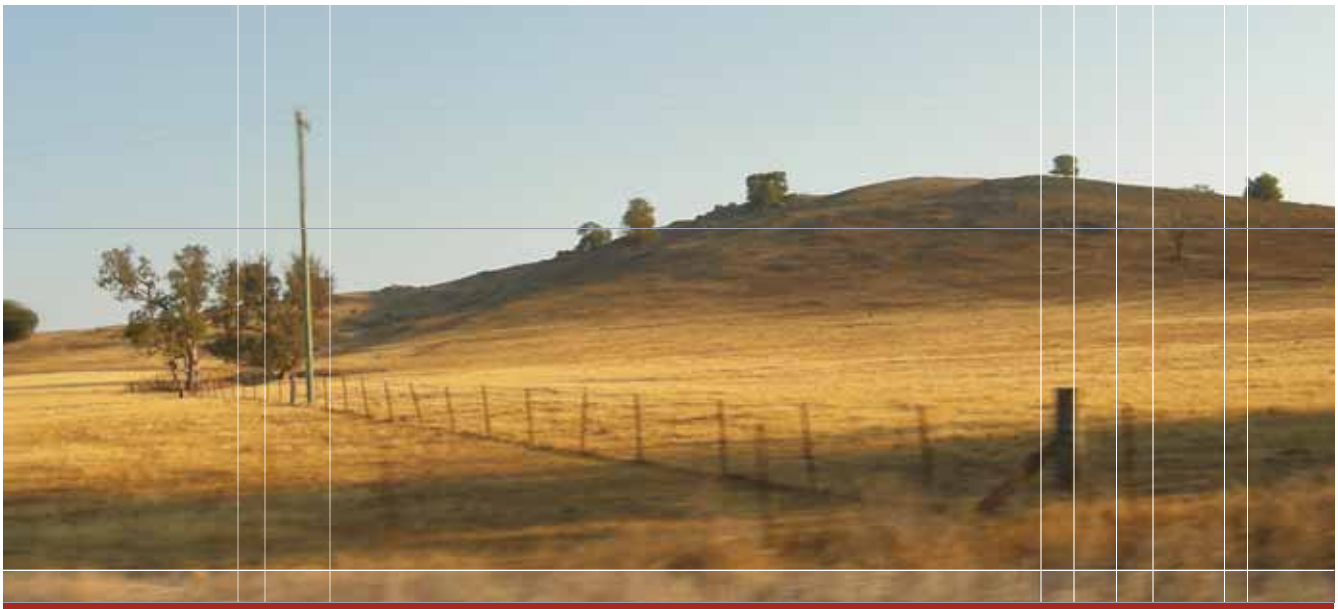

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outlook for biofuels in Australia

the challenges ahead

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» ***Australia's relatively small and gradually expanding biofuels industry offers a potential market for agricultural feedstocks, such as grains or molasses, for ethanol production, or tallow or oilseeds for biodiesel production.***

» ***However, as feedstocks represent around 60–70 per cent of the cost of producing biofuels, the recent rise in feedstock prices, combined with the moderation in world oil prices, may put downward pressure on biofuels producer returns.***

» ***Notwithstanding this, the relative movements of forecast world oil prices and forecast local feedstock prices in 2006-07 are expected to be more favourable for biofuels producers than in many years since 1995-96.***

current biofuels production in Australia

Biofuels currently comprise only a small proportion of Australia's liquid fuel supply. In 2005-06, Australia produced and consumed 57 million litres of biofuels, consisting of 41 million litres of fuel ethanol and 16 million litres of biodiesel. This compares with petrol consumption of 19 050 million litres and diesel consumption of 15 880 million litres in 2005-06. However, biofuels production and sales are rising, with more ethanol blended fuel reported to have been sold in the first four months of 2006-07 than in 2005-06 as a whole. Production capacity for biodiesel was boosted by the commissioning of several large new facilities in 2006. Ethanol production capacity is expected to expand in 2007 and 2008 with several large projects under way in both eastern and western Australia.

production processes

fuel ethanol

Ethanol can be produced industrially or from the fermentation of biomass feedstocks. The latter are typically obtained from agricultural sources, including waste starch, molasses, corn (maize), sorghum and low quality wheat. The next generation of technology could allow cellulosic material, such as crop waste, wood waste and grasses, to be economically used as feedstocks. The energy content of fuel ethanol is typically 68 per cent of the energy content of a litre of petrol, regardless of the feedstock used.

