

Economic Development and
Infrastructure Committee

Inquiry into Mandatory Ethanol and Biofuels Targets in Victoria

February 2008



Inquiry into Mandatory Ethanol and Biofuels Targets in Victoria

Report of the Economic Development and Infrastructure Committee on the Inquiry into Mandatory Ethanol and Biofuels Targets in Victoria

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Committee Members

This Inquiry was conducted during the term of the 56th Parliament.

The members of the Economic Development and Infrastructure Committee are:

Hon. Christine Campbell, MP (Chair)

Mr David Davis, MLC (Deputy Chair)

Mr Bruce Atkinson, MLC

Mr Peter Crisp, MP

Mr Brian Tee, MLC

Mr Evan Thornley, MLC

Hon. Marsha Thomson, MP

Staff

For this Inquiry, the Committee was supported by a secretariat comprising:

Executive Officer: Dr Vaughn Koops

Research Officer: Ms Yuki Simmonds

Administrative Officer: Ms Shanthi Wickramasurya

The Economic Development and Infrastructure Committee

The Victorian Economic Development and Infrastructure Committee is constituted under the *Parliamentary Committees Act 2003*, as amended.

The Committee comprises seven members of Parliament drawn from both houses and all parties.

Its functions under the Act are to inquire into, consider and report to the Parliament on any proposal, matter or thing connected with economic development, industrial affairs or infrastructure, if the Committee is required or permitted so to do by or under the Act.

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Terms of Reference

The Legislative Assembly under section 33 of the *Parliamentary Committees Act 2003* refers Terms of Reference requiring:

That the Economic Development and Infrastructure Committee inquire into, consider and report to Parliament on mandatory ethanol and biofuels targets in Victoria – and, in particular, the Committee is required to:

- a) report on the merits or otherwise of a mandated target for alternative fuels including biofuels and ethanol;
- b) report on whether a mandatory target should be 5% by 2010, 10% by 2015 or otherwise;
- c) report on the measures required by Government to facilitate an alternative fuels industry in Victoria for transport and non-transport applications; and
- d) report on how to maximise the regional economic development benefits of a mandatory biofuels target including jobs growth and investment potential.

The Committee is required to report to Parliament by 31 March 2008.

Chair's Foreword

Australia's transportation sector is almost entirely fuelled by products derived from petroleum and other, non-renewable, fossil fuels. While to date it has been possible to obtain fuel at relatively low cost from petroleum, oil production volumes are expected to decline, leading to increased prices and reduced fuel security. In this context there has been considerable interest in the exploration of alternative fuels such as ethanol, biodiesel and natural gas as a means to improve fuel security. Concerns about climate change and the health effects of transport emissions have also led to increased interest in cleaner transportation fuel technologies.

The Committee approached the Terms of Reference for this Inquiry with considerable enthusiasm, partly because biofuels have often been presented to the public as a potential solution to these challenges for future fuel use. However, the weight of evidence presented to the Committee indicated that with current technologies biofuels will have a small role in the Australian fuel mix until true alternatives to petroleum are identified.

The report contains 27 recommendations that the Committee believes are appropriate for the development of the biofuels and alternative fuels industries in Victoria. The key recommendation of the Committee is that the Victorian Government does not introduce a mandatory target for biofuels use at this time. While there are some greenhouse gas emissions and air emissions benefits associated with the use of biofuels – particularly biodiesel – there appear to be marginal fuel security benefits associated with biofuels use. Consequently the Committee does not believe that there is sufficient case at this time to warrant the introduction of a biofuels mandate for Victoria. Given rapid technological changes in the industry, however, the Committee recommends that the Government review the merits of a biofuels mandate by 2013.

Overseas experience has demonstrated that the key benefit associated with expansion of the biofuels industry is regional economic development. There are opportunities for rural and regional communities in Victoria to benefit from the establishment of local biodiesel production facilities. The Committee has made a number of recommendations encouraging the Victorian Government to support the development of local biodiesel industries in rural and regional Victoria.

During the course of this Inquiry the Committee became aware of the enormous potential for fuels derived from natural gas – such as CNG, LNG and LPG – to substantially alleviate fuel security concerns in Australia, as well as contribute to reduced greenhouse gas and air emissions from the transportation sector. Victoria has access to considerable reserves of natural gas that could be developed for use in transport, with appropriate support from the vehicle industry, fuel distributors and government. The Committee recommends that the Victorian Government carefully examine the costs and benefits associated with increasing market demand and infrastructure rollout for, and use of, natural gas fuels in Victorian transport.

While an overall consensus on the benefits and costs of biofuels use is emerging, there is still considerable debate about the true effect of biofuels use and production on the environment, fuel security and air emissions. In this context, it is critical that decisions about the direction of fuels policies be made with reference to independent, robust research.

The Committee received 65 written submissions during the course of this Inquiry, convened public hearings with 35 witnesses, and received briefings from a number of government representatives. On behalf of the Committee I thank these people and organisations for their important contribution.

I thank my fellow Committee Members for their contribution to the Inquiry – Mr David Davis (Deputy Chair); Mr Bruce Atkinson; Mr Peter Crisp; Mr Brian Tee; Mr Evan Thornley; and the Hon. Marsha Thomson. I also thank the Committee secretariat past and current for their hard work and support throughout this inquiry – Dr Vaughn Koops, Ms Yuki Simmonds, Ms Shanthi Wickramasurya, Mr Mark Roberts, Ms Mary Pink and Ms Felicity Lane.

Hon. Christine Campbell, MP

Chair

Executive Summary

Chapter One: Introduction

Transportation fuel use accounts for around 39 per cent of energy consumption in Australia. Most fuel used in the Australian fleet is derived from petroleum, and most is imported into Australia. Fuel imports into Australia are expected to rise substantially as demand increases.

There are emerging concerns about the use of petroleum fuels internationally. Transport fuels contribute around 15 per cent of all greenhouse gas (GHG) emissions in Australia, as well as significant quantities of air pollutants. Fuel security is also an important issue for government as concerns about remaining global reserves of petroleum increase.

The use of biofuels (principally biodiesel and ethanol) has been proposed as a means to alleviate pressure on petroleum fuel demand and to provide a means to reduce growth in GHG emissions in the transport sector. It has also been suggested that increased use of biofuels will benefit population health through reduced deaths and illnesses associated with transport air pollution, and benefit regional communities by providing a stimulus for regional development.

While the use of biofuels appears to offer a range of benefits, there is increased international debate about the overall merit of government intervention to assist the biofuels industry.

Chapter Two: Biodiesel

Biodiesel is a fuel that can be manufactured from a wide range of vegetable and animal fats and oils ("feedstocks"). Biodiesel has similar qualities to petroleum diesel and can be used as a petroleum diesel fuel additive or replacement. The cost of biodiesel is principally dependent on the price of feedstocks.

The use of biodiesel as a pure or blended fuel results in significant GHG emissions reductions compared to petroleum diesel. On a per-litre basis, blended biodiesel appears to provide greater benefit than unblended biodiesel. While the use of biodiesel leads to reductions in some air pollutant emissions and increases in others, the net effect of biodiesel use on population health appears to be positive.

In the months prior to November 2007 a number of biodiesel plants were placed on standby, reducing production capacity for biodiesel in Australia from 559.5 ML to 269.5 ML. In 2006-07 actual production in Australia was less than 50 ML. There is currently 50 ML production capacity for biodiesel in Victoria, with a further 211.8 ML due by 2008.

Feedstock availability is an important consideration for the biodiesel industry, with prices for principal feedstocks rising sharply in recent months. A number of new feedstocks for biodiesel are under development

that may provide improved environmental and productivity outcomes from biodiesel use.

Chapter Three: Ethanol

Ethanol is a fuel produced by the fermentation of sugars. Principal feedstocks for ethanol are molasses, wheat, sorghum, and corn. Ethanol can be used as a petrol additive in most vehicles at low concentrations. Modified or purpose-built vehicles are required for the use of ethanol in proportions above ten per cent. Consequently, the principle use of ethanol in Australia for the foreseeable future is as a blended fuel. Ethanol has a lower energy density than petrol, so that fuel consumption increases with its use.

The use of ten per cent blended ethanol in vehicles results in GHG emissions reductions of between 4.2 and 0.7 per cent. Use of ten per cent blended ethanol leads to around 20 per cent reductions in carbon monoxide emissions in vehicles, but increases emissions of the air pollutants nitrous oxide and particulate matter.

In the months prior to October 2007 some planned ethanol plants were put on hold until market conditions become more favourable. Production capacity for ethanol in Australia is currently 171.2 ML. Victoria does not currently produce ethanol, and Victoria's only planned ethanol plant is currently on hold.

With the development of second-generation feedstock (lignocellulosic) technologies there is potential for expanding the role of the ethanol industry in the fuel market. Current feedstocks for ethanol production are also generally food products, so that expansion of the fuel ethanol industry using current technologies is likely to exert pressure on food availability and prices.

Chapter Four: Compressed Natural Gas (CNG)

CNG is the compressed form of natural gas. There are significant natural gas reserves available in Australia, which means that there is potential for CNG to play an expanded role in the Australian fuel mix.

In order to use CNG in a conventional petrol or diesel vehicle a fuel conversion is required. There is currently a limited number of CNG-compatible vehicles in Australia, and limited CNG distribution infrastructure currently in place.

GHG emissions from CNG are up to 25 per cent lower than for unleaded petrol, provided CNG is used in an appropriately converted and tuned vehicle. Emissions of air pollutants are substantially reduced compared to unleaded petrol.

Chapter Five: Petroleum

Petroleum is the raw material used for the production of most automotive fuels, including petrol, diesel and liquefied petroleum gas (LPG).

Petroleum is refined through distillation and other methods to supply the Australian fleet. While distribution and operating costs contribute to the price of petroleum products in Australia, regional petroleum prices are used for setting benchmark prices in the Asia-Pacific market.

Australian refinery capacity is sufficient to supply most of Australia's demand for refined petroleum products. However, just 28 per cent of Australian industry output is produced from domestic oil sources. Most Australian crude oil is exported to markets where it can obtain higher prices, with Australian refined petroleum products largely obtained from imported oil.

Chapter Six: Fuels comparison

A comparison of GHG emissions for a range of fuels shows that the planned introduction of the premium unleaded petrol (PULP) Euro 4 vehicle standard in 2008 will result in small vehicle GHG emissions reductions of 17 per cent. The use of E10 may extend this benefit with GHG emissions reductions of between 2.7 per cent and 0.7 per cent. The use of petroleum diesel, CNG and LPG lead to similar reductions in GHG emissions of between 25 per cent to 32 per cent compared to unleaded petrol. B20 blends lead to GHG emissions reductions of between 37 per cent and 45 per cent compared to ULP. The use of hybrid-petrol and hybrid-diesel vehicles results in the largest GHG emissions reductions, at 54 per cent and 63 per cent respectively.

The use of biofuels leads to reductions in some air pollutants and increases in others. Ethanol and biodiesel produce increased emissions of nitrous oxides in vehicles, a contributor to smog through the formation of ozone. The use of ethanol can lead to reductions in carbon monoxide (CO) emissions compared to unleaded petrol, although life-cycle emissions of particulate matter (PM) increase substantially with use of ethanol and blended ethanol. Blended biodiesel use leads to reductions in PM emissions compared to petroleum diesel. CNG and LPG both lead to substantial reductions in all air emissions, with CNG producing the greatest CO reductions compared to ULP. The best air emissions outcomes can be obtained from the use of hybrid petrol and hybrid diesel vehicles.

The principal role of biodiesel and ethanol as a means to obtain fuel security will be as "fuel extenders" – fuels that can be used to replace a part of fuel consumption, but not form a substantial alternative to petroleum fuels. The efficiency and volume of biofuels production may increase with the development of second-generation (lignocellulosic) technologies.

CNG provides some promise as a means to increase fuel security, but low current utilisation means that substantial infrastructure and vehicle fleet investments will have to be made in order to realise the potential of this fuel. Care will also have to be taken to ensure that poor vehicle tuning does not undermine potential GHG benefits from CNG use.

Of all of the fuels considered in this report, expansion of the biofuels industry offers the greatest potential to encourage and support regional development, principally through demand for, and supply of, biofuels feedstock.

Chapter Seven: International government support for biofuels

In 2004 international biofuels production was sufficient to meet 1.3 per cent of world fuel use. 2004 estimates suggest that up to nine per cent of the world's agricultural land will be required for biofuels to supply ten per cent of fuel requirements.

The principal reasons cited by international governments for support of biofuels are: fuel security; lowered GHG emissions; improved air quality; and agricultural support. Most biofuels industry activity internationally is accompanied by active and long term government support.

Forms of support offered to the biofuels industry by governments include: import tariffs, fuel excise exemptions; mandate and targets; production subsidies; and support for production factors, distribution infrastructure, flex-fuel vehicles and research and development.

The net cost of government support for ethanol in five selected Organisation for Economic Co-operation Development countries (OECD) (including the US and Australia) is between US \$0.29 and \$1.00 per litre. For biodiesel the cost of support in these countries is between US \$0.20 and \$1.00. In some countries crop subsidies also contribute to costs incurred by government for biofuels production.

There is increasing international concern about the effect of biofuels production on food prices due to increased demand for feedstocks. Supplies of other crops may also be affected as agricultural producers divert production to biofuel feedstocks. Increases in international grain prices may disproportionately affect people in developing nations.

International evidence suggests that the cost of increased fuel security obtained through government support for biofuels may be high. In the US the cost to government of replacing one litre of fossil fuel by ethanol is approximately US \$1.00 - \$1.25, with the equivalent cost for biodiesel at US \$0.95 - \$1.20. In Australia the cost to government is in the order of US \$0.80 - \$2.10 per litre of fossil fuel replaced by ethanol, and US \$0.48 - \$0.95 per litre replaced by biodiesel.

The cost to government of obtaining GHG emissions reductions through biofuels also appears to be high. In Australia the cost to government per metric tonne of carbon equivalent abatement has been estimated at US \$250-\$1700 for ethanol, and US \$160 - \$600 for biodiesel.

Chapter Eight: Government biofuels initiatives

The Commonwealth Government convenes a number of grants and rebates programs to support the ethanol and biodiesel industries. Recent changes to excise arrangements for all fuels may have an effect on the biofuels industry. However, over the medium term biofuels will continue to receive support from the Commonwealth Government through production grants, which reduce the effective tax on alternative fuels. The development of national standards for biodiesel blends is emerging as an

important issue for the industry. The Committee supports the development of standards for biodiesel blends

In April 2007 the Victorian Government announced a commitment to a five per cent biofuels target by 2010. The Government currently supports the ethanol fuel industry by requiring the Government fleet to use ethanol blended fuel when it is available. There is also potential for further industry support through increased uptake of biodiesel in the Government fleet. The Victorian Government also provides industry support through the Biofuels Industry Grants program, and through various programs to increase consumer confidence in biofuels.

Chapter Nine: Appropriate industry support

There are a number of arguments for and against the establishment of a biofuels mandate in Victoria. Arguments for a mandate include that it would increase industry and consumer confidence; that industry development would improve rural and regional development; that it would push major oil companies “over the line” in support of biofuels; and that it would place Victoria in a position to quickly capitalise on the development of future biofuels technologies.

Arguments against a mandated target include caution about the risk associated with establishing a mandate in excess of production capacity; possible upwards pressure on food and feed prices; and infrastructure issues associated with fleet biofuels incompatibility issues.

The Committee determined that, on balance, the risks associated with the introduction of a biofuels mandate for Victoria outweighed the potential benefits. Consequently, the Committee recommends that a biofuels mandate not be introduced in Victoria for the time being. However, the Committee does support industry development through other means.

Biofuels offer promise as a means towards regional development in Victoria. The Committee supports introduction of a range of incentives for the biofuels industry in Victoria, directed at the long term and sustainable development of the industry. The Committee also recommends that measures to encourage fleet transformation be examined to increase the number of biofuels-compatible vehicles in Victoria. Finally, the Committee recommends that the Victorian Government encourage major oil companies to develop biodiesel-blending facilities.

Waste plastics to diesel offers potential for the generation of low-emissions automotive fuel. The Committee recommends that the Commonwealth Government be approached to consider changing regulations to allow plastics to diesel be applicable under current grant and excise arrangements for renewable fuels.

CNG is a vast and underutilised resource for use in transport applications in Victoria. The Committee recommends that the Victorian Government conduct an extensive evaluation of potential roles for CNG in the Victorian fuel mix.

Table of Recommendations

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| Recommendation 1: Given increasing interest in vehicle air emissions reductions in association with biofuels use, that EPA Victoria also implement procedures to ensure improved compliance of existing vehicles with current air emissions requirements. | 103 |
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Abbreviations

| | |
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| ABARE | Australian Bureau of Agricultural and Resource Economics |
| ACCC | Australian Competition and Consumer Commission |
| AFCP | Alternative Fuels Conversion Program |
| AIP | Australian Institute of Petroleum |
| AUD | Australian Dollars |
| B5 | Diesel containing 95 per cent petroleum diesel and 5 per cent biodiesel |
| B20 | Diesel containing 80 per cent petroleum diesel and 20 per cent biodiesel |
| B100 | 100 per cent Biodiesel |
| BDEP | Biodiesel Emissions Particulate Matter |
| BIG | Biofuels Infrastructure Grants |
| BTRE | Bureau of Transport and Regional Economics |
| CFGS | Cleaner Fuels Grant Scheme |
| CH ₄ | Methane |
| CNG | Compressed Natural Gas |
| CNGIP | Compressed Natural Gas Infrastructure Program |
| CO | Carbon Monoxide |
| CO ₂ | Carbon Dioxide |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| DDG | Dry Distillers Grain |
| DEH | Department of Environment and Heritage |
| DITR | Department of Industry, Tourism and Resources (Commonwealth) |
| FCAI | Federal Chamber of Automotive Industries |
| FFV | Flexible Fuel Vehicles |
| E5 | A blend of petrol containing 5 per cent ethanol |
| E10 | A blend of petrol containing 10 per cent ethanol |
| E20 | A blend of petrol containing 20 per cent ethanol |
| EGCS | Energy Grants Credit Scheme |
| ENRC | Environmental and Natural Resources Committee |
| EPA | Environment Protection Authority |
| ESC | Essential Services Commission |
| EU | European Union |

| | |
|------------------|--|
| FRC | Full Retail Contestability |
| GDP | Gross Domestic Product |
| GHG | Greenhouse gas |
| GL | Gigalitre (1,000,000,000 litres or 1,000 ML or 10 ⁹ litres) |
| GSI | Global Studies Initiative |
| GST | Goods and Services Tax |
| GVM | Gross Vehicle Mass |
| HAPs | Hazardous Air Pollutants |
| IEA | International Energy Agency |
| IMF | International Monetary Fund |
| LSD | Low Sulphur Diesel (<500ppm) |
| LNG | Liquefied Natural Gas |
| LPG | Liquefied Petroleum Gas |
| ML | Megalitre (1,000,000 litres or 10 ⁶ litres) |
| MON | Motor Octane Number |
| MPa | Megapascals |
| NGV | Natural Gas Vehicles |
| N ₂ O | Nitrous Oxide |
| NO _x | Nitrogen Oxides |
| nPAH | Nitro-Polycyclic Aromatic Hydrocarbons |
| O ₃ | Ozone |
| OECD | Organisation of Economic Co-operation and Development |
| PAH | Polycyclic Aromatic Hydrocarbons |
| Pb | Lead |
| PDEP | Petroleum Biodiesel Emissions Particulate Matter |
| PM | Particulate Matter |
| ppm | Parts Per Million |
| PULP | Premium Unleaded Petrol |
| RON | Research Octane Number |
| RVP | Reid Vapour Pressure |
| SO ₂ | Sulphur Dioxide |
| TGP | Terminal Gate Price |
| ULSD | Ultra Low Sulphur Diesel (<50ppm) |
| ULP | Unleaded Petrol |
| US | United States |

| | |
|------|-----------------------------------|
| VKT | Vehicle Kilometres Travelled |
| VOCs | Volatile Organic Compounds |
| WDG | Wet Distillers Grain |
| WTI | West Texas Intermediate |
| XLSD | Extra Low Sulphur Diesel (<10ppm) |

Chapter One: Key points

- Transportation fuel use accounts for around 39 per cent of energy consumption in Australia. Most fuel used in the Australian fleet is derived from petroleum, and most is imported into Australia. Fuel imports into Australia are expected to rise substantially as demand increases (p. 1).
 - Alongside a range of other fuels, biofuels have been proposed as a possible solution to some of the challenges facing the fuel sector, including concerns about climate change, fuel security, and the effect of vehicle fuel use on health. In the right conditions biofuels may form a small but important component of the Australian fuel mix (p. 2).
 - Key issues during consideration of the impact of fuel use include: greenhouse gas emissions; air pollutant emissions; the characteristics of individual fuels; and fuel security (p. 3).
 - During the course of this Inquiry the Committee received 65 written submissions. Four public hearings were convened with 35 witnesses representing 24 organisations attending. The Committee also received briefings from the Department of Primary Industries, Regional Development Victoria, the Environmental Protection Authority (EPA) Victoria and the Minister for Rural and Regional Development (p. 6).
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Chapter One: Introduction

On 1 March 2007 the Economic Development and Infrastructure Committee received a reference under the *Parliamentary Committees Act 2003* to inquire into mandatory targets for ethanol and biofuels use in Victoria. The terms of reference state that the Committee is required to:

- report on the merits or otherwise of a mandated target for alternative fuels including biofuels and ethanol;
- report on whether a mandatory target should be 5% by 2010, 10% by 2015 or otherwise;
- report on the measures required by Government to facilitate an alternative fuels industry in Victoria for transport and non-transport applications; and
- report on how to maximise the regional economic development benefits of a mandatory biofuels target including jobs growth and investment potential.

1.1 Biofuels in Australia

1.1.1 Transportation fuel use

Approximately 39 per cent of the final consumption of energy in Australia is in the transportation sector, with fuel consumed in road transportation accounting for most of the petroleum products used.¹ While Australia has substantial fossil fuel resources – including coal and crude oil – for a variety of reasons a high proportion of the fuel used in Australia’s vehicle fleet is imported from overseas.² In future Australia is likely to become more reliant on imported transport fuels as demand increases.

Fossil fuel use in the transportation sector accounts for 15 per cent of all greenhouse gas (GHG) emissions in Australia, and for a large proportion of nitrous oxide, particulate matter and volatile organic compounds emissions, all of which are thought to have a significant effect on

¹ Clara Cuevas-Cubria and Damien Riwoe, *Australian energy: national and state projections to 2029-30*, Canberra, 2006.

² Australian Institute of Petroleum, *Downstream petroleum 2005*, Australian Institute of Petroleum, Canberra, 2005; Australian Institute of Petroleum, 'Security of supply', viewed 3 October 2006, <<http://www.aip.com.au/issues/security.htm>>.

population health.³ In 2002, the Bureau of Transport and Regional Economics estimated that by 2010 GHG emissions from the Australian transport sector would increase by 40 per cent from 1990 levels, and by 2020 transport sector emissions would be 70 per cent higher.⁴ In 2000, 90 per cent of GHG emissions from the transport sector were attributable to road transport.⁵

Concerns have been raised that Australia's reliance on fossil fuels may constitute a threat to the security of the Australian fuel supply. There is also considerable debate throughout the world about when the level of maximum oil production, or 'peak oil', will occur and what effect declining oil production levels, coupled with expensive oil extraction technologies, may have on the world economy. Some commentators concerned about the vulnerability of fuel supplies to constricted supply and/or increasing costs have suggested that a diversified fuel mix with increased levels of domestic production would minimise risk associated with fuel security.⁶ In this context a range of alternative fuels – including biofuels – are being considered as a means to improve security of price and security of supply.

1.1.2 The place of biofuels

Against this background there has been increasing interest in the use of biofuels – principally ethanol and biodiesel – as alternatives to fossil fuels. Biofuels are produced from organic compounds, and are renewable, and as a result may produce fewer GHG emissions and lower air pollutant levels when the entire 'well to wheel' life-cycle of fuel use is considered.⁷ Studies conducted to date on the two major biofuels, ethanol and biodiesel, suggest that these fuels may have advantages over petroleum based fuels in terms of reduced net GHG emissions, reduced emissions of some air toxic substances, and (in the case of biodiesel) increased biodegradability. The incorporation of biofuels into the Australian fuel mix may also provide an ongoing market for the production of biofuels feedstocks, and so offer some support to the agricultural sector.

While there has been considerable optimism about the future role of biofuels in the Australian fuel mix, it is unlikely that biofuels produced with current technology will account for a large proportion of Australian fuel use in the short to medium term.⁸ There are also a number of consumer

³ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; Productivity Commission, *The private cost effectiveness of improving energy efficiency*, Productivity Commission, Canberra, 2005, p. 330.

⁴ Bureau of Transport and Regional Economics, *Greenhouse gas emissions from transport*, BTRE, Canberra, 2002.

⁵ Bureau of Transport and Regional Economics, *Greenhouse gas emissions from transport*, BTRE, Canberra, 2002.

⁶ J Bielecki, 'Energy security: is the wolf at the door?' *The Quarterly Review of Economics and Finance*, vol. 42, no. 2, 2002; Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005.

⁷ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003.

⁸ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003.

confidence, infrastructural and distributional problems that will have to be addressed before biofuels can play a significant role.⁹ However, in the right conditions biofuels may form a small component of the Australian fuel mix.

1.1.3 Key issues considered in this report

The Inquiry Terms of Reference required the Committee to focus principally on issues surrounding expansion of the alternative fuels industry in Victoria, with a particular focus on the biofuels ethanol and biodiesel. The Committee was also required to focus on the issue of whether a biofuels mandate was an appropriate mechanism for developing the biofuels industry in Victoria. While the principal focus of the Committee's deliberations has been on biofuels, the Committee also determined to examine potential roles for other alternative fuels in Victoria. The potential for development of the compressed natural gas (CNG) industry in Victoria was of interest in this regard.

While considering the overall costs and benefits associated with government support for the expansion of the biofuels industry a number of key topics emerge. These include:

- GHG emissions associated with fuel use;
- air emissions associated with fuel use and their effect on human health;
- fuel characteristics; and
- fuel security issues.

A brief overview of these topics is provided here as these topics are addressed for each fuel considered this report.

Greenhouse gas emissions

As discussed above, fuel emissions of greenhouse gases are of increasing concern throughout the world. When considering possible roles for biofuels and alternative fuels to alleviate emissions associated with the transport sector a wide range of GHG emissions sources must be considered.

In general, methods for calculating GHG emissions assume a life-cycle approach, accounting for total carbon emissions associated with the production and use of a product. For 'renewable' sources of energy such as fuels produced from plants, the carbon emitted by a fuel when it is burned is offset by the carbon absorbed by the plants from which it was made. GHG emissions calculations generally assume in this context that carbon emissions are equivalent to the carbon absorbed when the feedstock grows.

In the context of biofuels, there is a common misperception that because these fuels are obtained from biological, growing organisms the net GHG

⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003.

emissions associated with their use must be zero. However, this is not always the case, because most of the feedstocks used for biofuels are produced with assistance of non-renewable energy. When GHG emissions take account of the non-renewable energy used in production the overall benefits of biofuels can be substantially offset. Consequently, the life-cycle emissions of alternative and petroleum fuels must be carefully considered when assessing the merit of different approaches to reduce emissions in the transport sector.

Air emissions

Traditionally regulations governing vehicle emissions have focused on toxic air emissions. These include emissions of substances that are thought to have an adverse impact on population health or the environment, such as ozone and carbon monoxide. Although the greenhouse gas qualities of biofuels are frequently the attention of public discussion, there is potential for biofuels to contribute to reductions in certain toxic air emissions from the vehicle fleet.

In Australia the six criteria air pollutants relating to transport are carbon monoxide (CO), sulphur dioxide (SO₂), ozone (O₃), particulate matter (PM), oxides of nitrogen (NO_x) and lead (Pb).¹⁰ Sulphur dioxide and lead are not considered to be problems in Australian airsheds (a body of air contained by meteorology and topography in which a pollutant once emitted is contained) and have been excluded from analysis.¹¹ Ozone is formed as a result of a secondary reaction between NO_x and non-methane volatile organic compounds (NMVOCs) and are denoted as VOCs for the purposes of this analysis.¹²

Fuel characteristics

The Australian fleet is almost exclusively comprised of vehicles with internal combustion engines. As a consequence, consideration of the use of any alternative fuels (including biofuels) must carefully consider how the use of the fuel will affect the current fleet, or indeed if modifications to or replacement of the vehicle fleet will be required to make use of the fuel.

In this context, a number of fuel characteristics are considered for each fuel during the course of this report. These affect the performance of the engine in which the fuel is used. The most important include cetane, octane, and volatility.

Cetane: The cetane number is a measure of the readiness of a fuel to auto-ignite when injected into the engine and is also an indication of the smoothness of combustion.¹³ The higher the cetane number the better the ignition quality.

¹⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 73.

¹¹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 73.

¹² Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 73.

¹³ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 33.

Octane: One of the key characteristics is the octane rating of fuel, which refers to the tendency of fuel to self-ignite or knock in the compression stroke prior to the application of the spark.¹⁴ Octane performance of fuel is established by two measures: the research octane number (RON) and the motor octane number (MON).¹⁵ The RON is the measure of the anti-knock performance of a fuel when vehicles are operating under mild conditions. The MON measures performance of the fuel under more severe driving conditions.¹⁶ The difference between these two measures is referred to as octane sensitivity. Most petrol manufacturers attempt to maintain octane sensitivity at about eight to ten units to prevent high speed knock and possible engine damage.¹⁷

Volatility: Volatility is a measure of the fuel's evaporation against temperature and is commonly characterised by vapour pressure and the distillation curve.¹⁸ Volatility is measured as Reid Vapour Pressure (RVP) so that higher RVP corresponds with higher fuel volatility.¹⁹ The distillation test determines the fuel's volatility across the entire boiling range of petrol²⁰ and the distillation curve indicates at what temperature the percentage of fuel evaporates.²¹

Fuel security

Another important consideration in the context of fuel use is the issue of fuel security. As noted above, there are increasing concerns about the medium to long term availability of petroleum products. As known oil reserves are depleted it is likely that more and more expensive technologies will be required to extract and obtain petroleum. This will introduce pressures across the world economy, and may result in a substantial shift in energy use (particularly in the transport sector) throughout the world.

Another concern in the context of fuel security is the increasing reliance of a number of developed countries on imported petroleum products. There is a perception that this constitutes a security concern because fuel supply may become too dependent on factors outside national control, such as overseas conflict or monopolisation of resources.

In this context, there has been increasing interest in the development of domestic resources for the provision of fuel. These may include the production of fuels that can make use of existing infrastructure and

¹⁴ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 60.

¹⁵ Environment Australia, *Setting the ethanol limit in petrol*, Environment Australia, Canberra, 2002, p. 10.

¹⁶ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 7.

¹⁷ Environment Australia, *Setting the ethanol limit in petrol*, Environment Australia, Canberra, 2002, p. 10.

¹⁸ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 26.

¹⁹ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 62.

²⁰ Environment Australia, *Setting the ethanol limit in petrol*, Environment Australia, Canberra, 2002, p. 11.

²¹ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 27.

vehicles. Over time, however, there may be opportunities for the identification of new vehicle and energy technologies to satisfy international transport requirements.

1.1.4 Inquiry process

The Committee advertised the terms of reference and called for written submissions in Victorian and national newspapers in June 2007. The Committee received 65 written submissions (see Appendix One).

Four public hearings were convened through July and August 2007. Details of hearings are provided in Appendix Two. The Committee took evidence from and met with 35 witnesses representing 24 organisations during the course of the Inquiry, hearing from non-government organisations; peak industry groups; industry experts; and businesses working in the biofuels industry.

Committee members and staff were briefed by the Minister for Rural and Regional Development and representatives from the Department of Primary Industries, Regional Development Victoria and EPA Victoria. These meetings are listed in Appendix Three.

Many individuals and organisations contributed to this Inquiry by making written submissions and participating at public hearings. The Committee is grateful to these people for generously sharing their expertise and ideas.

1.1.5 Inquiry report

Chapters Two through Five of the report provide a brief overview of the two principal biofuels (biodiesel and ethanol), natural gas (CNG and LNG), and petroleum fuels (petrol, diesel and LPG). A number of topics are discussed in the context of each fuel, including production methods, fuel characteristics, infrastructure and handling issues, GHG emissions and air pollutant emissions, and current production.

Chapter Six provides a brief comparison of the fuels considered in previous chapters. In particular, the relative GHG emissions benefits of each fuel are examined, as well as air pollutant emissions associated with each fuel.

Chapter Seven provides an international overview of current policies to support the biofuels industry. A range of support mechanisms are examined, including excise relief, mandated targets, and production grants. Where possible, comparative estimates of the costs associated with different government programs and regulations are also provided.

Chapter Eight provides an overview of current government programs and regulations affecting the biofuels industry at Commonwealth and state/territory levels. In this chapter the Committee makes a number of recommendations for state government actions to support the biofuels industry.

In Chapter Nine the Committee examines appropriate actions for the Victorian Government to take in order to support the biofuels industry in an appropriate manner. Among the issues considered in this Chapter are whether or not a mandatory target for biofuels use should be introduced, and what form of support should be provided to rural and regional

communities in order to assist the development of the biofuels industry in Victoria. Potential roles in the Victorian fuel mix for selected fuels other than biofuels are also discussed.

Chapter Two: Key points

- Biodiesel is produced from vegetable and animal oils and fats. It can be used as a fuel in diesel engines. The main sources of oils and fats for biodiesel are canola, soy, tallow, cooking oils, and palm oils (p. 9). Biodiesel appears to cause little or no increase in damage or wear to engines compared with petroleum diesel (p. 14).
 - GHG emissions from fuel use vary depending on the feedstock used to produce biodiesel. Compared to ultra-low sulphur diesel (ULSD) and extra-low sulphur diesel (XLSD), substantial reductions in GHG emissions can be achieved through use of biodiesel (p. 19).
 - Compared to petroleum diesel, biodiesel can lead to reductions in carbon monoxide (CO), volatile organic compounds (VOCs) and particulate matter (PM) emissions (p. 21).
 - A large proportion of the costs associated with biodiesel production relate to feedstock prices. Over the last twelve months, the price of some biodiesel feedstocks has risen by more than 200 per cent (p. 23).
 - Throughout 2006 and 2007, a number of biodiesel plants were placed on standby due to unfavourable market conditions. However, Victorian biodiesel plants remain operational. While total operating capacity for Australian biodiesel production stood at 269.5 ML as of November 2007, the actual production of biodiesel was estimated to be around 50 ML (p. 25).
 - If production of biodiesel is to increase in Australia, there are concerns that current domestic feedstock production will not be sufficient to meet future demand. There are suggestions that imported feedstocks, such as palm oil, have detrimental environmental impacts (p. 27). There are however a number of emerging feedstocks that could potentially be obtained through current or next-generation agricultural production. Further work is required to determine the economic viability of using these feedstocks to produce biodiesel (p. 28).
 - Unlike ethanol, biodiesel has not been subject to any negative scrutiny in the marketplace. Diesel engine manufacturers are willing to warrantee their engines for use with B5, which has contributed to increased consumer confidence in biodiesel blended fuels (p. 31).
-

Chapter Two: Biodiesel

Biodiesel is a generic term used to describe fuels produced by the transesterification of vegetable or animal oils. Generally transesterification of the oil is performed with the use of methanol and a chemical catalyst, and the resulting fuel is usable in diesel engines without need for any modification.

Biodiesel is typically produced from feedstocks including canola, soy, algae, palm oils, cooking oils and tallows. The type of oil that is used to manufacture biodiesel affects characteristics of the fuel. For example, biodiesel produced from tallow, or animal fat, can begin to solidify as temperatures fall below 20°C, while biodiesel derived from rapeseed oil (canola) is liquid at a wider range of temperatures. Due to these and other variations particular varieties of biodiesel may be suited to specific applications, or to use during different times of year.²² Some of the differences in biodiesel attributable to the use of different feedstocks are discussed below.

2.1 Production methods

The manufacturing process for most forms of biodiesel is essentially similar, and involves combining the vegetable oil or animal fat feedstock with methanol (or ethanol) and a catalyst (sodium hydroxide or potassium hydroxide).²³ These substances are mixed and heated, forming methyl esters (biodiesel) and glycerol.²⁴ Often feedstock oils or fats are pre-treated to remove components that may adversely affect transesterification, such as free fatty acids (from tallow) and gummy materials (from vegetable oils).²⁵ Filtering may also be required when waste oil is used to manufacture biodiesel.²⁶ Excess alcohol (methanol or

²² Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003; Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007, p. 27; Leigh Watkins, Senior Manager, Strategic Solutions, Bendigo Bank, *Transcript of evidence*, Melbourne, 27 August 2007, p. 15.

²³ Barry Judd, *Biodiesel from tallow*, Energy Efficiency and Conservation Authority, Wellington, 2002, p. 7.

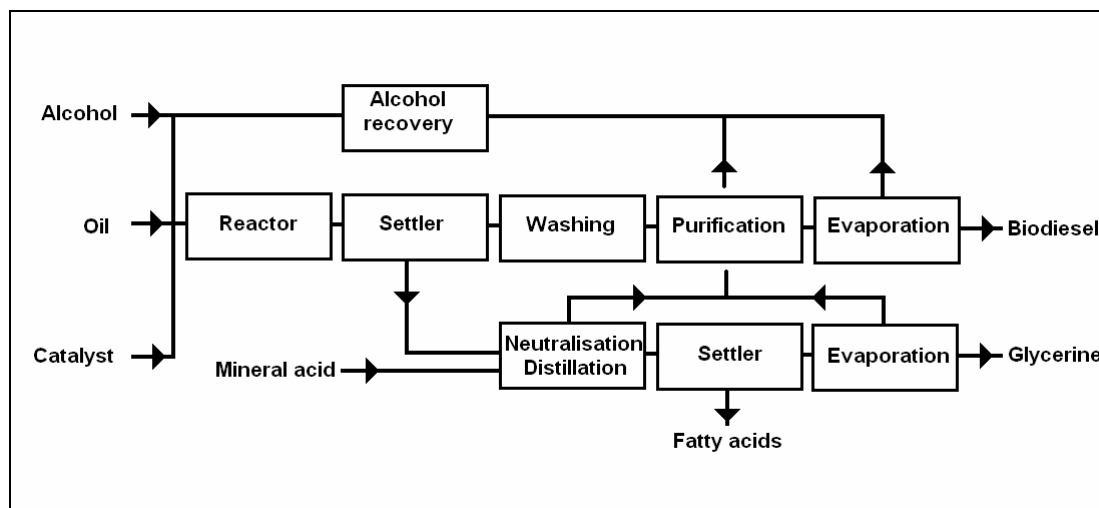
²⁴ Barry Judd, *Biodiesel from tallow*, Energy Efficiency and Conservation Authority, Wellington, 2002, p. 7.

²⁵ John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003; JA Kinast, *Production of biodiesels from multiple feedstocks and properties of biodiesels and biodiesel/diesel blends*, National Renewable Energy Laboratory, Illinois, 2003.

²⁶ John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003, p. 8.

ethanol) is typically removed in commercial-scale biodiesel production for use in further production cycles. Figure 1 provides a simple overview of steps involved in the commercial production of biodiesel.

Figure 1: Biodiesel production process



It is possible for both tallow and vegetable oils to be used interchangeably in many biodiesel production plants, as the main difference between feedstocks in the production of biodiesel is the temperature at which transesterification occurs.²⁷ Not all plants are able to process the full range of available feedstocks however, and single-stage manufacturing plants may only be able to produce biodiesel from one type of oil.²⁸ This is because various feedstocks require different forms of pre-treatment prior to transesterification.²⁹

2.1.1 Use of methanol and ethanol for biodiesel production

Ethanol can be used in place of methanol as a feedstock for the production of biodiesel.³⁰ While there are some differences in the viscosity and weights of biodiesel produced with ethanol, these do not tend to materially affect how the fuel can be used. In practice methanol is preferred over ethanol for biodiesel production because it is generally more cost-efficient.³¹ Advantages for methanol over ethanol include:

- methanol can usually be obtained at lower cost;

²⁷ John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003, p. 9.

²⁸ John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003, p. 9.

²⁹ John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003, p. 9; JA Kinast, *Production of biodiesels from multiple feedstocks and properties of biodiesels and biodiesel/diesel blends*, National Renewable Energy Laboratory, Illinois, 2003.

³⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 33.

³¹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003.

- methanol is more easily recovered for recirculation in the fuel production process;³² and
- methanol generally produces higher conversion fuel rates.

While methanol can be produced from renewable sources, most methanol is obtained as a by-product of fossil fuel production. This is largely because methanol can be purchased at low cost from fossil fuel producers.

2.1.2 Scale of production

In contrast with the production of other biofuels such as ethanol, it is possible to produce useful quantities of biodiesel in relatively small scale plants.³³ A number of enthusiasts have produced biodiesel individually and in small collectives in Victoria for a number of years in domestics and “back yard” operations.³⁴ In country Victoria some farmers have also produced small quantities of biodiesel for on-farm or local use.³⁵

The potential for biodiesel production to occur in smaller plants was regarded by some witnesses as an advantage, particularly if local communities were able to harness local supplies of oil for the production of diesel fuel.³⁶ The Committee was told that small scale, regionally located biodiesel plants, supported by local communities, may provide a way to sustain local economies and prevent the flow of funds out of smaller country communities.³⁷ The Committee heard that a number of small production facilities had been set up across Victoria, usually initiated by small collectives of people who pooled resources for the production of biodiesel for personal use. The Committee also heard that Bendigo Bank was supporting community pilot programs to facilitate the establishment of biodiesel production plants in regional communities.³⁸ These programs employ a variation of the Bendigo Bank’s Community Enterprise model, which has previously been used to assist the establishment of regional community-owned telecommunications infrastructure and businesses.³⁹ Smaller community biodiesel ‘hubs’ could also maximise environmental benefits, by reducing GHG and other emissions associated with the transport of fuels.

³² John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003, p. 10.

³³ Grown Fuel and Wimmera Biodiesel, *Submission*, no. 10, 26 July 2007; Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007.

³⁴ Enthusiast organisations include the Melbourne Biodiesel Club (www.melbournebiodiesel.org).

³⁵ Yarrock Pty Ltd, *Submission*, no. 33, 13 September 2006, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria.

³⁶ Doug Munro, Senior Consultant, Synergetics, *Transcript of evidence*, Melbourne, 6 August 2007, p. 11.

³⁷ Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007; Leigh Watkins, Senior Manager, Strategic Solutions, Bendigo Bank, *Transcript of evidence*, Melbourne, 27 August 2007.

³⁸ Leigh Watkins, Senior Manager, Strategic Solutions, Bendigo Bank, *Transcript of evidence*, Melbourne, 27 August 2007.

³⁹ Bendigo Bank, 'Community enterprise', viewed 31 October 2007, <<http://bendigobank.com.au/public/community/enterprise.asp>>.

Finding 1: Small scale and regionally located biodiesel plants have the potential to contribute to the expansion of local economies.

2.2 Fuel characteristics

2.2.1 Fuel efficiency

Typically, biodiesel contains about eleven per cent oxygen by weight, which results in a slightly lower energy content (by heating value) than is the case for petroleum diesel. Fuel efficiency is generally also slightly lower than an equivalent amount of petroleum diesel.⁴⁰ Most analyses of biodiesel assume that the relative energy density of biodiesel is 90 per cent that of petroleum diesel. This means that in theory an engine will consume more biodiesel than diesel for any given task.⁴¹

The lower energy density of biodiesel means that there may be a reduction in power in engines that use the fuel. The reduction in power is proportional to the ratio of biodiesel used by an engine, so that for example engines using B20 blends will experience less power loss than engines using B100.

While there is a theoretical loss of power and fuel efficiency with the use of biodiesel, there is evidence to suggest that losses are not substantial, particularly in blended fuels. A recent report by ICLEI Oceania on biodiesel use by local councils found that there was generally no loss of engine power from biodiesel use – and indeed, that some councils reported increased torque from biodiesel blends.⁴² ICLEI Oceania noted that even when test conditions showed a loss of fuel efficiency or power through use of biodiesel, vehicle operators often could not tell the difference between fuels in driving conditions.

From a life-cycle perspective, biodiesel may have a higher energy balance than petroleum diesel. The 'energy balance' of a fuel compares the amount of energy required to produce a fuel with the amount of energy obtained through its use. A study conducted for the US Departments of Agriculture and Energy in 1998 on urban bus fuel use found that the energy balance of biodiesel derived from soybeans was 3.24. This compared favourably with diesel, which had an energy balance of 0.83.⁴³

2.2.2 General fuel characteristics

Overall biodiesel has very similar characteristics to petroleum diesel. It tends to be more viscous than diesel, which means that it does not flow as freely. For most biodiesel blends this has little effect on engines.

⁴⁰ Barry Judd, *Biodiesel from tallow*, Energy Efficiency and Conservation Authority, Wellington, 2002, p. 4.

⁴¹ Barry Judd, *Biodiesel from tallow*, Energy Efficiency and Conservation Authority, Wellington, 2002, p. 2.

⁴² ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007, p. 32.

⁴³ J Sheehan, et al., *Life cycle inventory of biodiesel and petroleum diesel for use in an urban bus*, National Renewable Energy Laboratory, Washington DC, 1998.

A number of commentators note that biodiesel has some advantages over petroleum diesel: the temperature at which it ignites is higher than diesel (usually in excess of 120°C compared with 65°C for diesel); many varieties of biodiesel have a higher cetane index number than diesel; and biodiesel is non-toxic and breaks down more quickly in the environment.⁴⁴ Biodiesel also has very low to no sulphur content, although changes to the Australian Standard for Diesel mean that petroleum diesel will also have reduced sulphur emissions by 2009 (10 parts per million).⁴⁵

2.2.3 Water absorption

Like ethanol, biodiesel is hygroscopic, which means that it can absorb water from its surroundings and the atmosphere.⁴⁶ If excess water is absorbed by the fuel engine performance may be affected. This means that care must be taken during handling of the fuel to ensure that it does not come into contact with water, and often it also means that tanks formerly used to hold petroleum fuels must have any water removed before storing biodiesel.⁴⁷ In its report on biodiesel use by councils throughout Australia, ICLEI Oceania noted that seals on biodiesel tanks should be secured to prevent all water entering tanks, and that long term storage of biodiesel may necessitate keeping tanks full to minimise condensation.⁴⁸

2.2.4 Cetane

The cetane number is dependent upon the feedstock used during production of the given diesel fuel. As indicated in Table 1, some biodiesel fuels have a higher cetane number than diesel, and others have a lower cetane number. Overseas national standards typically set a minimum cetane number of 48 or 49 for biodiesel fuels, although the US currently allows a cetane number of 40 for biodiesel fuels. The Australian standard cetane number for B100 is currently 51, while the minimum cetane number for petroleum diesel is currently 46 (also see Table 7).⁴⁹

⁴⁴ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001; Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; CSIRO, *Submission*, no. 32, July 2007; CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003; Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007.

⁴⁵ Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007.

⁴⁶ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001.

⁴⁷ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001; Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007.

⁴⁸ ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007, p. 48.

⁴⁹ Fuel Standard (Automotive Diesel) Determination 2001 (Cth), section 3.

Table 1: Comparison of the cetane number of various diesel fuels.⁵⁰

| Fuel | Cetane Number |
|------------------------|---------------|
| Diesel | 51 to 58 |
| Biodiesel (FAMAE) | >40 |
| Palm oil methyl ester | 62 |
| Soy methyl ester | 46 |
| Sunflower methyl ester | 49 |
| Tallow methyl ester | 58 |

2.2.5 Lubricity

Lubricity is the ability to reduce friction between moving solid surfaces. Lubricity enhancing compounds are naturally present in diesel derived from crude oil, but processes to remove sulphur from petroleum diesel can also have the effect of reducing the lubricity of that fuel.⁵¹ Overseas studies have shown that biodiesel blends of greater than two per cent will increase the lubricity of ULSD.⁵² While additives can also improve the lubricity of ULSD fuels, these can have adverse effects on fuel performance if blended at high levels. Biodiesel does not have the potential for this kind of adverse effect because it is a compatible fuel in its own right, so the blending of biodiesel may offer a low risk means to achieve sufficient lubricity in ULSD fuel.⁵³

2.2.6 Engine issues

The Department of Environment and Heritage notes that the use of biodiesel may soften and degrade certain types of elastomers and natural rubber compounds (typically found in fuel hoses and fuel pump seals) contained within diesel engines.⁵⁴ This suggests that users of biodiesel should be aware of the potential for increased degradation of these engine components. The Royal Automobile Club of Victoria (RACV) express similar concerns highlighting that higher biodiesel blends can cause problems with engine lubricating oils, causing them to become more acidic and/or to become diluted.⁵⁵

⁵⁰ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 139.

⁵¹ Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003, p. 18.

⁵² ULSD has reduced lubricity as a result of processes employed to remove sulphur from the fuel.

⁵³ Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003, p. 18.

⁵⁴ Department of Environment and Heritage, *Setting national fuel quality standards: standardising diesel / biodiesel blends*, Department of Environment and Heritage, Canberra, 2006; Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003.

⁵⁵ Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003, p. 69; Royal Automobile Club of Victoria, *Submission*, no. 41, 27 September 2006, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria.

However, it has been noted that the tightening of standards for sulphur content in petroleum diesel has prompted the manufacture of fuel system components that are also suited for use with biodiesel.⁵⁶ While some commentators suggest that biodiesel may erode engine seals over time, no conclusive evidence in support of this claim has been identified.⁵⁷ In fact, evidence from Australian biodiesel tests indicate that biodiesel use causes no substantial increase in damage or wear to engines compared with petroleum diesel.⁵⁸ The Report of the Prime Minister's Biofuels Taskforce in 2006 reported on biodiesel trials undertaken in Camden Council (NSW) in 2003-04 and Newcastle City Council (NSW) in 2005-06.⁵⁹ In Camden a truck was run for one year on B100, and in Newcastle twelve buses were run on B20 for one year. After the trials the engines were dismantled and assessed, with none of the engines exhibiting evidence of abnormal wear or degradation.⁶⁰

While there is little evidence of damage to seals and hoses associated with the use of biodiesel, the solvent qualities of biodiesel may dislodge deposits that have accumulated in a fuel system through extended use of petroleum diesel.⁶¹ For this reason, vehicles switching from petroleum diesel to biodiesel often require regular maintenance of fuel filters for a short time following initial use of the new fuel. Some councils that participated in a program to test biodiesel use in existing fleets suggested that fuel filters should be checked regularly when higher concentrations of biodiesel are first used in a vehicle, until engine deposits in the fuel system of the vehicle have cleared.⁶² After this time councils reported that biodiesel could be used without issue.

2.2.7 Effects of feedstock on fuel characteristics

As noted above, the feedstock oil used to produce biodiesel can affect characteristics of the fuel. Some of the characteristics particularly affected include:

⁵⁶ Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003, p. 64.

⁵⁷ Federal Chamber of Automotive Industries, *Submission*, no. 20, 2 August 2007; ICLEI - Local Governments for Sustainability - Oceania, *Submission*, no. 36, 3 August 2007; ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007.

⁵⁸ Diesel Test Australia, *Submission*, no. 18, 8 September 2006, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria; ICLEI - Local Governments for Sustainability - Oceania, *Submission*, no. 36, 3 August 2007; ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007.

⁵⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 139.

⁶⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 140; Diesel Test Australia, *Submission*, no. 18, 8 September 2006, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria.

⁶¹ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001; ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007.

⁶² ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007, p. 55.

- the ‘cloud point’ and ‘pour point’ of fuels – referring to the temperature at which the fuel becomes opaque and the lowest temperature at which the fuel is observed to flow, respectively;
- the flash point (see above) – the temperature at which the application of a flame to vapour above the fuel will cause it to ignite;
- cetane number (see above) – a measure of the readiness of a fuel to auto-ignite when injected into the engine;
- oxidation stability – a measure of the propensity of a fuel to degrade; and
- lubricity – a measure of the ability to reduce friction between moving solid surfaces.

A 2003 US study on biodiesel produced from various feedstocks examined these and other fuel characteristics, comparing them with diesel fuel.⁶³ Study results for biodiesel fuels based on a range of feedstocks – including soy, canola, edible tallow, inedible tallow, yellow grease (cooking oil equivalent) and diesel (petroleum diesel) – are presented in Table 2.

Table 2: Comparison of selected fuel characteristics of biodiesel from various feedstocks and petroleum diesel.⁶⁴

| Flash point (°C) | | | | | |
|------------------|--------|---------------|-----------------|-------------|------------------|
| Soy | Canola | Edible tallow | Inedible tallow | Cooking oil | Diesel |
| 167 | 163 | 173 | 136 | 160 | 58 ⁶⁵ |
| Cloud point (°C) | | | | | |
| Soy | Canola | Edible tallow | Inedible tallow | Cooking oil | Diesel |
| 2 | -3 | 20 | 23 | 42 | -18 |
| Pour point (°C) | | | | | |
| Soy | Canola | Edible tallow | Inedible tallow | Cooking oil | Diesel |
| -1 | -4 | 13 | 8 | 12 | -27 |

⁶³ JA Kinast, *Production of biodiesels from multiple feedstocks and properties of biodiesels and biodiesel/diesel blends*, National Renewable Energy Laboratory, Illinois, 2003.

⁶⁴ Source: JA Kinast, *Production of biodiesels from multiple feedstocks and properties of biodiesels and biodiesel/diesel blends*, National Renewable Energy Laboratory, Illinois, 2003.

⁶⁵ Source: Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007, p. 5.

| Cetane number | | | | | |
|--------------------------------|-----------|---------------|-----------------|-------------|--------|
| Soy | Canola | Edible tallow | Inedible tallow | Cooking oil | Diesel |
| 47.2-59.0 | 55.0-53.9 | 63.6-64.8 | 54.3-61.7 | 52.2-57.8 | 47.0 |
| Oxidation stability (mg/100ml) | | | | | |
| Soy | Canola | Edible tallow | Inedible tallow | Cooking oil | Diesel |
| 16.0 | 44.9 | 8.1 | 41.0 | 6.2 | 2.3 |
| Lubricity ⁶⁶ | | | | | |
| Soy | Canola | Edible tallow | Inedible tallow | Cooking oil | Diesel |
| 6050 | >7000 | >7000 | >7000 | <7000 | 3600 |

The 2003 study also examined the effect of biodiesel blends on fuel characteristics. These tests showed that blended fuels generally moderated between the characteristics of the biodiesel and petroleum fuels proportionately – for example, a B20 blend of canola biodiesel produced a fuel with a pour point of -18°C and a cetane number of 48.8.⁶⁷

2.3 Infrastructure, handling and distribution issues

2.3.1 Site storage

Given the propensity for biodiesel to dislodge deposits in fuel systems, storage tanks previously used for storing petroleum diesel may need to be cleaned before storing biodiesel. As noted above, biodiesel is an hygroscopic fuel, and so may require monitoring of storage facilities to ensure that atmospheric or other water does not come into contact with the fuel.

Biodiesel biodegrades more rapidly than petroleum diesel, and in most cases biodiesel can be stored for no longer than six months without the addition of a stabilising agent.⁶⁸ As a consequence biodiesel storages must have a regular 'turn over' of three to six months to avoid biodegradation of the fuel.⁶⁹

These characteristics of biodiesel may require an initial investment in storage tank cleaning and maintenance if biodiesel is to be provided through existing infrastructure. Biodiesel may also require some changes to fuel storage practices, as suppliers may need to ensure that fuel is not stored over extended periods. Suppliers may also have to endeavour to keep tanks full in order to prevent condensation.⁷⁰ In most cases these

⁶⁶ Due to limitations of the testing equipment, lubricity measures above 7000 were not available from this test, JA Kinast, *Production of biodiesels from multiple feedstocks and properties of biodiesels and biodiesel/diesel blends*, National Renewable Energy Laboratory, Illinois, 2003.

⁶⁷ JA Kinast, *Production of biodiesels from multiple feedstocks and properties of biodiesels and biodiesel/diesel blends*, National Renewable Energy Laboratory, Illinois, 2003.

