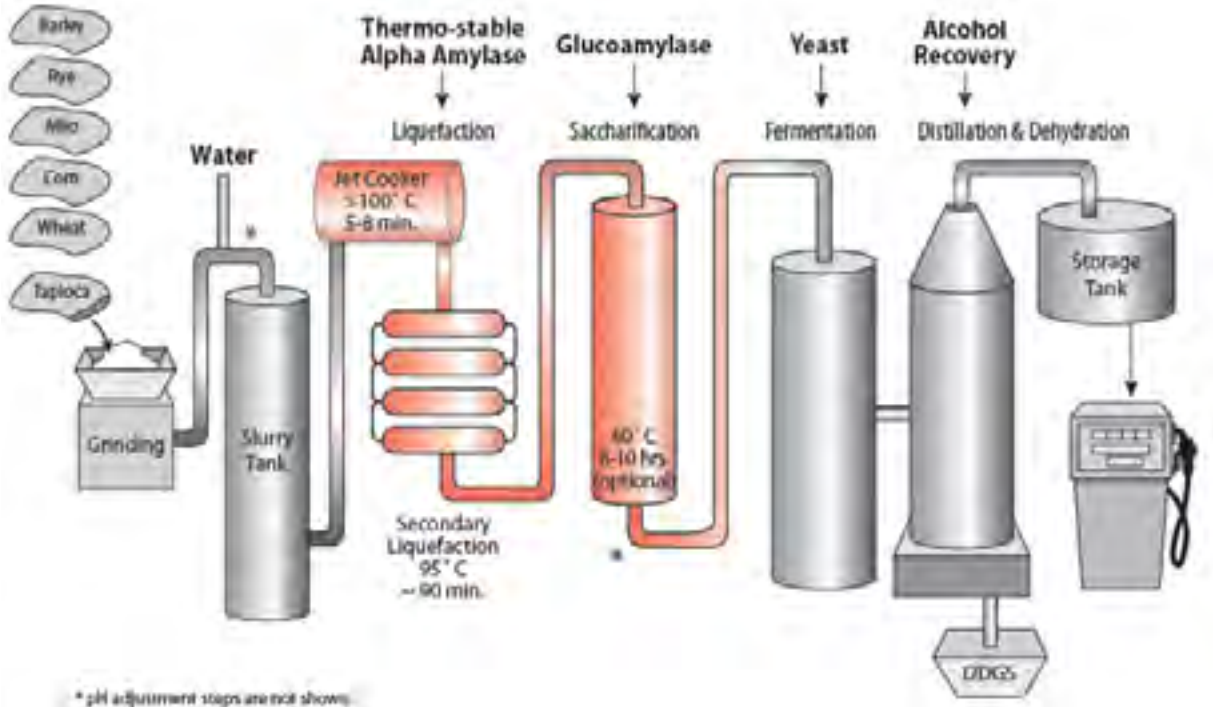


Figure 1. The conventional dry mill ethanol production process.

Source: Genencor International.

Wet mill facilities are 'bio-refineries' producing a host of high-valued products (Figure 2). Wet mill processing plants produce more valuable by-products than the dry mill process. For example, in wet mill plants, using corn as feedstock, they produce:

- ethanol;
- corn gluten meal (which can be used as a natural herbicide or as a high protein supplement in animal feeds);
- corn gluten feed (also used as animal feed);
- corn germ meal;
- corn starch;
- corn oil; and
- corn syrup and high fructose corn syrups.