Fuel ethanol is produced in two forms, hydrous (or hydrated) and anhydrous. Hydrous ethanol typically has a purity of about 95 per cent and has been used in Brazil since the late 1970s as a fuel in motor vehicles with modified engines. A second stage process is

used to produce high purity anhydrous ethanol for use in petrol blends. The 95 per cent pure product is dehydrated using azeotropic processes or a molecular sieve to remove the water, resulting in 99 per cent pure ethanol. Anhydrous ethanol is typically blended with petrol for use in unmodified engines. Since 1 July 2003 the maximum permissible limit on the ethanol component in petrol in Australia has been 10 per cent – this blend is known as E10 (Australian Government 2005).

biodiesel

Biodiesel is usually produced from a reaction of vegetable oil or animal fat with an alcohol such as ethanol or methanol in the presence of a catalyst to yield mono-alkyl esters and glycerine in a process known as transesterification. Depending on the feedstocks and processes employed, byproducts can include glycerine, fatty acids, fertiliser and oilseed meal. Potential feedstocks for biodiesel include vegetable oils, animal fats, such as tallow, and used cooking oils and fats.

The energy content of biodiesel varies between 88 per cent and 99 per cent that of diesel, depending on the feedstock and esterification process used. Subject to engine manufacturers' advice, biodiesel can be used as a direct replacement for diesel or in a blend such as B5 (5 per cent biodiesel and 95 per cent diesel) or B20 (20 per cent biodiesel and 80 per cent diesel) (Australian Government 2005).

Biodiesel can be made in virtually any scale of plant. Many farmers or groups of farmers are considering setting up small scale production facilities for biodiesel production to produce fuel for their own farm operations (Potter and McCaffery 2006). In southern Australia, oilseeds, such as canola or mustard, are being investigated as feedstocks for biodiesel production. Researchers who have investigated both the technical and economic aspects of small scale biodiesel production have concluded that any local or regional investment in biodiesel needs to occur with a thorough knowledge of the costs and the risks associated with variable feedstock and final product prices.

economics of production

An analysis of the economics of biofuels production (Short and Riwoe 2005) found that the three main factors influencing the rates of return obtainable by biofuels producers were:

- world oil prices
- costs of production, especially feedstock costs, and
- government support.

oil prices

Ethanol and biodiesel blended fuels are sold mainly into the transport fuels market in competition with traditional fuels, such as petrol and diesel. Consequently, the price that biofuels producers are able to obtain for their product will depend on the domestic prices of petrol and diesel, prices that are related in turn to the world oil price and the Australian exchange rate. The world oil price used in ABARE's analysis is the average price for West Texas Intermediate (WTI). WTI is a lighter grade crude oil similar to Tapis (east Malaysian), the particular crude oil used by Australian refiners as a price indicator.

World oil prices rose in 2004-05 and 2005-06, with the WTI price rising from an average of US$44 a barrel in the third quarter 2004 to US$70 a barrel in the second quarter 2006. After remaining at this level in the third quarter 2006, the price of WTI fell to average US$60 a barrel in the fourth quarter of 2006, and is forecast to average lower

1 West Texas Intermediate (WTI) price nominal price

WTI price	2004-05	2005-06	2006-07 a
US$ a barrel	48.77	64.22	61.02
A$ a barrel	65.03	85.63	79.76

a Average of actual prices for July 2006 – February 2007 and ABARE forecasts for March–June 2007. The most recent calendar year forecasts for the WTI are in this issue of *Australian Commodities*.

in the first and second quarters of 2007. Consequently, the price for WTI is forecast to average lower in 2006-07 than in 2005-06. Since the value of the Australian dollar has averaged around US75 cents since the fourth quarter of 2004, Australian dollar denominated oil prices have followed a similar pattern (table 1).