⁶⁸ Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003, p. 19.

⁶⁹ Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003, p. 20.

⁷⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003; ICLEI - Local Governments for Sustainability - Oceania, *Submission*, no. 36, 3 August

changes in practice would not be expected to impose a significant additional cost to the supplier.

2.3.2 Spillage

While the enhanced biodegradability of biodiesel may require some changes to fuel storage practices among suppliers, it also means that biodiesel degrades much more quickly in the environment in the event of accidental spillage. Studies on the biodegradability of biodiesel suggest that in aquatic environments, biodiesel breaks down approximately four times faster than petroleum diesel. A twenty per cent blend of biodiesel with petroleum diesel appears to have a disproportionate effect on biodegradability, with B20 degrading twice as fast as neat petroleum diesel under aerobic conditions (i.e. where oxygen is present).⁷¹ Biodiesel blends can also assist the biodegradability of diesel in anaerobic conditions, where petroleum diesel does not tend to break down.⁷²

For these reasons biodiesel may have a number of advantages over petroleum fuel for use in environments where the effects of accidental spills are severe. The use of biodiesel in marine vessels, for example, may reduce the environmental effects of fuel spillage. In addition, the reduced toxicity of biodiesel in comparison to petroleum diesel is likely to cause less damage to the environment through ordinary unintended spillage, such as leakage from fuel storage tanks.

2.3.4 Fuel handling

Most of the handling characteristics of biodiesel are similar to petroleum diesel, so that no special procedures are generally required. In some respects biodiesel may have advantages over petroleum diesel for fuel handling. For example, the flash point (i.e. the temperature at which biodiesel will combust) is higher for biodiesel than for petroleum diesel (100°C compared to 65°C, respectively).⁷³ This means that there is reduced potential for accidental ignition of biodiesel during handling of the fuel.

Biodiesel is non-toxic, so that adverse effects associated with accidental exposure to the fuel are generally less than those associated with exposure to petroleum diesel. In its submission to the Inquiry Smorgon Fuels noted that:

- the acute oral LD50 (lethal dose) of biodiesel is greater than 17.4 g/Kg body weight. By comparison, table salt (NaCl) is nearly ten times more toxic;

2007; ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007.

⁷¹ Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003, p. 19.

⁷² Environment Australia, *Setting national fuel quality standards: national standard for biodiesel - discussion paper*, Environment Australia, Canberra, 2003, p. 19.

⁷³ Diesel Test Australia, *Submission*, no. 18, 8 September 2006, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria.

- a 24-hour human patch test indicates that undiluted biodiesel produces very mild irritation. Irritation is less than that produced by a four per cent soap and water solution;
- the 96 hour lethal concentration of biodiesel grade methylesters is greater than 1000 mg/L for bluegill. Lethal concentrations at these levels are generally deemed "insignificant" according to NIOSH (National Institute for Occupational Safety and Health) guidelines in its Registry of the Toxic Effects of Chemical Substances.⁷⁴

2.4 Greenhouse gas emissions

Greenhouse gas (GHG) emissions associated with the use of biodiesel vary substantially depending on the feedstock used to produce the fuel. This is because estimates of GHG emissions take into account the amount of greenhouse gas generated while producing a fuel, as well as the GHG emissions produced when the fuel is used. Emissions from biodiesel when it is used – usually referred to as ‘tailpipe’ emissions – are generally similar regardless of feedstock. Because greenhouse gas estimates assume that carbon emitted from renewable resources will be reabsorbed when new feedstocks are grown, tailpipe GHG emissions from biodiesel are estimated at less than 1.1 per cent of petroleum diesel (see Table 3).

However, GHG emissions analysis also takes into account ‘upstream’ emissions – those emissions associated with the use of fossil fuels and other non-renewable fuels during production of the fuel. In the case of biofuels from feedstocks grown for a market, for example, this may include fossil fuels used in farm vehicles during harvest, and the use of fossil fuel products in fertilisers. As a result upstream emissions offset a proportion of the greenhouse benefits associated with the use of renewable fuels.

Some products (“waste products”) are considered to lie outside the market for the purpose of greenhouse gas calculations. The greenhouse gas estimations in Table 3 assume that waste oil has no other purpose or market, and as a result GHG emissions generated in the production of the oil are not counted. In the CSIRO *et al.* report *Appropriateness of a 350 million litre biofuels target* the authors noted that the upstream emissions associated with other products, such as low grade tallow, would be the same as waste oil if there was no other market for those products.⁷⁵ The Committee notes, however, that it received evidence indicating that there was currently a market for waste oil. Future calculations of upstream GHG emissions associated with this observation may reflect the emergence of a market for this product.

Table 3 shows the relative changes in GHG emissions associated with the use of B100 in comparison to ULSD and XLSD. ULSD (less than 50 parts per million sulphur) is the current minimum standard for diesel in Australia.

⁷⁴ Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007.

⁷⁵ CSIRO, *et al.*, *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 96.

It will be replaced by XLSD (less than ten parts per million sulphur) when the new minimum standard becomes active on 1 January 2009.⁷⁶

Table 3: Percentage change of life-cycle GHG emissions of B100 relative to ULSD and XLSD (rigid truck).⁷⁷

| GHG as CO ₂ -e (% change to each diesel type) | Biodiesel (canola) B100 | Biodiesel (tallow) B100 | Biodiesel (waste oil) B100 |
|--|----------------------------|----------------------------|-------------------------------|
| To ULSD | | | |
| GHG (upstream) | +298.8% | +267.2% | -49.7% |
| GHG (tailpipe) | -98.9% | -98.9% | -98.9% |
| GHG (life-cycle) | -23.0% | -29.0% | -89.5% |
| | | | |
| To XLSD | | | |
| GHG (upstream) | +266.0% | +237.0% | -53.9% |
| GHG (tailpipe) | -98.8% | -98.8% | -98.8% |
| GHG (life-cycle) | -23.3% | -29.3% | -89.5% |

Table 3 shows that there are appreciable life-cycle GHG emissions reductions associated with the use of biodiesel compared to both ULSD and XLSD. While the GHG emissions reductions are most pronounced when biodiesel is produced from waste cooking oil, there are also substantial reductions to be obtained through use of the other major feedstocks available in Australia – tallow and canola oil.

The Committee is also aware of evidence that biodiesel blends may provide a disproportionate reduction in GHG emissions relative to pure biodiesel (B100).⁷⁸ In particular, research by the CSIRO indicates that B20 biodiesel blends could provide total GHG emissions benefits greater than if the biodiesel was used in pure form or as a B5 blend (see Table 4). The Committee notes that there is also evidence that a 20 per cent biodiesel blend also seems to produce disproportionate benefits regarding air toxic emissions and engine operability (see below).

⁷⁶ Increased GHG emissions are associated with the production of ULSD over Low Sulphur Diesel (phased out on 1 January 2006) and XLSD over ULSD respectively.

⁷⁷ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 95.

⁷⁸ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 87; ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007.

Table 4: Percentage change of life-cycle GHG emissions of B5, B20 and B100 relative to ULSD (rigid truck).⁷⁹

| GHG as CO ₂ -e (% change to each diesel type) | Biodiesel (canola) | Biodiesel (tallow) | Biodiesel (waste oil) |
|--|--------------------------------|--------------------------------|------------------------------|
| | B5 / B20 / B100 | B5 / B20 / B100 | B5 / B20 / B100 |
| To ULSD | | | |
| GHG (upstream) | +14.27% +51.84% +298.80% | +12.90% +46.30% +267.20% | -1.05% -9.50% -49.70% |
| GHG (tailpipe) | -4.9% -21.6% -98.90% | -4.9% -21.6% -98.90% | -4.9% -21.6% -98.90% |
| GHG (life-cycle) | -1.50% -7.62% -23.00% | -1.5% -8.70% -29.00% | -4.18% -21.00% -89.50% |

2.5 Other emissions

A number of studies have been conducted on the impact of biofuels on air quality, although to date, debate still surrounds the impact of biofuels on air quality.⁸⁰ Exacerbating this problem is the fact that a variety of issues such as the vehicle type, feedstock type and the respective urban air shed all impact upon the performance of biofuels. While most research suggests that biofuels will deliver reductions in certain air pollutants such as carbon monoxide, it is unlikely that biofuels will deliver across the board reductions.

However, some recent research suggests that there may be significant health benefits associated with PM emissions from biodiesel as compared to petroleum diesel. In 2007 researchers at Deakin University subjected cultured human airway cells to varying proportions of petroleum diesel emissions particulate matter (PDEP) and biodiesel emissions particulate matter (BDEP), and compared damage to cells. The study found that higher proportions of BDEP relative to PDEP caused less damage to human airway cells.⁸¹ Results derived from this study are presented in Figure 2.

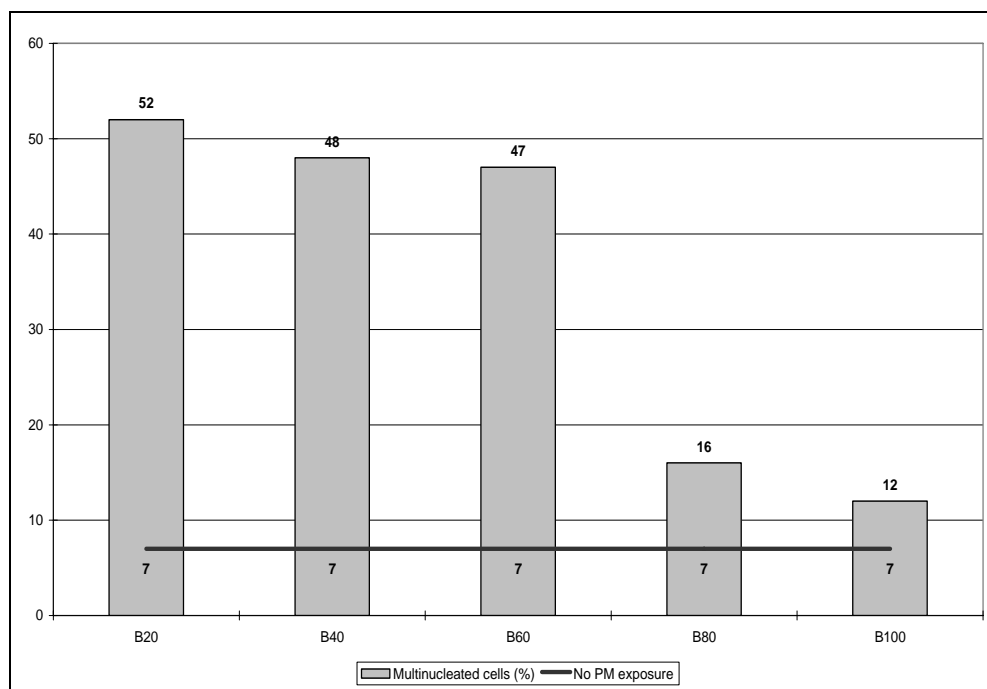
⁷⁹ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 95.

⁸⁰ Margaret Leigh Ackland, et al., 'Diesel exhaust particulate matter induces multinucleate cells and zinc transporter-dependent apoptosis in human airway cells', *Immunology and cell biology*, 2007; Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005; CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003; Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007; World Health Organization, 'WHO challenges world to improve air quality', viewed 6 October 2006,

<<http://www.who.int/mediacentre/news/releases/2006/pr52/en/index.html>>.

⁸¹ Margaret Leigh Ackland, et al., 'Diesel exhaust particulate matter induces multinucleate cells and zinc transporter-dependent apoptosis in human airway cells', *Immunology and cell biology*, 2007. This was found to be the case when human airway cells were exposed to PM emissions from petroleum diesel and biodiesel at similar concentrations. It is notable

Figure 2: Formation of multinucleated cells (%) upon exposure to increasing proportions of BDEP relative to PDEP.⁸²



Based on data prepared by the CSIRO in 2003, the use of biodiesel can lead to reductions in CO, VOCs and PM, and to increases in NOx emissions compared with petroleum diesel (see Table 5).⁸³ As is the case for GHG emissions, there appear to be disproportionate benefits from using biodiesel as a blended fuel, particularly as B20.⁸⁴

The use of biodiesel either as a pure or blended fuel appears to have substantial advantages over petroleum diesel with regard to reduced PM emissions, and to a lesser extent, reduced VOC emissions. There is some evidence that reductions in PM associated with biodiesel use occur principally at PM_{2.5} and less – that is, among smaller particles that are principally responsible for adverse health outcomes. The effects of air pollutant emissions are discussed in more detail in Chapter One.

that in practice, biodiesel PM emissions are *less* than petroleum diesel emissions ($8.6 \pm 1.3 \text{ mg m}^{-3}$ versus $12.9 \pm 0.9 \text{ mg m}^{-3}$), as reported in Linda Zou, 'Characterising vehicle emissions from the burning of biodiesel made from vegetable oil', *Environmental technology*, vol. 24, 2003.

⁸² Source: Margaret Leigh Ackland, et al., 'Diesel exhaust particulate matter induces multinucleate cells and zinc transporter-dependent apoptosis in human airway cells', *Immunology and cell biology*, 2007, p. 2. Unfortunately, human airway cell damage upon exposure to 100% petroleum diesel was not obtained in this study, so it is not possible to assess the relative benefits of biodiesel in blends less than 80 per cent.

⁸³ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003.

⁸⁴ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003.

Table 5: Percentage change of full life-cycle air pollutant emissions (as g/km) from B100 and B20, ULSD and XLSD (rigid truck).

| Life-cycle change in emissions | Biodiesel (canola) B100 | Biodiesel (canola) B20 | Biodiesel (tallow) B100 | Biodiesel (tallow) B20 | Biodiesel (waste oil) B100 | Biodiesel (waste oil) B20 |
|--------------------------------|-------------------------|------------------------|-------------------------|------------------------|----------------------------|---------------------------|
| To ULSD | | | | | | |
| CO | -27.24 | -16.08 | -36.70 | -17.74 | -46.91 | -19.54 |
| NOx | +16.79 | +2.51 | +15.33 | +2.25 | +4.10 | +0.27 |
| NM/VOC | -26.11 | -13.18 | -29.20 | -13.72 | -45.24 | -16.54 |
| PM | -15.14 | -4.37 | -15.83 | -4.50 | -23.40 | -5.81 |
| | | | | | | |
| To XLSD | | | | | | |
| CO | -26.25 | -14.13 | -35.83 | -15.81 | -46.20 | -17.63 |
| NOx | +29.94 | +12.53 | +28.31 | +12.24 | +15.80 | +10.04 |
| NM/VOC | -22.32 | -10.34 | -25.55 | -10.91 | -42.43 | -13.88 |
| PM | -11.10 | -5.75 | -11.82 | -5.87 | -19.73 | -7.27 |

2.6 Cost and revenue

Production costs for all biofuels are highly dependent on the price of feedstock. As biodiesel can be produced from a range of feedstocks, depending on the flexibility of the plant, there is some potential for manufacturers to select the most cost-efficient feedstock depending on market conditions.⁸⁵ The capacity for this to occur can however be affected by other factors, such as season, which may preclude the use of feedstocks that produce biodiesel with a high cloud point during winter, for example.⁸⁶

As noted above, feedstocks for biodiesel are oil, methanol (or ethanol) and a catalyst. The oil comprises approximately 90 per cent by volume of production feedstock, methanol a further ten per cent, and the catalyst a nominal proportion of feedstock. The output of the production process is approximately 90 per cent methylester (i.e. biodiesel) and ten per cent glycerine. An example of a typical input/output stream for biodiesel production is provided in Figure 3.⁸⁷

⁸⁵ Australian Biodiesel Group Ltd, *Submission*, no. 43, 8 August 2007; John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003; Barry Judd, *Biodiesel from tallow*, Energy Efficiency and Conservation Authority, Wellington, 2002.

⁸⁶ Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007; Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007; Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007.

⁸⁷ This example from JA Kinast, *Production of biodiesels from multiple feedstocks and properties of biodiesels and biodiesel/diesel blends*, National Renewable Energy Laboratory, Illinois, 2003, p. 3. Please note that biodiesel production in Australia is often

Figure 3: Typical input/output stream for biodiesel production.⁸⁸

| Input streams: | | |
|-------------------------------|---------|-------|
| Refined Oil | 1000 kg | 87.6% |
| Methanol | 107 kg | 9.3% |
| KOH 88% ⁸⁹ | 10 kg | 0.9% |
| Acid (sulphuric, acetic, HCL) | 8 kg | 0.7% |
| Water | 17 kg | 1.5% |
| Electricity | 20 kWh | n.a. |
| Output streams | | |
| Biodiesel | 1000 kg | 87.1% |
| Glycerine 88% | 125 kg | 10.9% |
| Fertiliser | 23 kg | 2.0% |
| By-product materials | nil | n.a. |

In its submission to the Inquiry, the CSIRO indicated that biofuels feedstocks accounted for approximately 80 per cent of the total cost of production.⁹⁰ Consequently, prices for biodiesel are very dependent on current market prices for key input commodities such as canola, tallow, palm oil or waste oil. The Committee heard from a number of witnesses that the prices of feedstock commodities had risen substantially over the past few years.⁹¹ Most of the major feedstocks for biodiesel production had risen up to 200 per cent over the past year. Witnesses suggested that the reasons for price increases were largely related to reduced supply as a result of the current drought, but that international demand for biodiesel feedstock oils and oilseeds was also driving up prices:

It is fair to say that biodiesel today, the economics of biodiesel today, is very different to the economics of biodiesel as short as 12 months ago. Part of that is the drought. Part of that is the cost of feedstock in some cases doubling; canola going from an average by-price of approximately \$800 to close to \$1200 a tonne; tallow going from approximately \$400 to \$450 a tonne to today between \$800 and \$900. Even if we had tallow there is not the availability because we are competing with food grade and so forth.⁹²

The production and transportation of biofuels feedstocks is often linked to the price of petroleum products, due to the use of petroleum-based

performed with a sodium hydroxide or potassium hydroxide catalyst, with which no fertiliser content is produced.

⁸⁸ Source: JA Kinast, *Production of biodiesels from multiple feedstocks and properties of biodiesels and biodiesel/diesel blends*, National Renewable Energy Laboratory, Illinois, 2003, p. 3.

⁸⁹ Potassium hydroxide.

⁹⁰ CSR Limited, *Submission*, no. 11, 27 July 2007. See also John Duncan, *Costs of biodiesel production*, Energy Efficiency and Conservation Authority, Wellington, 2003, p. 3. and Christopher Short and Damien Riwoe, *Biofuels: an assessment of their viability*, ABARE, Canberra, Appendix to the Report of the Biofuels Taskforce, 2005.

⁹¹ Natural Fuel Limited, *Annual report 2007*, Natural Fuel Limited, Perth, 2007; Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007.

⁹² Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007, p. 26.

products for fertilisers, for example, and the use of petroleum in the transport industry. For this reason, the price of biofuels may rise with the cost of oil, although the quantum of the price rise would likely be less than that of petroleum.

In a study conducted for the Prime Minister's Biofuels Taskforce, the Australian Bureau of Agricultural and Resources Economics (ABARE) estimated the cost of biodiesel production under various market conditions.⁹³ ABARE found that long term biodiesel production would only be viable when the price at which biodiesel could be produced was less than 40 cents per litre (for biodiesel from tallow), or 55 cents per litre (with excise relief and capital subsidies).⁹⁴ However, this estimate was based on an oil price of US \$32 per barrel from 2009-10 and an exchange rate of AUD 0.65 to the US dollar, so that it is possible given developments in the oil and foreign exchange markets that the threshold price for biodiesel may be higher.

2.7 Current production, potential and constraints

In August 2005 the Biofuels Taskforce reported that industry capacity to produce biodiesel was estimated at 15.5 ML. In 2005 it was estimated that total productive capacity for biodiesel would be 524.1 ML in 2006-07.⁹⁵

According to the Biodiesel Association of Australia current production capacity for biodiesel in Australia is 367 ML, with future production capacity expected to reach 837 ML. However, the Committee notes that all of this capacity may not be immediately available. Australian Biodiesel Group, for example, put its biodiesel production in Berkeley Vale on standby in 2006 due to unfavourable market conditions, and ceased biodiesel production in its Narangba plant in November 2007 for similar reasons.⁹⁶ On 2 November 2007 Australian Renewable Fuels announced that it would put its two plants in South Australia and Western Australia on 'care and maintenance' due to high tallow prices. Overall approximately 290 ML of biodiesel production capacity is currently on standby throughout Australia. Table 6 shows the approximate Australian production capacity for biodiesel as at November 2007.

⁹³ Christopher Short and Damien Riwoe, *Biofuels: an assessment of their viability*, ABARE, Canberra, Appendix to the Report of the Biofuels Taskforce, 2005.

⁹⁴ Christopher Short and Damien Riwoe, *Biofuels: an assessment of their viability*, ABARE, Canberra, Appendix to the Report of the Biofuels Taskforce, 2005, p. 13.

⁹⁵ The Biofuels Taskforce estimate did not include existing biodiesel production by Vilo Assets Management / Energetix Limited, which was 10 ML in 2006-07, and is expected to reach 100 ML by 2007-08.

⁹⁶ Australian Biodiesel Group Ltd, 'ABG Limited company update, 21 December 2006', viewed 31 October 2007, <www.abgbiodiesel.com/_data/ABJ%2021%20December%202006.pdf>.

Table 6: Estimated biodiesel production capacity, Australia, November 2007.⁹⁷

| Company | Location | Capacity (ML) | Status |
|---|-------------------|-----------------|------------------------|
| Australian Biodiesel Group | Berkley Vale, NSW | 40 | Standby |
| Australian Biodiesel Group | Narangba, Qld | 160 | Standby |
| Australian Renewable Fuels | Largs Bay, SA | 45 | Standby |
| Biodiesel Industries Australia | Rutherford, NSW | 12 | Operational |
| Eco Tech Bio Diesel | Narangba, Qld | 30 | Operational |
| Evergreen Fuels | Mossman, Qld | 0.5 | Operational |
| Future Fuels | Moama, NSW | 30 | Operational |
| Smorgon Fuels Ltd. | Laverton Vic | 50 | Operational |
| Australian Renewable Fuels | Picton, WA | 45 | Standby |
| Natural Fuel Australia | Darwin, NT | 147 | Operational |
| Axiom Energy | Geelong, Vic | 150 | Q4 2008 ⁹⁸ |
| Biodiesel Producers Ltd | Barnawartha, Vic | 60 | Q1 2008 ⁹⁹ |
| Biosel | Sydney, NSW | 4 | 2007 |
| Riverina Biofuels | Deniliquin, NSW | 40 | 2008 |
| Biosel | NSW | 24 | 2007/2008 |
| Natural Fuel Australia | Riverstone, NSW | 150 | Q1 2008 |
| Wimmera Biodiesel | Kaniva, Vic | 1.8 | Q1 2008 ¹⁰⁰ |
| Total capacity as at November 2007 | | 559.5 ML | |
| Operating capacity as at November 2007 | | 269.5 ML | |
| Total capacity | | 989.3 ML | |

While production capacity is the industry measure most often referred to, actual production of biodiesel is much lower. Accurate figures are not currently available, but the Committee received evidence that in 2006-07 just 50 ML of biodiesel was produced in Australia.¹⁰¹ This means that the ability of the industry to increase production towards capacity is untested. Consequently, it is difficult to determine what effect the effect of increased demand for feedstock may have on the market price of biodiesel should further incentives be provided to increased fuel production.

⁹⁷ Source: Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007; Biodiesel Producers Ltd, *Submission*, no. 49, 8 August 2007; Danny Goldman, Managing Director, Axiom Energy Ltd, *Transcript of evidence*, Melbourne, 31 July 2007; Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007; Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007, p. 62.

⁹⁸ Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007, p. 5; Danny Goldman, Managing Director, Axiom Energy Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 56.

⁹⁹ Biodiesel Producers Ltd, *Submission*, no. 49, 8 August 2007, p. 5.

¹⁰⁰ Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007, p. 53.

¹⁰¹ Australian Biodiesel Group Ltd, *Submission*, no. 43, 8 August 2007, p. 3.

2.7.1 Estimates of future feedstock capacity

A number of estimates have been developed examining what proportion of diesel fuel use could possibly be replaced by biodiesel using current generation technologies. The CSIRO's submissions to the inquiry noted research by ABARE indicating that feedstocks currently produced in Australia could probably produce enough biodiesel to satisfy around six per cent of current diesel consumption, with a range of four to eight per cent:¹⁰²

Used cooking oil can provide 0.6% of our diesel requirements as biodiesel, and tallow 2%. Our entire export crop of canola could provide another 4% on average; the total would vary from 4-8%.¹⁰³

One potential issue facing the development of the biodiesel industry in Australia is the ability of individual ventures to obtain accurate appraisals of the amount of given feedstocks available for purchase. The Committee heard from some witnesses that the business cases of some biodiesel ventures competed for the same resources, so that the overall viability of those industries could be compromised as competition for scarce resources developed:¹⁰⁴

I have worked with a lot of the buyers and people in Australia, and with a lot of them you will see the business plans they are relying on are saying oil is the other company. They usually use cooking oil to make it cheap and to make the economics work, and then you get your higher value feedstocks and it all sort of makes up. If there is one litre of used cooking oil, that is going to go to one company or the other; it cannot go to both.¹⁰⁵

Internationally, there is also evidence that biodiesel producers have been competing for the same feedstocks and that this has contributed to substantial price rises in certain commodities.¹⁰⁶

Given current estimates of feedstock availability, alternate feedstock sources will have to be identified in order for biodiesel production to meet more than ten per cent of Australia's diesel needs in future. Increased supplies of biodiesel feedstocks could potentially be obtained from three sources: increased agricultural production of oilseeds; increased imports of feedstocks, and/or; identification of new biodiesel feedstocks, such as algae. In the short term it appears that major increases in biodiesel production will likely be obtained through increased imports of biodiesel feedstocks.

2.7.2 Imported feedstocks

One of the key constraints on increased production of biodiesel in Australia is clearly the availability of suitable feedstock. Consequently a number of

¹⁰² Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007, p. 39.

¹⁰³ CSIRO, *Submission*, no. 32, July 2007, p. 5.

¹⁰⁴ Dr Tom Beer, Leader, Alternative Transport Fuels Stream, Energy Transformed Flagship, CSIRO, *Transcript of evidence*, Melbourne, 6 August 2007, p. 27; Danny Goldman, Managing Director, Axiom Energy Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 59; Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007, p. 38.

¹⁰⁵ Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007, p. 48.

¹⁰⁶ Natural Fuel Limited, *Annual report 2007*, Natural Fuel Limited, Perth, 2007.

the biodiesel plants currently running or proposed in Australia are located near ports so that imported feedstocks can be used when locally sourced products are unavailable or uneconomic. For example, Axiom Energy, which plans to commence production in Geelong in 2008, specifically chose a port location so that it maintained an ability to access imported feedstock should the need arise.¹⁰⁷

A number of submissions to the Inquiry noted the growing importance of palm oil as a feedstock for biodiesel production.¹⁰⁸ The Committee heard that concern has been expressed in the industry that the environmental impact of palm oil may outweigh any advantages associated with the use of biodiesel over petroleum diesel.¹⁰⁹ In particular, forest clearing associated with palm plantations in Indonesia and Malaysia may lead to a net increase in GHG emissions compared with petroleum diesel.

In Australia one major biodiesel producer – Natural Fuels Australia – is currently using imported palm oil as its primary feedstock. The Committee notes that, as is the case with other biodiesel feedstocks, the price of palm oil has risen sharply over the past year, and has sold for up to \$880 per tonne, up from \$400 per tonne.¹¹⁰ As a consequence biodiesel companies with an international focus are currently investigating the commercial viability of alternate feedstocks, such as jatropha oil and mustard seed oil.¹¹¹

Finding 2: On the basis of current biodiesel feedstock availability, it is likely that increased importation of feedstocks will be necessary if biodiesel production increases. Biodiesel producers should give careful consideration to the sustainability of imported feedstocks.

2.7.3 Emerging feedstocks

Rapid increases in the price of common feedstocks for biodiesel such as canola oil, tallow, palm oil and cooking oil have contributed to increasing interest in the identification of alternate feedstocks. Most of the alternate feedstocks currently being considered are obtained through current or next-generation agricultural production – including plant varieties such as jatropha, mustard, eucalyptus and mallee and algae. Some of these plant varieties (such as mallee and jatropha) are able to grow in marginal land,

¹⁰⁷ Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007; Danny Goldman, Managing Director, Axiom Energy Ltd, *Transcript of evidence*, Melbourne, 31 July 2007.

¹⁰⁸ Australian Biodiesel Group Ltd, *Submission*, no. 43, 8 August 2007; Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007; Danny Goldman, Managing Director, Axiom Energy Ltd, *Transcript of evidence*, Melbourne, 31 July 2007.

¹⁰⁹ Paula Arcari, ICLEI Oceania, *Transcript of evidence*, Melbourne, 27 August 2007, pp. 39-40; Dr Tom Beer, Leader, Alternative Transport Fuels Stream, Energy Transformed Flagship, CSIRO, *Transcript of evidence*, Melbourne, 6 August 2007, pp. 26,27; David Cumming, Manager, Corporate Affairs and Public Relations, RACV, *Transcript of evidence*, Melbourne, 31 July 2007, p. 21; Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007, p. 47; Chris Midgley, General Manager, Supply and Marine, Shell Australia, *Transcript of evidence*, Melbourne, 31 July 2007, p. 5; Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007, p. 28.

¹¹⁰ Chris Midgley, General Manager, Supply and Marine, Shell Australia, *Transcript of evidence*, Melbourne, 31 July 2007, p. 6; Natural Fuel Limited, *Annual report 2007*, Natural Fuel Limited, Perth, 2007.

¹¹¹ Natural Fuel Limited, *Annual report 2007*, Natural Fuel Limited, Perth, 2007.

further increasing their attractiveness as a feedstock that will not compete with existing food production.

The most discussed of these varieties is jatropha, which produces seeds from which an oil is extracted that can be used as a feedstock for biodiesel. The fuel produced from jatropha oil has a low pour point, and so is suitable for use in cooler climates. Jatropha is also able to be easily grown in marginal environments, such as sandy or saline soils, and is drought- and pest resistant – although historically these characteristics of jatropha have led to it being declared a weed, including in Western Australia.¹¹² Jatropha seeds are toxic, and ingestion of untreated seeds is fatal to humans and animals. In addition to these critical issues, one of the main barriers to the commercial application of jatropha in Australia is that there is currently no mechanical means for harvesting the seeds from which the oil is extracted. Mr Danny Goldman of Axiom Energy told the Committee that:

...there is not currently, I understand, a mechanical harvesting technique for jatropha. So it is really well suited for countries where it is used for poverty eradication with the manual picking of the product.¹¹³

It is likely that for the near future, or until the development of mechanical harvesting means, the use of jatropha oil for Australian biodiesel will be largely be obtained through imported feedstock.

Some interest has also been expressed in the use of eucalypt varieties, including mallee eucalypt, for biodiesel and ethanol production. According to the NSW Department of Primary Industries, the energy ratio (that is, the ratio of energy put in to energy put out) of eucalypts far exceeds oilseed crops such as canola and ethanol crops such as wheat and corn.¹¹⁴ However, it does not appear that the utilisation of eucalypt varieties for biofuels production is commercially viable given current oil extraction methods.

The Committee also heard about emerging technology for the production of biodiesel from algae. Smorgon Fuels Ltd is working with Hazelwood power station to use excess flue gasses to grow algae, from which oil can be extracted for biodiesel production:

...the benefit of algae has a number of issues. One is availability; two, it complements the guys from the Latrobe Valley because they are looking for ways to sequester carbon dioxide; and the yield per acre, depending on the specific species of algae, can be between 20,000, 50,000 and 100,000 litres of oil that is usable in biodiesel. Compare that to canola, which produces in a 12-month cycle 1000 litres of oil.¹¹⁵

¹¹² NSW Department of Primary Industry, 'New biofuel crop potential', viewed 31 October 2007, <<http://www.dpi.nsw.gov.au>>.

¹¹³ Danny Goldman, Managing Director, Axiom Energy Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 61.

¹¹⁴ NSW Department of Primary Industry, 'New biofuel crop potential', viewed 31 October 2007, <<http://www.dpi.nsw.gov.au>>.

¹¹⁵ Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007, p. 27.

The Committee is also aware that in New Zealand biodiesel is currently being produced from algae harvested from sewerage ponds as a commercial enterprise.¹¹⁶

2.8 Consumer confidence, standards and warranties

2.8.1 Consumer confidence

While consumer confidence has been a significant issue for the ethanol market, biodiesel has not been the subject of any negative scrutiny in the marketplace. Consequently it appears that consumer awareness, rather than consumer confidence, is currently the main hurdle for biodiesel demand in Australia.

2.8.2 Biodiesel fuel standards

Standards for B100 biodiesel are currently determined by the *Fuel Standard (Biodiesel) Determination 2003 (Cth)* under section 21 of the *Fuel Quality Standards Act 2000 (Cth)*. The Australian standard is broadly similar to the major international standards currently in place – EN 14214 (principally employed in Europe) and ASTM 6751 (preferred by the United States and Canada). Blends of biodiesel at five per cent or less (B5) are currently mixed to meet the general Australian diesel standard. Table 7 provides an overview and comparison of various fuels under these standards.

Table 7: Australian diesel and Australian and International Biodiesel Fuel Standards.¹¹⁷

| Criterion | Australian Diesel / B5 ¹¹⁸ | Australia Biodiesel (B100) ¹¹⁹ | EN 14214 ¹²⁰ | ASTM 6751 ¹²¹ |
|--------------------------------------|---------------------------------------|---|-------------------------|--------------------------|
| Density at 15°C (kg/m ³) | 820 - 850 | 860 - 890 | 860 - 900 | |
| Viscosity 40°C | 2.0 - 4.5 | 3.5 – 5.0 | 3.5 - 5.0 | 1.9 - 6.0 |
| Flashpoint | 61.5°C | 120°C | 101°C | 130°C |
| Sulphur (parts per million) | 50 ppm (10 ppm 2009) | 10 ppm | 10 ppm | 15 ppm |
| Sulphated Ash (% mass) | | 0.020 | 0.020 | 0.020 |
| Water (% volume) | | 0.050 | 0.050 | 0.050 |

¹¹⁶ Aquaflo Bionomic Corporation, 'NZ biofuel developer first in NZ invited to join prestigious US research hot-house', viewed 12 October 2006, <<http://www.girvan.org>>.

¹¹⁷ ASTM Standard D 6751 for Biodiesel Fuel Blend Stock (B100) ; Fuel Standard (Automotive Diesel) Determination 2001 (Cth); Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods (EU), EN 14214; Fuel Standard (Biodiesel) Determination 2003 (Cth)

¹¹⁸ Fuel Standard (Automotive Diesel) Determination 2001 (Cth)

¹¹⁹ Fuel Standard (Biodiesel) Determination 2003 (Cth)

¹²⁰ Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods (EU), EN 14214

¹²¹ ASTM Standard D 6751 for Biodiesel Fuel Blend Stock (B100)

| | | | | |
|--|-------|-------|-------|-------|
| Cetane No. | 46 | 51 | 51 | 47 |
| Methanol (% m/m) | | 0.200 | 0.200 | |
| Ester content (% m/m) | | 96.5 | 96.5 | |
| Free glycerol (% mass) | | 0.020 | 0.020 | 0.020 |
| Total glycerol (% mass) | | 0.250 | 0.250 | 0.250 |
| CCR (10% distillation residue, % mass) | 0.2 | 0.3 | | |
| Phosphorus (mg/kg) | | 10 | 10 | 10 |
| Distillation T90 | 360°C | 360°C | | 360°C |
| Total contamination (mg/kg) | | 24 | 24 | |

While an Australian standard currently exists for B100, no standard has yet been established for biodiesel in other blends such as B10 or B20. In November 2006 the Commonwealth Department of Environment and Heritage (DEH) released a discussion paper for the development of biodiesel blend standards, which examined a limited range of scenarios for the development of appropriate standards.¹²² Options included the development of a B5 standard, with B5 the maximum biodiesel blend permitted under the standard, and similarly, the development of a B6-B20 standard, with B20 the maximum blend permitted.¹²³

The discussion paper stated that the Commonwealth may make a determination to establish biodiesel blend standards other than those defined in the discussion paper. Submissions to the review closed in April 2007, with the matter referred to the Fuel Standards Consultative Committee for further consideration.

2.8.4 Vehicle warranties

The willingness of diesel engine manufacturers to warrantee their engines for use with biodiesel blended fuels is regarded as a major component of consumer confidence in the fuel. The Federal Chamber of Automotive Industries (FCAI) told the Committee that it generally supported biodiesel blends up to B5.¹²⁴ A number of diesel engine manufacturers will warrantee engines for use with biodiesel blends produced to standard up to B5, with one offering warranties for higher biodiesel blends. In its submission to the inquiry, Caterpillar noted that most of its engines were

¹²² Department of Environment and Heritage, *Setting national fuel quality standards: standardising diesel / biodiesel blends*, Department of Environment and Heritage, Canberra, 2006.

¹²³ Department of Environment and Heritage, *Setting national fuel quality standards: standardising diesel / biodiesel blends*, Department of Environment and Heritage, Canberra, 2006.

¹²⁴ Federal Chamber of Automotive Industries, *Submission*, no. 20, 2 August 2007; Keith Seyer, Director, Technical and Regulatory, Federal Chamber of Automotive Industries, *Transcript of evidence*, Melbourne, 6 August 2007.

certified to use biodiesel up to B30, with some ranges of engines restricted to B5 or B20.¹²⁵

Many small vehicle manufacturers do not support the use of biodiesel blends. A report by Duncan Seddon and Associates for DEH noted that while most manufacturers did not support biodiesel use, Peugeot did support blends of up to B30 in some models (see Table 8).¹²⁶

Table 8: Small vehicle manufacturer position on biodiesel blend use in diesel vehicles.¹²⁷

| Manufacturer / importer | Company policy |
|-------------------------|---------------------------------------|
| BMW | Not recommended |
| Chrysler | Not recommended |
| Ford | Not recommended |
| Holden | Maximum B5 |
| Holden Rodeo | Not recommended |
| Hyundai | Not recommended |
| Jaguar | Not recommended |
| Kia | Not recommended |
| Land Rover | Not recommended |
| Mazda | Maximum B5 |
| Mercedes Benz | Not recommended |
| Mitsubishi | Use at owners risk |
| Nissan | Maximum B5 |
| Peugeot | Acceptable with some models up to B30 |
| Volkswagen | Not recommended |

In its discussion paper of options for biodiesel blends, the DEH noted suggestions that blends could be capped at B5 because engine manufacturers generally do not offer warranties for blends greater than B5.¹²⁸ This would ensure that biodiesel could be marketed across Australia without causing concern to consumers, with the possibility of extending the range of permissible blends as consumer confidence in the product grew.

¹²⁵ Caterpillar Inc, *Submission*, no. 15, 2 August 2007, p. 4.

¹²⁶ Duncan Seddon and Associates, *Standardising biodiesel blends*, Department of Environment and Heritage, Canberra, appendix to discussion paper *Standardising diesel / biodiesel blends*, 2006, p. 62.

¹²⁷ Duncan Seddon and Associates, *Standardising biodiesel blends*, Department of Environment and Heritage, Canberra, appendix to discussion paper *Standardising diesel / biodiesel blends*, 2006, p. 62.

¹²⁸ Department of Environment and Heritage, *Setting national fuel quality standards: standardising diesel / biodiesel blends*, Department of Environment and Heritage, Canberra, 2006.

While most engine manufacturers have a position on the use of biodiesel in their engines, very little research on the effect of biodiesel blends on engines has been released to the public by manufacturers. As noted above, research that is publicly available indicates that biodiesel blends have few, if any, adverse effects on engines once deposits accumulated from petroleum fuels are removed from the fuel system.

Chapter Three: Key points

- Ethanol is a colourless, flammable liquid, commonly referred to as either grain alcohol or simply alcohol. While principally used in the manufacture of alcoholic beverages, ethanol may also be used as an alternative to petroleum and as a fuel additive. In Australia ethanol is produced from two main feedstocks: grain (largely wheat and sorghum) or sugarcane (using 'C' grade molasses) (p. 35).
 - Ten per cent blended ethanol (E10) provides some greenhouse gas (GHG) emissions reductions compared to unleaded petrol (ULP), although a proportion of these benefits are offset by higher GHG emissions released during feedstock and fuel production (p. 45).
 - On the basis of tailpipe emissions, E10 produces lower carbon monoxide (CO) and volatile organic compounds (VOC) emissions than ULP. These benefits are offset by the release of upstream emissions during ethanol production (p. 46).
 - Evidence suggests that approximately 60 per cent of the Australian vehicle fleet is able to use E10. E20 is not suitable for use in newer vehicles and most vehicles manufactured prior to 1986 are not compatible to use any blend of ethanol fuel (p. 42).
 - There has been extensive research around the establishment of second-generation biofuels technologies that obtain renewable energy from lignocellulosic biomass. As the feedstocks are primarily waste products, this method of ethanol production has the potential to reduce pressures on competition for feedstocks (p. 37).
 - Ethanol production increased from 22.7 ML in 2004-05 to 41 ML in 2005-06. There has also been a rapid increase in the availability of ethanol blended fuels throughout Australia, from 230 service stations selling E10 in 2006 to over 600 service stations in 2007 (p. 25).
 - Consumer confidence in ethanol blended fuels has been a major barrier preventing uptake in Australia. A number of awareness campaigns have been implemented to increase consumer confidence (p. 54).
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Chapter Three: Ethanol

Ethanol or ethyl alcohol (C_2H_5OH) is a colourless, flammable liquid commonly referred to as either grain alcohol or simply alcohol. While principally used in the manufacture of alcoholic beverages, ethanol may also be used as an alternative to petroleum and as a fuel additive.¹²⁹ Ethanol is produced from the fermentation of biomass feedstocks obtained from agricultural sources containing large amounts of sugar or starches that can be converted into sugars. Typical feedstocks include corn, wheat, barley, sorghum and sugarcane.¹³⁰ Ethanol can also be manufactured from crude oil, gas or coal, however less than five per cent of global ethanol production is made this way.¹³¹

Fuel ethanol is produced in two forms, hydrous and anhydrous. Hydrous ethanol has a purity of 95 per cent and contains water whereas anhydrous ethanol contains no water and is referred to as pure ethanol. Anhydrous ethanol is produced from further dehydrating hydrous ethanol to remove all water content.¹³²

Hydrous ethanol is currently only used in Brazil as a motor fuel in vehicles with modified engines.¹³³ In Brazil, 40 per cent of fuel ethanol production is used by vehicles operating on 100 per cent ethanol (E100), with the remainder used as a blended fuel, mainly E22.¹³⁴ Anhydrous ethanol is used in parts of Europe, the United States and Australia. It is blended in concentrations of around ten per cent with petrol for use in conventional petrol vehicles,¹³⁵ and in blends of up to 85 per cent for use in vehicles with modified engines known as flexible fuel vehicles (FFV).¹³⁶ Flexible fuel vehicles are not generally available in Australia, although the Committee

¹²⁹ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 11.

¹³⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 30.

¹³¹ John Urbanchuk, et al., *Economics of a Queensland ethanol industry*, LECG, Philadelphia, prepared for the Queensland Department of State Development and Innovation, 2005, p. 6.

¹³² Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 31.

¹³³ Environment Australia, *Setting the ethanol limit in petrol*, Environment Australia, Canberra, 2002, p. 6.

¹³⁴ I Klabin, 'Success with bioenergy: the Brazilian experience', Paper presented at the 2005 *World Congress World Agricultural Forum*, Missouri, USA, 2005.

¹³⁵ International Fuel Quality Centre, *Setting a fuel quality standard for ethanol: submission to the Australian Department of Environment and Heritage*, International Fuel Quality Centre, Houston, 2004, p. 7.

¹³⁶ Environment Australia, *Setting the ethanol limit in petrol*, Environment Australia, Canberra, 2002, p. 6.

was informed by SAAB Australia that it was conducting demonstrations with FFVs over coming months.¹³⁷

3.1 Production methods

In Australia feedstocks for ethanol production are primarily obtained from grains (largely wheat and sorghum) or sugarcane using 'C' grade molasses. Approximately 94 per cent of Australia's sugarcane is grown in Queensland, with five per cent coming from Northern New South Wales and a small percentage from Western Australia.¹³⁸ Wheat is grown in all Australian states while sorghum is mainly grown in New South Wales and Queensland as it grows better in warmer climates.¹³⁹

Ethanol yield from various feedstocks differs. For example, around 270 - 290 litres of ethanol can be produced per tonne of 'C' grade molasses (depending on the sugar content of the feedstock)¹⁴⁰ whereas one tonne of sugar can produce approximately 560 litres of ethanol.¹⁴¹ Ethanol yield from grain feedstocks lies between the respective yields of these two forms of sugar. The Committee received evidence from CSR Ethanol Limited that 420 litres of ethanol could be produced from one tonne of sorghum, with the same quantity of wheat producing around 370 litres of ethanol.¹⁴²

Ethanol production is an established technology, although various changes have been introduced in recent decades leading to substantial improvements in production efficiency.¹⁴³ While basic processes for production of ethanol from sugarcane and grains are similar, there are clear advantages in producing ethanol from sugarcane because the carbohydrate content of sugarcane is more readily fermentable.¹⁴⁴ In order for grains to be converted into ethanol an additional process is required to convert starches into sugar prior to fermentation.¹⁴⁵

Text Box 1: Ethanol production

Ethanol from molasses: Sugarcane is crushed and soaked and the sugar extracted. Molasses derived from this process are then fermented to ethanol using enzymes produced from yeast. The ethanol is then distilled until it comprises 96 per cent ethanol, water and other components. As ordinary distillation is unable to remove remaining water content from the ethanol, a specialised azeotropic distillation is employed to produce

¹³⁷ Parveen Batish, Director, SAAB Australia and New Zealand, *Transcript of evidence*, Melbourne, 27 August 2007.

¹³⁸ Department of Agriculture Fisheries and Forestry, 'The sugar industry', viewed 29 August 2007, <<http://www.daff.gov.au>>.

¹³⁹ Department of Agriculture Fisheries and Forestry, 'Coarse grains', viewed 29 August 2007, <<http://www.daff.gov.au>>.

¹⁴⁰ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 51.

¹⁴¹ Victorian Farmers' Federation, *Submission*, no. 33, 3 August 2007.

¹⁴² CSR Limited, *Submission*, no. 11, 27 July 2007.

¹⁴³ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 14.

¹⁴⁴ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 14.

¹⁴⁵ Dr Chris Hamilton, *Biofuels made easy*, Lurgi Pacific Pty Ltd, Melbourne, 2004.

anhydrous ethanol, often through the use of molecular sieves followed by further distillation.¹⁴⁶

Ethanol from grains: Feedstock grains are cleaned and milled to obtain a starchy feedstock. Two forms of milling can be employed in this process: wet or dry milling. Wet milling involves soaking feedstock grain to assist to break it down prior to converting the starch to sugar. Dry milling does not utilise this process prior to starch conversion. In both cases, starch is converted to sugar using a high-temperature enzyme process. The sugar is then fermented to ethanol employing the process used for sugar crops described above.¹⁴⁷

The final product is then typically 'denatured' by the addition of up to five per cent petrol or some other toxic substance in order to make it unfit for human consumption. This is typically performed so that the ethanol will not attract the excise associated with alcoholic beverages, which is generally higher than fuel excise.¹⁴⁸

3.1.1 Lignocellulosic technologies

Conventional processes for the production of ethanol rely on feedstocks commonly used as foods, such as grains and sugars. As with food production, a large part of the feedstock plants – such as the stalks and chaff – are not actually used in production and become waste products. These woody waste products – generally referred to as lignocellulosic biomass, represent a large quantity of potential energy that is not currently utilised.

Interest in the production of renewable energy sources from lignocellulosic biomass is growing substantially with considerable research projects underway in both Australia and internationally.¹⁴⁹ The potential for lignocellulosic biomasses as a feedstock is substantial given the various plant sources that it can be derived from – including agricultural and crop residues, such as wheat straw, corn leaves, stalks, rice straw and sugar cane bagasse; and forestry residues including rotten and dead wood, under-utilised wood and logging residues and excess small trees.¹⁵⁰

The structure of lignocellulosic biomasses comprise carbohydrate polymers that include cellulose and hemicellulose, lignin and a remaining

¹⁴⁶ International Fuel Quality Centre, *Setting a fuel quality standard for ethanol: submission to the Australian Department of Environment and Heritage*, International Fuel Quality Centre, Houston, 2004, p. 13. When the concentration of ethanol to water exceeds 96 per cent (which can be achieved by molecular sieves and other methods) it is no longer stable under distillation, so that ordinary distillation is able to remove remaining water.

¹⁴⁷ International Fuel Quality Centre, *Setting a fuel quality standard for ethanol: submission to the Australian Department of Environment and Heritage*, International Fuel Quality Centre, Houston, 2004, p. 14.

¹⁴⁸ Australian Ethanol Limited, 'Ethanol production process', viewed 31 July 2006, <<http://www.indcor.com.au/process.htm>>.

¹⁴⁹ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 124.

¹⁵⁰ International Fuel Quality Centre, *Setting a fuel quality standard for ethanol: submission to the Australian Department of Environment and Heritage*, International Fuel Quality Centre, Houston, 2004, p. 14.

small component containing extractives, acids, salts and minerals.¹⁵¹ Lignocellulosic technology seeks to break down the cellulose portions of plant matter into a form that can be used to produce ethanol.¹⁵² This process is similar to that used for converting traditional feedstocks into ethanol, however cellulose and hemicellulose must be first converted into sugars through hydrolysis fermentation before they are fermented and distilled into ethanol.¹⁵³

There are two common forms of hydrolysis fermentation. The first is acid hydrolysis that comprises a two step process of a diluted acid and a concentrated acid.¹⁵⁴ While this technology is the most widely used, it produces a number of undesirable by-products.¹⁵⁵ The second form of hydrolysis utilises biological enzymes. This technology is still being researched, however at this stage it appears to be more environmentally sound, and hold high sugar yields of 75-85 per cent. This is comparable to acid hydrolysis, which has a sugar yield of 50-70 per cent.¹⁵⁶

While large scale production of ethanol from lignocellulosic biomasses is not yet commercially competitive, the technology may provide an avenue to increase ethanol production substantially. Support for this technology is largely based on the premise that producing biofuels from plants will reduce the pressure on the food chain¹⁵⁷, with the 'food versus fuel' debate emerging as a contentious issue (see below). As lignocellulosic biomasses are primarily waste products, it is also likely to remain more affordable than food crop feedstocks and achieve a much better return on energy than ethanol produced from grain.¹⁵⁸

Finding 3: The advent of second-generation biofuels technologies could lead to increased availability of ethanol on the Australian fuel transport market and substantially improve the efficiency of ethanol production methods.

3.1.2 By-products

Ethanol produced from grain results in a number of by-products. The principle by-product of ethanol production is distillers grains. The sale of these by-products can generate additional revenue for ethanol manufacturers, and in many cases this revenue is a critical component of a

¹⁵¹ Carlo Hamelinck, et al., *Prospects for ethanol from lignocellulosic biomass: techno-economic performance as development progresses*, Copernicus Institute, Utrecht, 2003, p.7

¹⁵² Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 124.

¹⁵³ Northeast Regional Biomass Program, *An ethanol production guidebook for northeast states*, Northeast Regional Biomass Program, Washington, 2001, p. 23.

¹⁵⁴ Carlo Hamelinck, et al., *Prospects for ethanol from lignocellulosic biomass: techno-economic performance as development progresses*, Copernicus Institute, Utrecht, 2003, p. 11.

¹⁵⁵ Northeast Regional Biomass Program, *An ethanol production guidebook for northeast states*, Northeast Regional Biomass Program, Washington, 2001, p. 23.

¹⁵⁶ Carlo Hamelinck, et al., *Prospects for ethanol from lignocellulosic biomass: techno-economic performance as development progresses*, Copernicus Institute, Utrecht, 2003.

¹⁵⁷ Western Australia Biofuels Taskforce, *Western Australia Biofuels Taskforce Report*, Government of Western Australia, Perth, 2007, p. 38.

¹⁵⁸ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 125.

plants economic viability.¹⁵⁹ The importance of by-products to the viability of some ethanol plants was recently highlighted by the Chair of Australian Ethanol Limited when he stated:

The future of ethanol in Australia is in grain alcohol adopting the US model where the fuel ethanol revenue pays the bills and the profit comes from the distillers' grain by-product.¹⁶⁰

Distillers grain is produced from the distillation and dehydration process during ethanol production and provides a non-animal base, high protein livestock feed supplement.¹⁶¹ Wet Distillers Grain (WDG) comprises up to 70 per cent moisture and has a shelf life of between two and five days.¹⁶² As it involves the transport of 70 per cent water by weight of the total product, it can only be utilised by feedlots in close proximity to ethanol plants. The alternative to WDG is to dry the product to produce Dry Distillers Grain (DDG). While this is an energy intensive process¹⁶³ DDG has an almost indefinite shelf life and is relatively easy to transport.¹⁶⁴

The Committee received contrasting evidence regarding the value of distillers' grain. The Committee was informed of the high demand for WDG to feed beef and dairy cattle in the United States and Europe due to its protein content, nutritional value and moisture content improving weight gain and reducing incidents of illness among the feedlot.¹⁶⁵ However, logistical issues associated with the transportation of WDG was highlighted as a significant barrier.¹⁶⁶ The Committee also received evidence that DDG was of limited utility as a feed. This is because in proportions above 20 per cent of feed for beef and ten per cent of feed for pork extensive energy costs are required to convert the feed into animal weight.¹⁶⁷

Another by-product created in the production of ethanol is carbon dioxide, which is produced during the fermentation process. Many ethanol plants collect the carbon dioxide and after cleaning it of any residual alcohol, compress and sell it for use to carbonate beverages or in the flash freezing of meat.¹⁶⁸

¹⁵⁹ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 17.

¹⁶⁰ John Bonnardeaux, *Potential uses for distillers grains*, Department of Agriculture and Food, South Perth, March 2007, p. 3.

¹⁶¹ John Bonnardeaux, *Potential uses for distillers grains*, Department of Agriculture and Food, South Perth, March 2007, p. 1.

¹⁶² John Bonnardeaux, *Potential uses for distillers grains*, Department of Agriculture and Food, South Perth, March 2007, p. 3; Stock Feed Manufacturers' Council of Australia, *Submission*, no. 23, 3 August 2007.

¹⁶³ John Spragg, Executive Officer, Stock Feed Manufacturers' Council of Australia, *Transcript of evidence*, Inquiry into the production and/or use of biofuels in Victoria, Environment and Natural Resources Committee, Parliament of Victoria, 11 September 2006.

¹⁶⁴ John Bonnardeaux, *Potential uses for distillers grains*, Department of Agriculture and Food, South Perth, March 2007, p. 3.

¹⁶⁵ Wayne Turner, Chief Executive Officer, Agri Energy/Australian Biofuels Ltd, Australian Biofuels Limited, *Transcript of evidence*, Melbourne, 20 August 2007.

¹⁶⁶ Kevin Roberts, Vice President, Australian Lot Feeders' Association, *Transcript of evidence*, Melbourne, 31 July 2007.

¹⁶⁷ Australian Lots Feeders Association, *Submission*, no. 47, 8 August 2007.

¹⁶⁸ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 17.