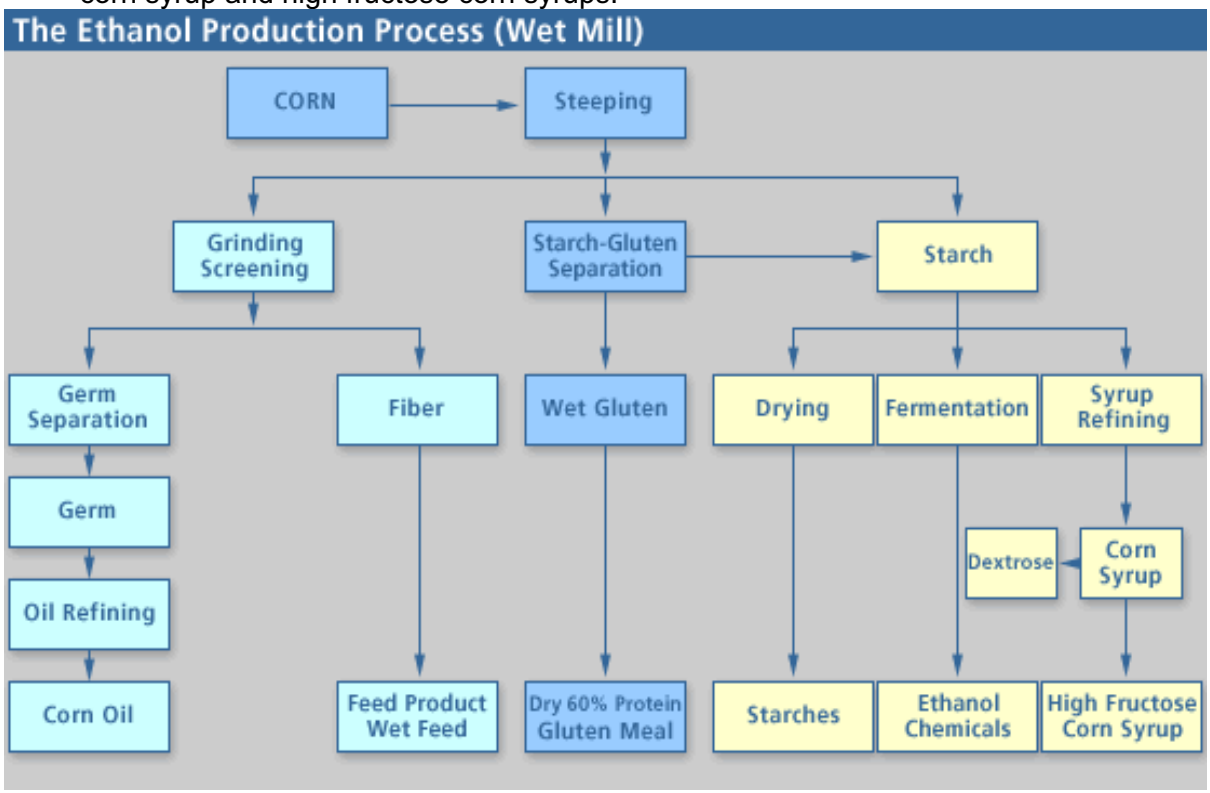


Figure 2. The conventional wet mill ethanol production process.

Source: The Renewable Fuels Association, USA.

Wet mill plants cost substantially more to build and have higher operating costs than dry mill processing plants and hence are usually much bigger than dry mill plants in order to achieve economies of scale.

In 2004, practically all of the proposed plants in the USA were dry mills.

2. TOTAL COST OF PRODUCTION

The total cost of ethanol production is the sum of the capital cost, the capital related charges or financial costs, and the production cash cost.

2.1 Capital and financial costs

The estimated capital costs of various dry mills in Australia are shown in Table 1. Dalby Bio-Refinery Limited will commence Stage One construction of an ethanol plant during the first half of 2006. The companies responsible for the Dalby ethanol plant are the Queensland Fuel Group, and Petrol Fuels and Lubricants. The first stage of the project will produce 40 million litres of ethanol while the full project will have annual production of 82 million litres. The Dalby Bio-Refinery will be the first dry mill ethanol plant constructed in Australia and the first plant built specifically for the production of ethanol for fuel since World War II.

Table 1 shows the capital cost for dry mills using grain as feedstock in Australia and Canada.

Table 1. Capital cost for dry mills using grain as feedstock in Australia and Canada

Location	Production capacity	Cost of mill	Grain tonnage processed	kg of grain required per L ethanol
	mL/year	AU$	'000 t/year	kg/L
Dalby Queensland 2005	40 then 82	Cost of first stage $54 million	214	2.68 kg wheat
Husky Loydminster, Canada 2004	130	$103.65 million	350	2.69 kg wheat
Coleambally, Riverina NSW 2005	90	$82.44 million	250	2.78 kg corn
Swan Hill, Victoria 2005	90	$82.44 million	250	2.78 kg corn

Source 2005: Dalby Bio-Refinery, Husky Energy Inc. and Australian Ethanol Ltd.

The capital cost above does not include capital related charges or financial costs which depend on the facility's outstanding debt and loan structure.

The Dalby Bio-Refinery is on the record as costing $80 million with 82 million litres capacity. After adjusting for the government capital subsidy that is capped at $10 million, the total capital cost, which includes financial costs, was imputed using a real rate of return of 7 per cent and a plant life of 20 years. This translates to a total capital cost, after subsidy, of 0.084 AU$/L (Centre for International Economics, August 2005).

2.2 Production cash cost

Ethanol production cash costs for two dry mills in USA, using corn as feedstock, are illustrated in Table 2 and Table 3.

Table 2. Production cash cost for two dry mills in USA using corn as feedstock

Item	Colorado mill 189.2 M L/year	Illinois mill 189.2 M L/year	Colorado mill	Illinois mill
OPERATING COSTS	**AU$/L ethanol**	**AU$/L ethanol**	**% of total cost**	**% of total cost**
Feedstock costs	$0.353	$0.307	70%	64%
Electricity	$0.011	$0.011	2%	2%
Natural gas	$0.067	$0.097	13%	20%
Waste management	$0.001	$0.001		
Water	$0.001	$0.001		
Chemicals, enzymes and yeast	$0.024	$0.024	5%	5%
Denaturant	$0.018	$0.018	4%	4%
Labour	$0.008	$0.008	2%	2%
Administration costs	$0.013	$0.014	3%	3%
Other costs	$0.007	$0.000	1%	0%
Total operating cost (a)	**$0.503**	**$0.481**	**100%**	**100%**
REVENUE FROM BY-PRODUCTS	**AU$/L ethanol**	**AU$/L ethanol**		
DDGS	$0.000	$0.092		
DWG	$0.111	$0.010		
Carbon dioxide	$0.011	$0.000		
Small producer tax credits	$0.011	$0.011		
Total by-product revenue (b)	**$0.133**	**$0.113**		
Ethanol production cash cost (a)-(b)	**$0.370**	**$0.368**	**AU$/L ethanol**	

Source: BBI International, 19 October 2005.
Exchange rate used: USc72.