For biofuels producers, the easing of world oil prices in 2006-07 and corresponding reductions in Australian denominated import prices for petrol and diesel mean that producers are likely to have to reduce the asking price of their product to remain competitive against petrol and diesel.

cost of production

The cost of producing biofuels includes both capital costs and operating costs. Feedstock costs represent a large proportion of the latter, typically 60–70 per cent. Fuel ethanol producers located in the grain belt use grains such as sorghum and wheat as feedstocks, while producers located in coastal north east Australia use molasses, derived from sugar cane. Biodiesel producers use a variety of fats and oils as feedstocks including used cooking oil, tallow and oilseeds, depending on availability and seasonal conditions. Byproducts from the production process can potentially yield a stream of revenue in the form of distillers' grains (when ethanol is produced from grain) or glycerine (when biodiesel is produced).

2 unit gross values of production of feedstocks in Australia

	2004-05 A$/t	2005-06 A$/t	2006-07 A$/t
Wheat	197	228	269 **f**
Sorghum	134	175	264 **f**
Sugar cane **a**	26	27	32 **f**
Canola seed	326	372	546 **f**
Tallow **b**	542	447	486 **c**

a The price of the sugar based feedstock used for ethanol production, C molasses, is likely to move with cane prices. **b** Unit export value for inedible mixed beef and mutton tallow, in drums. **c** Average for July–November 2006. **f** ABARE forecast.
Source: ABARE, *Australian Commodities*, March quarter 2007.

3 production of feedstocks in Australia

	2004-05 Mt	2005-06 Mt	2006-07 Mt
Wheat	21.9	25.1	9.8
Sorghum	2.0	2.0	1.0
Sugar cane	37.8	38.2	36.0
Canola seed	1.5	1.4	0.5

Sources: ABARE, *Australian Commodities*, March quarter 2007; Australian Crop Report, February 2007.

In 2006-07, the domestic prices of many feedstocks, particularly grains and oilseeds, are forecast to average higher than in 2005-06 because of a combination of higher world prices and drought induced lower domestic supplies (tables 2, 3).

For biofuels producers, higher prices for agricultural feedstocks in 2006-07 are likely to increase costs of production and reduce rates of return on invested capital. Consequently, 2006-07 will be a challenging year for Australian biofuels producers.

World oil prices are expected to average lower in 2006-07 than in 2005-06. However, they are still forecast to remain relatively high in historical terms. Other things being equal, it may be argued that the more feedstock purchasable with a barrel of oil, the more market conditions favour biofuels producers, whose products compete against traditional petroleum fuels derived from crude oil.

In figure A, the estimated quantities of different biofuels feedstocks that can be purchased by the price of one barrel of oil are presented. This is estimated by converting the West Texas Intermediate price of oil to Australian dollars and then dividing it by the unit gross values of production for the commodities shown for each year. These estimates provide a broad indication of the favourability of biofuels production. Because the quantity of biofuel obtainable from a particular feedstock can differ

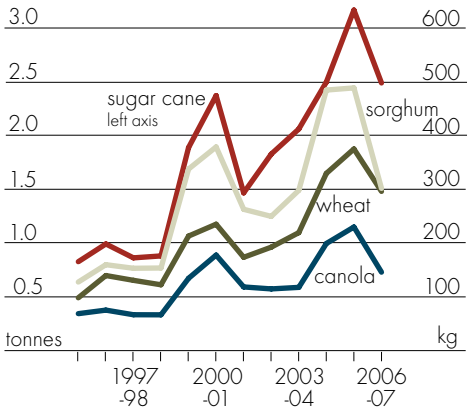
between different feedstock types, figure A should not be taken as a comparison of the commercial viability of using different feedstocks.