3.2 Fuel characteristics

3.2.1 Fuel consumption

Ethanol has a lower energy density than petrol, so that fuel consumption is increased when it is used as a fuel alternative or fuel additive. The energy content of ethanol is typically 68 per cent that of petrol.¹⁶⁹ In 2003 the Orbital Engine Company compared the fuel consumption of vehicles using neat petrol and E10 and determined that E10 increases fuel consumption in post-1986 vehicles by 2.8 per cent.¹⁷⁰ In a separate study, Orbital found ethanol blended fuels of 20 per cent (E20) used in post-1986 vehicles increased fuel consumption on average by five per cent.¹⁷¹

While reduced energy content of a fuel should theoretically translate into lower fuel prices, this has not occurred with the sale of E10. Because of high production costs, the price of E10 is generally priced at the same level as petrol. Consequently, there is a net cost to motorists when reduced fuel mileage is taken into consideration. In response a number of major oil companies are retailing their E10 products at a discounted price. For example, BP Australia launched its Bioreward Program in August 2006, which is a free reward card providing a three cents a litre discount on reductions on purchases of its ethanol blended fuel.¹⁷² Caltex and Shell Australia have also committed to offer their E10 products at a three cent a litre discount¹⁷³ and Mobil intends to price its E10 product competitively with other ethanol blended fuels on the market.¹⁷⁴

3.2.2 Fuel octane rating

When blended with petrol, ethanol can be used to increase the octane rating and consequently improve engine efficiency by reducing an engine's tendency to knock.¹⁷⁵ Fuel octane rating can also be improved during the refining process without the use of ethanol.¹⁷⁶ At present, Australian fuel refiners tend to employ the refinery process rather than use ethanol. The Australian Institute of Petroleum's submission to the Prime Minister's Biofuels Taskforce advised that the economics and availability of ethanol are key barriers to Australian fuel refiners using ethanol as an octane enhancer:

¹⁶⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 130.

¹⁷⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 131.

¹⁷¹ Orbital Engine Company, *Market barriers to the uptake of biofuels study: testing gasoline containing 20% ethanol (E20): phase 2B final report to the Department of the Environment and Heritage*, Perth, 2004, p. 6.

¹⁷² BP Australia, 'Bioreward program', viewed 6 September 2007, <<http://www.bp.com>>.

¹⁷³ Caltex, 'Caltex to discount all E10 petrol by 3 cents per litre', viewed 11 September 2007, <http://www.caltex.com.au/about_news_detail.asp?id=876>; Shell Australia, 'Shell and Coles promise discounted E10 across three states', viewed 6 September 2007, <<http://www.agric.wa.gov.au>>.

¹⁷⁴ Mobil Oil Australia, 'Mobil launches ethanol-blend petrol in Sydney', viewed 13 September 2007, <<http://www.exxonmobil.com>>.

¹⁷⁵ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 63.

¹⁷⁶ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target - appendices*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 61.

If a refiner locks in to ethanol as its primary route to enhance octane, its cost to produce petrol will depend partly on the ethanol economics. For example, if the cost of ethanol rises above the cost of other blendstocks, the resulting blend will be that much less competitive against other petrols.¹⁷⁷

In its report *Appropriateness of a 350 million litre biofuels target*, the CSIRO also noted issues around the cost and supply of ethanol when considering it as an octane enhancer. The CSIRO advised of the need to considerably expand current production of fuel ethanol if it is to be widely used in this form.¹⁷⁸

3.2.3 Volatility

Ethanol considerably increases volatility when blended with petrol. This can affect vehicle operability during start-up and warm-up under both hot and cold conditions.¹⁷⁹ Increased volatility can also cause vapour lock, which is the interruption of fuel flow due to vaporisation of fuel in the fuel system. This often results in poor hot weather driveability.

The volatility of fuel is also of considerable interest to agencies responsible for maintaining air quality, such as EPA Victoria. Fuel with higher volatility considerably increases evaporative emissions from the vaporisation of fuel in the fuel tank and fuel system.¹⁸⁰ These emissions are a precursor to photochemical smog, particularly in summer months. Photochemical smog contains oxidants that are produced by the action of sunlight reflecting on air containing VOC and nitrogen oxides (NO_x).¹⁸¹ These oxidants can have adverse environmental and health impacts, particularly in urban areas. Levels of photochemical smog are estimated by measuring ozone levels in the atmosphere:

In general, high levels of ozone are only a problem for major cities where emissions from concentrated urban activities can accumulate to high levels if the meteorology is favourable for pollution build up and for smog formation. Melbourne, Sydney, Perth, Brisbane and Adelaide are the main Australian cities of sufficiently large size and favourable meteorology for significant ozone formation.¹⁸²

As the presence of photochemical smog is airshed-specific, state and territory governments are responsible for controlling the vapour pressure of petrol. To ensure minimal smog formation, Reid Vapour Pressure (RVP) is regulated under environmental protection legislation and is generally only

¹⁷⁷ Australian Institute of Petroleum, *Submission*, no. 27, 24 June 2005, Submission to the Australian Government Biofuels Taskforce, Biofuels Taskforce, p. 19.

¹⁷⁸ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target - appendices*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 62.

¹⁷⁹ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 26.

¹⁸⁰ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 26.

¹⁸¹ Bureau of Transport and Regional Economics, *Health impacts of transport emissions in Australia: economic costs*, Australian Government, Canberra, 2005, p. 7.

¹⁸² Bureau of Transport and Regional Economics, *Health impacts of transport emissions in Australia: economic costs*, Australian Government, Canberra, 2005, p. 18.

applicable in summer and in urban areas.¹⁸³ EPA Victoria regulates RVP levels between 1 November and 31 March, however unlike Queensland and NSW, Victoria does not make any exceptions for ethanol blended fuels. In contrast to these states RVP levels have decreased in Victoria over the last four years. In 2003, section 27 of the *Environment Protection (Vehicle Emissions) Regulations 2003* stated the maximum monthly volumetric average vapour pressure is to be no more than 72kPa. In 2007, this had gradually decreased to a maximum of no more than 64kPa.¹⁸⁴

Section 28 of the *Environment Protection (Vehicle Emissions) Regulations 2003* provides exemptions to persons from the need to comply with the regulations. Shell Australia received a twelve month exemption for its ethanol blended fuels but expressed concerns to the Committee of the potential need to reformulate the fuel if the exemption is not continued.¹⁸⁵ Shell also expressed concern regarding the possible impact on fuel quality that may arise from other fuel suppliers not complying with the regulations:

Our concern has been that in the past some suppliers have not had that waiver and therefore have been supplying fuel which does not conform to the fuel standards; again, looking to make sure of a level playing field is one thing but reputation is a more important thing.¹⁸⁶

For an extra cost fuel refiners and blenders are able to make ethanol blended fuels that comply with set RVP levels. This is common practice in Brazil and the US, and could become an option for fuel refiners in Australia if tighter RVP standards are established.¹⁸⁷

The Victorian Government's *Driving growth: a road map and action plan for the development of the Victorian biofuels industry* highlights the need for a harmonised national approach to RVP regulations to assist fuel suppliers who export fuels to other states.¹⁸⁸ The Prime Minister's Biofuels Taskforce advised in its 2005 report that the Commonwealth Government was in dialogue with state and territory governments regarding the regulations of fuel parameters.¹⁸⁹ Since this time, there has been no information detailing the outcomes of this dialogue.

3.2.4 Potential vehicle damage

No evidence was received by the Committee describing actual damage to vehicles as a consequence of using ethanol blended fuels. The Committee was told however that some vehicles are unsuited to the use of ethanol at any concentration, including older vehicles and more recent models with

¹⁸³ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 147.

¹⁸⁴ Environment Protection (Vehicle Emissions) Regulations 2003 (Vic)

¹⁸⁵ Chris Midgley, General Manager, Supply and Marine, Shell Australia, *Transcript of evidence*, Melbourne, 31 July 2007, p. 3.

¹⁸⁶ Chris Midgley, General Manager, Supply and Marine, Shell Australia, *Transcript of evidence*, Melbourne, 31 July 2007, p. 3.

¹⁸⁷ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 68.

¹⁸⁸ Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007, p. 17.

¹⁸⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 148.

carburettor fuel systems.¹⁹⁰ Carburettor fuel systems require a fixed air to fuel ratio and so cannot adjust to the increased fuel oxygen levels found in ethanol blended fuels.¹⁹¹

Research conducted by Orbital Australia comparing the performance of vehicles operating on ethanol blended fuels to vehicles operating on neat petrol confirmed that carburettor vehicles should not use ethanol blended fuels.¹⁹² This includes most vehicles manufactured prior to 1986.¹⁹³ Orbital also reported that at least 59.9 per cent of the passenger and light commercial petrol vehicle fleet was suited to use E10.¹⁹⁴

The Committee received evidence that while a majority of new vehicles produced in Australia are compatible with E10, some new vehicles are not guaranteed to accept more than a five per cent ethanol blend (E5).¹⁹⁵ Consequently a marginally higher proportion of the Australian fleet is able to use E5 than E10, which according to Orbital Australia equates to 60.6 per cent of all vehicles.¹⁹⁶ Trials also conducted by Orbital Australia in 2002-04 determined E20 to be unsuitable for use in newer vehicles, and particularly unsuitable in older ones.¹⁹⁷

Over time it is expected that the proportion of vehicles that can safely use ethanol at concentrations of five or ten per cent will increase, as older vehicles are replaced and more ethanol capable vehicles are sold.

Finding 4: E10 is not compatible for use in older vehicles, in particular those from pre-1986. At present, E10 is compatible for use in 60.6 per cent of the Australian vehicle fleet. Fleet compatibility will increase as older vehicles are replaced with newer models.

3.2.5 Vehicle warranties

In its submission to the Inquiry, the Royal Automobile Club of Victoria (RACV) expressed concern about motorists potentially being denied warranty coverage when using ethanol blended fuels. RACV highlighted the importance of providing motorists with non-ethanol blended fuel options at service stations in instances when vehicle manufacturers advise against the use of ethanol.¹⁹⁸

While concerns about vehicle warranties have had a high profile in recent years, the Committee did not receive any evidence of a warrantee being

¹⁹⁰ Federal Chamber of Automotive Industries, *Submission*, no. 20, 2 August 2007, p. 2.

¹⁹¹ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 51.

¹⁹² Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 15.

¹⁹³ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 15.

¹⁹⁴ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 15.

¹⁹⁵ CSIRO, *Submission*, no. 32, July 2007, p. 6.

¹⁹⁶ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 15.

¹⁹⁷ Orbital Engine Company, *Market barriers to the uptake of biofuels study: testing gasoline containing 20% ethanol (E20): phase 2B final report to the Department of the Environment and Heritage*, Perth, 2004.

¹⁹⁸ Royal Automobile Club of Victoria (RACV) Ltd, *Submission*, no. 60, 23 August 2007.

denied because ethanol-blended fuel was used in the vehicle. In general, owners are responsible for ensuring that ethanol blended fuels are suitable for their vehicles.¹⁹⁹ The Committee also notes that fuel manufacturers and retailers, rather than vehicle manufacturers, would be held liable for vehicle failure as a result of poor fuel quality (rather than as a result of manufacturing failure).

3.3 Infrastructure, handling and distribution issues

There are a number of issues associated with the transportation, storage and handling of fuel grade ethanol and ethanol blended fuels. Care must be taken to ensure that fuels are safely blended and that fuel quality is maintained during distribution.²⁰⁰

Because ethanol is a flammable liquid, its production requires a high degree of control and monitoring. In Victoria, the storage and handling of ethanol is regulated under the *Dangerous Goods (Storage and Handling) Regulations 2000*, which is enforced by the Metropolitan Fire Brigade.²⁰¹

Due to ethanol's affinity with water, it is important to ensure that water contamination does not occur during the distribution or storage of ethanol blends. If there is too much water in the fuel or the storage tank, a process of phase-separation can occur where water and ethanol contained in the blended fuel separates from the petrol.²⁰² Evidence provided by Shell Australia about the importance of maintaining blending and storage infrastructure for ethanol blended fuels reiterates this point:

From there we have worked on developing the infrastructure in order to be able to blend effectively ethanol into main fuels. The key around that is to make sure that we are blending it to exactly the right specification, right to the 10 per cent limit, not over that top, not having low blends. Low blends result in a product which is hygroscopic and attracts water. If you are below 4 per cent ethanol in your fuel, you end up attracting water into it, which gives you engine problems. So having the right infrastructure to blend it safely is absolutely critical.²⁰³

In addition to efficient blending infrastructure, service station facilities may also have to be modified in order to retail ethanol blended fuels. These modifications can cost individual service stations thousands of dollars. In recognition of these costs, the Commonwealth Government launched the *Ethanol Distribution Program* in August 2006.²⁰⁴ The program provides grants of up to \$20,000 for retail service stations to reduce the cost of installing or converting infrastructure to supply E10.

¹⁹⁹ The Federal Chamber of Automotive Industries' (FCAI) website details a list of vehicle models suitable to run on E5 and E10, along with the details for various manufacturers.

²⁰⁰ Federal Chamber of Automotive Industries, *Submission*, no. 20, 2 August 2007, p. 3.

²⁰¹ Metropolitan Fire Brigade, *personal communication*, 7 August 2007.

²⁰² Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 28.

²⁰³ Chris Midgley, General Manager, Supply and Marine, Shell Australia, *Transcript of evidence*, Melbourne, 31 July 2007, p. 2.

²⁰⁴ AusIndustry, 'Ethanol distribution program', viewed 3 September 2007, <<http://www.ausindustry.gov.au>>.

The Queensland Government also implemented a similar grants program targeting various conversion projects, including assistance to establish E10 storage and blending facilities and signage for fuel distribution facilities.²⁰⁵

3.4 Greenhouse gas emissions

The use of ethanol as a transport fuel is claimed to have significant GHG benefits. Ethanol is often described as a 'renewable' fuel because it is produced from organic feedstocks. Although renewable fuels emit GHG emissions when they are combusted in vehicle engines, these emissions are not counted because it is assumed that the GHG emissions will be reabsorbed when new plants are grown for the next batch of biofuels. The production of petroleum from crude oil, by contrast, releases GHG emissions that will not be reabsorbed by the production of further petroleum fuels. Findings from empirical research studies that have examined the environmental benefits of ethanol blended fuels over ULP are divided on the overall quantum of GHG emissions.²⁰⁶ There is also very little Australian data.²⁰⁷

Analysis of life-cycle emissions is imperative when considering the performance of biofuels. A full life-cycle analysis considers emissions from vehicles (referred to as downstream or tailpipe emissions) and emissions associated with biofuels production, including processing, transportation and distribution.²⁰⁸ These 'upstream' emissions also take into account feedstock production, including the manufacture and distribution of fertiliser, soil preparation and harvesting.²⁰⁹

Since the Prime Minister's Biofuels Taskforce released its report in 2005, no further research has been conducted on the impact of E10 on vehicle emissions. Drawing on analyses conducted by CSIRO, the Australian Bureau of Agricultural and Resource Economics (ABARE) and the Bureau of Transport and Regional Economics (BTRE), the Biofuels Taskforce reported that ethanol blended fuels, in particular E10, provide some benefits to GHG emissions compared to ULP. Table 9 shows that the use of E10 reduces life-cycle GHG emissions by between 0.7 and 4.2 per cent.²¹⁰ While the use of E10 leads to reductions in GHG emissions at the tailpipe, a proportion of these benefits are offset by higher GHG emissions in the feedstock and fuel production.

²⁰⁵ Queensland Government, 'Queensland ethanol conversion initiative', viewed 19 November 2007, <<http://www.dtrdi.qld.gov.au>>.

²⁰⁶ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 13.

²⁰⁷ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 71.

²⁰⁸ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005.

²⁰⁹ Western Australia Biofuels Taskforce, *Western Australia Biofuels Taskforce Report*, Government of Western Australia, Perth, 2007, p. 63.

²¹⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 76.

Table 9: Life-cycle analysis of E10 impact on GHG emissions compared to ULP (%).²¹¹

| Fuel Type | GHG (upstream) | GHG (tailpipe) | GHG (life-cycle) |
|-----------------------------|----------------|----------------|------------------|
| E10 (molasses cogen energy) | 11.1 | -7 | -4.2 |
| E10 (molasses) | 20.5 | -7 | -2.7 |
| E10 (sorghum) | 25 | -7 | -2 |
| E10 (wheat) | 33.3 | -7 | -0.7 |
| E10 (wheat starch waste) | 20.4 | -7 | -2.7 |

3.5 Other emissions

In Australia, transport emissions account for a substantial proportion of air pollutants. Motor vehicles, for example, are estimated to emit more than 60 per cent of CO levels for the airsheds of capital cities, excluding Darwin.²¹² Other major transport-related pollutants deemed problematic in Australia include NOx, particulate matter (PM), and ozone and VOC.²¹³ PM emissions, comprised of fine particles of compounds emitted during the combustion of fuels, have a major detrimental effect on population health.²¹⁴

Evidence regarding the benefits of E10 on air pollutant emissions is still emerging, and the overall effect of air emissions on population health is unclear. The Prime Minister’s Biofuels Taskforce reported that on the basis of tailpipe emissions, E10 produced lower CO and VOC emissions relative to ULP.²¹⁵ However this was offset by the upstream processes utilised in the production of ethanol blended fuels, which lead to higher CO and VOC emissions. Overall, E10 reduced CO emissions by 21 to 26 per cent and resulted in little change of VOC emissions compared with ULP. NOx emissions resulting from E10 were higher at both the tailpipe and upstream processes, with an overall increase of five to twelve per cent depending on the feedstock (see Table 10).²¹⁶

²¹¹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 78.

²¹² Bureau of Transport and Regional Economics, *Health impacts of transport emissions in Australia: economic costs*, Australian Government, Canberra, 2005, p. xi.

²¹³ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 73.

²¹⁴ Tom Beer, et al., *Biofuels: an issues paper*, CSIRO, Aspendale, July 2007, p. 8.

²¹⁵ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 76.

²¹⁶ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 76.

Table 10: Life-cycle analysis of E10 impact on air emissions compared to ULP (%).²¹⁷

| Fuel Type | CO | NOx | VOC | PM |
|-----------------------------|-------|------|------|------|
| E10 (molasses cogen energy) | -22.3 | 5.0 | 0.2 | -7.4 |
| E10 (molasses) | -22.3 | 8.1 | -0.1 | 30.8 |
| E10 (sorghum) | -26.1 | 6.5 | -0.2 | 31.2 |
| E10 (wheat) | -20.8 | 12.6 | 2.2 | 38.4 |
| E10 (wheat starch waste) | -26.1 | 6.1 | -0.2 | 32.6 |

The impact of E10 on PM emissions requires closer examination. While E10 may result in lower tailpipe PM emissions, there is a lack of evidence supporting an exact estimate. In the report *Appropriateness of a 350 million litre biofuels target*, CSIRO identified a 0.1 per cent reduction in PM tailpipe emissions²¹⁸ however the Prime Minister's Biofuels Taskforce later increased this value to 40 per cent after consideration of three international studies.²¹⁹ The Committee notes that research is currently being conducted by CSIRO and Orbital Engines to determine the change in tailpipe and evaporative emissions when using E5 and E10 rather than ULP.²²⁰

3.6 Cost and revenue

According to the Centre for International Economics, the initial investment in an ethanol plant is between \$0.97 and \$1 per litre of annual capacity.²²¹ Upon completion of a plant the return on investment increases as output increases. When this occurs, the cost of capital is spread over a greater output and the relative initial capital cost reduces.

Operating costs for ethanol production are mainly associated with the purchase of feedstocks, utility expenses, consumables, labour, maintenance and administration. Feedstock purchase costs account for the majority of expenses, comprising between 60-80 per cent of total operating expenditure.²²² This is followed by utility and energy costs, which account for around ten per cent of total operating costs.²²³

²¹⁷ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 74.

²¹⁸ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003.

²¹⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 72.

²²⁰ Federal Chamber of Automotive Industries, *Submission*, no. 20, 2 August 2007.

²²¹ Centre for International Economics, *Impact of ethanol policies on feedgrain users in Australia*, Centre for International Economics, Canberra, 2005, p. 50.

²²² ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007, p. 214; CSIRO, *Submission*, no. 32, July 2007.

²²³ Department of Agriculture and Food, *Ethanol production from grain*, Government of Western Australia, Perth, 2006, p. 6.

The Committee received extensive evidence highlighting the impact of price variations of feedstocks on the profitability of ethanol.²²⁴ A number of factors affect feedstock price including international prices and demand, input cost fluctuations, and environmental factors such as drought. Table 11 and Table 12 show the change in supply and price of feedstocks in 2006-7 due to drought and increasing global prices as forecast by the ABARE.

Table 11: Unit gross values of production of feedstocks in Australia, 2004-05 to 2006-07.²²⁵

| Feedstock | 2004-5 A\$/t | 2005-06 A\$/t | 2006-07 A\$/t (forecast) |
|------------|-----------------|------------------|-----------------------------|
| Wheat | 197 | 228 | 269 |
| Sorghum | 134 | 175 | 264 |
| Sugar cane | 26 | 27 | 32 |

Table 12: Production of ethanol feedstocks in Australia, 2004-05 to 2006-07.²²⁶

| Feedstock | 2004-5 Mt | 2005-06 Mt | 2006-07 Mt (forecast) |
|------------|--------------|---------------|--------------------------|
| Wheat | 21.9 | 25.1 | 9.8 |
| Sorghum | 2.0 | 2.0 | 1.0 |
| Sugar cane | 37.8 | 38.2 | 36.0 |

ABARE forecast that 2006-07 would be a challenging year for biofuel producers due to higher feedstock prices increasing the cost of production and reducing the rates of return on capital costs.²²⁷ In 2007 concerns arising from lower than expected grains harvests received extensive media coverage throughout Australia. While Australia was reported to have significant rainfall in early 2007, poor rainfall since then suggests that as little as 15Mt of wheat will be produced over the course of the year. This is a substantial decrease from the 25.4Mt harvested in 2005-6.²²⁸ Low wheat stocks have been an issue elsewhere in the world with many of the wheat harvests in the northern hemispheres also affected by drought. It is estimated that the world wheat stocks are at 114Mt – the lowest since 1981.²²⁹ This has resulted in upward pressures on the global price for grains. In 2007-08, the global indicator price for coarse grains is forecast to

²²⁴ ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007.

²²⁵ ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007, p. 214.

²²⁶ ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007, p. 214.

²²⁷ ABARE, *Australian commodities - June Quarter*, Commonwealth of Australia, Canberra, 2007.

²²⁸ Leonie Wood, 'Field of dreams', *The Age*, 1 September 2007.

²²⁹ Leonie Wood, 'Field of dreams', *The Age*, 1 September 2007.

be around US \$169 per tonne, a five per cent increase from the previous year.²³⁰

There are a number of additional costs associated with ethanol production and post-production, such as costs associated with the blending and distribution of ethanol. Terminal costs depend on the size of installation and include storage tanks, pumps, loading arms and fire-safety equipment.

3.6.1 Income

A range of factors including feedstock price and availability, production costs, and the sale price of ethanol affect the profitability of an ethanol production facility. For ethanol to be considered competitive production needs to cost less or equal than the cost of producing traditional transport fuels.²³¹ The majority of ethanol production costs are directly associated with feedstock price, which provides an indication of how competitive ethanol blended fuels are against the price of fuel in the traditional petroleum market.²³²

The competitiveness and market appeal of biofuels is also largely dependent on world oil prices. In historical terms, world oil prices are relatively high at present, which provides more favourable conditions for the production of ethanol. According to ABARE:

...the more feedstock purchasable with a barrel of oil, the more market conditions favour biofuel producers, whose products compete against traditional petroleum fuels derived from crude oil.²³³

In Australia, fuel refiners use the price of Malaysia's Tapis Crude Oil as a price indicator. Biofuels producers may alter the asking price of their products in order to remain competitive against traditional fuels.²³⁴

Another key factor that influences the rate of return on investment in ethanol production is the level of government support provided to the industry. The ethanol industry receives a production grant of 38.143 cents per litre of fuel ethanol, which ensures the effective rate of excise for biofuels is zero until 1 July 2011. After this time, the production grants will be gradually phased down so that by 2015, ethanol producers will be required to pay fuel excises at half the rate applicable to petrol (see below).²³⁵

²³⁰ ABARE, *Australian commodities - June Quarter*, Commonwealth of Australia, Canberra, 2007.

²³¹ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 44.

²³² Centre for International Economics, *Impact of ethanol policies on feedgrain users in Australia*, Centre for International Economics, Canberra, 2005.

²³³ ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007, p. 214.

²³⁴ ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007.

²³⁵ ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007, p. 215.

3.6.2 Economic viability

The economic viability of ethanol production in Australia has been examined extensively. However, developments in the ethanol market over recent years, including historically high prices for oil as well as for ethanol feedstocks, mean that the findings of most studies may have little relevance to current market conditions.

In the 2003 report *Appropriateness of a 350 million litre biofuels target*, CSIRO determined that on the basis of the projected long-term world oil prices, the exchange rate, feedstock prices and government assistance, existing and new producers would earn relatively high rates of return until government assistance was phased out and world oil prices moderated.²³⁶ With no government assistance, CSIRO found that existing ethanol producers using waste starch were economically viable until capital replacement was required. New ethanol producers were not deemed to be economically viable in the long-term.²³⁷

In 2005, the Biofuels Taskforce requested that ABARE reassess the long-term economic viability of biofuels production. ABARE concluded that new ethanol producers would be economically viable if they receive some form of government assistance following 2015. At this stage, ethanol will be subject to a 12.5 cents per litre excise in 2015, which will be half the rate applied to petrol (25 cents per litre).²³⁸

In its submission to the Inquiry, CSR Limited addressed the economic viability of ethanol production in Victoria following the introduction of excise rates for alternative fuels from 1 July 2011:

Given that the market, under current Federal Government policy settings goes open in 2011, there is in CSR's view almost no prospect that a Victorian ethanol plant can be constructed in time to obtain a benefit from the existing border protection and low excise regime, - at least sufficient to generate enough cash flow to over come the enormous investment hurdle to build in Australia.²³⁹

Evidence of the difficulties surrounding ethanol production in Australia was also demonstrated when Agri Energy announced in October 2007 that all of its ethanol refinery investments, including its Swan Hill ethanol plant, had been put on hold. Agri Energy informed the Australian Stock Exchange that this was as "a result of current global biofuels market outlook reflecting ongoing high feedstock prices and continued uncertainty from the investment community, government and community support for alternative transport fuels in Australia."²⁴⁰

²³⁶ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003.

²³⁷ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003.

²³⁸ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 109.

²³⁹ CSR Limited, *Submission*, no. 11, 27 July 2007, p. 10.

²⁴⁰ Agri Energy Ltd, *Restructure of Australian operations*, Melbourne, 12 October 2007.

3.7 Current production, potential and constraints

While biofuels only comprise a small proportion of Australia's liquid fuel supply, biofuels production and sales are increasing. According to ABARE more ethanol blended fuel was produced and consumed in the first four months of 2006-07 than the entire 2005-06 year.²⁴¹ Of the 57 ML of biofuels produced in Australia in 2005-06, fuel ethanol accounted for 41 ML.²⁴² This is a large increase from previous years when only 22.7 ML of fuel ethanol was produced in 2004-05 and 28.5 ML in 2003-04.²⁴³ These fluctuations in ethanol sales were largely attributable to negative publicity associated with blended fuel sales in Sydney in 2002, and consequent reduction in ethanol sales. In 2002-03, more than 75 ML of ethanol was sold into the Australian fuel market.²⁴⁴

Compared to the ethanol markets in the United States and Brazil, Australia's ethanol industry is relatively small. At present, production capacity for ethanol in Australia exceeds production, even though several large ethanol production facilities are planned or under construction. The three major current producers of ethanol are the Manildra Group, located in Nowra (NSW), CSR Distilleries located in Sarina (Queensland) and the Rocky Point Mill and Distillery located south of Brisbane (Queensland). The Manildra Group has the largest production capacity of 100 ML, which is manufactured from waste streams of wheat and other grains.²⁴⁵ The CSR Distillery manufactures ethanol from 'C' grade molasses and produces 60 ML of hydrous ethanol and 32 ML of anhydrous ethanol.²⁴⁶ The Rocky Point Distillery has a production capacity of 16 ML from both 'C' grade molasses and grains.²⁴⁷

There are at least four new ethanol production facilities currently being constructed. No facilities are currently active or under construction in Victoria. As noted above, in October 2007 construction of a 100 ML ethanol plant planned for Swan Hill by Agri Energy was put on hold "a result of current global biofuels market outlook reflecting ongoing high feedstock prices and continued uncertainty from the investment community, government and community support for alternative transport fuels in Australia."²⁴⁸ Agri Energy had also planned to build ethanol facilities in NSW and Western Australia, however these have also been postponed.²⁴⁹

A breakdown of planned ethanol production facilities and those currently under construction are provided in Table 13.

²⁴¹ ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007, p. 212.

²⁴² ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007, p. 212.

²⁴³ ABARE, *Australian commodities - March Quarter*, Commonwealth of Australia, Canberra, 2007.

²⁴⁴ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 42.

²⁴⁵ Ian Thompson, 'How Swede It is', viewed 30 August 2007, <<http://www.biofuelsaustralasia.com.au>>.

²⁴⁶ CSR Limited, *Submission*, no. 11, 27 July 2007, p. 1.

²⁴⁷ Ian Thompson, 'How Swede It is', viewed 30 August 2007, <<http://www.biofuelsaustralasia.com.au>>.

²⁴⁸ Agri Energy Ltd, *Restructure of Australian operations*, Melbourne, 12 October 2007.

²⁴⁹ Peter Hemphill, 'Ethanol plant delayed', *Weekly Times*, 17 October 2007.

Table 13: Current and planned ethanol production, Australia, October 2007.²⁵⁰

| Organisation | Feedstocks | Capacity | Status |
|---|---------------------------------|------------------|-------------|
| Manildra (NSW) | Wheat | 105 ML | Operational |
| CSR (Qld) | C-Molasses | 50 ML | Operational |
| Rocky Point | C-Molasses | 16.2 ML | Operational |
| Primary Energy (Gunnedah, NSW) | Grain | 160 ML | 2009 |
| Primary Energy (Pinkenba, QLD) | Grain | 160 ML | 2009 |
| Primary Energy (Kwinana, WA) | Grain | 160 ML | 2008 |
| Dalby Biorefinery | Sorghum | 80 ML | Mid 2008 |
| Australian Ethanol (Coleambally, NSW; Condobolin, NSW and Oaklands NSW) | Corn, wheat, barley and sorghum | 200 ML | On hold |
| Australian Ethanol (Swan Hill, Vic) | Corn, barley and wheat | 100 ML | On hold |
| Australian Ethanol (Lake Grace, Western Australia) | Wheat | 200 ML | On hold |
| Operating capacity as of October 2007 | | 171.2 ML | |
| Total capacity less 'on hold' projects | | 671.2 ML | |
| Total capacity | | 1171.2 ML | |

Ethanol production from grain feedstock currently appears to be best suited to Victorian conditions. Ethanol produced from sugar and sorghum has a higher yield than grains, but these crops are suited to warmer climates than found in Victoria. CSR told the Committee that it regarded sorghum as the most viable feedstock for ethanol production due to its high starch content and ease of fermentation.²⁵¹ While sugar has a higher ethanol yield per tonne, the current price for sugar as a food means that it has a higher value in other markets. CSR Ethanol informed the Committee that all sugar based ethanol production in Australia is “value destroying” because of the price it can attract from export, and the capital costs associated with ethanol facilities.²⁵²

3.7.1 Availability

The Victorian Parliament’s Environment and Natural Resources Committee (ENRC) noted in its 2006 *Inquiry into the production and/or use of biofuels*

²⁵⁰ Australian Biofuels Pty Ltd, 'Coleambally ethanol production facility', viewed 20 September 2007, <<http://www.indcor.com.au>>; Australian Biofuels Pty Ltd, 'Condobolin ethanol production facility', viewed 20 September 2009, <<http://www.indcor.com.au>>; Australian Biofuels Pty Ltd, 'Oaklands ethanol production facility', viewed 20 September 2007, <<http://www.indcor.com.au>>; Peter Hemphill, 'Ethanol plant delayed', *Weekly Times*, 17 October 2007; Graham; Cuevas-Cubria Love, Clara, 'Outlook for biofuels in Australia', viewed 23 October 2007, <http://www.abareconomics.com/interactive/ac_mar07/htm/a5.htm>.

²⁵¹ CSR Limited, *Submission*, no. 11, 27 July 2007, p. 12.

²⁵² CSR Limited, *Submission*, no. 11, 27 July 2007, p. 15.

in Victoria that independent service stations had purchased more ethanol than the major petroleum companies. Of the 23 ML of fuel ethanol sold by the Manildra Group in a six month period, only 9 ML was purchased by major oil companies.²⁵³ Since this time there has been a large increase in the uptake of ethanol by major oil companies. In August 2007, BP Australia and the Manildra Group announced their supply agreement of 40 ML of ethanol in a twelve month period, which is in addition to 15 ML of ethanol already supplied by CSR Distilleries to BP Australia.²⁵⁴ Shell Australia will also receive 40 ML of ethanol from the Manildra Group in a twelve month period.²⁵⁵

The availability of ethanol in Australia has also increased rapidly over the last two years. In June 2005, the Commonwealth Department of Industry Tourism and Resources reported 70 stations were retailing ethanol, with this number increasing substantially to 230 stations in July 2006.²⁵⁶ Over a year later, this number has more than tripled with 659 service stations owned by major petroleum companies currently retailing E10 throughout Australia.²⁵⁷ This is in addition to small independent retailers who also sell ethanol blended fuels.

Of the major petroleum companies, service stations that currently sell E10 include:

- Exxon Mobil – 1 in Queensland²⁵⁸ and 1 in NSW,²⁵⁹
- BP Australia – 88 sites in ACT, NSW and Queensland;²⁶⁰
- Shell Australia – 105 in NSW, 64 in Queensland and 12 in ACT,²⁶¹
- Caltex – 110 in NSW, 74 in Queensland and 5 in ACT.²⁶²

United Petroleum also has a number of service stations that retail E10 throughout Australia, including 1 in ACT, 81 in NSW, 6 in Northern

²⁵³ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 11.

²⁵⁴ BP Australia, 'BP becomes Australia's largest marketer of biofuels', viewed 30 August 2007, <<http://www.bp.com>>.

²⁵⁵ Shell Australia, 'Shell Unleaded E10 launched', viewed 3 September 2007, <<http://www.shell.com>>.

²⁵⁶ Department of Industry Tourism and Resources, 'Media release: new ethanol confidence fuels 50% production jump', viewed 25 July 2006, <<http://minister.industry.gov.au>>.

²⁵⁷ BP Australia, 'BP becomes Australia's largest marketer of biofuels', viewed 30 August 2007, <<http://www.bp.com>>; Exxon Mobil, 'Ethanol', viewed 30 August 2007, <<http://www.exxonmobil.com>>; Tiffiney Gee, Media Relations and Communications Executive, Caltex Australia Ltd, *personal communication*, 23 October 2007; Shell Australia, 'All about Shell V-power racing', viewed 30 August 2007, <<http://www.shell.com>>; Shell Australia, 'Filling up with E10', viewed 30 August 2007, <<http://www.shell.com>>; United Petroleum, 'United Plus ULP locations', viewed 30 August 2007, <<http://www.unitedpetroleum.com.au/distributor-plusulp-locations.asp>>.

²⁵⁸ Exxon Mobil, 'Ethanol', viewed 30 August 2007, <<http://www.exxonmobil.com>>.

²⁵⁹ Mobil Oil Australia, 'Mobil launches ethanol-blend petrol in Sydney', viewed 13 September 2007, <<http://www.exxonmobil.com>>.

²⁶⁰ BP Australia, 'BP becomes Australia's largest marketer of biofuels', viewed 30 August 2007, <<http://www.bp.com>>.

²⁶¹ Shell Australia, 'Filling up with E10', viewed 30 August 2007, <<http://www.shell.com>>.

²⁶² Tiffiney Gee, Media Relations and Communications Executive, Caltex Australia Ltd, *personal communication*, 23 October 2007.

Territory, 18 in Queensland, 17 in South Australia, 12 in Tasmania and 65 in Victoria.²⁶³

Shell Australia also manufactures an ethanol blended fuel of five per cent (E5) called Shell V-Power Racing. This is retailed in 47 locations throughout Victoria, NSW, ACT and Queensland.²⁶⁴

The increased uptake of ethanol by the major oil companies coincides with the growing interest of various state governments in biofuels. Both the NSW and Queensland Governments are committed to introducing mandated targets for ethanol, with a two per cent ethanol mandate introduced in NSW in October 2007,²⁶⁵ and a five per cent mandate in Queensland from 2010.²⁶⁶ BP Australia however indicated to the Committee that the pending mandates had not contributed to its recent involvement with biofuels. Mr Frank Russell, Biofuels Project Director at BP stated:

Regarding our supply of ethanol in New South Wales, that has been going on for more than 12 months and was finally concluded about a month ago. These things take time, and the fact that New South Wales brought in a mandate probably did not have any impact on that negotiation.²⁶⁷

In contrast, the Manildra Group told the Committee it was clear that the major oil companies would not have entered agreements to secure supplies of ethanol if the NSW Government had not committed to a mandate.²⁶⁸

3.8 Consumer confidence, standards and warranties

Consumer confidence in ethanol blended fuels is viewed as a critical component for further development of the industry in Australia. The Committee received evidence from various organisations indicating that this issue required significant action in order to ensure greater uptake of ethanol by motorists.

As noted above, negative publicity regarding ethanol was widely reported in 2002-03 regarding allegations of vehicle damage resulting from the distribution of high-concentration ethanol blends throughout Sydney. In response to this publicity a number of oil companies suspended ethanol trials and service stations throughout Queensland and NSW displayed 'no ethanol' signs to alleviate community concerns.²⁶⁹ The Commonwealth Government responded by introducing a ten per cent cap on the amount of

²⁶³ United Petroleum, 'United Plus ULP locations', viewed 30 August 2007, <<http://www.unitedpetroleum.com.au/distributor-plusulp-locations.asp>>.

²⁶⁴ Shell Australia, 'All about Shell V-power racing', viewed 30 August 2007, <<http://www.shell.com>>.

²⁶⁵ Andrew Clennell, 'lemma to boost ethanol sales', *Sydney Morning Herald*, 14 February 2007.

²⁶⁶ Queensland Government, 'Australia urged to follow Queensland's green fuel lead', viewed 3 September 2007, <<http://www.sd.qld.gov.au>>.

²⁶⁷ Frank Russell, Head, Biofuels, BP Australia, *Transcript of evidence*, Melbourne, 27 August 2007, p. 23.

²⁶⁸ John Honan, Managing Director, Manildra Group, *Transcript of evidence*, Melbourne, 31 July 2007.

²⁶⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 127.

ethanol blended with petrol, as well as the requirement to label petrol containing ethanol at the bowser.²⁷⁰

In 2003 and 2005 the National Survey of Motorists' Attitudes questionnaires included questions about motorists' attitudes to buying ethanol blended fuels (see Table 14). Between 2003 and 2005 there was a slight improvement in the number of motorists who were happy to buy petrol containing ethanol, increasing from 22 per cent in 2003²⁷¹ to 25 per cent in 2005.²⁷² There was also a considerable decrease in the number of motorists who would be concerned to buy petrol containing ethanol, from 44 per cent in 2003²⁷³ to 35 per cent in 2005.²⁷⁴ Overall however the 2005 survey findings indicated motorists as a whole continue to have equivocal views about ethanol. Almost six in ten had reservations about the fuel, or were actively indisposed towards its use.²⁷⁵ Of these motorists, most reported they were concerned about potential vehicle damage arising from use of the fuel.²⁷⁶

Table 14: Comparison of attitudes to buying petrol containing ethanol, Australian motorists, 2003 and 2005.²⁷⁷

| Attitude | 2003 | 2005 |
|-------------------|------|------|
| Happy to buy | 22% | 25% |
| Not happy to buy | 44% | 35% |
| Have reservations | 19% | 21% |
| Unsure | 15% | 19% |

The findings of a more recent survey undertaken in June 2006 by the Manildra Group via a Newspoll Survey reflected more positive findings regarding community perceptions around ethanol. Seventy-eight per cent of respondents reported they would consider using ethanol blended fuels

²⁷⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 127.

²⁷¹ ANOP Research Services Pty Ltd, *Motorists' priorities and attitudes: detailed report on 2003 ANOP national study*, Report prepared for the Australian Automobile Association, Sydney, 2003, p. 28.

²⁷² ANOP Research Services Pty Ltd, *Motorists' attitudes: 2005 ANOP national survey*, Prepared for the Australian Automobile Association, Sydney, 2005, p. 7.

²⁷³ ANOP Research Services Pty Ltd, *Motorists' priorities and attitudes: detailed report on 2003 ANOP national study*, Report prepared for the Australian Automobile Association, Sydney, 2003, p. 28.

²⁷⁴ ANOP Research Services Pty Ltd, *Motorists' attitudes: 2005 ANOP national survey*, Prepared for the Australian Automobile Association, Sydney, 2005, p. 7.

²⁷⁵ ANOP Research Services Pty Ltd, *Motorists' attitudes: 2005 ANOP national survey*, Prepared for the Australian Automobile Association, Sydney, 2005, p. 7.

²⁷⁶ ANOP Research Services Pty Ltd, *Motorists' attitudes: 2005 ANOP national survey*, Prepared for the Australian Automobile Association, Sydney, 2005, p. 7.

²⁷⁷ ANOP Research Services Pty Ltd, *Motorists' priorities and attitudes: detailed report on 2003 ANOP national study*, Report prepared for the Australian Automobile Association, Sydney, 2003, p. 28; ANOP Research Services Pty Ltd, *Motorists' attitudes: 2005 ANOP national survey*, Prepared for the Australian Automobile Association, Sydney, 2005, p. 7.

and 91 per cent stated they would be more likely to consider using ethanol blended fuels if they knew it was safe to use.²⁷⁸

A number of state governments have conducted or plan to undertake education and awareness raising initiatives to improve consumer confidence in biofuels. The Queensland Government launched its state-wide '+e' market campaign in August 2006 to increase consumer knowledge about the benefits of ethanol.²⁷⁹ The Victorian Government also released its Biofuels Roadmap earlier this year, which details the Government's intention to undertake community awareness and education campaigns to increase confidence in biofuels.²⁸⁰

While consumer confidence in ethanol blended fuels is likely to continue improving, other factors may influence motorists' uptake of ethanol blended fuels. Cost is a key deciding factor for motorists when choosing a fuel, and there is likely to be little demand for ethanol blended fuel if there is no price advantage. The Prime Minister's Biofuels Taskforce noted in its report that pricing strategies reflecting higher fuel consumption, such as a discount of two to three per cent at the pump, would encourage uptake of the fuel.²⁸¹ A number of petroleum companies have discounted their E10 products to reflect the lower energy rating of ethanol, however the Committee received contrasting evidence regarding the impact of this price discount on motorists' uptake of E10. Shell Australia stated that despite providing a 3-cents-per-litre discount and conducting extensive advertising, the uptake of E10 has been limited.²⁸² The Manildra Group, on the other hand, advised the Committee:

The independents have needed the product because it is the only way that some of the independents have survived, because it has been cheaper and obviously people pulling into an independent petrol station are looking for a cheaper product.²⁸³

The Manildra Group also questioned the adequacy of the level of discounting offered to motorists by the major petroleum companies and indicated that higher savings to consumers would result in higher sales of ethanol blended fuels.²⁸⁴

Finding 5: A clear price advantage for use of ethanol blended fuels will encourage greater uptake by motorists.

²⁷⁸ Western Australia Biofuels Taskforce, *Western Australia Biofuels Taskforce Report*, Government of Western Australia, Perth, 2007, p. 51.

²⁷⁹ Queensland Government, 'About +e', viewed 12 September 2007, <<http://www.sd.qld.gov.au>>.

²⁸⁰ Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007, p. 20.

²⁸¹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 131.

²⁸² Chris Midgley, General Manager, Supply and Marine, Shell Australia, *Transcript of evidence*, Melbourne, 31 July 2007.

²⁸³ John Honan, Managing Director, Manildra Group, *Transcript of evidence*, Melbourne, 31 July 2007.

²⁸⁴ John Honan, Managing Director, Manildra Group, *Transcript of evidence*, Melbourne, 31 July 2007.

The Committee is of the view that fair and competitive pricing for ethanol blended fuels accompanied by accurate information on the fuel's merits will lead to further improvements in consumer confidence and uptake. While the Committee notes the role that governments can have in raising awareness, it agrees with the finding of the Biofuels Taskforce that it is the principal responsibility of fuel suppliers and retailers to inform consumers about their products, including ethanol and ethanol blended fuels.²⁸⁵

3.8.1 The food versus fuel debate

There has been extensive media coverage about the impact of increased production of biofuels on food prices with growing concerns of the linking of fuel and food markets. This is particularly evident in the US where the substantial investment in ethanol produced from corn has claimed to have had a significant impact on the cost and availability of food supplies both in the US and neighbouring countries.²⁸⁶ In providing evidence to the Committee, the Australian Lot Feeders' Association cited a study that found US consumers had experienced an increase in retail food prices of US \$47 per person due to increased ethanol production. This equated to US\$14 billion nationally.²⁸⁷

Because food and biofuels compete for land and water some commentators regard price increases for agricultural resources and food as inevitable.²⁸⁸ This may be particularly problematic for the world's poorer people who are estimated to spend between 50 to 80 per cent of household income on food.

The stage is now set for direct competition for grain between the 800 million people who own automobiles, and the world's 2 billion poorest people.²⁸⁹

There are also concerns in Australia that record high grain prices will affect the domestic food chain, in particular beef, dairy, pork, eggs and chicken.²⁹⁰ CSIRO noted in their submission to the Inquiry that as livestock is typically fed grain, rising grain prices could lead to higher livestock production costs, and potentially result in an increase in meat prices and less international sales.²⁹¹ By contrast, the Committee received evidence that as Australia is a major wheat exporter, an increase in demand for grains resulting from biofuels should not lead to rising feedstock prices.²⁹²

²⁸⁵ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 19.

²⁸⁶ Editorial, 'Up goes the price of food supplies', *Geelong Advertiser*, 18 September 2007.

²⁸⁷ Kevin Roberts, Vice President, Australian Lot Feeders' Association, *Transcript of evidence*, Melbourne, 31 July 2007, p. 37.

²⁸⁸ Erin Holt-Gimenez, 'The biofuel myths', *International Herald Tribune*, 10 July 2007.

²⁸⁹ Daniel Howden, 'The fight for the world's food', viewed 9 August 2007, <<http://www.independent.co.uk/incoming/article2697804.ece>>.

²⁹⁰ Asa Wahlquist, 'Agflation: how drought and oil combine to send food prices soaring', *The Australia*, 15 September 2007.

²⁹¹ CSIRO, *Submission*, no. 32, July 2007.

²⁹² John Honan, Managing Director, Manildra Group, *Transcript of evidence*, Melbourne, 31 July 2007; Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007.

Chapter Four: Key points

- Compressed natural gas (CNG) is pressurised natural gas that consists primarily of methane. Natural gas is compressed at refuelling stations using natural gas from existing pipelines (p. 59).
 - CNG is much safer than conventional petroleum fuels as it has a very narrow range of flammability. It is lighter than air so that when released it disperses rapidly upwards and dissolves into the atmosphere (p. 62).
 - One of the key constraints of CNG use as a transport fuel is the large space requirements of vehicle fuel cylinders. As a consequence, motorists are required to refuel their vehicles more frequently (p. 62).
 - On a life-cycle emissions analysis, CNG produces less GHG emissions than unleaded petrol and second-generation liquefied petroleum gas (LPG) vehicles, but more greenhouse gas (GHG) emissions than diesel and third-generation LPG vehicles (p. 64).
 - The production and use of CNG has also been demonstrated to produce significant reductions in air pollutant emissions (p. 66).
 - The cost of using CNG is considerably lower than other fuels. With the use of home refuelling applications, motorists will be able to refuel their vehicles for between 22 and 50 cents per litre of gas (p. 69).
 - As the cost of natural gas is not subject to world oil prices or foreign exchange rates, there is a view that the cost will remain relatively stable. Increased demand for natural gas exports may place upward pressure on domestic prices (p. 70).
 - Despite natural gas accounting for 20 per cent of Australia's primary energy needs, the adoption of CNG as a transport fuel has been poor. Two programs introduced by the Commonwealth Government to increase availability and uptake of CNG have had limited success (p. 72).
 - At present, the use of CNG is most common in larger vehicle fleets, such as buses and forklifts (p. 72).
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Chapter Four: Compressed Natural Gas

During the course of the Inquiry the Committee became aware of the potential for increased use of CNG to address at least some of the issues facing fuel consumption in Australia. In particular, witnesses suggested that CNG could alleviate some of the fuel security and air pollution concerns associated with the current Australian fleet:

We have vast gas reserves in this country. They find reserves in Western Australia and they just cap them. There is enough gas in some wells alone to satisfy the energy needs of Australia for 10 or 15 years, just in one well, and there are hundreds of them capped. The other advantage of Australia is that we are networked.²⁹³

As the Terms of Reference for the Inquiry required the Committee to “report on the measures required by Government to facilitate an alternative fuels industry in Victoria for transport and non-transport applications” the Committee determined to examine the CNG industry in more detail.

CNG is a transport fuel comprised of pressurised natural gas.²⁹⁴ Natural gas is primarily comprised of methane with smaller amounts of ethane, butane, propane, carbon dioxide, nitrogen, helium and hydrogen sulphide.²⁹⁵ Compared to petroleum based fuels, one cubic metre of CNG is thermally equivalent to around 1.1 litres of petrol, 1 litre of diesel and 1.5 litres of LPG.²⁹⁶

Liquefied natural gas (LNG) is also derived from natural gas for use as a transport fuel. CNG is natural gas compressed in a gaseous form at a pressure of between 16 and 25 megapascals (MPa). LNG is natural gas that has been liquefied by cooling to -161°C .²⁹⁷ The production of CNG is simpler and less costly than LNG as it does not require expensive cooling processes or storage in cryogenic tanks.²⁹⁸ Both fuels are appropriate for

²⁹³ John Lincoln, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 10.

²⁹⁴ CompAir, 'CNG vehicle refuelling solutions - About CNG & NVG's', viewed 2 November 2007, <<http://www.compair.com>>.

²⁹⁵ Asia Pacific Natural Gas Vehicles, 'Overview of natural gas', viewed 25 October 2007, <http://www.angva.org/ngv_01.html>.

²⁹⁶ Envestra, *Submission*, Australia's future oil supply and alternative transport fuels, The Senate Standing Committee on Rural and Regional Affairs and Transport, Commonwealth Parliament, p. 2.

²⁹⁷ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 91.

²⁹⁸ Wikipedia, 'Compressed natural gas', viewed 26 October 2007, <http://en.wikipedia.org/wiki/Compressed_natural_gas>.

use in heavy vehicles such as buses or forklifts. CNG can also be used in light vehicles.²⁹⁹

Natural gas is abundant in Australia and could play an important role in reducing Australia's reliance on imported petroleum products. In their inquiry into *Australia's future oil supply and alternative transport fuels*, the Standing Committee on Rural and Regional Affairs and Transport advised of the need to consider the role of natural gas in Australia's transportation fuel market.³⁰⁰ There are a number of issues that currently prevent widespread use of natural gas in transportation, mainly the lack of adequate refuelling infrastructure and the limited fuel range of CNG.

4.1 Production methods

The production of CNG as a transport fuel occurs at refuelling stations rather than at refining facilities. Natural gas is obtained from existing pipelines and pressurised using on-site compressors. Natural gas, the product that forms the base for CNG, is extracted from underground or subsea deposits, or is obtained during crude oil production.³⁰¹

When natural gas is first extracted it is attached to a number of gases and hydrocarbons that must be removed.³⁰² To remove these hydrocarbons, the gas is transported from gas fields to processing facilities through a network of gathering pipelines. The water content in natural gas is controlled via a dehydration plant and sulphur compounds and hydrogen sulphide are removed in a gas sweetening plant.³⁰³ Once it is refined to a purer form, the natural gas is considered 'dry' and is distributed to industrial, commercial and residential markets via a system of pipelines. Prior to entering the pipeline system natural gas must comply with purity specifications.³⁰⁴

At refuelling stations, natural gas is pressurised to elevated pressures to maximise the volume of CNG that can be stored in storage tanks. Natural gas is drawn from local pipelines at low pressure, compressed to 25 MPa in the fuelling equipment and then stored in pressure vessels at high pressure. As pressure in the vessel falls, the compressor draws more gas from the pipeline.³⁰⁵

There are two types of CNG refuelling stations: fast-fill and time-fill. Time-fill systems only use the compressor to directly fill vehicles rather than

²⁹⁹ Kevin Black, Technical and Infrastructure Manager, OES CNG, *personal communication*, 4 October 2006.

³⁰⁰ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 102.

³⁰¹ OES CNG, 'Compressed natural gas (CNG) Systems', viewed 25 October 2007, <<http://www.oes.net.au/compressed-natural-gas-cng-system.shtml>>.

³⁰² Natural Gas Supply Association, 'Overview of Natural Gas', viewed 29 October 2007, <<http://www.naturalgas.org/overview/overview.asp>>.

³⁰³ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 247.

³⁰⁴ Natural Gas Supply Association, 'Overview of Natural Gas', viewed 29 October 2007, <<http://www.naturalgas.org/overview/overview.asp>>.

³⁰⁵ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 247.

store gas in tanks.³⁰⁶ These systems refuel vehicles over a period of time and are suited to bus or truck depots where vehicle fleets can be refuelled over night.³⁰⁷ Fast-fill systems are more common for refuelling light vehicles and comprise a large compressor and high-pressure storage tanks. Fast-fill systems fuel vehicles in around the same time as it takes to fuel vehicles with petroleum based products.³⁰⁸

The production of LNG is more energy intensive than CNG as it is produced in a liquefaction plant where natural gas is refrigerated to a temperature of -161°C. This considerably reduces the volume of the gas, making it easier to store and distribute when exported to international markets.³⁰⁹ When LNG is exported, it requires transportation at atmospheric pressure in specially built tanks on double hulled ships.³¹⁰ Upon arrival at its destination, LNG can be transformed back into gas.³¹¹ At refuelling stations, LNG is stored in cryogenic storage tanks and pumped into vehicles using specialised cryogenic equipment.³¹²

4.2 Fuel characteristics

As part of the development of the national fuel quality standards, the Fuel Standards Consultative Committee reviewed the feasibility of developing a specific standard for CNG. After extensive consultation, the Committee recommended against developing a CNG standard because the quality of CNG was considered to be sufficiently controlled under the *Australian Standard 4564:2005 – Specification for general purpose natural gas*.³¹³ This specification ensures the safety of natural gas that is supplied for use in appliances and equipment and as fuel in natural gas vehicles (NGV). This recommendation was endorsed by the Commonwealth Government in 2005.³¹⁴

NGVs operate very similarly to petroleum compatible vehicles, however CNG is stored in high pressure cylinders on vehicles that are located either at the rear, top or undercarriage of vehicles.³¹⁵ LNG is also stored on board

³⁰⁶ CompAir, 'CNG vehicle refuelling solutions - About CNG & NVG's', viewed 2 November 2007, <<http://www.compair.com>>.

³⁰⁷ CompAir, 'CNG vehicle refuelling solutions - About CNG & NVG's', viewed 2 November 2007, <<http://www.compair.com>>.

³⁰⁸ Natural Gas Vehicles for America, 'Technology', <http://www.ngvc.org/tech_data/index.html>.

³⁰⁹ Allison Ball, et al., *The Asia Pacific LNG market: issues and outlook*, ABARE, Canberra, 2004, p. 16.

³¹⁰ Allison Ball, et al., *The Asia Pacific LNG market: issues and outlook*, ABARE, Canberra, 2004, p. 16.

³¹¹ Allison Ball, et al., *The Asia Pacific LNG market: issues and outlook*, ABARE, Canberra, 2004, p. 16.

³¹² Natural Gas Vehicles for America, 'Technology', <http://www.ngvc.org/tech_data/index.html>.

³¹³ Department of the Environment and Heritage, 'CNG quality to be managed by existing Australian standards', viewed 26 October 2007, <<http://eied.deh.gov.au>>.

³¹⁴ Australian Standards, 'AS4564-2005: Specification for general purpose natural gas', viewed 2 November 2007, <<http://www.saiglobal.com>>.

