Biodiesel in Australia

Benefits, Issues and Opportunities for Local Government Uptake

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Contents.

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"…biodiesel could… offer a more environmentally acceptable and domestically secure interim fuel option that at least contributes fewer GHGs and improves air quality…"

Abbreviations.

ABARE	Australian Bureau of Agricultural and Resource Economics
AGO	Australian Greenhouse Office
ASPO	Association for the Study of Peak Oil
BAA	Biodiesel Association of Australia
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2-e	Carbon Dioxide Equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTL	Coal to Liquid
GHG	Greenhouse Gases
GTL	Gas to Liquid
HC	Hydrocarbons
IEA	International Energy Agency
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LSD	Low Sulphur Diesel
NEPC	National Environment Protection Council
NOx	Oxides of Nitrogen
PAH	Policyclic Aromatic Hydrocarbons
PM	Particulate Matter
UCO	Used Cooking Oil
ULSD	Ultra Low Sulphur Diesel
VOC	Volatile Organic Compounds
XLSD	Extra-low Sulphur Diesel

Executive Summary.

This report - *Biodiesel in Australia* - provides a comprehensive overview of the benefits, issues and opportunities of biodiesel uptake for local governments in Australia, with a particular focus on Victoria. Councils in all jurisdictions will find value in using this document with the result that council staff, management and elected members will be informed and empowered to make appropriate decisions regarding biodiesel uptake by their council. This report has been funded by the State Government of Victoria through the Department of Sustainability and Environment, and produced by ICLEI Oceania.

An extensive research process included the participation of local governments as well as a range of industry stakeholders. The local government findings and testimonials presented in this report are based on survey results from 50 Australian local governments.

In 2004/05, transport as a whole accounted for approximately 24% of total energy consumption in Australia and contributed 14% of net greenhouse gas emissions, the highest emitting sector after stationary energy[96, 43]. Over three-quarters of this energy consumption, and the associated emissions, is attributed to road transport[97].

In Victoria, fuel consumption for road transport is increasing by 3-4% per year, with diesel usage increasing at more than twice the rate of petrol[15, 17]. By 2010, greenhouse gas emissions from the transport sector are predicted to be 44% higher than they were in 1990 [44].

The significant, and steadily rising contribution of fossil fuels to global emissions of greenhouse gases is one of two primary drivers for the increasing focus on alternative transport fuels such as biodiesel. The other is the increasing threat of worldwide fossil fuel scarcity and the implications of this for economic and national security.

Biodiesel is a renewable fuel whose primary feedstocks, such as used cooking oil, tallow and vegetable oils, can be grown and/or sourced locally for use in short turn-around times. Unlike fossil-based fuel, biodiesel is also part of a closed carbon loop in which the tailpipe emissions of carbon from biodiesel are, theoretically, no more than was extracted from the atmosphere by the feedstock plants during their growth.

While biofuels (including ethanol) currently account for less than 1% of the overall fuel market in Australia, biodiesel production grew fourfold in one year from 2003/04 to 2004/05 and the indications are that this growth trend will continue[19, 26].

In Australia, local government leads the way with biodiesel uptake. Beginning in 2002, biodiesel is now used by over 20 local governments and at least five of these operate their entire depot fleet on biodiesel blends.

Local governments reported overwhelmingly positive outcomes from their uptake of biodiesel. There are no operational problems reported from the use of certified fuel in conventional diesel engines, and over 80% of experienced councils indicated that biodiesel will continue to play a major role in council's future fuel usage.

To build on learnings from these experienced councils and ensure that the future implementation of biodiesel in local governments is both appropriate and environmentally sustainable, this report provides useful tools (project checklist, guidance on how to calculate GHG abatement and a summary reference list of benefits and issues) to assist councils with the planning and implementation of a successful biodiesel project, best practice examples for biodiesel uptake in the form of council testimonials and detailed case studies from five local governments, an example tender document to guide councils in the development of their own tender criteria, and also details of 26 council biodiesel projects covering five states.

The main factors considered by surveyed councils as critical to the success of their biodiesel projects are:

- Good research and planning;
- Risk management;
- Strong council support;
- Stakeholder engagement;
- Establishing a project team;
- Monitoring and reporting;
- Positive staff attitude.

Council motivations for biodiesel uptake, in order of significance, are:

- Reduced greenhouse gas emissions;
- Contributing to council abatement goals;
- Reduced environmental pollution;

Executive Summary.

- Fuel security (in terms of reduced reliance on fossil fuels);
- Improved community health;
- Encouraging local economic development;
- Financial savings;
- Opportunity to demonstrate leadership.

Studies show that biodiesel uptake can lead to life-cycle reductions in greenhouse gas emissions of up to 90% dependant on the blend [17]. In addition to greenhouse gases, diesel vehicles contribute a disproportionate amount of other emissions such as oxides of nitrogen and particulate matter, contributing to the formation of urban ozone and photochemical smog, and increasing cardiovascular, respiratory and cancer-related morbidity and mortality. All biodiesel blends result in significant reductions in particulate matter of between 30-90%, delivering clear benefits in terms of air quality and community health [17].

Councils reported many operational benefits of biodiesel uptake including improved lubricity, smoother vehicle operation, increased combustion, improved auto-ignition and safer handling. They also observed no perceptible difference in power or engine torque and noted that biodiesel uptake required no engine modification.

The operational and environmental benefits of biodiesel suggest that it can be a viable and preferable alternative to diesel. However, there are broader issues for local governments to consider. These include fuel quality, sustainability of supply, environmental and social impacts of feedstocks, cost, tax laws and warranty regulations.

Many councils indicated concern regarding feedstocksin terms of their sustainability, the life-cycle environmental impacts of their production, extraction and transportation, and the social and economic impact of food resources being used for fuel purposes.
A majority area of concern regarding sustainable feedstocks is the use of imported palm oil and the impact that an unregulated market is already having on deforestation, biodiversity and societies in tropical

Executive Summary.

regions. Councils indicated a preference for biodiesel from domestic, locally sourced and non-GMO (Genetically Modified Organism) products.

Most councils report that biodiesel uptake is generally cost-neutral. However, there are further potential economic benefits of biodiesel uptake relating to local economic development, and local governments can play an instrumental role in maximising these benefits through effective research and planning.

Local governments are thinking ahead and want to position themselves within an appropriate and stable framework that allows them to make sound environmental, economic and social decisions regarding council's future fuel use. Given the relatively early stage of the Australian biodiesel industry, this presents opportunities to review current policies and strategies surrounding biofuels to alleviate local government concerns. Within this context, the primary opportunity for local governments in relation to biodiesel exists in their being able to influence the direction that the industry takes from this point onwards.

This report makes the following recommendations with regard to establishing a stable framework for Australia's biodiesel industry and facilitating local government decision-making. Leadership and support at Federal and State levels is required to provide:

- Certification system around sustainable feedstocks and sources;
- Reliable emissions data;
- Rebates and incentives;
- Planning policies to support renewable industries;
- Cost guarantees;
- Assurance of supply and standards;
- Improved supply structure;
- Clarity and support on warranties - both producers' and manufacturers'; and
- More research, information and education.

With the announcement in June 2007 of a Victorian Parliamentary Inquiry into mandatory ethanol and biofuels targets in Victoria, set within the context of the existing Victorian Biofuels Action Plan, the Victorian State Government is well positioned to adopt a leadership role in Australia through establishing a sustainable model for biodiesel uptake and development that can be replicated in other states.
To ensure that this model meets the needs of local governments and safeguards against any potentially adverse environmental and social implications of biodiesel, it is recommended that the Victorian Government continue to liaise with ICLEI Oceania and other stakeholders in the local government sector.
The Victorian Government can play a key role through support for initiatives designed to further expand the body of knowledge and understanding around biodiesel, and provide education and assistance for potential users, including promoting the outcomes of this report.

Overall, this research shows that biodiesel could, within strict guidelines, offer a more environmentally acceptable and domestically secure interim fuel option that at least contributes fewer greenhouse gases and improves air quality, until such time as more advanced and ideally carbon-neutral transport technologies become commercially viable.

However, in order to have more than a limited impact on reducing the environmental impact of the transport sector and reducing reliance on fossil fuels, the uptake of less environmentally harmful alternative fuels needs to be part of a fully integrated and aligned transport approach. Councils therefore recognise that efforts to increase biodiesel uptake need to be pursued in conjunction with increasing fuel efficiency and reducing overall travel demand.

Chapter 1. Background to Petroleum and Alternative Fuels.

1. Introduction

In Australia, local governments are uniquely positioned to take innovative action on issues directly affecting their communities. They are able to lead and represent their communities in a more immediate way, and implement policies and plans that affect both council and the municipality within relatively short timeframes. As a consequence, local government is often the place where new ideas and technologies are given ground to demonstrate their broader applicability, leading to wider interest if they prove successful and, in some cases, policy changes and implementation at the state or even federal level.

Biodiesel has only recently started to raise significant interest in Australia. While some 'backyarders' have been producing biodiesel fuel for their own consumption for over 10 years, commercial businesses and big industry have not yet made major investments in biodiesel uptake in terms of demand. In contrast, some local governments in Australia have been using biodiesel since 2002 and at least six councils across Australia currently operate their entire depot fleet on biodiesel, some since 2003/04.

Biodiesel is a non-fossil carbon fuel, often referred to as an 'alternative fuel'. The phrase 'alternative fuel' is now widely used and has become a collective way of referring to a range of vehicle fuels that can, under certain circumstances, be more environmentally preferable than traditional fossil fuels. Other alternative fuels include ethanol, natural gas, biodiesel, biogas, and many others.

The two primary drivers for the increasing focus on alternative fuels are:

1. The impact that fossil fuels have already had and continue to have on emissions of greenhouse gases.
2. The increasing threat of fossil fuel scarcity and/or security.

By definition then, an alternative fuel ought to have less impact on our environment than fossil fuel, and have no or fewer issues around scarcity and/or security of supply.

The question of whether biodiesel meets these criteria, in ways that make it commercially viable, should be central to local government decisions regarding its uptake. This report investigates how local governments in Australia have gone about implementing successful biodiesel projects, the outcomes of these projects and the range of issues and opportunities relevant to more widespread uptake by local government in Australia.

"…an alternative fuel ought to have less impact on our environment than fossil fuel…"

Chapter 1. Background to Petroleum and Alternative Fuels.

1.1 The Use and Impact of Petroleum Fuels

1.1.1. Peak Oil

Since 1970, global oil consumption has increased more than 60%. By 2030, the International Energy Agency (IEA) predicts that this figure will be at least 50% higher again[1]. Many leading scientific bodies claim that remaining supplies of crude oil are insufficient to allow for this scale of growth. According to the IEA, the Association for the Study of Peak oil (ASPO) and Exxon Mobil, the rate of major oil discoveries has dropped dramatically since the 1960's (Figure 1) and remaining oil reserves are becoming harder and thus more expensive to extract [1,2,3]. There are detractors of the Peak Oil theory and many references can be found to improvements in technology extending the life of existing fields, studies that estimate higher reserves, and claims that untapped sources will soon become viable [4,5,6]. However, the majority of scientific and industry sources indicate that Peak Oil is an unavoidable consequence of the world's increasingly intensive use of this resource, although estimates may vary as to when it will occur.

In 2004, a senior executive at BP stated that he believed oil production would peak somewhere between 2010 and 2020 [7]. In the same year, Shell downgraded its stated oil reserves by 22% [8]. It took over 300 million years to create this resource and the world is currently using it at the rate of approximately 80 million barrels a day, "the fossil fuel equivalent of all the plant matter that grows on land and in the oceans over the course of a whole year", according to a University of Utah study [9]. By 2030, an additional 40+ million barrels a day will have to be discovered to meet projected demand, according to the US Energy Information Administration [1].

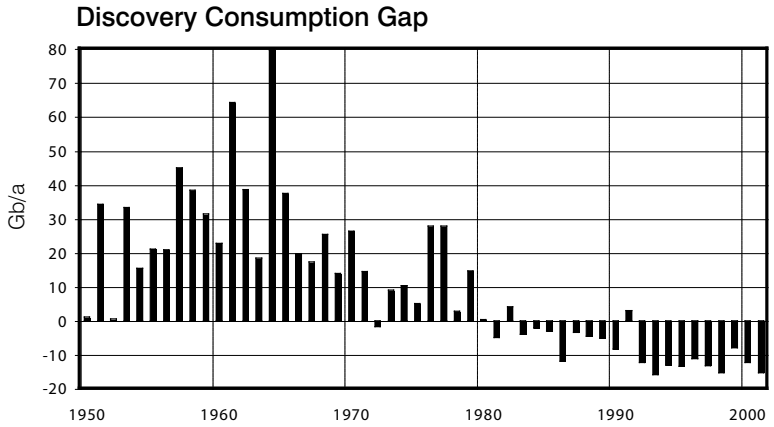


Figure 1. Balance between oil consumption and discovery. World moved into deficit in 1982.

From: ASPO Statistical Review of Oil and Gas (2002)
Note: Discoveries lead to reserves that are not used in one year and therefore a deficit cannot be ascribed to one year, as in the graph. However, the graph does indicate the trend towards fewer discoveries over time.

1.1.2. Oil Consumption

Transport currently accounts for 47% of the total worldwide demand for oil, and of the predicted future increase in this demand, two-thirds will come from the transport sector [10]. Between 1973 and 1998 global fuel use for road transport increased 65% (80% for freight alone) [10]. Between 1971 and 2000, Australia experienced a five-fold increase in fuel consumption for all transport, the fastest growth of all energy sectors, and in 2004/05, road transport accounted for 77% of all fuel consumption for transport [11, 12]. Between 2007 and 2010, fuel consumption for the Australian transport sector is expected to grow by nearly 7% [13], and by 2020 it is predicted to increase by approximately 50% [12]. In 2001, The Australian Bureau for Agricultural and Resource Economics (ABARE) estimated that by 2010, Australia will be dependent on foreign imports for over 60% of its domestic requirements of petroleum products (Figure 2) [14]. Currently, approximately 50% of domestic oil requirements are met through imports.

"By 2020 [fuel consumption for the Australian transport sector] is predicted to increase by approximately 50%".

In Victoria, between 1990 and 2010, there has been a steady increase in the growth rate of fuel used in the road transport sector from an average 0.45% per year to the current estimate of 4% per year (Table 1) [15]. However, the low growth rate between 1990 and 1995 may have been an anomaly resulting from the recession that took place in the early 1990's.

	Road	Air	Rail	Sea	Total
1990	220	21	2.4	16	259
1995	225	26	1.4	13	266
2000	258	34	1.6	10	303
2005	*310*	*40*	*1.4*	*10*	*361*
2010	*320*	*44*	*1.3*	*10*	*374*

Table 1: Victorian transport sector fuel consumption by sector (petajoules).

Source: DPI, 2002.
Note: Italics represent estimated consumption figures.

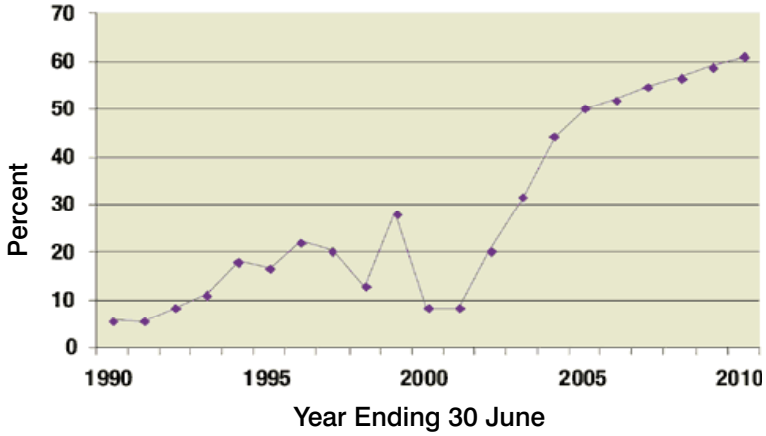


Figure 2. Percentage of Australia's Oil and Petroleum Products Consumption sourced from Imports.

Source: ABARE Energy Projections (2001).
Note: Projections beyond 2001 are based on ABARE consumption data and Geoscience Australia production projections.

Chapter 1. Background to Petroleum and Alternative Fuels.

Petrol and diesel are both petroleum fuels and diesel is sometimes referred to as petrodiesel, mineral diesel or fossil diesel. For the purposes of this report, it is simply called diesel. In 2001 over 90% of Australia's fuel use for road transport came from petrol and diesel, with petrol use being approximately 1.5 times that of diesel [16]. However, diesel use is increasing, and by 2005, demand for diesel was 34% of total transport fuel use (growing at 3% pa), while demand for petrol was 47% (growing at 1.2% pa) [17] (refer to Figure 3). The National Environment Protection Council (NEPC) estimates that in Australia, diesel vehicle use in metropolitan areas will increase 146% by 2010 [18]. In Europe, where diesel powered vehicles account for nearly half of all new car sales, 49% of fuel sales were of diesel in 2006 were of diesel.

With such high and increasing levels of global oil consumption, two interrelated issues commonly raised in support of alternative fuel technology are fuel scarcity and security, especially with the threat of Peak Oil. However, some also claim that there are still several decades, or centuries worth of oil yet to be extracted. The issue of fuel scarcity, in the context of Australia's declining reserves, is already acknowledged within the industry and all levels of government [20, 21], while that of fuel security emerges as a major driver for local governments in the uptake of alternative fuels and is addressed further in Chapter 2. Whether Peak Oil is already upon us, or still far in the future, the fact remains that it is a finite resource and we will not be able to keep consuming oil indefinitely.

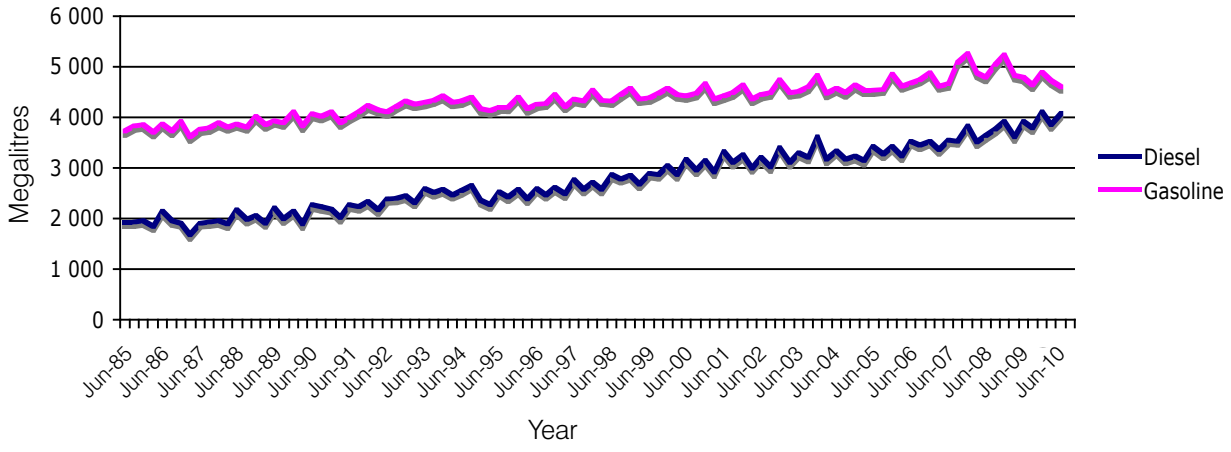
As yet, none of the alternative fuels on offer have managed to penetrate the transport market and replace either petrol or diesel to a significant extent. However, until such a time as the gap between existing technology and infrastructure, and a viable, commercial-scale alternative fuel can be narrowed, there are likely to be a host of interim options. Together these can be used to at least slow the rate of growth in oil demand, allow for further innovation, and address some of the adverse consequences of over 200 years of fossil fuel consumption, the most obvious one being increased levels of atmospheric CO_2. Alternative fuels such as biofuels, particularly biodiesel and ethanol, currently offer such interim options and global trends indicate an increasing interest in their providing a higher percentage of the national fuel consumption of several countries, including Australia. However, to be a viable interim option, they must, in addition to increasing domestic fuel security, also have less impact on the environment than the fossil fuels they are replacing.

1.2 Alternative Fuels

The current range of alternatives to petrol and diesel fall into two main categories: fossil fuel-based (non-petroleum) and biomass based.

Figure 3. Australian Gasoline and Diesel Sales 1981 to 2006.

Source: Bureau of Transport and Regional Economics. Land Transport Statistics[19].



1.2.1. Fossil Fuel-based Alternatives

There are several alternatives to conventional fossil fuels that are derived from applying alternative methods of production to crude oil, coal and gas to produce either gaseous fuels (compressed natural gas or CNG; liquefied petroleum gas or LPG) or liquid fuels (liquefied natural gas or LNG; Gas to liquid or GTL; coal to liquid or CTL). Although gaseous fuels still contribute to the consumption of finite fossil fuel resources, they do provide measurable reductions in greenhouse gas emissions compared with conventional fuels [22]. The liquid fuels, on the other hand, produce either slightly higher emissions to conventional fuels or, in the case of coal to liquid, up to 100% more, according to an industry association, based on current technologies [22, 23].

As alternatives to diesel use, the gaseous fuels (CNG and LPG) cannot be used in unconverted diesel engines, and the liquid fuels (GTL and CTL) are not yet available in Australia. However, there are plans to consider the development of GTL and CTL plants in the future[24] with Metex Resources Ltd. currently working with CSIRO on CTL trials, and Linc Energy working on an EIS for a CTL project in Queensland.

1.2.2. Biomass Alternatives

Biomass-based fuels, also known as biofuels are those derived from various methods of processing different types of organic matter and include, among others, biodiesel, ethanol, methanol and biogas. These fuels have been around since the turn of the 20th Century when both Rudolf Diesel and Henry Ford conceived engines to run entirely on biofuels. However, the advent of cheap extraction technologies meant that crude oil replaced biofuels as the widespread fuel of choice.

Biofuels are derived from renewable resources, able to be grown and/or sourced for use in short turn-around times and, depending on the upstream feedstock and fuel production processes, can deliver reduced greenhouse gases and other emissions over their full life-cycle as compared with fossil fuels. In terms of tailpipe emissions, they are regarded as being part of a closed carbon loop in which the tailpipe emissions of carbon from a 100% biofuel or the biofuel component of a blended fuel are, theoretically, no more than was extracted from the atmosphere by the plants during their growth.

The biofuels industry has undergone a rapid transformation in recent years with an increasing amount of research and development being focused on improving our current biomass-based fuel options and discovering new ones. Currently, these fuel options can be divided into two categories, first generation and second generation biofuels (see Information Box 1).

This report is focused on first generation biofuels, and primarily biodiesel, that local governments can and are using now and does not investigate the use of second generation biofuels.

Information Box 1: First and Second Generation Biofuels

First generation: Biodiesel, bioethanol from sugar and starch crops (known commonly as ethanol) and pure vegetable oil.

These fuels are now available at commercial scales and depending on the feedstocks, blend and production processes, can produce reductions in full life cycle greenhouse gases of up to 90% [22].

Second generation: Bioethanol (from lignocellulosic biomass), Hydro Thermal Upgrading (HTU) diesel, Bioethanol, Bio-DME, Bio-SNG (via biomass gasification), Biohydrogen (via biomass gasification).

These second generation fuels utilize more advanced production technologies that result in greater CO2 reduction than for the first generation fuels, however, they are not expected to be commercially available for another 5-10 years [25].

1.2.2.1 Biodiesel and Ethanol

The first generation biofuels, biodiesel and ethanol, together currently account for less than 1% of Australia's overall fuel market [19].

