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Fuel Ethanol—Background and Policy Issues

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Fuel Ethanol—Background and Policy Issues

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Glossary

Aldehyde	An organic compound containing the CHO radical.
Acetaldehyde	CH ₃ CHO, the major aldehyde emission produced in the combustion of ethanol.
Benzene, toluene and xylene.	The most widely used aromatic hydrocarbons, so named for their characteristic, strong sweet odour. Whilst used extensively for many industrial purposes they are classified as hazardous chemicals.
1, 3-Butadiene	A hazardous chemical of which small amounts are found in petrol. Used extensively in the manufacture of synthetic rubber and plastics.
Ethanol	An alcohol (C ₂ H ₅ OH), used for a variety of purposes.
Evaporative emissions	Emissions of fuel vapours to the atmosphere by evaporation of fuel.
Fuel ethanol	Ethanol blended with petrol, used as a fuel for the transportation sector.
Full fuel cycle	Full fuel cycle emissions take account of all emissions including aspects such as production, refining, distribution, evaporative etc rather than just tailpipe emissions.
Lignocellulose	The structural component of plant biomass and can be derived from trees, grasses, and from cereal and paper wastes.
Toluene	Colourless, aromatic liquid derived from coal tar or from the catalytic reforming of petroleum.
Xylene	Xylene is found in small amounts in gasoline. Another classified hazardous chemical used as a solvent in the printing, rubber, and leather industries.

Major Issues

Ethanol (C₂H₅OH), an alcohol, is used for a variety of purposes. This paper focuses on fuel ethanol, that is, ethanol blended with petrol used as fuel for transport. Whilst ethanol can be produced from a variety of feedstock, it is predominantly produced from agricultural crops including wheat starch and sugarcane.

The use of fuel ethanol in Australia is small. Total ethanol output is around 135 million litres of which around 50 million litres are used for fuel blending. The bulk of fuel ethanol is produced on the East coast and sold in New South Wales from independent outlets. These outlets are, in the main, supplied by the Manildra Group, which manufactures ethanol from wheat waste in Nowra, New South Wales. The major oil companies are assessing the manufacture and supply of fuel ethanol, and BP is marketing a 10 per cent by volume ethanol blended fuel in south-east Queensland.

Fuel ethanol attracted considerable negative comment during the closing months of 2002. The negativity centred on claims of possible damage to vehicles—which have not been substantially modified—from the use of blends above 10 per cent by volume of ethanol. A number of industry bodies and motoring organisations have called for a cap of 10 per cent by volume of ethanol in blended petrol. The negative publicity is likely to hamper the marketing of fuel ethanol including the market-accepted 10 per cent by volume blends.

The jury is still out as to whether high ethanol blends damage vehicles. The Commonwealth Government released a review of studies of the impacts of a 20 per cent ethanol blend on vehicles. The review found that the information is insufficient or conflicting but identified a number of problems such as the possible perishing and swelling of elastomeric and plastic materials making up fuel systems. The Government has commissioned a study, to be released in 2004, of the effects of high ethanol blends. Nonetheless, stakeholders in the motor vehicle industry have stated that warranties on motor vehicles and pump dispensing equipment could be at risk with the use of blends above 10 per cent ethanol.

Whilst the recent controversy has been dominated by the use of high ethanol content fuel, the main arguments that have long been advanced in favour of fuel ethanol include environmental benefits, the development of regional industries, and supplementation of the national fuel supply. Ethanol production from a range agricultural crops including wheat and sugarcane is also regarded as 'renewable' and sustainable. There is however a range of environmental and financial offsets associated with the use of fuel ethanol.

Fuel taxes can reduce the costs to society of emissions and greenhouse gases. But the Bureau of Transport and Regional Economics has concluded that government assistance to the use of alternative fuels such as ethanol has not been calibrated to reflect these costs, that environmental objectives could be achieved at lower cost, and that the cost of assistance probably exceeds the environmental benefits.

A major disadvantage of fuel ethanol is its production cost, which is around 70 cents a litre compared with around 35 cents per litre—at current world crude oil prices—for unleaded petrol. Consequently, the production of ethanol requires government assistance to be competitive even in the larger producers such as Brazil and the United States. A study by the Australian Bureau of Agricultural and Resource Economics found that the production of ethanol is not commercially viable in Australia without assistance.

Commonwealth assistance now takes the form of a grant of 38.143 cents per litre—the same rate as the excise on petrol. The Fuel Taxation Inquiry concluded that assistance to alternative fuels, including ethanol, has significant resource allocation effects that can no longer be justified. The Government has announced that it will provide a capital subsidy of 16 cents a litre for new or expanded facilities for biofuels, such as ethanol, until new production capacity reaches 310 million litres or by 30 June 2007, whichever comes sooner. This would further increase the misallocation of resources.

Assistance increases the production of ethanol and employment in regional areas. But much of this is activity 'redistributed' from other parts of the economy. The Fuel Taxation Inquiry noted that no analysis has been undertaken to establish the social benefits of assistance to regional areas and whether the benefits could be achieved at lower cost by other means.

There have been suggestions that the ailing sugar industry could be a direct beneficiary of an expansion of the ethanol industry via the mandatory use of ethanol blended petrol, in much the same way as corn producers have benefited from such programs in the mid-western United States. Whilst intuitively this suggestion would appear fundamentally sound, there are other important production and financial considerations. This would include whether sugar production would need to be directed primarily towards the ethanol market, which effectively would substantially increase the cost of ethanol feedstock.