³¹⁵ Natural Gas Vehicles for America, 'Technology', <http://www.ngvc.org/tech_data/index.html>.

vehicles in thermal storage tanks but requires only 30 per cent of the space required for CNG.³¹⁶

4.2.1 Fuel octane rating

Because methane is characterised by high knock resistance, CNG has a high octane rating. Its RON is around 120, which enables high compression ratios and high energy efficiency.³¹⁷ The optimisation of an engine's performance only occurs however in vehicles dedicated to CNG. In vehicles that are optimised for petrol use and have been converted to CNG the benefits of CNG are reduced due to the engine's compression ratio remaining at a level suitable for petrol.³¹⁸ Consequently, the high octane rating of CNG is not fully utilised.

4.2.2 Safety

As a fuel, CNG is perceived to be safer than petrol, diesel or LPG.³¹⁹ It has a very narrow range of flammability and will not burn in concentrations of air below five per cent and above 15 per cent by volume.³²⁰ Unlike liquid fuels, it is lighter than air and upon release disperses rapidly upwards and dissolves into the atmosphere.³²¹ CNG also requires a much higher ignition temperature of 650 degrees Celsius compared to 350 degrees Celsius for petrol and LPG.³²² The limited flammability and high ignition temperatures required for CNG makes auto-ignition or combustion very unlikely.³²³

Another safety feature of CNG is the highly engineered nature of the vehicle storage cylinders.³²⁴ Storage cylinders used in NGVs are much stronger than petrol or LPG tanks and must withstand a number of durability tests, including heat and pressure extremes, gunfire and fire.³²⁵

4.2.3 Fuel range

While extremely durable, the size of CNG cylinders presents a practical impediment to using CNG. Because CNG requires storage in high pressure tanks, the tanks are heavy and large, resulting in a loss of vehicle boot space.³²⁶ CNG is also characterised by limited fuel range so the storage of CNG in these cylinders is not as space efficient as liquid

³¹⁶ Natural Gas Vehicles for America, 'Technology', <http://www.ngvc.org/tech_data/index.html>.

³¹⁷ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 268.

³¹⁸ Australian Institute of Petroleum, 'Petroleum topic fact sheet - alternative transport fuels', viewed 10 October 2007, <http://www.aip.com.au/industry/fact_alt_fuels.htm>.

³¹⁹ OES CNG, *Natural gas vehicles: securing Australia's energy and environmental future*, Melbourne, June 2007, p. 6.

³²⁰ John Lincoln, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 11.

³²¹ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 268.

³²² Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 268.

³²³ Natural Gas Vehicle Association, 'Safety', viewed 1 November 2007, <http://www.ngva.co.uk/index/fuseaction/site.articleDetail/con_id/5036>.

³²⁴ John Mikolajunas, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 3.

³²⁵ John Mikolajunas, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 3.

³²⁶ Australian Institute of Petroleum, 'Petroleum topic fact sheet - alternative transport fuels', viewed 10 October 2007, <http://www.aip.com.au/industry/fact_alt_fuels.htm>.

fuels.³²⁷ As a result, vehicles need to refuel more frequently. This issue was presented to the Committee as the biggest disadvantage to using CNG.³²⁸

The Committee received evidence indicating that cylinders with a water capacity of 90 litres would only store the equivalent of 25 litres of petrol.³²⁹ Compared to diesel, CNG requires 3 to 4.5 times more volume on board a vehicle.³³⁰ While larger cylinders increase fuel range, this limits the broader application of CNG within lighter vehicle fleets. While there is the potential for tanks to be designed into the structure of vehicles, this is unlikely to occur until demand for CNG increases.

The Committee is aware that factory built CNG vehicles are available elsewhere in the world. One example is the Honda Civic GX NGV that is available in the US.³³¹ This model is accompanied by a home refuelling appliance that is installed at motorists' residences. OES CNG is currently developing a home compressor system, which are likely to be available on the Australian market towards the end of 2008.³³² Until the issue of refuelling infrastructure is addressed, these home compressors could potentially alleviate concerns regarding the limited fuel range of CNG by enabling motorists to refuel their vehicles at home.

Limited fuel range is not an issue when using LNG as the liquefaction of natural gas reduces the bulk of the gas, allowing greater volumes to be stored in smaller spaces.³³³

4.2.4 Vehicle conversion

There are three types of NGVs that can operate on CNG: dedicated NGVs, bi-fuel vehicles and dual fuel vehicles.³³⁴ Dedicated vehicles operate only on natural gas and can be converted petrol or diesel engines or factory built.³³⁵ At present, no factory built light vehicles are available in Australia. Heavier vehicles, such as buses and forklifts, that generally have ready access to private refuelling stations are available. Bi-fuel vehicles allow use of either petrol or natural gas but not simultaneously. Dual-fuel vehicles operate on a small amount of diesel to provide the spark for natural gas ignition.³³⁶

³²⁷ Kevin Black, Technical and Infrastructure Manager, OES CNG, *personal communication*, 31 October 2007.

³²⁸ John Lincoln, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 16.

³²⁹ Kevin Black, Technical and Infrastructure Manager, OES CNG, *personal communication*, 31 October 2007.

³³⁰ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 52.

³³¹ Honda, 'The 2008 Honda Civic GX CNG', viewed 12 November 2007, <<http://automobiles.honda.com/civic-gx/>>.

³³² Kevin Black, Technical and Infrastructure Manager, OES CNG, *personal communication*, 31 October 2007.

³³³ Natural Gas Vehicle Association, 'What is LNG?' viewed 1 November 2007, <http://www.ngva.co.uk/index/fuseaction/site.articleDetail/con_id/5030>.

³³⁴ Natural Gas Vehicle Association, 'What are NGVs?' viewed 1 November 2007, <http://www.ngva.co.uk/index/fuseaction/site.articleDetail/con_id/5027>.

³³⁵ Natural Gas Vehicle Association, 'What are NGVs?' viewed 1 November 2007, <http://www.ngva.co.uk/index/fuseaction/site.articleDetail/con_id/5027>.

³³⁶ Advanced Fuels Technology Pty Ltd, 'Natural gas vehicles', viewed 1 November 2007, <<http://www.advancedfuels.com.au/ngv.htm>>.

The Committee was informed that the cost of converting a modern vehicle to operate on natural gas was around \$4500, double that of an LPG conversion.³³⁷ The cost of converting a heavy vehicle is substantially higher as it requires the compression ratio to be scaled back. This was estimated to cost between \$25,000 and \$40,000.³³⁸

4.3 Infrastructure, handling and distribution Issues

The use of natural gas in residential, industrial and commercial markets throughout Australia over the past 40 years has created extensive pipeline distribution systems that are of a very high standard.³³⁹ Given this, there are few issues associated with distribution to service stations, commercial and industrial operations or residences.

Unlike petroleum based fuels, the distribution of natural gas via the transmission and distribution pipelines avoids potential ground or water pollution.³⁴⁰ Because of the physical characteristics of natural gas and CNG, there are no major safety concerns when leakages occur.³⁴¹

4.4 Greenhouse gas emissions

Proponents of natural gas strongly advocate the environmental benefits associated with the widespread use of CNG as a transport fuel.³⁴² Because natural gas comprises mainly methane, it is associated with lower carbon dioxide (CO₂) emissions at combustion. At the tailpipe, one megajoule of natural gas is equivalent to approximately 40 grams of CO₂. This is compared to 67 grams produced from the combustion of petrol.³⁴³

A life-cycle analysis of CNG provides a slight variation to these environmental claims. The GHG emissions released into the atmosphere during upstream processes somewhat reduce the environmental benefits experienced at the tailpipe. Methane is a powerful GHG and can result in adverse effects when accidentally released from transmission and distribution pipeline systems or fuel tanks.³⁴⁴ The natural gas industry claims that such fugitive losses of methane would be less than two per cent.³⁴⁵

GHG emissions are also emitted during the transformation of natural gas into transport fuels, in particular LNG. According to the Senate Standing Committee on Rural and Regional Affairs and Transport, the energy

³³⁷ Kevin Black, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 14.

³³⁸ Kevin Black, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 15.

³³⁹ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 254.

³⁴⁰ OES CNG, *Natural gas vehicles: securing Australia's energy and environmental future*, Melbourne, June 2007, p. 4.

³⁴¹ OES CNG, *Natural gas vehicles: securing Australia's energy and environmental future*, Melbourne, June 2007, p. 4.

³⁴² OES CNG, *Natural gas vehicles: securing Australia's energy and environmental future*, Melbourne, June 2007, p. 4.

³⁴³ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 99.

³⁴⁴ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 254.

³⁴⁵ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 256.

expended to produce LNG minimises any CO₂ advantage over conventional petroleum.³⁴⁶

The 2004 CSIRO life-cycle emissions analysis for light vehicles, noted in Chapter Four, examined the use of CNG in comparison with petrol, diesel and LPG. The research findings demonstrated that CNG produced less GHG emissions than petrol and second-generation LPG vehicles but produced more emissions than diesel and third-generation LPG vehicles.³⁴⁷ The CSIRO study also showed that the use of petrol hybrid and diesel hybrid engines resulted in substantially improved GHG emissions savings compared to petrol, diesel, LPG and CNG (see Table 15).

In their analysis, CSIRO noted that the advantage of diesel over CNG related to the technical advancement of diesel engines.³⁴⁸ The Committee is of the view that further reductions in GHG emissions using CNG can potentially be achieved with improvements to NGV engine technology. This is likely to occur at a rate faster than future developments in diesel engine technology.³⁴⁹

Table 15: Life-cycle emissions of GHG from family-sized vehicles, kg CO₂-e per km.³⁵⁰

| Family-sized vehicle type | GHG (upstream) | GHG (tailpipe) | GHG (life-cycle) | % change from ULP |
|----------------------------------|----------------|----------------|------------------|-------------------|
| ULP – Euro 3 | 0.05145 | 0.29770 | 0.3491 | base |
| PULP – Euro 4 | 0.04724 | 0.24202 | 0.2892 | -17% |
| ULS PULP – Euro 4 | 0.04879 | 0.24202 | 0.2908 | -17% |
| XLS PULP – Euro 4 | 0.04938 | 0.234369 | 0.28471 | -18% |
| LSD | 0.03613 | 0.19642 | 0.2325 | -33% |
| ULSD | 0.04104 | 0.19642 | 0.2374 | -32% |
| XLSD – Euro 3 | 0.04150 | 0.19299 | 0.23449 | -33% |
| LPG Autogas: 2 nd Gen | 0.03914 | 0.26189 | 0.3013 | -14% |
| LPG Propane: 2 nd Gen | 0.03973 | 0.26235 | 0.3021 | -13% |
| LPG Autogas: 3 rd Gen | 0.03341 | 0.21752 | 0.2509 | -28% |
| LPG Propane: 3 rd Gen | 0.03308 | 0.21752 | 0.2506 | -28% |
| PULP – Hybrid | 0.02588 | 0.13300 | 0.1589 | -54% |
| LSD – Hybrid | 0.01979 | 0.10800 | 0.1278 | -63% |

³⁴⁶ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 101.

³⁴⁷ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 1.

³⁴⁸ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 98.

³⁴⁹ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 98.

³⁵⁰ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 113. Note: Australia current complies with Euro 3 for petrol and diesel products, and from 2006 complied with Euro 4 for diesel sulphur levels.

| | | | | |
|-----|---------|---------|--------|------|
| CNG | 0.05484 | 0.20644 | 0.2613 | -25% |
|-----|---------|---------|--------|------|

4.5 Other emissions

Life-cycle analyses of air pollutant emissions produced from the use of CNG and LNG highlight the benefits of using these fuels over other petroleum-based fuels. In the 2001 study *Life-cycle emissions analysis of alternative fuels for heavy vehicles*, the CSIRO determined that CNG and LNG emitted lower levels of hydrocarbons than LSD vehicles.³⁵¹ Both fuels were also found to produce substantially lower Particulate Matter (PM) emissions compared to low sulphur diesel (LSD) vehicles.³⁵² CNG also emitted less nitrogen oxides (NOx) emissions.³⁵³

The life-cycle emissions analysis of light vehicles undertaken by CSIRO in 2004 confirmed reductions in air pollutants as a result of using CNG. An examination of tailpipe and upstream processes indicated that CNG emitted less PM emissions than diesel, petrol and hybrid vehicles and produced similar emissions to third-generation LPG vehicles.³⁵⁴ CNG emitted slightly higher NMVOC emissions than third-generation LPG and diesel vehicles.³⁵⁵

Table 16: Life-cycle emissions of pollutants from family-sized vehicles.³⁵⁶

| Family-sized vehicle type | CO (g) (% change from ULP) | NOx (g) (% change from ULP) | NMVOC (g) (% change from ULP) | PM (mg) (% change from ULP) |
|---------------------------|----------------------------------|-----------------------------------|-------------------------------------|-----------------------------------|
| ULP – Euro 3 | 1.439 (base) | 2.074 (base) | 0.679 (base) | 16.106 (base) |
| PULP – Euro 4 | 0.867 (-39.7%) | 0.392 (-81.1%) | 0.479 (-29.5%) | 8.607 (-46.6%) |
| ULS PULP – Euro 4 | 0.869 (-39.6%) | 0.404 (-80.5%) | 0.487 (-28.3%) | 8.71 (-45.9%) |
| XLS PULP – Euro 4 | 0.826 (-42.6%) | 0.408 (-80.3%) | 0.49 (-27.8%) | 8.75 (-45.7%) |
| LSD | 0.054 (-96.2%) | 0.745 (-64.1%) | 0.117 (-82.8%) | 50.494 (+213.5%) |
| ULSD | 0.062 (-95.7%) | 0.781 (-62.3%) | 0.121 (-82.2%) | 50.757 (+215.1%) |
| XLSD – Euro 3 | 0.071 | 0.817 | 0.124 | 45.7 |

³⁵¹ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 49.

³⁵² Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 47 & 53.

³⁵³ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 49.

³⁵⁴ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 98.

³⁵⁵ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 112.

³⁵⁶ Source: Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 112.

| | | | | |
|----------------------|-------------------|-------------------|-------------------|-------------------|
| | (-95.1%) | (-60.6%) | (-81.7%) | (+183.7%) |
| LPG Autogas: 2nd Gen | 1.776 (+23.4%) | 1.074 (-48.2%) | 0.343 (-49.5%) | 6.059 (-62.4%) |
| LPG Propane: 2nd Gen | 1.045 (-27.4%) | 1.269 (-38.8%) | 0.322 (-52.6%) | 6.145 (-61.8%) |
| LPG Autogas: 3rd Gen | 1.15 (-20.1%) | 0.134 (-93.5%) | 0.195 (-71.3%) | 4.531 (-71.9%) |
| LPG Propane: 3rd Gen | 1.15 (-20.1%) | 0.133 (-93.6%) | 0.193 (-71.6%) | 4.511 (-72.0%) |
| PULP – Hybrid | 0.544 (-62.2%) | 0.144 (-93.1%) | 0.235 (-65.4%) | 4.525 (-71.9%) |
| CNG LV | 0.544 (-62.2%) | 0.144 (-93.1%) | 0.235 (-65.4%) | 4.525 (-71.9%) |

4.6 Costs and revenue

4.6.1 Production costs

As the use of CNG is not widespread throughout Australia, there is limited information available on the relevant pricing schemes. Given this, it is appropriate to report on the pricing schemes of natural gas, of which the price of CNG is typically based around.

The costs associated with the production of natural gas relate to refining processes, the transmission and distribution of gas to the major markets and retail based activities. A number of different organisations are involved in the natural gas industry with some organisations involved in various operations of the industry and others only involved in one or two operations.³⁵⁷

The production of gas includes the exploration and extraction of gas from Australia's major basins. The transmission of natural gas involves transporting it from gas fields to city gate stations via large pipelines systems operating at high pressures.³⁵⁸ At this point the transmission systems and distribution networks become linked.³⁵⁹ From these gas stations, distribution networks provide gas to residential, commercial and industrial customers. Prior to distribution gate stations reduce the pressure of the gas according to its application. At this stage, the gas is also metered and odorised.³⁶⁰ Gas retailers are responsible for the sale of natural gas to customers and for organising delivery of natural gas to residences.

³⁵⁷ Productivity Commission, *Review of the Gas Access Regime*, Australian Government, Canberra, 2004, p. 15.

³⁵⁸ NERA Economic Consulting, *The gas supply chain in Eastern Australia: a report to the Australian Energy Market Commission*, Sydney, 2007, p. 36.

³⁵⁹ NERA Economic Consulting, *The gas supply chain in Eastern Australia: a report to the Australian Energy Market Commission*, Sydney, 2007, p. 52.

³⁶⁰ NERA Economic Consulting, *The gas supply chain in Eastern Australia: a report to the Australian Energy Market Commission*, Sydney, 2007, p. 52.

For residential customers, gas retailers provide the interface between gas producers and the transmission and distribution pipeline owners.³⁶¹ Prices that retailers negotiate with each of these operators are reflected in the final cost of the gas paid by consumers.

Text Box 2: Victoria's Gas Market

In Victoria, the gas industry is regulated by the *Victorian Gas Industry Act 2001*.³⁶² This Act details the responsibilities of the Essential Services Commission (ESC) and the Victorian Energy Networks Corporation (VENCorp), both of which oversee the various aspects of the supply and sale of gas in Victoria. The ESC is also legislated under the *Essential Services Commission Act 2001*.³⁶³

The ESC is Victoria's independent economic regulator of the gas retail market. Its key objective is to protect the long term interests of gas consumers with regard to the price, quality and reliability of gas services.³⁶⁴

VENCorp is the system operator for the Victorian gas transmission network and is the manager of the Victorian wholesale gas market. In this role, VENCorp informs market participants, such as gas producers, retailers and end-users on pricing, gas demands and forecasts.³⁶⁵ In the retail gas market, VENCorp manages the gas Full Retail Contestability (FRC) functions. The FRC was introduced in 2002 to enable Victorian gas users to choose their gas retailer from all the gas retailers competing in Victoria.³⁶⁶

VENCorp also administers Victoria's physical spot market, which provides an avenue where users can trade gas supply imbalances.³⁶⁷ The spot price viewed as a proxy for the price paid for natural gas in the Victorian basins. In the period of 1 January 2002 to 31 January 2007, the Victorian spot price averaged \$2.94 per GJ.³⁶⁸

4.6.2 Income

The natural gas market is made up of various localised submarkets rather than one single market.³⁶⁹ Because of this, differing gas prices exist for each sub-market and are influenced by local supply and demand factors. For example, in Victoria approximately one third of natural gas is consumed by residential customers compared to only ten per cent in other

³⁶¹ NERA Economic Consulting, *The gas supply chain in Eastern Australia: a report to the Australian Energy Market Commission*, Sydney, 2007, p. 67.

³⁶² Gas Industry Act 2001

³⁶³ Essential Services Commission Act 2001 (Vic)

³⁶⁴ Essential Services Commission Act 2001 (Vic)

³⁶⁵ VENCorp, 'Gas Wholesale Market', viewed 12 November 2007, <<http://www.vencorp.com.au/index.php?sectionID=7721&pageID=7729>>.

³⁶⁶ VENCorp, 'Gas Retail Market', viewed 12 November 2007, <<http://www.vencorp.com.au>>.

³⁶⁷ NERA Economic Consulting, *The gas supply chain in Eastern Australia: a report to the Australian Energy Market Commission*, Sydney, 2007, p. 26.

³⁶⁸ NERA Economic Consulting, *The gas supply chain in Eastern Australia: a report to the Australian Energy Market Commission*, Sydney, 2007, p. 34.

³⁶⁹ NERA Economic Consulting, *The gas supply chain in Eastern Australia: a report to the Australian Energy Market Commission*, Sydney, 2007, p. 32.

jurisdictions.³⁷⁰ In Western Australia, a large proportion of natural gas is consumed by the mining industry.³⁷¹

Despite the differing supply and demand factors among jurisdictions, the breakdown of costs paid by customers for natural gas in residential settings is similar. Of total residential costs:

- 30 per cent is accounted for by the ex-plant price of gas and transportation of that gas to the gate stations;
- 60 per cent is accounted for by local distribution and metering costs;
- 8 per cent is accounted for by the retailer's billing, marketing and customer service costs; and
- 2 per cent is accounted for by the retailer's net profit margin.³⁷²

At present it is estimated that natural gas is supplied to residential networks in urban areas for around 33 cents per litre.³⁷³

4.6.3 Australia's fuel and taxation system

On 1 July 2006, the Commonwealth Government introduced a new fuel excise system that aims to improve competitive neutrality between various fuels.³⁷⁴ The system is being gradually phased in until 1 July 2015.³⁷⁵

Alternative fuels including CNG enter the excise system on 1 July 2011. On the basis that all alternative fuels will be discounted at a rate of 50 per cent, the total excise payable on CNG by 1 July 2015 will be 19.0 cents per cubic metre.³⁷⁶ The Goods and Services Tax is also payable on natural gas.³⁷⁷

4.6.4 Retail CNG prices

The cost of CNG is considerably lower than other fuels. It is estimated that a vehicle operating on CNG will pay approximately 26 cents for the equivalent of one litre of petrol or 19 cents for the equivalent of one litre of

³⁷⁰ Productivity Commission, *Review of the Gas Access Regime*, Australian Government, Canberra, 2004, p. 18.

³⁷¹ Productivity Commission, *Review of the Gas Access Regime*, Australian Government, Canberra, 2004, p. 18.

³⁷² NERA Economic Consulting, *The gas supply chain in Eastern Australia: a report to the Australian Energy Market Commission*, Sydney, 2007, p. 68.

³⁷³ OES CNG, 'Compressed natural gas (CNG) Systems', viewed 25 October 2007, <<http://www.oes.net.au/compressed-natural-gas-cng-system.shtml>>.

³⁷⁴ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004.

³⁷⁵ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004.

³⁷⁶ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004.

³⁷⁷ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 26.

LPG.³⁷⁸ This provides substantial savings on fuel even when taking into account the limited fuel range of CNG.

Information provided by Advanced Fuels Technology indicates that the price of CNG at a refuelling station is based on the following:

- the gas supply price (\$/GJ) to the meter;
- the electricity supply price required to run the compressor;
- capital costs associated with the CNG refuelling station and its installation; and
- a retail margin for the service station owner.³⁷⁹

With home compressor systems currently being developed by OES CNG, motorists will have the capability to refuel their NGVs at home for between 22 and 50 cents per litre of gas.³⁸⁰ Mr Lincoln of OES CNG claims that at a cost of \$7000 for a complete home compressor and vehicle conversion, motorists will earn their money back in less than 18 months.³⁸¹

4.6.4 Price stability

Unlike petroleum-based fuels, the cost of natural gas in Australia is not yet tied to international pricing. Because it is not subject to world oil prices or foreign exchange rates, there is a perception that the cost of natural gas will remain relatively stable.³⁸² This is considered beneficial in the current environment where the price and availability of petroleum based fuels can be volatile.

It has been suggested that Australia's LNG export market may influence domestic natural gas prices. In their examination of the future demand and supply of gas for domestic use in September 2007, the Australian Ministerial Council on Mineral and Petroleum Resources advised of the potential for natural gas to become a global commodity:

Global and domestic demand for natural gas is likely to increase as a result of increased economic growth and the attractiveness of gas as a relatively cheap, abundant and low emission transition fuel as more countries establish schemes to reduce greenhouse gas emissions.³⁸³

The increased demand for LNG in Japan, the Republic of Korea and China and the declining production of natural gas in Europe and North America

³⁷⁸ OES CNG, 'Compressed natural gas (CNG) Systems', viewed 25 October 2007, <<http://www.oes.net.au/compressed-natural-gas-cng-system.shtml>>.

³⁷⁹ Sean Blythe, Chief Executive Officer, Advanced Fuels Technology Pty Ltd, *personal communication*, 9 November 2007.

³⁸⁰ John Lincoln, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 10.

³⁸¹ John Lincoln, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 15.

³⁸² OES CNG, *Natural gas vehicles: securing Australia's energy and environmental future*, Melbourne, June 2007, p. 6.

³⁸³ Ministerial Council on Mineral and Petroleum Resources, *Ministerial Council on Energy Joint Working Group on Natural Gas Supply*, September 2007, p. 11.

has led to a global trade in natural gas.³⁸⁴ It is forecast that global LNG export and import capacity will double by 2010.³⁸⁵ Australia's existing role in the LNG export market is already placing upward pressure on the domestic price of natural gas in certain segments of Australia's gas industry. In Western Australia, where LNG exports are currently viable, gas prices are double the price of gas in the eastern markets.³⁸⁶

4.7 Current production, potential and constraints

Natural gas is Australia's third major energy source following coal and oil and accounts for 20 per cent of the country's primary energy needs.³⁸⁷ According to the Commonwealth Department of Industry, Tourism and Resources, total identified Australian natural gas resources comprise over 160,000 petajoules (PJ) of energy.³⁸⁸ Over 3.4 million households and 105,000 commercial and industrial customers receive natural gas through Australia's distribution network of over 75,000 kilometres of pipelines.³⁸⁹ In Victoria alone, 1.5 million households are supplied with gas through a distribution network of 25,000 kilometres of pipelines.³⁹⁰

There are three large transmission networks in Australia, located in South Eastern Australia, Western Australia, and the Northern Territory.³⁹¹ A large proportion of Australia's natural gas is obtained from Western Australia with 66 per cent extracted from the Carnarvon Basin in 2005-06.³⁹² In that year 19 per cent of Australia's natural gas came from Victoria (mainly from the Gippsland Basin) and 13 per cent was obtained in South Australia (principally from the Cooper-Eromanga Basin.)³⁹³ The Western and Northern reserves support LNG facilities, in particular the supply of gas to international markets.³⁹⁴ Table 17 shows Australia's production of gas according to state jurisdictions.

³⁸⁴ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 93.

³⁸⁵ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 93.

³⁸⁶ Ministerial Council on Mineral and Petroleum Resources, *Ministerial Council on Energy Joint Working Group on Natural Gas Supply*, September 2007, p. 16.

³⁸⁷ Department of Industry Tourism and Resources, 'Australian natural gas industry', <<http://www.oes.net.au/compressed-natural-gas-cng-system.shtml>>.

³⁸⁸ Department of Industry Tourism and Resources, 'Australian natural gas industry', <<http://www.oes.net.au/compressed-natural-gas-cng-system.shtml>>.

³⁸⁹ EnergySafe Victoria, 'Natural Gas in Australia', viewed 26 October 2007, <<http://www.esv.vic.gov.au>>.

³⁹⁰ EnergySafe Victoria, 'Natural gas in Victoria', viewed 26 October 2007, <<http://www.esv.vic.gov.au>>.

³⁹¹ Department of Industry Tourism and Resources, 'Australian natural gas industry', <<http://www.oes.net.au/compressed-natural-gas-cng-system.shtml>>.

³⁹² ABARE, *Energy in Australia 2006*, Department of Industry, Tourism and Resources, Canberra, 2007, p. 35.

³⁹³ ABARE, *Energy in Australia 2006*, Department of Industry, Tourism and Resources, Canberra, 2007, p. 35.

³⁹⁴ Ministerial Council on Mineral and Petroleum Resources, *Ministerial Council on Energy Joint Working Group on Natural Gas Supply*, September 2007, p. 8.

Table 17: Australia's production of natural gas by state and territory, 2000-01 to 2005-06.³⁹⁵

| Jurisdiction | 2000-01 GL | 2001-02 GL | 2002-03 GL | 2003-04 GL | 2004-05 GL | 2005-06 GL |
|--------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Northern Territory | 459 | 471 | 452 | 423 | 479 | 494 |
| Queensland | 632 | 533 | 650 | 640 | 706 | 653 |
| South Australia | 5765 | 6308 | 5754 | 4288 | 4149 | 4004 |
| Victoria | 6507 | 6671 | 6533 | 7747 | 7758 | 7435 |
| Western Australia | 18641 | 18560 | 20179 | 20561 | 24582 | 25887 |
| Total | 32004 | 32543 | 33568 | 33659 | 37674 | 38473 |

Australia is the 18th largest producer of natural gas and the seventh largest exporter of LNG in the world.³⁹⁶ Geoscience Australia estimates that current and recoverable reserves total 4085.46 billion cubic metres, which at current rates of production equates to a resource life of 65 years.³⁹⁷ Other estimations have forecast that natural gas reserves are sufficient to meet demand for 100 years, with some gas wells alone satisfying the energy needs of 10 to 15 years.³⁹⁸

Australia exported 15.2 million tonnes of LNG in 2006-07, an increase of 22 per cent from the previous year. The value of these exports was \$5.2 billion, which is expected to increase by eight per cent in 2007-08.³⁹⁹

4.7.1 Availability

Despite Australia's extensive pipeline distribution system, the use of natural gas as a transport fuel is minimal. Elsewhere the use of CNG is more widespread, with more than 1 million NGVs on the roads in Brazil and at least half a million in Europe.⁴⁰⁰ In these regions, the use of CNG as a transport fuel has received extensive government support. In Brazil, the regional government in Rio de Janeiro legislated for the mandatory use of CNG in all official government vehicles. The City of Stockholm in Sweden requires all service stations in the city to have a CNG refuelling station.⁴⁰¹ The Chinese Government has nominated 16 cities (including Shanghai and Beijing) that must convert their bus and taxi fleets to alternative fuels in

³⁹⁵ ABARE, *Energy in Australia 2006*, Department of Industry, Tourism and Resources, Canberra, 2007, p. 36.

³⁹⁶ Austrade, 'Oil and gas overview', viewed 25 October 2007, <<https://www.austrade.gov.au/Oil-Gas-overview/default.aspx>>.

³⁹⁷ Geoscience Australia, *Submission*, no. 127, Australia's future oil supply and alternative transport fuels, The Senate Standing Committee on Rural and Regional Affairs and Transport.

³⁹⁸ OES CNG, *Submission*, no. 53, 13 August 2007, p. 9.

³⁹⁹ ABARE, *Australian commodities*, Australian Government, Canberra, 2007, p. 312.

⁴⁰⁰ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 92.

⁴⁰¹ Kevin Black, Technical and Infrastructure Manager, OES CNG, *personal communication*, 31 October 2007.

time for the 2008 Olympic Games. It is estimated that approximately 90 per cent of these alternative fuels will be derived from natural gas.⁴⁰²

The Committee is aware of the Commonwealth Government's attempts to encourage the take up of natural gas as a transport fuel. In 1999, the Prime Minister delivered the 'Measures for a Better Environment' package that launched the Alternative Fuels Conversion Program (AFCP).⁴⁰³ This Program committed \$75 million until 2007-08 to support conversion, purchase or fuel system upgrades of commercial road vehicles and buses over 3.5 tonnes to either CNG or LPG.⁴⁰⁴ The Program specified strict environmental criteria that required demonstration of a five per cent reduction in GHG emissions with the use of CNG in heavy vehicles.⁴⁰⁵ In its 2001-02 Annual Report, the Australian Greenhouse Office reported that the AFCP resulted in the delivery of 557 CNG buses in NSW, Queensland, South Australia and Western Australia, making Australia the second largest CNG bus fleet operator, on a per capita basis, in the world.⁴⁰⁶

At the same time, the Commonwealth Government introduced the CNG Infrastructure Program (CNGIP), a \$7.6 million program that aimed to facilitate the development of a network of publicly accessible CNG refuelling stations throughout Australia.⁴⁰⁷ The program was flagged as part of Australia's contribution to the Kyoto Treaty.⁴⁰⁸

The Committee heard evidence of the CNGIP's limited success in establishing CNG refuelling stations. As a result the program was rolled back and dedicated funds were either diverted to biofuels or returned to consolidated revenue. Mr Kevin Black, Technical and Infrastructure Manager of OES CNG, informed the Committee of how the policy settings at the time did not accurately target CNG:

The problem is that out of the 13 million vehicles on Australian roads, 350,000 of them qualified to be considered under that program. The diesel engine technology was just not sufficiently advanced at that time to enable us to move forward. Although funds were allocated to two of the major gas companies to put in 16 refuelling stations, they decided that there would not be enough customers, and anyway it was not their core business anymore and they pulled out.⁴⁰⁹

This point highlights the 'chicken and egg' dilemma associated with securing investment in CNG in Australia. It is estimated that only 25 light vehicles and 50 light commercial CNG-compatible vehicles currently

⁴⁰² Envestra, *Submission*, Australia's future oil supply and alternative transport fuels, The Senate Standing Committee on Rural and Regional Affairs and Transport, Commonwealth Parliament, p. 12.

⁴⁰³ Senator the Hon Robert Hill, 'Converting \$12.4 million into improved greenhouse performance', viewed 25 October 2007, <<http://www.environment.gov.au/minister/env/2000/mr21aug00.html>>.

⁴⁰⁴ Australian Greenhouse Office, 'Alternative fuels conversion programme', viewed 25 October 2007, <<http://www.greenhouse.gov.au/transport/afcp/index.html>>.

⁴⁰⁵ Australian Greenhouse Office, 'Alternative fuels conversion programme', viewed 25 October 2007, <<http://www.greenhouse.gov.au/transport/afcp/index.html>>.

⁴⁰⁶ Australian Greenhouse Office, *Australian Greenhouse Office annual report 2001-2002*, Australian Greenhouse Office, Canberra, 2002.

⁴⁰⁷ Australian Greenhouse Office, *Australian Greenhouse Office annual report 2001-2002*, Australian Greenhouse Office, Canberra, 2002.

⁴⁰⁸ Kevin Black, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 12.

⁴⁰⁹ Kevin Black, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 12.

operate in Australia.⁴¹⁰ Because there is limited demand for CNG, companies are reluctant to invest in establishing refuelling stations. However insufficient refuelling infrastructure discourages motorists from converting their vehicles to CNG.⁴¹¹

At present, there are only four refuelling sites in Australia, located at Moorebank, NSW; Goulburn, NSW; Fyshwick, ACT; and Mile End, South Australia.⁴¹² In addition, there are 130 depot-based private refuelling stations that are used for refuelling CNG compatible forklifts and buses, of which there are around 3000 and 1400 in Australia respectively.⁴¹³

The lack of CNG refuelling infrastructure is commonly perceived to be the largest barrier to the development of a viable CNG industry and the widespread adoption of CNG as a fuel in Australia.⁴¹⁴

Finding 6: CNG has the potential to significantly contribute to Australia's fuel transport mix.

⁴¹⁰ Kevin Black, Technical and Infrastructure Manager, OES CNG, *personal communication*, 31 October 2007.

⁴¹¹ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 97.

⁴¹² Kevin Black, Technical and Infrastructure Manager, OES CNG, *personal communication*, 31 October 2007.

⁴¹³ Kevin Black, Technical and Infrastructure Manager, OES CNG, *personal communication*, 31 October 2007.

⁴¹⁴ OES CNG, *Submission*, no. 53, 13 August 2007; Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 97.

Chapter Five: Key points

- In Australia, the three main petroleum products are petrol, diesel and liquefied petroleum gas (LPG) (p. 77).
 - The downstream sector of the petroleum industry, which comprises refinery processes and the marketing and sale of petroleum products to the general public, has undergone considerable change over the last 20 years. The number of operating refineries has reduced from ten to seven. There has also been a decrease in the number of retail sites from 20,000 in 1970 to less than 7,000 today (p. 91).
 - In Australia the four major petroleum companies – BP Australia, Caltex, Exxon Mobil and Shell Australia – account for 90 per cent of total fuel sales (p. 91).
 - The introduction of the *Fuel Quality Standards Act 2000* placed limitations on specified characteristics of petrol, diesel and LPG, which along with emerging engine technologies has improved vehicle efficiency and reduced fuel pollutants (p. 61).
 - Diesel vehicles produce less tailpipe greenhouse gas emissions (GHG) emissions than petrol or LPG vehicles. This is the result of the introduction of the extra low sulphur diesel (XLSD) Euro 3 vehicle. However, the upstream emissions released during production of XLSD are substantially higher than the other fuels due to the additional refining process required to reduce the sulphur content (p. 83).
 - The Bureau of Transport and Regional Services (BTRE) projected that metropolitan vehicle kilometres will increase by 46 per cent by 2020. Despite this, it determined there would be an overall reduction in pollutant emissions, in particular carbon monoxide (CO) and volatile organic compounds (VOC) emissions, due to a new and more efficient vehicle fleet. It was predicted that particulate matter (PM) emissions would remain stable (p. 84).
 - There has been a rapid uptake of LPG in Australia, facilitated by the Commonwealth Government's LPG Vehicle Scheme. This scheme provides financial assistance to motorists to either purchase a new LPG vehicle or convert a new or used vehicle to use LPG. As of October 2007, a total of 82,763 grants had been provided to Australian motorists (p. 82).
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Chapter Five: Petroleum

Petroleum is a complex mixture of naturally occurring liquids that are found in geological formations of the Earth.⁴¹⁵ In the refinery process, crude oil and natural gas are broken down and blended into usable products such as petrol, diesel and LPG. These three fuels are the key focus of this Chapter.

Australia's petroleum industry is comprised of upstream and downstream sectors. The 'upstream sector' refers to processes involved in the extraction of petroleum from the natural environment,⁴¹⁶ whereas the 'downstream sector' refers to domestic refineries, wholesalers, importers, distributors and retailers.⁴¹⁷ The downstream sector is considered vital to the Australian economy. It employs 97,000 people and is valued at \$14 billion per annum.

5.0.1 Petrol

Petrol or automotive gasoline is a flammable mixture of hydrocarbons derived from petroleum.⁴¹⁸ It is principally used as a fuel in internal-combustion engines and is the most widely used automotive fuel in Australia. The most common type of petrol is unleaded petrol (ULP), which has been recommended for use in the majority of vehicles since 1986. Premium unleaded petrol (PULP) is another type of petrol that is used in vehicles with high compression ratios.

5.0.2 Diesel

Diesel or automotive diesel oil is a product derived from the distillation of crude oil and is used only in compression ignition engines, commonly referred to as diesel engines. Diesel is a 'middle distillate', reflecting its weight compared to lighter fuels such as petrol and heavier fuels such as fuel oil, lubricating oils, wax, and tar.⁴¹⁹

⁴¹⁵ Australian Institute of Petroleum, 'Petroleum topic fact sheet - refining of petroleum', viewed 2 October 2007, <http://www.aip.com.au/industry/fact_refine.htm>.

⁴¹⁶ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 9.

⁴¹⁷ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 84.

⁴¹⁸ Australian Institute of Petroleum, 'Petroleum topic fact sheet - refining of petroleum', viewed 2 October 2007, <http://www.aip.com.au/industry/fact_refine.htm>.

⁴¹⁹ Department of Industry Tourism and Resources, 'Diesel - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>; Department of Industry Tourism and Resources, 'Fuel standards', viewed 3 October 2007, <<http://www.industry.gov.au>>.

5.0.3 Liquefied Petroleum Gas

LPG is a colourless and odourless gas that burns readily in air and is used as a fuel in a range of applications.⁴²⁰ Automotive LPG is a mixture of hydrocarbons, mainly propane and butane. Bottled gas that is used solely for domestic purposes consists only of propane.⁴²¹ Automotive LPG contains a mixture of propane and butane and cannot be used for domestic purposes. LPG can occur naturally where it is extracted along with crude oil and natural gas, or it can be extracted from crude oil during the refinery process.⁴²²

LPG is an important transport fuel for light duty vehicles in Australia, and has the third largest market share of Australian fuels behind petrol and diesel. On a global scale Australia has among the highest per capita usage of LPG. It is estimated that by 2010 LPG will account for at least eight per cent of all road transport fuel usage.⁴²³

5.1 Production methods

Crude oil and natural gas are extracted from the natural environment by sinking an oil well into underground oil reserves. They are then transported to refineries by pipelines and/or ships to be broken down and blended into useable products.⁴²⁴

While refineries differ by size and production processes, there are a set of typical functions common to all refineries. The key refining processes are the separation of crude oil into its component parts ('fractions') using distillation, followed by further treatment of the fractions using methods (such as cracking, reforming, alkylation, polymerisation and isomerisation) to convert them into various petroleum products.⁴²⁵ The products resulting from these processes are then blended to meet the various fuel specifications.⁴²⁶

5.2 Fuel characteristics

The composition of petroleum products has changed over the last five years as a result of the introduction of national fuel quality standards under the *Fuel Quality Standards Act 2000*. The *Fuel Standard (Petrol) Determination 2001*, *Fuel Standard (Automotive Diesel) Determination 2001* and the *Fuel Standard (Autogas) Determination 2003* specify

⁴²⁰ Department of Industry Tourism and Resources, 'Liquefied Petroleum Gas (LPG) - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁴²¹ Australian Institute of Petroleum, 'Petroleum topic fact sheet - liquified petroleum gas', viewed 3 October 2007, <http://www.aip.com.au/industry/fact_liquid_gas.htm>.

⁴²² Australian Institute of Petroleum, 'Petroleum topic fact sheet - liquified petroleum gas', viewed 3 October 2007, <http://www.aip.com.au/industry/fact_liquid_gas.htm>.

⁴²³ Environment Australia, *Proposed standards for liquefied petroleum gas (autogas)*, Department of the Environment and Heritage, Canberra, October 2001, p. 7.

⁴²⁴ Australian Institute of Petroleum, 'Petroleum topic fact sheet - refining of petroleum', viewed 2 October 2007, <http://www.aip.com.au/industry/fact_refine.htm>.

⁴²⁵ Australian Institute of Petroleum, 'Petroleum topic fact sheet - refining of petroleum', viewed 2 October 2007, <http://www.aip.com.au/industry/fact_refine.htm>.

⁴²⁶ BP Australia, 'How the refining process works', viewed 25 September 2007, <<http://www.bp.com>>.

limitations on the characteristics of petrol, diesel and LPG in order to reduce fuel pollutants and achieve tighter emissions standards.⁴²⁷

Changes to fuel quality standards in Australia were made in response to amendments to the European fuel specifications, which accommodated emerging engine emission technologies and vehicle emission requirements.⁴²⁸

The Commonwealth Department of Transport and Regional Services administers the Australian Design Rules, which establish emissions, noise and fuel consumption labelling standards for vehicles.⁴²⁹ The Australian Design Rules are gradually harmonising with vehicle standards developed by the Economic Commission for Europe. Table 18 details the timetable of the adoption of vehicle standards for light vehicles in Australia.

Table 18: Timeline for the adoption of European Standards for light vehicles in Australia.⁴³⁰

| Vehicle Type | Standard | Adoption Date |
|-----------------------------|----------|-----------------|
| Petrol, LPG and NG Vehicles | Euro 2 | 1/1/03 – 1/1/04 |
| | Euro 3 | 1/1/05 – 1/1/06 |
| | Euro 4 | 1/7/08 – 1/7/10 |
| Diesel Vehicles | Euro 2 | 1/1/02 – 1/1/03 |
| | Euro 4 | 1/1/06 – 1/1/07 |

The progressive introduction of the fuel standards from 2002 to 2006 has required significant financial investment in Australian refineries. Prior to 2002 an estimated \$2 billion was invested to update refinery equipment and technology to ensure compliance with the national fuel requirements.⁴³¹

The key focus of regulations for both petrol and diesel is sulphur content, which has been progressively tightened over time. Sulphur affects vehicle

⁴²⁷ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 40.

⁴²⁸ Department of Transport and Regional Services, 'General information - emissions and ADR's', viewed 17 October 2007,

<<http://www.dotars.gov.au/roads/environment/impact/index.aspx>>.

⁴²⁹ Department of Transport and Regional Services, 'General information - emissions and ADR's', viewed 17 October 2007,

<<http://www.dotars.gov.au/roads/environment/impact/index.aspx>>.

⁴³⁰ Department of Transport and Regional Services, 'General information - emissions and ADR's', viewed 17 October 2007,

<<http://www.dotars.gov.au/roads/environment/impact/index.aspx>>.

⁴³¹ Australian Competition and Consumer Commission, *Senate Economics Legislation Committee inquiry into the price of petrol in Australia - ACCC submission*, Commonwealth of Australia, Canberra, July 2006, p. 10.

emissions by reducing the efficiency of catalytic converters.⁴³² In diesel and petrol vehicles, sulphur contributes to the formation of PM emissions.⁴³³

In 2002, the sulphur content was 500ppm for both diesel and petrol, which was substantially reduced to 150ppm for petrol in January 2005⁴³⁴ and 50ppm for diesel in January 2006.⁴³⁵ Since 1 January 2008, the sulphur content of PULP has been 50ppm.⁴³⁶ From 1 January 2009, diesel will comprise 10ppm sulphur.⁴³⁷

Finding 7: The introduction of national fuel quality standards and vehicle emission standards has improved engine performance and reduced adverse effects of the transport sector on the environment.

5.2.1 Petrol

Fuel octane rating

As described in Chapter Three, the octane rating of petrol is a measure of the petrol's ability to resist auto-ignition.⁴³⁸ Vehicles are designed to use fuels with specific octane ratings.⁴³⁹ The use of petrol with a different octane rating to that specified for an engine can lead to knocking and severe engine damage.⁴⁴⁰ Petrol with a higher octane rating is suited for use in engines with higher compression ratios. These engines are generally more fuel-efficient than engines that have lower compression ratios.⁴⁴¹

In Australia refinery processes are typically used to convert low octane fuels into higher octane fuels. In Europe and Asia, oxygenated organic compounds are added to petrol to enhance its octane rating. In Australia the use of these compounds is prohibited. In November 2000, the Commonwealth Government examined the suitability of a number of octane enhancing additives and determined that most were not appropriate due to their potential to contaminate surface and water ground supplies.⁴⁴²

⁴³² Environment Australia, *Proposed standards for fuel parameters (petrol and diesel)*, Department of the Environment and Heritage, Canberra, May 2000, p. 25.

⁴³³ Environment Australia, *Proposed standards for fuel parameters (petrol and diesel)*, Department of the Environment and Heritage, Canberra, May 2000.

⁴³⁴ Department of Environment and Water Resources, 'Petrol standards', viewed 11 October 2007, <<http://www.environment.gov.au>>.

⁴³⁵ Department of Environment and Water Resources, 'Diesel standards', viewed 11 October 2007, <<http://www.environment.gov.au>>.

⁴³⁶ Department of Environment and Water Resources, 'Petrol standards', viewed 11 October 2007, <<http://www.environment.gov.au>>.

⁴³⁷ Department of Environment and Water Resources, 'Diesel standards', viewed 11 October 2007, <<http://www.environment.gov.au>>.

⁴³⁸ Environment Australia, *Proposed standards for fuel parameters (petrol and diesel)*, Department of the Environment and Heritage, Canberra, May 2000, p. 59.

⁴³⁹ Department of Environment and Heritage, 'Setting the ethanol limit in petrol', viewed 11 October 2007, <<http://eied.deh.gov.au>>.

⁴⁴⁰ Environment Australia, *Proposed standards for fuel parameters (petrol and diesel)*, Department of the Environment and Heritage, Canberra, May 2000.

⁴⁴¹ Environment Australia, *Proposed standards for fuel parameters (petrol and diesel)*, Department of the Environment and Heritage, Canberra, May 2000, p. 61.

⁴⁴² These additives included methyl tertiary-butyl ether (MTBE), di-isopropyl ether (DIPE), ethyl tertiary-butyl ether (ETBE), tertiary amyl methyl ether (TAME) and ethyl tertiary amyl ether (ETA). Environment Australia, *Proposed management of petrol octane*

Ethanol can be used as an octane enhancer but issues regarding cost and supply are barriers to widespread use in Australia.⁴⁴³ For this reason Australian fuel refiners are likely to continue to employ the three in-house plant refinery processes of isomerisation, alkylation and reforming to enhance the octane rating of petrol.⁴⁴⁴

5.2.2 Diesel

The most important characteristics pertaining to diesel fuel are cetane, density, viscosity and volatility. These characteristics are discussed in the context of biodiesel use in Chapter Two. The similarity of petroleum diesel to biodiesel in all but a few respects means that further discussion of fuel characteristics is not required here.

5.2.3 LPG

LPG is comprised of light hydrocarbons that are gaseous at normal temperatures and pressures but can easily liquefy at increased pressures or reduced temperatures.⁴⁴⁵ LPG is stored in vehicles in a liquid form in a steel tank and is converted to a gas via a regulator for intake to the engine.⁴⁴⁶

The combustion and vaporisation of LPG are typically characterised by the motor octane number (MON) value, vapour pressure and hydrocarbon composition.⁴⁴⁷ These factors impact the environmental performance and operability of LPG fuel.⁴⁴⁸

Residue limits

A common problem with LPG is the build up of a brown, waxy residue in LPG fuel systems. This can lead to start-ability and driveability issues, particularly in the winter months.⁴⁴⁹ To ensure the effective operability of engines, the residue content of LPG fuel must be controlled so that the presence of deposits in regulators and vaporisers is minimised.⁴⁵⁰

enhancing additives/products, Department of the Environment and Heritage, Canberra, November 2000.

⁴⁴³ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target - appendices*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 62.

⁴⁴⁴ Environment Australia, *Proposed management of petrol octane enhancing additives/products*, Department of the Environment and Heritage, Canberra, November 2000, p. 4.

⁴⁴⁵ Department of Environment and Water Resources, 'Frequently asked questions: autogas fuel quality standards', viewed 16 October 2007, <<http://www.environment.gov.au>>.

⁴⁴⁶ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 293.

⁴⁴⁷ For further information on the MON value and vapour pressure, refer to page 5 of report.

⁴⁴⁸ Environment Australia, *Proposed standards for liquefied petroleum gas (autogas)*, Department of the Environment and Heritage, Canberra, October 2001, p. 17.

⁴⁴⁹ RACV, 'Fuel', viewed 18 October 2007, <<http://racv.com.au>>.

⁴⁵⁰ Department of Environment and Water Resources, 'Frequently asked questions: autogas fuel quality standards', viewed 16 October 2007, <<http://www.environment.gov.au>>.

LPG conversions

Petrol and diesel vehicles can install LPG systems for as little as \$1500 depending on the vehicle type.⁴⁵¹ New vehicles can also be factory-fitted with LPG systems. LPG dedicated vehicles are also available on the market, and are estimated to cost \$800 more than the price of a new petrol operated vehicle.⁴⁵² The conversion of an existing vehicle to LPG requires the installation of carbon steel tanks, which may reduce available boot space in the vehicle. In LPG dedicated vehicles the tank is built into the design of the vehicle and does not take up more space than a typical petrol tank.⁴⁵³

There are currently over 500,000 LPG vehicles on the roads in Australia.⁴⁵⁴ This number is rapidly increasing with a long waiting list for vehicles to be converted. Uptake of LPG in Australia has been facilitated by the Commonwealth Government's *LPG Vehicle Scheme* that provides financial assistance to private motorists to either purchase a new LPG vehicle or convert a new or used vehicle to use LPG. As of 7 October 2007 a total of 82,763 grants had been provided to Australian motorists.⁴⁵⁵ It is expected that a total of \$776.1 million will be spent by the Scheme's completion in June 2014.⁴⁵⁶

Vehicle warranties

There is little concern regarding continued vehicle warranty coverage when installing LPG systems into vehicles. Vehicle manufacturers warrant LPG systems that they fit or endorse. Damage to vehicles caused by an LPG system fitted by another business is normally covered by the LPG system supplier and installer. According to LPG Autogas Australia, suppliers and installers provide a warranty for two years or 50,000 kilometres.⁴⁵⁷

5.3 Infrastructure, handling and distribution issues

Refineries and large fuel handling terminals are recognised points of hazard that require effective and comprehensive safety management systems. There are also potential environmental hazards relating to the contamination of marine and bird life during the transportation of oil in tankers. Leakages at service stations and refuelling depots can also contaminate groundwater supplies.⁴⁵⁸

⁴⁵¹ Australian Liquefied Petroleum Gas Association Limited, 'Autogas information kit', viewed 16 October 2007, <<http://www.lpgaaustralia.com.au>>.

⁴⁵² Australian Liquefied Petroleum Gas Association Limited, 'Autogas information kit', viewed 16 October 2007, <<http://www.lpgaaustralia.com.au>>.

⁴⁵³ Australian Liquefied Petroleum Gas Association Limited, 'Autogas information kit', viewed 16 October 2007, <<http://www.lpgaaustralia.com.au>>.

⁴⁵⁴ Australian Liquefied Petroleum Gas Association Limited, 'Autogas information kit', viewed 16 October 2007, <<http://www.lpgaaustralia.com.au>>.

⁴⁵⁵ AusIndustry, 'LPG vehicle scheme statistics', viewed 17 October 2007, <<http://www.ausindustry.gov.au>>.

⁴⁵⁶ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007.

⁴⁵⁷ LPG Autogas Australia, 'What about my vehicle warranty?' viewed 16 October 2007, <<http://www.lpgautogas.com.au/index.cfm?Action=FAQ>>.

⁴⁵⁸ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 335.

As the Australian petroleum industry is an established industry there are few issues with the storage and distribution of petroleum products. Storage tanks are located at coastal seaport terminals throughout Australia, which either store domestic products or imported fuels (largely from South-East Asia). The storage of petroleum products is regulated by state governments under various legislative frameworks that aim to protect the environment and promote the safety of persons and property.⁴⁵⁹ In Victoria, the storage of petroleum products is regulated under the *Dangerous Goods Act 1985*, which details the general duties for the manufacture, storage, transport, transfer, sale and use of dangerous goods.⁴⁶⁰ The *Road Transport (Dangerous Goods) Act 1995* regulates the transport of dangerous goods by road in order to promote public safety and protect property and environment.⁴⁶¹

5.4 Greenhouse gas emissions

In 2004 the CSIRO conducted a life-cycle emissions assessment of fuels for two sizes of light vehicles, family-size and compact-size, under various vehicle technologies.⁴⁶² The fuels included in the assessment were petrol, diesel, LPG in dual-fuel vehicles and CNG. Each fuel was examined on the basis of upstream and tailpipe emissions. From the results, CSIRO determined that diesel operated vehicles released less total GHG emissions than petrol or LPG vehicles, with the extra low sulphur (XLS) diesel Euro 3 vehicle emitting the least tailpipe emissions.⁴⁶³ The upstream emissions from this vehicle were substantially higher however because of additional refining processes required to reduce the sulphur content.⁴⁶⁴

Second-generation LPG vehicles produced the highest amount of GHG life-cycle emissions. In the Senate report *Australia's future oil supply and alternative transport fuels*, the CSIRO were quoted as questioning the optimum performance of LPG in dual-fuel vehicles:

A vehicle designed for optimum petrol performance is very unlikely to be optimised to minimise emissions under LPG use.⁴⁶⁵

When comparing LPG to petrol vehicles, CSIRO advised of the appropriateness of comparing second-generation LPG vehicles with ULP vehicles and third-generation LPG vehicles with PULP vehicles.⁴⁶⁶ On this basis, the life-cycle emissions of LPG vehicles were below those of the equivalent class of petrol vehicles.⁴⁶⁷ A third-generation LPG vehicle is

⁴⁵⁹ Dangerous Goods Act 1985 (Vic)

⁴⁶⁰ WorkSafe Victoria, *Your health and safety guide to dangerous goods*, State of Victoria, Melbourne, June 2007.

⁴⁶¹ WorkSafe Victoria, *Your health and safety guide to dangerous goods*, State of Victoria, Melbourne, June 2007.

⁴⁶² Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004.

⁴⁶³ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 98.

⁴⁶⁴ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 115.

⁴⁶⁵ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007.

⁴⁶⁶ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 98.

⁴⁶⁷ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 98.

more efficient than a second-generation LPG vehicle as it combines fuel injection technology with electronic management features whereas second-generation vehicles comprise only electronic control.⁴⁶⁸

5.5 Other emissions

As changes in fuel standards and vehicle emission technologies have improved the environmental performance of motor vehicles, these changes have also impacted the level of air pollutant emissions released into the atmosphere. Each fuel produces different types of pollutants with some pollutants being more harmful than others. Petrol operated vehicles emit significant levels of CO and VOC whereas diesel vehicles produce high levels of nitrogen oxides (NOx) and particulate matter (PM) emissions.⁴⁶⁹ LPG vehicles produce substantially lower levels of PM emissions.