Ethanol production in Australia (mostly from sugarcane, grains and grain residues) is much higher than biodiesel production, however it has dropped dramatically over recent years[17]. This decline in production is variously ascribed to: lack of a ready market for ethanol in Australia; lack of consumer confidence; potential for feed grain prices to affect its financial viability; and, lack of incentives resulting in high-risk for potential developers and investors[24]. The Commonwealth Government's Ethanol Distribution Programme, announced in August 2006, involves an investment of $17.2 million over three years to reduce infrastructure costs and encourage ethanol uptake. Also in 2006, BP committed to plans that will add over 160ML in ethanol production capacity per annum by 2008. These developments may bring about an increase in ethanol production in the near future.

In contrast, biodiesel production has grown fourfold over the same period, albeit from a lower base [26].

"…most of the current generation of alternative fuels, such as ethanol, biodiesel, CNG and LPG, are widely regarded as interim options…"

Ethanol differs from biodiesel in its production method, the type of biomass or feedstock used in production, and also in the suitability of each fuel for different vehicles. Ethanol is produced from the fermentation of carbohydrates such as sugar, starch and cellulose found in sugar cane, sugar beet, wheat, corn and other such biomass. The resulting product can be mixed with petroleum fuel, in various proportions, to produce the final blended ethanol biofuel, i.e. E5 (5% ethanol) or E100 (100% ethanol). Ethanol can only be used in petrol vehicles to a maximum of 10% ethanol without changes to the fuel system. However, some vehicle manufacturers do not recommend the use of ethanol in certain of their models, while others are listed as being suited to a maximum blend of E5. See Useful Links, Fuel Supply & Standards (Appendix A) for more information.

Biodiesel, on the other hand, is produced from organic oils and can be mixed with petroleum diesel, again in varying proportions, to produce biodiesel blends, i.e. B5 (5% biodiesel) to B100 (100% biodiesel). Biodiesel can only be used in diesel vehicles, with no engine modification required. The organic oils used in biodiesel production are derived from animal sources in the form of waste animal fats (tallow), or vegetable sources in the form of used cooking oil or from the compression of oilseeds such as soybean, canola, rapeseed, and palm.

Owing to the rapid pace of developments in fuel technology and the fact that "second-generation" biofuels are already under investigation and even development, most of the current first generation biofuels, such as ethanol and biodiesel, are widely regarded as interim options. Consequently, it is important to consider any significant investment in new infrastructure required for their uptake. CNG, LPG and hydrogen can be used as alternatives to petroleum only in appropriately converted engines. For GTL and CTL, no modification is required. Similarly, for ethanol and biodiesel, no engine modification is required. Furthermore, the distribution and storage infrastructure that is already in place is, occasionally with minor preparations or modifications, suitable for the liquid alternatives, whereas gaseous fuels require investment in new infrastructure.

The remainder of this report will focus solely on biodiesel. Further information regarding the abovementioned alternative fuels, including second generation biofuels, can be found in the Biofuels Taskforce Report [17], CSIRO's Life-Cycle Emissions Analysis [27], the Report of the Senate Committee [24] and the website of the Biofuels Association of Australia (BAA) (refer to Appendix A: Useful Links).

2.1 Global Context

Biodiesel accounts for just 5% of global biofuel production with 90% of this market focused in Europe [17]. However, the US is rapidly increasing its share of the global market, currently rated number three in the world's top five biodiesel producers (Table 2).

The first commercial-scale biodiesel plant in Europe was opened in 1987 in Austria. Since that time, biodiesel production has taken a while to gain traction, but is now increasing rapidly. For example, there are now over 120 plants operating across Germany, France, Italy, Austria and Sweden, with an increase in production of biodiesel in the European Union of 65% in just one year alone between 2004 to 2005 (Figure 4) [29].

In Europe, the main feedstock used in biodiesel production is rapeseed, with small amounts of soybean and palm oils. In the US and Brazil, soybean oil is the primary feedstock. In several countries across Asia, various combinations of palm, coconut, jatropha and tallow oils are used. Different feedstocks have different energy balances (the ratio of energy input to energy output) and also require different production processes. It is important to take these factors into consideration when comparing studies on performance, emissions and life-cycle cost/benefit analyses emerging from different countries.

At the present time, the two primary applications of biodiesel in the US, Europe and Australia are in farming and freight [29, 30, 31]. Globally, biodiesel is also making increasing headway into the passenger vehicle market, especially in Europe, as well as into government and local governments fleets - many of which are introducing biodiesel as an exercise in local or national leadership.

Country	Production (million litres ML)
Germany	1,920
France	511
USA	290
Italy	227
Austria	83
Australia	14

Table 2: Top five Biodiesel Producers in 2005 (WWI, 2006) [28]. Australian figure from Biofuels Taskforce Report [17]

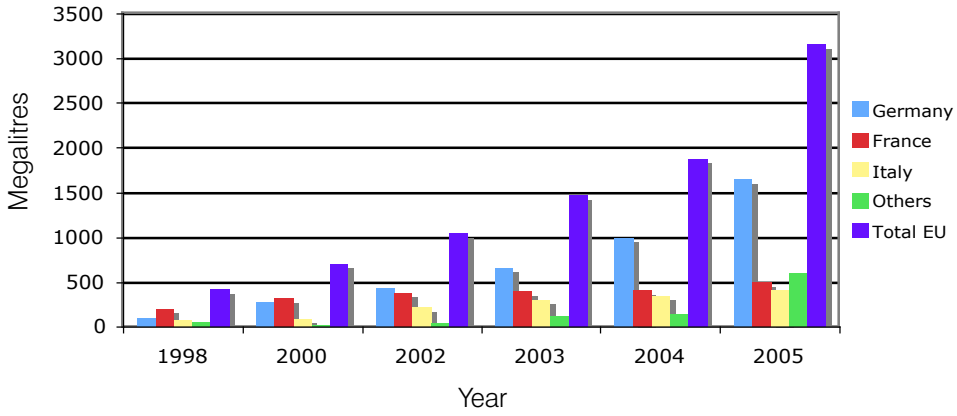


Figure 4. European Biodiesel Production (ML) 1998 to 2005

Source: European Biodiesel Board

2.1.1 Biodiesel uptake in Europe and North America

Europe

- The City of Graz in Austria runs its entire bus fleet on B100 and the city's largest taxi company is also switching all vehicles over to biodiesel [32].
- In the UK, several local government and police authorities are using biodiesel in their fleets including Dorset County Council, Easington District Councils, three Tayside Councils in Scotland and London's Metropolitan Police.
- Since January 2007, UK major supermarket chain Tesco has been running over 2000 of its vehicles on B50. It has also introduced commercial biodiesel pumps at over 50% of its retail forecourts [33].
- Biodiesel is available at more than 150 retail outlets across the UK [34].

North America

- In the US, new guidelines now require many government fleet vehicles to run on B20 [28].
- The Halifax Regional Municipality (Canada) has switched its entire bus fleet to run on B20 [35].

There is also a global trend towards biodiesel mandates, which are already driving uptake in several states across the US, including Minnesota, Washington, Louisiana and Illinois. In 2005, the US Government declared a mandate for the use of B20 biodiesel in all US Navy and Marine non-tactical diesel vehicles as part of efforts to increase the use of domestic and clean fuels [36]. Mandates are also in place in Brazil and India, with many other countries and municipalities undertaking similar legislative changes.

"In the UK, several local government and police authorities are using biodiesel in their fleets including Dorset County Council, Easington District Councils, three Tayside Councils in Scotland and London's Metropolitan Police."

2.2 Biodiesel in Australia

2.2.1. Production and Capacity

There is a fairly large and growing number of biodiesel producers in Australia, most of which have production capacities above 20ML per year (Table 3).

In 2005/06, the NSW facilities of Biodiesel Industries Australia and Australian Biodiesel Group, and the South Australian based Australian Renewable Fuels had a combined production capacity of approximately 264.7ML. A host of smaller production facilities exist with production capacities of between one and 14ML annually. There are also many 'backyard' operations scattered across the country that produce biodiesel both for their own use and a small catchment of other local users.

Production capacity is not the same as actual production. The latter depends heavily on the availability of feedstocks, particularly domestic and local feedstocks, as well as customer demand. As yet, actual production in Australia has not reached capacity. For instance, the Biofuels Taskforce Report (2005) states that actual production in Australia for 2004/05 was only 4ML despite a production capacity of 15.5ML [17]. Australian sales of biodiesel for 2005/06 totalled 16ML, compared with an estimated capacity of approximately 400 ML.

Based on new facilities either planned or presently under construction, production capacity is predicted to increase over seven-fold in 2007/08 to approximately 750ML, according to a 2006 ABARE Conference paper [37], or 790ML according to the Biofuels Taskforce Report [17]. This increase comes from expansions in two of the existing major producers - Australian Biodiesel Group and Australian Renewable Fuels, in addition to new developments from producers in Victoria, New South Wales, Queensland, South Australia and the Northern Territory. There can be considerable variation in estimated production capacities, illustrated by the fact that both the ABARE and Biofuels Taskforce estimates for 2007/08 do not include several other facilities either planned or under construction in several states. Using figures from several sources, including biofuels associations, company reports and press releases, Table 3 provides an estimate of current and future biodiesel production capacity to 2008.

The dramatic increase in facilities over the last year, including those already operational and those under construction or planned, demonstrates a strong growth trend in the biodiesel market in Australia.

Biodiesel Capacity	State	05/06	06/07	07/08
Biodiesel Industries Australia (BIA)	NSW	20	12	12
Australian Biodiesel Group (ABG)	NSW	40	200	200
Australian Biodiesel Group (ABG)	QLD	160	160	160
Australian Renewable Fuels (ARF)	SA	44.7	44.7	44.7
Australian Renewable Fuels (ARF)	WA		44.5	44.5
Eco Tech	QLD	30	30	30
Evergreen Fuels	QLD	0.5	0.5	0.5
ReeFUEL	QLD	2	2	Closed
Vilo Assets Management (Energetix Biodiesel)	VIC	50	50	50
Future Fuels	NSW	50	50	50
Axiom Energy	*VIC*		*150*	*150*
Biodiesel Producers	*VIC*		*60*	*60*
Midfield Meats	*VIC*		*10*	*10*
AJ Bush	*QLD*		*60*	*60*
Natural Fuels Australia (NFA)	*NT*		*147*	*147*
Biosel	*NSW*		*4*	*4*
Riverina Biofuels	*NSW*		*40*	*40*
Biosel	*NSW*			*24*
Natural Fuels Australia (NFA)	*NSW*			*150*
BP Bulwer	*QLD*			*110*
TOTALS		**397.2**	**1,064.7**	**1,348.7**

Table 3. Estimated Biodiesel Production Capacity, in million litres (ML), for 2005/06, 2006/07 and 2007/08. [17, 37, 38]

Note: Facilities in italics are either already under construction or planned. Totals for 2006/07 and 2007/08 include these facilities expected capacities.

2.2.2. Production in Victoria

Biodiesel producers are not always the suppliers of their product to the market. Producers often sell their 100% biodiesel product to blenders and suppliers/distributors who then act as distributors to the end user or retailer.

As reflected in Table 3, Vilo Assets Management (operating as Energetix) are as yet the only major operational producer located in Victoria. Biodiesel Producers and Axiom Energy are this year developing facilities in Victoria with an estimated combined capacity of 210ML. Biodiesel Producers Barnawartha plant is under construction and will use tallow and waste oil feedstocks. Axiom's Geelong plant is scheduled to be operational by the end of 2007 and will make use of palm oil and tallow feedstocks. Midfield Meats has also announced a new plant to be developed in Warrnambool using wholly tallow feedstock, adding another 10ML capacity sometime in the next year. Owing to the present lack of local producers, Victorian biodiesel users have up to now been sourcing their fuel from interstate producers.

Most of the biodiesel available in Australia is produced using canola, tallow and waste vegetable oil, often referred to as used cooking oil (UCO) or recycled oil. Some producers also use palm oil and other imported feedstocks and with the three largest facilities scheduled to be developed in 2007/08 intending to use imported palm and coconut oils in their production processes, this sector of the industry could expand considerably in the future. Currently, for most councils in Australia, between 60-100% of their biodiesel is comprised of tallow and/or UCO with canola making up the remainder. With the present water shortages across Australia and the irrigation requirements for canola, this raises questions about the sustainability (and ethics) of using limited water supplies to grow crops for fuel. Croydon Bus Services in Melbourne was an early adopter of biodiesel back in 2002. The company had a very positive experience using 100% canola biodiesel (B100) but had to cease the project in 2003 due to the impact of drought on feedstock supplies [39].

2.3. Environmental Impacts of Diesel vs Biodiesel

The current and potential environmental impacts of diesel are important to consider since switching to biodiesel can significantly alter these impacts within the transport sector.

2.3.1. Land and Water

The use of diesel and other petroleum-based fuels can have significant implications for the biodiversity of land and water habitats. Minor spills and leakages can enter waterways through stormwater drainage, predominately as runoff from roads, marinas, industrial areas and storage tanks (above and below ground), with environmental impacts including:

- Decreased plant and animal growth;
- Disrupted reproductive cycles;
- Localised death of plants and animals;
- Disruption of migratory routes used by water birds and marine life;
- Introduction of toxins into the foodchain.

Diesel does not biodegrade easily, so toxins can persist for years in the environment and lead to an accumulated concentration over time. For these reasons the Victorian Department of Sustainability and Environment (DSE) cites petroleum and its by-products as a major toxicant with significant implications for biodiversity [40].

Biodiesel, on the other hand, biodegrades relatively quickly in the natural environment. Studies have found that B100 is approximately four times more biodegradable than diesel and B20 twice as biodegradable, meaning that after 28 days, B100 is 95% degraded, compared with just 40% for diesel [38, 41]. Biodiesel is therefore especially preferable to petroleum fuel in areas where spills are common or the potential consequences are severe. Marine environments, including waterways and catchments, are areas that can benefit significantly from its use in terms of reducing the impacts of potential fuel spills or leaching.

2.3.2. Emissions

A large number of studies have been conducted into the impact of different biodiesel blends and feedstocks on atmospheric emissions from transport. The most important factor to determine when investigating and comparing figures on biodiesel emissions is whether these are based on full life-cycle emissions, sometimes called 'well-to-wheel" or simply the tailpipe, or point source emissions.

2.3.2.1 Life-Cycle Emissions

Life-cycle emissions are those associated with every stage of the extraction, production, transport, processing, conversion and distribution of the fuel before it arrives in the vehicle engine, in addition to the subsequent tailpipe, or point source emissions that result from the fuel's combustion. The analysis of these emissions, termed life-cycle analysis (LCA), is very complex and difficult to accurately assess for all scenarios. However, LCAs currently provide the best method of assessing the comparative environmental impact of transport fuels, and the methodologies behind them are constantly being refined and improved.

Life-cycle greenhouse gas emissions for fossil fuel-based alternatives such as LPG, CNG and LNG are between 1% and 8% lower than those for diesel [27] while for ethanol, the reduction is between 1% and 11.5% depending on the feedstocks, percentage blends, and use of co-products[17]. Comparative emissions from biodiesel are discussed in the following sections.

2.3.2.2. Carbon Dioxide (CO2) and Greenhouse Gases (CO2-e)

Gases that contribute to global warming via the greenhouse effect, which include carbon dioxide, methane and nitrous oxide from fuel combustion, are collectively termed greenhouse gases (GHG's) and measured in units of carbon dioxide equivalent or CO_2-e.

Global anthropogenic emissions of CO_2, the main gas responsible for global warming and climate change, are steadily increasing. In 2005, transport as a whole was estimated to account for 13.5% of global CO_2 emissions, constituting the second highest emitting sector behind stationary energy [42]. In Australia, in 2004, transport as a whole accounted for 14% of net greenhouse gas emissions with an annual growth rate of 1.8% [43]. By 2010, emissions from this sector are predicted to be 44% higher than they were in 1990 [44]. In 2004, emissions from the transport sector in Victoria accounted for 15.4% of total CO_2-e emissions. This represents a significant 16.4% increase since 1990 [45].

The greenhouse benefits, in terms of reduced CO_2 and CO_2-e emissions, of both fossil and biomass-derived alternative fuels can sometimes be over or understated if analyses only reflect the tailpipe emissions.

As the definition suggests, tailpipe or point source emissions are based solely on what is emitted from the vehicle's tailpipe on combustion of the fuel. Much of the benefit of using biodiesel is proposed to lie in its less energy-intensive life-cycle as compared with fossil fuels, particularly as the latter become harder to extract. Consequently, a comparison of data based on LCA emissions can lead to very different conclusions than one based simply on tailpipe emissions, where there may be little change for some emissions, such as carbon dioxide (CO_2), compared with normal diesel.

However, the biological component of biodiesel is not a fossil fuel and so, unlike the tailpipe emissions of CO_2 from fossil fuels that has been sequestered underground for millions of years, the CO_2 emitted by B100 derived from seed crops was recently extracted from the atmosphere during the growth of the plants. These plants may be used directly in biodiesel production or may be eaten by grazing animals, which then become the source of tallow for biodiesel production. Apart from minor amounts of other greenhouse gases such as methane and NOx that may be produced on combustion, tailpipe emissions from biodiesel are not contributing additional CO_2 to the current carbon cycle and are therefore regarded as being carbon neutral. As the Western Australian Department of Agriculture explains:

"The carbon in vegetable oil has been captured by plants from the atmosphere as they grow in the field. It has fixed atmospheric carbon and therefore is a carbon neutral fuel"[46]

This is reflected in the emission factors from the Australian Greenhouse Office (AGO) 2006 Factors and Methods Workbook where direct/point source (tailpipe) emissions for 100% biodiesel are zero, while those for B20 are approximately 20% less than for diesel. In terms of LCA, CSIRO analyses have shown that B20 can produce full life-cycle reductions in greenhouse gas emissions of between 7% and 20% depending on the feedstock and the type of diesel blend: for B100, emission reductions of between 23% and 90% can be achieved, depending on the feedstocks and the respective emissions associated with their extraction, production, transport, processing, conversion and distribution (refer to Figure A1, Appendix B).

2.3.2.3 Other Emissions: Diesel vs Biodiesel

Although diesel fuel emits roughly the same amounts of carbon dioxide (CO_2) per litre as petrol, it contributes disproportionately higher levels of other atmospheric emissions [47]. In 2001, when diesel vehicles comprised less than 10% of the national vehicle fleet, they contributed 40% of all oxides of nitrogen (NOx) and 60-80% of all emissions of particulate matter (PM) [18].

Apart from CO_2 and CO_2-e, other emissions of significance in the comparison between diesel and biodiesel are those associated with the formation of ozone and those directly implicated in a range of cancer-related, cardiovascular and respiratory illnesses.

Ozone

Oxides of nitrogen (NOx), hydrocarbons (HC), carbon monoxide (CO) and volatile organic compounds (VOC's) all contribute to the formation of urban ozone and photochemical smog.

Oxides of nitrogen are precursors to both photochemical smog, a further cause of cardiovascular and respiratory diseases, as well as additional particulates on reaction with other pollutants [48]. In terms of LCA, NOx emissions range between 5% lower and 30% higher than diesel for B100, depending on the feedstock, and between 5% lower and 12% higher for B20, again depending on the feedstock and also the type of diesel blend (Taskforce report). Tailpipe tests show a more consistent increase of between 6% and 11% (Appendix B, Table A2). The Biodiesel Association of Australia (BAA) notes that there are technologies to control NOx emissions that can be used in B100 due to its absence of sulphur, and some additives also exist for biodiesel blends to reduce the NOx emissions [49]. In addition, new technologies are being investigated that allow the fuel to burn at a higher temperature, which will also reduce NOx.

Hydrocarbon emissions are reduced between 6% and 93% for biodiesel, carbon monoxide by between 15% and 50%, and VOC's by between 5% and 50% (up to 65% for tailpipe analyses (Appendix B, Table A2) depending on the blend, feedstocks and type of base diesel used [38, 17].

Particulate Matter and PAH's

Exposure to particulate matter (PM) and polycyclic aromatic hydrocarbons (PAHs) is statistically implicated in a range of cardiovascular, respiratory and cancer-related morbidity and mortality. Research in Australia concludes that there is "no safe threshold for particle exposure", indicating that exposure to any amount of particulate matter is considered a health threat [18]. Therefore, decreasing particulate matter in the atmosphere is clearly desirable [50, 51]. The NEPC estimates that there are up to 2400 deaths annually in Australia due to particulate matter, with an associated health cost of $17.2 billion per year [52].

"The effects of particulate matter are considered a 'significant problem' in Melbourne and the biggest source of this type of pollution within the transport sector is diesel fuel".

CSIRO analyses have shown that a 20% biodiesel blend can produce life-cycle reductions in particulates of approximately between 5% and 15% while for B100, reductions of up to 39% can be achieved [17]. Based on tailpipe emissions tests, reductions in PM for B20 and B100 are between 38% and 91% (Appendix B, Table A2). According to the BAA, PAHs are reduced by approximately 13% for B20 and 80% for B100 [49], again depending on the blend, feedstock and type of base diesel used.

Sulphur dioxide (SO_2)
Sulphur dioxide is an irritant gas that can cause respiratory illnesses and is a significant contributor to acid rain.

Up until 2003, diesel fuel was a major source of SO_2 in Australia with levels as high as 5,000ppm, compared to the current one-day air quality standard of 0.08ppm [53, 54]. Since then, Australia has set a sulphur standard for diesel of 50ppm which is met by ultra-low sulphur diesel (ULSD) and a new standard of 10ppm will be introduced in 2009, which will be met by extra-low sulphur diesel (XLSD). Essentially, there are no sulphur emissions from B100 and as most biodiesel blends are now blended with ULSD or XLSD, sulphur emissions from biodiesel have been virtually eliminated.

The CSIRO document "Life-cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles" [27] contains comprehensive emissions data on a range of alternative fuels for heavy vehicles under different driving scenarios, and also includes a ranking system for all fuels in terms of air quality and greenhouse emissions. CSIRO also conducted an in-depth analysis of the life-cycle emissions associated with different blends and feedstocks of biodiesel, as part of The Biofuels Taskforce Report [17]. The report provides tables of the percentage changes, relative to diesel, in the upstream, tailpipe and full life-cycle emissions for a range of biodiesel blends. (Refer to Appendix A: Useful Links).

In terms of addressing rising greenhouse gas emissions and the immediate local health impacts of particulates, it appears that biodiesel could be part of the solution to the social and economic impact of these emissions and therefore offer a preferable alternative to fossil fuel for our future transport needs.

2.3.2.4. Emissions in Context: Pollution in Victoria

Over half of Melbourne's summer air pollution is due to motor vehicle emissions and these vehicles are also the biggest overall polluter, above industry [55]. EPA Victoria states that transport accounts for the following percentages of Melbourne's major air pollutants [54]:

- 80 per cent of carbon monoxide (CO);
- 60 per cent of nitrogen oxides (NOx);
- 40 per cent of volatile organic compounds (VOCs);
- 30 per cent of particulate matter (PM) - resulting in winter smog.

Carbon monoxide, nitrogen oxides and VOC's combine to form ozone in the lower atmosphere, which we experience as summer smog. The effects of particulate matter are considered a "significant problem" in Melbourne and the biggest source of this type of pollution within the transport sector is diesel fuel [56].

Due to increased fuel standards, improved vehicle designs and the introduction of unleaded fuel, certain emissions have actually been decreasing since the 1990's. According to the EPA, levels of nitrogen dioxide (NO_2 - one of the NOx gases that contributes to photochemical smog and is a respiratory irritant) and CO have halved since 1985 and ozone levels are consistently below the health standard.