Australia's reserves of crude oil are considered to be low with the reserves to production ratio estimated to be below 10 years. This indicates Australia's resources of crude oil will run down in the not too distant future. Fuel ethanol presently contributes little to fuel security; current use represents only 0.19 per cent of total petrol and diesel use (31 billion litres), and 0.33 per cent of total petrol use (18.5 billion litres).

Interest groups have called for the mandatory use of fuel ethanol with suggested ethanol content ranging from two to 10 per cent. This would require ethanol production to expand to 360 million and 1.8 billion litres respectively. However, to supply the 10 per cent content blend seems to be beyond the realms of practicality as well as being prohibitively expensive in terms of the cost of assistance.

Introduction

The use of fuel ethanol attracted considerable negative press and public comment in the later part of 2002. Because of the importance of fuel, this issue warrants fuller discussion by outlining the various benefits and costs of using fuel ethanol in the Australian transportation sector.

Whilst ethanol is used for a variety of manufacturing uses, including the alcoholic component of beverages, its use as a fuel extender is the focus of this report. Ethanol as a fuel has been utilised almost since the building of the first mass-produced motor vehicle; fuel ethanol was used extensively in north Queensland from 1929 to 1957.¹ This was a requirement under the Queensland Motor Spirit Vendor's Act although this was rescinded in 1957. Fuel ethanol has been marketed in New South Wales since 1994 while BP began marketing 10 per cent ethanol blend petrol in south-east Queensland in 2002.

The task of developing and marketing fuel ethanol—even at the generally accepted 10 per cent ethanol by volume—has been made more difficult by the recent barrage of negative press and public comment. The negativity centres around high ethanol blended fuel being sold in New South Wales by independent retailers. Although higher ethanol blends are used elsewhere in the world, principally in Brazil, the car fleet there has specific fuel line and engine component modification allowing it to run on these higher blends. Most commentators concur that 10 per cent is the most acceptable ethanol blend that requires no vehicle modification. Above this threshold, there is broad consensus that damage can occur to vehicle fuel systems and engine components without modification.

Ethanol is produced from a range of agricultural crops, such as wheat and sugar cane and as such the fuel stock is 'renewable'. The ethanol industry in Australia is quite small, in the order of 135 million litres, compared to the world's largest producer—Brazil—which has an annual output of some 12 billion litres. The United States produces around seven billion litres annually. The Commonwealth Government has a policy objective of increasing output of biofuels (including ethanol) to 350 million litres by 2010.²

Increased ethanol production could assist in expanding existing industries and developing new ones in rural and regional Australia. Increased production could extend and supplement Australia's declining crude oil reserves. However, at the end of the day it depends on an analysis of benefits and costs of such strategies. These issues are addressed in the paper.

Background

Ethanol (ethyl alcohol, C₂H₅OH) is an alcohol made by fermenting and distilling simple sugars. Ethanol can be manufactured from:

- biomass via the fermentation of sugar derived from grain starches of many crops including wheat wastes and sugar
- biomass via the utilisation of the lignocellulosic fraction of crops or
- petroleum and natural gas via an ethylene intermediate step.

Ethanol is used in the manufacture of alcoholic beverages and it is denatured (made unfit for human consumption) when used for fuel and a variety of other manufactures such as methylated spirits.

Ethanol is now the most widely used alternative fuel in the world; the biggest use of ethanol in the United States is as an additive in gasoline. It serves as an oxygenate (to prevent air pollution from carbon monoxide and ozone), as an octane booster (to prevent early ignition, or 'engine knock'), and as an extender of gasoline.³

The recent negativity towards fuel ethanol centred on claims of possible damage to unmodified vehicles from the use of blends above 10 per cent by volume of ethanol. Various industry bodies and motoring organisations, including the National Roads and Motorist's Association and the Australian Automobile Association have called for a 10 per cent cap by volume on ethanol blended petrol. Queensland has legislative requirements that ethanol blended fuel not exceed 10 per cent whilst South Australian does not allow the use of ethanol in petrol. Ethanol blends well above 10 per cent by volume have been marketed by number of independent service stations in New South Wales since 1994. A consequence of the negative publicity will be to hamper the further development of a fuel ethanol industry—including the marketing of the accepted 10 per cent by volume blends.

The jury is still out as to whether high ethanol blends can damage vehicles. The Commonwealth Government released a literature review based assessment on the impacts of a 20 per cent ethanol gasoline blend on the Australian vehicle fleet in December 2002.⁴ Whilst it determined, in many cases, that there is insufficient or conflicting information available, the review did identify a number of areas where problems could arise with the use of high blend ethanol petrol. These problems included possible perishing and swelling of elastomeric and plastic materials making up the fuel systems, especially in older vehicles and the potential for corrosion of the metal components of engines. The Commonwealth Government has commissioned a detailed study into the effects of the use of high ethanol blended petrol with findings to be released in 2004. Regardless of the eventual findings, virtually every stakeholder in the motor vehicle industry has stated publicly that warranties on motor vehicles and pump dispensing equipment could be put at risk with the use of ethanol blends above 10 per cent.

Industry Structure

The Australian ethanol industry is relatively small, indeed, minuscule by world standards. Presently there are three Australian producers with a total output in the order of 135

million litres. This compares with production of 12 billion litres in Brazil, by far the world's largest producer followed by the United States at seven billion litres. Australia's main producers are shown in Table 1.