In 2003, the BTRE conducted base case projections of metropolitan vehicle kilometres travelled (VKT) by 2020 and projected that total VKT would increase by 1.9 per cent per annum, a total of 46 per cent by 2020⁴⁷⁰. The Bureau concluded that while VKT would increase, there would be an overall reduction in pollutant emissions due to a newer and more efficient vehicle fleet. Reductions in the vehicle emissions of CO and VOC were estimated to be substantial whereas it was expected that PM emissions would remain stable.⁴⁷¹

There are ongoing concerns regarding the increasing number of diesel vehicles in Australia and the impact this could have on the level of PM emissions in urban areas. Diesel vehicles release more PM emissions into the atmosphere than either petrol or LPG with diesel estimated to produce 20 times more PM emissions than petrol vehicles, depending on the vehicle emissions control technology.⁴⁷²

In their life-cycle emissions assessment of light-sized vehicles, CSIRO examined the upstream and tailpipe air pollutant emissions of CO, NOx, VOC and PM and found that diesel produced more PM emissions than petrol.⁴⁷³ The XLS 2003 diesel vehicle emitted PM emissions almost three times the rate of the ULP Euro 3 vehicle.⁴⁷⁴ Petrol vehicles, on the other hand, produced more VOC emissions than diesel or LPG vehicles because of its high vapour pressure.⁴⁷⁵ Third-generation LPG vehicles emitted the

⁴⁶⁸ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 1.

⁴⁶⁹ Bureau of Transport and Regional Economics, *Health impacts of transport emissions in Australia: economic costs*, Australian Government, Canberra, 2005, p. 25.

⁴⁷⁰ Bureau of Transport and Regional Economics, *Urban pollutant emissions from motor vehicles: Australian trends to 2020*, Department of Transport and Regional Services, Canberra, 2003, p. vi.

⁴⁷¹ Bureau of Transport and Regional Economics, *Urban pollutant emissions from motor vehicles: Australian trends to 2020*, Department of Transport and Regional Services, Canberra, 2003, p. viii.

⁴⁷² Bureau of Transport and Regional Economics, *Health impacts of transport emissions in Australia: economic costs*, Australian Government, Canberra, 2005, p. 27.

⁴⁷³ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 1.

⁴⁷⁴ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 112.

⁴⁷⁵ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 112.

least amount of NO_x and PM emissions, although they emitted more CO emissions compared to the equivalent class of petrol vehicle, the PULP Euro 4 vehicle.⁴⁷⁶

5.6 Costs and revenue

Costs associated with the production of petroleum fuels are principally derived from the refining, wholesale and retailing of fuels. Operating costs associated with the refining of crude oil into petroleum products comprise utilities, consumables, labour and administration. Because all of Australia's refineries are more than fifty years old, there are also extensive costs incurred from upgrading ageing equipment or upgrading equipment to meet new industry environmental emission standards.⁴⁷⁷

Wholesale costs are derived from storage of fuels, as well as the distribution of those fuels to various retail outlets, transport operators, industrial and commercial businesses.⁴⁷⁸ Retail outlets also incur operating costs, such as labour, utilities, maintenance and credit card service fees.⁴⁷⁹

Further to the refinery capital and operating costs, the price of crude oil contributes to Australian refining costs. The price of Malaysia's Tapis crude oil is used as the benchmark for setting crude oil prices in the Asia-Pacific market and for Australia. Prices in regional markets reflect the supply and demand balance in each market and can move independently of other markets.⁴⁸⁰ Given this, Tapis crude oil may be priced very differently to the US market benchmark, the West Texas Intermediate (WTI). At the end of the first week in January 2008, the price of Tapis crude oil was \$AUD 72.5 cents per litre, which had steadily increased from the previous 12 month average of \$AUD 58.3 cents per litre.⁴⁸¹ As a comparison, the WTI averaged around US\$65 a barrel mid 2007,⁴⁸² which equated to \$AUD46.1 cents per litre.

5.6.1 Income

While the price of crude oil contributes to refining costs, petroleum prices are not based solely on the cost of oil imported to Australia. Petroleum prices are also not based on local production costs. Rather they are an independently priced and traded commodity. While prices for crude oils

⁴⁷⁶ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 112.

⁴⁷⁷ The Senate Standing Committee on Economics, *Petrol prices in Australia*, Parliament of Australia, Canberra, December 2006, p. 11.

⁴⁷⁸ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006.

⁴⁷⁹ Caltex, 'Petrol pricing - the plain facts', viewed 25 September 2006, <http://www.caltex.com.au/assets/pricing_plain/Petrol_Price_Brochure.pdf>.

⁴⁸⁰ Australian Institute of Petroleum, 'Facts about prices and the Australian fuel market', viewed 4 October 2007, <<http://www.aip.com.au>>.

⁴⁸¹ Australian Institute of Petroleum, 'Weekly petrol prices report - week ending 6 January 2008', viewed 11 January 2011, <<http://www.aip.com.au/pricing/pdf/Weekly%20Petrol%20Prices%20Report.pdf>>.

⁴⁸² ABARE, *Australian commodities - June Quarter*, Commonwealth of Australia, Canberra, 2007, p. 307.

and petroleum fuels may have similar fluctuations, the price of these fuels can and do move independently of the price of crude oil.⁴⁸³

The process of 'import parity pricing' is adopted to determine Australian petroleum prices.⁴⁸⁴ The relevant benchmark adopted by the Australian petroleum companies for petrol is the Singapore Mogas 95 Unleaded. Singapore Gasoil is the relevant benchmark adopted for diesel.⁴⁸⁵ Singapore is used as the benchmark in Australia as it is the "major trading centre in Asia for petroleum products, the most likely source of fuel imported into Australia and the closest major refining centre in Australia".⁴⁸⁶ Australian petroleum companies are also required to compete with other refiners in the Asia-Pacific region who market refined petroleum products in both Australia and Asia.⁴⁸⁷

The benchmark price for diesel will often be substantially higher than the petrol price as they are influenced by different supply and demand pressures. Diesel is the dominant fuel in Asia and in recent years there has been a significant increase in demand as a result of economic and industrial growth in China.⁴⁸⁸ The availability of diesel may also be influenced by greater production of kerosene, jet fuel and heating oil in Asia, which are middle distillates like diesel.⁴⁸⁹ Increased demand for these fuels may result in refiners producing lower amounts of diesel fuel.⁴⁹⁰

The price of petrol and diesel extends beyond the import parity price to include the wholesale petrol price referred to as the Terminal Gate Price (TGP). This represents a combination of factors, including:

- the daily price of the Singapore Mogas 95 Unleaded or Singapore Gasoil;
- shipping charges, local wharfage and terminal costs
- Australian taxes;
- the value of the Australian dollar against the US currency;
- costs of meeting Australian fuel quality standards;
- refinery operating costs; and

⁴⁸³ The Senate Standing Committee on Economics, *Petrol prices in Australia*, Parliament of Australia, Canberra, December 2006, p. 8.

⁴⁸⁴ The Senate Standing Committee on Economics, *Petrol prices in Australia*, Parliament of Australia, Canberra, December 2006, p. 7.

⁴⁸⁵ Australian Institute of Petroleum, 'Facts about diesel prices', viewed 4 October 2007, <http://www.aip.com.au/pricing/facts/Facts_about_Diesel_Prices.htm>.

⁴⁸⁶ The Senate Standing Committee on Economics, *Petrol prices in Australia*, Parliament of Australia, Canberra, December 2006, p. 7.

⁴⁸⁷ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁴⁸⁸ Australian Institute of Petroleum, 'Facts about diesel prices', viewed 4 October 2007, <http://www.aip.com.au/pricing/facts/Facts_about_Diesel_Prices.htm>.

⁴⁸⁹ Australian Institute of Petroleum, 'Facts about diesel prices', viewed 4 October 2007, <http://www.aip.com.au/pricing/facts/Facts_about_Diesel_Prices.htm>.

⁴⁹⁰ Department of Industry Tourism and Resources, 'Diesel - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

- refiner margin.⁴⁹¹

The international price for LPG in the Asia-Pacific region is based on the Saudi Aramco Contract Price (Saudi CP).⁴⁹² Australian LPG prices are closely associated with international prices as Australian LPG producers can either export their product or sell it in the domestic market. Similar to prices for petrol and diesel, an Australian landed price is determined for LPG that is based on the Saudi CP, freight allowance, insurance, storage and handling. It is estimated that these costs can total more than US\$45 per tonne.⁴⁹³

5.6.2 Australia's fuel taxation and excise system

Petroleum products are subject to the Goods and Services Tax (GST) and fuel excise, which accounts for approximately \$13 billion collected annually from the Commonwealth Government.⁴⁹⁴ Australia's tax on petrol is the lowest of 28 Organisation for Economic Cooperation Development (OECD) countries in cents per litre and is the fifth lowest for diesel.⁴⁹⁵

In July 2006, the Commonwealth Government introduced fuel tax reforms so that fuel excise is applicable to all fuels used in internal combustion engines, with excise rates based on the energy content of fuels.⁴⁹⁶ As detailed further in Chapter Eight, from 1 July 2011, all alternative fuels enter the excise system including LPG, although these fuels will incur excise at half the rate of other petroleum fuels. On 1 July 2015, the excise payable on LPG will be 12.5 cents per litre.⁴⁹⁷

The GST payable on all petroleum products sold in Australia is a broad based consumption tax levied at an ad valorem tax of ten per cent.⁴⁹⁸ The Commonwealth Government does not retain any GST revenue as it is transferred to the states and territories.⁴⁹⁹

5.6.3 Retail petroleum prices

Retail prices for petrol and diesel are made up a number of components, including the TGP as well as transport costs, administration and marketing costs, and retail fuel outlet operating costs, such as labour, utilities and

⁴⁹¹ Australian Institute of Petroleum, 'Facts about prices and the Australian fuel market', viewed 4 October 2007, <<http://www.aip.com.au>>; The Senate Standing Committee on Economics, *Petrol prices in Australia*, Parliament of Australia, Canberra, December 2006, p. 9.

⁴⁹² Department of Industry Tourism and Resources, 'Liquefied Petroleum Gas (LPG) - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁴⁹³ Department of Industry Tourism and Resources, 'Liquefied Petroleum Gas (LPG) - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁴⁹⁴ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 94.

⁴⁹⁵ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 94.

⁴⁹⁶ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 96.

⁴⁹⁷ Department of Industry Tourism and Resources, 'Liquefied Petroleum Gas (LPG)', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁴⁹⁸ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 26.

⁴⁹⁹ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

rent.⁵⁰⁰ The TGP equates to approximately 95 per cent of the retail price, with distributors and retailers receiving the remaining 5 per cent of revenue. Retail prices for LPG are also based on the Australian landed price in addition to transportation and storage costs, wholesale and retail selling margins and bulk breaking costs. As LPG is transported in tanks under pressure, it is more expensive to transport than petrol and diesel.⁵⁰¹

The introduction of the fuel quality standards by the Commonwealth Government in 2002 is said to have increased wholesale petroleum prices by around two to three cents per litre. This increase would impact petroleum retail prices.⁵⁰²

The retail prices for petroleum products vary widely across metropolitan and regional areas, reflecting local area factors and competition. The price of petroleum products is associated with a high degree of price elasticity of demand for the product with consumers often basing their purchasing decisions on small differences in price.⁵⁰³

Metropolitan retail outlets are heavily influenced by discounting and pricing cycles largely due to retail operators aggressively discounting fuel prices to capture larger market shares. Competitors tend to monitor neighbouring prices and similarly lower their prices. Freight is also typically higher for regional deliveries.

While petrol and LPG fuels are subject to aggressive discounting, this is not the case for diesel fuels. In Australia, the majority of diesel is sold in bulk to commercial and industrial customers with only 25 per cent of diesel sold through fuel outlets. Because of this, there is very little difference in the price of diesel in metropolitan and regional areas.⁵⁰⁴ According to the Australian Institute of Petroleum, the price difference for diesel in metropolitan and regional areas averaged only 2 cents per litre.⁵⁰⁵ Because diesel is not as heavily discounted as petrol, its retail price is often more expensive in the marketplace. This is despite diesel being marginally cheaper than petrol to refine.⁵⁰⁶ Table 19 highlights the differing prices for petrol and diesel.

⁵⁰⁰ Australian Institute of Petroleum, 'Facts about prices and the Australian fuel market', viewed 4 October 2007, <<http://www.aip.com.au>>.

⁵⁰¹ Department of Industry Tourism and Resources, 'Liquefied Petroleum Gas (LPG) - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁵⁰² Australian Competition and Consumer Commission, *Senate Economics Legislation Committee inquiry into the price of petrol in Australia - ACCC submission*, Commonwealth of Australia, Canberra, July 2006, p. 10.

⁵⁰³ BP Australia, *Submission by BP Australia Pty Ltd to the ACCC inquiry into the price of unleaded petrol*, 3 August 2007, p. 27.

⁵⁰⁴ Australian Institute of Petroleum, 'Facts about diesel prices', viewed 4 October 2007, <http://www.aip.com.au/pricing/facts/Facts_about_Diesel_Prices.htm>.

⁵⁰⁵ Australian Institute of Petroleum, 'Facts about diesel prices', viewed 4 October 2007, <http://www.aip.com.au/pricing/facts/Facts_about_Diesel_Prices.htm>.

⁵⁰⁶ Caltex, 'Petrol pricing - the plain facts', viewed 4 October 2007, <http://www.caltex.com.au/pricing_pla.asp>.

Table 19: Average prices for unleaded petrol and diesel (week ended 6 January 2008).⁵⁰⁷

| State/ Territory | Unleaded Petrol cpl \$A | Diesel cpl \$A |
|------------------|----------------------------|-------------------|
| National average | 139.4 | 150.4 |
| NSW | 141.1 | 153.1 |
| VIC | 140.7 | 149.6 |
| QLD | 133.7 | 143.9 |
| SA | 140.9 | 151.9 |
| WA | 139.4 | 155.3 |
| NT | 148.4 | 155.9 |
| TAS | 142.0 | 155.3 |

5.6.4 Petroleum profit margins

The Legislative Assembly of Queensland's *Inquiry into petrol pricing in Queensland* received evidence indicating that while profits for the refining industry have recently increased, profits are typically very low.⁵⁰⁸ It is estimated that the average profit made by oil companies over the last ten years was approximately one cent per litre.⁵⁰⁹ In evidence provided to the *Inquiry into petrol pricing in Queensland*, Caltex advised that in 2004-05 it made a profit of \$595 million for its Australian operations, which equated to a profit of 2.2 cents per litre of petroleum products.⁵¹⁰

Retail fuel outlets also receive minimal profits due to intense competition in the marketplace. Many outlets operate on profit margins of three cents per litre, which is generally obtained from profits made on convenience items rather than petroleum products.⁵¹¹

5.7 Current production, potential and constraints

The Australian petroleum industry comprises four main suppliers of petroleum fuels, each of which own and operate refineries and bulk fuel terminals in various parts of Australia. Most of them also import fuel into Australia.⁵¹² These four companies are BP Australia, Caltex, Exxon Mobil and Shell Australia. Between them, they own and operate seven petroleum refineries located in Queensland (2), NSW (2), Victoria (2) and WA (1).⁵¹³

⁵⁰⁷ Australian Institute of Petroleum, 'Weekly petrol prices report', viewed 9 January 2008, <<http://www.aip.com.au/pricing/weeklyreport.htm>>.

⁵⁰⁸ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 13.

⁵⁰⁹ Australian Institute of Petroleum, 'Facts about prices and the Australian fuel market', viewed 4 October 2007, <<http://www.aip.com.au>>.

⁵¹⁰ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 14.

⁵¹¹ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 14.

⁵¹² Mobil Oil Australia, 'Mobil Oil Australia Submission to ACCC Petrol Pricing Inquiry', viewed 26 September 2007, <<http://www.accc.gov.au>>.

⁵¹³ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

These refineries were constructed in the 1950s and 1960s and while they have been extensively modified, they are old and small by international standards. Due to the design of the refinery equipment, the production of petroleum fuels is essentially fixed. The relative proportion of petrol that can be produced is roughly 46 per cent and 29 per cent for diesel.⁵¹⁴

Despite Australia producing 85.6 million barrels of crude oil a day, only around 28 per cent of refinery input is sourced from domestic oil sources.⁵¹⁵ Crude oils produced in Australia tend to be lighter and sweeter than world crude oils and do not necessarily match the products demanded in Australia. These oils also tend to attract higher prices on the global market. Because of this, the majority of domestic crude oils are exported while domestic refiners import cheaper alternatives from South-East Asia and the Middle East.⁵¹⁶ In 2006-07, the export of crude oil from Australia was estimated to be almost 16 gegalitres, with the value increasing 25 per cent to \$8.3 billion.⁵¹⁷ This is forecast to increase by a further three per cent to \$8.6 billion in 2007-08.⁵¹⁸

In 2006-07, Australian refineries produced 39,453 ML of petroleum products (petrol, diesel, jet fuel, LPG, fuel oil and other).⁵¹⁹ This is relatively small in comparison to the production capacity of refineries in the Asia-Pacific Region where the combined production of all of Australia's refineries is less than the capacity of some single refineries in Asia.⁵²⁰

Table 20: Petroleum production capacity of major oil companies, Australia, 2005.⁵²¹

| Company | Location | 2005 Capacity (ML pa) |
|--------------|--------------------------------|-----------------------|
| Caltex | Lytton Brisbane, QLD | 6110 |
| | Kurnell Sydney, NSW | 7210 |
| BP Australia | Kwinana Kwinana, WA | 8030 |
| | Bulwer Island Brisbane, QLD | 5100 |

⁵¹⁴ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁵¹⁵ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁵¹⁶ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁵¹⁷ ABARE, *Australian commodities*, Australian Government, Canberra, 2007, p. 312.

⁵¹⁸ ABARE, *Australian commodities*, Australian Government, Canberra, 2007, p. 312.

⁵¹⁹ Department of Industry Tourism and Resources, *Australian petroleum statistics*, no. 131, Australian Government, Canberra, June 2007.

⁵²⁰ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁵²¹ Department of Industry Tourism and Resources, 'Refining and fuels', viewed 24 September 2007, <<http://www.industry.gov.au>>.

| | | |
|----------------------------|------------------------------|---------------------------|
| ExxonMobil | Altona Melbourne, VIC | 4640 |
| | Port Stanvac Adelaide, SA | Mothballed 1 July 2003 |
| Shell Australia | Geelong Geelong, VIC | 6900 |
| | Clyde Sydney, NSW | 4980 |
| Total Operational Capacity | | 42 970 |

In 2006-07, Australian refineries produced 17,232 ML of petrol. Of this, 776 ML was exported, mainly to New Zealand (at 622 ML). In addition, 2,920 ML of petrol was imported, mainly from Singapore.⁵²²

Australian refineries produced 11,055 ML of automotive diesel oil in 2006-07. Of this, 288 ML was exported with Singapore receiving 91 ML. Australia imported 3,395 ML of diesel, also mainly from Singapore.⁵²³

Australia produced a total of 5,937 ML of LPG during 2006-07, however only 23 per cent or 1,387 ML was produced in refineries. The remaining 77 per cent was obtained from the production of crude oil and natural gas.⁵²⁴ Australia exported 2,823 ML of LPG, with the largest market located in Japan, the Republic of Korea and China. Australia imported 745 ML of LPG, mainly from Saudi Arabia. These figures include LPG used in automobiles, as well as in other applications.⁵²⁵

According to the Australian Bureau of Agricultural and Resource Economic (ABARE), Australian refining capacity and refining output is expected to increase by 1.3 per cent per annum while Australia's consumption of petroleum products is projected to rise by around 2 per cent per year.⁵²⁶ Given this, the proportion of petroleum products sourced from domestic refineries is projected to decrease from the current level of 80 per cent to less than 70 per cent by 2029-30.⁵²⁷

5.7.1 Availability

The retail fuel sector comprises a large number of operators despite significant reductions over the last 20 years.⁵²⁸ In June 2004, there were approximately 6,650 service stations in Australia, a reduction of 19 per

⁵²² Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁵²³ Department of Industry Tourism and Resources, 'Diesel - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁵²⁴ Department of Industry Tourism and Resources, 'Liquefied Petroleum Gas (LPG) - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁵²⁵ Department of Industry Tourism and Resources, 'Liquefied Petroleum Gas (LPG) - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁵²⁶ ABARE, *Energy in Australia 2005*, Australian Government, Canberra, 2005, p. 28.

⁵²⁷ ABARE, *Energy in Australia 2005*, Australian Government, Canberra, 2005, p. 29.

⁵²⁸ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 84.

cent since 2000.⁵²⁹ A large number of these operators are owned or directly associated with the four major petroleum companies with their share of retail fuel sales estimated to equal approximately 90 per cent of total fuel sales in Australia.⁵³⁰ All of these companies retail their own brands of petrol, diesel and LPG.

The retail fuel sector has undergone substantial structural change over the last few years due to the entry of supermarket chains Woolworths and Coles Myer into the market. During 2003, Coles Myer and Woolworths entered alliances with Shell Australia and Caltex respectively with both marketing “shopper docket discounts”. The shopper dockets offer four cents per litre discounts on fuel purchases provided that at least \$30 of groceries is purchased from an allied supermarket.⁵³¹

In response to growing concerns of the expansion of supermarkets in the fuel retail market, the Australian Competition and Consumer Commission (ACCC) conducted an extensive review of the tying of fuel discounts to grocery purchases. In February 2004, the ACCC determined that the shopper docket schemes were leading to lower prices in the fuel market and encouraging competition.⁵³²

Regarding the sale of petroleum fuels, Australian motorists purchased 19,251 ML of petrol in 2006-07, which included sales of regular unleaded petrol (82.6 per cent), premium unleaded petrol (9.4 per cent) and 0.3 ML of lead replacement petrol.⁵³³ Motorists purchased 17,028 ML of automotive diesel oil in 2006-07⁵³⁴ and 4,037 ML of LPG, 2,336 ML of which was for automotive use.⁵³⁵

5.8 Consumer confidence, standards and warranties

5.8.1 Pricing

In recent years, one of the biggest concerns for motorists is rising petrol prices. The 2007 Australian Automobile Association’s national survey into motorists’ attitudes indicated that petrol price is the biggest concern for motorists, increasing from 20 per cent in 2005 to 42 per cent in 2007.⁵³⁶

The Legislative Assembly of Queensland’s *Inquiry into petrol pricing in Queensland* reported that prices for ULP and diesel peaked in Australian capital cities in 2005 with increases of 38 per cent and 27.3 per cent

⁵²⁹ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 11.

⁵³⁰ Department of Industry Tourism and Resources, 'Petroleum retail', viewed 3 October 2007, <<http://www.industry.gov.au>>.

⁵³¹ Department of Industry Tourism and Resources, 'Petroleum retail', viewed 3 October 2007, <<http://www.industry.gov.au>>.

⁵³² Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 87.

⁵³³ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁵³⁴ Department of Industry Tourism and Resources, 'Diesel - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁵³⁵ Department of Industry Tourism and Resources, 'Liquefied Petroleum Gas (LPG) - frequently asked questions', viewed 2 October 2007, <<http://www.industry.gov.au>>.

⁵³⁶ Australian Automobile Association, 'Australian motorists' concerns', viewed 26 September 2007, <<http://www.aaa.asn.au>>.

respectively. Petrol prices peaked at 132.8 cents per litre in September 2005 and diesel peaked at 134.3 cents per litre in October 2005.⁵³⁷ Petrol and diesel prices have peaked again more recently, with Melbourne petrol prices averaged at 133.6 cents per litre and diesel prices at 142.5 cents per litre in the first week of January 2008.⁵³⁸ Despite these increases, Australian petrol prices are among the lowest in the OECD. In 2005, Australian petrol prices were the fourth lowest after Mexico, US and Canada.⁵³⁹

While there is a perception among the general public that the Commonwealth Government can control fuel prices, this responsibility lies with the state and territory governments under the Australian Constitution.⁵⁴⁰ Most state governments provide subsidies to reduce petrol prices, either state-wide as is done in Queensland, Tasmania and the Northern Territory or in country areas, such as in New South Wales and South Australia.⁵⁴¹ Victoria and Western Australia have also introduced legislation to increase the transparency of fuel prices.

The ACCC has no power to regulate fuel prices however it is responsible for investigating anti-competitive behaviour in the domestic fuel market.⁵⁴² During 2006, the ACCC conducted an inquiry into the price of ULP due to the identification of a substantial divergence between movements in Australian retail petrol prices and the international benchmark price of the Singapore Mogas 95 unleaded.⁵⁴³ Usually, movements in Australia's petrol prices follow the international benchmark, however the ACCC noted that the price of the Singapore Mogas 95 unleaded decreased from late May 2007 while domestic prices continued to increase.⁵⁴⁴ Upon completion of the Inquiry in December 2007, the ACCC determined that there was no clear evidence of price fixing or collusion between the major participants in the industry.⁵⁴⁵

⁵³⁷ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 18.,

⁵³⁸ Australian Institute of Petroleum, 'Weekly petrol prices report - week ending 6 January 2008', viewed 11 January 2011, <<http://www.aip.com.au/pricing/pdf/Weekly%20Petrol%20Prices%20Report.pdf>>.

⁵³⁹ Legislative Assembly of Queensland, *Inquiry into petrol pricing in Queensland*, April 2006, p. 17.,

⁵⁴⁰ Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁵⁴¹ Caltex, 'Petrol pricing - the plain facts', viewed 4 October 2007, <http://www.caltex.com.au/pricing_pla.asp>.

⁵⁴² Department of Industry Tourism and Resources, 'Petrol - frequently asked questions', viewed 24 September 2007, <<http://www.industry.gov.au>>.

⁵⁴³ Australian Competition and Consumer Commission, *Inquiry into the price of unleaded petrol - issues paper*, Australian Government, Canberra, June 2007, p. 7.

⁵⁴⁴ Australian Competition and Consumer Commission, *Inquiry into the price of unleaded petrol - issues paper*, Australian Government, Canberra, June 2007, p. 8.

⁵⁴⁵ Australian Competition & Consumer Commission, *Petrol prices and Australian consumers*, Commonwealth of Australia, Canberra, 2007, p. v.

Chapter Six: Key points

- There are very few studies that compare the greenhouse gas (GHG) emissions performance and air emissions performance of the fuels considered in this report. However, studies that do exist suggest that relative to unleaded petrol use (ULP):
 - compressed natural gas (CNG) and liquefied petroleum gas (LPG) produce around 25 per cent less life-cycle GHG emissions;
 - blended ethanol (E10) produces about 0.7 – 2.5 per cent less GHG emissions;
 - diesel vehicles produce around 30 per cent less GHG emissions, and biodiesel (B20) from 37 per cent less GHG emissions;
 - petrol hybrid vehicles produce around 54.5 per cent less GHG emissions; and
 - diesel hybrid vehicles produce around 63.4 per cent less GHG emissions (p. 97).
 - The introduction of the Euro 4 vehicle standard in Australia in 2008 will result in GHG emissions reductions of 17 per cent for premium unleaded petrol (PULP) vehicles compared to current generation ULP vehicles (p. 97).
 - As is the case with GHG emissions, few studies on air emissions compare a range of fuel types. Existing studies indicate that relative to ULP the best air quality improvements are obtained from the use of LPG, CNG or petrol hybrid vehicles (p. 101).
 - Currently biofuels do not offer substantial improvements to fuel security. Supply security issues may be alleviated through increased use of CNG, LNG and LPG in the Australian fleet. The current lack of distribution infrastructure for natural gas transport fuels is a major barrier to development of a market for these fuels (p. 103).
 - Fuel security can also be improved by exploring ways to extend petroleum use, for example, through the introduction of more efficient vehicles into the Australian fleet and through increased use of public transportation (p. 103).
 - Based on current technologies, natural gas and its derivatives are the alternative fuels that are most likely to provide substantial gains in domestic fuel security (p. 103).
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Chapter Six: Fuels comparison

In the preceding chapters a wide range of characteristics of orthodox and alternative fuels have been carefully examined. In this Chapter available data regarding key qualities of these fuels is presented for comparison.

6.1 Life-cycle greenhouse gas emissions

While data on GHG emissions and air emissions by a number of fuels are currently available, the Committee notes that some of this data is constructed around very limited samples of vehicles or test conditions. Furthermore, there are few studies that present the wide range of fuels presented in previous chapters for comparison. Finally, data on life-cycle GHG and air pollutant emissions is often in excess of five years old, and so do not account for changed fuel and engine technologies:

...most people are still relying on the work [the CSIRO] did in 2001. Even at the time we said that would have about a five-year lifetime because everything changes. The technologies change, the fuel mixes change, the prices change. The methods of allocation that you need change and the whole work should be redone again. That was a heavy vehicles report, we did the light vehicles report in 2004 and we did receive financial support from the Victorian [EPA] to help us do that, which was much appreciated, but that is coming up to probably its five-year lifespan as well. It should all be redone.⁵⁴⁶

There are very few studies that directly compare the relative GHG emissions associated with the use of different fuels in vehicles. As noted in the quote from Dr Tom Beer of the CSIRO above, the 2001 study *Life-cycle emissions analysis of alternative fuels for heavy vehicles* is still one of the only sources for this kind of comparison. However, even this study does not allow a satisfactory comparison of the full range of fuels examined in this report. In Table 21, Table 22 and Table 23, life-cycle GHG emissions for buses and heavy vehicles are presented.

⁵⁴⁶ Dr Tom Beer, Leader, Alternative Transport Fuels Stream, Energy Transformed Flagship, CSIRO, *Transcript of evidence*, Melbourne, 6 August 2007, p. 31.

Table 21: Life-cycle GHG emissions for urban buses, CO²-e g/km.⁵⁴⁷

| Fuel | GHG (upstream) | GHG (tailpipe) | GHG (total) | % change from ULSD |
|------|----------------|----------------|-------------|--------------------|
| ULSD | 245 | 1425 | 1670 | base |
| LPG | 227 | 1313 | 1540 | -8% |
| CNG | 149 | 1401 | 1550 | -7% |
| LNG | 288 | 1382 | 1670 | 0% |
| B20 | 335 | 1065 | 1400 | -16% |
| B100 | 847 | 0 | 847 | -49% |

Table 22: Life-cycle GHG emissions for heavy vehicles, CO²-e g/km.⁵⁴⁸

| Fuel | GHG (upstream) | GHG (tailpipe) | GHG (total) | % change from LSD |
|------|----------------|----------------|-------------|-------------------|
| LSD | 260 | 1387 | 1647 | base |
| CNG | 130 | 1224 | 1354 | -19% |
| LNG | 304 | 1457 | 1761 | +5% |
| B35 | 629 | 1013 | 1642 | -2% |
| B100 | 634 | 0 | 634 | -62% |

Table 23: Estimated truck GHG emissions per tonne-kilometre, various fuels.⁵⁴⁹

| Fuel | GHG (upstream) | GHG (tailpipe) | GHG (total) | % change from ULSD |
|---------------|----------------|----------------|-------------|--------------------|
| ULSD | 0.0255 | 0.0800 | 0.1055 | base |
| B100 (canola) | 0.0480 | 0.0000 | 0.0480 | -55% |
| B100 (tallow) | 0.0470 | 0.0000 | 0.0465 | -56% |
| B100 (UCO) | 0.0080 | 0.0000 | 0.0079 | -93% |
| CNG | 0.0151 | 0.0701 | 0.0852 | -19% |

⁵⁴⁷ Tom Beer, et al., *Life-cycle emissions analysis of alternative fuels for heavy vehicles*, CSIRO, Canberra, CSIRO Atmospheric Research report to the Australian Greenhouse Office, 2000, p. 32.

⁵⁴⁸ Tom Beer, et al., *Life-cycle emissions analysis of alternative fuels for heavy vehicles*, CSIRO, Canberra, CSIRO Atmospheric Research report to the Australian Greenhouse Office, 2000, p. 33.

⁵⁴⁹ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001, p. 437. One tonne-kilometre refers to the emissions associated with the transportation of one tonne of load for kilometre.

| | | | | |
|----------------|--------|--------|--------|------|
| LNG | 0.0143 | 0.0690 | 0.0833 | -21% |
| LPG (Autogas) | 0.0207 | 0.0723 | 0.0930 | -12% |
| E85 (molasses) | 0.0483 | 0.0000 | 0.0483 | -54% |
| E85 (wheat) | 0.0769 | 0.0000 | 0.0769 | -27% |

A notable change from these studies and later research directed particularly on ethanol and biodiesel (referred to in Chapters Two and Three) is that later studies are considerably more conservative in the attribution of GHG emissions reductions to biofuels. Consequently it has been very difficult for the Committee to determine whether there are any clear GHG emissions advantages associated with particular fuels. Clearly, more research into emissions from different fuels will be required if transportation is to be adequately integrated into any future analyses of GHG emissions.

While recognising that current data is insufficient, evidence that does exist appears to indicate that CNG and LPG offer similar GHG emissions benefits to the use of B20 in heavy vehicles. The GHG emission performance of liquefied natural gas (LNG) appears to be similar to that of ultra low sulphur diesel (ULSD).

In 2004 the CSIRO conducted a GHG emissions analysis of family-sized vehicles. That research did not include comparison of the effect of biofuel blends on GHG emissions. However it is possible to estimate the relative effect of biofuels on GHG emissions through comparison of results from the 2004 CSIRO study and research on biofuels use presented in earlier chapters. As with the observations above, the data in Table 24 should be regarded as indicative of the relative effect of biofuels and other fuels on vehicle GHG emissions. Accurate comparisons will only be possible with new research into these issues.

Table 24: Estimated life-cycle GHG emissions for passenger vehicles, CO²-e g/km.⁵⁵⁰

| Fuel | GHG upstream | GHG tailpipe | GHG total | % change from ULP |
|-------------------------|--------------|--------------|-----------|-------------------|
| ULP– 1999 Euro 3 | 0.05145 | 0.2977 | 0.3491 | base |
| PULP– 2003 Euro 4 | 0.04724 | 0.24202 | 0.2892 | -17.2% |
| XLS Diesel: 2003 Euro 3 | 0.0415 | 0.19299 | 0.23449 | -32.8% |
| LPG Autogas: 3rd Gen | 0.03341 | 0.21752 | 0.2509 | -28.1% |
| PULP— hybrid | 0.02588 | 0.133 | 0.1589 | -54.5% |

⁵⁵⁰ Sources: Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004; Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005. GHG emissions reductions figures are derived from the Biofuels Taskforce report (2005). B20 GHG emissions figures are based on emissions reductions figures from the Biofuels Taskforce report relative to XLSD emissions figures supplied in the CSIRO report on light vehicles emissions.

| | | | | |
|-------------------|---------|---------|--------|--------|
| LS Diesel— hybrid | 0.01979 | 0.108 | 0.1278 | -63.4% |
| CNG LV | 0.05484 | 0.20644 | 0.2613 | -25.2% |
| E10 (molasses) | | | | -2.7% |
| E10 (wheat) | | | | -0.7% |
| B20 (canola) | | | | -37.3% |
| B20 (tallow) | | | | -38.1% |
| B20 (waste oil) | | | | -45.1% |

Table 24 shows that there are potentially significant GHG emissions advantages over the use of ULP in the passenger vehicle fleet. CNG and LPG reduce emissions between 25 and 28 per cent compared to ULP. Significant gains will also be made when Australia adopts the Euro 4 standard for petrol in place of the current Euro 3 standard in July 2008.

Although requiring substantial fleet transformation, significant gains could also be obtained through increasing the number of diesel vehicles in the Australian fleet. The addition of biodiesel as a blended fuel would enhance GHG emissions reductions obtained from diesel vehicles further. The most dramatic improvement to GHG emissions reductions in the Australian fleet can be obtained through increased adoption of either petrol-hybrid or diesel-hybrid vehicles. The GHG emissions benefits from the use of ethanol as a blended fuel are comparatively modest.

Finding 8: The use of ethanol and biodiesel blended fuels leads to GHG emissions reductions. Of current fuel and vehicle technologies, petrol-hybrid and diesel-hybrid vehicles provide the greatest overall reduction in GHG emissions.

6.2 Air emissions

As is the case with GHG emissions data, there is a limited range of data available with which to compare air emissions from the range of fuels considered in this report. Table 25, Table 26 and Table 27 show emissions of nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOCs) and particulate matter (PM) for a range of fuels in heavy vehicles, obtained from the 2001 CSIRO report *Life-cycle emissions analysis of alternative fuels for heavy vehicles* referred to above, and from the CSIRO report *Comparison of transport fuels*.

Table 25: Life-cycle air emissions for urban buses, g/km.⁵⁵¹

| Fuel | CO (% change from ULSD) | NOx (% change from ULSD) | NMVOG (% change from ULSD) | PM (% change from ULSD) |
|------|-------------------------------|--------------------------------|----------------------------------|-------------------------------|
| ULSD | 5.3 (base) | 15.6 (base) | 2.61 (base) | 0.42 (base) |
| LPG | 3.57 (-32.6%) | 6.33 (-59.4%) | 1.87 (-28.4%) | 0.16 (-61.9%) |
| CNG | 0.75 (-85.8%) | 10.5 (-32.7%) | 3.03 (+16.1%) | 0.06 (-85.7%) |
| LNG | 11.9 (+124.5%) | 34.1 (+118.6%) | 5.29 (+102.7%) | 0.09 (-78.6%) |
| B20 | 7.29 (+37.5%) | 24.7 (+58.3%) | 2.69 (+3.1%) | 0.63 (+50.0%) |
| B100 | 11.2 (+111.3%) | 19.9 (+27.6%) | 2.86 (+9.6%) | 1.44 (242.9%) |

Table 26: Life-cycle air emissions for heavy vehicles, g/km.⁵⁵²

| Fuel | CO (% change from ULSD) | NOx (% change from ULSD) | NMVOG (% change from ULSD) | PM (% change from ULSD) |
|------|-------------------------------|--------------------------------|----------------------------------|-------------------------------|
| ULSD | 8.15 (base) | 11.29 (base) | 2.45 (base) | 0.725 (base) |
| CNG | 14.98 (+83.8%) | 8.58 (-24.0%) | 0.53 (-78.4%) | 0.3622 (-50.0%) |
| LNG | 9.17 (+12.5%) | 5.74 (-49.2%) | 3.24 (+32.2%) | 0.137 (-81.1%) |
| B35 | 6.65 (-18.4%) | 15.63 (+38.4%) | 2.74 (+11.8%) | 0.722 (-0.4%) |
| B100 | 9.73 (+19.4%) | 12.97 (+14.9%) | 2.63 (+7.3%) | 1.27 (+75.2%) |

⁵⁵¹ Tom Beer, et al., *Life-cycle emissions analysis of alternative fuels for heavy vehicles*, CSIRO, Canberra, CSIRO Atmospheric Research report to the Australian Greenhouse Office, 2000, p. 31.

⁵⁵² Tom Beer, et al., *Life-cycle emissions analysis of alternative fuels for heavy vehicles*, CSIRO, Canberra, CSIRO Atmospheric Research report to the Australian Greenhouse Office, 2000, p. 33.

Table 27: Estimated truck air emissions per tonne-kilometre, various fuels.⁵⁵³

| Fuel | CO (% change from ULSD) | NOx (% change from ULSD) | PM (% change from ULSD) |
|----------------|-------------------------------|--------------------------------|-------------------------------|
| ULSD | 0.379 (base) | 1.102 (base) | 38.3 (base) |
| B100 (canola) | 0.189 (-50.1%) | 1.436 (+30.3%) | 33.1 (-13.6%) |
| B100 (tallow) | 0.188 (-50.4%) | 1.431 (+29.9%) | 33 (-13.8%) |
| B100 (UCO) | 0.156 (-58.8%) | 1.31 (+18.9%) | 30.5 (-20.4%) |
| CNG | 0.014 (-96.3%) | 0.179 (-83.8%) | 8.4 (-78.1%) |
| LNG | 0.015 (-96.0%) | 0.258 (-76.6%) | 8.2 (-78.6%) |
| LPG (Autogas) | 0.046 (-87.9%) | 0.17 (-84.6%) | 10.8 (-71.8%) |
| E85 (molasses) | 1.01 (+166.5%) | 1.116 (+1.3%) | 32.8 (-14.4%) |
| E85 (wheat) | 1.258 (+231.9%) | 1.311 (+19.0%) | 60.1 (+56.9%) |

While variation in existing data suggests that more work can still be done to establish emissions trends for the fuels shown above, existing studies do show that substantial life-cycle reductions in CO, NOx and PM emissions from vehicles can be obtained from the use of CNG and LPG in buses and heavy vehicles. Data obtained from a study on light vehicle air emissions show a similar pattern (see Table 28).

⁵⁵³ Tom Beer, et al., *Comparison of transport fuels*, Prepared for the Australian Greenhouse Office, Melbourne, 2001.

Table 28: Estimated life-cycle air emissions for passenger vehicles, g/km.⁵⁵⁴

| Fuel | CO (% change from ULP) | NOx (% change from ULP) | NM VOC (% change from ULP) | PM (% change from ULP) |
|-------------------------|------------------------------|-------------------------------|----------------------------------|------------------------------|
| ULP- 1999 Euro 3 | 1.439 (base) | 2.074 (base) | 0.679 (base) | 16.106 (base) |
| PULP- 2003 Euro 4 | 0.867 (-39.7%) | 0.392 (-81.1%) | 0.479 (-29.5%) | 8.607 (-46.6%) |
| XLS Diesel: 2003 Euro 3 | 0.071 (-95.1%) | 0.817 (-60.6%) | 0.124 (-81.7%) | 45.7 (+183.7%) |
| LPG Autogas: 3rd Gen | 1.15 (-20.1%) | 0.134 (-93.5%) | 0.195 (-71.3%) | 4.531 (-71.9%) |
| PULP- hybrid | 0.328 (-77.2%) | 0.217 (-89.5%) | 0.307 (-54.8%) | 4.716 (-70.7%) |
| LS Diesel- hybrid | 0.028 (-98.1%) | 0.425 (-79.5%) | 0.116 (-82.9%) | 27.61 (+71.4%) |
| CNG LV | 0.544 (-62.2%) | 0.144 (-93.1%) | 0.235 (-65.4%) | 4.525 (-71.9%) |
| E10 (molasses) | (-22.3%) | (+8.1%) | (-0.1%) | (+30.8%) |
| E10 (wheat) | (-20.8%) | (+12.6%) | (+2.2%) | (+38.4%) |
| B20 (canola) | (-95.8%) | (-55.7%) | (-83.6%) | (+167.4%) |
| B20 (tallow) | (-95.8%) | (-55.8%) | (-83.7%) | (+167.1%) |
| B20 (waste oil) | (-95.9%) | (-56.7%) | (-84.3%) | (+163.1%) |

Overall, it appears that the use of CNG vehicles provides the greatest overall air emissions advantage over ULP. The introduction of vehicles that meet the Euro 4 standard in 2008 is likely to lead to substantial improvements in overall air emissions. The advantages can be substantially improved through the use of petrol-hybrid vehicles, with the overall advantage approaching that of CNG.

While diesel engines have substantially better outcomes than ULP for CO, NOx and VOC emissions, there are substantially increased PM emissions associated with the use of this fuel. As noted in Chapter Two, the use of biodiesel can offset these emissions because biodiesel blends reduce

⁵⁵⁴ Sources: Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Aspendale, Victoria, 2004, p. 116; Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005. Air emissions reductions figures are derived from the Biofuels Taskforce report (2005). B20 air emissions figures are based on emissions reductions figures from the Biofuels Taskforce report relative to XLS Diesel emissions figures supplied in the CSIRO report on light vehicles emissions.

diesel PM emissions. Furthermore, there is some evidence that the PM emissions associated with biodiesel blends are less harmful to human health than those from petroleum diesel.

The use of ethanol blended fuels appears to provide some advantages through reduced CO emissions. However, these advantages appear to be offset by increased VOC and PM emissions.

Finding 9: The use of CNG in heavy and light vehicle fleets provides significant reductions in air pollutant emissions compared to other vehicle and fuel types.

While the use of new fuels and vehicle technologies provide one means towards reducing air emissions, the Committee is also cognisant that substantial reductions in air emissions could also be obtained by reducing the number of smoky vehicles on Victorian roads. The Environmental Protection Authority (EPA) in Victoria is responsible for monitoring vehicle air emissions in Victoria, and for ensuring that vehicles comply with air emissions requirements. Currently EPA Victoria runs two “smoky vehicle” programs – a “public” (community) reporting program and an “official” reporting program. These programs are described in Text Box 3. Numbers of smoky vehicle reports for both programs are provided in Figure 4.

Text Box 3: EPA Victoria smoky vehicle spotting programs⁵⁵⁵

Official smoky vehicle spotting program: This program relies on reported observations by Victoria Police and EPA officers of vehicles that are in breach of the regulations. Reports are submitted in writing using a standard spotting form. The registered owners of vehicles are sent a warning letter requesting they fix their vehicle. The letter contains the date, time and location of the offence. They are warned of potential fines should they be reported again. They are not required to reply or submit evidence of compliance.

Experience has shown that only a very small number are repeat or serial offenders. These offenders can be issued with further warnings requiring evidence of compliance, infringement notices, attendance for an inspection by EPA officers or court prosecution. Officers reporting vehicles are aware that the report may result in a fine being issued or a court prosecution.

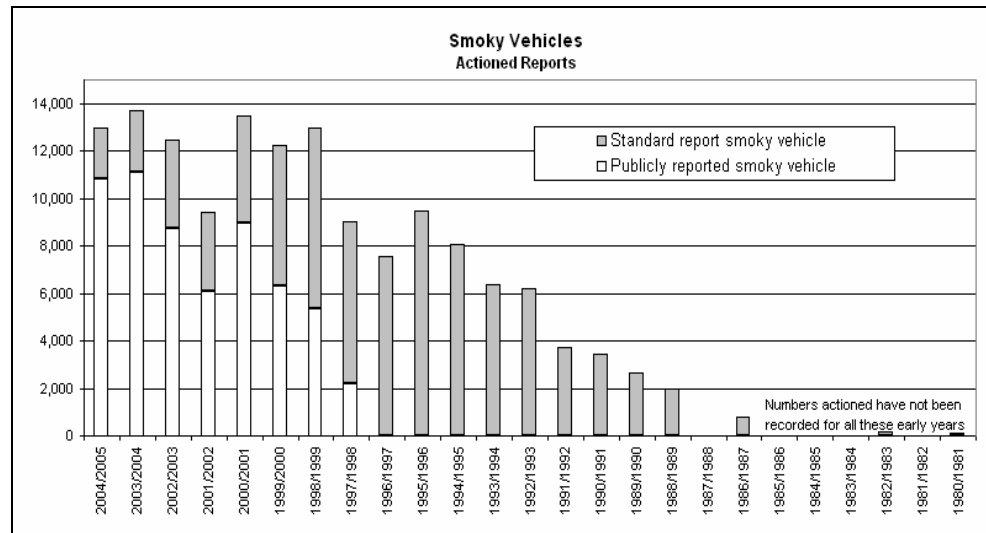
Public smoky vehicle spotting program: This program relies on reports from members of the community. Reports under the program must contain the registration number, a physical description of the vehicle, and the date, time and location. Reporters are also required to provide their name and contact details.

If the vehicle description matches that contained in the registration database, owners are sent an “advisory” letter. This letter sets out clearly the origin of the report along with a request to check their vehicle. It does not allege an offence and is couched in non-accusatory wording. They are not required to submit evidence of compliance, however many do so.

⁵⁵⁵ Kristian Handberg, Team Leader (acting) - Greenhouse Policy Atmosphere & Noise Unit, EPA Victoria, *personal communication*, 11 October 2007.

While in the initial stages of the program, reports were received primarily in writing, the rapid increase in numbers has required the introduction of a web based reporting system to enable batch processing. Telephone reporting is also available via a call centre. Call centre operators enter the details directly into the web based system. This high level of automation enables both programs to be operated by one administrative officer with input and advice from technical officers as required.

Figure 4: Smoky vehicle reports, EPA Victoria, 1980-2005.⁵⁵⁶



The Committee is of the opinion that further air emissions benefits could be obtained through an assessment of the current smoky vehicle spotting programs, with a view to improving procedures to ensure vehicle compliance occurs. Toward this end, the Committee recommends that EPA Victoria evaluate the effectiveness of its programs. In particular the EPA should examine internal mechanisms for acting upon public reporting of smoky vehicles in order to ensure that it is an effective means for achieving compliance with vehicle emissions regulations.

Recommendation 1: Given increasing interest in vehicle air emissions reductions in association with biofuels use, that EPA Victoria also implement procedures to ensure improved compliance of existing vehicles with current air emissions requirements.

6.3 Fuel security

The consideration of various fuels in Chapters Two through to Five of this report show that no fuel provides a complete solution to concerns surrounding fuel security. A recent study by CSIRO for the Rural Industries Research and Development Corporation suggests that in order to significantly contribute to Australia's fuel security, biodiesel and ethanol would need to account for 10 to 20 per cent of the total fuel mix.⁵⁵⁷ While

⁵⁵⁶ Kristian Handberg, Team Leader (acting) - Greenhouse Policy Atmosphere & Noise Unit, EPA Victoria, *personal communication*, 11 October 2007.

⁵⁵⁷ Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007, p. 24.

some commentators argue these fuels could be viable “interim” fuels for Australia the limited availability of suitable feedstocks is a significant barrier to substantial development of the biofuels sector. In its submission to the Inquiry, the CSIRO advised that if Australia’s entire exports of sugar, C-molasses, wheat and coarse grains were used to produce ethanol between 22 and 40 per cent of Australia’s petrol requirements could be met.⁵⁵⁸

Consequently, unless land use is transferred from other valuable purposes to biofuels production, it is likely the principle role of these fuels will be as a petroleum fuel extender until a truly alternative means of providing energy for transport can be developed. Given CSIRO and other advice, the Committee is concerned about the potential repercussions associated with transferring such large areas of food producing land to fuel producing land. The Committee notes the possibility, however, that in the medium to long term the development of commercially competitive lignocellulosic technologies may alter the fuel security potential of biofuels.

While LPG is an increasingly popular fuel in Australia, the overall benefit of increased adoption in the vehicle fleet as a fuel security measure is also limited. This is because LPG for the Australian market is typically obtained from crude oil, and so is bound up with the security issues associated with the petroleum industry. It does however have the potential to contribute to fuel security by improving the efficiency of petroleum refining. Expanded extraction of LPG from natural gas reserves may also provide an opportunity to decouple this fuel from petroleum, and so increase overall fuel security. According to LPG Australia, the production of LPG from oil refining is forecast to decline, with naturally occurring LPG set to increase with the discovery of a large number of wet gas wells.⁵⁵⁹ Estimates by the Australian Bureau of Agricultural Resource Economics indicate that on the basis of increasing production of natural gas, Australian LPG production will increase in the long term.⁵⁶⁰

Increased use of natural gas as a transport fuel in the Australian fleet would provide increased fuel security, largely due to the large reserves of gas currently available in Australia. In order for this to occur substantial investment in refuelling infrastructure and the vehicle fleet is required. While fuel conversions can allow vehicles to operate on CNG, the emissions benefits of CNG use can be largely offset if engines are not carefully tuned to ensure efficient use of the fuel. While the barriers to the widespread adoption of CNG in Australia are significant, CNG should certainly be considered as a means to improve fuel security in Australia over the medium term.

Identification of further reserves of fuel is not the only way to improve fuel security. Fuel security can also be improved by using existing supplies more efficiently, and by reducing the range of applications in which fuel is required. In this context, high efficiency engines (such as hybrid engines) provide a potential means for improving fuel security by reducing demand for petroleum. From a demand side perspective, measures to reduce

⁵⁵⁸ CSIRO, *Submission*, no. 32, July 2007, p. 5.

⁵⁵⁹ Raymond North, *Transcript of evidence*, Australia’s future oil supply and alternative transport fuels, Standing Committee on Rural and Regional Affairs and Transport, Commonwealth Parliament, 9 June 2006, p. 61.

⁵⁶⁰ ABARE, *Energy in Australia 2005*, Australian Government, Canberra, 2005, p. 25.

transport use or to improve the efficiency of transport (such as through the promotion of public or shared transport, for example) can also provide an effective means to improve fuel security.

Finding 10: Based on current technologies, natural gas is the alternative fuel that is most likely to provide substantial gains in domestic fuel security.

Another energy source that has received attention as a potential means to reduce reliance on imported fuel is coal. Coal-to-liquids technology is well established and viewed by some Australian and international organisations as a viable method for producing liquid fuels in the future.⁵⁶¹ While there are substantial reserves of coal in Australia, the Committee notes that the environmental performance of coal-to-liquids is poorer than the environmental performance of comparatively mainstream alternative fuels such as natural gas.⁵⁶²

6.4 Regional development

As the discussion above shows, there are a complex range of issues associated with each of the fuels discussed above in terms of their contribution to GHG emissions reduction, air emissions and fuel security. Compared to other fuels, however, biofuels provide the best means to support industry growth and to stimulate agricultural production.

⁵⁶¹ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 111.; Monash Energy, 'Monash Energy Report 2005', viewed 4 January 2008, <<http://www.monashenergy.com.au/pdfs/06anglocoalsdreport.pdf>>.

⁵⁶² Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 112.

Chapter Seven: Key points

- Globally, ethanol accounts for approximately 88 per cent of biofuel production. The United States produces 36 per cent of the world's ethanol followed by Brazil, which produces 33.3 per cent (p. 107).
 - Biodiesel production accounts for substantially less of the world's biofuels than ethanol. Most biodiesel production occurs in the European Union (p. 107).
 - Government support for biofuels is generally premised on the following key objectives:
 - to improve overall energy security and lower dependence on petroleum fuels;
 - to reduce the environmental impact of transport fuels; and
 - to provide agricultural support and facilitate regional development (p. 109).
 - The cost of government support to biofuels industries is substantial. In 2007, the cost of biofuels support to Organisation for Economic Co-operation Development (OECD) governments was estimated to be in the order of US\$13-15 billion. Government initiatives to support biofuels industries can include fuel tax exemptions; production subsidies; grants for capital and infrastructure projects; and incentives for increased availability of biofuels compatible vehicles. Indirect government costs are incurred from the establishment of measures such as biofuels mandates and subsidies to the production of feedstock crops (p. 110).
 - The cost to government associated with the provision of biofuels production subsidies in the United States (US), European Union (EU), Canada, Australia and Switzerland is between US \$0.29 and US \$1.00 per-litre of ethanol, and US \$0.20 and US \$1.00 per litre of biodiesel (p. 118).
 - There are emerging concerns about the effect of increasing biofuels feedstocks prices and the flow-on effect these may have on food and fuel markets. The introduction of biofuels mandates may exacerbate price pressures on feedstocks used as both biofuels and food (p. 119).
 - While there are few carbon markets currently in operation, it is estimated that the minimum cost per tonne of GHG emissions abatement associated with biofuels is extremely high (p. 121).
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Chapter Seven: International government support for biofuels

Currently the production of biofuels is actively supported by a large number of countries in the Americas, Europe, Australasia and Asia. There are a range of reasons for support for biofuels in these countries, and a number of different approaches to the mode of government support offered. In this chapter a brief overview of the justifications for increased biofuels support in various countries is provided, along with some of the current evidence about the cost of providing effective support to the industry.

7.1 Global biofuel production

Ethanol accounts for approximately 88 per cent of global biofuel production, and biodiesel about 12 per cent. Between 2000 and 2005 global production of ethanol more than doubled and biodiesel production expanded four fold.⁵⁶³ Brazil produces 33.3 per cent of the world's ethanol, with the United States responsible for 36 per cent of global ethanol production. Until 2005, Brazil produced more ethanol than the United States. Other significant producers include China, Spain, France and India. Due in part to domestic policy initiatives, and the emergence of potential export markets (particularly through policies in Japan to meet part of its Kyoto targets through use of biofuels), Thailand is expected to emerge as a significant producer of fuel ethanol.

Biodiesel production is substantially less than ethanol production, and is concentrated in Europe. Currently the most accurate measure for biodiesel volume is capacity, rather than production – although according to the International Energy Agency (IEA) biodiesel production correlates closely with biodiesel capacity in Europe.⁵⁶⁴ Global biodiesel capacity in 2002 was approximately 1.5 GL, with Germany, France and Italy accounting for around 83 per cent of global biodiesel capacity, and the EU collectively producing around 90 per cent of global biodiesel. By 2006 approximately 6.5 GL of biodiesel production capacity was available globally, with 74.6 per cent of this capacity located in the EU.⁵⁶⁵

⁵⁶³ Worldwatch Institute, *Biofuels for transportation: global potential and implications for sustainable agriculture and energy in the 21st century. Extended summary*, Worldwatch Institute, Washington, 2006, p. 4.