However, one area where air quality objectives are not being met is on main roads whose primary traffic are diesel vehicles [57]. A 2002 report from the NEPC states that high particulate emissions from diesel vehicles in certain areas of Melbourne may impact on the health of local residents [58]. In some areas of Melbourne, EPA monitoring has revealed levels of PM that regularly exceed the health standard and are on average 30% higher than other areas [53]. Prof. Abramson from Monash University explains:

"Diesel exhaust is a chemical cocktail of about 450 different compounds. At least 40 are toxic contaminants like arsenic, benzene, cadmium, dioxins, toluene and formaldehyde. Even the two most carcinogenic chemicals ever discovered…are found in diesel exhaust, especially from engines working under heavy load. The particles provide a microscopic delivery system that carries these toxic payloads inside the body, and deep into the lungs." [48]

Cancer is not the only potential impact. Studies suggest that other respiratory illnesses such as chronic obstructive pulmonary disease, pneumonia, and asthma, as well as heart disease can result from exposure to PM from diesel vehicles. Those most at risk are children, the elderly, and those with existing problems [18].

The area within 150m of main roads is regarded as a hazard zone and within a 50mm area concentrations of PM can be between two and ten times higher than background levels. For just three of these problematic areas of Melbourne, it is estimated that approximately 7000 people per area are potentially at risk from up to 15,000 trucks passing each day [53].

2.3.2.5. Emissions and Health Costs

It is often difficult to calculate the actual health benefits of certain lifestyle changes or new technologies such as biodiesel. However, many models of health cost have now been developed which provide an indication of the estimated dollar savings that result from a reduced risk of illness and disease.

Significant financial savings can be made, in terms of avoided health costs from per tonne reductions in NOx, HC and especially PM (refer to Table 4). Putting the figure for PM in context, data from Newcastle City Council, based on 13 different depot vehicles, has shown that B20 used in heavy vehicles results in a reduction of 0.56 kg of PM per tonne GVM per 100,000km, and for light vehicles, the figure is 3.09 kg per tonne GVM per 100,000km.

A possible reason for the greater PM reduction in light vehicles is that the heavy vehicles already use particulate control technology. That the light vehicles on B20 emit more PM than the heavy vehicles on diesel supports this suggestion.

Emission	Avoided Health cost/tonne
Nox	$1385
HC	$1440
PM	$17600

Table 4.
Avoided Health costs per tonne for reductions in NOx, HC and PM. [59]

With the encouragement of broader uptake of biodiesel, especially in urban areas where cumulative reductions from a higher number of diesel vehicles will have a greater effect, it can be seen that biodiesel could have a measurable and significant positive impact on health and numerous other qualitative benefits of improved community health.

The points covered in this section illustrate why it is important for local governments in Victoria to consider the environmental impacts of their current fuel choices when assessing alternative options for their council.

2.3.3. Implications of Biodiesel Feedstocks

Making the decision to use biodiesel for perceived environmental and social benefits starts to become more complex when considering that the source of the biodiesel feedstock(s) can have significant environmental, ethical and social implications.

2.3.3.1. Oilseeds

One of the primary feedstocks for biodiesel in Australia is canola oil. Up until recently, the primary markets for this product were domestic and overseas food and livestock industries, and, to a lesser extent, cosmetics and industrial lubricants. The rapid growth of the biodiesel industry over the past two years has led to fears that it will compete with these other markets for feedstock oil, and drive up the price for these industries and their commodities both domestically and overseas. This is the basis for what is becoming a common debate regarding biofuels, that of 'food versus fuel' [60, 61].

In Australia, the debate can be more accurately described as food and water versus fuel. With Australia's limited resources of water and viable arable land, the question of whether it is appropriate to use these resources to fulfil transport needs will become more critical as demand for biodiesel increases and supplies of tallow and UCO become insufficient to meet this demand.

Much research is being conducted into oilseed crops that can be grown in marginal agricultural areas, or even semi-desert environments, thus removing the need to compete with these other markets. It has been estimated that 20-30 million hectares of marginal land in Australia would be suited to the cultivation of such crops and just a fraction of this 20-30 million hectares would provide "…feedstocks to supply up to 50% of national diesel needs" [62].

"…the source of the biodiesel feedstock can have significant environmental,ethical and social implications".

However, it is also acknowledged that the 'food and water-versus-fuel' trade off is a real possibility in Australia if these innovations in new feedstock sources and investments in new conversion technologies proceed too slowly [63].

2.3.3.2. Transport

There are currently ten commercial-scale biodiesel facilities in Australia, with plans for another ten over the coming year or so. Most of these facilities will have to source their feedstocks from a wide area, which can add a significant environmental cost in terms of transport emissions. There is a potential that the emissions saved as a result of using biodiesel may be negated or greatly reduced if the UCO is sourced from 20 small establishments instead of one or two, or the canola or tallow is sourced interstate or internationally rather than locally.

These different scenarios are not factored into the AGO emissions factors and it is therefore important for councils themselves to mitigate this risk and take responsibility for ensuring that their decisions really do result in a net beneficial outcome for the environment and not just for council's own emissions.

2.3.3.3. Biodiesel from Palm Oil

The majority of concern regarding the environmental sustainability and social impact of feedstocks is focused on the use of imported palm oil.

When practiced unsustainably and with no regulation, which it is estimated is the case with most of the available product, the production of palm oil results in massive deforestation of often virgin rainforest in Malaysia, Indonesia and Central America; the destruction of habitat (threatening biodiversity and endangered species); and the draining and burning of peat lands and the consequent release of millions of tonnes of carbon into the atmosphere each year. It also impacts on local livelihoods, taking much needed land away from food cultivation in communities with inadequate nutrition. It is the margins of existing plantations that are most at risk as the increasing worldwide demand for biodiesel feedstocks pushes up the commodity price of this oil and encourages additional clearing to take advantage of the market [64, 65, 66, 67, 68].

The Roundtable on Sustainable Palm Oil (RSPO) is an international organisation established in 2004 by industry stakeholders to promote sustainable production.

It states that, *"There are instances where the development of new oil palm plantations has led to conversion of forests with high conservation value and has threatened the rich biodiversity in these ecosystems. The use of fire for preparation of land for oil palm planting has also been reported to contribute to the problem of forest fires and in many instances the expansion of oil palm has also given rise to social conflicts between local communities and plantation owners…it is imperative that [the] expansion must be done sustainably. To ensure this happens, it is necessary to develop a globally acceptable definition of sustainable palm oil production and use as well as implement better management practices that comply with this definition."* [69].

The RSPO has a large membership base including many global corporations, indicating the high level of international concern around this practice [69].

Awareness of the potential negative environmental and social impacts of an increased market for biodiesel, and biofuels in general, is growing. A UN report on bioenergy released 8 May, 2007 highlights the critical points decision makers need to consider and warns that:

"Unless new policies are enacted to protect threatened lands, secure socially acceptable land use, and steer bioenergy development in a sustainable direction overall, the environmental and social damage could in some cases outweigh the benefits" [70].

In April 2007, the Netherlands stated that it would no longer support biofuels that are produced on carbon-rich soils such as peatlands. Over 50% of new palm oil plantations in Indonesia are on peatlands, which means that many Indonesian and Malaysian biodiesel producers will lose the market of the 4th largest palm oil importer [71]. These companies will be looking elsewhere to replace this market, to nations that have not yet regulated their biofuels markets, and this includes Australia. There are several biodiesel producers/suppliers in Australia that are including imported palm oil in their planned production capacities for 2007/08. In addition to being an environmental risk, the use of imported feedstock does little to improve national fuel security and limits the economic benefits from domestic feedstock production. This may be a driver for biodiesel customers to be specific in their contract agreements about the composition and source of the biodiesel purchased, not just about the supply, as company policies and ownership can change within the contract period.

"…a need is emerging for the monitoring and policing of palm oil…"

In May 2007, the UK Government designed the world's first reporting and certification system for biofuels. The long-term view is that this will set the stage for a similar framework to be developed at a global level [72].

Similarly to the Forest Stewardship Council, a need is emerging for the monitoring and policing of palm oil, a consequence of which could be a certification system, similar to that of the UK's, guaranteeing the source of the product.

The above-mentioned organisations, reports and schemes are listed in Appendix A: Useful Links.

2.4. Government Policy and Targets.

There has been a steady transition in both Federal and Victorian Sate Government policy regarding the use of biofuels over the last five years from recommendations to defined targets. This provides a clear indication of the acknowledgement both of climate change and the increasing need to address this and other issues arising from a fossil fuel driven economy.

In 2001, the Australian Government set a national biofuels target with the objective that "…biofuels, produced in Australia from renewable resources, contribute at least 350ML to the total fuel supply by 2010". This target applies to all biofuels, not just biodiesel, and is the equivalent of 1% of Australia's current annual transport fuel consumption. Two years later, in 2003, the results of an investigation commissioned by the Australian Government into the appropriateness of that target were released [73]. In 2005, the Government restated its commitment to this target and started working with stakeholders on a Biofuels Action Plan.

The Victorian State Government, in their Victorian Greenhouse Strategy (released 2002), promotes the uptake of alternative fuels as one means of addressing the high contribution of the transport sector to the State's greenhouse gas emissions [74]. The 2005 update to the Strategy recognises the increasing demand for low-carbon alternative fuels and commits to ensuring that options and policies for these fuels are supported [75]. In May 2006, the Victorian Government set a target of 60% reductions on GHG emissions, based on 2000 levels, by 2050. Two months later, the Victorian Sustainability Action Statement was released in which the Government committed to providing $100,000 to develop a Biofuels Action Plan [76]. The aim of the plan is to respond to Victorian and Commonwealth initiatives designed to increase demand for biofuels by building the capacity of the local biofuels industry to increase their production capacity. As part of this plan, the Victorian Government will,

"…trial the use of biodiesel (B5) in our heavy vehicles depot and work in partnership with International Council or Local Environmental Initiatives [ICLEI Oceania] to promote the use of biodiesel in heavy vehicles in the local government sector".

Finally, as of April 2007, the Victorian Government intends to establish a target of 5% of all fuel consumption to come from biofuels by 2010 [77]. If this target is not achieved, the Government will consider mandating the use of biofuels.

Well before these recommendations and targets emerged at the State level, local governments have been aware of these issues and working towards reducing their GHG emissions. Toronto was the first city to adopt GHG reduction targets in 1989, and in 1993, just one year after the United Nations Framework Convention on Climate Change was launched, municipal leaders met at the UN headquarters in New York where the worldwide Cities for Climate Protection (CCP) Program was launched [78].

Many local governments in Australia have committed to taking action to reduce their GHG emissions, especially through their participation in ICLEI's CCP Australia Program, launched in Australia in 1997. Local government has been one of the first sectors to start recording and reporting on their emissions and also the first to implement actions specifically designed to reduce these emissions. Similarly, it is at the local government level in Australia that the first medium-scale inroads into commercial biodiesel uptake have

been made, beginning in 2002 with Newcastle City Council. By 2005, the Council of Camden, Townsville, Adelaide City Councils and the Cities of Onkaparinga, Fremantle, Melville and Sydney, and Noosa Shire Council had all trialled biodiesel, with all except the Cities of Fremantle and Melville continuing its use at council beyond the trial period. Since 2005, many more local governments across Australia have trialled biodiesel (refer to Appendix E), including Brisbane City Council, which has demonstrated biodiesel's suitability for marine applications through its trial of B20, B50 and B100 in two of their Mono Hull ferries. Positive outcomes from this trial have led Council to consider its expansion into the Council bus fleet. Further uptake by local governments in Australia is expanded on in Chapter 3.

Initial use at state government level included all metro and suburban trains and most of the buses in Adelaide running on B20 since 2004 "with no negative impacts whatsoever" and plans to increase the blend to B50 (Ian Maxfield, TransAdelaide) [79]. In Western Australia, approximately 7% of the bus fleet currently operates on B5 and a major producer is working with the state government to implement the uptake of B5 in all TransPerth buses with a view to increasing the blend to B10 or B20 within six months of implementation [80, 81].

In contrast to local governments, there are not yet any large-scale industry users in Australia, although many are currently undertaking trials and there are various small-scale, private users across Australia for different purposes. The major industry users are expected to be from the freight, agricultural and mining sectors.

The learnings and experiences of Australian local governments, especially those early pioneering councils, can provide valuable insights concerning the issues and opportunities for biodiesel uptake more broadly as well as help to reveal the broader implications of a target-driven increase in uptake.

Chapter 3. Local Government Experience with Biodiesel

Introduction

Many local governments in Australia have between one and five years experience with biodiesel implementation or research. The insights they have gained allow the benefits of biodiesel to be assessed at a practical level, as well as provide an opportunity to identify existing issues and opportunities relating to its uptake, as well as any that may arise in the future.

Based on recent surveys and interviews with Australian councils, this section summarises the various steps, considerations, issues and associated challenges that councils have faced regarding biodiesel uptake, and concludes with some outcomes from successful council projects. First, a brief overview of the councils that contributed their thoughts and experiences to this report will provide context for the sections that follow.

3.1. Research Scope and Approach

The findings in this report are based on survey responses collated from 23 of the approximately 30 local governments across Australia that have either direct experience in the implementation of biodiesel at council or have undertaken considerable biodiesel research. These 23 'experienced' councils are based in Victoria (6), New South Wales (6), Western Australia (5), Queensland (3) and South Australia (3).

Contributions were also sought from the remaining 55 Victorian CCP councils identified as 'non-biodiesel'. Of these 55 councils, 25 participated via survey and their responses were initially collated separately to acknowledge the potential for different perspectives from those of the experienced councils. Two non-biodiesel councils from Western Australia and South Australia also contributed as a result of an incorrect assumption that they were experienced' councils.

The two surveys designed for the experienced and non-biodiesel councils can be found in Appendix F.

3.2. Research Findings

Local governments in Australia so far report unanimously positive outcomes from their implementation of biodiesel in council fleets. There are no operational problems reported from the use of biodiesel in conventional diesel engines, provided the fuel is of a certified standard, and over 80% of experienced councils indicate that it will continue to play a major role in council's future fuel usage.

As well as resulting in quantifiable greenhouse gas reductions that contribute to their CCP reduction goals, councils report the positive impact their actions are having on air quality and the health of their communities, as well as improving safety for fuel handlers and vehicle operators. There is always the potential for fuel spillages and leakages, especially where large quantities of fuel are stored and used in a range of depot vehicles. With biodiesel, these incidents pose less of an environmental and safety threat, due to the fuel's biodegradability and high flash point.

"Local Governments… report unanimously positive outcomes from their implementation of biodiesel in council fleets".

In terms of these and other operational and environmental properties of biodiesel, as discussed in some detail in Chapter 4, biodiesel appears to offer a viable and preferable alternative to diesel. However, there are broader issues regarding the production of biodiesel and its uptake on a commercial scale that can significantly influence its operational, environmental and economic viability. These include such issues as fuel quality, sustainability of supply, environmental and social impacts of feedstocks, cost, tax laws and warranty regulations.

The following sections investigate the experiences of local government uptake of biodiesel in Australia, and provide valuable insight into each of these issues and the subsequent question of the viability of biodiesel in a local government context.

3.2.1. Council Usage

Survey responses revealed that B20 is by far the most widely used biodiesel blend, being the fuel of choice for 78% of experienced councils, including five in Victoria. One council in Victoria that has been using B5 in their entire council fleet since 2006 intends to switch to B20 over the coming months. B100 has been used in five councils across Australia - two in Western Australia, one in South Australia, one in Queensland and another in New South Wales.

B50 has been used in two NSW councils, though one of these has since switched to B20.

Of the 26 'non-biodiesel' councils, most had not considered which blend they might use, but of the six that did respond to this question, four indicated that B20 would be their preferred choice.

"Four councils run their entire depot fleet on biodiesel blends, involving between 140 and 300 vehicles."

'Experienced' councils are using biodiesel in a range of depot vehicles, including:

- Tractors;
- Mowers;
- Streetpath sweepers;
- Trucks - including tipper trucks, compactors garbage, recycling and waste trucks;
- Major plant;
- Backhoes;
- Heavy and light commercial fleet;
- Community buses.

The volume of usage varies depending on the size of the council and the number of vehicles. Four of the surveyed councils run their entire depot fleet on biodiesel blends, involving between 140 and 300 vehicles.

These councils each use between 270,000 litres and 1.2 million litres of biodiesel per year. Other councils, with between four and 55 vehicles on biodiesel, use 20,000 to 50,000 litres per year.

3.2.2. Motivations for Biodiesel uptake

When questioned about their motivations for using biodiesel, 76% of all councils rated the potential abatement of GHGs as very significant. This was by far the most important motivation for biodiesel uptake as identified by these 50 councils. Other motivators that were identified, and the percentage breakdown of council responses across each individual motivation, are listed in Table 5.

From this Table, it is evident that emissions are the primary concern for councils in relation to their uptake of biodiesel, both in terms of reducing GHG emissions and contributing towards their abatement goals. Reduced pollution and reduced reliance on fossil fuels are also significant while of least concern overall is financial savings, however, this is not the case for both groups of councils.

"…emissions are the primary concern for councils in relation totheir uptake of biodiesel"

One council that had a clear environmental motivation for biodiesel uptake from the start was Sydney City Council, as Nik Midlam explains:

"The biodiesel program came about through Council's commitment to reduce greenhouse gas emissions. Although Council's fleet emissions are a relatively small component of its total emissions, using biodiesel is strongly aligned with its goals to reduce overall emissions through efficiency measures, alternative energy sources, and the use of offsets." (Refer to Appendix K for full case study).

When responses from the two groups of councils were collated separately, the questions of financial savings and local economic development as motivators produced less consistent responses than for the others.

Motivation	Very Important	Somewhat Important	Not too Important	Not Important
Reduced Fossil Fuel Reliance	42	38	6	0
GHG abatement	76	20	2	0
Reduced Pollution	48	40	2	2
Council Goals	56	24	4	2
Financial Savings	36	28	20	4
Local Economic Development	40	36	10	0
Community Health	40	38	12	0

Table 5.
Percentage of the 50 surveyed councils that considered seven motivations for biodiesel uptake to be very important, somewhat important, not too important or not important.

3.2.2.1 Financial and Economic Motivations

Only one experienced council rates financial savings as a very important motivation and only 30% indicate that it is somewhat important. In fact, over 43% of experienced councils indicate that financial savings are either not too important or not important at all. This contrasts with the non-biodiesel councils of which 63% rate financial savings as very important, almost equal with greenhouse gas abatement. Similarly, only 17% of experienced councils rate local economic development as a very important motivation while 59% of non-biodiesel councils indicate it as being very important.

"…experienced councils have found that biodiesel uptake is more or less cost neutral…"

For many 'non-biodiesel' councils, a change in council policy involving the uptake of an alternative fuel may perhaps need to be justified on more than environmental and health grounds. With the recent increases in fuel prices, many councils believe that alternative fuels offer a means of softening the impact of their rising fuel bills. Highlighting the potential for financial savings, as well as new investment in local economic development, may make it more likely for some councils that the investment in time, resources and, sometimes, new infrastructure, that biodiesel uptake initially requires is justified. This might explain the emphasis 'non-biodiesel' councils place on these financial motivations. While in some instances, suppliers may artificially keep the price of their biodiesel below that of diesel, or offer special rates to encourage demand, this is less often the case now that the tax laws for producers have changed, and special rates cannot be sustained in the long-term without a broader based support for the industry.

Experienced councils implemented their projects prior to the recent fuel price increases, and place greater emphasis on the environmental benefits of uptake as well as notions of leadership, which at least five of these councils indicated was an important additional motivator. As Bankstown City Council indicated in a recent press release:

"Bankstown Council hopes that by having implemented this change to biodiesel, other commercial enterprises within the community will see how easy it is to make this switch and follow council's lead". [82]

Since implementation, experienced councils have found that biodiesel uptake is more or less cost neutral and, having appreciated the benefits of reduced GHG's and pollution, their projects have continued on this basis. As Alex Malone from the City of Greater Bendigo states:

"Although the uptake of biodiesel has not resulted in any significant economic savings, which was one of the original motivations, the City of Greater Bendigo is now committed to its on-going use for purely environmental reasons." (Refer to Appendix I for full case study).

While support for a domestic biodiesel industry will undoubtedly create more jobs and generate local investment, this is still viewed by experienced councils as less important than considerations around the environment and fuel security

This survey result may also illustrate a difference between "innovators" and "early adopters" versus the "early majority", as defined by Everett Rogers, where the former are characterised as being venturesome leaders with a greater propensity to take risk, while the latter are more deliberate, acting through a varied network of social contacts [83]. Whatever category councils consider they are in, each will have different priorities, and therefore motivations, that drive the investigation and/or uptake of biodiesel. In any case, it is important to establish that the motivations and resulting expectations of all those involved are based on sound research. This increases the likelihood that project outcomes will meet expectations, and the resulting project will be judged a success, leading to positive outcomes.

3.2.3. Benefits of Biodiesel

The most important question concerning biodiesel uptake is whether the proposed benefits are verifiable. Depending on councils' motivations, these benefits were found to range from the operational, environmental (emissions/pollution) and, in some cases, financial/economic.

3.2.3.1. Operational Benefits

Based on the responses of the 23 experienced councils who participated in this research, technological benefits of biodiesel uptake include:

- No loss of engine power;
- No fuel problems, providing the fuel is certified to Australian standards;
- No change to vehicle operation or reliability;
- Smoother vehicle operation. (Note: Biodiesel increases the cetane number of diesel fuel (refer to section 4.1.4). This results in smoother combustion and easier starting);
- Increased engine torque;
- Improves lubricity (Note: Biodiesel is often added to diesel precisely for this effect. The US National Biodiesel Board, in collaboration with ARF Ltd. conducted comprehensive lubricity tests, revealing that the addition of just 2% biodiesel to any diesel fuel improves its lubricity;
- Safer handling, due to its biodegradability and non-toxicity;
- No engine conversion required for diesel vehicles;
- Less pungent odour compared with diesel. First-hand accounts from vehicle operators commonly report that as well as smoother and quieter vehicle operation, the use of biodiesel also results in the pleasant odour of chips!

Peter Dormand from Newcastle City Council testifies to the many operational benefits from biodiesel uptake that council has observed since the implementation of their successful project in 2003.

"These [emissions] reductions came with no loss of power and no loss of fuel economy. The potential benefits of biodiesel are actually increased by using B20 in more vehicles rather than B100 in just a few. No differences were noted in either fuel performance or operational characteristics across Council's entire fleet of 212 vehicles. Tests indicated no loss of power and responses from vehicle operators have been unanimously positive."

Some other operational benefits include:

- *Biodiesel acts as a better lubricant than sulphur, which is used in normal diesel;*
- *Normal diesel does not contain oxygen. By adding biodiesel, the fuel becomes oxygenated which helps it to burn more efficiently and therefore cleaner;*
- *Biodiesel is non-toxic, which is a huge benefit for depot workers who come into regular direct contact with vehicle fuel, and in the case of spillages, especially a benefit for waterways; and*
- *Biodiesel use requires no diesel vehicle modifications and no maintenance modifications whatsoever."*

(Refer to Appendix G for full case study)

And from Jack Mazek at Adelaide City Council:

"…vehicles have now been operating for over 2 years. Biodiesel has proved to be more lubricating on the engine than petroleum diesel, offering better engine protection against wear."

(Refer to Appendix H for full case study).