The ethanol operating costs breakdown of an Australian dry mill using wheat as feedstock is similar to a dry mill in USA using corn as feedstock when both sell their by-product as DWG. Dry mills selling their by-product as DDGS have higher energy costs. The total cash cost of production of ethanol in USA is around AU$0.36-0.37 per litre (October 2005). In June 2004, Australian Ethanol Ltd (then known as Australian Biofuels), had projected its fuel ethanol production cash cost, after crediting back the distillers grain and carbon offsets (and before financing the facility), at about AU$0.30-0.34 per litre in Australia.

Table 3. Grain ethanol plant typical operating costs breakdown (Australia and USA)

Items	Australia dry milling (wheat)	Dry mill Colorado (corn)	Dry mill Illinois (corn)
Grain feedstock	72%	70%	64%
Utilities (electricity, gas)	17%	17%	23%
Consumables	4%	8%	9%
Labour	4%	2%	2%
Maintenance	1%	0%	0%
Administration and expenses	2%	3%	3%

Source: BBI International, October 19, 2005 and Australian Ethanol Ltd 2005.

3. EXPENSES

Tables 2 and 3 demonstrate that the major expenses for ethanol production are feedstock and energy.

3.1 Feedstock

The type, availability, and price of grain all factor into the profitability of producing ethanol. Any type of grain containing starch can be used to produce ethanol. Grains such as wheat, barley, corn, sorghum and other cereals typically contain 55-70 per cent starch. A typical grain analysis for varieties grown in Australia is contained in Table 4.

The important factor is not so much the cost of the grain but the cost of starch. One tonne of starch will produce around 620 litres of ethanol. This translates to:

- 1 tonne of grain at 60 per cent starch producing 360 litres of ethanol;
- 1 tonne of grain at 70 per cent starch will produce 420 litres of ethanol (an increase of 17 per cent).

Table 4. Typical feedstock analysis (%db)

Typical analyses	Wheat	Barley	Corn	Sorghum
Moisture (%db)	12.5	10.0	14.0	14.0
Starch (%db)	65.3	60.0	70.0	74.6
Protein (%db)	13.0	10.0	9.5	8.0
Fibre (%db)	9.0	10.2	11.5	10.0
Fat (%db)	2.0	3.0	3.9	3.1
Ash (%db)	2.5	2.5	1.6	1.0
Other sol. (%db)	8.7	14.3	3.5	3.3
Total (%db)	**100.0**	**100.0**	**100.0**	**100.0**

Source: GRDC.

Ethanol mills buy grain for its starch. Starch typically accounts for around 61-65 per cent of wheat grain weight when 100 per cent dry. The higher the starch percentage content the higher the grain price that can be accommodated. Average Western Australian Wheat Pool prices for downgraded wheat or feed grain are given in Table 5. Feedstock represents 72 per cent of the operating costs (Table 3) and, based on target costs for the starch only at AU$230-AU$280 per tonne (2005), the effect of wheat price on the cash cost of ethanol production is shown below (Table 6).

Table 5. WA wheat pool price (AU$/t) for feed grain (moisture content: 10.5 per cent)

Grade	2001 $	2001/02 $	2002/03 $	2003/04 $	2004/05 $	5 yr average $
Feed Grain	184.98	188.77	238.22	204.97	170.00	197.39

Source: J. Henderson, DAFWA 2006.

Table 6. Wheat prices and estimated cash cost of ethanol production

Wheat pool price FOB (AU$ per tone)	$164.33	$172.39	$180.45
Estimated net cash cost of ethanol production (AU$/L)*	$0.30	$0.33	$0.36

* Assuming an income from the Distillers Wet Grain (DWG) of 20 cents per litre of ethanol produced.

Availability of grain is also very important particularly since many ethanol processing facilities have only three production days of storage.

3.2 Energy costs

In the USA, the critical energy cost for ethanol production is the price of natural gas, which is used both to heat the mashed grain to produce ethanol and to dry the co-product distillers grain to produce DDGS.

In Australia, energy costs for a dry mill accounts for about 10 per cent of operating expenses. This means that price variation doesn't impact on profitability as much as grain price variation, but it is still important.

Since deregulation began in 1999 gas prices in WA have fallen substantially - around one-half. Gas prices of around US$1.50 per gigajoule (or MMBtu) are believed to be capable of negotiation with the gas producers in WA. Meanwhile, in the USA, natural gas has significantly increased in price since 2002 and was more than US$10.00 per gigajoule in 2005 in Illinois, one of the States with the lowest natural gas prices (Tables 7).

4. INCOME

Three products are produced from ethanol dry mills: ethanol, distillers' grain and carbon dioxide.

4.1 Ethanol

The price of ethanol is the most important factor when considering the profitability of an ethanol production facility. As it relates to income and profits, ethanol sales account for 70-80 per cent of the revenue from an ethanol plant. A change of four cents per litre of ethanol changes income by over $3 million for an 80 million litre plant.

Since ethanol is a close substitute for gasoline, the ethanol price in the USA reflects the wholesale gasoline price. Studies have confirmed the strong positive correlation between ethanol prices and petrol prices. The paper *Risk Factors in Ethanol Production* analyses the relationship between prices of inputs and outputs associated with ethanol production. In that paper, the statistical tool of correlation coefficient is used to compare price series to each other to see how closely related they are. If the correlation between two price series is equal to one, then the two price series are said to be perfectly positively correlated, which means the two prices rise together and fall together. If the correlation between two price series is equal to negative one, the two price series are said to be perfectly negatively correlated, which means that as the price of one rises the other falls. If the correlation is zero, the two are said to have no relationship with each other.