Table 1. Australian ethanol production

Company	Feedstock	Million litres per annum
CSR	molasses	55
Manildra Group	starch	75
Rocky Point/Bundaberg	molasses	5
Total		135

Source: CSR Distilleries

Of total domestic output, around 50 million litres of ethanol are used for blending with fuels. This market is dominantly supplied by Manildra from its Bomaderry plant near Nowra in New South Wales and now to a lesser extent with CSR supplying BP with around four million litres per year to produce its E10 blend petrol being marketed in south-east Queensland.

Exports currently are around 30 to 35 million litres annually, which are mainly directed to the Asian beverage market (Japan, Sri Lanka, Korea etc). This market is dominantly supplied by CSR from its Sarina plant in Queensland.

The Australian domestic market for ethanol, apart from fuel ethanol, is around 42 million litres. The main applications are pharmaceuticals, foods and beverages, chemical manufactures, paints and thinners, aerosols and cosmetics.

Marketing

The bulk of ethanol blended fuel is sold in New South Wales, from around 200 or so independent outlets. The Manildra Group supplies these outlets in the main. The other major oil companies are assessing the manufacture and supply of fuel ethanol following BP's foray into this market in south-east Queensland in 2002.

Much of the present controversy is related to the use of blends in the range of 20 per cent ethanol being marketed by independent outlets. Manildra maintain this is the percentage that makes it viable in the current market to blend ethanol.⁵ A large part of the controversy relates to the non-labelling of petrol containing ethanol and the fact that customers cannot determine what in fact they are buying. High ethanol blends petrol has attracted descriptions such as 'car rotting additives'.⁶

BP's foray into the retailing of ethanol blended petrol has been accompanied by the labelling of ethanol content at its retail outlets. The Queensland Government now fuels its Q-fleet in Brisbane with E10 fuel. BP contends that ethanol blended petrol should be

mixed at terminals to ensure product quality and that ethanol blend fuels should meet all Australian standards.⁷

As outlined in the Fuel Security section at page 15, current fuel ethanol use represents only 0.19 per cent of total petrol and diesel use. Ethanol is now produced only on the East coast. Transportation of ethanol to other parts of Australia to comply with possible mandatory requirements resulting in substantial new ethanol production, would have substantial cost implications. The marketing of fuel ethanol would necessitate the building of additional infrastructure. Most petrol outlets presently market in the order of four to five products, namely, unleaded petrol, premium unleaded petrol, lead replacement petrol, diesel and autogas, each with separate facilities. Marketing of fuel ethanol would require an additional set of facilities, with particular attention to control of water contamination and this is discussed in the Environmental and Other Offsets section at page 11.

Industry Opportunities

Two claimed benefits for the use of fuel ethanol are that ethanol is produced from renewable sources and that it creates jobs in rural and regional areas. Increased production would necessitate the expansion of existing facilities as well as bringing new production on line. The troubled sugar industry has been flagged as a potential beneficiary.

Whilst the expansion of ethanol production would lead to increased economic activity in regional areas, some expansion would be at the expense of existing industry. It has been estimated that a mandatory 10 per cent ethanol mix in petrol would transfer a \$3 billion slice of the fuel market from the oil companies to ethanol producers such as Manildra. Treasury would lose more than a \$1 billion a year in petrol excise. But such a move could create 90 000 jobs, mostly in the bush.⁸ Other analyses indicate much lower cost estimates. For example, the Australian Institute of Petroleum estimates that 10 per cent of the petrol market has a value of the order of \$600 to \$700 million. A study for the Australian Bureau of Agricultural and Resource Economics estimated that if fuel ethanol were to capture ten per cent of the petrol market by 2010, the annual loss to government revenue (in the form of zero excise) would be about \$688 million.⁹

Is the use of Fuel Ethanol a benefit for the Sugar Industry?

The Australian sugar industry is well dispersed along Australia's eastern seaboard and any increase in demand for sugar products including ethanol production would boost economic activity in this region. The distribution of the sugar industry is shown in Figure 1.

There have been suggestions that the ailing sugar industry could be a direct beneficiary of an expansion of the ethanol industry via the mandatory use of ethanol blended petrol, in much the same way as corn producers have benefited from such programs in the mid-western United States. Whilst intuitively this suggestion would appear fundamentally sound, there are other important financial considerations.

Ethanol now produced from the sugar industry comes from C molasses, a waste low-value end product also used as cattle feed. Despite low prevailing sugar prices, a redirection of first express juices—the primary sugar cane product—to ethanol production would greatly increase the price of ethanol feedstock and hence the cost of producing ethanol. Although sugar prices have declined in real terms over the last thirty years, present prevailing prices—well over A\$200/tonne—are still higher than sugar farmers are likely to receive if they were producing feedstock for ethanol production.

Figure 1: The Australian Sugar Industry



Source: Canegrowers Association

Treasury has cast doubt on whether the mandatory blending of ethanol with petrol would benefit sugar farmers:

... ethanol producers would be unwilling, at best, to pay more than the world price if they were to buy sugar as an ethanol stockfeed (sic). The only effect on sugar farmers would be that exports would be displaced. The price received for sugar would remain the same and, overall, sugar farmers would be no better off.¹⁰

Further:

... a mandate of excised ethanol is likely to add approximately 0.75 cents per litre to the retail price for each per cent of ethanol mandated ... A mandate would also obviously transfer considerable income to ethanol producers.¹¹

If mandatory use of fuel ethanol was introduced (see section on Fuel Security, page 15), there would be a substantial permanent increase in demand for ethanol, which would push prices up. But would such price increases encourage a shift from the sugar market to the ethanol market?