Between 1995-96 and 1998-99, the annual oil price (WTI) was relatively low, in the range US$14–22 a barrel (US$18–29 in real terms – 2006-07 dollars) – equivalent at that time to A$23–29 a barrel (A$29–37 in real terms). Prices for the agricultural commodities, including grains, were relatively high over that period, although easing. Overall, these price movements were relatively unattractive for biofuels production in that period. However, in 1999-2000, oil prices rose appreciably and feedstock prices continued to ease, making biofuels production relatively more attractive in the years 1999-2000 and 2000-01 (the first peak in figure A).

In 2001-02, domestic feedstock prices rose. Even though oil prices remained high, the relative attractiveness of biofuels production appears to have declined (see the trough in figure A). More recently, in 2004-05, the world oil price moved even higher and feedstock prices eased, increasing the attractiveness of biofuels production once more.

While not as favourable as in 2004-05 and 2005-06 (when oil prices were at recent peaks and feedstock prices lower) the relative movements of forecast world oil prices and forecast local feedstock prices in 2006-07 are still expected to be more favourable for biofuels producers than in many of the years since 1995-96.

A quantities of feedstock purchasable with the price of one barrel of oil



The price of sugar cane is used in the calculation as a proxy for the price of C molasses, the cane based product that historically has been used in Australia for ethanol production.

government support

In addition to world oil prices and domestic feedstock prices, the other main influence on biofuels producer returns is the level of support received from the government. In 2001, the Australian Government set an objective that biofuels would contribute at least 350 million litres to the total fuel supply by 2010.

Production of both fuel ethanol and biodiesel is encouraged through the payment of production grants (subsidies) of 38.143 cents a litre on biofuels. The production grants ensure the effective rate of excise for biofuels will be zero until 1 July 2011, when fuel excise will begin to be applied. The effective rates of excise will increase annually until final rates of 12.5 cents a litre for ethanol and 19.1 cents a litre for biodiesel are reached on 1 July 2015. In energy

4 biofuels excise rates in Australia [a]

	ethanol			biodiesel		
	excise	effective relief		excise	effective relief	
	nominal	nominal	real	nominal	nominal	real
	c/L	c/L	2004-05 c/L	c/L	c/L	2004-05 c/L
2005-06	0	38.1	37.1	0	38.1	37.1
2006-07	0	38.1	36.2	0	38.1	36.2
2007-08	0	38.1	35.3	0	38.1	35.3
2008-09	0	38.1	34.5	0	38.1	34.5
2009-10	0	38.1	33.6	0	38.1	33.6
2010-11	0	38.1	32.8	0	38.1	32.8
2011-12	2.5	23.4	19.7	3.8	32.1	25.6
2012-13	5.0	20.9	17.1	7.6	28.3	21.9
2013-14	7.5	18.4	14.7	11.4	24.5	18.3
2014-15	10.0	15.9	12.4	15.3	20.6	14.8
2015-16	12.5	13.4	10.2	19.1	16.8	11.6

a The Short and Riwoe (2005) analysis was in 2004-05 terms. From 2011-12, excise for biofuels will be applied on an energy content rather than volume basis. Since ethanol has an energy content of 0.68 relative to petrol, Short and Riwoe (2005) assumed that the relevant nominal excise baseline for ethanol would fall to 25.9 cents a litre in 2011-12. The energy content of biodiesel was assumed to be 94 per cent that of petrol, resulting in a nominal excise baseline of 35.8 cents a litre from 2011-12.
Source: Short and Riwoe (2005, tables 9–10, pp. 15–16)

content terms, these final rates of excise represent a 50 per cent discount on the rates levied on petrol and diesel (ATO 2006).