Table 8 lists the correlation co-efficient between major economic factors in ethanol production. The relationship of ethanol price to unleaded petrol price of 0.58 shows that the prices of ethanol and unleaded petrol are relatively highly correlated as expected since they are substitutes.

Table 8. Correlation between selected monthly price series, USA, from 1992-2003

	Unleaded petrol	DDGS	Corn	Grain sorghum	Natural gas	Electricity
Ethanol	0.58	0.26	0.14	0.17	0.49	0.09
Unleaded		-0.15	-0.11	-0.05	0.64	-0.11
DDGS			0.77	0.74	-0.25	0.25
Corn				0.97	-0.21	0.19
Sorghum					-0.17	0.17
Natural gas						-0.26

Source: USDA, Energy Information Administration (EIA), and Nebraska Ethanol Board (September 2004).

A chart comparing ethanol prices (not including the US$0.52/gallon government subsidy) and unleaded petrol prices in Omaha, Nebraska are displayed in Figure 3. Note how the two price series move fairly close together over the time period. The correlation of 0.58 from Table 8 above shows that the prices of ethanol and unleaded gasoline are relatively highly correlated, but not perfectly so, as some people believe. Sometimes the price of ethanol is higher than unleaded gas because the relative supply and demand for each are big drivers in the price pattern.

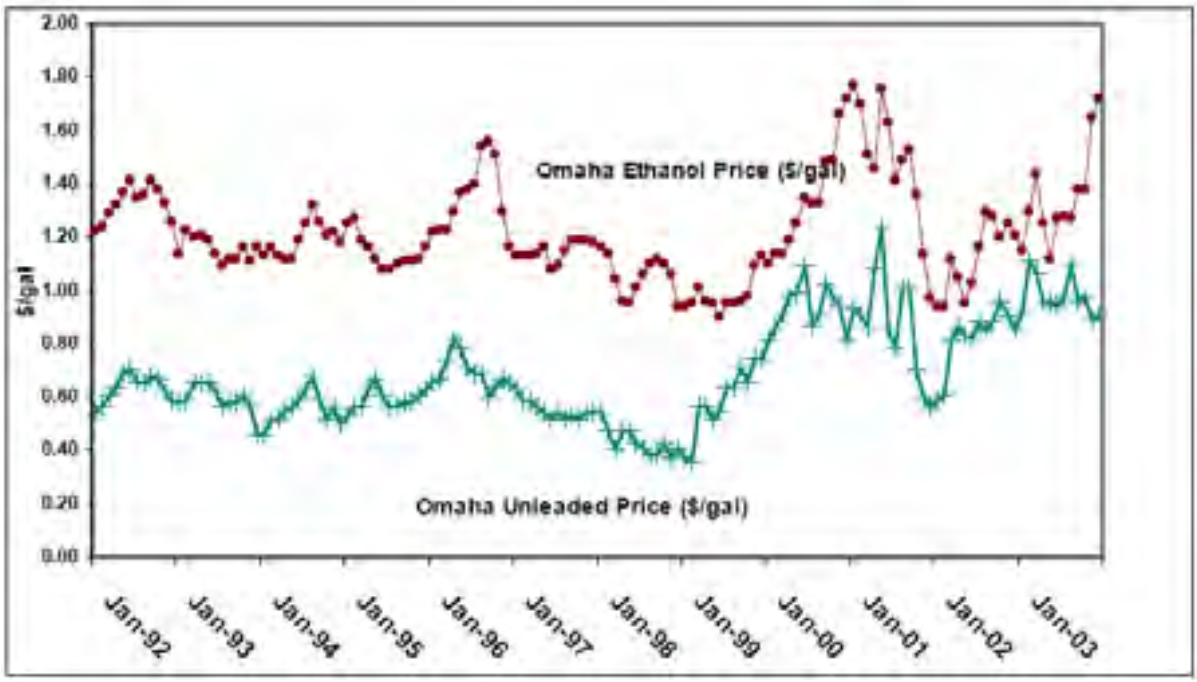


Figure 3. Omaha Ethanol (Nebraska) and unleaded wholesale price for 1992-2003.
Source: Nebraska Ethanol Board.

Since the price of ethanol is related to the price of petrol, it is therefore important to make the right assumptions and projections about petrol or crude oil prices when assessing the long-term viability of ethanol production.

Although grain represents 60-70 per cent of the operating costs (Table 2), the data in Table 9 demonstrates that ethanol and grain feedstock prices have almost no correlation which substantiates that the price of ethanol rarely responds to the price of grain as illustrated in Figure 4.

Figure 4. Variation in ethanol and corn prices.
Source: Ethanol Spot Price Data: Oil Price Information Service.

4.2 Distillers grain

A large quantity of distillers' grain is produced as a co-product in ethanol production. Distillers face the challenge of having to move this co-product into the market at whatever the prevailing price is in order to minimise the cost of storing and managing the products on site. Distillers grain can be sold as a wet product – mash and syrup (30 per cent solids), or as a dry feed (92 per cent solids). Drying is costly, as it requires the input of further energy.

Dry distillers' grain has a shelf life of 12 months or more and, in the USA, is packaged and traded as a commodity product.