Whilst it is difficult to answer such a question precisely, some part of the sugar market would no doubt be directed to ethanol production. Whilst it could not be concluded that such a development would be a panacea for the sugar industry, an expanded market for sugar products would no doubt assist the economic fundamentals of the sugar industry.

As with any change in well established and reliable product supply such as the petroleum product market, a shift to high dependence on fuel supply from agricultural production, including sugar, may result in some unforeseen difficulty. For example, any large-scale crop failure for any variety of reasons including disease and drought would quickly dry up ethanol supplies, leaving ethanol producers requiring alternative supplies including imports.

Economics of Fuel Ethanol Use

The discussion on the economics of fuel ethanol use is disaggregated into industry assistance, and the benefits and costs of subsidising fuel ethanol.

Industry Assistance

The main barrier to the increased use of fuel ethanol is that it costs more to produce than petroleum products. It costs around 70 cents a litre to produce ethanol and around 35 cents a litre to produce petrol at prevailing crude oil prices. To enable fuel ethanol to compete with petrol, its use has been assisted. Assistance has taken three main forms:

- zero rate of excise
- bounty payments to producers, and
- since 18 September 2002, a subsidy to producers.

Excise

Zero-rating the excise on fuel ethanol while imposing excise on petroleum products has been the main form of assistance. Zero-rating was introduced to reduce dependence on imported petroleum.¹² In 2000–01, the cost to government in terms of revenue forgone from zero-rating was about \$16 million.¹³

On 12 September 2002, the Government announced that it would impose [excise on fuel ethanol](#) blended with petrol at the same rate as the excise on unleaded petrol, namely, 38.143 cents per litre, with effect from 18 September 2002 until 17 September 2003.¹⁴ Customs duty on imports of 38.143 cents per litre was also imposed.¹⁵ The excise and customs duties are projected to raise \$26 million in 2002–03, \$34.4 million in 2003–04, \$44.6 million in 2004–05 and \$61.5 million in 2005–06.¹⁶ The Government also introduced a production subsidy of 38.143 cents per litre (discussed below).

The imposition of the same rate of excise on petrol and fuel ethanol is administratively advantageous in that it simplifies the calculation of excise payable on blended fuels. The decision is also consistent with the Fuel Taxation Inquiry's recommendation that all liquid fuels, including fuel ethanol, be subject to excise:

The Inquiry considers that the scope of the excise base should be broadened from 'liquid **petroleum products**' to 'liquid **fuels** (irrespective of derivation) and liquefied and/or compressed natural and petroleum gases'. Therefore, the broadest fuel excise base within the terms of reference would include the currently excised petroleum based fuels ... while incorporating petroleum substitute fuels such as ethanol ...¹⁷

But on an *energy content* basis, the excise on fuel ethanol is higher than on petrol. That's because fuel ethanol produces only 68 per cent of the energy of petrol when combusted.¹⁸ If excise was based on energy content, the excise on fuel ethanol would be around 26 cents per litre.¹⁹ Fuel ethanol has thus moved from being tax advantaged (zero-excise) relative to petrol to being tax disadvantaged. The advantaging or disadvantaging of one fuel relative to others is contrary to the principle of tax 'neutrality', that is, that taxes should minimise discrimination in favour of, or against, any particular economic choice such as which goods to buy. Tax neutrality would be achieved if all liquid fuels were taxed on their relative energy content as the Fuel Taxation Inquiry recommended.²⁰

Bounty

In the 1993–94 Budget, the Keating Government announced that it would provide a bounty for domestic production of fuel ethanol. The bounty came into effect on 23 June 1994 under the [Bounty \(Fuel Ethanol\) Act 1994](#). The bounty was additional to the zero-rating of excise.

The Howard Government announced the abolition of the bounty in the 1996–97 Budget. The Minister for Resources and Energy stated that the Government decided to end the scheme because it did not achieve its objective.²¹ The Minister's decision was based on a report—by the Bureau of Resource Sciences, the Australian Bureau of Agricultural and Resource Economics and a steering committee representing five departments—that recommended the bounty cease.²² The Report concluded among other things that:

While the Scheme has initiated new production, distribution and use of fuel ethanol, an economically viable industry ... has not been developed.²³

Production Subsidy

When the Government imposed excise on fuel ethanol, it also announced a subsidy to domestic production of the same amount. The subsidy is to be provided over 12 months while the Government considers long-term arrangements for the renewable energy industry. The budgetary subsidy will make the cost of assistance transparent, which was not the case when excise was zero-rated. The subsidy is projected to cost \$26 million in 2002–03 and \$7.2 million in 2003–04.²⁴

On an *energy content* basis, the value of the subsidy exceeds the rate of excise. The [Australian Bureau of Agricultural and Resource Economics](#) estimated that if the zero-rating of excise were replaced by a subsidy of 38 cents per litre, the subsidy would be 50 per cent greater than the excise on petrol.²⁵

Other Forms of Assistance

Pilot Plant

In his statement on [Australia's response to climate change](#), the Prime Minister, the Hon. John Howard, confirmed funding of \$2 million towards an ethanol pilot plant.²⁶ The pilot plant would be built to demonstrate new Australian technologies for the production of ethanol from wood fibres and simultaneous waste treatment.