The full refund of excise through the production grant will allow producers to operate successfully at a higher cost of production than if excise had not been refunded. However, because production grants are paid in nominal terms on a per litre basis, the amount of support they deliver would effectively fall through time in real terms, even before the scheduled reduction in support from 1 July 2011 (table 4).

Government support has also been provided to some biofuels producers through the $37.6 million Biofuels Capital Grants Program. Seven companies received these grants, provided at a rate of 16 cents a litre for new or expanded projects producing a minimum of 5 million litres of biofuels a year (DITR 2006b). Over the lifetime of the plant, however, the amount of support delivered by the program is estimated to be in the order of 1 cent a litre of production.

In December 2005, after considering the recommendations of the 2005 Biofuels Taskforce (Australian Government 2005), the government announced a Biofuels Action Plan. Under this plan, company action plans are submitted to the Australian Government by petroleum product refiners and marketers. Collective company plans for biofuels production and sales currently exceed the 350 million litres target.

In August 2006, the government announced a new $17.2 million Ethanol Distribution Program aimed at assisting service station operators to upgrade their equipment and increase their sales of ethanol blended fuel. The program recognises the need for action at the retail level to complement that at the production level (DITR 2006a).

The *Renewable Energy Development Initiative* (REDI) is a $100 million grants program supporting renewable energy innovation and related early stage commercialisation. Under this initiative, a number of biofuels projects have been awarded grants, including projects for algal feedstock diesel production, technology for converting plant waste into ethanol, and high yielding sugar cane feedstock technology (Bioenergy Australia 2007).

current and planned capacity

During 2005-06 there was increased interest in biofuels, fuelled by a sharp increase in oil prices and relatively low feedstock prices. Several new biofuels production facilities were planned to come on line in 2006 and 2007; however, some of these have been postponed, as the effects of drought and the downward trend in oil prices became apparent. Notwithstanding the challenge posed by the current easing in oil prices and high cost of many feedstocks, biofuels producers will have assessed their long term prospects over a range of possible oil and feedstock price scenarios.

Based on an assessment undertaken in February 2007, the current and planned capacity of biofuels plants is shown in tables 5 and 6.

ethanol

There are currently three ethanol production facilities in Australia – the Manildra facility in New South Wales and the CSR and Rocky Point distilleries in Queensland (table 5). The largest of these is the 100 million litres a year Manildra facility, followed by CSR distilleries in Sarina, which expanded their capacity to 32 million litres a year in August 2006.

Several large new ethanol production facilities are planned or are currently under construction (table 5). Under an agreement with BP, the annual production capacity of Primary Energy's new ethanol plant in Kwinana, Western Australia, could be doubled from

80 to 160 million litres. Commencement of construction of a 120 million litres a year plant at Gunnedah is scheduled for 2007, while recently a 160 million litres a year plant has been proposed for Brisbane. With construction of its Swan Hill ethanol project expected to be complete in 2007, Australian Ethanol is currently evaluating sites for similar facilities, all of which would use grain as a feedstock.

Current concerns for prospective fuel ethanol producers include the rising cost of feedstocks, and securing a regular supply of feedstocks as well as contracts for the supply of biofuels for blending. Some earlier proposed fuel ethanol projects may have been halted or postponed because of these concerns.

Regularity of feedstock supply may remain a concern for ethanol producers, particularly grain based producers, as grain based production capacity increases. If all the grain based facilities in table 5 were to come on stream from the planned startup dates and to operate at full capacity, ethanol producers could be seeking as much as 2.5 million tonnes of grain (sorghum or wheat) a year by 2011-12. It is doubtful whether all of this could be supplied as sorghum, traditionally the lowest priced of the coarse grains, production of which averaged 2 million tonnes a year from 2003-04 to 2005-06, of which an average of 1.7 million tonnes a year were consumed by existing domestic users.