Wet distillers' grain has a shelf life of 4-5 days and involves the transport of 70 per cent water by weight of total product. Wet distillers' grain supply transport is economically viable usually within a 200 km radius from the ethanol production facility.

These facts are important as they affect both profitability and logistics.

The variety of decisions regarding the production and marketing of distillers' grains are very important for ethanol-producing plants. Next to ethanol, DDGS accounts for the second largest source of income for the plant. In the USA, DDGS typically makes up 10-20 per cent of total income depending on inputs and outputs prices, federal and state incentives, plant size and whether a plant has income from CO_2.

A typical feed analysis for the wet distillers' grain is shown in Table 9.

Table 9. Wet distillers grain typical analysis

Moisture	**% of total product**	**70%**
Dry solid matter	% of total product	30%
Protein	% of dry matter	27%
Digestibility	% digestible of dry matter	69.9%
Fat (ether extract)	% of dry matter	4.6%
Metabolisable energy	MJ/kg of dry matter	10.6%

Source: Australian Ethanol Ltd and GRDC.

The Chairman of Australian Ethanol Ltd stated that: "The future of ethanol in Australia is in grain alcohol adopting the USA model where the fuel ethanol revenue pays the bills and the profit comes from the distillers' grain by-product. With a strong cattle industry and continuous demand for Australian red meat; fuel ethanol from grain is the future".

In 2004/05, Australian beef exports to Japan increased by 27 per cent and half of this beef was grain-fed, representing an increase in lot-fed product of 45 per cent over the previous financial year. As demand in Japan has grown, Australia's lot feeding capacity has expanded, allowing the industry to better supply the type and quality of beef required to meet the gap left by the absence of US product. A similar story applies to beef exports to Korea, up by 123 per cent on last year. Figure 5 below shows the increasing trend in cattle feeding nationally, and in Western Australia. The trend is generally upward as demand for lot-fed cattle grows. The spike in 2001/02 is an aberration due to increased drought feeding across Australia. Although the Japanese and Korean markets will eventually reopen their markets to US product, Australian grain-fed beef producers, including Western Australian, have always had a strong presence in those markets and they are confident to retain that strong presence as well as some of the newly gained markets.

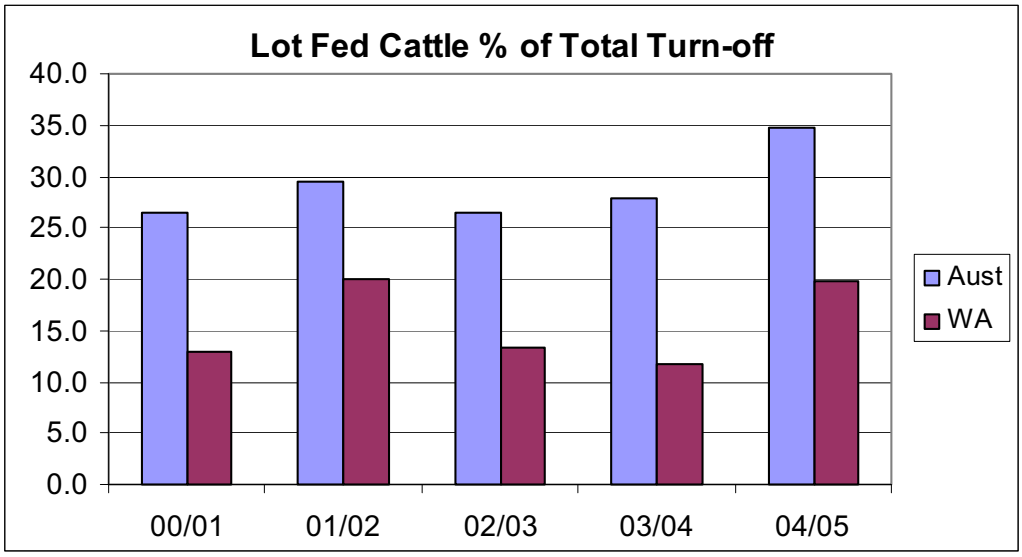


Figure 5. Trend in cattle feeding nationally, and in Western Australia.
Source: ABS, ALFA, DAFWA.

4.3 Carbon dioxide

The third product produced in ethanol plants is carbon dioxide and it contributes very little towards profitability. The profitability of capturing and marketing the carbon dioxide is very low.

Australian Ethanol Ltd anticipates revenues from the carbon offsets equivalent to 1-2 cents per litre of ethanol produced.

5. ANALYSIS OF PROFITABILITY

Ethanol, biodiesel, petrol and diesel producers all currently pay fuel excise at 38.1 cents per litre, but ethanol and biodiesel producers receive a production grant of AU$ 0.381 cents per litre which, in effect, fully offsets the excise paid by producers (Table 10).

The Government's policy for biofuels has altered considerably over the past two years. Ethanol will increasingly be subject to fuel excise, from an effective rate of zero until 2011 to a maximum of 12.5¢/L by 2015; reflecting its energy content while retaining a net tax and outlays advantage over traditional petrol (Table 10).