3.2.3.2. Environmental benefits

Reduced Emissions

Australian data for biodiesel emissions has only recently been analysed and it is local governments that are leading the way in much of this emissions testing. In 2003, Newcastle City Council was one of the first councils to instigate a comprehensive biodiesel emissions test, followed closely by the City of Onkaparinga (SA) in 2004. The Council of Camden and Noosa City Council have also conducted emissions testing and Brisbane and Townsville City Councils are either near completion or in the process of collating the results of their emissions tests. The results of Newcastle's tests have been widely used as a benchmark for subsequent tests and to provide guidelines for the impact of biodiesel on emissions in an Australian context.

Of the 23 councils with biodiesel experience, four have conducted their own thorough emissions testing and all four report that, based on these tailpipe tests, CO_2 emissions reduced by between 0.1% and 3.8% (remembering that the fossil component of this CO_2 is less, or zero, depending on the blend - refer to section 2.3.2.), particulates by an average 63% and black smoke by approximately 50%. Using the AGO full life-cycle emission factors, experienced councils are able to report annual GHG savings of between 10 and 800 tonnes annually, depending on the blend, feedstocks and annual consumption. Peter Dormand notes that at Newcastle City Council,

"Council's analyses of B20 across 13 test vehicles found reductions of an average 39 per cent for particulates and 29 per cent for black smoke. CO_2e emissions were reduced by between 600 and 720 tonnes per year according to emission factors from the Australian Greenhouse Office, in the Department of the Environment and Heritage." (Refer to Appendix G for full case study).

Noosa City Council, the Council of Camden and the City of Onkaparinga have also conducted thorough emission analyses. In addition to carbon dioxide, most of these analyses assessed methane, oxides of nitrogen (NOx), and particulates. Some also assessed hydrocarbons and smoke opacity.

Emission analyses are an expensive undertaking for councils and, given the level of information already available, it is not something that councils should consider as necessary. There is generally broad agreement between council tests and scientific studies on the impact of biodiesel on emissions, and the range of percentage changes which they document can be used as a guide for the likely reductions councils can expect, relative to the composition of their biodiesel and its application.

Summary tables showing the results of council tests for a range of tailpipe emissions, as well as CSIRO LCA analyses, for CO, NOx, PM and VOC appear in Appendix B, Tables A1 and A2. See also Appendix A: Useful Links for links to further resources and information on emissions.

In order to gain a more accurate assessment of the potential environmental impacts of the particular biodiesel that council intends to purchase, it is important to know the types and sources of feedstocks that the producer uses (refer to section 2.3.3 and section 3.2.4.2: Measuring and Reporting GHG Emissions). The feedstock composition of biodiesel is a significant factor influencing the choice of fuel for 64% of councils surveyed. Among the concerns raised by these councils were the sustainability of the feedstock, the life-cycle environmental impacts of its production, extraction and transportation, and the social and economic impact of its production for fuel purposes. Further preference was indicated for domestic, locally sourced and non-GMO products.

Nik Midlam from the City of Sydney Council indicates that Council's choice of biodiesel supplier was heavily influenced by environmental considerations:

"When selecting a biodiesel fuel provider, the City of Sydney Council took environmental impacts into consideration. South Australian Farmers Fuels was chosen on the basis that it used Australian petro-diesel in the blend, and the company offsets emissions associated with producing and transporting the fuel through tree planting programs." (Refer to Appendix K for full case study).

Benefit to Land and Marine Environments
The benefit to marine environments, waterways and catchments is not quantifiable, especially given the large scale of these systems and the relatively small changes in local fuel use. However, in the same way that many small sources cumulatively contribute to fuel contamination in these systems, any action that reduces some of these sources will, over time, have at least a stabilising effect and in more contained environments, such as marinas and bays, perhaps even lead to measurable improvements.

Until such time as there are quantifiable changes, the benefits of using a fuel that is generally between two and four times more biodegradable than normal diesel, have to be assumed. However, the fact that 48% of councils rate reduced environmental pollution as a very important motivation for biodiesel uptake the third most significant behind reduced GHG emissions and council goals (Table 5), illustrates that this is regarded by local governments as an important environmental benefit of biodiesel uptake.

3.2.3.3. Economic and Market Benefits

Financial savings
In terms of financial savings as a result of biodiesel, the results are less consistent. Much depends on the terms of the contract negotiated with the supplier. Some suppliers have a policy of maintaining the price of their biodiesel a few cents below that of normal diesel, regardless of increases and decreases in the base price. This may not be a permanent situation and is certainly not the case for all suppliers. Joint purchasing agreements between two or more councils offer one way of successfully negotiating short term price reductions that can result in a positive financial outcome for councils.

Hume City Council has recently reported that this approach, in conjunction with the Cities of Ballarat and Hobsons Bay, has resulted in significant, and unexpected, financial savings for their upcoming project, due to be implemented in July/August 2007.

Some councils report that overall costs work out less than for normal diesel due to lower maintenance requirements on biodiesel vehicles. In most cases however, the cost of biodiesel uptake appears to be cost neutral compared to normal diesel. This is a long-term view, taking into account price fluctuations both above and below the price of normal diesel.

The above conclusion does not include situations in which an initial investment in infrastructure or emissions testing is required. This can involve a considerable outlay for council, to upgrade existing tanks, install new ones or conduct performance and emissions testing if required. New tanks can cost upwards of $40,000 for approximately 40,000 litres capacity (approximately $1.00 - $1.50 per litre), depending on the site, the type of bunding and the technical systems it includes. Unless external funding is secured, which has been the case for several councils including Hume, Hobson's Bay and Adelaide City Councils, this may be a capital cost to council. Hume, Hobsons Bay and Ballarat City Councils chose to purchase infrastructure through a joint purchasing agreement that delivered cost savings for this component in addition to savings obtained through the fuel supply contract referred to previously. Similarly, a group of councils in WA are also discussing the possibility of sharing a tank and locating it at a site convenient for joint access.

"Joint purchasing agreements offer… one way of successfully negotiating short-term price reductions…"

Joint purchasing agreements, such as those undertaken by the Cities of Ballarat, Hobsons Bay and Hume as part of their EPA funded project, can both reduce the collective effort and create purchasing leverage with the suppliers. However, councils should be aware of implications of undertaking joint tender processes, in particular the legal oversight required and allocation of sufficient time for activities such as the compilation, review and approval of tender documents, registration with the Purchasing Board, clarification of responses to the tender, the development of the final contract and its approval by the various legal and project delegates.

Chapter 3. Local Government Experience with Biodiesel

All documents relating to the Cities of Ballarat, Hobsons Bay and Hume's joint tender process for infrastructure and fuel supply are available from the CCP website (see Useful Links, Appendix A)

Emissions and dynamometer testing is an expensive exercise and, unless external funding is secured, can be a significant barrier if council insists on undertaking it. However, the City of Greater Bendigo, which runs 140 vehicles on biodiesel, did not plan to run any scientific tests. As Alex Malone, Manager of Presentation and Works says:

"There has been enough research undertaken to demonstrate reduction in smoke and PM emissions without us trying to duplicate the results."
(Refer to Appendix I for full case study).

Most experienced councils report that, notwithstanding possible initial investments in infrastructure, biodiesel uptake works out to be more or less cost-neutral, as Nik Midlam of the City of Sydney Council notes:

"Importantly, the cost to use biodiesel is equivalent to petro-diesel, therefore there is no extra Council budget allocation or external funding required."
(Refer to Appendix K for full case study).

Local and Regional Economic Development
Peter Dormand has stated that a major motivation for Newcastle City Council's project back in 2002 was the opportunity to play an instrumental leadership role in transforming the market. At that time, there was very limited support for biodiesel production in Australia, especially in terms of the production of feedstock oils from crops. Much of the available biodiesel was produced using imported rapeseed and canola oils from Europe. As Peter explains:

"Newcastle City Council recognised an opportunity to assist a local industry Biodiesel Industries Australia (BIA) become established through imports and grow sufficiently to support the development of a local plant. BIA is now one of Australia's largest producers of biodiesel sourced from Australian feedstocks…Council takes satisfaction in the knowledge that their efforts have, in part, contributed to a new, home-grown biodiesel industry." (Refer to Appendix G for full case study).

The example of Newcastle City Council illustrates the extent to which local governments can directly influence the development of local industries and markets.The security of having a guaranteed demand from a council enabled a local industry to transition to a commercial scale and become an established player on the Australian biodiesel scene.

In Victoria, Mission Biodiesel was awarded a grant, in partnership with Buloke Shire Council, to expand an existing biodiesel production facility. It is intended that this expansion would be facilitated by, and in turn provide market support to, local farmers whose canola would be used as the primary feedstock. Keeping all aspects of the production process local, the plan includes establishing a canola crushing plant on-site to extract the oil rather than use an external company. This model incorporates multiple potential benefits for both the council and the business, including a reduction in transport costs to external processing facilities, maximising local employment opportunities, increasing the opportunity for value-added products in the form of stockfeed from the residue of the crushing process, saving money long-term on the production process, establishing a local market, increasing awareness, reducing council's GHG emissions and the opportunity to exhibit leadership.

More recently, there was the Mount Evelyn Biodiesel Project, involving the Shire of Yarra Ranges, in partnership with the Victorian Government, Department of Sustainability and Environment, Alternative Technology Association, Alternative Fuels and Energy (AFE), Fastfuel, Tiamat Goldiesel, local businesses and consumers. The project aimed to demonstrate the viability of establishing small-scale biodiesel plants capable of providing a service to local businesses and the community through the diversion of waste oil from landfill and access to a reliable supply of locally sourced and produced biodiesel. To support the project during the initial establishment phase, the Shire of Yarra Ranges and other fuel consumers were contracted to purchase the biodiesel for their use over a 12-month trial period. Unfortunately, due to changes in Federal tax laws for producers that came into effect in July 2006, which included the removal of the biodiesel excise exemption, the project became financially unviable. However, given more favourable incentives or possible changes in the fuel market in the future, the scope of the intended

project demonstrates the kind of positive development that can potentially encourage local investment and produce multiple community benefits.

Also in Victoria, the Bendigo Bank is piloting a project that aims to establish a broader-scale project to provide community ownership of the production and use of biodiesel thereby increasing local investment and boosting the local economy.

The Bendigo Bank: an Example of Local Economic Development

Initiated by two pilot communities, Bendigo Bank has worked closely to assist in operating a user trial of Bio-Diesel in both communities. To date this trial has seen the fuel used in 350+ different diesel engines and we have delivered more than 700,000 litres of Bio-Diesel blends to customers.

The current trials have been an important step in proving the viability of Bio-Diesel and dispelling many of the myths around the fuel and its use. However, the trial of Bio-Diesel has only been the first step in a broader project designed to assist communities in obtaining greater security over liquid fuel and retain capital wherever possible.

The project aims to work with those communities who wish to retain capital in their area, and build a sustainable business around the distribution of renewable fuels. It can also facilitate further economic development in those communities through participation in the Bio-Diesel value chain. These activities may include producing and processing inputs (feedstock) and processing bi-products from Bio-Diesel refining (like stockfeed).

Community Energy Australia has been working very hard on ensuring that Bio-Diesel sourced for blending is of the highest standard, ensuring that any fuel delivered meets the Australian Diesel Standard (allowing customers to claim applicable excise rebates).

Bendigo Bank and its partner's strong commitment to improving environmental outcomes also means a strong preference away from Bio-Diesel produced from Palm Oil grown as a result of clear felling of rainforest. For this reason we have been very careful to access fuel only from producers where domestic feedstocks have been used.

Courtesy of Callum Wright, Operations Manager, Bendigo Bank, Melbourne.

3.2.3.4. Qualitative Benefits

Surveyed councils have also identified many qualitative benefits of biodiesel uptake, both to council and the community. These were reported as:

- Practical demonstration of the success and suitability of biodiesel;
- Increased staff awareness and acceptance;
- Good council PR;
- Stimulation of local industry/consumer interest;
- Media interest which added support for continuation of the project;
- Increased confidence within council to effect change, even at the State level.

For Newcastle City Council, Peter Dormand reflected as follows on the qualitative benefits:

"Direct benefits to the community come from the creation of new opportunities and the encouragement and support of a council that has already taken the first step. This benefit also extends to other communities, as over the last four years Council has received a least one enquiry about its biodiesel project each week from other councils around Australia and New Zealand.

Local Government is in a great position to lead by example and you can't expect others in the community to take action for our climate if we as local governments aren't prepared to do it ourselves".

(Refer to Appendix G for full case study).

3.2.4. Issues Associated with Biodiesel Uptake

Councils may encounter a range of issues during the planning and implementation of a biodiesel project. However, these issues are by no means the same for every council and, apart from a small number of cases where there is currently a lack of local suppliers, do not constitute insurmountable barriers to local government uptake of biodiesel as a whole. Indeed, while some experienced councils report that one or two of these issues presented significant challenges - that were eventually overcome - others encountered no such issues, either throughout the planning and implementation of their project, or since.

The council situation, approach and level of knowledge play a large part in determining the significance of any issue and whether it can be overcome. Certain issues will appear fairly immediately and depend on the individual council context. As such, councils may be able to be more pro-active in finding solutions to these challenges through appropriate project management and communications. For the purposes of this report, these are termed management issues. Other issues relate more to external regulations, which councils may have to find ways to negotiate, depending on their significance. For the purposes of this report, these are termed regulatory issues. Finally, there are practical issues, which may arise as a result of the changeover to an alternative fuel. These are grouped under technological issues.

3.2.4.1. Management Issues

Resistance within Council

Council support and enthusiasm is not always immediate and rarely unanimous. Resistance can come from any level of council and the strategies used to address it are broadly similar, though the methods may differ slightly. Whether resistance is met at the level of staff, management, upper management, executive or elected members, successful councils have found that the solution relies on education. This can take many forms - informal and formal meetings, information sessions, workshops and seminars (including guest speakers), attendance at local events and/or conferences and even field trips - all of which have been used by the councils participating in this research to overcome internal resistance.

Peter Dormand from Newcastle City Council comments that even though resistance may not overtly present itself, you have to be alert to the subtle barriers that can appear before you. There can also be instances where people change their mind in an instant. You may have established 100% commitment at the outset, but when it comes to action, that commitment can wane for a multitude of reasons. The energy of a project can therefore 'morph', as Peter describes it, and much of this will be due to factors beyond the control of the project manager. In this regard, it is important to be aware that the internet can provide justification and support for almost any viewpoint and this further highlights the value of thorough research to enable common myths to be dispelled before they gain support. Many such myths relate to maintenance and vehicle operation and are in most cases a result of poor quality fuel. However, numerous scientific studies have demonstrated that there is no additional maintenance and no perceptible change in vehicle performance as long as you put measures in place to ensure the quality of the fuel and so, as Peter Dormand says, "it's all a deception based on hearsay".

Even in Newcastle, a progressive council by national standards, the perception of risk needed to be addressed, especially as the project involved the council service that is most susceptible to community disproval - garbage collection. Depending on the council situation, good project communications can be a challenge, but is often a critical element for ensuring a consistent level of commitment, and it is important in all projects to identify and address real and perceived risks throughout.

Whether there is general support for innovation and new ideas within council, or whether these are more often met with varying degrees of resistance, experienced councils have proven that successful biodiesel projects can be established whatever end of this spectrum that council lies. The case studies illustrated in this report are provided to outline practical examples of how to go about implementing a successful project in a range of council situations. Those councils who believe that it might present too great a challenge would be well placed referring to these case studies to learn how it is possible to move from planning to implementation, sometimes within just a few months.

Project Funding

Lack of funding can be a significant barrier and for many councils, the termination or continuation of a project has rested solely on this issue. Depending on the extent of investment required, councils may be able to allocate the necessary budget internally or may need to seek external funding. Investment may simply be in the form of staff time and council resources or it may include the cost of cleaning existing storage tanks or of installing new storage tanks, which cost on average between $1.00 and $1.50 per litre of tank volume.

In either situation, it is beneficial, if not essential, to develop a business case to support the associated project plan. This should include a scope of the project itself (vehicles, blend etc.), the type of investment required (time, resources, finances), project participants, stakeholders, proposed budget, expected outcomes (quantified where possible), potential impacts (social, environmental, economic) and long-term benefits. This will help to justify the allocation of council budgets and/or increase the likelihood of a successful application for external funding.

Hobsons Bay City Council, recently commissioned a feasibility study for their joint biodiesel project with Hume and Ballarat City Councils, assisted by seed funding from ICLEI Oceania. The study was designed to "scope the opportunities for biodiesel supply and distribution with local industry and Council's fleet and contracted services". To this end, it investigated the needs and requirements of prospective biodiesel producers and suppliers, potential demand, financial and environmental implications, and finally suitable locations for a new facility. This funded process will help to ensure that this joint project takes into account all potential stakeholder considerations prior to implementation and increases the likelihood of effective and positive outcomes.

Experienced councils recommend keeping abreast of the types of funding opportunities that exist in the council's region or state, as well as at the federal level. Each state provides some form of regularly updated regional funding and grants register, either through the local government association or relevant state government department. Various councils have received support for their biodiesel projects from the Environment Protection Authority in Victoria, NSW Department of Environment and Conservation, the NSW RTA, Department of Environment and Heritage (now the Department of Environment and Water Resources) and SA Energy Research Council.

Project Monitoring

It is important to be able to assess how successful, or not, a project has been. To do this accurately, procedures must be set in place from the beginning so that any changes or observations resulting from the project can be noticed and properly attributed.

Some monitoring and measuring procedures that successful councils have implemented include:

- An assessment of council's current fuel use and associated emissions;
- An estimation of council's projected fuel use and emissions based on current rates of growth;
- Based on these figures, calculate the expected impact of introducing the chosen blend and feedstock composition of biodiesel to the council fleet;
- An assessment of the engine and transmission prior to and during the project to monitor engine condition and performance;
- Oil samples taken prior to and during the project, again to determine the condition of the engine;
- Fuel sampling and testing for each delivery to ensure standards and contract requirements are being maintained;
- A procedure for recording driver assessments and observations of vehicle performance on biodiesel.

Peter Dormand of Newcastle City Council comments on the advantage council gained in their biodiesel implementation from having already established effective procedures for project management and monitoring during previous council projects:

"The measurement and management processes that had been developed and refined for water and energy were easily built into the planning process for biodiesel so we knew that we would be able to identify whether it was making a difference. The ability to monitor outcomes was a vital component of the project."
(Refer to Appendix G for full case study).

Uptake and Efficiency
- Integrated Travel Demand Management

A concern raised by several experienced councils and also highlighted by Tim Grant from CSIRO is that biodiesel, and alternative fuels in general, may be viewed as a way of maintaining the current transport paradigm in a less damaging and 'sustainable' way. However, current transport habits and growth trends are themselves not sustainable. There is a need for both increased efficiency and a reduction in overall fuel demand, at the same time as proportionately increasing the use of less environmentally harmful alternatives.

As energy consumption for transportation continues to rise worldwide, the subsequent impact of fuels on our environment is rising accordingly. Perhaps slightly less so with biodiesel, but such first generation biofuels can only make a small contribution to meeting fuel demand due to the limited availability of feedstocks and therefore cannot deliver the 60-80% emission cuts that are called for to avoid dangerous climate change. Biodiesel is not a panacea to our transport problems as it sometimes carries with it significant environmental and social issues, though these can turn out to be less than for normal diesel. It is a matter of choosing what will be least harmful, from a choice of products that all have negative impacts to varying degrees.

Progressive councils therefore see it as critical that the uptake of alternative fuels is accompanied by equal efforts to decrease demand. This can be done by increasing overall efficiency, whether through reducing fleet size, downsizing vehicles, rationalising journey plans or even keeping tyres pumped to their optimum pressures (an average increase in fuel efficiency of 5%) as well as through efforts to change transport behaviour.

At Sydney City Council, the uptake of biodiesel was just one in a series of actions to reduce council's transport emissions:

"The biodiesel program…is part of a range of recent fleet initiatives including:

- *Reducing the average engine size and overall number of fleet vehicles;*
- *Purchasing SMART cars and Hybrid cars;*
- *Using recycled oil; and*
- *Providing an incentive for staff with vehicles to choose efficient models."* (Refer to Appendix K for full case study).

As Tim Grant from CSIRO pointed out through a personal communication, if there are to be any regulations put in place relating to transport, they should be around efficiency rather than fuel content, a view supported by more than one council in calling for broader environmental mandates.

3.2.4.2 Regulatory Issues

There are three issues that are repeatedly highlighted as presenting challenges of varying degrees to council uptake of biodiesel. These are:

- Fuel supply and quality/standards;
- Warranties;
- Tax credits.

Fuel Supply and Standards

Issues surrounding the supply and availability of biodiesel are regarded by most of the 50 councils as potentially presenting very significant obstacles to overcome and for almost half, the quality of the fuel is also a very significant issue.

At the moment, there are still many areas of Australia that are not well serviced by biodiesel suppliers. For some councils, mainly in Queensland and New South Wales, this has meant that they have had to arrange transport of small amounts of fuel over fairly large distances, which has increased the cost of the biodiesel relative to diesel, to the point where the project can become unviable. The two councils in which this has actually happened have temporarily suspended their projects until such time as a local supply becomes available. For other councils, failure to secure a reliable supply of high quality fuel has resulted in the termination of trials due to contamination issues, as occurred in Newcastle in 2003.

The availability of biodiesel in Victoria, and also other states, at a level where supply can be guaranteed, has so far been one of the main factors in councils' choice of fuel supplier. With few local producers, it is first a matter of who can provide a reliable supply, in relatively low volumes, and then, at a cost comparable to that of diesel. With the introduction of more local options in Victoria, as well as other States over the coming year, councils will potentially be able to choose suppliers based on factors such as cost, feedstocks and their sources rather than simply who can provide a guaranteed supply.

Presently, Victorian councils source their biodiesel either from Energetix (Vilo Assets Management Pty. Ltd), part of the Victor Smorgon Group, which is currently the state's only operational, commercial-scale producer, or from interstate producers via distributors such as Caltex in NSW and SAFF in SA.

The biodiesel industry has been growing fast over the last year, as illustrated in Table 3. Several councils have acknowledged that with current trends in the market - the increasing appearance of local producers and a broadening of the supply network, they do not anticipate that securing an adequate supply will be a long-term problem. At present, there are approximately 40 retail outlets of biodiesel across all states and territories and the forecast from industry stakeholders is for further growth of this network in the future [38, 84].

There are currently four retail outlets located in Victoria, and SAFF has plans to open an additional 31 small, medium and large outlets during the 2007/08 financial year and a further 49 by June 2009 [85]. These facilities will all be located in remote and rural regions of Victoria. There are also at least three new wholesale facilities either under construction or still in planning for the state.

On the issue of fuel quality and standards, there has also been significant progress over the past year. The biodiesel standard for B5 is the same as for normal diesel and, providing the fuel meets this standard, B5 can be used in any diesel vehicle. There is also an Australian biodiesel standard for B100. However as yet, there are no formal biodiesel standards for blends between B5 and B100. Despite this fact, several producers offer blends of between B20 and B50 that certifiably meet the Australian automotive diesel standard.

The added advantage of choosing a supplier who can provide a product certified to the Australian standard is in minimising potential contamination issues and the extra costs incurred as a result. Newcastle City Council encountered this problem at the beginning of their implementation and has since addressed it by developing a batch testing procedure for each delivery. The fuel they originally purchased back in 2002 was not to a certified standard, and even though the fuel they now purchase is certified, this testing procedure safeguards against any contamination that might occur during loading and delivery. Their case study in Appendix G provides more information about this.