In most years, wheat would be available even if sorghum were not. Wheat production is higher than sorghum (averaging 24.4 million tonnes a year over the same period) and

5 ethanol production capacity in Australia [a]

company/location	capacity ML/yr	startup date	feedstocks	feedstock use at full capacity [b] kt/yr
Manildra Group Nowra, New South Wales	100	existing	waste wheat starch, some low grade grain	na
CSR Distilleries Sarina, north Queensland	32	expanded in August 2006	molasses	128
Rocky Point Sugar Mill Woongoolba (Brisbane), Queensland	20–25 [c]	March 2008 expansion	molasses, sorghum	80–100
Primary Energy Gunnedah, New South Wales	120	2009 [d]	coarse grains, (mostly sorghum) wheat	300
Primary Energy Pinkenba (Brisbane), Queensland	160	2009 [d]	grain	400
Australian Ethanol Swan Hill, Victoria	100	early 2008	wheat, corn, barley	245
Dalby Biorefinery Dalby, Queensland	80	mid-2008	sorghum	200
Primary Energy Kwinana (Perth), Western Australia	160	planned 2008	wheat	400
Australian Ethanol Coleambally (Riverina), New South Wales	200	2010 [e]	wheat	490
Australian Ethanol, Lake Grace, Western Australia	200	2010 [e]	wheat	490

a Based on a review of the projects listed in Australian Government (2005), and recent announcements. Not all proposed projects may be included. **b** ABARE estimate. **c** Currently 5 million litres. **d** Based on plans to start construction early 2008. **e** Based on feasibility studies currently under way.

with domestic consumption averaging 5.3 million tonnes a year, the exportable surplus of wheat is higher. Nonetheless, large falls in wheat production can occur in drought years – wheat production fell to only 10.1 million tonnes in 2002-03 from 24.3 million tonnes the year before, and to 9.8 million tonnes in 2006-07, down from 25.1 million tonnes the year before. The appearance of a new group of domestic grain buyers requiring at least 2.5 million tonnes of grain would also represent a potential increase in total domestic sorghum and wheat use of the order of 35 per cent over average domestic use in the period 2003-04 to 2005-06.

biodiesel

Four new biodiesel facilities were commissioned in 2006 (table 6). The annual production capacities of the two located near Brisbane are 160 million litres and 30 million litres respectively, while those of the new facilities located at Adelaide and Bunbury (Western Australia) are both 45 million litres. A large 140 million litre a year facility at Darwin has been completed and is expected to begin producing at full capacity early in 2007. Over

6 potential biodiesel production capacity in Australia [a]

location	capacity ML/yr	startup date	feedstocks	feedstock use at full capacity [b] kt/y
Biodiesel Industries Australia Rutherford (Hunter Valley), New South Wales	15–20	existing	tallow, used cooking oil, canola oil	14–18
Australian Renewable Fuels Largs Bay (Adelaide), South Australia	45	March 2006	canola oil, tallow, used cooking oil	41
Eco-Tech Biodiesel Narangba (Brisbane), Queensland	30	February 2006	tallow, used cooking oil	28
Australian Biodiesel Group Narangba (Brisbane), Queensland	160	July 2006	tallow, soy bean oil	147
Australian Renewable Fuels Picton (Bunbury), Western Australia	45	July 2006	canola oil, tallow, used cooking oil	41
Natural Fuels Australia Darwin, Northern Territory	138	February 2007	palm oil, soybean oil	130
South Australian Farmers Fuel Adelaide, South Australia	15	2008	canola oil, tallow, used cooking oil	14
Biodiesel Producers Australia Albury, New South Wales	60	mid-2007	tallow, used cooking oil, vegetable oils	55
Axiom Energy Geelong, Victoria	150	mid-2007	used cooking oil, tallow, palm oil	135
Riverina Biofuels Deniliquin, New South Wales	40	2007	tallow	36
Energetix Biodiesel Melbourne, Victoria	100 [c]	mid-2007 expansion	tallow, canola oil, used cooking oil	90
Future Fuels Moama, New South Wales	30+	existing	canola oil	na
BP Australia Bulwer, Queensland [d]	110	2007	tallow	100

a Based on a review of the projects listed in Australian Government (2005), and recent announcements. Not all proposed projects may be included. **b** ABARE estimate. **c** Currently 12 Ml/yr. **d** Biofuel production facility to use tallow hydrogenation technology developed by BP.

the next year an expansion is planned for the Energetix Biodiesel facility and several other producers plan to open new facilities (table 6).