Table 10. Effective fuel tax rates for ethanol at 1 July 2003 to 2015 (cents/L)

Year	Fuel tax	Ethanol production grant	Effective tax
2003	38.143	38.143	**0.0**
2004	38.143	38.143	**0.0**
2005	38.143	38.143	**0.0**
2006	38.143	38.143	**0.0**
2007	38.143	38.143	**0.0**
2008	38.143	38.143	**0.0**
2009	38.143	38.143	**0.0**
2010	38.143	38.143	**0.0**
2011	38.143	35.643	**2.5**
2012	38.143	33.143	**5.0**
2013	38.143	30.643	**7.5**
2014	38.143	28.143	**10.0**
2015 onwards	38.143	25.643	**12.5**

Source: Treasury.

To compare the price of imported petrol with the cost of domestically produced ethanol, allowance must be made for the different energy densities of ethanol and petrol. The energy density of ethanol is around 68 per cent of petrol. In a competitive market, ethanol might be expected to be priced lower than petrol to reflect this energy difference. In January (12/1/2006), the Terminal Gate Price[1] was AU$1.145 per litre and ethanol would have been priced at AU$0.778 per litre (AU$1.145 * 0.68) to compete on an energy basis with petrol. A further 10 cent per litre discount, to make ethanol cheaper than unleaded petrol and increase its competitive edge, brings the ethanol to a threshold price[2] of AU$0.698 per litre which is close to the minimum AU$0.625 cents per litre targeted by Australian Ethanol Ltd.

As stated before, the ethanol price is strongly correlated to the unleaded petrol price. In the USA, E85 fuel sells at around US$0.25-US$0.30 per gallon less than gasoline or 10 Australian cents per litre less.

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1 *Terminal Gate Price is the international parity price for fuel sold in Australia and is calculated on a daily basis. It relates to the Singapore refined fuel price plus freight, handling, margin, excise and GST.*

2 *Ethanol Threshold Price is the maximum price at which ethanol could be sold and still remain competitive with unleaded petrol on a price base.*

Table 11 and Flowchart 1 show that a strong Australian dollar and a low crude oil price decrease the profitability of ethanol production.

Assuming a long-term US$/A$ exchange rate of 0.65, with current government assistance, the required oil price is estimated to be US$25-30 per barrel for viability in 2015 (report of the Biofuels Taskforce to the Prime Minister, August 2005). Should the long term oil price be higher and all other things being equal, the commercial viability prospects of biofuels would improve. This was confirmed by the Definitive Feasibility Study (March 2005) commissioned by Australian Ethanol Ltd for their Swan Hill Ethanol Project. The outcome of the Definitive Feasibility Study is that the Swan Hill Ethanol Project met the targeted investors' return at an assumed long run oil price of US$30 per barrel at an exchange rate of US$0.70 and ethanol price of $0.625 per litre delivered into Melbourne. Since completion of both reports, the medium term oil price has increased to well over US$30 per barrel (Figure 6) and, in the current situation, the targeted ethanol price of $0.625 per litre delivered into Melbourne by Australian Ethanol Ltd is realistic and achievable despite a stronger US$/A$ exchange rate of 0.75 (Table 12).

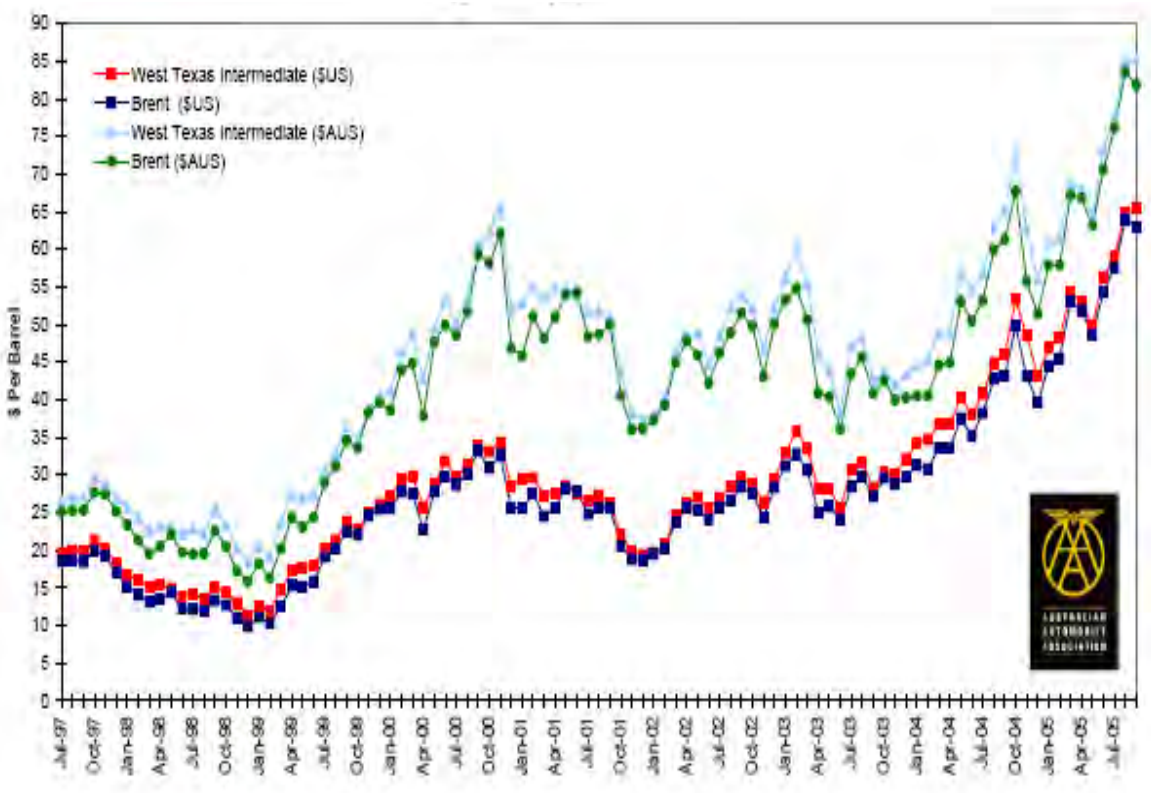


Figure 6. Average monthly spot crude oil prices (US$/barrel).