Diesel and Alternative Fuels Grants Scheme

Fuel ethanol is defined as an 'alternative fuel' for the purposes of the [Diesel and Alternative Fuels Grants Scheme Act 1999](#). This scheme provides grants to the users of diesel and alternative fuels used in transporting goods and passengers on public roads in regional and rural areas in vehicles that have a gross vehicle mass of 4.5 tonnes or more. The grant rate for fuel ethanol is 20.809 cents per litre. However, as at September 2001, no claim for a grant had been lodged.²⁷

Research and Development

On 15 September 2002, the Government announced that it would provide the Sugar Research Institute with up to \$400 000 to test new [ethanol technology](#) that could make the cost of producing fuel ethanol competitive with petrol.

Greenhouse Gas Abatement Programme

Under the Greenhouse Gas Abatement Programme, the Federal Government is funding a \$7.35 million ethanol project at the [Mossman Central Sugar Mill](#), and is providing \$8.8 million to [BP](#) to market a fuel ethanol and petrol blend from its Bulwer Island refinery. Both projects are located in Queensland.

Future assistance

The Government has proposed providing a [capital subsidy](#) to expand production capacity:

The Coalition will set an objective that fuel ethanol and biodiesel produced in Australia from renewable sources will contribute at least 350 million litres to the total fuel supply by 2010. Progress towards the objective will be reviewed in 2006:

To implement the 350 million litre objective, the Coalition will provide, through a grant process from 2002/03, a capital subsidy for new or expanded domestic production infrastructure of \$0.16 per litre of biofuel, until total new domestic production capacity reaches 310 million litres or by end-2006/07, whichever is sooner; and

To be eligible for the subsidy a new or additional production plant must be able to produce a minimum volume of 5,000,000 litres of biofuel each year. A maximum grant of \$10 million will apply for each new or expanded plant.²⁸

Benefits and Costs of Subsidising Fuel Ethanol

Assistance to fuel ethanol has economic benefits and costs. The question that arises is whether the benefits outweigh the costs. As the Bureau of Transport and Communications Economics pointed out in a research report on transport and greenhouse gases:

The danger to the community of not basing decisions on cost-effectiveness is an unnecessary loss in welfare. Every dollar spent unnecessarily on reducing greenhouse emissions also reduces the community's ability to fund other projects such as hospitals, schools or defence.²⁹

A number of arguments have been advanced in favour of assistance to the fuel ethanol industry.³⁰ They include:

- environmental benefits
- regional development, and
- fuel security and diversity.³¹

Environment

As with most analyses of environmental assessments and impacts, there is a range of environmental benefits and offsets relating to the production and use of fuel ethanol and these are discussed under the relevant headings below.

Environmental benefits

The key environmental benefits claimed for using ethanol blended petrol vis a vis conventional petrol include the following:

- production of ethanol from agricultural crops is regarded as being 'renewable' unlike production of refined petroleum product from crude oil, which is a finite resource
- reduced tailpipe exhaust emissions of carbon monoxide, hydrocarbons, 1-3 butadiene, benzene, toluene and xylenes³² and reduced *full fuel lifecycle* emissions of greenhouse gases. Whilst there is little or no benefit in reduced tailpipe emissions of carbon dioxide compared with petroleum fuels, the production of ethanol is generally regarded as greenhouse gas neutral.

There have been many studies on the levels of emissions from transport fuels including the alternative fuels such as the ethanol-blends. The results of these studies are mixed—with ranges of emission data—although there is some broadly based agreement. The main environmental benefits of using ethanol-blended petrol are reduced vehicular tailpipe emissions of carbon monoxide, total hydrocarbons, 1-3 butadiene, benzene, toluene and xylenes and in some cases nitrogen oxides. Further acknowledged environmental benefits include the fact that ethanol is an oxygenate—that it has a high oxygen content—and as such enhance octane ratings. Higher octane fuels result in a higher proportion burn and reduced smog-causing and carbon monoxide emissions. Carbon monoxide is one of the principal vehicle pollutant emissions of most concern to human health, particularly in high-density urban areas.

Fuel ethanol is set to replace the use of petrol containing the additive methyl tertiary butyl ether (MTBE)—an oxygenate—because of environmental concerns such as water supply contamination in the State of California in the United States. This fact alone significantly enhances its environmental credentials. ChevronTexaco, which controls 18 percent of the California retail gasoline market, has begun the switch to ethanol and will complete the switch for southern California in May 2003. The company will stop using MTBE statewide by the end of 2003 in compliance with the state's MTBE ban. According to the official ChevronTexaco announcement:

Chevron's cleaner-burning gasoline with ethanol will have more of the air quality benefits of today's gasoline, but without the water pollution attributed to MTBE.³³

The positive benefits relating to greenhouse gas emissions—primarily reduced carbon dioxide emissions—depends upon how the ethanol is produced. Whilst ethanol produced from cellulosic (woody) feedstock results in substantially reduced *full fuel cycle* greenhouse gas emissions, ethanol produced from starchy crops as in Australia (wheat waste and sugar cane) does not produce significant *full fuel cycle* greenhouse gas savings over conventionally produced gasoline.³⁴ Differences in the *full fuel cycle* analyses arise because of differences in the production processes. Agriculture production of wheat and

sugar involve high use of machinery and fertiliser, which in themselves are net emitters of greenhouse gases.