Although current biodiesel production capacity is larger than ethanol production capacity and there are more projects expected to come on line in the short term, biodiesel producers are also experiencing difficulties in securing customers for their product. The Australian Biodiesel Group's Berkeley Vale refinery in New South Wales, for example, was mothballed in December 2006, leaving their Narangba facility in Queensland to meet demand requirements. In addition, many of the plants currently operational are operating significantly below full production capacity and expect to continue doing so over the next year.

The relative flexibility of biodiesel plants to use a variety of vegetable oils and animal fats makes it more difficult to calculate the likely increase in demand for particular vegetable oils or animal fats if all the new facilities shown in table 6 were to come on stream from the planned startup dates and were to operate at full capacity. The potential total feedstock (tallow, used cooking oil and oilseeds) requirements in table 6 exceed 800 000 tonnes. Industry estimates put the annual availability of used cooking oil at around 50 000 tonnes a year, while annual production of tallow in Australia averages around 500 000 tonnes, of which around 350 000 to 400 000 tonnes is exported. On these figures, local used cooking oil and tallow alone would be unable to provide all feedstock requirements if all the new facilities shown in table 6 were to come on stream from the planned startup dates and operate at full capacity.

Unlike grain-based ethanol producers, however, biodiesel producers are generally located at or near ports, and would have the option of supplementing local supplies of vegetable oils and animal fats with imported oils such as palm oil or imported tallow if required.

issues

Based on output from the new production capacity established in 2006 and further new capacity expected to be added from now until 2010, Australia's output of biofuels is expected to increase over the next few years. The growth of the biofuels industry has raised many issues, including the rationale for government support, its effectiveness and cost, resource allocation effects, environmental benefits, the effect on domestic markets for agricultural feedstocks, security of supply for feedstocks, and the potential effect on Australian producers of agricultural feedstocks.

The current system of government support for biofuels can be expected to result in economic costs to the community and its value to producers will decline over time (Short and Riwoe 2005). Because production grants are paid on a nominal per litre basis, in real terms, the amount of support they deliver will effectively fall over time, even before the scheduled reduction in support from 1 July 2011. On the figures shown in table 4, the real per litre support provided by refunding fuel excise for fuel ethanol could fall to 27 per cent of its 2005-06 level by 2015-16, while the real support provided for biodiesel could fall to 31 per cent of its 2005-06 level. Other things being equal, in the long term, this decline in support could reduce the effectiveness of the production grants in encouraging greater production of biofuels. Furthermore, while the real level of support per litre will decline through time, the financial and economic cost of delivering this support could rise appreciably in the future as total biofuels production rises.

The planned reduction in government support, particularly if combined with a further easing in world oil prices, may encourage biofuels producers to seek ways of reducing production costs, particularly feedstock costs. However, there may be limited scope to reduce feedstock costs, as the prices for the feedstocks currently used by biofuels producers are influenced by competition from other human or livestock users, and available supplies. In the longer term, if biofuels production were to increase significantly, domestic feedstock prices could rise because of the additional demand for feedstocks from biofuels producers. The payment of production grants for biofuels effectively represents an implicit tax on other consumers of these feedstocks.

Some of the potential problems caused by the competition for feedstocks between biofuels producers and other consumers may be reduced when biofuels are able to be commercially produced from alternative, nonfood sources such as cellulosic raw material. Research and development of this technology is being undertaken in a number of countries.

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