Source: US Energy Information Administration, Australia Tax Office.

Assuming that ethanol producers are able to sell all they can produce at prevailing market prices, that is, there are no problems with market barriers or consumer confidence, the production of ethanol from grain is a commercially viable operation (Flowchart 1):

- **Under the current tax rate:** When the crude oil price is US$30/bbl or higher.
- **After 2015:** When the crude oil is above US$55/bbl.

Table 11. Sensitivity of ethanol threshold price to changes in crude oil price**

Crude oil in US$ per barrel	**US$/bbl**	**30**	**40**	**45**	**55**	**60**	**70**	**75**
Exchange rate US$	US$	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Crude oil in AU$ per litre	AU$/L	0.25	0.34	0.38	0.46	0.50	0.59	0.63
Refiners margin (%)	%	6%	6%	6%	6%	6%	6%	6%
Refiners profit (¢/L)	AU$/L	0.02	0.02	0.02	0.03	0.03	0.04	0.04
Refined petrol price (from Singapore)	AU$/L	0.27	0.36	0.40	0.49	0.53	0.62	0.67
Petrol excise	AU$/L	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Petrol GST	AU$/L	10%	10%	10%	10%	10%	10%	10%
Retail/wholesale margins and transport	%	4%	4%	4%	4%	4%	4%	4%
Terminal gate price*	AU$/L	0.74	0.84	0.89	0.100	0.105	0.115	0.120
Equivalent ethanol price (the energy density of ethanol is around 68 per cent of petrol)	AU$/L	0.504	0.573	0.608	0.677	0.711	0.780	0.815
Discount to make ethanol competitive	%	10%	10%	10%	10%	10%	10%	10%
Ethanol threshold price**	**Auc/L**	**45.3**	**51.6**	**54.7**	**60.9**	**64.0**	**70.2**	**73.4**

* Terminal Gate Price is the international parity price for fuel sold in Australia and is calculated on a daily basis. It relates to the Singapore refined fuel price plus freight, handling, margin, excise and GST.

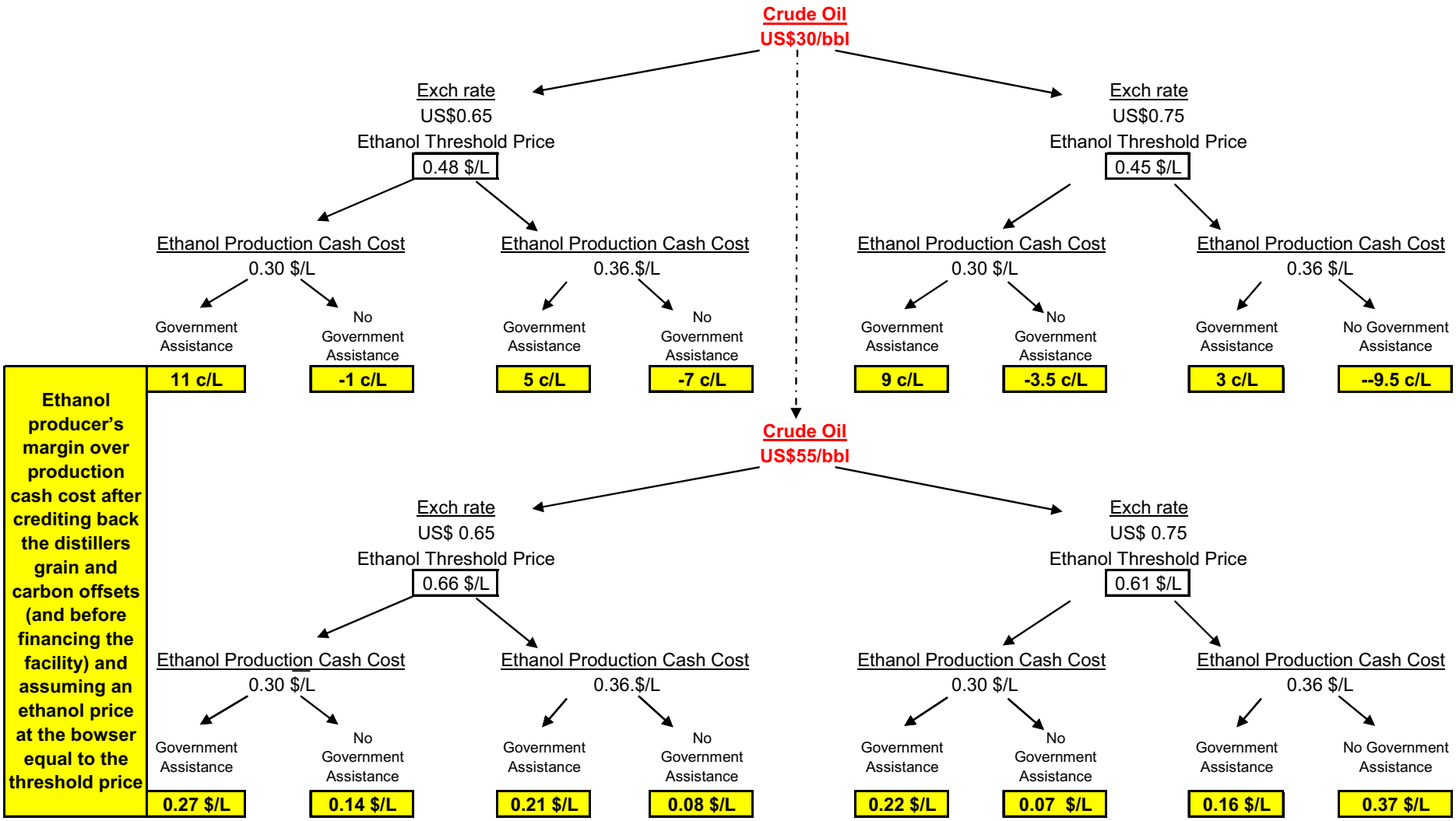
** Ethanol Threshold Price: Maximum price at which ethanol could be sold and still remain competitive with unleaded petrol on a price base.