Environmental and Other Offsets

There are a number of offsets to the environmental benefits of using fuel ethanol and these include the following:

- an increase in emissions of aldehydes (formaldehyde and acrolein), and particularly acetaldehydes
- as an alcohol, ethanol contains the hydroxyl group giving it an affinity for water. If water content of either the fuel supply system, distribution system or vehicle storage tanks exceeds a threshold content of a couple of per cent water, then phase separation of the ethanol/water and petrol mix can occur leading to subsequent vehicle driveability problems and potential engine damage. Some ethanol blends are unsuitable for non-automotive use—such as aviation, boats and a range of hand held devices and lawnmowers. The Boating Industry Association of NSW, in a national advertising campaign, warned boat owners that the use of ethanol blended petrol above 10 per cent in outboard motors could be a marine safety hazard³⁵
- if an ethanol/petrol blend is spilt in a small watercourse or drain, the petrol may be able to be skimmed off the top but the ethanol will dissolve and be almost impossible to recover. Ethanol is, however, more easily biodegraded or diluted to non-toxic concentrations than is petrol.

Ethanol has a lower energy content than petrol—around two thirds. As such, the use of ethanol blended fuels result in a loss of fuel economy. The higher the ethanol blend, the greater the loss in fuel consumption. A 10 per cent ethanol blend results in a loss of fuel consumption of around three per cent.

Externalities

Air pollution and greenhouse gas emissions are 'external costs' or 'negative externalities' of fuel use. Externalities arise when one party imposes on, or provides to others, costs or benefits that are not captured in market transactions. For example, trucks impose 'negative' externalities such as noise and air pollution on residents living near highways, but there is no market transaction whereby the users of the truck services compensate residents for the cost of the externalities. In other words, there has been 'market failure'.

While negative externalities impose costs on society:

... eliminating them altogether (for example, by banning cars totally) would also impose significant costs. A socially optimal level lies somewhere in between, with some amount of 'bad' tolerated in exchange for the benefits of economic activity. However, the social

benefits of reducing an externality must outweigh the social cost of doing so, if the community is to benefit overall.³⁶

Economic instruments—such as taxes, charges and subsidies—can reduce the costs to society of negative externalities by 'internalising' them. The Fuel Taxation Inquiry concluded:

The above analysis shows fuel taxation to be an appropriate instrument for charging for the externalities of fuel use for which there is a strong correlation between the external cost and the type or amount of fuel used. Climate change is an example of such a cost.³⁷

Do the Environmental Benefits of Fuel Ethanol Justify Assistance?

The environmental benefits of fuel ethanol and the negative externalities resulting from the use of petrol and diesel are often cited as a justification for assisting fuel ethanol.³⁸ The question that arises is whether the benefits justify the cost of assistance.

The first point to note is that the level and structure of fuel taxes are unrelated to environmental benefits. The Bureau of Transport and Regional Economics (BTRE), in a report titled [Greenhouse Policy Options for Transport](#) published in May 2002, that is, before the Government ended the zero-rating of excise, found:

Ideally, in order to avoid distorting relative prices of different types of fuel from different sources, any program to tax fuels according to emissions would need to cover all fuels. The fuel duty concessions in place today have not been calibrated to reflect the external costs associated with fuel use. In the absence of such calibration, it is likely that some fuels are over- or under-subsidised and that environmental objectives could be achieved at lower cost, by calibrating the concessions/taxes to better reflect the different levels of environmental damage associated with different fuels.

The subsidy inherent in the excise exemption of alternative fuels probably exceeds the environmental benefits it is meant to target. As the B[ureau] of T[ransport] and C[ommunications] E[conomics] observed:

On the basis of the limited emissions costing available, it appears unlikely that the environmental benefits from most alternative fuels are as large as the existing 'subsidy' they now receive.³⁹

The review of the bounty noted above also cast doubt on the cost-effectiveness of assistance in terms of attaining the environmental benefits of fuel ethanol:

Current production and use of fuel ethanol is not cost effective in reducing emissions of greenhouse gas and environmental air pollutants. There are both positive and negative identifiable pollution outcomes. The evidence, although extensive and complex, is also ambiguous and often contradictory. Under current use and circumstances it is difficult to conclude that there are net benefits from displacing petrol with fuel ethanol.⁴⁰

The environmental benefits of alternative fuels relative to petrol and diesel may be declining. The Fuel Taxation Inquiry observed that:

[Petroleum product substitutes] have some environmental benefits relative to petrol and diesel, but even these are lessening with improved technology.⁴¹

Regional Development

It has been argued that assisting production of fuel ethanol benefits regional areas including through flow-on effects to input producers.⁴² The Manildra Group claims that, if half of transport fuel were in the form of domestically-produced fuel ethanol, more than 200 000 jobs would be created directly in regional areas.⁴³ In the United States where fuel ethanol is assisted by a partial exemption from the motor fuels tax, about 90 per cent of the feedstock for fuel ethanol production is corn. The effect is to increase the demand for corn, raising its price above what it would otherwise be. It has been estimated that this results in additional revenue to corn producers of \$US2. 4 billion annually.⁴⁴

It is important to distinguish between 'redistributed' economic activity and social benefits resulting from that activity. The level of production of ethanol and employment in regional areas is dependent on government assistance. Activity in ethanol production is thus largely a transfer of income from taxpayers to ethanol producers by means of assistance. The Fuel Taxation Inquiry in assessing the consequences of its recommendation that fuel ethanol be subject to excise found:

The extent of these impacts is difficult to assess. For some sectors, such as ethanol and biodiesel, where the industries are at an early stage of development, the imposition of excise will affect their future viability, even though it was based on an artificial tax advantage.⁴⁵

Similarly, a study for the Australian Bureau of Agricultural and Resource Economics of the commercial viability of increasing production of ethanol by the Australian sugar industry concluded:

It is also clear that commercial viability of both existing and expanded fuel ethanol production is dependent on significant levels of government intervention, including features such as the following:

Continued availability of full exemption from fuel excise (or an equivalent rebate);

Other financial or other assistance that the government may provide from time to time to investment in a fuel ethanol industry (for example, under G[reenhouse] G[as] A[batement] P[rogramme] and other existing or new programs).⁴⁶

The withdrawal or reduction of assistance would thus be likely to result in a contraction of the industry. A United States study concluded that fuel ethanol production from corn

would decline if the part exemption from the Federal excise on motor fuels were eliminated.⁴⁷

This raises the question of whether the higher levels of ethanol production and usage that government assistance stimulates can be justified in terms of the benefits to the national economy or to particular regional areas. The Fuel Taxation Inquiry noted:

... no analysis has been undertaken to establish the benefits to rural and regional areas of the tax concessions and whether they could be achieved at lower cost by other means.⁴⁸

The net effect on employment in regional areas of assistance to fuel ethanol is unclear. That's because assistance to an industry also reduces activity in other industries. For example, such expenditure reduces spending and activity elsewhere in the economy, for example, regional tourism.

Resource Allocation

As noted, several reports have concluded that the fuel ethanol production is not commercially viable without government assistance. Assistance to fuel ethanol may also be a misallocation of resources. Resources such as land, labour and capital among different uses are said to be allocated 'efficiently' when they are used to produce the goods and services that consumers want most and are employed in the most productive industries. Industry assistance can 'distort' the economically efficient allocation of resources by interfering with decisions such as which goods and services to buy and which industries to invest in. For example, the exemption of petroleum product substitutes from excise encouraged motorists to buy them rather than petroleum products.

The Fuel Taxation Inquiry concluded that:

... the use of fuel taxation concessions to encourage the production and use of alternative fuels has significant resource allocation effects that can no longer be justified.

This conclusion is based on three considerations:

The emergence of specific policy objectives for fuel taxation concessions (such as air quality in urban areas) means that the use of broad based fuel taxation instruments, originally intended to encourage the use of petroleum substitutes *per se*, irrespective of where, when or how they are used, is no longer valid.

Despite the use of taxation concessions to encourage the use of petroleum substitutes over the past 20 years, the energy inefficiency, inconvenience and lack of access to those fuels has restricted their use to a small proportion of transport fuel. This is not expected to change over the next 20 years, by which time a new generation of engine technology, replacing both petroleum products and their substitutes may have emerged.

Regulatory requirements which are ensuring improved standards in both the quality of petroleum products and engine design, mean the traditional relationships between petroleum products and substitutes on environmental performance are changing.⁴⁹

The Government's proposal to provide a capital subsidy to expand production would further increase the misallocation of resources.

Fuel Security

An argument advanced for subsidising alternative fuels is that they can replace petroleum-based fuels and so reduce dependence on petroleum imports and vulnerability to external supply disruptions. As noted, the Government originally introduced the zero-rating of excise for fuel security reasons.

Australia's resources of crude oil are considered to be low. Studies by Geoscience Australia indicate Australia's reserves to production ratio of crude oil to be below 10 years. Whilst this does not mean Australia's crude oil reserves will be exhausted within ten years—because production is offset by successful exploration and development—such a low figure indicates Australia's resources of crude oil will begin to run down in the not too distant future.

Alternative fuels generally and fuel ethanol in particular contribute little to reducing reliance on petroleum products. In Australia, fuel ethanol use is equivalent to 0.19 per cent of petrol and diesel use, 0.33 per cent of petrol use and 1.5 per cent of petrol use in greater Sydney, the main market.⁵⁰ The situation is similar in the United States where fuel ethanol is equivalent to only 1.4 per cent of petrol consumption by volume.⁵¹

The Fuel Taxation Inquiry questioned the effectiveness of assistance in achieving fuel security (see above section on Resource Allocation).

In the United States:

In terms of energy, ethanol accounts for approximately 0.7 per cent. This small market share led the G[eneral] A[ccounting] O[ffice] to conclude that the ethanol tax incentive has done little to promote energy security.⁵²

To increase fuel ethanol's market share, it would necessary to increase assistance. A constraint on doing this would be the cost to the Budget (see section on Industry Opportunities page 4).

Endnotes

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1. Bureau of Transport and Communications Economics, 'Alternative Fuels in Australian Transport', Information Paper 39, AGPS, Canberra, p. 51.