⁵⁶⁴ International Energy Agency, *Biofuels for transport: an international perspective*, International Energy Agency, Paris, 2004, p. 28. The Committee notes that this does not presently appear to be the case in Australia.

⁵⁶⁵ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 10.

Table 29: Top five ethanol and biodiesel producers 2005.⁵⁶⁶

| Top Five Ethanol Producers, 2005 | | Top Five Biodiesel Producers, 2005 | |
|----------------------------------|--------------------------------|------------------------------------|--------------------------------|
| | Production (million litres) | | Production (million litres) |
| Brazil | 16,500 | Germany | 1,920 |
| United States | 16,230 | France | 511 |
| China | 2,000 | United States | 290 |
| European Union | 950 | Italy | 227 |
| India | 300 | Austria | 83 |

In 2004 the OECD estimated that biofuels production was sufficient to meet 1.3 per cent of world fuel use.⁵⁶⁷ With the exception of Brazil, where ethanol production was equal to 21.6 per cent of transport fuel use in 2004, biofuels account for less than two per cent of transport fuel use in biofuels producing countries (see Table 30). In 2005 the OECD calculated that a substantial proportion of available agricultural land would have to be used for biofuels production in order to meet a ten per cent transport fuels biofuels target (Table 30). While Australia was not included in the OECD calculations, the Committee is aware that the agricultural requirements for large-scale biofuels production in Australia would be substantial.⁵⁶⁸

Table 30: Production of biofuels as proportion of total transport fuel use and land requirements for 10% biofuels production, major biofuels producing regions, 2004.⁵⁶⁹

| Country / Area | 2004 biofuel production | Land area needed for 10% biofuels production |
|---------------------------------------|-------------------------|--|
| USA | 1.6% | 30% |
| Canada | 0.3% | 36% |
| EU-15 | 0.8% | 72% |
| Poland | 0.4% | 6% |
| Brazil | 21.6% | 3% |
| World | 1.3% | 9% |
| Five major biofuels producing regions | 1.3% | 37% |

⁵⁶⁶ Source: Worldwatch Institute, *Biofuels for transportation: global potential and implications for sustainable agriculture and energy in the 21st century. Extended summary*, Worldwatch Institute, Washington, 2006, p. 6.

⁵⁶⁷ Working Party on Agricultural Policies and Markets, *Agricultural market impacts of future growth in the production of biofuels*, OECD, Paris, 2006, p. 15.

⁵⁶⁸ Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007, p. 23.

⁵⁶⁹ Working Party on Agricultural Policies and Markets, *Agricultural market impacts of future growth in the production of biofuels*, OECD, Paris, 2006, p. 15.

7.2 The rationale for governmental support

Government support for biofuels is generally premised on four main policy objectives. In 2005 a report by the OECD noted that the major objectives of government policies supporting for the production of biofuels are based on a desire to:

- improve overall energy security and lower dependence on petroleum fuels;
- decrease motor vehicle contributions to growing air pollution in urban centres; and
- lower the contribution of transport fuels to GHG emissions.⁵⁷⁰

A report by IEA in 2004 found that while energy security and environmental concerns are drivers of biofuels policy, in many IEA countries⁵⁷¹ biofuels production provides a means for agricultural support.⁵⁷² According to this report:

Current policies related to biofuels in many IEA countries, and particularly in the EU, appear to be driven largely by agricultural concerns, perhaps more than by energy concerns. Agricultural policy in many countries is complex and serves multiple policy objectives. Major producer support schemes are in place around [IEA countries]. Although the OECD does not support the use of agricultural subsidies.... [s]ome studies have shown that the cost of subsidising increased biofuels production will be at least partly offset by resulting reductions in other agricultural subsidies.⁵⁷³

This finding was also supported in the report of the Prime Minister's Biofuels Taskforce, which found that "support for agriculture is, or becomes so once government assistance is established, the primary driver of biofuel assistance in all cases except for countries with limited capacity to increase agricultural production."⁵⁷⁴

Finding 11: Internationally, the key driver of government support for biofuels is regional and agricultural development.

Globally, the development of biofuels industries is characterised by active government support. A commonly cited rationale for this support is that because the biofuels industry is relatively new and is unable to take advantage of economies of scale, the higher cost of biofuels makes it

⁵⁷⁰ International Energy Agency, *Biofuels for transport: an international perspective*, International Energy Agency, Paris, 2004, p. 25; Working Party on Agricultural Policies and Markets, *Agricultural market impacts of future growth in the production of biofuels*, OECD, Paris, 2006, p. 17.

⁵⁷¹ Namely Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Republic of Korea, Luxembourg, The Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and the United States.

⁵⁷² International Energy Agency, *Biofuels for transport: an international perspective*, International Energy Agency, Paris, 2004, p. 21.

⁵⁷³ International Energy Agency, *Biofuels for transport: an international perspective*, International Energy Agency, Paris, 2004, p. 21.

⁵⁷⁴ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 10.

difficult for widespread use to occur without strong policy intervention.⁵⁷⁵ This argument anticipates that once the biofuels industry is sufficiently established policy intervention can be reduced or eliminated. While this may be the case, there is evidence that strong policy intervention may be required over a long period in order to sustain the biofuels industry. The US, for example, has provided subsidies to the biofuels industry since 1978.

Finding 12: Ongoing provision of government-funded programs and subsidies is a key feature of the biofuels industry internationally.

7.3 Forms of government support for biofuels

A recent report by the Global Studies Initiative (GSI) indicates that government support for the ethanol and biodiesel industries is substantial. In the 2007 report *Biofuels – at what cost?* GSI estimated that OECD governments collectively provided at least US \$11 billion of support to the ethanol and biodiesel industries in 2006 alone. In 2007, the cost of government support for biofuels was expected to be in the order of US \$13-15 billion.⁵⁷⁶ These estimates do not account for all of the costs associated with government support for biofuels through, for example, subsidies to feedstock crops, or the wider economic costs associated with the introduction of a mandate for biofuels use.

A wide range of models for providing support to the biofuels industry are currently employed. Some of the most popular include the introduction of a fuel mandate, tax and excise concessions, and production and/or industry grants.

7.3.1 Import tariffs

Many countries apply tariffs to imported ethanol, which has the effect of supporting the domestic ethanol industry. The EU, US, Canada, Switzerland and Australia all apply tariffs to imports, for example, although the world's second-largest ethanol producer Brazil does not (see Table 31). Exceptions to import tariffs are usually available when countries have entered into free trade arrangements. Currently Australia has one of the highest import tariff rates for ethanol in the OECD, although imported ethanol will be eligible for production grants from 2011, offsetting the price differential between domestic and offshore-produced ethanol.

⁵⁷⁵ International Energy Agency, *Biofuels for transport: an international perspective*, International Energy Agency, Paris, 2004, p. 21.

⁵⁷⁶ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 4.

Table 31: Applied tariffs on undenatured ethyl-alcohol in selected countries, as of 1 January 2007.

| Country | Applied tariff | Exceptions |
|----------------|--------------------------|---|
| Australia | 5% + AUD \$0.38142/litre | USA, New Zealand |
| Brazil | None | n.a. |
| Canada | C \$0.0492/litre | FTA partners |
| European Union | € 19.2/hectolitre | EFTA countries, developing countries in GSP |
| Switzerland | CHF 35 per 100kg | EU, developing countries in GSP |
| US | 2.5% + US \$0.51/gallon | FTA partners, CBI partners |

7.3.2 Fuel excise tax exemptions

The most common form of industry support to the biofuels industry in the OECD takes the form of reductions to, or exemptions from, the excise applied to other transport fuels. The US was one of the first countries to allow exemptions from fuel excise for ethanol, although the excise exemption was modified in 2004 to an income tax credit due to excessive costs associated with this policy.⁵⁷⁷ Within the US, a number of individual states continue to offer concessions on fuel excise for ethanol production. Concessions for E10 of up to US \$0.041 / gallon are principally provided in 'corn belt' states such as Montana, Iowa and Maine, with other states offering excise concessions on E85 only.⁵⁷⁸ In Canada fuel excise concessions offered by the provinces also 'stack' with federal concessions to produce increased net concessions for ethanol and biodiesel production.

In the EU, fuel excise concessions or exemptions are offered for ethanol in all member countries except the Czech Republic, Finland, Greece, Italy and Luxemburg. Germany grants excise concessions for E85, but as it has mandatory ethanol blending requirements no excise concession is offered for lower blends of ethanol. All countries in the EU provide fuel excise exemptions or concessions for biodiesel.

7.3.3 Mandates and targets

In addition to the measures above, a number of countries and states have introduced targets and mandates for the use of biofuels. Most countries that have introduced targets and mandates apply them generally to 'biofuels', although a number (including NSW and Queensland) specify either ethanol and/or biodiesel targets. In Table 32, mandates and targets on biofuels production in various countries are provided. In Table 33 countries and states that have either ethanol and/or biodiesel-specific mandates are listed.

⁵⁷⁷ Fuel tax revenues in the US were hypothecated to the Federal Highway Trust Fund, so that over time some US states experienced substantial reductions in road funding.

⁵⁷⁸ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, pp. 64-65.

Table 32: Use and blending share targets and mandates for biofuels, by country.⁵⁷⁹

| Country | Target or Mandate? | Quantity or blending share |
|----------------|--------------------|--|
| Australia | Target | 350 ML by 2010 |
| Victoria | Target | 5% by 2010 |
| China | Target | 15% by 2020 |
| European Union | Target | 2% by 2005; 5.75% by 2010; 10% by 2020 |
| Austria | Mandate | 2.5% by 2006; rising to 5.75% by 2009 |
| Belgium | Target | 2.5% by 2005; 5.75% by 2010 |
| Czech Republic | Target | 3.7% by 2005; 5.75% by 2010 |
| Estonia | Target | 2% by 2005; 5.75% by 2010 |
| Finland | Mandate | 2% by 2008; 4% by 2009; 5.75% by 2010 |
| France | Mandate | 7% by 2010; 10% by 2015 |
| Greece | Target | 0.7% by 2005; 5.75% by 2010 |
| Hungary | Target | 0.6% by 2005; 5.75% by 2010 |
| Ireland | Target | 0.06% by 2005 |
| Italy | Target | 1% by 2005; 2.5% by 2010 |
| Latvia | Target | 2% by 2005; 5.75% by 2010 |
| Lithuania | Target | 2% by 2005; 5.75% by 2010 |
| Luxembourg | Mandate | 2% from 2007 |
| Netherlands | Mandate | 2% by 2007, increasing to 5.75% by 2010 |
| Poland | Target | 0.5% by 2005; 5.75% by 2010 |
| Portugal | Target | 2% by 2005; 5.75% by 2010 |
| Slovakia | Mandate | 2% by 2006; 5.75% by 2010 |
| Spain | Mandate | 1.2% by 2006; rising to 5% by 2010 |
| Sweden | Target | 3% by 2005; 5.75% by 2010 |
| United Kingdom | Mandate | 2.5% by 2008; 3.75% by 2009; 5% by 2010 |
| Japan | Target | 500 GL by 2010 |
| New Zealand | Mandate | 3.4% by 2012 |
| Norway | Mandate | 2% by 2008; 5% by 2009; 7% by 2010 |
| USA (federal) | Mandate | 2.78% by volume of gasoline consumption in 2006 (15 GL); 28 GL by 2012 |
| Iowa | Target | 10% by 2009; 25% by 2020 |

⁵⁷⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, pp. 63-64; CSR Limited, *Submission*, no. 11, 27 July 2007; Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 28.

Table 33: Use and blending share mandates for ethanol and/or biodiesel, by selected country and province / state.⁵⁸⁰

| Country (state or province) | Ethanol | Biodiesel |
|--------------------------------|---|--|
| | Quantity or blending share | Quantity or blending share |
| Argentina | | 10% (proposed) |
| Australia | | |
| New South Wales | 2% by 2007; 10% by 2011 | |
| Queensland | 10% by 2010 | |
| Brazil | 4.5% by 1977; 20-25% by 1991 | 2% by 2008; 5% by 2013 |
| Canada | | |
| Canada (federal) | 5% by 2010 | 2% by 2012 |
| British Columbia | 5% by 2010 | 5% by 2010 |
| Saskatchewan | 1% by 2005; 7.5% by 2007 | 2.5% by 2008; 5% by 2010 |
| Manitoba | 8.5% by 2008 | |
| Ontario | 5% by 2007; 10% by 2010 | |
| Quebec | 5% by 2012 | |
| China | 10% by 2020 (proposed) | |
| Colombia | 10% in cities with population > 500,000 | |
| European Union | | |
| Germany | 3.6% by 2010 | 4.4% by 2007 |
| India | 5% in nine states by 2002 | 20% by 2011 (proposed) |
| New Zealand | | 0.53% by 2008 |
| USA | | |
| Hawaii | 85% of gasoline must exceed E10 by 2006 | |
| Louisiana | 2% after ethanol produced from local feedstock exceeds 190 ML per month | 2% after biodiesel produced from local feedstock exceeds 38 ML per month |
| Minnesota | 20% by 2013 | 2% by 2005 |
| Missouri | 10% by 2008 | |

⁵⁸⁰ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 66; Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007, p. 67; Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 30; Working Party on Agricultural Policies and Markets, *Agricultural market impacts of future growth in the production of biofuels*, OECD, Paris, 2006, p. 20.

| | | |
|-------------------|---|-------------------------|
| Montana | 10% after ethanol production certified at 150 ML p.a. | |
| New Mexico | | 5% by 2012 |
| Oregon | 10% by 2007 | 2% by 2007; 10% by 2010 |
| Oregon (Portland) | 10% by 2007 | 2% by 2007; 10% by 2010 |
| Washington | 2% by 2008 | 2% by 2008 |

While most jurisdictions have proposed biofuels targets that specify the date by which the targets become active, it is notable that some states in the US have linked the trigger point at which mandates become binding to biofuels production.

7.3.4 Direct production subsidies

Recently there has been a move in many principal biofuels-producing nations towards the volumetric subsidies and/or consumption mandates. From 2004 the US federal government provided an excise credit of US \$0.51 per gallon of ethanol to fuel blenders. An excise credit of US \$1.00 per gallon and US \$0.50 per gallon was also provided for biodiesel produced from agricultural fats and oils and biodiesel produced from waste oil, respectively. These excise credits are not taxed under corporate revenue.⁵⁸¹ The US federal government also offers a “small producer” tax credit for the first 15 ML of ethanol or biodiesel produced in factories with a capacity of less than 60 ML. This tax credit is worth US \$0.10 per gallon of ethanol or biodiesel produced.

As is the case with fuel excise tax concessions, individual states in the US also offer volumetric subsidies on ethanol and biodiesel production.⁵⁸² In some cases producer payments are contingent on the fuel being produced from feedstock sourced from the US state in question. In Missouri payments are further restricted to companies that are at least 51 per cent owned by agricultural producers who are residents of the state and are actively involved in agricultural production.

In 2008 Canada will eliminate fuel-excise tax exemptions for ethanol and biodiesel and move towards specific producer payments for biofuels production. The federal government has allocated C \$1.5 billion (US \$1.4 billion) over seven years, with payments until 2009 provided at a rate of C \$0.10 per litre for “renewable alternatives to gasoline” and C \$0.20 per litre for “renewable alternatives to diesel”. After 2010 rates will decrease until completion of the scheme.⁵⁸³ Individual provinces within Canada also offer, or plan to offer, grants for biofuels production.

⁵⁸¹ Working Party on Agricultural Policies and Markets, *Agricultural market impacts of future growth in the production of biofuels*, OECD, Paris, 2006, p. 19.

⁵⁸² Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, pp. 25-26.

⁵⁸³ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 26.

Production subsidies are less widespread in the EU, with only Latvia and the Czech Republic offering production subsidies for biofuels production.

7.3.5 Support to production factors

Internationally, a pervasive feature of government support to the biofuels industry is the provision of capital grants, government loans or government guaranteed loans for the construction of biofuels facilities. This support is often provided by multiple levels of government within a given jurisdiction, with programs or schemes typically offered at national, state or provincial, and local government level. Consequently it is difficult to determine the full extent of support offered to the industry by these means.

A recent international study on levels of government subsidies to the biofuels industry suggested that in countries with federal systems of government, new or established biofuels ventures could be substantially funded by government assistance through 'subsidy stacking', where investors in biofuels plants are able to access multiple sources of public financing assistance. According to this study:

It is not uncommon for biofuel plants in the United States to benefit from a combination of municipal-government support, often in the form of free land or utility connections; state-level support, such as tax credits for investment, or economic development grants or loans; and support from federal agencies under various regional development, agricultural or energy programmes. While any one investment aid may not be sufficient to trigger development of a new plant, when they are combined with other programs the total value can be significant. In one specific plant examined in the U.S. state of Ohio, for example, more than 60 per cent of the plant's capital is being provided by government-intermediated credit or grants.⁵⁸⁴

Canada's Ethanol Expansion Program has addressed this issue through a requirement that total assistance from all levels of government not exceed 50 per cent of total project costs, with grant recipients required to disclose all sources of funding before entering into agreement with the government.

While information on capital support for biofuels projects in the European Union is difficult to obtain, the 2007 report *Biofuels – at what cost?: government support for ethanol and biodiesel in OECD countries* noted that grants ratios of 15 to 40 per cent of total investment costs were common, with government support covering up to 60 per cent of costs in some cases.⁵⁸⁵

In Sweden tax incentives are offered for the construction of new biofuels plants, while in Brazil biofuels plants are subject to reduced levels of industrial tax. China allows tax exemptions for biofuels industries.⁵⁸⁶

⁵⁸⁴ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 33.

⁵⁸⁵ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 33.

⁵⁸⁶ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, pp. 66-67.

Various forms of government loans are also employed to assist the biofuels industry internationally. In Canada 'contingent' loans have been made available by government for the biofuels industry, where the requirement for loan repayments is dependent on market conditions.⁵⁸⁷ China also provides loan assistance for the development of biofuels plants.⁵⁸⁸ In the US, Canada, Thailand and Austria government loans have also been made available to encourage increased community and farmer participation in biofuels manufacturing, particularly through the establishment of small- and medium-sized plants.⁵⁸⁹

7.3.6 Support for biofuels distribution infrastructure

A number of countries and jurisdictions have offered grants, tax concessions and/or subsidies for fuel distribution infrastructure upgrades in order to facilitate the provision of biofuels to the market. In the US up to 30 per cent of the cost of infrastructure upgrades (particularly for the provision of E85-capable infrastructure) is covered by government assistance. France and the United Kingdom also provide capital allowances and grants for refuelling infrastructure upgrades.⁵⁹⁰

A different approach to infrastructure development has been adopted in Sweden, where in 2006 it became compulsory for petrol stations selling in excess of 3000m³ of fuel per year to also sell renewable fuels. In 2009 all petrol stations selling more than 1000m³ of fuel per year will also be required to sell renewable fuel. Subsidies of up to 30 per cent of investment costs are provided to assist the industry to meet these requirements.⁵⁹¹

7.3.7 Support for flex-fuel vehicles

A number of countries, including Brazil, the US, Cyprus, France, Ireland and Sweden offer various forms of support for the provision of flex-fuel vehicles (FFVs) to the market. In Brazil tax exemptions are offered for vehicles that are capable of running on higher blends of ethanol. An agreement was also reached with vehicle manufacturers and importers that two-thirds of new vehicles sold from 2007 would be flex-fuel (E85 capable) vehicles. All cars currently sold in Brazil are capable of running on ethanol in blends up to E25.

⁵⁸⁷ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 33.

⁵⁸⁸ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 68.

⁵⁸⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, pp. 67-68; Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 33.

⁵⁹⁰ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 34.

⁵⁹¹ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 34.

In Sweden incentives are offered for FFV use, including reduced registration charges and road taxes, with some cities also offering free parking and waived congestion charges to FFVs. In the US since 1988 incentives have been offered to manufacturers for the production of FFVs. Other incentives offered in certain states in the US include allowing FFVs to use high-occupancy vehicle lanes regardless of how many passengers are in the vehicle, and exemptions from emission testing or motor vehicle inspections.

In the US, the intention of FFV purchase and use incentives was that as more FFVs entered the market, fuel providers would start providing more E85 pumps in service stations. However, this has not tended to occur, and most FFV owners in the US tend to run their vehicles exclusively on petrol.

7.3.8 Support for research and development

Internationally, government support for research and development of biofuels technology is pervasive. Most current research is directed at the development of second-generation fuel technologies, particularly the development of more cost-effective means of producing ethanol from lignocellulosic material. The research focuses on a number of factors in the production process – including feedstock technologies; enzyme and pre-production treatments; and the fermentation of lignocellulosic materials for the production of ethanol.

7.4 The cost of government support for biofuels

The net cost of government support for biofuels is difficult to determine, particularly given the complexity of excise, production and infrastructure assistance provided by various levels of government, and the less transparent costs associated with indirect support to the biofuels industry. The GSI analysis of subsidies costs associated with biofuels production found that per-litre equivalent costs ranged between US \$0.29 and US \$1.00 for ethanol in the US, EU, Canada, Australia and Switzerland, with the per-litre equivalent cost of biodiesel between US \$0.20 and US \$1.00 (see Table 34). This study also distinguished between total per-litre cost of subsidies at current volumes of production (including fixed expenditure such as through capital grants etc.) and variable cost per-litre (that is, the proportion of cost that is linked to production volume, and so will remain constant as volumes increase).

Table 34: Approximate average and variable rates of support per litre of biofuel produced in selected OECD countries (US\$ per litre).⁵⁹²

| OECD economy | Ethanol | | Biodiesel | |
|--------------|--------------|---|---------------|---|
| | Average | Variable | Average | Variable |
| US | 0.29 to 0.36 | Federal: 0.15 States: 0 to 0.11 | 0.54- 0.67 | Federal: 0.26 States: 0 to 0.26 |
| EU | 1.00 | 1.00 | 0.70 | 0.70 |
| Canada | 0.40 | Federal: up to 0.10 Provinces: 0 to 0.10 | 0.20 | Federal: up to 0.20 Provinces: 0 to 0.20 |
| Australia | 0.40 | 0.30 | 0.40 | 0.30 |
| Switzerland | 0.60 | 0.60 | 1.00 | 0.60 to 2.00 |

7.4.1 Crop subsidies

The cost estimates cited above approximate the direct cost to government of providing support to biofuels production, but do not account for the full range of costs associated with the promotion of biofuels by governments. In some countries – particularly the US and member states of the EU – payments to the farming sector for agricultural production of commodities such as ‘energy crops’ comprise additional, but less direct, costs associated with the biofuels industry. In the EU for example, under the Common Agricultural Policy the set-aside subsidy is increased if land is planted to produce feedstock for biofuels. In the US corn crops are heavily subsidised, with corn growers receiving fixed annual payments on corn harvests. Other biofuels feedstock crops such as sorghum and soy are also subsidised. As a significant proportion of US corn is now diverted to the production of ethanol, this effectively constitutes a subsidy to the biofuels industry through reduced feedstock prices. As indicated in Table 35, at least US \$918 million of agricultural subsidies paid every year between 2000 and 2005 benefited the biofuels industry.

Table 35: Biofuels share of agricultural subsidies to primary fuel feedstocks, United States, 2000-2005 (US \$million p.a.).⁵⁹³

| | Corn | Sorghum | Soy |
|---|--------------|------------|--------|
| Subsidy to crop, average 2000-2005 (US \$million p.a.) | \$6840 | \$595 | \$3250 |
| Share of crop converted into biofuels | 12-20% | 11-17% | 1% |
| Biofuels industry share of crop subsidy (US \$million p.a.) | \$820-\$1368 | \$65-\$101 | \$33 |

⁵⁹² Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 39.

⁵⁹³ Doug Koplou, *Biofuels - at what cost? Government support for ethanol and biodiesel in the United States*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2006, p. 39.

7.4.2 Crop and food prices

Over the past few years prices for feedstocks associated with the production of biofuels have increased substantially. These increases are due to a number of factors, including drought in key feedstock-producing areas and the longer-term effects of policy reforms that have reduced crop surpluses. While demand for biofuels feedstocks is likely to have also contributed to price increases, little research has been completed to date on the relative contribution of this and other factors to feedstock market prices.

The effect of increasing feedstock prices is variable and wide-ranging, particularly as the feedstocks for biofuels tend to be edible products suitable for food or livestock protein feeds. Internationally the effect of rising prices partly attributable to biofuels feedstock demand on the cattle industry has been ameliorated because by-products from ethanol production, principally dried or wet distillers grain, can be used for the production of cattle feed. However, the pig and poultry industries have been disproportionately affected internationally due to the dependence of these industries on energy grains. There is also emerging evidence that increased demand for tallow by the biodiesel industry is reducing margins for the soap industry.

Internationally, concern is increasing about the effects of increased diversion of food crops to biofuels production, and in particular, whether this contributes to increased food prices.⁵⁹⁴ In October 2007 the International Monetary Fund (IMF) suggested that “until new technologies are developed, using food to produce biofuels might further strain already tight supplies of arable land and water all over the world, thereby pushing food prices up even further.”⁵⁹⁵ The IMF found that:

Higher biofuel demand in the United States and the European Union (EU) has not only led to higher corn and soybean prices, it has also resulted in price increases on substitution crops and increased the cost of livestock feed by providing incentives to switch away from other crops.

Notable flow-on effects of increased prices for biofuels feedstocks have recently been noted by international media. In Italy a one day “pasta” strike was organised in protest at a 20 per cent rise in the price of wheat. In 2007 the Mexican government put a cap on tortilla prices following increases in the price of corn generally attributed to increased demand for corn to produce ethanol in the US. In a recent analysis of US energy policy one commentator has suggested that “...a part of the burden of reducing [US] oil imports by substituting corn-derived ethanol is being paid by the poor in Mexico.”⁵⁹⁶

⁵⁹⁴ The Royal Society, *Sustainable biofuels: prospects and challenges*, The Royal Society, London, 2008, p. 37.

⁵⁹⁵ Valerie Mercer-Blackman, et al., 'Biofuel demand pushes up food prices', *IMF Research Department*, 2007, viewed 17 October 2007,

⁵⁹⁶ Arjun Makhijani, *Carbon-free and nuclear-free: a roadmap for US energy policy*, Nuclear Policy Research Institute and the Institute for Energy and Environmental Research, Takoma Park, 2007, p. 47.

While food price increases may have occurred in any case due to agricultural sector policy realignment, drought and other natural (and uncontrollable) events, it is likely that the recent expansion of the biofuels market has substantially increased demand for these products. As a result, price increases for feedstocks and substitute products are likely to be higher than if the biofuels industry had not experienced rapid growth. While the cost associated with this development is not directly shouldered by government, the aggregate effect of increased food prices on national and international markets and economies should be carefully examined when biofuels policies are considered.

7.4.3 Cost of fossil-fuel displacement

One of the reasons commonly cited for increasing biofuels production internationally – particularly in the US and the EU – is that the domestic production of biofuels will make states less vulnerable to disruptions in the supply of petroleum products. However, as discussed in earlier chapters, the production of biofuels does not directly offset petroleum demand because a certain amount of fuel is required to bring the biofuel to market. For this reason, the production of one litre of biodiesel does not necessarily mean that one litre less of petroleum diesel will be required. When fossil fuels generally are taken into account (rather than just petroleum fossil fuels), the displacement factor of biofuels is further reduced, because fossil fuel energy (through coal for electricity generation for example) forms an additional proportion of inputs to biofuels production on top of energy derived from petroleum.

Table 36 shows the cost to government associated with displacing one litre of petrol or diesel with an energy-equivalent amount of ethanol or biodiesel. When fossil fuel displacement, rather than just petroleum displacement, is taken into account, the cost per equivalent litre to governments increase substantially.

Table 36: Cost associated with petroleum fuel and fossil fuel displacement associated with the use of ethanol and biodiesel, 2006 (US\$).⁵⁹⁷

| OECD economy | Ethanol | | Biodiesel | |
|--------------|----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|
| | Per LPE displaced ⁵⁹⁸ | Per LPE of fossil fuels displaced | Per LDE displaced ⁵⁹⁹ | Per LDE of fossil fuels displaced |
| US | 0.40-0.50 | 1.00-1.25 | 0.560-0.75 | 0.95-1.20 |
| EU | 1.40 | 2.00-6.20 | 0.70 | 0.75-1.50 |
| Australia | 0.65 | 0.80-2.10 | 0.43 | 0.48-0.95 |
| Canada | 0.50 | 0.70-2.20 | 0.24 | 0.26-0.50 |
| Switzerland | 0.90 | 1.00-1.25 | 0.60-2.10 | 0.70-3.50 |

⁵⁹⁷ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 45.

⁵⁹⁸ Litre of Petrol Equivalent

⁵⁹⁹ Litre of Diesel Equivalent

7.4.4 Cost of greenhouse gas emissions reductions

As is the case with fossil fuel displacement, the cost efficiency of biofuels for greenhouse gas (GHG) emissions replacement depends on the extent to which biofuels displace petroleum products (and fossil fuels), and on the subsidy cost of production. As noted in the CSIRO report on GHG emissions associated with biofuels, there is considerable variability in the life-cycle emissions benefits from biofuels produced from different feedstocks. Moreover, differences associated with environment, distance from the market, and farming practices can mean that even biofuels produced from the same feedstock can have quite different GHG emissions profiles.

In Table 37 the cost per tonne of carbon dioxide (CO₂) emissions avoided as a result of biofuels use is provided. While the cost of GHG emissions abatement associated with biofuels use is a contentious issue, several sources have estimated the minimum cost per tonne of CO₂ abatement associated with ethanol at US \$250 or more.⁶⁰⁰

Table 37: Subsidy cost of greenhouse gas emissions abatement, US \$ per metric tonne of selected OECD countries.⁶⁰¹

| OECD economy | Ethanol | Biodiesel |
|--------------|----------|-----------|
| US | <450 | 250-600 |
| EU | 700-5500 | 260-1000 |
| Australia | 250-1700 | 160-600 |
| Canada | 250-1900 | 250-450 |
| Switzerland | 330-380 | 250-1750 |

Internationally there are few carbon markets currently operating. The Chicago Climate Exchange is a voluntary exchange market that trades abatement certificates, with the current price of each certificate (signifying one metric tonne of CO₂ abatement) trading at around US \$2.10. The European Union Emission Trading Scheme is also currently trading EU Allowances at around €22.35 (US \$32.93) per tonne of CO₂-e.⁶⁰² In 2006, the NSW Greenhouse Gas Reduction Scheme imposed a penalty of \$11.50 (US \$10.17) for every tonne of CO₂ that eligible electricity providers produce in excess of regulated quotas. In comparison to these “market” prices for GHG emissions abatement, the cost of GHG emissions

⁶⁰⁰ International Energy Agency, *Biofuels for transport: an international perspective*, International Energy Agency, Paris, 2004, p. 15; William Jaeger, et al., *Biofuel potential in Oregon: background and evaluation of options*, Department of Agricultural and Resource Economics, Corvallis, Oregon State University, 2007.

⁶⁰¹ Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 47.

⁶⁰² US dollars here provided at a conversion rate of 1 EUR = 1.48006 USD; 1 AUD = 0.884132 USD (16 January 2008).

abatement through biofuels is extremely high and not economically feasible.

Finding 13: Internationally, the cost to government of achieving GHG emissions reductions through biofuels production is at least five times more expensive than obtaining GHG emissions reductions through existing emissions trading markets.

Chapter Eight: Key points

- Since the Commonwealth Government announced its intention to achieve a 350 ML biofuels target by 2010, a range of biofuels-related initiatives have been established:
 - the Biofuels Capital Grants Program – one-off capital grants to seven biofuels production facilities (p. 126);
 - the Ethanol Distribution Program – grants payable to service stations with the objective of increasing the volume of E10 sold throughout Australia (p. 127);
 - the Cleaner Fuels Grant Scheme (CFGS) – provision of grants to producers and importers of eligible cleaners fuels that have a reduced impact on the environment (p. 129); and
 - the Energy Grants Credit Scheme (EGCS) – provision of grants for specified activities using the alternative fuels of ethanol, biodiesel, liquefied petroleum gas (LPG) and compressed natural gas (CNG) (p. 131).
 - In July 2006, the Commonwealth Government standardised the fuel tax regime. One of the main reforms was the incorporation of all road transport fuels into the excise system, including biodiesel and ethanol. From 1 July 2011 to 1 July 2015, fuel excise will be gradually phased in for all alternative fuels. These fuels will receive an ongoing discount rate of 50 per cent on the excise rate applied to other fuels (p. 129).
 - Under the *Fuel Quality Standards Act 2000*, the Commonwealth Government introduced a ten per cent limit on the volume of ethanol to be blended with petrol and a fuel standard for B100. The Department of Environment and Heritage (DEH) is currently determining what form of standard should be applied to blended biodiesel fuels. DEH is also examining whether labelling requirements should be established for biodiesel blends (p. 133).
 - Various states and territory governments have introduced policy initiatives to support the biofuels industry. Both NSW and Queensland Governments have committed to the introduction of an ethanol blend mandate, with the NSW mandate coming into effect in October 2007 and the Queensland mandate to be introduced in 2010 (p. 138 & 139). While the Victorian Government has not committed to a mandate, it has established a volumetric target of five per cent biofuels consumption by 2010 (p. 136).
 - As part of the policy document *Driving Growth: a road map and action plan for the development of the Victorian Biofuels industry*, the Victorian Government launched the Biofuels Infrastructure Grant, a \$5 million fund to assist the development of infrastructure relevant to biofuels projects. To date, no grants have been allocated (p. 136).
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Chapter Eight: Government biofuels initiatives

This chapter provides an overview of current government programs and regulations applicable to the biofuels industry. Commonwealth and Victorian programs and regulations are considered in detail, followed by a brief overview of developments and regulations affecting the biofuels industry in other jurisdictions.

8.1 Commonwealth

The Committee notes that all of the Commonwealth initiatives and programs discussed in the following paragraphs were established prior to the 42nd Parliament of Australia. The Committee notes that the current Commonwealth Government has not yet publicly presented any formal policy on biofuels.

8.1.1 350 ML Biofuels Target

In 2001, the Commonwealth Government announced the establishment of a 350 ML biofuels target, to be achieved by 2010.⁶⁰³ In 2003, the CSIRO, Australian Bureau of Agriculture and Resources Economics (ABARE) and Bureau of Transport and Regional Economics (BTRE) were commissioned by the Commonwealth Government to investigate the environmental, economic and regional benefits of the 350 ML biofuels target in the report *Appropriateness of the 350 million litre biofuels target*. The report's key conclusion was that the costs of implementing a policy to assist the biofuels industry to meet the target would outweigh the benefits.⁶⁰⁴ Soon after, the Government announced new excise arrangements for all alternative fuels, including ethanol and biodiesel to assist form the basis of a viable biofuels industry in Australia.⁶⁰⁵

In 2005, the findings of the report *Appropriateness of the 350 million litre biofuels target* were re-examined by the Prime Minister's Biofuels Taskforce. Based on the then state of the biofuels industry, the Taskforce advised it was unlikely that the 350 ML target would be achieved by 2010. In response, the Prime Minister reaffirmed the Government's commitment to achieve the target and collaborated with major petroleum companies, members of the Independent Petroleum Group and major retailers to develop the Biofuels Action Plan. On the basis of each company's

⁶⁰³ Department of Industry Tourism and Resources, 'Alternative transport fuels: biofuels', viewed 12 November 2007, <<http://www.industry.gov.au>>.

⁶⁰⁴ CSIRO, et al., *Appropriateness of a 350 million litre biofuels target*, Australian Government Department of Industry Tourism and Resources, Canberra, 2003, p. 170.

⁶⁰⁵ Department of Industry Tourism and Resources, 'Alternative transport fuels: biofuels', viewed 12 November 2007, <<http://www.industry.gov.au>>.

projections detailed in the Action Plan, the Prime Minister announced that biofuels production would exceed the target of 350 ML by 2010.⁶⁰⁶

8.1.2 Biofuels Capital Grants Program

The Biofuels Capital Grants Program was launched in July 2003 to increase the domestic biofuels market. The total fund comprised \$37.6 million and was allocated as one-off capital grants for the development of new biofuels production facilities, or for projects to expand production capacity in existing plants. Grants were provided at a rate of 16 cents per litre for projects producing a minimum of 5 ML of biofuels per annum.⁶⁰⁷ Biofuel producers that received grants under the scheme are listed in Table 38.

Table 38: Successful applicants under the Biofuels Capital Grants Program, 2006.⁶⁰⁸

| Company | Biofuel | Plant location | Grant value |
|--------------------------------|-----------|-------------------|-------------|
| CSR Distilleries | Ethanol | Sarina, Qld | \$4.16m |
| Biodiesel Industries Australia | Biodiesel | Rutherford, NSW | \$1.28m |
| Schumer Pty Ltd | Ethanol | Woongoolba, Qld | \$2.4m |
| Biodiesel Producers Ltd | Biodiesel | Barnawartha, Vic | \$9.6m |
| Australian Renewable Fuels | Biodiesel | Port Adelaide, SA | \$7.15m |
| Riverina Biofuels Pty Ltd | Biodiesel | Deniliquin, NSW | \$7.15m |
| Lemon Tree Ethanol Pty Ltd | Ethanol | Millmerran, Qld | \$5.85m |

In its report to the Prime Minister, the Biofuels Taskforce questioned the long-term viability of some of the biofuels projects that received grants. The Taskforce noted that because the announcement of the Biofuels Capital Grants Program was made prior to the Government's announcement of its fuel taxation reforms (see below), some biofuel producers may not have factored in the commercial implications of the reforms into their business plans. The Biofuels Taskforce suggested that these changes particularly

⁶⁰⁶ Prime Minister of Australia, 'Biofuels target to be met', viewed 29 July 2006, <www.pm.gov.au/news/media_releases/media_Release1734.html>.

⁶⁰⁷ Department of Industry Tourism and Resources, 'Alternative transport fuels: DITR programs supporting alternative fuels', viewed 12 November 2007, <<http://www.industry.gov.au>>.

⁶⁰⁸ Department of Industry Tourism and Resources, 'Alternative transport fuels: DITR programs supporting alternative fuels', viewed 12 November 2007, <<http://www.industry.gov.au>>.

affected those in the biodiesel industry who intended to use tallow and recycled cooking oil as feedstocks.⁶⁰⁹

8.1.3 Ethanol Distribution Program

The Ethanol Distribution Program was introduced in August 2006 by the Commonwealth Government to increase the number of service stations selling E10, increase the volume of E10 sold and encourage the sale of E10 at a lower price than regular unleaded petrol.⁶¹⁰

The Program provides the following grants to service station retailers:

- an Infrastructure Upgrade Grant of up to \$10,000 for service stations that upgrade existing equipment or install new equipment; and
- a further Sales Target Grant of up to \$10,000 for those retailers who upgraded their service station and that have reached a specified E10 sales target within twelve months of completing the upgrade.⁶¹¹

As of 31 August 2007, \$88,038 worth of upgrade grants had been allocated to nine independent service stations in Victoria. No sales target grants had been allocated by that date.⁶¹² By contrast, service stations in NSW had received \$695,796 in grants since August 2006.⁶¹³ Differences in the provision of grants between Victoria and NSW reflect a range of factors relevant to the ethanol industry in each state. NSW has an established ethanol production capacity in contrast to Victoria. Furthermore, the recent announcement of a two per cent ethanol mandate by the NSW Government has provided considerable stimulus for further grant applications under the Ethanol Distribution Program.

Finding 14: The Ethanol Distribution Program has contributed to improved public access to ethanol blended fuels.

8.1.4 Fuel excise reform

From 1 July 2006, the Commonwealth Government standardised the fuel tax regime. A key reform is the application of excise on all fuels used in road transport based on the energy content of each fuel rather than volume (see Table 39).

⁶⁰⁹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 50.

⁶¹⁰ AusIndustry, 'Ethanol distribution program', viewed 3 September 2007, <<http://www.ausindustry.gov.au>>.

⁶¹¹ AusIndustry, 'Ethanol distribution program', viewed 3 September 2007, <<http://www.ausindustry.gov.au>>.

⁶¹² AusIndustry, 'Ethanol distribution program - grant recipients as of 31 August 2007', viewed 16 November 2007, <<http://ausindustry.gov.au>>.

⁶¹³ AusIndustry, 'Ethanol distribution program - grant recipients as of 31 August 2007', viewed 16 November 2007, <<http://ausindustry.gov.au>>.

Table 39: Australian fuel excise rates from 1 July 2006.⁶¹⁴

| Fuel type | Energy content (megajoules/litre) | Excise rate (cents/litre) | Discount rate |
|--|--|------------------------------|------------------------------|
| High-energy content fuels: petrol, diesel, gas to liquids, biodiesel | Above 30 | 38.143 | 19.1 (biodiesel) |
| Mid-energy content fuels: LPG, LNG, ethanol, dimethyl ether | Between 20 and 30 | 25.0 | 12.5 (all) |
| Low-energy content fuels: methanol | Below 20 | 17.0 | 8.5 (methanol) |
| Others: CNG | Between 38 and 41 (megajoules per cubic metre) | 38.0 (cents per cubic metre) | 19.0 (cents per cubic metre) |

At present, ethanol and biodiesel are effectively excise free, as they both receive production grants that off-set the excise (see below). Other alternative fuels, such as LPG, CNG and liquefied natural gas (LNG) do not currently attract excise. From 1 July 2011 however, fuel excise will gradually phase in for all alternative fuels until 1 July 2015.⁶¹⁵ Alternative fuels will receive an ongoing excise discount of 50 per cent on the full excise rate. By 1 July 2015, the total tax payable on ethanol will be 12.5 cents per litre and the total amount payable on biodiesel will be 19.1 cents per litre (see Table 40).⁶¹⁶

Table 40: Net excise rates for alternative fuels, 1 July 2011 – 1 July 2015.

| Fuel | 1 July 2011 | 1 July 2012 | 1 July 2013 | 1 July 2014 | 1 July 2015 |
|-----------|-------------|-------------|-------------|-------------|-------------|
| Ethanol | 2.5 | 5 | 7.5 | 10 | 12.5 |
| Biodiesel | 3.82 | 7.64 | 11.46 | 15.28 | 19.1 |
| LPG | 2.5 | 5 | 7.5 | 10 | 12.5 |
| LNG | 2.5 | 5 | 7.5 | 10 | 12.5 |
| CNG | 3.8 | 7.6 | 11.4 | 15.2 | 19 |

⁶¹⁴ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 96.

⁶¹⁵ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 96.

⁶¹⁶ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 96.

8.1.5 Cleaner Fuels Grant Scheme

The Cleaner Fuels Grant Scheme (CFGS) is the provision of grants to licensed excise manufacturers and importers of eligible cleaner fuels that have a reduced impact on the environment.⁶¹⁷ Since September 2003, the Scheme has been applicable to biodiesel that meets the biodiesel fuels standard, as well as ultra low sulphur fuels that meet sulphur content requirements.⁶¹⁸ Grants payable to ethanol production have been covered under the Ethanol Production Grants Program since September 2002. Similar to the production and importation of biodiesel, ethanol producers are eligible to receive 38.143 cents per litre of ethanol that can be used in, or as, a transport fuel in Australia.⁶¹⁹ This grant is not payable to imported ethanol.⁶²⁰ As noted in the previous section, these production grants currently offset the fuel excise and customs duty payable on biodiesel and ethanol.⁶²¹

From 1 July 2011, the CFGS relevant to biodiesel production will come under the *Energy Grants (Cleaner Fuels) Scheme Act 2004* and be expanded to include the manufacturing and importation of ethanol, CNG, LNG, LPG, methanol and renewable diesel.⁶²² From this point the CFGS will be gradually phased out with grants reduced in annual increments until 1 July 2015.⁶²³ These changes are outlined in Table 41.

Table 41: Production grants payable to alternative fuels, 1 July 2010 – 1 July 2015.

| Fuel | 1 July 2010 | 1 July 2011 | 1 July 2012 | 1 July 2013 | 1 July 2014 | 1 July 2015 |
|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
| Ethanol | 12.5 | 10 | 7.5 | 5 | 2.5 | 0 |
| Biodiesel | 19.1 | 15.28 | 11.46 | 7.64 | 3.82 | 0 |
| LPG | 0 | 10 | 7.5 | 5 | 2.5 | 0 |
| LNG | 0 | 10 | 7.5 | 5 | 2.5 | 0 |
| CNG | 0 | 15.2 | 11.4 | 7.6 | 3.8 | 0 |

The rationale for the Commonwealth Government gradually phasing out the CFGS is to provide sufficient time for alternative fuel producers to establish their credentials in the Australian transport market.⁶²⁴ The

⁶¹⁷ Australian Taxation Office, 'An overview of excise on fuel ethanol', viewed 19 September 2007, <<http://www.ato.gov.au/businesses/content.asp?doc=/content/52768.htm>>.

⁶¹⁸ Australian Taxation Office, *The cleaner fuels grants scheme*, Australian Government, Canberra, December 2006, p. 2.

⁶¹⁹ AusIndustry, 'Ethanol production grants program', viewed 19 September 2007, <<http://www.ausindustry.gov.au>>.

⁶²⁰ AusIndustry, 'Ethanol production grants program', viewed 19 September 2007, <<http://www.ausindustry.gov.au>>.

⁶²¹ Australian Taxation Office, 'An overview of excise on fuel ethanol', viewed 19 September 2007, <<http://www.ato.gov.au/businesses/content.asp?doc=/content/52768.htm>>.

⁶²² Energy Grants (Cleaner Fuels) Scheme Act 2004 (Cth)

⁶²³ Australian Taxation Office, 'An overview of excise on fuel ethanol', viewed 19 September 2007, <<http://www.ato.gov.au/businesses/content.asp?doc=/content/52768.htm>>.

⁶²⁴ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 96.

Committee received evidence from stakeholders in the biofuels industry regarding factors that had prevented this from occurring. A common barrier is the lack of interest in biofuels by the major petroleum companies:

I think there is some degree of disappointment about the uptake. The oil companies, as we have discussed, have not been that enthusiastic about [ethanol]. They are becoming more enthusiastic in New South Wales but nowhere else. The most recent figures for the fiscal year 2006 show no sales in South Australia, no sales in Western Australia, no sales in Tasmania, no sales in the Northern Territory and modest in Victoria. Victoria is below its quota. Victoria's takes a quarter of the country's petrol, but way less in terms of blended ethanol.⁶²⁵

Increasing feedstock prices and low oil prices were also barriers perceived to influence the long-term viability of biofuels production. Recent media coverage of the closure of a number of biofuel facilities throughout Australia suggest that some biofuels stakeholders are of the opinion that the Commonwealth's fuel tax reforms were detrimental to the industry.⁶²⁶

Another emerging issue for the biofuels industry is the eligibility of imported ethanol for the receipt of production grants under the *Energy Grants (Cleaner Fuels) Scheme Act 2004* from 1 July 2011. When this occurs there will be parity between imported and domestically produced ethanol, which may place stress on the Australian ethanol industry as its production costs are currently higher than those for major global exporters of ethanol. However, the Committee heard from some witnesses that the opening of the ethanol market to international competition was of potential benefit to Victorian consumers. For example, the Victorian Farmers Federation advised in its submission to the Inquiry that the importation of cheaper alternative fuels could alleviate concerns regarding high fuel prices held within the farming industry.⁶²⁷

In August 2007, the Victorian Minister for Regional and Rural Development called on the Commonwealth Government to extend the full production grant of 38.143 cents per litre payable to ethanol and biodiesel until at least June 2016.⁶²⁸ In recognition of the significant role of the production grants in encouraging continued growth in the biofuels industry, the Committee acknowledges and supports this request.

Finding 15: A number of key barriers have prevented the biofuels industry from reaching its full potential in the Australian fuel transport market. The Cleaner Fuels Grant Scheme should be extended to assist the biofuels industry address these barriers.

⁶²⁵ Martyn Evans, Consultant, Manildra Group, *Transcript of evidence*, Melbourne, 31 July 2007, p. 33.

⁶²⁶ Peter Hemphill, 'Ethanol plant delayed', *Weekly Times*, 17 October 2007; Matt O'Sullivan, 'Clean fuel company shuts works, sack workers', *The Age*, 5 November 2007.

⁶²⁷ Victorian Farmers' Federation, *Submission*, no. 33, 3 August 2007.

⁶²⁸ Minister for Regional and Rural Development, 'Allan calls on Federal Government to extend ethanol excise rebate', viewed 14 November 2007, <<http://www.legislation.vic.gov.au>>.

8.1.6 Energy Grants Credit Scheme

The Energy Grants Credit Scheme (EGCS) was introduced in July 2003 to provide grants for specified activities using specified fuels, such as biodiesel, ethanol, LPG and CNG.⁶²⁹ In addition to using an alternative fuel, the following requirements must be satisfied to be eligible under the Scheme.

- the vehicle must be used on public roads;
- the alternative fuel must be used in vehicles that weigh over 20 tonnes gross vehicle mass (GVM) in all areas, or at least 4.5 tonnes GVM only when operating outside of or across defined metropolitan boundaries.⁶³⁰

Changes to fuel credit arrangements will see the scheme end on 1 July 2010, and potentially be replaced by fuel tax credits under the *Fuel Tax Act 2006* (discussed below).⁶³¹ As described in Table 42, grants payable to alternative fuels under the EGCS are currently being phased out in five annual steps until 1 July 2010.⁶³²

Table 42: EGCS rates, 1 July 2006 – 1 July 2010.⁶³³

| Fuel | 1 July 2006 | 1 July 2007 | 1 July 2008 | 1 July 2009 | 1 July 2010 |
|-----------|-------------|-------------|-------------|-------------|-------------|
| Biodiesel | 14.808 | 11.106 | 7.404 | 3.702 | 0.0 |
| Ethanol | 16.647 | 12.485 | 8.324 | 4.162 | 0.0 |
| LPG | 9.540 | 7.155 | 4.770 | 2.385 | 0.0 |
| LNG | 6.504 | 4.878 | 3.252 | 1.626 | 0.0 |
| CNG | 10.094 | 7.570 | 5.047 | 2.523 | 0.0 |

8.1.7 Fuel Tax Act 2006

As part of the Commonwealth Government standardisation of the fuel tax regime, reforms were introduced to reduce the fuel tax burden on businesses and households.⁶³⁴ Rather than focus on the type of fuel used, the *Fuel Tax Act 2006* focuses on the application of fuels. The Act regulates the provision of fuel tax credits for businesses or domestic heating and electricity generation, with the use of conventional petroleum

⁶²⁹ Australian Taxation Office, 'Alternative fuels', viewed 13 November 2007, <http://ato.gov.au/content/downloads/n15227-10-2006_w.pdf>.

⁶³⁰ Australian Taxation Office, 'Alternative fuels', viewed 13 November 2007, <http://ato.gov.au/content/downloads/n15227-10-2006_w.pdf>.

⁶³¹ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 97.

⁶³² Australian Taxation Office, 'Alternative fuels', viewed 13 November 2007, <http://ato.gov.au/content/downloads/n15227-10-2006_w.pdf>.

⁶³³ Australian Taxation Office, 'Alternative fuels', viewed 13 November 2007, <http://ato.gov.au/content/downloads/n15227-10-2006_w.pdf>.

⁶³⁴ Department of the Prime Minister and Cabinet, *Securing Australia's energy security*, Commonwealth of Australia, Canberra, 2004, p. 97.

fuels such as petrol and diesel eligible for such credits.⁶³⁵ Fuel tax is now only applicable to fuel used in private vehicles and for private purposes, as well as fuel used on-road and in light vehicles for business purposes.⁶³⁶

Under the *Fuel Tax Act 2006*, fuel tax credits can be claimed by businesses if petrol or diesel is used in vehicles with a GVM greater than 4.5 tonnes travelling on public roads, or in the generation of electricity.⁶³⁷ Regarding diesel use, the Act requires that certain environmental criteria be satisfied in order to receive tax credits unless the vehicle is used in primary production or on an agricultural property.⁶³⁸ Businesses using diesel in non-transport related activities such as rail or marine transport, certain primary production activities (agriculture, fishing and forestry) and mining can also claim tax credits.⁶³⁹ To receive tax credits the fuel must comply with the relevant fuel quality standard under the *Fuel Quality Standards Act 2000*.

With the end of the ECGS on 1 July 2010, there are concerns in the biofuels industry about the application of the *Fuel Tax Act 2006* to the use of alternative fuels. Alternative fuels are not eligible to receive fuel tax credits until they begin to incur fuel tax from 1 July 2011. However, because the tax payable on alternative fuels is discounted at 50 per cent of the full energy content rate, the tax incurred will be less than the road user charge.⁶⁴⁰ Therefore, it is not expected that on-road users of alternative fuels will be entitled to claim fuel tax credits until the tax payable on these fuels exceeds the road user charge.⁶⁴¹

Stakeholders in the biofuels industry suggest that the inability of businesses that use alternative fuels to receive fuel tax credits removes the competitive advantage of these fuels over conventional fuels. This is further exacerbated by the inability of businesses to claim tax credits for use of B100 under the Act.⁶⁴² These concerns are particularly relevant to the mining, marine, agricultural and construction industries where the use of biodiesel in these off-road applications is most suited. On this basis, the tax regime is claimed to substantially reduce the viability of selling biofuels in Australia, making it "virtually impossible to sell biofuels because incentives for users had almost dried up."⁶⁴³

⁶³⁵ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 97.

⁶³⁶ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 97.

⁶³⁷ Australian Taxation Office, 'So what's stopping you? claim fuel tax credits for your business', viewed 12 November 2007, <http://ato.gov.au/content/downloads/n15397_01_2007.pdf>.

⁶³⁸ Australian Taxation Office, 'So what's stopping you? claim fuel tax credits for your business', viewed 12 November 2007, <http://ato.gov.au/content/downloads/n15397_01_2007.pdf>.

⁶³⁹ Australian Taxation Office, 'So what's stopping you? claim fuel tax credits for your business', viewed 12 November 2007, <http://ato.gov.au/content/downloads/n15397_01_2007.pdf>.

⁶⁴⁰ The Treasury, *Fuel tax credit reform*, Australian Government, Canberra, 2005.

⁶⁴¹ The Treasury, *Fuel tax credit reform*, Australian Government, Canberra, 2005.

⁶⁴² Biodiesel Producers Ltd, *Submission*, no. 49, 8 August 2007.

⁶⁴³ Matt O'Sullivan, 'Clean fuel company shuts works, sack workers', *The Age*, 5 November 2007.

8.1.8 Fuel Standards

Under the *Fuel Quality Standards Act 2000*, the Commonwealth Government introduced a ten per cent limit on the volume of ethanol to be blended with petrol in July 2003. This followed research by the Orbital Engine Company that determined 20 per cent ethanol in petrol could cause engine problems.⁶⁴⁴ To support the ten per cent ethanol limit, the *Fuel Quality Information Standard (Ethanol) Determination 2003* came into effect on 1 March 2004. This determination specifies the labelling requirements for the sale of ethanol blends with petrol, which ensures motorists are informed when petrol contains ethanol.⁶⁴⁵

At this stage, no fuel quality standard exists for ethanol. Proposed standards were released for comment in August 2005 by DEH, however no further development has occurred to date.

In September 2003, DEH implemented the *Fuel Standard (Biodiesel) Determination 2003*, which outlines the fuel standard for B100.⁶⁴⁶ There is currently no standard for biodiesel blends, although a number of fuel retailers currently offer B5 and B20 to consumers. In September 2005, the Prime Minister announced the Government's intention to work with the fuel and transport industries to establish standards for biodiesel blends in order to provide greater certainty to the biofuels market and to increase consumer confidence.⁶⁴⁷ DEH released the discussion paper *Setting National Fuel Quality Standards: Standardising Biodiesel/Diesel Blends* in November 2006 to seek comment on options. The fuel standard for a biodiesel blend is yet to be finalised.