A reputable producer will have their blended fuel certified to meet the Australian diesel standard and will also guarantee their fuel against causing any damage to the engine or its components. Council may wish to take additional precautions and, like Newcastle, establish a batch-testing procedure for each delivery, at least in the early stages. As Peter Dormand advises, this can be $100 every two weeks well spent.

Following a similar experience, the Council of Camden had this comment:

"…a batch of B100 fuel that did not meet specification was supplied on a verbal clearance without a Certificate of Analysis…As a result of the poor fuel, the B100 truck suffered several breakdowns and problems with fuel filters and the fuel injection system…This highlights the importance of biodiesel producers ensuring good fuel quality as the industry develops in Australia. Camden Council also recommend obtaining written clearance prior to accepting delivery of a batch of biodiesel fuel." [86]

For links to further information on Australian biodiesel standards and also the Council of Camden's biodiesel project, see Appendix A: Useful Links.

Warranties

Despite the perceived risk, the research for this report did not uncover any instances where vehicle warranties have been voided as a result of using biodiesel. The primary issue appears to be the vague language used by vehicle manufacturers when they refer to the use of biodiesel in their vehicles. This lack of clarity gives the impression to prospective biodiesel users that there are potential operational problems with its use. All the evidence points to there being no such problems. In the unlikely event of any engine problems resulting from the use of biodiesel, the fuel supplier is liable, not the vehicle manufacturer, providing a statement to that effect appears in the supplier's warranty terms. The vehicle manufacturer's warranty is still valid for any problems relating to engine parts and workmanship, unless they specifically state that the use of biodiesel voids this responsibility.

"Most vehicle manufacturers are now in the process of updating their warranties to include biodiesel…"

Back in 2002, Newcastle City Council were in the position of being among the first to face the issue of manufacturers' warranties, as Peter Dormand explains:

"The project also encountered reluctance from vehicle manufacturers to overtly state their position regarding the use of biodiesel, and claims that it caused damage in older vehicles. However, Council's own evidence from 12 months' rigorous fuel maintenance analysis on 11 different vehicles demonstrated that there were no changes in the engines as a result of using biodiesel. Council now asks vehicle manufacturers for their warranty terms regarding biodiesel prior to purchase, which has had a positive impact on encouraging change. "
(Refer to Appendix G for full case study).

Most vehicle manufacturers are now in the process of updating their warranties to include biodiesel - at least B5 or to a given national or international standard. These warranties are already in place in Europe and the US, which has led several councils to call their vehicle manufacturers to account for the inconsistencies in their warranty terms and to subsequently negotiate more acceptable terms.

Most fuel manufacturers and suppliers can provide a list of the current warranty terms for all major vehicle manufacturers and are willing to explain the potential implications for councils.

Concerns regarding supplies of consistently high quality fuel are rapidly losing currency as a reasonable barrier to council uptake of biodiesel. It is likely only a matter of time before certified biodiesel becomes more widely available in most states, although more remote and sparsely populated regions may still struggle to make it cost effective. For both fuel (supply and quality/ standards) and warranties, much comes down to the contract that council agrees to with their fuel supplier as this provides the opportunity to safeguard council against potential problems relating to the fuel and its use. Most of this work can be done in the tendering stage, where council can include all fuel specifications and requirements for compliance by a supplier. The fuel specification developed by Hume City Council is provided in Appendix L. Some of the factors that councils may want to consider in their tender are:

- Certified fuel standard;
- Guaranteed minimum blend;
- Provision of a summer and winter blend;
- Type of feedstock - suggest a minimum % renewable;
- Source of feedstock - policy around local, national or imported product;
- Quantity and source of any vegetable oil component - GMO or non-GMO;
- Frequency and volume of deliveries;
- Batch testing protocol;

The points covered thus far in benefits and issues surrounding biodiesel uptake demonstrate the importance of preparation and careful planning in laying a strong foundation for a successful project. Hume City Council is about to emerge successfully from several months of careful planning and preparation, with the result that they have many useful experiences and learnings to share.

Council Snapshot - Hume City Council. Project Planning and Preparation

"External funding was the key [success] factor. The project initially had cautious support from internal stakeholders until more information from the research data became available.

Hume City Council staff led a study group to Newcastle City Council (NCC)… to further investigate their project outcomes. The NCC trial report and subsequent learnings were key to the development of the Hume project. Extensive research data was also sourced from biodiesel manufacturers and organisations both local and abroad.

Other key steps to establishing the project included:

- Extensive investigations into local and overseas projects;
- Compilation of considerable test data and learnings/outcomes from other organizations;
- Securing external funding for project implementation;
- Commitment and persistence of the project manager in developing a trial to demonstrate the lack of risk and overcome substantial internal resistance;
- Prior existence and maintenance of strong, positive relationship between the project manager and the fleet department.

In September 2006, Hume conducted a trial of B20 Biodiesel in two selected vehicles in order to allay any doubts senior management may have had about a wide-scale project, and to introduce the alternative fuel to operators. The operators' response was extremely positive. Fuel filter inspections were carried out and revealed little change in their serviceability.

Specifications for fuel quality, supply, and sustainability on a life cycle basis have now been developed for the 12-month project and will be reviewed upon completion of the EPA project criteria. Fuel supply tenders are currently being advertised. Feedstocks for the biodiesel component of the B20 blend have a mandated 40 per cent minimum recycled component. Virgin feedstocks must be GMO free, locally sourced agricrop (south east corner - Australia).

Extensive discussions with local biodiesel suppliers conclude that a legally binding supply agreement for the fuel quantities required can be established. Storage will be an EPA funded 60,000 litre above ground, approved, self-bunded, flammable liquid storage tank, with dual vehicle fuelling capabilities and electronic data management. No vehicle modifications are required although during the fuel transition phase, fuel filter inspections/replacements will be carried out by fleet services." (Refer to Appendix J for full case study).

Tax Credits/Grants

The third most commonly cited regulatory issue surrounding biodiesel uptake is the complexity of, and misunderstandings regarding, fuel tax credits. Fuel tax credits and grants can affect local governments in two ways. Firstly, directly, through councils being eligible to claim tax credits and grants themselves, and secondly, indirectly through biodiesel producers and suppliers who are eligible to claim certain credits and grants and who are then able to pass this saving on as a price reduction to councils.

In the first case, the Energy Grants Credit Scheme (EGCS) allows eligible councils to claim up to 14.808 cents for each litre of biodiesel purchased. This grant is being phased out gradually over the next four financial years as it merges into the mainstream Fuel Tax Credit scheme. Currently, under the Fuel Tax Credit scheme, councils may be eligible to claim a tax credit of up to 18 cents per litre for biodiesel blends of between 1% and 48%. After July 1 2011, the EGCS will cease to exist and fuel tax credits of up to 38 cents per litre will be available for biodiesel [87, 88].

In the second case, there are two schemes under which a biodiesel importer, producer and/or blender might claim a tax credit or grant for the production of an alternative fuel. These are the Australian Government's

Product Stewardship for Oil program, which encourages the recycling of oils, and the Cleaner Fuels Grants Scheme, designed to encourage the manufacture of alternative fuels.

To be eligible, the fuel must meet the Australian biodiesel standard, so it is worth considering that producers or suppliers whose product is certified to these standards may be receiving credits and/or grants, which can allow them to reduce the price of their fuel to the end-user, including councils. However, this reduction rarely matches the total available rebate of 38.5 cents per litre. The manufacture of biodiesel, whether certified or non-certified, requires a totally new infrastructure, compared with fossil fuel, and these capital costs affect the end-user price of the fuel until such time as these costs are recovered. In addition, in order to meet Australian Standards, each batch of fuel must be tested, which is an expensive process. Once these varying costs are factored in, the actual difference in price between certified and non-certified fuel may not be significant, although there are the advantages of guaranteed fuel quality and warranty compliance, as discussed above, that are added benefits of choosing a certified supplier.

Both the EGCS and Fuel Tax Credit scheme are subject to certain conditions, details of which can be found from the Australian Tax Office (ATO) [87, 88] (refer to Appendix A: Useful Links).

The ATO is also available to answer specific questions and discuss councils' eligibility in relation to these schemes.

Currently, experienced councils attest that the cost of purchasing biodiesel is roughly comparable to that of diesel. As a result, existing and future (post 2011) grants and tax credits do not provide significant financial incentives for biodiesel uptake, as opposed to diesel, particularly as fuel tax credits are also available for diesel fuel use. However, given the demonstrated potential for widely varying prices in the fossil fuel market and, for biodiesel, the likely increased production of, and new developments in feedstocks, the development of new production techniques, efficiencies in distribution and a more highly developed and established infrastructure, it is not certain how these grants and tax credits will affect biodiesel usage in the future. A leading biodiesel supplier to local governments in NSW believes that, with the aforementioned trends in biodiesel, it stands an even better chance of being cost competitive post 2011, even if the effective grants and tax credits that are available for each fuel remain broadly similar.

Measuring and Reporting Greenhouse Gas Emissions

As outlined in Chapter 1, there is a wide range of estimates available of the likely reductions in GHG emissions that can be expected from biodiesel. The different estimates depend on the percentage blend, the types and proportions of feedstocks used in the blend, their source, the type of base diesel, and the focus of the emissions analysis - whether it is taking into account the full life-cycle of the fuel, or simply the tail-pipe or point-source emissions.

The Australian Greenhouse Office (AGO) produces a "Factors and Methods Workbook" for use in Australian greenhouse gas emission calculations and reporting[89]. The workbook contains emission factors (EF), which allow the CO_2-e emissions associated with the combustion of various types of fuel, the consumption of purchased electricity and the extraction of fossil fuels to be determined. There are three emission factors for each type of transport fuel, which relate to the focus of the emissions analysis, what they term the "scope". Scope 2 is relevant to electricity only and is therefore not considered here. Scopes 1 and 3 are used by the AGO to provide the three emission factors for each type of fuel as follows:

- Scope 1: The point-source or direct emission factor for combustion emissions;
- Scope 3: The indirect emission factor for fuel extraction emissions;
- Full Fuel Cycle: The full fuel cycle emission factor (Scope 1 + Scope 3).

For the first time, the most recent edition of the workbook, released in December 2006, includes fuel combustion emission factors for ethanol and biodiesel. There are emission factors for Scope 1, Scope 3 and Scope 1+3 for both B100 and B20 and for each of Australia's three primary biodiesel feedstocks - canola, tallow and waste oil.

In addition to the point-source or tail-pipe emissions (scope 1), the full fuel cycle emission factors for biofuels, as listed in the AGO's workbook, can take into account:

- Extraction, production and transport of purchased fuels consumed;
- Extraction, production and transport of other purchased materials or goods;
- Transportation of products, materials and waste;
- Use of products manufactured and sold;
- Disposal (end of life) of products sold;
- Disposal of waste generated (including transport);
- Employees commuting to and from work; and
- Outsourced activities.

The CSIRO/ABARE report "Appropriateness of a 350 Million Litre Biofuels Target" goes into more detail as to exactly what is included in the life cycle analyses of these biofuels[73].

Most commonly, biodiesel is a mixture of two or more feedstocks. If a minimum waste-oil content has been stipulated in the supplier contract, then the appropriate emission factor can be used for that percentage of the fuel, and the remainder calculated at the higher factor for either canola or tallow. In the case of councils using a biodiesel blend somewhere between B20 and B100, it is advisable to calculate the emission reductions for both B20 and B100 and provide an estimation of the potential reduction given the percentage blend.

The potential emission benefits of B100 biodiesel per litre are greater when it is blended with diesel (refer to Information Box 2: Calculating GHG Emissions, section 3.2.4.2), and theoretically more sustainable as it requires less feedstock to obtain comparable emission reductions. However, this fact has to be weighed against councils' other priorities and motivations for the uptake of biodiesel such as reducing reliance on fossil fuel, reducing environmental pollution and improving community health.

The AGO fuel combustion emission factors can be found on page 10 of the Factors and Methods Workbook (refer to Appendix A: Useful Links).

"The potential emission benefits of B100 per litre are greater when it is blended with diesel".

The AGO acknowledges that the emissions factors they provide are default factors only, *"to be used in the absence of better data on emissions that may result, for example, on actual production methods employed"*.

This highlights the importance of councils knowing as much as possible about the fuel they are purchasing. For instance, if the biodiesel supplier cannot specify the percentage feedstock components of its product, then the full fuel cycle (Scope 1 + 3) emissions will always be calculated using the highest emission factor of the known feedstocks. Similarly, in the case of suppliers that offer a generic Australian standard biodiesel whose blend can vary between 5% and 22% according to seasonal conditions. Unless the supplier can provide councils with a definite percentage blend for each delivery, emissions abatement for all Scopes will be calculated according to the lowest blend – B5. Under both situations, councils may report emissions abatement figures lower than they actually are, but this is an appropriately conservative approach. A further reason for gaining knowledge about the fuel, feedstocks and the production processes is that, as the AGO states above, if it can be proved that actual production methods result in lower emission factors than those provided in the Factors and Methods Workbook, then councils may be able to claim greater CO_2-e abatement from their biodiesel uptake.

Information Box 2: Calculating GHG Emissions

The tailpipe greenhouse gas benefits of biodiesel can be calculated using scope 1 emission factors. There is considerable uncertainty over the life-cycle greenhouse gas benefits of biodiesel, as they depend on the specific feedstock and production method used. Life-cycle benefits are generally calculated using scopes 1+3 emission factors. The AGO Factors and Methods Workbook 2006 provides default scope 1 and scopes 1+3 emission factors, which can be used in the absence of better data.

The examples below demonstrate how biodiesel emissions can be calculated, using the emission factors from the AGO Factors and Methods Workbook 2006.

Scope 1 The following example compares the CO2-e emissions associated with the combustion of 100,000 litres of normal diesel, B100 and B20 using scope 1 emission factors.

Diesel: **270 tonnes CO2-e (EF = 2.7 tonnes CO2-e/kL)**
B100: **0 tonnes CO2-e (EF = 0 tonnes CO2-e/kL)**
B20: **210 tonnes CO2-e (EF = 2.1 tonnes CO2-e/kL)**

The potential CO2-e abatement associated with 100,000 litres B100 is obviously greater than for 100,000 litres of B20 - 270 tonnes as compared with 60 tonnes. However, the increase in abatement is not proportional to the increase in the blend. If 100,000 litres of B100 were used to create 500,000 litres of B20 (20% of 500,000 is 100,000 litres), then the potential emissions abatement for these 500,000 litres (100,000 litres of B100) would be 300 tonnes CO2-e, an extra 30 tonnes CO2-e:

Diesel: **1,350 tonnes CO2-e (EF = 2.7 tonnes CO2-e/kL)**
B20: **1,050 tonnes CO2-e (EF = 2.1 tonnes CO2-e/kL)**

Scope 1 + 3 The following example compares the CO2-e emissions associated with the combustion of 100,000 litres of normal diesel, B100 (tallow) and B20 (tallow) using full fuel cycle emission factors (Scope 1 + 3).

Diesel: **300 tonnes CO2-e (EF = 3.0 tonnes CO2-e/kL)**
B100 (tallow): **190 tonnes CO2-e (EF = 1.9 tonnes CO2-e/kL)**
B20 (tallow): **270 tonnes CO2-e (EF = 2.7 tonnes CO2-e/kL)**

The potential CO2-e abatement associated with 100,000 litres B100 (tallow) is greater than for 100,000 litres of B20 (tallow) - 110 tonnes as compared with 30 tonnes. However, once again the increase in abatement is not proportional to the increase in the blend. If 100,000 litres of B100 (tallow) were used to create 500,000 litres of B20 (20% of 500,000 is 100,000 litres), then the potential emissions abatement for these 500,000 litres (100,000 litres of B100) would be 150 tonnes CO2-e, an extra 40 tonnes CO2-e:

Diesel: **1,500 tonnes CO2-e (EF = 3.0 tonnes CO2-e/kL)**
B20 (tallow): **1,350 tonnes CO2-e (EF = 2.7 tonnes CO2-e/kL)**

To summarise for scope 1 and scope 1 + 3, if council uses 100,000 litres of diesel per annum, the abatement that can be achieved using different scenarios of B20 and B100 is as follows:

	Fuel Type (100,000L total)	Emissions (t CO2-e/kL)	Abatement (t CO2-e/kL)
Scope 1	Diesel	270	-
	B100	0	70
	B20	210	60
	(20,000L B100	*0)*	54
	(80,000L Diesel	*216)*	

	Fuel Type (100,000L total)	Emissions (t CO2-e/kL)	Abatement (t CO2-e/kL)
Scope 1+3	Diesel	300	-
	B100	190	210
	B20	270	30
	(20,000L B100	*38)*	22
	(80,000L Diesel	*240)*	

It is also important to consider that the on-road fuel efficiency of a vehicle using B20 versus B100 may vary, thus altering the total amount of fuel used for a given amount of travel and thus the total amount of greenhouse gas emissions.

Regulatory Issues Concerning Imported Feedstock Oil

There is currently no system in place in Australia to monitor and regulate the source of imported oils. However, councils can, through their policies, tenders and fuel contracts, encourage producers and distributors to become increasingly aware of the implications of their feedstock choices and thereby create their own informal type of certification.

Survey responses on the question of palm oil revealed that 66% of councils in this study are opposed to using fuel sourced from imported palm oil. A further 10% said that they would only use it if it came from a proven or certified sustainable source. 22% of councils were not sure or did not answer this question.

Biodiesel producers were also surveyed for their response to this question - five responded. One producer indicates that the choice of feedstocks is not an issue and that they would not be opposed to using palm oil on account of the drought reducing the availability of local feedstocks. Two producers are directly opposed to using palm oil because of its poor track record of sustainable production practices and because there are other suitable oils such as coconut and jatropha. Of the remaining two producers, one views palm oil as an acceptable supplement until the domestic industry is further developed, though they would prefer to use recycled oils. The final producer states that all their feedstocks are considered on the basis of being verifiably environmentally sustainable. Therefore, although they support the use of palm oil as a 'logical scaleable solution', given Australia's limited domestic feedstocks, this would depend on there being criteria to assure its sustainability, which they acknowledge may take a few years.

The issues now emerging around biodiesel feedstock sources are seen by many councils as potentially negating the original benefits of its uptake. Unless some kind of certification scheme is created around the use of imported oils, and more accurate methods developed to assess the environmental and social impacts of increasing the amount of land allocated for fuel, the quantification of biodiesel impacts will become increasingly unreliable and/or unfavourable. As Bill O'Regan from the City of Onkaparinga says:

"It could destroy the biodiesel industry if regulations are not put in place early on".

This lack of regulation presents an opportunity to local governments in Australia and this is discussed in Chapter 5.

3.2.4.3. Technological Issues

The most common technological issues raised concerning the use of biodiesel are related to filters, clouding or temperature stability, loss of power and its ability to absorb water.

Filter Changes

Biodiesel acts as a very effective solvent and cleans the residue left by diesel from all related parts of the engine. This residue becomes trapped in engine filters and can impede fuel flow resulting initially in a loss of power and ultimately in break down. It is now widely accepted, based on council experience, that changing the filter once, after approximately 2-3 months or a full tank of fuel, whichever comes first, is all that is required and there will be no subsequent changes necessary. The engine will actually be cleaner than it was previously. A 5-micron filter is widely regarded as producing optimum results at filtering out the diesel residues.

If existing diesel tanks have been chosen to store biodiesel, its solvency properties will also clean diesel residue from these tanks. This contaminated fuel may then be injected directly into the vehicle fuel tanks. The City of Greater Bendigo and Newcastle City Council encountered this problem and as a result fitted filters on to the fuel lines, or bowsers, of their storage tanks. Another option is to have the tanks properly cleaned before the biodiesel is introduced.

No experienced councils regard filter clogging as a problem. It is accepted as a necessary step in the initial changeover to biodiesel and results in no long-term maintenance issues.

Clouding

Clouding relates to the cold-filter properties of the fuel (refer to section 4.2.4.) and can be an issue with higher biodiesel blends (above B20) in regions where the temperature drops below approximately 15 ^{o}C. Newcastle, Hume, Hobsons Bay City Councils and

possibly other councils have included specifications for summer and winter biodiesel blends to compensate for seasonal changes in feedstock characteristics.

Loss of Power

No councils have experienced or measured any loss of power from B20. In 2004, the RTA conducted dynamometer tests on 12 Newcastle City Council diesel vehicles running on diesel, filtered diesel and B20 biodiesel. The results of these tests revealed no loss of power across all vehicles. In South Australia, a one-year bus trial indicated that vehicle performance was comparable to that of diesel.

Some differences in power have been observed with B100. A report produced by the Council of Camden in 2004 notes that under test conditions, a truck running on B100 experienced a 17% loss of power. However, the vehicle operators themselves did not perceive any loss of performance during operation. Croyden Bus Services trialled B100 in 2002 and recorded an average 5% loss of power.

A certain loss of power is to be expected from B100 owing to the lower energy density of biodiesel per litre as compared with diesel. At high blends, this difference will become more apparent and also results in slightly higher fuel consumption (5% for Croydon Bus Services, 25% for the City of Onkaparinga). However, the City of Onkaparinga also notes that, after conducting dynamometer tests using diesel and B100, "engine power developed was the same when operating on both fuels." Following a pre-project trial of B20 in two vehicles at Hume City Council, tests revealed a "marginal increase in performance and fuel consumption." Stuart Nesbitt from Hume City Council elaborates further:

"Biodiesel like LPG contains less energy per unit than fossil diesel. Fuel consumption therefore increases to compensate for the lower energy component. During our trial we increased average performance by 1 per cent and fuel consumption increased by an average of 2.3 per cent - almost identical to NCC's trial results."
(Refer to Appendix J for full case study).

There appears to be no grounds for the assertion that biodiesel produces a noticeable decrease in vehicle performance at a blend of B20. There is also little difference in fuel consumption at this concentration. Alex Malone from the City of Greater Bendigo adds:

"Council staff observed no significant changes in vehicle performance, which is a promising result for the continued use of biodiesel" (Refer to Appendix I for full case study).

Water Absorption

Biodiesel is hygroscopic, meaning that it can absorb water from its surroundings and draw moisture from the atmosphere, which can cause contamination. Consequently, it is important to ensure that tanks intended for biodiesel storage are thoroughly cleaned to ensure they contain no water prior to installing biodiesel, and that all seals are secure to prevent moisture from the atmosphere entering the tank.

As Adelaide City Council warns:

"An important lesson learnt during this process was that biodiesel readily absorbs moisture and, if long-term storage is planned, care should be taken to keep tanks full, thereby reducing condensation levels."
(Refer to Appendix H for full case study)

Councils should therefore consider this when determining the size of storage tank that they will need.

Council Snapshot - City of Greater Bendigo: Overcoming Obstacles

During the planning and implementation of its biodiesel project, the City of Greater Bendigo encountered several regulatory and technological issues including fuel supply, clouding, standards, warranties, storage and resistance:

"The main obstacles encountered when implementing the trial were finding a suitable supply, possible problems with engines and manufacturers' warranties, storage facilities and staff perceptions of biodiesel.

There are no suppliers of bio fuel in Bendigo. There is a local community-based purchasing scheme that is still in its infancy and could not offer value for money or provide any guarantee with their biodiesel. Further research highlighted Vilo Assets Management as a potential supplier. The company maintains reliable quality control, guarantee their product, blend in differing ratios, are competitive with terminal gate pricing and could deliver tanker loads as required.