Effect of the ethanol threshold price on the commercial viability of the mill, <u>under the present fuel excise schedule</u>

Ethanol at pump (assuming it is equal to threshold price)	**AU$/L**	**0.453**	**0.516**	**0.547**	**0.609**	**0.640**	**0.702**	**0.734**
Ethanol production cash cost (assumed)	AU$/L	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Ethanol Excise	AU$/L	0	0	0	0	0	0	0
Ethanol GST	AU$/L	10%	10%	10%	10%	10%	10%	10%
Distributor/retailer margins and freight	%	6%	6%	6%	6%	6%	6%	6%
Ethanol producer's margin over production cash cost if ethanol price at the bowser is equal to the threshold price	AU$/L	0.03	0.08	0.11	0.16	0.19	0.24	0.27

Effect of the ethanol threshold price on the commercial viability of the mill, <u>after</u> 2015

Ethanol at pump (assuming it is equal to threshold price)	**AU$/L**	**0.453**	**0.516**	**0.547**	**0.609**	**0.640**	**0.702**	**0.734**
Ethanol production cost (assumed)	AU$/L	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Ethanol Excise	AU$/L	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Ethanol GST	AU$/L	10%	10%	10%	10%	10%	10%	10%
Distributor/retailer margins and freight	%	6%	6%	6%	6%	6%	6%	6%
Ethanol producer's margin over production cash cost if ethanol price at the bowser is equal to the threshold price	AU$/L	-0.096	-0.043	-0.016	0.037	0.064	0.117	0.144



Flowchart 1. Sensitivity of ethanol threshold price and producer's profit margin to changes in crude oil price, exchange rate and cost of production.

Source: J. Bonnardeaux, Department of Agriculture and Food Western Australia 2006.

Table 7. Price of Natural Gas sold to commercial consumers in Illinois (US$ per gigajoule)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1989	4.2	4.66	4.77	4.61	4.62	4.84	5.10	5.19	4.88	4.39	4.20	4.38
1990	4.56	4.97	4.83	4.50	4.66	5.00	5.11	4.92	4.37	4.37	4.26	4.56
1991	4.74	4.55	4.39	4.56	5.24	6.41	5.30	5.36	4.58	4.31	4.16	4.23
1992	4.44	4.52	4.11	4.02	4.80	5.94	5.48	5.31	5.28	4.89	4.93	4.88
1993	4.89	4.81	4.63	5.24	5.99	6.78	5.99	6.53	5.80	5.49	5.00	5.03
1994	5.01	5.04	5.28	5.74	6.07	6.12	6.44	6.20	5.77	4.81	4.33	4.63
1995	4.39	4.44	4.53	4.42	5.16	5.16	5.35	5.01	5.23	4.23	4.11	4.00
1996	4.07	4.31	4.75	5.00	6.19	6.68	7.09	7.66	6.25	5.23	4.83	5.20
1997	5.87	5.66	4.95	4.62	4.91	5.52	5.66	6.08	6.22	5.79	5.26	5.21
1998	4.76	4.68	4.72	5.26	6.84	6.25	8.18	6.41	6.10	5.32	4.88	4.69
1999	4.43	4.45	4.40	4.79	6.50	7.07	7.87	8.43	7.15	6.28	6.12	5.34
2000	4.92	5.05	5.38	5.89	7.59	10.33	9.92	9.29	9.06	9.50	8.42	8.63
2001	11.13	10.76	9.02	8.53	8.78	9.04	7.41	7.54	6.30	4.80	5.49	5.15
2002	6.21	6.16	6.40	6.76	8.87	10.74	10.38	9.90	9.33	8.31	8.35	8.14
2003	6.98	7.19	9.47	9.18	9.78	11.05	10.86	10.13	9.11	8.37	8.23	7.82
2004	8.55	8.28	8.17	8.96	10.45	10.97	12.10	11.31	10.64	9.32	9.86	9.44
2005	9.31	9.10	8.77	10.33	11.43	11.86	12.24	12.86	13.69	14.25		

Updated on 12 December 2005.
Source: US Energy Information Administration.

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