There is strong support within the biodiesel industry for the establishment of a standard for a biodiesel blend higher than B5. There is a general consensus that B5 meets the diesel standard.⁶⁴⁸ Many have also called for a B20 fuel standard, or higher if it can be demonstrated that those blends comply with the existing diesel standard. Rather than facilitate further development of the biodiesel industry, it is suggested that the establishment of a B5 standard would do nothing but maintain the status quo. In particular, Biodiesel Producers Limited advised in its submission to the DEH discussion paper that a capped blend standard of B5 would hinder the uptake of biodiesel:

Our major concern is that the arbitrary choice of a lower blend such as B5 as the capped blend which meets the Diesel Standard will create significant logistical problems for virtually all producers, force them to deal

⁶⁴⁴ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 35.

⁶⁴⁵ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 35.

⁶⁴⁶ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 36.

⁶⁴⁷ Department of Environment and Heritage, 'Biodiesel fuel quality standard', viewed 14 November 2007, <<http://www.environment.gov.au>>.

⁶⁴⁸ Department of Environment and Heritage, *Setting national fuel quality standards: standardising diesel / biodiesel blends*, Department of Environment and Heritage, Canberra, 2006, p. 7.

with the oil majors in a situation where the oil majors have significant market power and reduce the uptake of biodiesel.⁶⁴⁹

The Committee is aware of the important role that fuel standards have in the biofuels industry. Fuel standards assist to maintain the quality of the product, and therefore the integrity of the industry, as well as increase consumer confidence in the use of biofuels. Fuel standards can also assist to resolve vehicle manufacturer concerns about biofuels, which may be of benefit to the emerging biodiesel industry. The Committee notes, for example, that in Europe the introduction of biodiesel standards and quality control requirements led to the provision of engine warranties for the use of B100 by a number of vehicle manufacturers.⁶⁵⁰

Recommendation 2: That the Victorian Government work with other state governments, in particular NSW and Queensland, to advocate to the Commonwealth Government for the continued development of harmonised and consistent biofuels standards.

The Committee is aware of concerns within the biodiesel industry about the detrimental effect a biodiesel blend limit of B5 may have on industry development. In particular, the economic viability of biodiesel production would be severely compromised by the introduction of a B5 limit, because this would require biodiesel producers to sell their product at lower blends, and so increase the relative costs of product distribution. The introduction of a B5 limit on biodiesel would also restrict the emerging market for B20 fuels offered by independent service stations. Consequently, the Committee strongly urges the Victorian Government to liaise with the Commonwealth Government to ensure that standards for both B5 and B20 are developed for the Australian market.

Recommendation 3: That the Victorian Government request that the Commonwealth Government introduce biodiesel blend standards for both B5 and B20 blends.

8.1.9 Biodiesel labelling standards

As with ethanol blended fuels, it is essential that biodiesel blended fuels are labelled at places where it is sold. In its report to the Prime Minister, the Biofuels Taskforce identified a gap in the information provided to motorists regarding the percentage of biodiesel that is blended with diesel at service stations.⁶⁵¹ The DEH discussion paper *Setting national fuel quality standards: standardising biodiesel/diesel blends* (also discussed above) sought comment on the need to establish a labelling standard to be displayed where biodiesel blends are sold.⁶⁵²

⁶⁴⁹ Biodiesel Producers Ltd, *Submission*, November 2006, *Setting national fuel quality standards: standardising diesel/biodiesel blends*, Department of Environment and Heritage, p. 1.

⁶⁵⁰ Australian Renewable Fuels Ltd, 'Biodiesel fact sheet 5', viewed 19 November 2007, <http://www.arfuels.com.au/files/ARF_Fact_Sheet_5_Warranties.pdf>.

⁶⁵¹ Biofuels Taskforce, *Report of the Biofuels Taskforce to the Prime Minister*, Australian Government, Canberra, 2005, p. 140.

⁶⁵² Department of Environment and Heritage, *Setting national fuel quality standards: standardising diesel / biodiesel blends*, Department of Environment and Heritage, Canberra, 2006, p. 12.

The Committee is of the opinion that the establishment of a biodiesel labelling standard is essential. It is important that motorists are provided with relevant information to assist them choose the appropriate fuel for their vehicle. Because most Australian vehicle manufacturers do not support the use of biodiesel blends over B5, labelling standards are necessary when biodiesel blends in excess of B5 are sold.

Recommendation 4: That the Victorian Government request that the Commonwealth Government create a biodiesel labelling standard.

8.1.10 Monitoring the quality of biofuels

In order to be eligible for the Commonwealth Government's CFGS or the EGCS biodiesel must meet the biodiesel standard. In order to claim the Cleaner Fuel Grant biodiesel manufacturers/importers are required to provide a certificate from an accredited National Association of Testing Authority or recognised laboratory to the Australian Taxation Office to demonstrate that the biodiesel meets the standard.⁶⁵³ These processes are largely self-regulated, which according to some witnesses can be problematic in instances where rogue biodiesel producers have little regard for fuel quality standards.⁶⁵⁴

The *Fuel Quality Standards Act 2000* provides the framework for the enforcement of the various fuel standards. Section 38 of the Act covers the appointment of inspectors who are employed by the Commonwealth Government to monitor compliance of fuel suppliers.⁶⁵⁵ While compliance monitoring is delegated to State authorities in some jurisdictions, in Victoria compliance monitoring is conducted directly by the Commonwealth. Section 41(1) describes the monitoring powers of inspectors, which enables them to among other things search premises and examine any fuel or fuel additives on the premises.⁶⁵⁶ It was suggested to the Committee that there is a current lack of enforcement of the biodiesel standards.⁶⁵⁷ While to date the use of biodiesel has not been associated with incidents of engine damage, continued consumer confidence is critical to the long term success of the biodiesel industry. Consequently efforts should be made to ensure no poor quality biodiesel is sold on the market.

Ongoing and regular monitoring of fuel under the *Fuel Quality Standards Act 2000* is an important process that contributes to public assurance that the quality of biofuels available on the transport fuel market is of high quality.

It is in our interest and in everybody else's interest for a sustainable part of a total energy solution that quality be something that is mandated and enforced and people can feel comfortable that it is right. Then those people who are genuine manufacturers will survive and those who are

⁶⁵³ Australian Taxation Office, 'What are my record keeping requirements?' viewed 15 November 2007, <<http://www.ato.gov.au>>.

⁶⁵⁴ Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007, p. 26.

⁶⁵⁵ Fuel Quality Standards Act 2000 (Cth)

⁶⁵⁶ Fuel Quality Standards Act 2000 (Cth)

⁶⁵⁷ Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007, pp. 28-29.

backyarders or shonks, or whatever word you want to use, will fall by the wayside in due course. The consumer needs to be well assured that the quality is there, that we are going to take care of them, we stand by our fuel and that they will not have problems with their engines.⁶⁵⁸

Recommendation 5: That the Victorian Government advocates that the Commonwealth Government increase resources and personnel allocated to monitoring biodiesel fuels to ensure that all suppliers provide biodiesel to the market that meets the Australian standard.

8.2 Victoria

8.2.1 Biofuels Road Map

On 18 April 2007, the Victorian Government launched *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*.⁶⁵⁹ This document describes a number of initiatives to encourage the development of a biofuels industry in Victoria and identifies ways to overcome barriers preventing industry expansion.⁶⁶⁰

One of the key biofuels commitments under the Biofuels Road Map is a volumetric target of five per cent biofuels consumption by 2010. The Government indicated it will consider mandating the target if consumption levels do not reach this level by 2010.⁶⁶¹

8.2.2 Biofuels Infrastructure Grants (BIG)

As part of the Biofuels Road Map, the Victorian Government launched the Biofuels Infrastructure Grant (BIG). BIG is a \$5 million fund to assist the development of industry-critical infrastructure relevant to biofuel projects.⁶⁶² BIG is funded through the Government's Regional Infrastructure Development Fund, which was established to improve the capacity and economic development of regional Victoria.⁶⁶³

In September 2007, the Minister for Regional and Rural Development announced the Victorian Government's first grant allocation of \$400,000 to contribute to an upgrade of road infrastructure in the area surrounding the Swan Hill ethanol plant.⁶⁶⁴ The developers of the Swan Hill plant have since put plant construction on hold due to unfavourable market conditions. The Victorian Government is yet to make any further announcements on the allocation of biofuel grants.

⁶⁵⁸ Reno Beltrame, Technical Manager, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007, p. 29.

⁶⁵⁹ Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007.

⁶⁶⁰ Minister for Regional and Rural Development, 'Government backs cleaner, greener biofuels industry', viewed 14 November 2007, <<http://www.legislation.vic.gov.au>>.

⁶⁶¹ Victorian Government, *Submission*, no. 65, 12 September 2007, p. 17.

⁶⁶² Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007, p. 2.

⁶⁶³ Business Victoria, 'Regional Infrastructure Development Fund', viewed 14 November 2007, <<http://www.business.vic.gov.au>>.

⁶⁶⁴ Minister for Regional and Rural Development, '\$400,000 to support Swan Hill ethanol plant', viewed 14 November 2007, <<http://www.legislation.vic.gov.au>>.

8.2.3 Government vehicle fleet and transport

In the *Inquiry into the production and/or use of biofuels in Victoria*, the 55th Victorian Parliament's Environment and Natural Resources Committee recommended that the Victorian Government require the use of biodiesel blends in its vehicle fleets where available⁶⁶⁵ and conduct research into the viability of using biodiesel blends in public transport.⁶⁶⁶ In response, the Government stated it would trial the use of B5 in the heavy vehicles depot and promote the use of biodiesel in heavy vehicles in the local government sector through the International Council for Local Environment Initiatives.

In its submission to the current Inquiry, the Victorian Government advised that Government vehicles are encouraged to use ethanol blended petrol wherever it is available, practicable and cost effective. The Government also advised that it will work in partnership with the Municipal Association of Victoria and the Victorian Transport Association to trial and promote the use of biodiesel in heavy vehicles.⁶⁶⁷

The Committee supports these initiatives in recognition of the role governments have in promoting the use of biofuels generally. A number of witnesses informed the Committee that the use of biofuels in the Government vehicle fleet, rail, bus and marine applications would provide leadership on biofuels and increase consumer confidence, especially within the transport and logistics industries.⁶⁶⁸

The Committee recognises the Victorian Government's potential to promote the use of biofuels in public and private transport. Evidence provided to the *Inquiry into the production and/or use of biofuels in Victoria* by the Department of Infrastructure referred to individual trials of biofuels by Melbourne bus operators. Trial results demonstrated no adverse effects on bus performance from biodiesel blends of between 10 and 20 per cent. A five per cent power loss was experienced in lower power rated engines using B100.⁶⁶⁹ Currently, five per cent biodiesel can be blended with petroleum diesel with the resulting fuel able to meet the general Australian diesel fuel standard.

In previous chapters the Committee noted evidence suggesting superior environmental performance of biodiesel over other diesel fuels when assessed on life-cycle emissions. The use of biodiesel as a blended fuel appears to contribute to reductions in harmful air emissions, including particulate matter (PM) and "black smoke", which are thought to have a substantial adverse effect on population health. The Committee also noted

⁶⁶⁵ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 100.

⁶⁶⁶ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 101.

⁶⁶⁷ Victorian Government, *Submission*, no. 65, 12 September 2007, p. 31.

⁶⁶⁸ Hobsons Bay City Council, *Submission*, no. 14, 2 August 2007; Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007, p. 9.

⁶⁶⁹ Department of Infrastructure, *Submission*, no. 39, 19 August 2006, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria, p. 2.

research suggesting that PM emissions from biodiesel blends was less harmful to humans than PM emissions from petroleum diesel.⁶⁷⁰

As noted in the ICLEI report on the uptake of biodiesel blended fuels at the local government level, a number of local councils experienced positive results from trials requiring the use of biodiesel fuel in their vehicle, truck and community bus fleets.⁶⁷¹ The Committee believes there are substantial public health and industry development benefits to be obtained through the broader utilisation of biodiesel blended fuels in the Victorian transport sector. To determine the feasibility of this, the Committee recommends that the Victorian Government conduct a pilot project requiring the use of B5 with a selected public transport provider.

Recommendation 6: That the Victorian Government initiate a pilot project with a public or privately owned public transport provider to use B5.

If the results of the project are positive, the Victorian Government should work towards increasing use of biodiesel fuel in the wider transport sector. In recognition of issues regarding supply and blending infrastructure, the Committee recommends that biodiesel use be phased in to the transport sector. One means to achieve this is for the Government to require transport providers use biodiesel fuel as part of contract tenders.

Recommendation 7: That the Victorian Government require transport providers to use biodiesel blended fuel when contracts become available for renewal or tender.

8.3 Other Jurisdictions

8.3.1 Australian Capital Territory

The ACT Government has announced that it will consider the use of E10 in its Government fleet when the fuel becomes more readily available in the ACT.⁶⁷²

8.3.2 NSW Government

On 1 October 2007, the NSW Government introduced an ethanol mandate requiring that two per cent of the petrol sold in NSW be ethanol. Under the *Biofuel (Ethanol Content) Act 2007*, primary petrol wholesalers are responsible for ensuring that ethanol makes up a minimum of two per cent of the total volume of NSW petrol sales.⁶⁷³

Primary wholesalers are required to report quarterly on the total volume of petrol sales, including petrol ethanol blends and the total volume of ethanol in the petrol sold. The NSW Government has established the Office of

⁶⁷⁰ Margaret Leigh Ackland, et al., 'Diesel exhaust particulate matter induces multinucleate cells and zinc transporter-dependent apoptosis in human airway cells', *Immunology and cell biology*, 2007.

⁶⁷¹ ICLEI Oceania and Department of Sustainability and Environment, *Biodiesel in Australia: benefits, issues and opportunities for local government uptake*, Melbourne, 2007, p. 29.

⁶⁷² Department of Agriculture and Food, 'Australian Capital Territory government biofuels initiatives', viewed 21 November 2007, <<http://www.agric.wa.gov.au>>.

⁶⁷³ *Biofuel (Ethanol Content) Act 2007 (NSW)*

Biofuels within the Department of State and Regional Development to manage the implementation of the *Biofuel (Ethanol Content) Act 2007*.⁶⁷⁴ The Committee notes that some mechanisms have been introduced by the NSW Government to ensure that constrained supplies of ethanol do not adversely affect the fuels market. Under the *Biofuel (Ethanol Content) Act 2007*, the ethanol volumetric requirement may be suspended by the Minister if it appears that available supply is insufficient for the market.

Prior to the introduction of the ethanol mandate, the NSW Government endorsed the use of biofuels and other alternative fuels as part of the Cleaner NSW Government Fleet Policy. As part of this policy, all NSW Government employees have been required to use E10 blends from 1 July 2006 in government-owned vehicles where practicable and cost-effective.⁶⁷⁵

8.3.3 Northern Territory Government

As part of its Solar Cities Program, the Northern Territory Government is conducting a trial to determine the feasibility of using biodiesel in remote community power stations. The Program also tests various other measures such as rooftop photovoltaics in order to demonstrate the possibility of achieving more sustainable energy practices in the near future.⁶⁷⁶

In conjunction with Natural Fuels Australia and Charles University the Northern Territory Government is also trialling the use of B20 in the Darwin bus fleet.⁶⁷⁷

8.3.4 Queensland Government

In 2005, the Queensland Government launched the Queensland Ethanol Industry Action Plan, supported by a \$7.3 million fund to assist the ethanol fuel industry and increase consumer confidence.⁶⁷⁸ The rationale for the Action Plan was based on a recognition of the need to diversify Queensland's sugar industry to "improve its competitiveness, increase its production range and continue to generate wealth in regional Queensland".⁶⁷⁹

One of the key initiatives of the Action Plan is the Queensland Ethanol Conversion Initiative to improve the capacity of the State's fuel industry to actively promote ethanol blended fuel. Projects available for assistance under the Initiative include:

- conversion of existing fuel storage tanks;

⁶⁷⁴ Department of State and Regional Development, 'Office of biofuels', viewed 20 November 2007, <<http://www.business.nsw.gov.au/region/biofuels/officeofbiofuels.htm>>.

⁶⁷⁵ Premier of New South Wales, 'M2006-05: Biofuels and other alternative fuels', viewed 2 October 2006, <<http://www.premiers.nsw.gov.au/premiers/includes/printerfriendly.asp>>.

⁶⁷⁶ Northern Territory Government, 'Renewable energy', viewed 21 November 2007, <<http://www.nt.gov.au/nreta/environment/greenhouse/emissions/energy.html>>.

⁶⁷⁷ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 105.

⁶⁷⁸ Queensland Government, 'Queensland ethanol conversion initiative', viewed 19 November 2007, <<http://www.dtrdi.qld.gov.au>>.

⁶⁷⁹ Queensland Government, 'Queensland ethanol conversion initiative', viewed 19 November 2007, <<http://www.dtrdi.qld.gov.au>>.

- signing, re-badging, promotional and advertising activities;
- establishment of plant capacity to blend ethanol with petrol or diesel; and
- distribution, storage and handling facilities of ethanol blended diesel fuel.⁶⁸⁰

Under the Ethanol Action Plan, the Queensland Government also implemented the state-wide 'e+' marketing campaign, which aims to increase consumer knowledge about fuel ethanol. The 'e+' symbol is displayed at points where ethanol blended fuels are sold.

From a policy perspective, the Queensland Government announced in early 2007 its commitment to introduce a five per cent ethanol mandate in 2010. Rather than introduce an immediate mandate, the Government advised that by 2010 there would be sufficient ethanol capacity to meet the demand brought about by a mandate.⁶⁸¹ In August 2007, the Queensland Government called upon the Commonwealth Government to maintain its excise relief beyond 30 June 2011 to encourage further development of ethanol plants.⁶⁸²

8.3.5 South Australia

In May 2007, the South Australian Minister for Employment, Training and Further Education launched the Diesel Emissions Equipment Training Facility at the O'Halloran Hill TAFE Campus.⁶⁸³ The \$320,000 facility will train diesel mechanics in the latest techniques to measure and reduce fuel emissions, and work in conjunction with the University of Adelaide to test biodiesel with a prototype engine.⁶⁸⁴

As part of the South Australian Government's clean fuel initiative, the metropolitan rail and bus fleet have operated on B5 since March 2005.⁶⁸⁵ It is intended that a proportion of the fleet will use B20 over time.⁶⁸⁶

8.3.6 Tasmania

In early 2007, the Tasmanian Parliament's Environment, Resources and Development Committee established terms of reference to inquire into the

⁶⁸⁰ Queensland Government, 'Queensland ethanol conversion initiative', viewed 19 November 2007, <<http://www.dtrdi.qld.gov.au>>.

⁶⁸¹ Queensland Government, 'Queensland ethanol conversion initiative', viewed 19 November 2007, <<http://www.dtrdi.qld.gov.au>>.

⁶⁸² Queensland Government, 'Queensland ethanol conversion initiative', viewed 19 November 2007, <<http://www.dtrdi.qld.gov.au>>.

⁶⁸³ Minister for Employment Training and Further Education, 'TAFE SA initiative to help reduce exhaust emissions', viewed 21 November 2007, <<http://www.greenhouse.sa.gov.au>>.

⁶⁸⁴ Minister for Employment Training and Further Education, 'TAFE SA initiative to help reduce exhaust emissions', viewed 21 November 2007, <<http://www.greenhouse.sa.gov.au>>.

⁶⁸⁵ Environment and Natural Resources Committee, *Inquiry into the production and/or use of biofuels in Victoria*, Parliament of Victoria, Melbourne, October 2006, p. 106.

⁶⁸⁶ Department of Agriculture and Food, 'South Australia Government biofuels initiatives', viewed 21 November 2007, <<http://www.agric.wa.gov.au>>.

development and use of alternative vehicle fuels in Tasmania, with particular reference to:

1. the relative merits of the use of diesel, CNG, LNG, biodiesel blends, B100 and other alternative fuels for vehicles owned by state and local governments, state owned companies, government businesses and the broader community; and
2. options in the agricultural and transport sectors for developing and processing alternative fuels.⁶⁸⁷

The Committee is scheduled to table its report in parliament in 2008.

8.3.7 Western Australia

In February 2006, the Western Australian Biofuels Taskforce was established to examine options to facilitate the development of the biofuels industry in Western Australia. The Taskforce released its report in April 2007 and made 24 recommendations to the Western Australian Government to assist the future development of the biofuels industry. Some of the recommendations included:

- introduce a five per cent biofuel target of total transport fuel produced and consumed in Western Australia by 2010;
- lobby the Commonwealth Government to amend recent legislative changes to the *Fuel Tax Act 2006*, particularly as it relates to biodiesel;
- develop a state-wide biofuels campaign that encourages uptake of biofuels;
- encourage the introduction of biodiesel in the operations of high diesel users, such as mining and transport companies and local councils; and
- provide market leadership by adopting biodiesel and ethanol in government fuel contracts.⁶⁸⁸

Prior to the establishment of the Western Australian Biofuels Taskforce, a number of existing projects were underway in Western Australia to promote the biofuels industry. The Department of Agriculture and Food conducted biodiesel commercial trials for two years and now owns at least ten vehicles that use B100, in addition to eight research stations that use biodiesel made from mustard seed in tractors, headers and generators.⁶⁸⁹

⁶⁸⁷ Environment Resources and Development Committee, 'Terms of reference', viewed 21 November 2007, <<http://www.parliament.tas.gov.au/ctee/erdterms.pdf>>.

⁶⁸⁸ Western Australia Biofuels Taskforce, *Western Australia Biofuels Taskforce Report*, Government of Western Australia, Perth, 2007, p. xiv.

⁶⁸⁹ Western Australia Biofuels Taskforce, *Western Australia Biofuels Taskforce Report*, Government of Western Australia, Perth, 2007, p. 4.

In June 2006, the Department of Planning and Infrastructure commenced trials of B5 in one of its bus fleets.⁶⁹⁰

⁶⁹⁰ Department of Agriculture and Food, 'Western Australia Government biofuels initiatives', viewed 16 November 2007, <<http://www.agric.wa.gov.au>>.

Chapter Nine: Key points

- A biofuels mandate should only be introduced if it provides the most effective and efficient means by which to address a specific market failure. (p. 146) The Committee considered a wide range of evidence to determine whether the anticipated benefits from biofuels use were sufficient to justify the introduction of a biofuels mandate in Victoria. The Committee determined that a biofuels mandate is not currently appropriate for Victoria (p. 154).
 - A national emissions trading scheme is required in order to provide a market mechanism by which to evaluate the merits of different methods of greenhouse gas (GHG) emissions abatement. At present the cost of GHG emissions abatement from biofuels appears to be high compared to other GHG emissions abatement methods (p. 157).
 - Caution must be exercised to ensure rural and regional biofuels plants are commercially and environmentally sustainable (p. 160). In particular, feedstock demand should be carefully monitored to ensure prices do not escalate unreasonably during periods of drought or low productivity. Opportunities for rural and regional development will be maximised through the establishment of biofuels plants in rural and regional Victoria (p.161).
 - One barrier to development of the ethanol industry in Australia is low fleet compatibility with higher blends of ethanol. The Committee recommends that consumer confidence programs be complemented by actions to increase the proportion of ethanol-compatible vehicles in Victoria (p. 168).
 - Major oil companies form a critical part of the Australian fuel retailing and distribution market. The Committee recommends that major oil companies be encouraged to develop biodiesel blending facilities in Victoria (p. 169).
 - Research into future fuel technologies is emerging as an important issue for governments. A coordinated, interjurisdictional approach to research and development of new biodiesel feedstocks and technologies is required from the Commonwealth, state and territory governments of Australia (p. 170).
 - The conversion of waste plastics to diesel fuel could potentially become a valuable fuel source in the future (p. 173).
 - The use of compressed natural gas (CNG) as a transport fuel in Australia is minimal despite the large abundance of natural gas in Australia and the existing pipeline distribution system. Insufficient refuelling infrastructure is a key barrier preventing the widespread use of CNG (p. 175).
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Chapter Nine: Appropriate industry support

In this Chapter a range of measures to support the biofuels and alternative fuels industries are considered. The main focus of this Inquiry is on the place of biofuels in Victoria, and in particular on whether the introduction of a mandated target for biofuels is appropriate for Victoria. However, as noted in earlier chapters, during the course of this Inquiry the Committee also developed an interest in the role that other fuels may play in the Victorian fuel mix. In this context the Committee has particularly focused on the potential for CNG, plastics-to-diesel and methanol to play a greater role in Victorian transport.

9.1 The appropriateness of a biofuels mandate for Victoria

One of the key issues the Committee was asked to consider during the course of this Inquiry was whether a biofuels mandate was an appropriate mechanism for supporting the development of a biofuels industry in Victoria. In April 2007 the Victorian biofuels policy document *Driving growth: a road map and action plan for the development of the Victorian biofuels industry* outlined a number of programs and policies that were to be undertaken in Victoria in order to support the biofuels industry. The Roadmap noted that:

If production levels are not being sustained by consumption levels and targets are not met by 2010, the Victorian Government may consider mandating 5% biofuel level.⁶⁹¹

As noted in Chapter Six, an important component of the Victorian Government's approach to increasing utilisation of biofuels was support for consumer awareness and confidence in biofuels. This goal was supported by introducing a commitment to use ethanol and biodiesel in the Victorian Government fleet, to lobby the Commonwealth Government for the establishment of appropriate standards and the continuation of industry production grants, and to provide assistance for regional communities to establish biofuels facilities, among other initiatives.

9.1.1 Types of mandates

A number of witnesses before the Committee noted that a biofuels mandate could be implemented in a number of ways.⁶⁹² For example, government could require that:

⁶⁹¹ Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007, p. 20.

- 1) a **blend mandate** be introduced, where all fuel sold contain a minimum proportion of biofuel (for example, that all petrol sold be at least E10, and all diesel at least B5);
- 2) a **volumetric mandate** be introduced, where biofuels form a minimum proportion of all fuel used or sold in Victoria (for example, 400 ML of biofuels be sold in Victoria over a certain period, without specifying whether the biofuel is sold as B5, E10, E85, B100 and so on); or
- 3) that certain industry or market sectors, businesses, regions and/or types of transport or fuel users be required to use biofuels in accordance with 1) or 2) above.

In general witnesses who discussed biofuels mandates with the Committee favoured a volumetric target (option 2 above), whether or not those witnesses agreed that a mandate was appropriate for Victoria.⁶⁹³ This is because under a volumetric mandate system there is increased flexibility for fuel suppliers and retailers to determine where biofuels should be sold into the market, and at what blend. For example, instead of selling all consumers a five per cent biofuels blend, infrastructure, distribution and fleet costs could be reduced if one tenth of consumers were sold a fifty per cent blend. This flexibility would allow suppliers and retailers to explore the most efficient way to deliver biofuels to the market. The Committee agrees that volumetric targets or mandates provide a superior mechanism to blend mandates as a way of delivering biofuels to the market.

Finding 16: Volumetric biofuels targets or mandates, rather than blends or segmented mandates, provide superior opportunities for market efficiencies to be explored.

9.1.2 When should a mandate be employed?

The Victorian Government's submission to the Inquiry stated that "[a]dditional biofuel policies will need to be justified on the basis that they are addressing specific market failures in a least cost manner."⁶⁹⁴ The Committee believes that any decision to introduce a mandate for increased use of biofuels in Victoria should be subject to this criterion. In order for this to occur, a determination must be made to establish:

- a) that a market failure has occurred; and
- b) that a biofuels mandate provides the least cost manner in which to address the market failure.

In this context, 'least cost' should be regarded in terms of financial cost and also in terms of net impact on wider Victorian society.

⁶⁹² Caterpillar Inc, *Submission*, no. 15, 2 August 2007, p. 1; Midfield Meats, *Submission*, no. 4, 13 July 2007, p. 1; Starfish Ventures Pty Ltd, *Submission*, no. 2, 5 July 2007, p. 1.

⁶⁹³ BP Australia, *Submission*, no. 63, 27 August 2007; Caterpillar Inc, *Submission*, no. 15, 2 August 2007; Midfield Meats, *Submission*, no. 4, 13 July 2007; Chris Midgley, General Manager, Supply and Marine, Shell Australia, *Transcript of evidence*, Melbourne, 31 July 2007; Service Station Association Ltd, *Submission*, no. 6, 24 July 2007; Starfish Ventures Pty Ltd, *Submission*, no. 2, 5 July 2007.

⁶⁹⁴ Victorian Government, *Submission*, no. 65, 12 September 2007, p. 17.

A market failure occurs when a proportion of the costs for a given service or product are incurred by people other than the supplier or consumer of that service or product (often referred to as 'externalities'); when the most efficient outcome for a market does not occur because sellers or buyers in the market have excessive influence over the market; and when the benefits of utilising alternative goods, technologies and services are undervalued and/or unexplored; including when the future cost of failing to reduce exposure to risk is undervalued. Each of these conditions has separate relevance to the biofuels industry in Australia, and a separate rationale for the provision of government assistance to the industry by means of a biofuels mandate.

Externalities

The first type of market failure that proponents suggest a biofuels mandate will address environment and health issues that have been discussed throughout this report. These issues include:

Greenhouse gas emissions: There is increasing concern internationally that the full cost of petroleum fuel use is not completely incurred by the people that enjoy the benefits of that fuel. For example, there is no cost currently attached to carbon emissions from vehicle use, although the cumulative effect of carbon emissions may have a substantial effect on the wellbeing of a very large number of people. Biofuels, through reducing GHG emissions associated with vehicle use, may go some way toward addressing this market failure.

Air emissions: As is the case with GHG emissions, there is also evidence that the full cost (in terms of public health and health care costs) of petroleum fuel use in vehicles is not incurred by the people who benefit from the use of those vehicles. The reduction of air pollutants and emissions that harm population health through use of biofuels may address this market failure.

Excessive influence within a market

The second type of market failure occurs when the best outcome for society is not achieved because one or more groups within the market have sufficient influence to prevent the competitive distribution of resources. Relevant issues for the biofuels industry include:

Fuel security: Commentators suggest that the increasing reliance of Australia on imported petroleum leaves it excessively vulnerable to foreign fuel supplies and markets over which it has little control. The domestic production of biofuels may enable Australia to more effectively control and secure its fuel supplies, reducing its vulnerability to overseas events, and reducing the balance of trade for fuel products.

Australian fuels market: The market power of the entrenched oil companies may constitute a market failure if this power is used to prevent the biofuels industry from competing in the vehicle fuels market.

Undervaluing risk and undervaluing alternative goods, services, and technologies.

Market failure may also occur when the market does not adequately value the cost to consumers should a certain set of circumstances eventuate.

When an adequate value is not attached to risks, it is likely that there will be underinvestment in measures to alleviate costs potentially associated with those risks. In the fuels industry it is arguable that there is currently underinvestment in infrastructure and alternative technologies that may alleviate the potential costs should, for example, peak oil occur in the next ten years, or should the effects of climate change become manifest in advance of the 'best guess' estimate of scientists, the market and governments.

Does a mandate provide a least cost means for addressing market failure?

Establishing that biofuels are capable of addressing a market failure is not in itself sufficient to justify the introduction of a biofuels mandate. Careful consideration should also be made of whether other actions can be undertaken to address markets failures at less cost. Government should also consider whether less prescriptive measures – such as a biofuels target – or other forms of industry assistance – such as infrastructure grants – would constitute an equally effective and less costly means by which to obtain the same objectives.

9.1.3 Arguments in support of a mandate

The Committee received a wide range of evidence on the potential benefits of adopting a biofuels mandate.⁶⁹⁵ In addition to the potential benefits of a biofuels mandate for addressing the three key market failures described above (GHG emissions, air emissions and fuel security), the Committee was told that a mandate would: provide market certainty for investment in Victorian biofuels infrastructure;⁶⁹⁶ provide an additional market for Victorian agricultural produce;⁶⁹⁷ provide additional incentive for oil

⁶⁹⁵ Australian Biodiesel Group Ltd, *Submission*, no. 43, 8 August 2007; Australian Medical Association (Victoria) Ltd, *Submission*, no. 39, 7 August 2007; Australian Renewable Fuels Ltd, *Submission*, no. 45, 8 August 2007; Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007; Biodiesel Producers Ltd, *Submission*, no. 49, 8 August 2007; Eco2Sys Australia, *Submission*, no. 16, 2 August 2007; Grown Fuel and Wimmera Biodiesel, *Submission*, no. 10, 26 July 2007; Hobsons Bay City Council, *Submission*, no. 14, 2 August 2007; Manildra Group, *Submission*, no. 25, 31 July 2007; Midfield Meats, *Submission*, no. 4, 13 July 2007; Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007; Starfish Ventures Pty Ltd, *Submission*, no. 2, 5 July 2007; Sustainability Victoria, *Submission*, no. 61, 23 August 2007; TFA Project Group, *Submission*, no. 46, 8 August 2007; Kearney, Dr Ray University of Sydney, *Submission*, no. 18, 2 August 2007.

⁶⁹⁶ Australian Biofuels Pty Ltd, *Submission*, no. 26, 3 August 2007, p. 3; Eco2Sys Australia, *Submission*, no. 16, 2 August 2007, p. 4; Midfield Meats, *Submission*, no. 4, 13 July 2007, p. 1; Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007, p. 9.

⁶⁹⁷ Australian Biofuels Pty Ltd, *Submission*, no. 26, 3 August 2007; Graeme Ford, Executive Manager, Policy, Victorian Farmers' Federation, *Transcript of evidence*, Melbourne, 20 August 2007; Grown Fuel and Wimmera Biodiesel, *Submission*, no. 10, 26 July 2007; Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007; Midfield Meats, *Submission*, no. 4, 13 July 2007; Victorian Farmers' Federation, *Submission*, no. 33, 3 August 2007; Leigh Watkins, Senior Manager, Strategic Solutions, Bendigo Bank, *Transcript of evidence*, Melbourne, 27 August 2007.

companies to roll out infrastructure to support biofuels,⁶⁹⁸ and improve consumer confidence.⁶⁹⁹

Industry and consumer confidence

Submissions to the Inquiry noted that the introduction of a biofuels mandate would provide the fuels market and consumers with a clear indication that the government considered the increased use of biofuels to have considerable merit.⁷⁰⁰ The provision of a mandate would give investors certainty that if they could produce biofuels that were priced competitively with other biofuels (in contrast to biofuels priced competitively with all other fuels) there would be a market for that product in Victoria. The Committee received evidence that this would likely increase investment in the Victorian biofuels industry.⁷⁰¹

Submissions to the Inquiry also noted that a mandate would signal to consumers that government was of the opinion that biofuels were acceptable for use in vehicles, and consequently alleviate consumer concerns about the effect of biofuels on vehicles.⁷⁰² The endorsement of biofuels by this mechanism may provide an additional demand stimulus for biofuels in the market.

Rural and regional benefits

A number of submissions to the Inquiry noted that the introduction of a biofuels mandate could provide further opportunities for the development of regional biofuels production facilities, and for benefits to farmers from increased production of biofuels feedstocks.⁷⁰³ Witnesses suggested that rural and regional Victoria would benefit from possible increases to the price offered for biofuels feedstocks such as wheat and canola, and through increased supplies of distillers grain as feed for the livestock industry.⁷⁰⁴ Most witnesses also noted that increased grain prices may

⁶⁹⁸ Australian Biofuels Pty Ltd, *Submission*, no. 26, 3 August 2007, p. 2; John Honan, Managing Director, Manildra Group, *Transcript of evidence*, Melbourne, 31 July 2007, p. 29; Manildra Group, *Submission*, no. 25, 31 July 2007, p. 1.

⁶⁹⁹ Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007, p. 3; Eco2Sys Australia, *Submission*, no. 16, 2 August 2007, p. 4.

⁷⁰⁰ Australian Biofuels Pty Ltd, *Submission*, no. 26, 3 August 2007, p. 3; Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007, p. 3; Eco2Sys Australia, *Submission*, no. 16, 2 August 2007, p. 4; Midfield Meats, *Submission*, no. 4, 13 July 2007, p. 1; Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007, p. 9.

⁷⁰¹ Australian Biofuels Pty Ltd, *Submission*, no. 26, 3 August 2007, p. 3; Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007, p. 3; Eco2Sys Australia, *Submission*, no. 16, 2 August 2007, p. 4.

⁷⁰² Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007, p. 3; Eco2Sys Australia, *Submission*, no. 16, 2 August 2007, p. 4.

⁷⁰³ Australian Biofuels Pty Ltd, *Submission*, no. 26, 3 August 2007, p. 2; Graeme Ford, Executive Manager, Policy, Victorian Farmers' Federation, *Transcript of evidence*, Melbourne, 20 August 2007; Grown Fuel and Wimmera Biodiesel, *Submission*, no. 10, 26 July 2007; Paul Martin, Grown Fuel, *Transcript of evidence*, Melbourne, 31 July 2007; Midfield Meats, *Submission*, no. 4, 13 July 2007, p. 4; Victorian Farmers' Federation, *Submission*, no. 33, 3 August 2007, p. 4; Leigh Watkins, Senior Manager, Strategic Solutions, Bendigo Bank, *Transcript of evidence*, Melbourne, 27 August 2007.

⁷⁰⁴ Peter Anderton, Chief Executive Officer, Agri Energy, Australian Biofuels Limited, *Transcript of evidence*, Melbourne, 20 August 2007, pp. 13, 18; John Honan, Managing Director, Manildra Group, *Transcript of evidence*, Melbourne, 31 July 2007, p. 30; Stewart Rendell, Feedstock and Agriculture, Australian Biofuels Limited, *Transcript of evidence*, Melbourne, 20 August 2007, p. 13; Wayne Turner, Chief Executive Officer, Agri

potentially have a deleterious effect on the livestock sector of the farming industry (see below).⁷⁰⁵

Participation of oil majors in biofuels market

Some witnesses and submissions noted that one of the main effects of a biofuels mandate would be to push oil majors “over the line” in their support for biofuels.⁷⁰⁶ Witnesses suggested that the oil majors were capable of quickly implementing systems for obtaining, producing and distributing biofuels blends, but that without a strong compulsion from government there was little reason for them to do so. The introduction of a biofuels mandate in Victoria would ensure that major oil companies would actively support the biofuels industry.

The adoption of biofuels mandates in other jurisdictions

Some submissions also suggested to the Committee that the introduction of mandates by other states and other countries provided an incentive for similar measures to be introduced in Victoria.⁷⁰⁷ They argued that the increased industry development that would occur with the introduction of a mandate would put Victoria in a position to maximise the benefits of future industry developments, such as the development of second-generation (lignocellulosic) biofuels technologies.

9.1.4 Arguments against a mandate

The Committee also received a range of evidence on the possible disadvantages of introducing a biofuels mandate for Victoria. Submissions to the Committee noted that while the introduction of a biofuels mandate may produce benefits to certain sectors of the Victorian economy, there was also increased risk of disadvantages to other sectors. In general, submissions and witnesses that did not accept the need for a biofuels mandate supported a market-based approach for encouraging development of the industry.⁷⁰⁸

Energy/Australian Biofuels Ltd, Australian Biofuels Limited, *Transcript of evidence*, Melbourne, 20 August 2007, p. 12.

⁷⁰⁵ Australian Lots Feeders Association, *Submission*, no. 47, 8 August 2007; Australian Pork Limited, *Submission*, no. 55, 17 August 2007; Flour Millers Council of Australia, *Submission*, no. 28, 3 August 2007; Graeme Ford, Executive Manager, Policy, Victorian Farmers' Federation, *Transcript of evidence*, Melbourne, 20 August 2007; Doug Munro, Senior Consultant, Synergetics, *Transcript of evidence*, Melbourne, 6 August 2007; Simon Ramsay, President, Victorian Farmers' Federation, *Transcript of evidence*, Melbourne, 20 August 2007; Kevin Roberts, Vice President, Australian Lot Feeders' Association, *Transcript of evidence*, Melbourne, 31 July 2007; Kenton Shaw, General Manager, Pork Production, QAF Meat Industries, *Transcript of evidence*, Melbourne, 31 July 2007; Stock Feed Manufacturers' Council of Australia, *Submission*, no. 23, 3 August 2007; Victorian Farmers' Federation, *Submission*, no. 33, 3 August 2007.

⁷⁰⁶ Australian Biofuels Pty Ltd, *Submission*, no. 26, 3 August 2007, p. 2; John Honan, Managing Director, Manildra Group, *Transcript of evidence*, Melbourne, 31 July 2007, p. 29; Manildra Group, *Submission*, no. 25, 31 July 2007, p. 1.

⁷⁰⁷ Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007; Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007.

⁷⁰⁸ Australian Lots Feeders Association, *Submission*, no. 47, 8 August 2007; Australian Pork Limited, *Submission*, no. 55, 17 August 2007; BP Australia, *Submission*, no. 63, 27 August 2007; CSR Limited, *Submission*, no. 11, 27 July 2007; Ford Motor Company of Australia Limited, *Submission*, no. 8, 25 July 2007; Nissan Motor Company (Australia) Pty Ltd, *Submission*, no. 42, 7 August 2007; Royal Automobile Club of Victoria (RACV) Ltd, *Submission*, no. 60, 23 August 2007; Service Station Association Ltd, *Submission*, no. 6, 24

The danger of exceeding state production capacity

The Committee received evidence that one of the most critical considerations for the introduction of a mandate would be to ensure that it does not exceed production capacity.⁷⁰⁹ In particular, witnesses suggested that the benefits to Victoria of a biofuels mandate would be greatly diminished if biofuels and the feedstocks to produce them could not be obtained from within the state. The two considerations raised in this context were:

- that rural and regional Victoria obtain maximum benefit from biofuels production under a mandate; and
- that biofuel (and fuel) prices not be excessively inflated as a result of undersupply under a biofuels mandate.

Current developments in the Victorian ethanol market mean that it is likely that no significant Victorian production of this fuel will occur prior to 2010, and so it is unlikely that Victorian grains farmers will be able to benefit from state-based production in the medium term. Consequently, it is likely that the ethanol component of any Victorian biofuels mandate will have to be met from interstate or international production.⁷¹⁰

The Victorian biodiesel market already has more than 110 ML of production capacity in place (with more than 260 ML capacity planned by 2009), so that the biodiesel component of a biofuels mandate could probably be met from local production. A substantial proportion of biodiesel production is likely to be obtained from tallow, which would benefit Victorian producers (as well as interstate tallow producers). Axiom Energy, which expects to begin biodiesel production from Geelong by the end of 2008, nevertheless told the Committee that it believed production in the short term would also have to be met from feedstock imports.⁷¹¹

The Victorian Government has committed to rural and regional development through development of the biofuels industry, anticipating that a proportion of benefit to country Victoria will be through the provision of feedstock.⁷¹² Currently, benefits to Victorian farmers from the introduction of a biofuels mandate would likely be restricted to growers of canola and livestock producers via tallow production (although the direct benefits to livestock farmers through increased demand for tallow are likely to be

July 2007; Shell Company of Australia Ltd, *Submission*, no. 17, 2 August 2007; Stock Feed Manufacturers' Council of Australia, *Submission*, no. 23, 3 August 2007; Victorian Farmers' Federation, *Submission*, no. 33, 3 August 2007.

⁷⁰⁹ Automotive Alternative Fuels Registration Board, *Submission*, no. 27, 3 August 2007, p. 1; Axiom Energy Ltd, *Submission*, no. 24, 31 July 2007, p. 3; BP Australia, *Submission*, no. 63, 27 August 2007, p. 3; Eco2Sys Australia, *Submission*, no. 16, 2 August 2007, p. 5; Flour Millers Council of Australia, *Submission*, no. 28, 3 August 2007, p. 1; ICLEI - Local Governments for Sustainability - Oceania, *Submission*, no. 36, 3 August 2007, p. 3; Shell Company of Australia Ltd, *Submission*, no. 17, 2 August 2007, p. 5; Stock Feed Manufacturers' Council of Australia, *Submission*, no. 23, 3 August 2007; Swan Hill Rural City Council, *Submission*, no. 52, 15 August 2007, p. 2; Synergetics, *Submission*, no. 34, 3 August 2007, p. 5.

⁷¹⁰ BP Australia, *Submission*, no. 63, 27 August 2007.

⁷¹¹ Danny Goldman, Managing Director, Axiom Energy Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 59.

⁷¹² Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007.

small). Without the development of further biofuels plants in rural and regional Victoria there are likely to be few direct benefits to Victorian farmers or communities from the introduction of a biofuels mandate.

In the medium to long term, the introduction of a biofuels mandate is likely to result in increased benefits to country Victoria through production of feedstocks for biodiesel rather than ethanol. This is because first-generation technologies currently employed for the production of ethanol favour feedstock crops such as sugar and sorghum over wheat.⁷¹³ As a result, northern states are likely to be at a competitive advantage in the production of ethanol compared to Victoria.⁷¹⁴ While the outlook for biodiesel feedstock production in Victoria is better, mainly due to tallow production, over time faster growing crops from warmer climates may provide a more efficient source of biodiesel feedstocks.

The more critical issue affecting the Victorian public is that a biofuels mandate not exceed the capacity of the Australian and international biofuels market to maintain supply at reasonable cost. If, as it appears is the case with ethanol production, a biofuels mandate cannot be met exclusively from within Victoria, careful consideration should be given to likely developments in the Australian market for biofuels production. In particular, careful consultation should occur interstate to ensure that collective biofuels mandates do not exceed supply, and that surplus ethanol capacity – particularly from Queensland and New South Wales – will be available for import into Victoria. In this context, it is preferable that consideration should take place in the context of national discussions on biofuels mandates.⁷¹⁵

Food and feedstock price increases

One of the major concerns currently expressed about the development of first-generation biofuels is that the feedstocks for biofuels (and in particular ethanol) are often foodstuffs, or used for animal feed.⁷¹⁶ If a biofuels mandate is introduced it provides a potential source of upward pressure on the price associated with feedstocks.⁷¹⁷ Professor German Spangenberg of the Department of Primary Industries suggested that competition between the use of grains and other products for use as food or biofuels feedstocks was unsustainable:

...a sustainable bioenergy sector will require the uncoupling of [food and biofuels feedstocks].... in order not to distort the market and the price of food and feed.... I am mindful that the demand for energy is almost unlimited. Therefore establishing policy frameworks that would drive

⁷¹³ CSR Limited, *Submission*, no. 11, 27 July 2007, p. 16.

⁷¹⁴ CSR Limited, *Submission*, no. 11, 27 July 2007, p. 16; Martin Jones, Manager, Government Relations, CSR Ethanol, *Transcript of evidence*, Melbourne, 20 August 2007, pp. 21-22.

⁷¹⁵ Bus Association Victoria, *Submission*, no. 12, 30 July 2007, p. 18.

⁷¹⁶ Arjun Makhijani, *Carbon-free and nuclear-free: a roadmap for US energy policy*, Nuclear Policy Research Institute and the Institute for Energy and Environmental Research, Takoma Park, 2007; Valerie Mercer-Blackman, et al., 'Biofuel demand pushes up food prices', *IMF Research Department*, 2007, viewed 17 October 2007,

⁷¹⁷ Australian Lots Feeders Association, *Submission*, no. 47, 8 August 2007; Australian Pork Limited, *Submission*, no. 55, 17 August 2007; Flour Millers Council of Australia, *Submission*, no. 28, 3 August 2007; Stock Feed Manufacturers' Council of Australia, *Submission*, no. 23, 3 August 2007.

bioenergy production, if it competes with food and feed, I think will create significant problems.⁷¹⁸

A number of witnesses told the Committee that the price for certain foods and grains was already increasing as a result of demand for biofuels feedstocks.⁷¹⁹ These witnesses suggested that the introduction of a biofuels mandate could further exacerbate upwards pressure on food and feedstock prices.

Increasing pressure on biofuels feedstock prices could have flow on effects to other agricultural prices, because as the price of biofuels feedstocks increase, farmers may switch production to higher-value products therefore reducing supply of alternative products. For example, there is evidence that the price of soy in the US has increased as farmers have switched production from that crop to corn in order to take advantage of higher prices offered by the ethanol industry.⁷²⁰ Witnesses from the livestock and feed industries told the Committee of their concern that the introduction of a biofuels mandate could increase the cost of feed, which would consequently contribute to increases in the cost of meat and milk production.⁷²¹

The main concern raised in submissions and by witnesses was that a biofuels mandate would create a level of demand that would have to be compulsorily met by the industry, regardless of feedstock price. As noted by the Global Subsidies Initiative in 2007, “one often over-looked effect of mandating biofuel content in transport fuels is that it establishes a legal priority for liquid fuels over other competing users of the same biomass

⁷¹⁸ Professor German Spangenberg, Department of Primary Industries, *Transcript of evidence*, Melbourne, 27 August 2007, p. 55.

⁷¹⁹ Australian Lots Feeders Association, *Submission*, no. 47, 8 August 2007; Australian Pork Limited, *Submission*, no. 55, 17 August 2007; Australian Renewable Fuels Ltd, *Submission*, no. 45, 8 August 2007; Dr Tom Beer, Leader, Alternative Transport Fuels Stream, Energy Transformed Flagship, CSIRO, *Transcript of evidence*, Melbourne, 6 August 2007; Biodiesel Producers Ltd, *Submission*, no. 49, 8 August 2007; Biofuels Association of Australia, *Submission*, no. 44, 8 August 2007; Flour Millers Council of Australia, *Submission*, no. 28, 3 August 2007; Graeme Ford, Executive Manager, Policy, Victorian Farmers' Federation, *Transcript of evidence*, Melbourne, 20 August 2007; Smorgon Fuels Pty Ltd, *Submission*, no. 30, 3 August 2007; Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007; Professor German Spangenberg, Department of Primary Industries, *Transcript of evidence*, Melbourne, 27 August 2007; Stock Feed Manufacturers' Council of Australia, *Submission*, no. 23, 3 August 2007; Victorian Farmers' Federation, *Submission*, no. 33, 3 August 2007.

⁷²⁰ Richard Doornbosch and Ronald Steenblik, *Biofuels: is the cure worse than the disease?*, Round Table on Sustainable Development, Paris, OECD, 2007; Doug Koplow, *Biofuels - at what cost? Government support for ethanol and biodiesel in the United States*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2006; Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007.

⁷²¹ Australian Lots Feeders Association, *Submission*, no. 47, 8 August 2007; Australian Pork Limited, *Submission*, no. 55, 17 August 2007; Flour Millers Council of Australia, *Submission*, no. 28, 3 August 2007; Kevin Roberts, Vice President, Australian Lot Feeders' Association, *Transcript of evidence*, Melbourne, 31 July 2007; Kenton Shaw, General Manager, Pork Production, QAF Meat Industries, *Transcript of evidence*, Melbourne, 31 July 2007; Stock Feed Manufacturers' Council of Australia, *Submission*, no. 23, 3 August 2007; Victorian Farmers' Federation, *Submission*, no. 33, 3 August 2007.

feedstocks.⁷²² As a consequence, if feedstock supplies are not sufficient to satisfy demand in the food, livestock and biofuels industries there is a risk that significant upward pressure could be exerted on food and feedstock prices.

However, as noted above, the lack of ethanol production facilities in rural and regional Victoria may mean that the introduction of a biofuels mandate in Victoria has little impact on local demand for grains for ethanol production. Nevertheless, increased aggregate demand for biofuels associated with the introduction of a mandate in Victoria may still contribute to general increases in feedstock prices across Australia, and so for Victorian farmers.

Vehicle compatibility

As noted in earlier chapters, there is still considerable debate about the capacity of vehicles to use ethanol and biodiesel without damage. While there is emerging evidence that certain blends of biofuels, such as biodiesel in blends of up to 20 per cent, do not cause engine damage many vehicle manufacturers do not yet offer warranties on use of fuel blends above E10 or B5.⁷²³ As a result, vehicle owners may become concerned about the use of blended biofuels, even when independent studies show few deleterious effects associated with particular blends in certain vehicles.

A recent study by Orbital Australia indicated that around 40 per cent of the Australian fleet was not suited to use any ethanol blended fuel.⁷²⁴ Consequently a five per cent biofuels mandate in Victoria would probably have to be met by half of the Victorian fleet running on an ethanol blend of at least E10. The introduction of a mandate would require consideration by government about what actions should be taken to ensure that these vehicles are catered for in the fuel market while ensuring that E10 compatible cars made use of the blended fuel. While the introduction of a price signal for ethanol blends could contribute to market transformation, the Victorian Government submission to the Inquiry notes that many of the vehicles not compatible with E10 are owned by households on lower incomes, so that there may be equity issues associated with the introduction of a price signal for E10.⁷²⁵

9.1.5 Introduction of a Victorian biofuels mandate

The Committee has considered a wide range of evidence pointing towards the benefits of biofuels use, much of which is considered in detail below.

⁷²² Ronald Steenblik, *Biofuels - at what cost? Government support for ethanol and biodiesel in selected OECD countries*, International Institute for Sustainable Development, Geneva, prepared for the Global Studies Initiative, 2007, p. 40.

⁷²³ Automotive Alternative Fuels Registration Board, *Submission*, no. 27, 3 August 2007; Bus Association Victoria, *Submission*, no. 12, 30 July 2007; Federal Chamber of Automotive Industries, *Submission*, no. 20, 2 August 2007; Hobsons Bay City Council, *Submission*, no. 14, 2 August 2007; ICLEI - Local Governments for Sustainability - Oceania, *Submission*, no. 36, 3 August 2007; Service Station Association Ltd, *Submission*, no. 6, 24 July 2007.

⁷²⁴ Orbital Australia Pty Ltd, *Assessment of the operation of vehicles in the Australian fleet on ethanol blend fuels*, Commonwealth of Australia, Canberra, 2007, p. 15; Victorian Government, *Submission*, no. 65, 12 September 2007.

⁷²⁵ Victorian Government, *Submission*, no. 65, 12 September 2007, p. 13.

However, one of the main tasks for the Committee was to consider whether the benefits of biofuels use provided sufficient justification for the introduction of a mandate in Victoria. On review of the evidence, the Committee is of the opinion that there is a very real potential for costs and risks associated with the introduction of a biofuels mandate to exceed overall benefits. In particular the Committee is concerned that:

- the GHG emissions benefits, while real, would be obtained at a cost that far exceeds the cost of achieving GHG emissions abatement by other means;
- the fuel security benefits obtained from a biofuels mandate would be marginal, and subject to factors over which government has no control such as drought and disease;
- rising international demand for biofuels and biofuels feedstocks could place considerable upwards pressure on biofuels prices, the net effect of which would considerably outweigh benefits to Victorian producers and consumers;
- Victorian rural and regional economies may not substantially benefit from a biofuels mandate if, as appears likely, feedstock and biofuels production occurs principally interstate or elsewhere.

One remaining argument in favour of a biofuels mandate is that it would provide a mechanism for forcing the development of fuel distribution infrastructure and fleet transformation, so that in the event that second-generation biofuels become commercially viable, Victoria would be able to quickly take advantage of new technologies. While this may eventuate, the Committee notes that the development of commercially viable lignocellulosic ethanol production is by no means assured, and in any case may take decades to reach the market. The Committee does not believe significant and wide-reaching public policy should be formed in anticipation of future technological developments, and so does not regard this as sufficient reason to recommend the introduction of biofuels mandates in Victoria.

For these reasons the Committee does not recommend that the Victorian Government introduce a biofuels mandate unless or until substantial technological developments in the industry dramatically improve Victoria's productive potential for biofuels.

Recommendation 8: That the Victorian Government not establish mandatory targets for biofuels at this time.

The Committee believes that the risks described above are principally associated with the introduction of a biofuels mandate in Victoria. The Committee is of the opinion, however, that support should be provided to the Victorian biofuels industry through other means. There is compelling evidence that there are substantial health benefits, for example, associated with the use of biodiesel blends, and this may warrant increased government support to the industry. Furthermore, the Committee believes that if the development of second-generation (lignocellulosic) biofuels technologies comes to fruition, they may substantially improve the future place of biofuels in the Victorian fuel mix. Consequently, the Victorian

Government should work to ensure that it is positioned to take advantage of these emerging technologies. These issues, and recommendations associated with them, are discussed below.

While the Committee has determined that it is not in Victoria's interests to introduce a biofuels mandate in 2010, the Committee believes that a mandate should be re-evaluated and re-assessed in five years in order to take account of ongoing changes in the market. In particular, there is potential for the viability of biofuels to improve with the introduction of second-generation (lignocellulosic) technologies for fuel production. The Committee also notes that Australian governments have committed to the introduction of a carbon trading system by 2011, and that this may substantially alter the economics of producing and selling biofuels in Australia. For this reason the Committee recommends that the Victorian Government review the appropriateness of a biofuels mandate in five years time, after the current market has had sufficient time to mature, and in consideration of future biofuels technology developments.