There was initial concern that biodiesel would cloud in cold weather and block fuel systems and that the solvent effect would cause impurities in the tanks to mobilise. However, up to now, this has not proved to be the case and suitable blending and varying of feedstocks by the manufacturer to suit the application and the weather make this unlikely to be an issue. In-line filters were added to the bowsers at the depot and the mobile fuel delivery vehicles as a precaution. There have been no problems with filter clogging and routine services and filter changes have been adequate for vehicle maintenance.

Using a biodiesel blend that meets the Australian Standard for Diesel will meet manufacturers' requirements and the reputable biofuel suppliers will guarantee their product against engine or fuel system damage.

Council's only storage facility at its depot is a large underground tank. It was therefore deemed more cost-effective to run the whole fleet on biodiesel rather than establish a new, smaller storage facility.

Management discovered that many plant operators, supervisory staff and mechanics were sceptical and reluctant to trial biodiesel. Hence it was decided to begin the trial with a low 5 percent (B5), which when added to the remaining fuel in the storage tank would be less than 5 per cent and reduce the risk of any problems. Management planned to gradually increase the blend and note any problems or concerns that arose. All 140 vehicles now run on B20 and since the start of the trial there have been no problems or issues. The initial scepticism has been overcome and the City of Greater Bendigo now acknowledges that biodiesel is certainly a viable alternative fuel." (Refer to Appendix I for full case study).

3.2.5. Success Factors

The main factors considered by experienced councils as critical to the success of their biodiesel projects are:

- Good research and planning
- Risk management
- Strong council support
- Stakeholder engagement
- Establishing a project team
- Monitoring and reporting
- Positive staff attitude

Good research and planning

This includes conducting research on biodiesel uptake in general and its appropriateness for council taking into account availability, costs, infrastructure, etc. as well as thorough planning around meeting council expectations.

There are many ways to approach the research process and the information box at the end of this section is intended to provide councils with several suggestions on where to start, based on responses from the 50 surveyed councils. (refer to Information Box 3: Project Research in this section).

Risk Management

Thorough research and planning plays a significant role in risk management as it provides the opportunity for many potential issues to be identified and addressed early in the project.

Jack Mazek at Adelaide City Council illustrates the important role that research and planning played in the early management of a potential risk, subsequently saving council money:

"It was initially believed that the existing diesel storage tanks on Council's depot would be unsuitable, with interstate trials suggesting the need for a new a storage system - and significant cost implications. However, by applying careful research and planning, the existing underground storage tanks were cleaned successfully, removing all traces of diesel." (Refer to Appendix H for full case study).

For those issues that arise during project implementation, it is important to address these fully and openly to avoid unnecessary setbacks and ensure the long-term viability of the project. Some actions towards risk management that can be taken early include:

- Sourcing fuel that meets Australian standards;
- Obtaining a fuel warranty from the supplier;
- Establishing a batch-test procedure;
- Educating operators and maintenance staff with regard to fuel filters;

Strong Council Support

This involves gaining the support and interest of upper management, executives, relevant departments and staff, thereby generating awareness and acceptance of the project across all levels of council.

Of those councils that have implemented successful biodiesel projects, 80% indicate that upper managerial support was integral and essential to a successful outcome. Depending on the cost and size of the project, controlling decisions at some councils can be made at the manager level and, for many councils, certain services are contracted out, in which case the support of contract managers and contractors is equally important to that of upper management, CEO and elected members.

Stakeholder Engagement

Good stakeholder engagement helps to ensure that all aspects of the project are addressed and that the best interests of council, with regard to project outcomes, are always adhered to. Experienced councils report that optimum outcomes, as regards stakeholder engagement and the on-going maintenance of relations, are achieved via frequent face-to-face meetings with all project partners.

Establishing a Project Team

A project team provides the forum to include all those directly involved and interested in the project in regular discussions and decision-making. The opportunity to be involved and contribute at every stage of project development helps to create a sense of ownership and investment in positive outcomes (leading to positive staff attitude). The project also benefits from the varied perspectives of multiple participants, which can also play a large part in risk management.

An effective project team would include all relevant council departments and staff as well as project partners and other stakeholders.

Monitoring and Reporting

It is important to be able to monitor the project's progress at various stages, as well as accurately assess its success. This requires that a process is established prior to implementation that:

- Determines what will be measured;
- Provides a baseline or control against which subsequent measurements can be compared;
- Sets the frequency of monitoring and;
- Establishes indicators of success;

Monitoring was a key factor in the success of Adelaide's biodiesel project as Jack Mazek explains:

"In order to demonstrate the environmental benefits of biodiesel use, the vehicles' diesel exhaust emissions readings were monitored and then compared with their biodiesel exhaust emissions using SAFF's Portable Exhaust Analyser. Council then monitored fuel consumption and driveability factors throughout the trial."

(Refer to Appendix H for full case study).

Positive staff attitude

When planning a framework for project success, it is also helpful to look beyond what is necessary to what is desirable. Enthusiasm, interest and participation from as many people as possible increases motivation, creates a sense of ownership, introduces different perspectives on plans, problems and their solutions and generally has a positive impact on any project.

It is often not something that is formally planned, but the importance of this factor should not be overlooked. Several councils report the major positive impact that staff attitude had on the project during implementation and also post project when a sense of achievement following a successful outcome can increase council's confidence and sense of leadership in taking further action against rising greehouse gas emissions. According to Peter Dormand of Newcastle City Council:

"One of the biggest benefits of the project for council has been the increasing feeling of confidence and desire to tackle new climate solution challenges".

(Refer to Appendix G for full case study).

Information Box 3: Project Research

For councils considering implementing biodiesel into their fleet, good information and research is an essential part of successful planning and decision-making. Knowing clearly beforehand what the options are, and the likely impacts of each of these options, allows best practice strategies to be identified and put in place at the ground level. Good background research also helps to avoid potential issues and guards against the judgements of less well-informed or sceptical project stakeholders.

There is a wealth of information available on biodiesel, particularly via the internet. It is all valuable and useful in different ways, depending on the intent and the focus. However, as with all research, it is important to bear in mind the source of any materials being used and remain aware of potential vested interests or agendas.

Councils report that by far the most popular source of information on biodiesel is through contact with other experienced councils and/or regional alliances. This report provides case studies from five experienced councils and also a list of all known councils in Australia that have implemented biodiesel projects. These can be found in Appendices G to K respectively.

The second most widely used source of information for councils is the internet. A good place to start is the Biodiesel Association of Australia [31] (BAA) where you will find factsheets and a host of additional links to useful materials as well as other state-based biodiesel websites. They also have an on-line forum where you can post questions and learn from other biodiesel users across the country.

Producers and suppliers are also useful sources of information, provided you seek a range of perspectives, supported by your own independent research.

Finally, councils also gained information through environmental magazines and other media, biodiesel groups, industry associations, consultants, government departments, seminars, workshops and conferences, and books.

Chapter 4. Operational and Technical Properties of Biodiesel

The most important questions for councils regarding the use of any alternative fuel in their fleets are whether it will cause operational problems in their vehicles and whether there are technological characteristics that require it to be handled and maintained differently from their normal fuel.

This is especially the case in councils' diesel vehicle fleet where the demands on the vehicles are often very high and the consequences of mechanical failure can be damaging to essential council services such as waste collection.

Setting aside the management and regulatory issues associated with biodiesel uptake that have been discussed in Chapter 3, this chapter provides an overview of the basic operational and technical properties of biodiesel.

Table 6. Energy Content, in MJ/L, for various biodiesel feedstocks [22, 89]

Fuel	CSIRO (B100)	AGO (B100/B20)
Diesel	*38.3*	*38.6*
Canola Oil	36.9	34.7 / 37.8
Soybean Oil	39.8	
Sunflower Oil	38.1	
Tallow	39.9	34.7 / 37.8
Used Cooking Oil (UCO)	36.3	34.7 / 37.8
Palm Oil	37.8	

4.1. Operational Properties of Biodiesel

When looking at the use of biodiesel as an alternative to petroleum based fuels, it is necessary to look at its operational properties, including energy content, energy balance, freezing or melting point, and Cetane (efficiency of combustion). These properties vary according to the feedstocks used in the fuel's production and the differences in these properties, specific to biodiesel, are summarised below to allow a clearer understanding of the use of biodiesel for local governments.

4.1.1. Energy Content

The energy content is the amount of potential energy contained in a unit of feedstock, also called its calorific value. This is important to consider as it affects the fuel consumption rate, since the higher energy content the greater potential fuel efficiency. Figures from CSIRO and the Australian Greenhouse Office (AGO) suggest that the energy content of diesel versus biodiesel is broadly comparable, with variations in the energy content for biodiesel depending on the percentage blend and the type of feedstocks [22, 89] (refer to Table 6). Some of this variation can be explained by different irrigation regimes or different types of animal oils (tallow) being used for each of the feedstocks being tested. In order to accurately determine the energy content of a particular fuel it is necessary to know the feedstock/s and percentage blend.

These figures represent the results of recent analyses and are by no means absolute. According to CSIRO figures (Table 6), B100 manufactured using 100% tallow or soybean oil will have a higher energy content than ordinary diesel. However, as the components of other oils increase, the energy content will decrease. In order to accurately determine the environmental impact and fuel consumption of each fuel it is necessary to know the feedstock/s and percentages being used.

4.1.2. Energy Balance

In addition to the actual energy content of the feedstock itself, it is also important to consider the energy input that was required to produce one unit of energy output. In other words, what is the amount of energy required to produce one unit of fuel. This provides a more accurate means of determining the economic and environmental viability of the final fuel. However, figures for the economic viability of a certain fuel are also influenced geographically and over time, dependant on many factors including cost of production, sale price and market prices for the various types of energy input that are required in each case.

Fuel	WWI (FEB)	CSIRO (EROEI)
Diesel	0.8 - 0.9	38.6
UCO	5 - 6	34.7 / 37.8
Rapeseed	~2.5	3.77 (EU)
Soybean	~3	1.93 - 3.2 (US)
Sunflower		3.2 (US)
Mustard		1.47 - 5.19 (Au)
Canola		1.39 - 3.62 (Au)
Tallow		4.5 (US)
Palm Oil	~9	9

Table 7. Energy balance figures (FEB and EROEI) for different biodiesel feedstocks [28, 90]

There are several methods of measuring and describing energy balance, including the energy return on energy invested (EROEI or EROI), the energy profit ratio (EPR), and the fossil energy balance (FEB). It is important to be aware which measurement is being quoted when comparing figures on energy balance as methodologies differ in how they count fossil fuels and they are therefore not comparable.

The WWI has calculated energy balance using FEB and found that diesel has a negative energy balance, requiring more energy to produce one unit of diesel fuel than that unit in turn provides on use. However, for biodiesel, the balance is positive for all feedstocks and ranges from a 2.5 increase on energy input for rapeseed oils to factor 9 for palm oil (refer to Table 7).

The EROEI figures from CSIRO provide a less clear distinction between diesel and biodiesel feedstock oils. As indicated above, one reason for this is the different methodologies and assumptions that lie behind these various ways of calculating energy balance, particularly as there is no agreed standard on which activities should be included and how far back in the supply chain the calculations should go.

However, this Australian research shows that biodiesel from any feedstock, provides at least a 3.2 multiple on energy input compared to diesel (1.5-4 for crops, 4-5 for tallow and 5-6 for waste oil) [90].

4.1.3. Cold-Flow Properties

How a fuel behaves under different temperatures, often referred to as its cold-flow properties, determines three factors that affect its performance - cloud point, pour or melt -point and fuel-filter plugging point.

Cloud point
The temperature at which certain dissolved constituents in the fuel (such as paraffin wax) start to crystallize and separate from the oil. If the fuel is not maintained above the cloud point, these crystals can potentially cause fuel filters to clog.

Pour point or melt point
The minimum storage temperature above which solidified fuel melts and below which the fuel will cease to flow.

Fuel filter (or cold filter) plugging point
The temperature at which the fuel will start to clog the filter.

For example, the melting point temperatures for different biodiesel feedstocks vary significantly, highlighting differences in suitability for use in certain applications and under various climatic situations (refer to Table 8). Generally, tallows and oils from tropical seeds such as palm and coconut tend to have higher threshold temperatures for all three cold-flow properties. In regions of Australia where winter and night-time temperatures can drop below melting point threshold temperatures (typically 15-20 °C), biodiesel producers need to ensure that the proportion of tallows and tropical oils is limited to avoid operational problems. Many producers already offer seasonal blends to account for the different temperature characteristics of feedstocks. As with the energy balance figure, the cloud, pour and fuel filter plugging points of a blended biodiesel are always a product of the relative proportions of each feedstock used in its production.

Oil	Melting Point °C
Sunflower	-17
Soybean	-16
Rapeseed	-10
***Canola**	*-4 to -6*
***UCO**	*< -3*
Palm	35
Mutton tallow	42
Beef tallow	50

Table 8. Melting point in °C of various feedstock oils [90, 91].
*Oils in Italics are estimated based on estimates from several sources. Value for UCO will vary depending on composition.

Figures for fuel filter plugging point, cloud point and pour point for a range of typical Australian feedstocks can be found in Appendix B, Table A2.

4.1.4. Cetane

The cetane number of a fuel is a measure of how efficiently the fuel auto-ignites on injection and also indicates the efficiency of combustion. It is analogous to octane levels for petrol. High cetane fuels are easy starting, start better at low temperatures, and generally provide for smoother operation. On the other hand, low cetane fuel can cause misfiring, tarnish on pistons, engine deposits, rough operation, high knocking (high noise level), and lower fuel consumption [92].

According to most studies, biodiesel feedstocks have a higher cetane number than diesel. Blending biodiesel to any level will therefore generally increase the fuel's performance in the areas listed above. A range of cetane numbers for several biodiesel feedstocks is provided in Appendix B, Table A3.

4.2. Technological Considerations of Biodiesel

4.2.1. Filters

Diesel engines require no modification to run on biodiesel, however, some components and servicing processes may need modification. One of the features of biodiesel is that it acts as an excellent solvent. On combustion, diesel produces water and carbon, which combine to form deposits that collect over time in the bottom of fuel lines, tanks and delivery systems. When biodiesel is introduced into the engine, it starts to break down these deposits, causing filters to initially become clogged.

To avoid this being an issue, some users have suggested cleaning the filters more regularly at the start, and that it will take between one and three tanks, and two to three filter changes to attain optimum performance. Once the deposits have been effectively 'cleaned' from the engine, there should be no further problems. Some users have found no difference in filter-changing requirements when switching to biodiesel, which may be as a result of starting with a lower blend rather than B50 or B100.

4.2.2. Biodegradability

As noted briefly in Chapter 2, B100 is approximately four times more biodegradable than diesel and B20 twice as biodegradable.

The biggest issue concerning the biodegradability of biodiesel is that it limits its long-term storage capacity to approximately six months before the fuel starts to degrade to levels that will affect vehicle operation and performance. Therefore it is not an optimal fuel for storage for long-term or low use purposes.

4.2.3. Flash Point

The flash point is the temperature at which fuels combust. B100 biodiesel has a much higher flash point than diesel, igniting at approximately 125 °C as compared with about 58 °C for diesel [49]. This makes biodiesel, and its blends, a safer fuel to handle and store in relation to high temperatures or use near or with potential ignition sources.

4.2.4. Clouding

Clouding is related to the fuel's cold-filter properties and occurs when the ambient temperature drops below a certain level and constituents of the oil start to crystallise. The level at which this happens is dependent on the feedstocks, as shown in section 4.1.3, as well as the proportion of diesel used in the biodiesel if blended. The use of high proportions of tallow during winter is suspected to be problematic in regions of Australia where night-time and winter temperatures can drop below approximately 15 °C. This has also raised some concerns about the availability of useable, cost-effective, domestic feedstocks during colder months.

However, biodiesel blends up to B100 are used in northern Europe, America and Canada. The Biodiesel Association of Australia explains that "twenty percent biodiesel blends have been used in the upper Wisconsin area and in Iowa during -25° F [-32 °C] weather with no problems." [31]. The City of Graz in Switzerland runs its entire bus fleet on B100 during summer and, in winter, reduces the blend to B70 and introduces an additive to prevent clouding. Similarly in Canada, a report from Clean Cities Virginia on the use of B20 in two tractor-trailers noted that there were no cold-handling problems at -13 °C and the use of a standard cold-flow diesel package was sufficient. This is an inexpensive liquid additive that controls wax crystal formation at low temperatures. Most biodiesel suppliers in Australia should be able to provide cold-flow packages if necessary.

Chapter 5. The Future of Biodiesel for Local Governments in Australia

5.1. Looking Ahead

This research suggests that as oil costs and greenhouse mitigation concerns continue to increase, biodiesel will likely play a more prominent future role in Victoria and Australia-wide within local government fleets and in the community.

However, feedback from 50 councils has illustrated some differences regarding the role that councils believe biodiesel will and/or should play in the future.

The divisions largely reflect different perspectives on the many economic and environmental factors that require consideration in relation to biodiesel in Australia, as reflected in Chapter 2.

A focus on the long-term implications of these economic and environmental factors can be readily encapsulated by two questions, that of future council usage and also the appropriateness of a biodiesel mandate. The focus of this section, of looking ahead at biodiesel usage by local governments in Australia, will tease out the key issues within these questions.

5.1.1. Future Usage

As part of the survey, councils were asked if they thought that biodiesel would play a significant role in council's future fuel usage in 2010. The results showed that 83% of experienced councils and 52% of non-biodiesel councils thought that it would. However, 37% of non-biodiesel councils believed that it would not play a significant role in council's future fuel use, whilst only one experienced council was of this opinion. Three councils from each group did not respond to the question.

To understand the concerns raised by approximately a third of councils overall who believe that biodiesel will not play a significant role in council's fuel usage in 2010, it is necessary to further investigate three key issues, those of sustainability of supply, GHG abatement, and the environmental impact of feedstocks.

5.1.1.1 Sustainability of Supply

A major concern influencing council decisions on biodiesel uptake is the sustainability of supply and access to this resource. This is based on various estimations of the large area of Australian land that would be needed to grow crops for fuel rather than food in order to offset a relatively small percentage of the country's growing transport emissions. Waste cooking oil and tallow are also finite resources. There is only so much feedstock available and as demand increases, competition may push the price up and the industry may be unable to meet demand through domestic feedstocks at an economically viable price.

Recent figures from CSIRO, for example, put the potential proportion of Australia's diesel usage that could be offset by biodiesel, using domestic feedstocks, at 10% (based on unpublished calculations by CSIRO). National diesel consumption in 2005/06 was 15,880 ML, which means that, based on the CSIRO research, 1,588ML of this could theoretically be offset through the uptake of either 1,588 ML of B100 or 7,940 ML of blended B20. With 219 CCP councils Australia-wide, each council could implement the uptake of 1 ML of B20 per year and still leave 7,721 ML of B20 from domestic feedstocks available for other users.

In Victoria, according to further analyses by CSIRO, there is the potential for waste cooking oil, the cheapest biodiesel feedstock, to provide 20ML of Victoria's annual biodiesel needs. Tallow from Victoria and the south of NSW, could contribute another 134 ML and is the next cheapest feedstock. Victoria's entire oilseed crop, if used solely for fuel, could provide 140 ML of biodiesel. This means that there is theoretically 294 ML of B100 biodiesel available annually in Victoria, or 1,470 ML of B20. If all 65 Victorian CCP councils were to use the 540,000 litres a year that the City of Greater Bendigo uses in its entire depot fleet of 140 vehicles, there would still be 1,435 ML of B20 available for other Victorian users.

This indicates the hypothetical potential for the uptake and impact of domestic biodiesel in Victoria. However, there are competing markets for waste oil and tallow, and obvious issues concerning the use of increasingly limited land and water resources to grow crops solely for fuel. Waste oil even raises some questions concerning the boundaries around palm oil regulations or policies, as a significant proportion of waste vegetable oil is palm oil, though this is perhaps an issue for the broader food industry.

Of course, imported feedstocks could further increase the potential for biodiesel use both in Victoria and Australia as a whole. However, the life-cycle impacts of these feedstocks would have to be known before it was assumed that their use would result in net GHG benefits. Additionally, there is the potential that some second-generation biofuels with fewer direct environmental issues will become commercially available within the next five years. For example, Energetix (Vilo Assets Management Pty. Ltd) intend to establish a trial plant that will harvest microalgae grown on coal-fired power generation flue gas for use in the production of biodiesel. Energetix anticipate that this biodiesel will be commercially available in Victoria in two years [98, 99].

5.1.1.2. GHG Abatement

Many councils have been trialling and using biodiesel as a way of reducing transport emissions and meeting greenhouse gas reduction goals, such as for the CCP program. However, there is as yet no clear consensus as to accurate greenhouse benefits of using biodiesel rather than diesel due in most part to the complexity of life cycle analyses, and the use of differing feedstock and blends (refer to section 2.3.2. and section 3.2.4.2: Measuring and Reporting GHG Emissions).

This uncertainly was reflected through the survey, with several councils regarding the GHG benefits that are ascribed to biodiesel as negligible, or not proportionate to the investment and effort required. The fact that figures for life-cycle analyses can vary quite considerably, for reasons outlined in Chapter 2, further complicates the situation for many of these councils who believe that they "vary too much to be convincing".

"potential GHG abatement [in Victoria] of up to 441,000 tonnes Co2-e".

However, on the flip side, many councils take the stance that it is a good thing for the environment, especially in terms of air quality, and despite uncertainty in quantifying GHG benefits, are prepared to act now and assess these benefits later. Greater certainty regarding greenhouse benefits will increase the uptake of biodiesel, but as the climate crisis deepens, this may also increase uptake through the sheer desire to act and do the right thing.

Based on current knowledge and methods regarding the GHG benefits of domestic feedstocks, if Australia were to use its estimated available capacity of domestically sourced biodiesel (1,588 ML of B100 or 7,940 ML of blended B20), this would provide potential annual GHG abatement of up to 2,500,000 tonnes CO_2-e according to the AGOs emission factors, depending on the blend and the feedstocks (this assumes an average emission factor for B100 across all three feedstocks as no one feedstock could provide the total volume).

In Victoria, the estimated available supplies of used cooking oil (UCO), tallow and oilseed could together displace 6% of Victoria's annual diesel consumption in 2004/05, with potential GHG abatement of up to 441,000 tonnes CO_2-e according to the AGOs emission factors, again depending on the blend and feedstocks (this is based on the emission factors for canola and tallow as they make up the majority of the feedstocks). This is equivalent to taking 88,200 cars off the road for a year.

5.1.1.3. Environmental impact of feedstocks

Several councils demonstrate wariness about committing to a future of increased biodiesel usage that involves unsustainable practices, including the destruction of tropical forests and peatlands for palm oil plantations, use of limited water supplies to grow fuel, and land for fuel competing with land for food. The use of palm oil is a particular concern for many councils, so much so that some have passed resolutions banning its use by their council.

In order to both minimise the potential impact of imported feedstocks and maximise the benefits that can be derived from Australia's domestic capacity, some councils recommend that the use of biodiesel be limited to certain applications. Stuart Nesbitt form Hume City Council, is of the opinion that:

"Sustainable Biodiesel is…a finite resource, and its consumption must be carefully managed to achieve maximum benefit. As a result I now only advocate biodiesel consumption in diesel fleets operating in dense urban environments where improved air quality

is important, or in ecologically sensitive environments. The greatest advantage of biodiesel is in air quality improvements, so the use of Biodiesel as a finite resource should be contained to areas of use where this benefit can be best exploited." (Refer to Appendix J for full case study).