2. The Howard Government, Putting Australia's Interests First, 'Our Future Action Plan, Biofuels for Cleaner Transport', Election 2001 at www.liberal.org.au.
3. B. D. Yacobucci, J. Womach, 'Fuel Ethanol: Background and Policy Issues', Congressional Research Service, The Library of Congress, 2 July 2002.
4. Orbital Engine Company, 'A Literature Review Based Assessment on the Impacts of a 20% Ethanol Fuel Blend on the Australian Vehicle Fleet', Report to Environment Australia, Canberra, November 2002.
5. Fred Brenchley, 'Ethanol flashpoint', *The Bulletin*, January 28, 2003, pp. 28–29.
6. Mike Seccombe, 'Secrecy over car-rotting additive', *Sydney Morning Herald*, 10 December 2002, p.1.
7. Peter MacCuspie, 'Ethanol-The BP experience in Australia', *Biofuels 2002*, 31 October-1 November 2002, Brisbane.
8. Fred Brenchley, 'Ethanol flashpoint' *The Bulletin*, January 28, 2003, pp. 28–29.
9. B. Naughten, *Viability of Sugar Cane Based Fuel Ethanol*, Australian Bureau of Agriculture and Resource Economics Report to the Department of Agriculture, Forestry and Fisheries, Canberra, October 2001, p. 34 at:
<http://www.affa.gov.au/content/output.cfm?ObjectID=C966A946-0DB8-4BD3-9EE73220FF10D630>
10. 'Cut ethanol's subsidy, set a limit, then hands off', *Canberra Times*, 6 February 2003.
11. 'Ethanol risk revelations damaging to government', *Australian Financial Review*, 25 November 2002.
12. *Fuel Taxation Inquiry Report*, March 2002, p. 42 at:
<http://fueltaxinquiry.treasury.gov.au/content/welcome.asp>
13. Australian Biofuels Association, *Renewable Ethanol Fuel: 15 Questions*, 2002, p. 5.
14. *Mid-Year Economic and Fiscal Outlook*, 2002–03, p. 100.
15. See Australian Customs Notice 2002/53, 18 September 2002 at:
http://www.customs.gov.au/site/index.cfm?nav_id=670&area_id=5
16. *Mid-Year Economic and Fiscal Outlook*, 2002–03, p. 42.
17. *Fuel Taxation Inquiry Report*, op. cit., p. 104.
18. *ibid.*, p.105.
19. Based on table 4.2 of the *Fuel Taxation Inquiry Report*, March 2002, p. 110.
20. *Fuel Taxation Inquiry Report*, op. cit., p. 29.
21. Hon. W Parer, 'Ethanol Bounty Scheme Ended', Media Release, 21 August 1996.
22. Department of Primary Industries and Energy, 'Portfolio Evaluation for the Ethanol Bounty Scheme', August 1996.

23. Department of Primary Industries and Energy, *Portfolio Evaluation for the Ethanol Bounty Scheme*, Canberra, August 1996, p. 1–6.
24. *Mid-Year Economic and Fiscal Outlook*, 2002–03, p. 46.
25. B. Naughten, *Viability of Sugar Cane Based Fuel Ethanol*, Australian Bureau of Agriculture and Resource Economics Report to the Department of Agriculture, Forestry and Fisheries, Canberra, October 2001, p. 34.
26. Hon J. Howard, 'Safeguarding the Future: Australia's Response to Climate Change', Media Release, 20 November 1997, p. 10.
27. Manildra Group submission (no. 247) to the Fuel Taxation Inquiry.
28. National Party of Australia, *Biofuels for Cleaner Transport*, Coalition Policy Statement, 2001.
29. Bureau of Transport and Communications Economics, *Transport and Greenhouse. Costs and Options for Reducing Emissions*, Report 94, AGPS, Canberra, 1996, p. xxix.
30. Australian Biofuels Association, op. cit., p. 6.
31. Australian Biofuels Association, *Renewable Ethanol Fuel: 15 Questions*, 2002, p. 6.
32. Apace Research Ltd, 'Intensive Field Trial of Ethanol/Petrol Blend in Vehicles', ERDC Project No.2511, Canberra, December 1998, p. III.
33. See http://www.ethanolmarketplace.com/011303_news.asp
34. Bureau of Transport and Communications Economics, 'Alternative Fuels in Australian Transport', Information Paper 39, AGPS, Canberra, p. xx.
35. The Boating Industry of NSW, 'Ethanol is no sweetener', *The Sun Herald*, 22 December 2002, p.66.
36. Bureau of Transport and Communications Economics, *Externalities in the Transport Sector*, Information Sheet 10.1, January 1998.
37. *Fuel Taxation Inquiry Report*, op. cit., pp. 83–4.
38. *ibid.*, p. 13.
39. Bureau of Transport and Regional Economics, *Greenhouse Policy Options for Transport*, Report 105, 2002, p. 87. The reference in the quotation is to: Bureau of Transport and Communications Economics, *Alternative Fuels in Australian Transport*, Information Paper 39, AGPS, 1994, p. 213.
40. Department of Primary Industries and Energy, *Portfolio Evaluation for the Ethanol Bounty Scheme*, Canberra, August 1996.
41. *Fuel Taxation Inquiry Report*, op. cit., p. 8.
42. Submission 247 (Manildra Group) to the Fuel Taxation Inquiry.
43. *ibid.*
44. B. Yacobucci and J. Womach, op. cit., p. 6.
45. *Fuel Taxation Inquiry Report*, op. cit., p. 22.

46. B. Naughten, op. cit., p. 36.
47. Food and Agricultural Policy Research Institute, *Effects on Agriculture of Elimination of the Excise Tax Exemption for Fuel Ethanol*, Working paper 01-97, 8 April 1997.
48. *Fuel Taxation Inquiry Report*, op. cit., p. 17.
49. *ibid.*, pp. 42–3.
50. Australian Biofuels Association, op. cit., p. 2.
51. B. Yacobucci and J. Womach, op. cit., p. 5.
52. *ibid.*, p. 13.