Recommendation 9: That the Victorian Government conduct a formal review of the merits of a mandatory biofuels target by 2013.

While the Committee believes that the introduction of a biofuels mandate is not an appropriate mechanism to encourage industry development in Victoria, it also recognises that changes to the biofuels market over time should lead to a further assessment of a biofuels mandate. As new technologies emerge, other renewable fuels may also emerge that provide similar or enhanced benefits to those associated with biofuels. Governments have typically regarded biofuels as a group comprised of ethanol and biodiesel, however the Committee believes that this definition should be expanded in future programs to encompass a wider range of fuels that can be obtained from biological feedstocks, such as methanol and biobutanol. In this way the wider range of emerging technologies associated with renewable fuels use could be identified and developed through government programs and initiatives.

Finding 17: If a mandatory target for biofuels is to be introduced by the Victorian Government, the target should be expanded to include all alternative fuels that are derived from renewable organic sources.

Finally, the Committee is also of the opinion that a wide range of factors and conditions should be very carefully evaluated prior to establishing any mandatory targets for biofuels in Victoria. The biofuels industry is very complex, particularly as it is an emerging industry with very significant developments occurring internationally. The total benefits and costs associated with the widespread adoption of biofuels are still poorly understood, and as a result, it is very difficult to make any informed evaluation of biofuels use compared to other fuels and technologies. The Committee is concerned about emerging international evidence that shows the net benefits associated with biofuels mandates are minimal, or even non-existent. Consequently the Committee finds that caution should be exercised by Government should it consider the introduction of a mandate.

Finding 18: If a mandatory target for biofuels were to be introduced in future, the Victorian Government should carefully consider the following issues regarding feedstocks, agricultural requirements, practices and anticipated benefits:

- expected availability of local feedstocks;
- level of uptake that can be supported by sustainable use of local feedstocks for fuel purposes;
- environmental and economic implications of driving demand that leads to supplementing domestic feedstocks with imported products;
- the sustainability of potential imported feedstocks;
- net health costs and benefits due to reduced life-cycle CO, VOCs and PM emissions, and increased NOx emissions;
- net greenhouse gas emissions compared to other abatement methods; and
- agricultural resources required to meet the target and the likely impact on existing land and water availability.

9.2 Environmental issues

9.2.1 Greenhouse gas emissions

Greenhouse gas emissions produce an aggregate effect that leads to climate change. While a wide range of sectors contribute to GHG emissions – stationary energy, transport, industry, agriculture and so on – ultimately it is the overall quantity of GHG emissions that determines climate change. Measures to reduce GHG emissions should therefore be primarily targeted to where the most reductions can be obtained for the least cost. The Committee recognises, however, that effective GHG emissions abatement will require a broad range of measures across a wide range of sectors.

The potential for biofuels to contribute to reduced GHG emissions in the transport sector is one of the most commonly cited reasons for increased government support for the industry. With more than 15 per cent of total Australian GHG emissions accounted for by transportation fuel use, and with transportation expected to grow by more than 25 per cent over the next decade, there is an urgent need to address these emissions.

As described in Chapters Two and Three, use of both biodiesel and ethanol is associated with life-cycle GHG emissions reductions compared to the use of petroleum fuels. Consequently proponents of biofuels often argue that the adoption of biofuels is one means by which concrete action can be taken to reduce GHG emissions. As noted in Chapter Seven several countries have explicitly linked the adoption of biofuels to GHG emissions reductions targets, and intend to refer to biofuels use when calculating GHG emissions for obligations under the Kyoto protocol.

While biofuels may offer an important means to reduce GHG emissions in the transport sector, biofuels do not comprise the only way of reducing emissions. Significant advances in engine efficiency and design have substantially reduced GHG emissions in petroleum and diesel engines over the last decade. Alternate engine technologies have also been refined in recent years, so that very high rates of engine efficiency (and consequent proportionally low GHG emissions) can be obtained from electrical hybrid engines, in which highly optimised combustion engines are

used to power electrical engines.⁷²⁶ Fully electrical engines can also provide transport solutions with minimal tailpipe GHG emissions – although the life-cycle levels of emissions associated with this technology would depend on the methods used for the production of stationary energy.⁷²⁷ The principal advantage of biofuels over these vehicle technologies is that biofuels can be used in the current Australian fleet – although, as noted in previous chapters, for the vast majority of vehicles only blended fuels can be used in this regard.

As indicated in Chapter Seven, there is evidence to suggest that the cost of GHG emissions abatement from biofuels use is far higher than the current market price for GHG emissions abatement. The Committee recognises, however, that over time the market price for GHG emissions may increase, as current prices may reflect “low hanging” GHG abatement measures that may be quickly exhausted should GHG emissions targets and trading be more widely adopted.

At the present time however no mechanism exists with which to properly evaluate the relative merits of different methods of GHG emissions abatement. The Committee is of the opinion that the best means to prioritise different approaches to GHG emissions abatement is to attach a market price to GHG emissions through a national emissions trading scheme. An emissions trading scheme should allow GHG emissions from all sectors of the Australian economy to be assessed and traded in order to maximise benefits.

Recommendation 10: That the Victorian Government continue to support the establishment of a national emissions trading scheme and request that a national greenhouse gas emissions target be established. The trading scheme and target should apply to transport applications.

A comprehensive emissions trading scheme will require the development of a new range of skills, occupations and market expertise in order to maximise the efficiency of emerging markets. Through the course of this Inquiry the Committee has become aware that a consensus on appropriate methodology for the evaluation of GHG emissions will be required if any future emissions trading schemes are to function effectively. Given the wide range of scientific evidence, industries, and trading mechanisms potentially involved in emissions trading, the Committee believes that Victoria should be actively developing a pool of expertise in anticipation of the introduction of an emissions trading market. The Committee believes that the Victorian Government should begin to actively develop GHG emissions auditing protocols and methodologies, and to ensure that these are applicable to all of the major sectors where energy use occurs. In particular, GHG emissions auditing processes should be developed that allow rigorous analysis of transport fuel emissions on a life-cycle basis. The Victorian Government should also actively disseminate these methodologies to facilitate the development of industry expertise in anticipation of GHG emissions trading.

⁷²⁶ CSIRO, *Submission*, no. 32, July 2007, p. 8.

⁷²⁷ CSIRO, *Submission*, no. 32, July 2007, p. 8.

Recommendation 11: That the Victorian Government work with industry to develop a comprehensive GHG emissions auditing process, with a particular focus on emissions associated with transport applications.

The Committee acknowledges that while currently GHG emissions abatement measures are probably obtained for least cost in the stationary energy sector, over time GHG emissions abatement strategies will have to encompass all sectors of the economy. A key focus of GHG emissions reduction technologies in future will be to determine means by which transport solutions can be obtained through renewable energy sources. While the biofuels industry appears to offer one of the more immediate solutions for renewable transport energy, over time a broader range of options should be considered for the transport sector. Toward this end, the Committee recommends that the Victorian Government continue to examine a broad range of options for obtaining transport needs from renewable energy sources, with a key focus on the reduction of GHG emissions associated with the use of transportation.

Recommendation 12: That the Victorian Government continue to facilitate the development of a renewable fuels industry, with the key focus being the reduction of greenhouse gas emissions.

Government use of biofuels GHG emissions data

During the course of this Inquiry the Committee has noted a wide range of claims about the potential for biofuels to provide GHG emissions abatement. Often the potential for GHG emissions reductions in the transport sector by use of biofuels appears to be overstated in documents that promote the biofuels industry.

As noted in Chapters Two and Three the amount of GHG emissions abatement associated with the use of biofuels is dependent on the feedstock from which the fuel is produced, and to a lesser extent, the process used for the manufacture and transportation of the fuel. However, most sources citing the benefits of biofuels use refer to GHG emissions benefits associated with the 'best case' emissions reductions – for ethanol, production from sugar and for biodiesel, production from waste cooking oil. The Victorian Government's April 2007 policy statement on biofuels, for example, noted that "[o]n a life-cycle analysis the use of biodiesel in vehicles can produce up to 80% less greenhouse gas than petroleum diesel."⁷²⁸ While this is true for biodiesel produced from waste cooking oil, in practice most biodiesel in Victoria will be obtained from tallow and canola at 29 per cent and 23 per cent less life-cycle GHG emissions, respectively.

The Committee notes, however, that the Victorian Government's submission to the Inquiry provides a balanced assessment of current knowledge regarding GHG emissions associated with the production and use of biofuels. The Committee is encouraged that the Victorian Government is conversant with complexities associated with the analysis of GHG emissions associated with biofuels use.

⁷²⁸ Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007, p. 8.

In the report “Sustainable biofuels: prospects and challenges”, the British Royal Society highlighted the importance of thoroughly assessing the environmental sustainability of all biofuels policies to ensure the basis for such policies are reliable.⁷²⁹ As a general principle, the Committee is of the opinion that if the use of biofuels in Victoria is to be justified with reference to GHG emissions abatement, it is preferable that figures quoted in reference to biofuels use reflect actual expected GHG emissions reductions.

9.2.2 Feedstock sustainability

During the course of the Inquiry, a number of witnesses raised concerns with the Committee about the possibility that unintended environmental effects associated with increased biofuels production may outweigh benefits derived from fuel use. Most witnesses in this context noted that the environmental impact of palm oil production for biodiesel may have substantial deleterious effects on the environment. Recent reports of extensive forest felling for palm oil production, and of reclaiming peat swamps for plantations, have raised concerns about the sustainability of palm oil production practices.

Similarly, the Committee heard that increased production of biofuels feedstocks within Victoria could also potentially place strains on the environment if development of the industry was not properly monitored. If current food production is to be maintained, witnesses suggested that the expansion of cropping to provide biofuels feedstocks may stretch farming resources unacceptably.

If biofuels are not produced in an environmentally sustainable manner, many of the most powerful arguments for development of the industry are eroded. For this reason, the Committee recommends that the Victorian Government ensure that biofuels produced and/or sold in Victoria be obtained from environmentally sustainable feedstocks and production processes.

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| Recommendation 13: That the Victorian Government ensure that biofuels manufactured and/or sold in Victoria are obtained from environmentally sustainable sources. |
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9.3 Regional development

First generation biofuels are largely reliant on agricultural produce for feedstock. As a consequence development of the biofuels industry has also been regarded as providing opportunities for rural and regional development. In the Victorian Government’s policy document *Driving growth*, for example, the Minister for Rural and Regional Development stated that:

The biofuels industry offers significant potential for investment and growth in provincial Victoria. A sustainable supply of energy can be grown in

⁷²⁹ The Royal Society, *Sustainable biofuels: prospects and challenges*, The Royal Society, London, 2008, p. 48.

Victoria from renewable organic sources and provide not only economic benefits to rural communities but cleaner air.⁷³⁰

As noted in previous chapters, it appears that encouragement for the production of agricultural produce for use in biofuels production will contribute to improved returns for grain and oilseed producers in rural and regional areas. The challenges for Victoria when considering what measures should be employed to support the biofuels industry are to ensure:

- that Victorian grains and oilseed production is used for biofuels feedstock, or that Victorian grain and oilseed producers benefit from increased demand for feedstock;
- that Victorian livestock industries are not unfairly affected by price increases to biofuels feedstocks;
- that where possible, local agricultural feedstock can be converted into higher value biofuels through local industries; and
- that the Victorian Government avoids creating an industry that is subsidy-dependent over the long term.

A number of witnesses and submissions to the Inquiry observed that prices for many of the commodities used as biofuels feedstocks are currently determined by international markets. Consequently international supply and demand (and factors affecting that supply and demand) will have a major influence on the profitability of local farmers. This means that Victorian grain and oilseed producers could benefit from price increases generated by international and interstate biofuels demand, even if substantial demand for feedstock is not generated in Victoria.

9.3.1 Competitive advantages and risks for regional biofuels plants

The main means by which grain and oilseeds producers could benefit from Victorian (as compared to interstate or international) biofuels production is through the construction of biofuels plants in rural and regional centres. This would allow grain and oilseed producers to maximise profits because costs associated with the transportation of produce to market would be reduced.

I can tell you that out of the Murray River area [the cost of transporting grain] is roughly \$50 a tonne delivery to port. In a normal year that is somewhere between 25 per cent and 35 per cent of the cost, delivered to port. That is just to get it to the ship. So whatever it is, it would be quite significant, I think. So there is a fair transport cost on grain delivered internationally.⁷³¹

⁷³⁰ Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007, p. 2.

⁷³¹ Kenton Shaw, General Manager, Pork Production, QAF Meat Industries, *Transcript of evidence*, Melbourne, 31 July 2007, p. 39.

Notably, this profit margin would most likely be realised only if biofuels plants were located in rural and regional areas. If biofuels plants were principally established in Melbourne it is likely the current quantum of transportation costs would be maintained.

In this context, an important consideration for the development of Victorian grains and oilseeds production are current restrictions on grain imports into Victoria. In order to satisfy biosecurity requirements imposed by the Australian Quarantine and Inspection Service imported grains cannot be transported outside metropolitan Melbourne unless those grains originate from interstate. This means that biofuels plants in Melbourne will be able to access international grain and oilseeds markets when sourcing feedstocks, while rural and regional biofuels plants will not have access to those imported feedstocks. These restrictions affect other industries that utilise grains for use in regional Victoria – most notably in the context of this Inquiry, the Victorian stockfeed industry.

Text Box 4: Feedmills operating in Victoria

Victoria currently has around 43 operating feedmills producing livestock feed, with 33 of those located outside metropolitan Melbourne.⁷³² Feedmills principally utilise locally-grown grains and agricultural produce where these are available, although in the current drought feedmills have been forced to import grain from interstate (and internationally) in order to maintain production.⁷³³

In this context, concerns were expressed to the Committee about the possible effect of increased competition for grain in regional Victoria that would occur with increased ethanol production. As noted in previous Chapters, while wet and dry distillers grains can be used for livestock feed, there are some concerns within the industry about the general use of these products. Restrictions on the import of grains from international markets present a risk that grain prices could be driven above international prices if regional Victoria does not produce enough grain to satisfy demand in any particular year. The risk of this occurring will increase if ethanol production interstate reduces grain surpluses available for export. Such developments are a potential source of financial risk for both the ethanol and stockfeed industries.

Demand for biodiesel feedstocks, such as tallow and canola, have less potential for price competition with the feedstock industry because these products comprise a far smaller proportion of livestock feed. Nevertheless, as the same import restrictions apply to biodiesel feedstocks as they apply to ethanol feedstocks, increased competition for regional produce could potentially lead to similar price pressures if Victoria does not produce sufficient feedstock to satisfy demand in any particular year.

⁷³² Stock Feed Manufacturers' Council of Australia, *Submission*, no. 15, 8/9/06, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria, p. 6.

⁷³³ Stock Feed Manufacturers' Council of Australia, *Submission*, no. 15, 8/9/06, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria, p. 7.

Finding 19: The risk of feedstock price escalation will increase if the capacity of biofuels plants in rural and regional Victoria is not carefully monitored to ensure feedstock demand will not exceed regional supplies during periods of drought or low-productivity.

Community owned biodiesel enterprises

With this observation in place, the Committee believes there are opportunities for regional development to occur through increased biofuels production in country Victoria. The Committee also believes that of the two main biofuels – ethanol and biodiesel – biodiesel has the greatest potential as an industry for rural and regional Victoria. This is principally because it is not regarded as practicable to construct ethanol plants with production capacities less than 100 ML, whereas biodiesel plants can be constructed with far smaller volumes. Consequently there are more opportunities for communities to form collectives for the production and sale of biodiesel than ethanol.

The Committee notes that there is considerable interest in smaller scale biodiesel production in regional Victoria. Chapter Two discussed current developments toward biodiesel production facilities in regional Victoria, such as the Wimmera Biodiesel plant in Kaniva and Community Enterprise programs assisted by the Bendigo Bank. These projects offer a potential means to retain funds that would ordinarily flow out of regional communities through the purchase of fuel.

Community support is a critical component of small scale biofuels production projects, because this provides critical mass to maintain the viability of the enterprise. Consequently the viability of community enterprises will rely on commitments from major local consumers of fuel such as local government and businesses to support biofuels production by purchasing the fuel. Community-owned ventures can also benefit from the support of local farmers, who may commit to growing feedstock for use in biofuels production. The Bendigo Bank Community Enterprise biodiesel pilot program currently being trialled in Rupanyup / Minyip and Elmore is taking a staged approach to community-owned biodiesel production to ensure that the enterprise remains commercially sustainable, ensuring that demand for the fuel exists prior to construction of local biodiesel production facilities (see Text Box 5).

Text Box 5: Summary of the Bendigo Bank community bank biodiesel model.⁷³⁴

Community Enterprise has developed a five stage model that communities could work through that would build towards the ultimate goal of building a biodiesel production facility in a local community. Each stage is initially designed to be self-sustaining in its own right – allowing communities as much or as little participation in the production of biodiesel as suits their aspiration and motivation.

Stage 1: Biodiesel is trialled with a small group of local users (8 – 10 prominent local bulk users of diesel fuel – such as broad acre

⁷³⁴ Leigh Watkins, Senior Manager, Strategic Solutions, Bendigo Bank, *Transcript of evidence*, Melbourne, 27 August 2007.

farmers/earthmovers etc). This group works to demonstrate that biodiesel is a suitable fuel for use in all diesel applications. This group will eventually become a body of local expertise around the use and handling of biodiesel. It also works to build a demand base in order to attract further investment from within and external to the local community.

Stage 2: The community identifies sufficient demand to underpin the establishment of a local storage and distribution business (including local fuel storage tanks, and possibly a delivery truck and employment of a driver if necessary). To establish this business, communities need to raise around \$500K in local capital and obtain 4 ML worth of annual diesel usage from a broad base of local customers (probably somewhere in the order of 150 pledge customers).

Stage 3: Stage three involves the investigation into the most appropriate oilseeds that can be grown by local farmers to produce biodiesel. The goal of this stage is to establish a local crush mill in broad-acre farming communities that can produce vegetable oil suitable for refinement into biodiesel. This oil can be back loaded to the refinery in the same trucks that deliver wholesale fuel to the local storage and distribution facility, significantly improving the logistics costs of fuel procurement. Local farmers can also start to bridge the economic gap between the return on oilseed crops and the input cost of fuel.

Stage 4: Communities identify markets for biodiesel by-products, such as oilseed meal. This stage may involve the construction of a large crush mill.

Stage 5: Communities to establish their own biodiesel production facility (refinery) leveraging the expertise and technology of proven large scale providers and attracting appropriate partners to assist in obtaining the necessary capital to build the required infrastructure to ensure sufficient capacity to process large volumes to high quality.

The Committee believes that community-based biodiesel enterprises offer an exciting means to encourage regional development in Victoria. The Committee also acknowledges that it may be appropriate for the Victorian Government to actively support the development of these enterprises through various forms of assistance, provided adequate measures are put in place to ensure that any business venture is commercially sustainable. One important role for the Victorian Government in this regard is to promote the potential benefits for rural and regional communities investing in biodiesel distribution and production in order to stimulate public awareness and interest.

Recommendation 14: That the Victorian Government promote the benefits to regional Victoria of investment in biodiesel plants, particularly where the majority of raw materials are sourced locally and key consumers are local businesses.

Local government support will play a critical role in the development of small scale or community-based biodiesel production, for example, through fuel purchases and assistance for planning approvals. The Committee notes that a number of local governments throughout Victoria have already expressed interest in local biodiesel production, and that some local governments provide active support to local industry by purchasing

biodiesel for fleet operations. Given the important role for local government in the promotion of regional biodiesel production, the Committee recommends that the Victorian Government examine means by which local government support for biodiesel production may be encouraged.

Recommendation 15: That the Victorian Government find mechanisms to encourage local councils to support local biofuel-related initiatives.

The Committee received very positive feedback from industry participants about local and state government support for biodiesel project development. However, the Committee believes that there are opportunities for the Victorian Government and local governments to assist biodiesel industry development through harmonised regulations and advice for biodiesel plants and related infrastructure. This would facilitate industry development by providing a level playing field and industry certainty for enterprises and businesses contemplating entry into the industry. Consequently the Committee recommends that issues pertaining to the development of the biodiesel industry in Victoria be discussed at a future regional councils meeting.

Recommendation 16: That the Victorian Government place on the agenda for a future regional councils meeting the issue of support for the biodiesel industry. Consideration of support for the biofuels industry should consider uniform regulation across government and councils to provide information about, and streamline processes for, the establishment of biodiesel facilities.

The Committee believes that a staged process for the development of biofuels facilities in rural and regional Victoria represents the most responsible means for expanding the industry. Building demand for biofuels products prior to the establishment of biofuels production plants is a critical component of industry development. However, the Committee also believes that once a country community has demonstrated that it is able to sustain a local biofuels industry the Victorian Government should assist it to commence biofuels production through the provision of grants for infrastructure development. The Committee notes the Victorian Government established the Biofuels Infrastructure Grants (BIG) scheme in April 2007 in order to assist the development of industry-critical infrastructure relevant to biofuel projects, and that criteria for this scheme have not yet been formalised. Consequently, the Committee recommends that a particular focus for this program be the development of biofuels infrastructure, including biodiesel plants, in rural and regional Victoria.

Recommendation 17: That the Biofuels Infrastructure Grants (BIG) program continues to prioritise biodiesel initiatives in regional areas.

The Biofuels Infrastructure Grants scheme is a new development, and the Committee also acknowledges that as there are few examples of community-based biodiesel facilities in Australia, the overall economic viability of such developments is yet to be determined. For this reason the Committee recommends that the effectiveness of the BIG program be carefully evaluated, with careful attention paid to:

- local economic benefits;

- GHG emissions efficiencies realised as a result of local fuel production; and
- the environmental sustainability of local feedstock production.

If the economic and community benefits of the BIG program can be proven over time, the Committee recommends that the program be expanded to assist the development of the biodiesel industry in rural and regional Victoria into the next decade.

Recommendation 18: That the BIG program be independently evaluated and extended if the evaluation indicates proven economic benefits to regional areas.

Subsidies for biofuels production

The Committee notes that overseas the biofuels industry has been heavily supported by a range of measures that provide financial assistance for feedstock production as well as the final product. In countries such as the United States, and throughout the European Union, subsidies offered to the industry include state payments for so-called “energy crops” that are used for the production of biofuels. The establishment of mandates, production grants and excise adjustments for the biofuels industry also supports the development of new agricultural practices that exist principally due the provision of government support.

In the United States and throughout Europe, the cost of these initiatives to government is often justified through the comparison of subsidies previously paid for farm production with current expenditure on biofuels industry incentives. These comparisons usually show that support for the biofuels industry offsets farm subsidies, and that there is a net benefit to government due to the production of a useful product as a result of the reallocation of government financial assistance.

The Committee notes that, in contrast to these countries, the farming sector in Australia is not currently the recipient of large subsidies for “business as usual” activities. In fact, one of the main competitive advantages of the Australian farming sector in world markets is that it is able to provide high quality produce at prices among the lowest in the world. As such, the relative cost to Australian governments of encouraging the development of a biofuels industry by means of new subsidies and payments is higher than for nations that have provided historically higher support to farming industries.

Consequently, the Committee urges the Government to carefully consider the overall cost and long term implications of providing support to the Victorian biofuels industry that extends beyond one-off grants or short term assistance. Given that the long term place of biofuels in the Victorian fuel mix is by no means assured, the Committee strongly suggests that the Victorian Government is careful to avoid the creation of a feedstock or biofuels production industry that is reliant on government subsidies for survival.

Finding 20: Future government support for the biofuels industry should focus on ways to support industry development without the need for long-term government grants or subsidies.

Employment opportunities through biofuels

Throughout the Inquiry, the Committee received evidence regarding the potential for the biofuels industry to provide ongoing employment opportunities, particularly in regional areas. For example, Axiom Energy informed the Committee that their biodiesel project would directly and indirectly employ 40 people in the Geelong region.⁷³⁵ The Victorian Government's biofuels roadmap estimated that 84 full time positions, and 168 indirect jobs would be created with the development of the biofuels industry in Victoria.⁷³⁶

The Committee also heard that there were some concerns about the net employment benefit to regional Victoria of increased biofuels production. There were suggestions that gains in biofuels sector employment would be obtained at the expense of employment in other sectors.⁷³⁷ In his presentation to the Committee, Mr Roberts of the Australia Lot Feeders' Association argued that a biofuels mandate could lead to a net reduction in jobs in rural and regional Victoria:

We believe that [a biofuels mandate] could actually close down some feedyards, and I think Kenton would suggest piggeries as well. That, I think, is just detrimental to what is trying to be achieved. People are saying they want to see jobs. Well, we are suggesting to you that you are putting jobs at risk where they use less tonnages and employ more people. The feedlot industry has the same situation. A 30 000-head feedyard employs 50 people and uses approximately 100 000 tonnes of grain.⁷³⁸

While biofuels production may provide some employment benefits and opportunities for local farmers to diversify their income streams, the Committee believes the key benefit of biofuels to regional development is through increased production of biofuels in regional areas where investment in local communities is retained.

9.4 Industry development

While the potential for rural and regional development associated with biofuels production is significant, the Committee also recognises that more general industry support is appropriate for development of the industry. The Committee notes that the Victorian Government has announced a number of initiatives to support the biofuels industry, such as through various mechanisms to improve consumer confidence in biofuels and

⁷³⁵ Danny Goldman, Managing Director, Axiom Energy Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 56.

⁷³⁶ Regional Development Victoria, *Driving growth: a road map and action plan for the development of the Victorian biofuels industry*, Victorian Government Melbourne, 2007, p. 8. The Committee notes that these estimates were provided prior to the announcement that the Swan Hill ethanol plant was to be put on hold.

⁷³⁷ Rural Industries Research and Development Corporation, *Biofuels in Australia - issues and prospects*, Rural Industries Research and Development Corporation, Canberra, 2007, p. 45.

⁷³⁸ Kevin Roberts, Vice President, Australian Lot Feeders' Association, *Transcript of evidence*, Melbourne, 31 July 2007, p. 42.

through the BIG scheme referred to above. While the Committee has suggested caution should be taken against uncritical support for the industry, the Committee does recognise that there are a number of potential benefits associated with increased uptake of biofuels in the Victorian transport sector. In general, the Committee believes current activities to support the biofuels industry by the Victorian Government are appropriate. The Committee recommends however that future assistance to the biofuels industry should carefully consider all of the potential costs and benefits associated with support for the industry.

Recommendation 19: That cost-benefit analyses regarding the expansion of a biofuels industry in Victoria should be conducted through an independent and transparent process that examines:

- production, infrastructure and distribution costs;
- agricultural requirements, including land and water usage;
- feedstock prices;
- government support;
- energy security;
- life-cycle greenhouse gas emissions;
- fleet transformation; and
- life-cycle air pollutants.

Vehicle technology development

Through the course of this Inquiry the Committee became aware that the compatibility of the Australian fleet with biofuels use was a critical issue for further uptake. Concerns about damage to vehicles associated with the use of blended ethanol comprise a significant consumer barrier to increased uptake of the fuel, even though there is little evidence to support the claim that ethanol blends have actually caused any engine damage in Australia to date.

While the current supply of fuel ethanol in Victoria is limited, the Committee recognises that future technological developments in the industry may dramatically improve the economic viability of fuel ethanol. If second-generation (lignocellulosic) ethanol production becomes commercially viable, opportunities may emerge for a review of Victorian biofuels targets. The Committee believes that in the meantime there is an opportunity for the Victorian Government to provide support for an emerging ethanol industry through improving the capacity of the Victorian fleet to use fuel blends in excess of E10.

The Committee heard from GM Holden that the production price premium associated with an E24 compatible engine was in the order of tens of dollars over the price of E10 vehicles.⁷³⁹ Consequently, the Committee understands that the capacity of the Victorian fleet to use ethanol blended fuels up to E24 could be obtained at relatively little expense to consumers.

The Committee also believes there is capacity for the Government to provide support to the biodiesel and other alternative fuel industries to enable greater use of these fuels in the Victorian vehicle fleet. Unlike ethanol blended fuels, increased uptake of biodiesel is not constrained by

⁷³⁹ Ernie Tamburrini, Director, Powertrain Engineering, GM Holden, *Transcript of evidence*, Melbourne, 27 August 2007, p. 48.

lack of consumer confidence. Rather there are a number of Australian vehicle manufacturers reluctant to warranty use of any biodiesel fuels or biodiesel blends higher than 5 per cent in their vehicle fleet. Based on the European experience, the Committee is aware of the capacity for certain diesel vehicles to use biodiesel blends of up to 100 per cent. The Committee therefore believes further work is required to determine compatibility of Australian manufactured diesel vehicles with higher blends of biodiesel fuels.

The Committee recommends that the Victorian Government, in consultation with the Commonwealth and other state and territory governments, consider the feasibility of increasing the capability of all vehicles sold in Australia to operate on a range of fuels, including higher blends of biofuels. As part of this, the E10 requirement should be extended to permit the wide-spread introduction of flex-fuel technology in Australia. Flex-fuel vehicles currently retailed in Brazil, the United States and Europe (and recently promoted in Australia by SAAB) are capable of running on a range of fuels from petroleum-only to up to 85 per cent ethanol blends.

Recommendation 20: That the Victorian Government, in consultation with other state governments and the Commonwealth Government, investigate the feasibility of requiring all vehicles sold in Australia to comprise technology to enable use of a range of fuels, including higher blends of biofuels.

Biodiesel industry support

As noted previously, the Committee is of the opinion that biodiesel is the biofuel most suited to domestic production in the state of Victoria. Furthermore, the GHG emissions and air emissions benefits associated with the use of biodiesel appear to be significant, and provide a potentially important means of obtaining environmental goals in the transport sector.

The Committee was told that a critical factor for the expansion of the biofuels industry was support for the fuels by major oil companies. In their submission to the Inquiry, Biodiesel Producers Limited told the Committee that one of the barriers to the inclusion of biodiesel in products sold by the major oil companies was that these companies had not been able to come to an agreement on how to disperse the infrastructure costs associated with the construction of biodiesel blending facilities.⁷⁴⁰ Biodiesel Producers told the Committee that biofuels managers in the major oil companies were constrained by high benchmarks on capital expenditure within oil companies, which essentially meant biodiesel would not be sold without the exertion of external pressure on companies to make biodiesel blends available.⁷⁴¹

The placement of shared biodiesel blending facilities in the Melbourne terminal has the potential to remove many of the current reservations against biodiesel blending currently held by major oil companies. Consequently, the Committee recommends that the Victorian Government examine mechanisms to encourage major oil companies to construct biodiesel blending infrastructure in shared facilities.

⁷⁴⁰ Biodiesel Producers Ltd, *Submission*, no. 49, 8 August 2007.

⁷⁴¹ Biodiesel Producers Ltd, *Submission*, no. 49, 8 August 2007.

Recommendation 21: That the Victorian Government encourage major oil companies to construct shared biodiesel blending facilities at the Melbourne terminal.

9.5 Research and development

In previous chapters the Committee has identified a number of gaps in current knowledge about the costs and benefits associated with the uptake of biofuels. In particular, there is little current evidence available on the comparative benefits of biodiesel and ethanol when compared to other alternative fuels such as CNG, liquefied natural gas (LNG) and liquefied petroleum gas (LPG). Given the increasing prominence given to the biofuels industry, and given contemporary debates about the role of biofuels in the Victorian (and Australian) fuel mix, new and robust data on a range of alternative fuels is urgently required. While the Committee has made a number of findings on the relative benefits of biofuels and other fuels, available data should be more robust in order to provide policy makers with the best information when making determinations on the place of biofuels in the future fuel mix. Consequently the Committee recommends that the Victorian Government support new scientific research into the costs and benefits associated with biofuels use, with particular regard to benefits obtained from GHG emissions and air emissions reductions.

Recommendation 22: That independently, peer-reviewed research be conducted at regular intervals to provide updated data on the life-cycle greenhouse gas emissions and life-cycle air pollutants produced from the use of biofuels in transport applications.

An overwhelming consensus among witnesses and submissions to the current Inquiry was that transport fuel was emerging as a critical issue across the world, due to concerns about fuel security, GHG emissions, and air pollution. While the Committee heard a number of views about whether biofuels would comprise an appropriate response to these issues, there is no doubt that issues surrounding future fuels will become increasingly prominent. While the future direction of fuel use is not clear, it is clear that current patterns of fuel use cannot be sustained without substantial costs being incurred – either by the economy, the environment, or in terms of population health. For this reason, it is crucial that the Victorian Government continue to monitor developments in the transportation and fuel sectors to ensure that the most promising emerging technologies are evaluated for potential application in Victoria.

Finding 21: The identification and evaluation of emerging vehicle and fuel technologies is a critical function of government, with the identification of low GHG emissions technologies of particular importance to future transport needs.

The Committee was also interested in the potential for future development of the biodiesel industry through exploration of new and emerging feedstocks, such as jatropha, eucalypts and algae. The Committee was very interested in the innovative trials currently being conducted by Smorgon Fuels Pty Ltd to produce biodiesel from algae.

We are in the process at the moment of working with the Latrobe Valley where we, in partnership, are developing the technology where we will be taking their flu gases, CO₂, NO_x and SO_x and redirecting that into a facility—reactors, for a better word—where we will then harvest and grow algae.... We are anticipating by Christmas to have a half a hectare to a hectare of production of a species of algae, and hopefully next year some time we will start to extract some oil. Now, that is all—we are still in the R and D, we are still in the planning but we are moving forward. The benefit of algae has a number of issues. One is availability; two, it complements the guys from the Latrobe Valley because they are looking for ways to sequester carbon dioxide; and the yield per acre, depending on the specific species of algae, can be between 20,000, 50,000 and 100,000 litres of oil that is usable in biodiesel. Compare that to canola, which produces in a 12-month cycle 1000 litres of oil. Now, granted, we will need a lot of land. The guys at Hazelwood have a lot of land. We do not need to have drinking water. We can use the water that they use to cool their towers.⁷⁴²

Biodiesel from algae presents a potentially high-yield means of obtaining large quantities of product with vastly improved resource efficiency compared to the production of biodiesel from crops and animal products. Depending on the metric used, biodiesel from algae may also provide an effective means to obtain life-cycle GHG emissions reductions from Victoria's coal-fired electricity generators, at least until such time as practical carbon sequestration technologies are developed.

The Committee is highly supportive of the initiative taken by Smorgon Fuels to develop biodiesel from algae technologies in Victoria. While the private sector is making substantial progress in the development of next-generation feedstock and production technologies the Committee believes there is a role for government and tertiary institutions in biodiesel research and development.

The Committee believes that measures should be taken across jurisdictions to assess the feasibility of developing these biodiesel feedstock resources. Measures that could be explored include the development of improved harvesting technologies, or methods for improving feedstock oil yield. Consequently, the Committee recommends that representations be made by the Victorian Government through representation on the relevant ministerial council to explore options for a national approach to biodiesel feedstock technology development.

Recommendation 23: That through representation on the relevant ministerial council the Victorian Government seek to place on the agenda for consideration the development of a nationally coordinated research program to examine feedstock and biodiesel production technologies for application in the Australian biodiesel industry.

9.6 Developing the market for other fuels in Victoria

During the Inquiry the Committee received evidence highlighting the potential for fuels other than biofuels or conventional petroleum fuels to

⁷⁴² Mile Soda, Managing Director, Smorgon Fuels Pty Ltd, *Transcript of evidence*, Melbourne, 20 August 2007, p.27.

contribute to Australia's transport market. CNG was one such fuel, which as discussed in Chapter Four, is supported by Australia's abundant supply of natural gas and an existing pipeline distribution system. Methanol, which can also be extracted from natural gas, has been flagged as another alternative fuel. Another option is diesel produced from waste plastics. While this industry is still in its infancy, it could become a valuable fuel source in the future.

9.6.1 Waste plastics to diesel fuel

The method of converting waste plastics to diesel fuel was brought to the Committee's attention by a Victorian based company, Ozmotech. Ozmotech have spent the last four years refining what is claimed to be the only existing proven technology in the world that converts unwashed and unsorted waste plastics into high energy diesel fuel.⁷⁴³ The ThermoFuel system is designed to process 20 tonnes of waste plastics per day and produce up to 18,000 litres of diesel fuel.⁷⁴⁴ A typical plant may potentially divert almost 6,800 tonnes of waste plastics away from landfill per annum.⁷⁴⁵

One advantage of this system is that it is able to process lower-grade plastics that ordinarily go to landfill. Consequently it provides a means to manufacture a useful product (diesel fuel) from products that currently have no other value or application.

Diesel produced by this technique has a similar make-up to that of petroleum diesel and can be used in any standard diesel engine. Unlike biodiesel, plastics-to-diesel fuel requires no blending and complies with the fuel quality standards of Australia, Europe and the US.⁷⁴⁶ Given this, there are no concerns with vehicle engine warranties and there is no need to modify engines to enable its use.

Greenhouse gas emissions and other air pollutants

The Committee was told that life-cycle GHG and air emissions of plastics-to-diesel fuel performed better than petroleum diesel and were comparable to that of biodiesel.⁷⁴⁷ In particular, the Committee was told that tailpipe carbon monoxide (CO) and particulate matter (PM) emissions are substantially reduced with the use of plastic-to-diesel compared to petroleum diesel. However, more research is required to determine actual life-cycle GHG and air emissions associated with the use of this fuel.⁷⁴⁸

Disposal of plastics to landfill is an issue of particular importance to municipal authorities. A possible environmental benefit of plastics-to-diesel fuel is the potential for reduced disposal of waste plastics to landfill. According to Ozmotech, Australia disposes 1 million tonnes of waste

⁷⁴³ Ozmotech Pty Ltd, *Business strategy 2008-2012*, Notting Hill, Victoria, 2007, p. 9.

⁷⁴⁴ Ozmotech Pty Ltd, *Submission*, no. 62, 27 August 2007, p. 1.

⁷⁴⁵ Ozmotech Pty Ltd, *Submission*, no. 62, 27 August 2007, p. 2.

⁷⁴⁶ Marc Middleton, Marketing Manager, Ozmotech Ltd, *Transcript of evidence*, Melbourne, 27 August 2007, p. 3.

⁷⁴⁷ Marc Middleton, Marketing Manager, Ozmotech Ltd, *Transcript of evidence*, Melbourne, 27 August 2007.

⁷⁴⁸ Marc Middleton, Marketing Manager, Ozmotech Ltd, *Transcript of evidence*, Melbourne, 27 August 2007, p. 8.

plastics per annum and recycles only 232,000 tonnes of the plastics consumed each year.⁷⁴⁹

The Committee also heard that the waste plastics generated by a population of 100,000 people would be sufficient to supply a plant, meaning that there is potential for plants to be established in major regional centres such as Ballarat, Wodonga, Bendigo and Geelong.⁷⁵⁰

Government support

Currently plastics-to-diesel fuel is not classified as an 'alternative fuel' for the purposes of the Commonwealth Government's fuel excise regime, and so is subject to excise rates equivalent to petroleum diesel. Mr Marc Middleton, Marketing Manager for Ozmotech told the Committee that in his view the definition of 'alternative fuels' employed under the scheme should be extended to "include those [fuels] produced from wastes, or other methods that do not deplete the earth's natural resources".⁷⁵¹

In 2001, the Australian Taxation Office provided Ozmotech with 'Administratively Binding Advice' stating that plastics-to-diesel fuel was not an excisable product. This was determined on the basis that the feedstock was so far removed from its original petroleum source that it was considered an 'alternative fuel'.⁷⁵² This advice was overruled however with the introduction of the *Fuel Tax Act 2006*. The Commonwealth Government's response to an appeal on the decision stated:

- there were insufficient environmental benefits to warrant a change;
- the plastics feedstocks are fossil based resources; and
- waste plastics are not a renewable source.⁷⁵³

In August 2007, Ozmotech appealed the decision again in a submission to the Department of Environment and Water Resources. The submission updated the environmental emissions data (as discussed previously) and explained the disassociation of waste plastics from petroleum:

The essence of this is that the link from the plastics to their fossil resource is broken at the conclusion of the plastic's useful life. From that point forward, further use, re-use, recycling, or, at worst landfilling, has zero depletion effect on the original resource. The fact that plastic is a

⁷⁴⁹ Ozmotech Pty Ltd, *A submission to the Department of Environment and Water Resources to specify non-fossil fuels produced by pyrolysis of waste plastics as an alternative fuel*, Notting Hill, Victoria, 2007, p. 8.

⁷⁵⁰ Marc Middleton, Marketing Manager, Ozmotech Ltd, *Transcript of evidence*, Melbourne, 27 August 2007, p. 9.

⁷⁵¹ Marc Middleton, Marketing Manager, Ozmotech Ltd, *Transcript of evidence*, Melbourne, 27 August 2007, p. 4.

⁷⁵² Ozmotech Pty Ltd, *A submission to the Department of Environment and Water Resources to specify non-fossil fuels produced by pyrolysis of waste plastics as an alternative fuel*, Notting Hill, Victoria, 2007, p. 3.

⁷⁵³ Ozmotech Pty Ltd, *A submission to the Department of Environment and Water Resources to specify non-fossil fuels produced by pyrolysis of waste plastics as an alternative fuel*, Notting Hill, Victoria, 2007, p. 3.

hydrocarbon becomes immaterial to its further treatment. The depletion effect cannot be counted twice.⁷⁵⁴

At the time of finalising this report, Ozmotech had not received a response from the Department. Consequently plastics-to-diesel fuel incurs the same excise rate of 38.143 cents per litre as other petroleum based fuels. It is also not eligible for the 50 per cent discount rate that all other alternative fuels will receive from 1 July 2011.

The Committee is of the view that the potential benefits of plastics-to-diesel should be further explored. Plastics-to-diesel appears to provide environmental and emissions advantages over petroleum diesel. In the Committee's view the fossil fuel product [waste plastic] used for the production of plastics-to-diesel fuel is sufficiently removed from its source as to be considered an alternative fuel. However, at the time of tabling this report the Committee had not received detailed information about upstream emissions associated with the production of this fuel. The Committee was also unable to determine whether the net GHG emissions benefit of plastics-to-diesel exceeded the GHG emissions impact of plastics sent to landfill (which may be considered a form of carbon sequestration).

Recommendation 24: That the Victorian Government request the Commonwealth Government to review and assess plastics-to-diesel fuel with a view to including this fuel under the definition of "cleaner fuels" in the *Energy Grants (Cleaner Fuels) Scheme Act 2004 (Cth)*.

At the time that the Commonwealth Government announced the fuel tax reforms, Ozmotech were in partnership with Axiom Energy. The deal was cancelled however because the unexpected 38.143 excise rate had not been factored into the business plan and it was no longer workable. While there has been no further progress in Australia, Ozmotech continues to market the ThermoFuel system around the world.

We have got about \$300 million worth of orders all around the world, yet we cannot put one in our own backyard. We are embarrassed and frustrated to the point of distraction whereby we are unable to bring clients to Australia to see a plant working, to our own facility.⁷⁵⁵

The Committee notes the potential economic benefits that could result from the development of a viable plastics-to-diesel fuel industry in Australia. In contrast to biofuels, the diversion of waste plastics to fuel production is unlikely to place any pressure on the production of other consumable goods. Ozmotech informed the Committee that if this fuel becomes eligible for the same tax concessions as other alternative fuels, a number of investments would be secured throughout Australia, and particularly in Victoria.⁷⁵⁶ This could lead to regional development benefits through the

⁷⁵⁴ Ozmotech Pty Ltd, *A submission to the Department of Environment and Water Resources to specify non-fossil fuels produced by pyrolysis of waste plastics as an alternative fuel*, Notting Hill, Victoria, 2007, p. 6.

⁷⁵⁵ Marc Middleton, Marketing Manager, Ozmotech Ltd, *Transcript of evidence*, Melbourne, 27 August 2007, p. 5.

⁷⁵⁶ Marc Middleton, Marketing Manager, Ozmotech Ltd, *Transcript of evidence*, Melbourne, 27 August 2007, p. 7.

creation of employment opportunities and efficient waste management practices.

Recommendation 25: That the Victorian Government request the Commonwealth Government review and assess plastics-to-diesel fuel with a view to introducing a 50 per cent reduction to standard fuel excise rates applied to plastics-to-diesel fuel from 1 July 2011, in line with excise rates to be introduced for other alternative fuels.

9.6.2 Compressed Natural Gas

Throughout the Inquiry, the Committee received evidence from various witnesses highlighting the potential for CNG to contribute to Australia's fuel transport market. The abundance of natural gas in Australia and the existing pipeline distribution system were viewed as advantages to the establishment of a viable CNG industry in this country. Mr Cumming of the Royal Automobile Club of Victoria (RACV) told the Committee:

Why we never had CNG filling stations up the Hume Highway 20 years ago – I am absolutely amazed. This has been discussed for a very long time. We just have so much gas in this country that is being exported to Japan and elsewhere. It really could be used in Australia. I do not why there is no desire to use more CNG. I know the tanks involved have to be fairly large, but trucks have the capacity to carry those tanks. There is no doubt that using those gas supplies would make a huge difference to the air quality of Australia.⁷⁵⁷

During the *Inquiry into Australia's future oil supply and alternative transport fuels*, the Standing Committee on Rural and Regional Affairs and Transport concluded that "from the perspective of the beneficial impacts on the terms of trade and energy security and as an indigenous replacement for depleting conventional oil stocks, [CNG] must be considered from the perspective of its relative abundance".⁷⁵⁸

As discussed in Chapter Four, the air emissions performance of CNG is comparable if not better than most petroleum based fuels, with further improvements likely to be achieved through the tightening of natural gas vehicle technology.⁷⁵⁹ The Committee is aware however of the key barriers currently preventing the widespread use of CNG in Australia, most of which relate to the lack of refuelling infrastructure and its poor fuel range. A number of witnesses informed the Committee of the 'chicken and egg' dilemma associated with the CNG industry in Australia. In particular, witnesses expressed concern with the reluctance of service stations to invest in CNG refuelling infrastructure due to the limited demand for the fuel.⁷⁶⁰ While the Commonwealth Government implemented a program to encourage growth in refuelling infrastructure, it was ill-managed and the

⁷⁵⁷ David Cumming, Manager, Corporate Affairs and Public Relations, RACV, *Transcript of evidence*, Melbourne, 31 July 2007, p. 22.

⁷⁵⁸ Standing Committee on Rural and Regional Affairs and Transport, *Australia's future oil supply and alternative transport fuels*, Commonwealth of Australia, Canberra, 2007, p. 102.

⁷⁵⁹ Tom Beer, et al., *Life-cycle emissions analysis of fuels for light vehicles*, CSIRO, Ascendale, Victoria, 2004, p. 98.

⁷⁶⁰ Ron Bowden, Chief Executive Officer, Service Station Association fo Australia, *Transcript of evidence*, Melbourne, 6 August 2007, p. 3; John Mikolajunas, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 14.

allocated funds were eventually diverted to other programs.⁷⁶¹ Since then, there has been limited interest in CNG. The Committee believes there is merit in examining the feasibility of an expanded CNG industry in Australia, with particular attention to developing strategies that will address existing barriers.

Recommendation 26: That the Victorian Government conduct an extensive cost-benefit analysis of the merits of an expanded CNG industry in Victoria, with particular attention to infrastructure requirements and initiatives to increase market demand.

Because of the barriers associated with CNG, the Committee notes that its use is often promoted in larger vehicle fleets, such as buses and forklifts. These fleets are more suitable to carry the large storage tanks required for CNG than lighter vehicles and they can also be refuelled overnight by private refuelling systems stationed at vehicle depots. In recognition of these benefits, the Victorian Government should conduct a pilot program with one of its bus fleets to determine the feasibility of adopting CNG as a main fuel source. A number of bus companies already use CNG throughout Australia and the experiences of these companies could be drawn upon to inform the program with regard to the economics of CNG use and its environmental impact.

Recommendation 27: That the Victorian Government conduct a public transport pilot program with CNG.

9.6.3 Methanol

Another energy source that has received attention as a potential alternative fuel is methanol. Methanol is a clear, colourless liquid that is highly flammable and can be derived from either natural gas or biomass. When derived from biomass, methanol is typically manufactured by thermal processes where a feedstock (such as wood) is gasified to a synthesis gas, and carbon monoxide and hydrogen in the gas are reacted over a catalyst to form methanol.⁷⁶² Using this method of production, methanol could be considered a biofuel. However this method for methanol production is not yet cost-efficient, and so methanol-from-biomass is not commonly manufactured. Around 90 per cent of the world's methanol is extracted from natural gas.

Methanol is often used in chemical-manufacturing processes. It is an ingredient in the fuel octane enhancer methyl tertiary butyl ether (MTBE). As a fuel additive, methanol has blending advantages over ethanol although it has greater solvent and corrosive properties, and is more toxic when released into the environment. The National Pollutant Inventory ranked methanol 24th out of 93 substances (with one being the highest perceived risk).⁷⁶³

⁷⁶¹ Kevin Black, OES CNG Ltd, *Transcript of evidence*, Melbourne, 31 July 2007, p. 12.

⁷⁶² Barney; Mardon Foran, Chris, *Beyond 2025: Transitions to a biomass-alcohol economy using ethanol and methanol*, CSIRO, Canberra, 1999, p. 6.

⁷⁶³ National Pollutant Inventory, 'Methanol', viewed 8 December 2007, <<http://www.npi.gov.au/database/substance-info/profiles/pubs/methanol-factsheet.pdf>>.

In its submission to the Inquiry, MEO Australia suggested that methanol derived from natural gas could provide a bridge to the production of methanol-from-biomass.⁷⁶⁴ While the Committee acknowledges this possibility, methanol produced from biomass is a long way from being commercially competitive. However, the Committee recognises the potential for methanol to be used as an energy source for fuel cell powered vehicles.

Finding 22: Methanol has a potential role in the future fuel mix, and developments in methanol fuel production and engine technologies should be monitored by government.

The report was adopted by the Committee on Wednesday 23 January 2008.

⁷⁶⁴ MEO Australia Ltd, *Submission*, no. 50, 8 August 2007, p. 2.

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Yarrock Pty Ltd, *Submission*, no. 33, Inquiry into the production and/or use of biofuels, Environment and Natural Resources Committee, Parliament of Victoria, 13 September 2006.

Zou, L, 'Characterising vehicle emissions from the burning of biodiesel made from vegetable oil', *Environmental technology*, vol. 24, 2003, pp. 1253-1260

Appendix One: List of Submissions

ANL Container Line

Australian Biodiesel Group Ltd

Australian Biofuels Pty Ltd

Australian Lots Feeders Association

Australian Medical Association (Victoria) Ltd

Australian Pork Limited

Australian Renewable Fuels Ltd

Automotive Alternative Fuels Registration Board

Axiom Energy Ltd

Mr Ken Barker

Biodiesel Producers Ltd

Biofuels Association of Australia

BP Australia

Bus Association Victoria

Caterpillar Inc

City of Greater Geelong

CMEIG (Vic)

Countryenergy

CSIRO

CSR Limited

Earth Rescue Incorporated

Eco2Sys Australia

ENERGEX Limited

Environmental Farmers Network

ExxonMobil Australia

Federal Chamber of Automotive Industries

Flour Millers Council of Australia
Ford Motor Company of Australia Limited
GM Holden
Grown Fuel and Wimmera Biodiesel
Hobsons Bay City Council
ICLEI - Local Governments for Sustainability - Oceania
Iveco Trucks Australia Limited
Manildra Group
Mr John McHardy
Dr Ian McPhail
Melbourne Water
MEO Australia Ltd
Midfield Meats
National Centre for Sustainability
Nissan Motor Co. (Australia) Pty Ltd.
OES CNG
Ozmotech Pty Ltd
Mr Nick Pastalatzis
Public Transport Users Association (Incorporated)
Renewable Oil Corporation
Royal Automobile Club of Victoria (RACV) Ltd
Scania Australia
Service Station Association Ltd
Shedden Uhde (Australia) Pty
Shell Company of Australia Ltd
SMARTtimbers Cooperative
Smorgon Fuels Pty Ltd
Starfish Ventures Pty Ltd

Stock Feed Manufacturers' Council of Australia

Sustainability Victoria

Swan Hill Rural City Council

Synergetics

TfA Project Group

TRUenergy

University of Sydney

Victorian Automobile Chamber of Commerce

Victorian Catchment Management Council

Victorian Farmers' Federation

Victorian Government

Appendix Two: List of witnesses

Public hearings

Melbourne 31 July 2007

| | |
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| Mr Chris Midgley | General Manager, Supply and Marine Shell Australia |
| Mr John Lincoln Mr John Mikolajunas Mr Kevin Black | OES CNG |
| Mr David Cummings | Manager Corporate Affairs and Public Relations RACV |
| Mr John Honan Mr Martyn Evans | Managing Director Consultant Manildra Group |
| Mr Kevin Roberts | Vice President Australian Lot Feeders' Association |
| Mr Kenton Shaw | General Manager, Pork Production QAF Meat Industries |
| Mr Paul Martin | Grown Fuel |
| Mr Danny Goldman Mr David Vinson | Managing Director Technical Director Axiom Energy Ltd |

Melbourne 6 August 2007

| | |
|----------------|---|
| Mr Ron Bowden | Chief Executive Officer Service Station Association of Australia |
| Mr Doug Munroe | Senior Consultant Synergetics |
| Mr Keith Seyer | Director, Technical and Regulatory Federal Chamber of Automotive Industries |

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| Dr Tom Beer | Leader, Alternative Transport Fuels Stream, Energy Transformed Flagship |
| Mr Peter Campbell | Team Member CSIRO |

Melbourne 20 August 2007

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|-----------------|--|
| Mr Simon Ramsay | President |
| Mr Graeme Ford | Executive Manager, Policy Victorian Farmers Federation |

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| Mr Wayne Turner | Chief Executive Officer |
| Mr Peter Anderton | Chief Executive Officer, Agri Energy |
| Mr Adrian Lumb | General Manager, Marketing and Corporate Services |
| Mr Stewart Rendell | Feedstock and Agriculture Australian Biofuels Limited |

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| Mr Martin Jones | Manager Government Relations CSR Ethanol |
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| Mr Mile Soda | Managing Director |
| Mr Reno Beltrame | Technical Manager Smorgon Fuel Pty Ltd |

Melbourne 27 August 2007

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| Mr Marc Middleton | Marketing Manager Ozmotech Pty Ltd |
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| Mr Leigh Watkins | Senior Manager, Strategic Solutions Bendigo Bank |
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| Mr Frank Russel | Head Biofuels BP Australia |
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| Professor Michael Brear | Senior Lecturer, Department of Mechanical and Manufacturing Engineering University of Melbourne |
| Mr Tony Kitchener | Cash Engineering |

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| Ms Paula Arcari | ICLEI Oceania |
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| Mr Ernie Tamburrini | Director, Powertrain Engineering GM Holden |
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Mr Parveen Batish

Director

SAAB Australia and New Zealand

Prof German Spangenberg

Department of Primary Industries

Appendix Three: List of briefings and site visits

Briefings

Melbourne 16 July 2007

| | |
|------------------|-----------------------------------|
| Ms Lea Corbett | Executive Director Infrastructure |
| Mr Craig Eyes | Program Manager, Infrastructure |
| Mr Glenne Drover | Manager, Energy |

Regional Development Victoria

| | |
|--------------------|--|
| Mr Richard Bolt | Secretary |
| Ms Marianne Lourey | Executive Director, Energy |
| Mr John Krbaleski | Director of Energy and Sustainability Policy |

Department of Primary Industries

Melbourne 8 October 2007

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|---------------------------|---|
| The Hon. Jacinta Allan MP | Minister for Regional and Rural Development |
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| Mr Glenne Drover | Manager, Energy |
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Regional Development Victoria

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| Mr Mick Bourke | Chair |
| Mr Kristian Handberg | Acting Team Leader, Greenhouse Policy, Atmosphere and Noise Unit |

EPA Victoria

Site visits

Laverton 4 June 2007

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| Mr Mile Soda | Managing Director |
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Smorgon Fuels Pty Ltd