However, others are of the opinion that Australia's biodiesel production and demand is still well short of capacity using domestic feedstocks and such limitations would impede the further development of this industry in Australia. As Peter Dormand from Newcastle City Council states:

"It would be wrong for us as a nation to slow the momentum for uptake before capacity has been reached and our efforts and energy should go into driving the market. We can work out what we're going to do when we can't supply it. At the moment, this is not the case so we need to get on with the job." (Refer to Appendix G for full case study).

Being aware, at this relatively early stage, of the potential implications for Australian biodiesel producers of an unregulated increase in demand, and taking note of recent developments in biofuels policy in Europe, it is perhaps wise to put in place various safeguards as soon as possible both in relation to the best use of Australia's domestically produced biodiesel and the source of supplementary imported feedstocks.

5.1.2. A Biodiesel Mandate

Mandates offer another means, along with tax incentives, rebates and targets, of creating policies to support the use of biodiesel. They consist of establishing, by law, a minimum level of consumption. There are two primary forms such a mandate can take.

The first is a mandated level of national consumption, which could require, for example, that a minimum of 5% of national fuel consumption requirements be met by biodiesel annually. With this type of mandate, there is no stipulation as to the percentage blend that is to be used as long as the total national use equates to 5% at the end of the year. This means that areas with limited biodiesel availability could use a lower percentage blend, say B2, while other areas might be in a position to use a higher blend, say B20 or higher. In this way the mandate can be met in a variety of ways according to the pattern of availability and uptake across the country.

The second type of mandate is a minimum biodiesel blend to be applied nationally for all diesel fuel usage. This would require that all diesel fuel be blended to a minimum level of, for example, 5% biodiesel.

While mandates can certainly create a clear signal in support of biodiesel uptake, there are two main concerns. The first is around feedstock availability. Given that the CSIRO has estimated that 10% of current national diesel consumption could be displaced using domestic feedstocks, a mandate any higher than this will put pressure on domestic resources, could adversely impact on market prices for canola and other oilseed crops and would almost certainly necessitate a growth in imported feedstocks. While this may provide localised GHG and other benefits in the short term, it raises the issues around food vs fuel, life-cycle impacts and fuel security that have been discussed previously. Furthermore, as fuel consumption for transport is expected to increase significantly over the coming years, the potential proportion of Australia's fuel requirements that could be met using domestically sourced biodiesel will decline accordingly.

The second concern is that any mandate would have to be accompanied by price controls to ensure that diesel users were not disadvantaged through being required by law to purchase a higher cost fuel. This might necessitate close control on feedstock prices and regular adjustments, in the form of rebates or grants, in response to fluctuations in the fossil fuel market.

The Biofuels Taskforce reports that biodiesel producers, state governments and members of parliament support the introduction of a biodiesel mandate [17]. However, automotive associations, vehicle manufacturers and, as might be expected, major oil companies are opposed to such mandates, as are livestock industries due to the potential impact on grain prices. Following the recent Parliamentary Inquiry into the Production and/or use of Biofuels in Victoria [93], the committee concludes that the significant growth in Australia's biodiesel industry demonstrates that it is sufficiently viable without further government support in the form of a mandate. However, it does support an extension of the Victorian policy requiring the use of ethanol blends in Government fleets, whenever practicable, to include the use of biodiesel.

Of the 40 councils that responded to the question of a national biodiesel mandate, 55% support a mandated level of biodiesel uptake. The most commonly proposed mandate level was B20, followed by B5, with a few councils calling for higher levels, up to B40. Many councils that support a mandate are unsure at what level this should be set and place certain provisos around its introduction.

Some of these provisos focus on environmental or sustainability issues (note: the following dot points are either quoted or paraphrased from council responses):

- "A level that promotes the use of sustainable biodiesel, but not one that opens the floodgates to imports such as palm oil"
- Support a mandate "…provided there is sufficient Australian based production capacity"
- Support a mandate provided it is "…linked to a sustainable domestic supply"

Others reasons given by councils in support of a mandate include the overall reduction in transport emissions that would follow and that it encourages the use of waste products. However, this report has shown that the volumes of waste oil that are currently available would be quickly outweighed by demand if a significant national-level mandate were introduced. Therefore the implications of meeting this mandate from all feedstocks have to also be considered. From a behavioural point of view, some councils believe that a mandate would overcome existing resistance to change. A progressively higher mandate, spread over five years would, it is proposed, enable the industry and market to adjust gradually to an increase in demand and avoid placing undue pressure on users to meet blend and usage levels until the availability and economics were favourable. The introduction of a biodiesel mandate would need to be accompanied by consumer education to overcome negativity surrounding the fuel's compatibility with diesel engines and other operational characteristics. Existing tax policies that work against transport efficiency and the uptake of alternative fuels would also need to be revised.

Acknowledging the limited availability of domestic feedstocks and aware of the potential to target biodiesel's air quality benefits to the most affected areas, many councils support a mandate targeted at fleet operations only, not for general domestic consumption.

While the majority of surveyed councils do support a biodiesel mandate, there are still 45% that do not. The reasons for this are largely economic, and focus on the points raised earlier regarding the current lack of price controls.

Councils would be disadvantaged if forced to purchase higher cost fuel, and the current lack of availability in many areas, especially rural and remote regions, would push costs up even more. Rather than mandates, some councils believe that more advantageous tax credits and rebate schemes would better support growth in the biodiesel industry and encourage uptake. Such schemes could make biodiesel more economically viable, perhaps even a cheaper fuel option compared with diesel. Under a broader system of credits and rebates, other alternative fuels could also become more economically viable and indeed some councils see fuels such as natural gas, biogas and ultimately hydrogen, as having a longer-term future than biodiesel.

"…many councils support a mandate targeted at fleet operations only, not for general domestic consumption."

A final concern raised regarding a biodiesel mandate is that, like offsets, it would not directly encourage any change in behaviour but is, in effect, a way of carrying on business-as-usual while hopefully reducing the impact of that behaviour. However, as this report has illustrated, Australia's fuel needs for transport are expected to grow considerably and there is the possibility that, without associated changes in behaviour involving fuel efficiency and demand management, any GHG abatement resulting from biodiesel uptake could be negated by an overall increase in fuel consumption.

5.2. Opportunities for a Sustainable Biodiesel Industry

Many councils acknowledge that huge potential exists for biodiesel uptake within local governments, creating opportunities for councils not only to contribute to reduced GHGs and air/water pollution but also to:

- Display leadership to their wider communities and nationally;
- Encourage creativity and openness to new ideas and technologies;
- Reduce reliance on finite fossil fuels;
- Increase security in Australia's ability to produce domestic energy;
- Generate local economic development and employment in regional and rural areas;
- Foster diversity in Australia's domestic markets, and;
- Work collaboratively with various stakeholders and form regional partnerships to facilitate change beyond their council boundaries.

The issues surrounding biodiesel uptake that have been identified by councils at this relatively early stage of the Australian biodiesel industry also present opportunities to review current policies and strategies and make changes that could enable more informed and beneficial decisions to be made regarding biodiesel uptake.

"local governments… [can]…influence the direction that the industry takes from this point onwards."

Councils have themselves suggested several steps that could be taken in this direction, thereby making it easier for them to make these decisions. These include:

- Leadership and support at Federal and State levels;
- Rebates and incentives (i.e. green grants/greenhouse credits & offsets);
- Planning policies to support renewable industries;
- Guaranteed costs and long-term supplies;
- Improved supply structure;
- Reliable data - ICLEI/AGO endorsed;
- More research, information and education;
- Clarity on warranties - both producers' and manufacturers'.

What this indicates is that local governments are thinking ahead and want to position themselves within an appropriate and relatively stable framework that allows them to make optimum decisions, environmentally, economically and socially, regarding council's future fuel use.

The primary opportunity for local governments in relation to biodiesel exists in their being able to influence the direction that the industry takes from this point onwards.

Being held increasingly accountable for their environmental impact and more directly answerable to their communities, local governments could lose considerable standing if the decisions they make regarding biodiesel uptake turn out, under scrutiny, to be either more harmful for the environment or simply replace one set of problems with another.

5.2.1. Local Government Policy Criteria

The issues raised in Chapter 3 regarding GHG abatement, supply, feedstocks, sustainability, costs and efficiency may justifiably lead to uncertainty within local governments about the future of biodiesel.

However, they also provide focal points around which local governments have the opportunity to state what would be an acceptable future industry, such that they, and Australia as a whole, might stand to benefit economically and environmentally.

If local governments place parameters around their support of biodiesel now, for instance by requiring guaranteed fuel standards, feedstocks, sources of feedstocks and supply guarantees, then the industry is more likely to develop according to these parameters. If the industry is unable to meet these parameters, then this will indicate that, in its current guise, the industry is not providing a viable alternative to normal diesel, either in terms of reducing the impact of fossil fuels on our environment or adequately addressing issues of fuel scarcity and/or security.

There are precedents and possible models already emerging for this type of pro-active engagement.

The Netherlands' new position, and also the UK government's new reporting and certification framework for biofuels (see Chapter 2, Information Box 1), are indications that industry practices are ultimately controlled by what the market determines is acceptable.

Australia needs to start looking ahead, taking note of the trends already emerging in Europe, and position itself to establish an appropriate framework for its biodiesel industry from, almost, the ground up. The Netherlands has also established the world's first guidelines for the production of biofuels, which, along with the UK's new system, could form the basis of just such a framework. These guidelines include criteria for the impacts on GHG emissions, local food supplies and prices, biodiversity, water supplies, soil quality and social well being of workers. If limited domestic supplies mean that imported palm oil is set to become a necessary component of Australian biodiesel, then local governments are increasingly reflecting that some kind of TBL framework is needed to ensure this, or indeed any biodiesel feedstock, is not causing more environmental harm than the original diesel fuel.

Local governments can take each of the uncertainties around the future of biodiesel and turn these into the bases of a regulatory framework by incorporating them into council policies and contracts. To this end, possible questions that could be asked towards the formulation of such council policies and contracts are:

GHG abatement

What are the optimum blend and the optimum feedstocks for maximum GHG abatement, also taking into consideration other emissions and the most appropriate application in terms of their impact, ie. urban, rural, fleet only etc.?

Supply

What level of demand can be reasonably met with a guaranteed supply? Given this level, what is the most appropriate application for maximum benefit?

Feedstocks

What is the preferred order of hierarchy of supply for feedstocks? Should there be a limit on the proportion of domestic oilseed for fuel to control price competition with grain for livestock and food? Are the feedstocks sourced locally, interstate or overseas? Under what conditions?

Sustainability

Are the feedstocks produced sustainably and with minimal harm to the environment? How is this ascertained? Is this guaranteed or certified?

Costs

Does the current legislation act as a disincentive to the use of alternative fuels and vehicle efficiency? Can council take any action to address this?

Efficiency

Are transport efficiency and reducing fuel demand given at least equal emphasis and support as the uptake of alternative fuels?

Ideally, more emphasis should be given to transport efficiency and reducing fuel demand than the uptake of alternative fuels as these measures should reduce the amount of alternative fuel that needs to be purchased.

5.2.2. Local Economic Development

The emergence and establishment of renewable/sustainable-focused industries in a certain area can lead to similar businesses being attracted to the same area, based on the assumption that there is local awareness around such goods and services and therefore the market is more accessible. Often flagship businesses or industries, such as biodiesel, or in the case of Portland Victoria, a wind farm blade factory [94], can be catalysts for this kind of development and as more businesses are attracted, mutually reinforcing supply chains can develop around supporting their specific needs and markets.

It is difficult in these early stages of Australia's biodiesel industry to accurately assess the long-term impact that local government uptake could have on local economic development. However, the increased demand from local governments in Victoria is almost certainly a contributing factor in the expansion of existing producers/suppliers from other States and the establishment of new enterprises within Victoria. This is leading to the creation of additional jobs for a domestic market that previously did not exist, being met almost solely through imports. A US University of Missouri study has estimated that the production of approximately 380ML of biodiesel can generate an increase of AU$10 million in personal income and an additional 6,000 jobs [95].

"…the creation of additional jobs for a domestic market that previously did not exist…"

For local governments that have adopted a regional development model, encouraging this kind of development can be part of a broader strategy that may focus on creating a hub for sustainable businesses.

Local economic development can be a positive outcome of biodiesel uptake and local governments can play an instrumental role in maximising the benefits through effective research and planning. As facilitators of this kind of development, local governments can seize the opportunity to act as information brokers, demonstrating leadership for further uptake within the community, as well as support for existing and new businesses. This could take the form of campaigns, workshops or forums that foster networking and partnerships between businesses and the community. Such partnerships often bring the potential to link to funding opportunities and attract investment from research and development bodies. Ultimately it can be seen how such an area could develop into a 'centre of excellence' for renewable/sustainable resources.

This model can be expressed in a variety of ways and the council context will be a significant determinant of the actual outcome. For instance, the resources available in a rural council, which may be a centre for agricultural activity, are very different from those of an urban council, which may be a regional transport hub. Capitalising on the local resources and perceived needs in each case will require different planning processes and produce different results. However, in both cases, the uptake of biodiesel is feasible and the previous examples of local economic development in relation to biodiesel demonstrate the potential added value of such a project beyond the environmental and possible short-term financial benefits. As Hobsons Bay City Council indicates, with reference to their planned and soon-to-be implemented joint biodiesel project with Hume and Ballarat City Councils:

"…economically, it would open new markets for farmers and potentially lower the fuel costs for transport companies; socially, it may create new employment opportunities in Buloke; environmentally, it would greatly improve air quality in Hobsons Bay and the lower the community's greenhouse gas emissions."
(Matt Aquilina, Hobsons Bay City Council).

5.3. Future Developments in Biodiesel

As well as formulating plans and policies based on the current state of the biodiesel industry in Australia and other parts of the world, it is also important to consider the possibility of new developments in the future.

Second generation fuels are already being developed and these could significantly influence the future of biodiesel in Australia as most of them require much reduced energy investment compared with energy return and therefore produce lower life-cycle emissions. Some of these biodiesel sources also avoid issues of food vs fuel as they are not competing for the same land or resources and can even make use of arid, high saline regions with formerly no economic value. Others make further use of our society's increasing volumes of waste, in the form of sewage and plastics. Some of the potentially more viable feedstock sources currently being investigated and, in some cases, already under production, include jatropha, mustard and algae (from sewage as well as microalgae). For most of these second generation biofuels, it is likely to be between five to ten years before they are commercially available, although biodiesel producers in some areas are progressing faster in this direction with Energetix in Victoria (contracted biodiesel supplier to the Cities of Ballarat, Hobsons Bay and Hume) expecting their microalgae-sourced biodiesel to be commercially available in two years [98].

These developments could significantly alter the outlook for biodiesel, both economically and environmentally, creating opportunities to address some of the challenges that this fuel currently presents. This leads to a final point regarding the future of biodiesel.

In their 2005 report, the Biofuels Taskforce states that new biodiesel production appears to be uneconomic in the long-term, and to remain viable after the 19c/L production grant ceases (2015) would require subsidies of between 21 and 32 c/L [17]. Also:

"Greenhouse gas benefits alone would not warrant further assisting biofuels, given the availability of much cheaper carbon reduction options"

Weighed carefully against environmental implications, the decision of whether or not to support biodiesel does not rest solely on economics. As Peter Dormand says:

"One of the most positive outcomes of Newcastle's biodiesel project was the increased confidence to tackle new things, to look for and try alternatives."
(Refer to Appendix G for full case study)

In the current world situation with fast approaching dangerous levels of atmospheric CO_2, and with transport as one of the largest, and fastest growing, contributing sectors, there will need to be a radical change in transport behaviour over the next two decades. A readiness and flexibility to try new things and remain open to constant improvements and developments will create more opportunities for creativity to be tested and for effective solutions to emerge faster than if they were met too soon with scepticism and resistance.

> "…the unquantifiable benefits of supporting and encouraging innovation and flexibility must not be overlooked."

In terms of dollars per tonne of GHG emissions, some councils argue that there are more effective means of achieving abatement, particularly if further support in the form of tax incentives, rebates, grants and price regulations are required to encourage more widespread production, supply and uptake. Currently, as is evident from experienced councils, there is proportionately very little initial investment required from councils in order to implement biodiesel uptake, and after this initial investment, the annual GHG savings are effectively at no extra cost. However, even if this were not the case, our transport infrastructure and patterns of behaviour are so heavily entrenched, and this sector accounts for such a significant and increasing proportion of fossil fuel emissions, that the unquantifiable benefits of supporting and encouraging innovation and flexibility must not be overlooked.

5.4. Conclusion

To constitute a viable alternative to normal diesel fuel, biodiesel ought to be less harmful to the environment and have fewer issues around fuel scarcity and/or security.

This report has highlighted that biodiesel has many practical advantages over normal diesel in terms of safety, toxicity, biodegradability, emissions, and elements of vehicle performance. There are few practical problems that may be associated with biodiesel uptake besides the initial fuel filter changes (not regarded as a problem by any experienced councils), an increase in NOx emissions (technologies are currently being researched to address this) and the possibility of slightly reduced power with blends above B50. However, biodiesel can present several regulatory, managerial and administrative challenges for councils in relation to the fuel itself - feedstocks, supply, availability, standards, sustainability and life-cycle impacts, as well as its implementation - resistance, funding, warranties, tax credits and emissions monitoring/calculations. Unlike practical problems, of which there are few, all of the regulatory, managerial and administrative challenges in relation to biodiesel uptake are either subject to change and, ideally, improvements or within councils' power to influence.

This highlights the fact that there are currently no prohibitive barriers to local government uptake of biodiesel. There may be barriers that, depending on the situation, present councils with varying degrees of challenge. However, these also present opportunities for councils to identify the areas where they need to exert greater control and demand clearer signals from both industry and government regarding the future of this fuel. A clear opportunity exists in the fact that the industry is expanding significantly and demand has not yet reached Australia's capacity for biodiesel production using just domestic feedstocks.

CSIRO estimated that biodiesel produced using domestic feedstocks could potentially offset approximately 10% of Australia's annual diesel usage and 6% of Victoria's. If deployed in the most effective manner, this could form an important component of Australia's future domestic fuel security, which will most likely be comprised of a suite of alternative options, rather than just one. It would at least ensure that essential services could be maintained in the event of a shortage of fossil fuels.

The degree to which biodiesel can offer local governments an environmentally preferable alternative to normal diesel differs depending on its production and use. As Tim Grant from CSIRO says, it cannot be regarded as an 'environmentally friendly' fuel in terms of full life-cycle analysis as there are, at the present time, no environmentally friendly fuels, given that they all result in the addition of more GHGs to the atmosphere than there were to begin with. However, biodiesel could, under certain conditions, offer a more acceptable interim option, that at least contributes fewer GHGs and improves air quality, until such time as more advanced, ideally carbon-neutral transport technologies become commercially viable.

There is currently a prime opportunity for local governments in Australia to address the challenges, and also frame or define the opportunities that biodiesel presents through being pro-active in setting conditions or parameters around local government uptake and thereby influencing the way the industry unfolds from this point forward.

In setting these parameters, local governments will need to weigh current and future opportunities for biodiesel uptake against changing environmental, social, economic and ethical implications surrounding its production and supply processes.

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98. Australian Broadcasting Corporation (ABC) News, 2007, Green service station opens in Vic. Lateline Business. Reporter Stephanie Ferrier, July 26 2007. www.abc.net.au/lateline/business/items/200706/s1962973.htm

99. Energetix, 2006, Submission to the Victorian Parliamentary Inquiry in to the Production and/or use of Biofuels in Victoria. www.parliament.vic.gov.au/enrc/inquiries/biofuels/submissions.html

Appendix A. Useful Links

Energy Balance

http://en.wikipedia.org/wiki/EROEI

2006 Worldwatch Institute (WWI) report
www.worldwatch.org/taxonomy/term/445

Fuel Supply & Standards

Camden Council biodiesel reports:
www.camden.nsw.gov.au/page/biodiesel_project.html

Updates of progress towards setting biodiesel standards and a summary of the current biodiesel fuel quality standard can be obtained via the DEWR website:
www.environment.gov.au/atmosphere/fuelquality/standards/biodiesel/index.html
www.environment.gov.au/atmosphere/fuelquality/standards/biodiesel/summary.html

The Biodiesel Association of Australia and Australian Biofuel Users are good places to keep track of activities and developments with regard to Australian biodiesel standards.

Biodiesel Association of Australia
www.biodiesel.org.au/

Australian Biofuel Users
www.biofuel.org.au/

Federal Chamber of Automotive Industries.
Capability of vehicles to satisfactorily operate on Ethanol Blend petrol:
http://www.fcai.com.au/ethanol.php/2007/05/00000005.html

ATO Tax Credits

“Biodiesel - fuel tax credits and fuel grant entitlements” (Factsheet number 16229)
www.ato.gov.au/businesses/content.asp?doc=/content/80526.htm

“Alternative Fuels” (Factsheet number 15227)
www.ato.gov.au/businesses/content.asp?doc=/content/82426.htm

Emissions

CSIRO (2000). Life-Cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles – Stage 1. Tom Beer, Tim Grant, Richard Brown, Jim Edwards, Harry Watson & David Williams.
www.greenhouse.gov.au/transport/publications/lifecycle.html

US National Biodiesel Board
www.biodiesel.org/

Australian Greenhouse Office (AGO) Factors and Methods Workbook
www.greenhouse.gov.au/workbook/index.html

Camden Council’s emissions analyses and project reports are available on-line at:
www.camden.nsw.gov.au/page/biodiesel_project.html

Appendix A. Useful Links

Other Emissions

Biofuels Taskforce Report
http://www.pmc.gov.au/publications/biofuels_report/index.cfm

Review of United Nation's report on Bioenergy:
www.biofuelreview.com/content/view/957/

UK Government reporting and certification scheme
www.ecofys.com/com/publications/brochures_newsletters/Ecofysnewsletter/newsletter_may2007.htm

Biodiesel Association of Australia (BAA) guidelines for "Creating a Sustainable Biodiesel Industry in Australia". These can be found under 'sustainability' on their home page:
www.biodiesel.org.au/

Palm Oil Info Box Links

Roundtable on Sustainable Palm Oil
www.rspo.org/default.aspx

Biodiesel General

Biodiesel Association of Australia
www.biodiesel.org.au/

Journey to Forever. Biodiesel
journeytoforever.org/biodiesel.html

National Biodiesel Board (US site).
Link to a list of factsheets with a wide range of topics including biodiesel basics, performance and usage, health and environment, engine manufacturers and production.
www.biodiesel.org/resources/fuelfactsheets/default.shtm

European Union Refuel Project.
www.refuel.eu/home/

Biodiesel: A Fuel for the Future. Robert Passey, Masters Thesis. Murdoch University. WA.
www.sustainability.dpc.wa.gov.au/CaseStudies/biodiesel/biodiesel.htm

Biodiesel Encyclopaedia
www.castoroil.in/reference/plant_oils/uses/fuel/bio_fuels.html

Calais, P., Sims, R. A., 1999, A comparison of life-cycle emissions of liquid biofuels and liquid and gaseous fossil fuels in the transport sector, Renewable Energy Transforming Business, Murdoch University, Perth.

Cities for Climate Protection, Australia (CCP-Au). Link to the Biodiesel Project web page, which includes information on the research process and outcomes, report downloads, case studies and supplementary tender documents from EPA Victoria.
http://www.iclei.org/index.php?id=7076

Appendix B. Tables and Figures

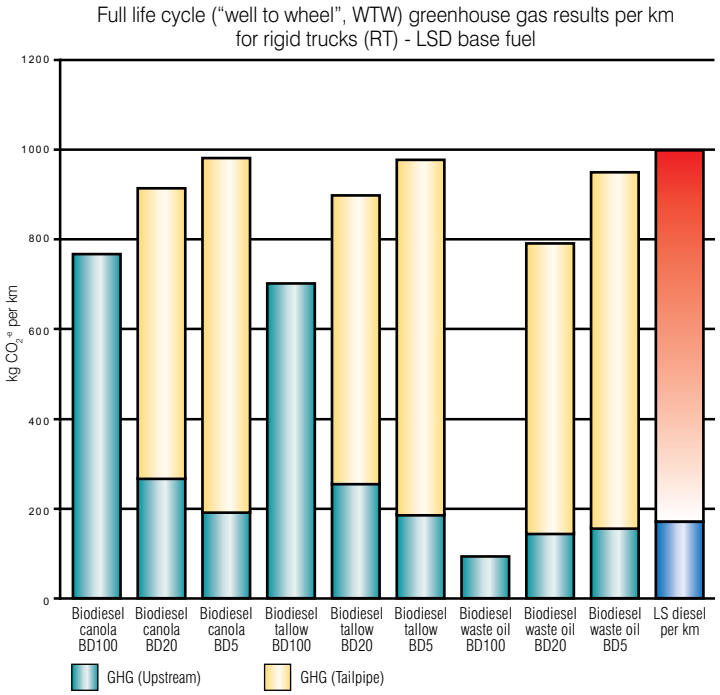

Figure A1. Full life cycle GHG emissions from B100, B20, and B5 as compared to Low Sulphur Diesel.
Source: Beer et al (2003)[75].

	B100 (Canola)	B100 (Tallow)	B100 (UCO)	B20 (Canola)	B20 (Tallow)	B20 (UCO)
CO	-27.24	-36.7	-46.91	-16.08	-17.74	-19.54
Nox	16.79	15.33	4.1	2.51	2.25	0.27
PM	-15.14	-15.83	-23.4	-13.18	-13.72	-16.54
VOC	-26.11	-29.2	-45.24	-4.37	-4.5	-5.81

Table A1. Percentage changes in LCA emissions of carbon monoxide, oxides of nitrogen, particulate matter and volatile organic compounds with B100 and B20 as compared with ULSD.
Source: Biofuels Taskforce Report (2005) [17].

Council/ Emissions	Newcastle B20 (UCO) Average over 12 different vehicle types	Camden B100 (UCO) Waste Collection Trucks	Noosa B20 (Tallow) 1 waste truck & 2 others	Noosa B20 (UCO) 1 waste truck & 2 others
CO_2	-0.8	-3.8	-0.1	-3.2
Nox	+7.2	+6.6	+11.0	-36.6
PM	-38.5	-90.9	-60.8	-61.1
HC		-67.7		
VOC		-22 - 65		
SMOKE OPACITY	-30.4	-78.7	-38.2	+50.0
PAH		-75		

Table A2. Percentage Changes in Tailpipe Emissions from biodiesel as compared with diesel based on council emissions tests.
Source: Council reports.

Note: The figures in Table A2 are intended as a guide only and are not directly comparable due to differences in the vehicles, blends and feedstocks used and the testing conditions. Furthermore, some councils noted anomalies in their results and these have been highlighted in their detailed reports with attempts at explanation. It is recommended that the council reports, available either from the council website or by contacting them directly, be consulted in order to fully appreciate and understand the context of these figures.

Feedstock	FFPP˚C	Cloud Point ˚C	Pour Point ˚C
Diesel	*-20*	*-18*	*-27*
Canola	-4	-3	-4
Soy	-2	2	0
Palm	na	12	12
Tallow	10	14	na
Canola B20	-11	-15	-18

Table A2. Fuel Filter Plugging point, Cloud point and Pour point, in °C for diesel and various biodiesel feedstocks. **Source:** DTA, 2006 [97]

Fuel/Feedstock	CSIRO	Journey to Forever	Calais & Sims
Diesel	*51 - 58*		*40*
Sunflower Oil	49	52	
Soybean Oil	46	53	~56
Canola			40 to 50
Palm Oil	62	65	>59
Tallow	58	75	>70
Biodiesel - Average	55		45 to 65

Table A3. Cetane numbers for diesel and various biodiesel feedstocks.
Source: CSIRO (2001) [22], Calais & Sims (2002) [98], Journey to Forever [99].

Appendix C. Quick Reference Summary. Benefits and Issues Associated with Biodiesel Uptake

This summary is designed to provide councils with a simplified overview of the basic benefits and issues associated with biodiesel uptake. Further information regarding these points can be found in the main document.

Benefits

Environmental benefits

- Reduces life-cycle greenhouse gases (GHGs): approximately 69-90% for B100; 12-18% for B20;
- Reduces particulate matter (PM) by 30 - 60%;
- Reduces visible black smoke, caused by larger particulates such as soot, by approximately 30%;
- 50% less lower atmosphere ozone potential than normal diesel (results in photochemical smog);
- 90% reduction in cancer risk over normal diesel, according to BAA due to reductions in both PM and polycyclic aromatic hydrocarbons (PAHs);
- Improved community health due to the reduced risk of cardiovascular, respiratory illnesses resulting from reductions in both hydrocarbons (HCs) and PM;
- Biodegradeable;
- Non-toxic;
- Reduces waterways pollution;
- Diverts waste oil and tallows from landfill.

Economic and Market benefits

- Potential to be a completely domestic fuel, thus increasing fuel security;
- Diversion of import expenditure to a domestic market;
- Creation of additional employment opportunities;
- Creates new markets and opportunities for local industry;
- Reduces government and industry disposal costs.

Operational benefits

- Requires no vehicle modification as a replacement in diesel vehicles;
- Increases fuel lubricity which can extend engine life;
- Has a high cetane number which:
    - Improves auto-ignition
    - Increases combustion
    - Decreases engine 'knocking'
- All biodiesel blends up to B100 produce no perceptible difference in power and torque to normal diesel. There is little change in fuel consumption with B20, although with higher blends, fuel consumption can increase slightly, up to between 3% and 25% for B100, according to different studies and types of test;
- Safer to handle and transport;
    - High flash point, reducing the chance of accidental combustion
- Produces a less pungent odour compared to diesel.

Other

- Encourages innovation and flexibility in Australia's fuel usage;
- Displays leadership in tackling GHG emissions and transport habits in general.

Appendix C. Quick Reference Summary. Benefits and Issues Associated with Biodiesel Uptake

Issues

Management issues

- Resistance from staff, management and/or upper management/executive;
- Funding for the allocation of staff time and resources, and, if required, for upgrading existing, or installing new infrastructure;
- Assessing alignment with current purchasing and/or environmental policies;
- Developing tenders and contract agreements for fuel supply;
- Establishing project monitoring, measurement and evaluation procedures;
- Lack of certainty regarding the future of the industry.

Regulatory Issues

- Lack of a regulatory system for monitoring and certifying imported feedstocks to ensure they are from environmentally sustainable sources;
- Perceived lack of regulatory support for biodiesel uptake at State and Federal levels, either via policies or financial incentives;
- Obtaining fuel of a certified quality based on Australian standards;
- Securing warranties from fuel suppliers and vehicle manufacturers;
- Assessing eligibility for tax credits;
- Life-cycle analyses still in early phases - emission factors and GHG abatement calculations are not yet conclusive and do not include all methods of production.

Technological issues

- Securing a guaranteed reliable and long-term supply;
- Ascertaining types and sources of feedstock to assess climatic suitability and environmental impact;
- May need to consider different blends to suit climate as incorrect choice of feedstock may impact on reliability;
- Cannot be stored longer than one year;
- Solvency 1: removes deposits left by diesel. Existing storage tanks need to be cleaned prior to installing biodiesel Filters need to be changed more frequently at first, until storage and/or engine system cleaned;
- Solvency 2: Biodiesel at higher blends can react with elastomers and natural rubber compounds over time. The BAA recommends that they be replaced with suitable elastomers;
- Hygroscopic: Biodiesel can absorb water from its surroundings and draw moisture from the atmosphere, which can cause contamination. Need to ensure cleaned tanks contain no water prior to installing biodiesel and that all seals are secure;
- Slightly higher fuel consumption for higher percentage blends (between 3% and 25% for B100 according to different studies and tests) though no noticeable difference in power. Negligible change in fuel consumption for B20;
- Increased emissions of oxides of nitrogen (NOx), a highly reactive group of gases. Research is progressing on cetane enhancers and other methods of reducing these emissions from biodiesel.

Appendix D. Council Checklist for Biodiesel Uptake

This checklist is intended for use by Australian local governments to assist with the planning and implementation of a successful biodiesel project. It is based on comprehensive research carried out as part of this report, which includes the experiences and insights gathered from 50 Australian councils.

For three stages of project management - planning, implementation and outcomes, there is a section consisting of a series of questions that can assist councils to frame the structure of their project at each stage. These questions have also been designed, based on industry research and council experience, to increase the likelihood that the project is successful and achieves optimum results in terms of environmental, economic and social outcomes.

Further background and information regarding these questions can be found in the main document, particularly Chapter 2, Local Government Experience and Learnings, Issues Associated with Biodiesel Uptake, Council Concerns, and Chapter 3, Opportunities for a Sustainable Biodiesel Industry.

Planning

	Have you researched the use of biodiesel in other councils and more generally?
	Do you have upper management/executive support?
	Do you have inter-departmental support?
	Do you have a project team that includes all relevant players and departments, i.e. Fleet, Environment, Purchasing, Contracts, Finance, and others?
	Have you raised awareness and educated whole of council about the project?
	Have you acknowledged the role of the original champion, if there is one?
	Have you established council's primary motivations for using biodiesel?
	Have you acknowledged and addressed the expectations of all involved?
	Does council have a purchasing policy or environmental guidelines for the purchase of preferred products?
	Have you established the optimal blend and level of deployment to meet desired outcomes?
	Have you done a cost/benefit analysis that includes GHG abatement, health and other environmental considerations as well as conversion costs (infrastructure, tank cleaning etc.)?
	Are efficiency measures being considered/implemented alongside the uptake of alternative fuels?

Appendix D. Council Checklist for Biodiesel Uptake

Implementation

	Have you ascertained whether biodiesel is a viable fuel option in your council area?	
		Is there a local supplier?
		What will be the cost as compared with normal diesel?
		Does council currently have adequate storage facilities?
		Will there be additional infrastructure costs, ie. storage tanks, cleaning?
		Is there funding available?
		Is there the opportunity to partner with other councils?
	Is the fuel certified to Australian standards?	
	Does the supplier provide a warranty on their fuel?	
	Can the supplier provide a guaranteed percentage blend with each delivery?	
	Can the supplier tell you the feedstocks and proportions of each that comprise their biodiesel?	
	Can they tell you the source of these feedstocks - local, interstate?	
	Are the source and type of feedstocks likely to vary?	
	Is the supplier likely to use imported feedstocks?	
	Does the supplier have an environmental policy around their feedstocks?	
	Is your council in an area that may need to consider seasonal blends?	
	Have you stipulated adequate terms in your supply contract to cover council's environmental, social and economic requirements? Consider your current and potential future reporting requirements.	
	Have you checked your warranty agreements, both with fuel suppliers and vehicle manufacturers?	
	Have you considered establishing a batch testing procedure for each delivery?	
	Have you considered installing filters at the bowser?	
	Have you prepared those involved for initial filter changes?	

Outcomes

	Do you have adequate systems in place to monitor progress and measure outcomes?
	Does council want to place signage on the vehicles involved?
	Has council considered a community meeting, press release or other means of publicising their motivations and decision-making process?
	Have outcomes been weighed against the original motivations and expectations for the project?
	Will project outcomes be communicated adequately to all those involved, the whole of council and the community?
	Does the assessment of the project's success incorporate the potential for future developments and improvements with second-generation biodiesel?

Appendix E. Australian Local Government Biodiesel Projects

The following table provides a list of all known local governments in Australia that have implemented biodiesel usage at their councils, either in the form of trials or permanent uptake, or that have carried out extensive research as part of the pre-implementation phase of their projects.

This information enables local governments that are investigating biodiesel to assess the extent and range of biodiesel uptake that has already taken place and identify councils of a similar size, location or situation that have found it to be an appropriate fuel for their needs. All of these councils have agreed to share information with other CCP local governments.

Of the five councils classified as 'researched', three are in Western Australia, where it is claimed there have been problems around supply and consequently, there is as yet no planned implementation date. The two remaining councils are in Victoria, one of which is Benalla Rural City, which recently passed a council resolution to begin their biodiesel trial over the coming months. The other is the Shire of Yarra Ranges whose project, as part of the Mount Evelyn Biodiesel project, is no longer going ahead due to changes in tax laws for producers. However, their knowledge, and insights, regarding biodiesel uptake, as well as those of the WA councils, are still valuable and these councils may find alternate suppliers that will enable them to implement their projects in the future.

The Victorian Northeast Greenhouse Alliance (NEGA) and Central Victorian Greenhouse Alliance (CVGA) are both currently involved in research and investigation into the viability of biodiesel uptake for their member councils.

Council	Blend	Vehicles	Implemented or Researched
VICTORIA			
Hume	B20	97 heavy & light commercial fleet	Implementation June/July 2007
Hobsons Bay	B20	Unknown	Implementation July/August 2007
Ballarat	B20	Unknown	Implementation July/August 2007
Bendigo	B5/20	140 vehicles – whole depot fleet	Implementation July/August 2007
Benalla	B20	All plant vehicles	Researched 2006
Yarra Ranges	B20	60 depot & plant vehicles	Researched 2007
Darebin	B20	11 tippers, mowers & tractors	Implemented 2007
La Trobe	B20	2 street sweepers	Implemented 2004
NEW SOUTH WALES			
Newcastle	B20	212 depot vehicles	Implemented 2002
Sydney	B50	164 major plant, heavy & light fleet	Implemented 2005
Bankstown	B20	64 depot vehicles – tractors, trucks and earth movers	Implemented 2006
Marrickville	B20	4 trucks – tippers & compactors	Implemented 2007
Leichardt	B20/50	55 vehicles, tippers, small equipment & compactors	Implemented 2006
Manly	B20	4 community buses	Implemented 2006
Gosford	B100	3 depot vehicles	Implemented 2002
Camden*	B100	2 waste vehicles	Implemented 2003
SOUTH AUSTRALIA			
Onkaparinga*	B100/20	23 trucks (garbage/recycling & greenwaste)	Implemented 2003
Adelaide	B20	200 vehicles – whole depot fleet plus generators	Implemented 2005
Norwood Payneham & St. Peters	B20	10 depot vehicles	Implemented 2005
WESTERN AUSTRALIA			
Cambridge	B20/30	15 depot vehicles	Researched 2006
Canning	B20	20-25 tractors & mowers	Researched 2005
Melville	B100	1 truck	Implemented 2003
Fremantle	B100	7 mowers and streetpath sweepers	Implemented 2002/03
Gosnells	B20	Unkown	Researched 2006
QUEENSLAND			
Townsville	B20/100	9 trucks, backhoes & light vehicles	Implemented 2004
Brisbane	B20, 50 & 100	2 mono hull ferries	Implemented 2006
Noosa	B20	4 light truck, waste trucks and 4x4.	Implemented 2005

Appendix F. Council Surveys.
Local Government Biodiesel Survey 1

ICLEI-A/NZ is currently researching a guide "Biodiesel and Local Government", funded by the Victoria State Government, Department of Sustainability and Environment. The guide is due to be completed by June 2007. To provide the most current knowledge and advice, we have designed a survey for Australian councils who have (or are in the process of) implementing a biodiesel project/initiative.

The aim of this survey is to assist ICLEI-A/NZ in developing a guide that will empower local governments in Australia to make appropriate decisions regarding the uptake of Biodiesel. To achieve this, we are seeking information on:

- The background of Council's project/initiative;
- The steps taken to establish and sustain the project initiative;
- Project outcomes; and
- Lessons learnt.

We ask that you take some time to fill in this survey with your experiences. The information you provide will be used to compile overall learnings, and ICLEI-A/NZ may request that we follow up some details with the view of creating case studies.

Your assistance is greatly appreciated and will be valued by all CCP councils.

Instructions:

- This is an electronic survey. Type your answers in the grey, shaded boxes; the boxes will expand as you type, so you can make your answers as long as you wish. Clicking in the "check boxes" will check or uncheck them.
- Please return the completed survey, together with any supporting materials, to:

Paula Arcari
CCP State and Biodiesel Project Manager
E: paula.arcari@iclei.org
P: 03 9660 2280

Appendix F. Council Surveys.
Local Government Biodiesel Survey 1

Name:_____ Council:_____

Position at Council:_____

Summary

1. Please describe the nature of the biodiesel project or initiative undertaken at Council eg. Description, start date, duration, research or action, number and type of vehicles etc.

Description (research or action): Vehicles (number/type):

Start Date (and finish, if trial): Percentage mix:

Source (supplier & feedstock): Average fuel consumption/yr:

Getting Started

2. Using the graded responses below, please indicate how important the following motivations were for undertaking this project. What was it that actually convinced council to proceed? (Please indicate in the comments box).

Motivation	**Very Important**	**Somewhat Important**	**Not too Important**	**Not at all Important**
Reducing fossil fuel use/reliance	☐	☐	☐	☐
Reducing greenhouse gases	☐	☐	☐	☐
Reducing pollution (air/waterways)	☐	☐	☐	☐
Financial Savings	☐	☐	☐	☐
Contribute to council abatement goals	☐	☐	☐	☐
Support domestic & local economic development	☐	☐	☐	☐
Community health benefits	☐	☐	☐	☐
Other	☐	☐	☐	☐

Comments:_____

3. What information was necessary to get the project/initiative up and running? How did you go about sourcing this information? Was this easy?

Answer:_____

4. Did you encounter any resistance within Council? What form did this take and how was it addressed? If not, what was pivotal in this?

Answer:_____

5. Do you work/have you worked with other councils in any way, on this or other projects, perhaps as part of a regional group? If so, please describe the collaboration. If not, would this be an option for the future?

Answer:_____

Project Support

6. Stakeholders (please provide position, title and department):

- Who initiated the project and who managed it (if different)?
- Were other Council staff involved? Who, from which departments?
- Was there Executive and/or Elected Member support for the project? What form did this support take and how was it obtained?

Initiated: _____

Managed:_____

Involved:_____

Support: _____

7. Who supplies/supplied the biodiesel for this project? What were the reasons for choosing this supplier? Is the source of feedstock a factor in Council's choice of biodiesel?

Answer:_____

8. Would your council be opposed to sourcing Biodiesel produced from imported Palm Oil?

Yes: ☐ No: ☐

Why?:_____

9. Were any logistical problems encountered during the project/initiative in relation to funding, fuel supply or technology issues? What were they, and what was the outcome?

Answer:_____

Project Outcomes and Learnings

10. Have you observed any benefits from using biodiesel at Council? What are they?

Answer:_____

11. Overall, what were the key success factors of the project/initiative?

Answer:_____

12. How would you rate the significance of the following factors as **barriers/obstacles** to the implementation and successful outcome of your biodiesel project?

Issue	Very Significant	Significant	Somewhat Significant	Not Significant
Capacity/Supply	☐	☐	☐	☐
Fuel Standards	☐	☐	☐	☐
Warranties	☐	☐	☐	☐
Tax Credits	☐	☐	☐	☐
Emission Factors	☐	☐	☐	☐
Other	☐	☐	☐	☐

13. With reference to the main barriers/obstacles of your project/initiative, what were they, what impact did they have and, if relevant, how were they addressed? What would you do differently next time?

Barrier/Obstacle	Impact	How Addressed	What to do Different
1._____	_____	_____	_____
2._____	_____	_____	_____
3._____	_____	_____	_____
4._____	_____	_____	_____

14. What opportunities do you see for the biodiesel industry in relation to local government?

Answer:_____

Are there any external and/or internal changes that you think would be either necessary or desirable in order to better realise these opportunities?

Answer:_____

15. Do you envisage biodiesel playing a significant role in council fuel usage in 2010?

Yes: ☐ No: ☐

16. In your personal opinion, should there be a mandated level of Biodiesel usage in Australia?

Yes: ☐ No: ☐

What level? Why?: _____

17. Do you have any other comments you would like to add?

Answer:_____

OTHER INFORMATION

18. Are there any reports or documents available that you would be willing to provide to ICLEI-A/NZ?

Answer:_____

19. Do you give permission for ICLEI-A/NZ to cite this material for the Department of Sustainability and Environment Biodiesel Project report "Biodiesel and Local Government" and other ICLEI-A/NZ programs?

Yes: ☐ No: ☐

20. Do you give permission for other CCP councils to acquire access, on request, to the information and materials provided in this survey?

Yes: ☐ No: ☐

Thank you for your time.

Appendix F. Council Surveys.
Local Government Biodiesel Survey 2

ICLEI-A/NZ is currently researching a guide "Biodiesel and Local Government", funded by the Victoria State Government, Department of Sustainability and Environment. To provide the most current knowledge and advice, we have designed a survey for any Australian councils who have not implemented a biodiesel project at Council. If your council has implemented a Biodiesel project at any time, please inform your State Manager and an alternate survey will be forwarded to you.

The aim of this survey is to assist ICLEI-A/NZ in developing a guide that will empower local governments in Australia to make appropriate decisions regarding the uptake of Biodiesel. To achieve this, we are seeking information on

- Council perceptions of biodiesel;
- The opportunities and challenges for uptake; and
- Current trends and likely future developments.

We ask that you take some time to fill in this survey with your thoughts and experiences. The information you provide will be used to compile overall learnings, and ICLEI-A/NZ may request that we follow up some of the details you provide.

Your assistance is greatly appreciated and will be valued by all CCP councils.

Instructions:

- This is an electronic survey. Type your answers in the grey, shaded boxes; the boxes will expand as you type, so you can make your answers as long as you wish. Clicking in the "check boxes" will check or uncheck them.
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Appendix F. Council Surveys.
Local Government Biodiesel Survey 2

Name:_____ Council:_____

Position at Council:_____

Background

1. Please indicate whether your Council has:

☐ Tried to implement a Biodiesel project.
Please give details on the planned project (number/type of vehicles, Biodiesel blend etc.). What happened?
NOTE: If Council was able to partially/fully implement a biodiesel project, stop filling out this survey and request a survey for councils that have developed a biodiesel project.
Details:_____

☐ Considered Biodiesel uptake as a possibility.
Please explain (what type of project are you considering/considered?)
Details:_____

☐ Never considered using Biodiesel.
Please Comment:_____

☐ Would not use Biodiesel.
Why Not?:_____

☐ Other.
Please Comment:_____

2. If you have some knowledge of Biodiesel usage, what are your principal sources of this information?
Was this information easily obtained?
Answer:_____

Council Uptake

3. What benefits, if any, do you perceive there are in the uptake of Biodiesel?
Answer:_____

4. Using the graded responses below, please indicate what would be the key motivations for implementing a biodiesel project at your council?

Motivation	Very Important	Somewhat Important	Not too Important	Not at all Important
Reducing fossil fuel use/reliance	☐	☐	☐	☐
Reducing greenhouse gases	☐	☐	☐	☐
Reducing pollution (air/waterways)	☐	☐	☐	☐
Financial Savings	☐	☐	☐	☐
Contribute to council abatement goals	☐	☐	☐	☐
Support domestic & local economic development	☐	☐	☐	☐
Community health benefits	☐	☐	☐	☐
Other	☐	☐	☐	☐

Comments:_____

5. Are you aware of any potential issues or problems with Biodiesel usage, especially any that might act as challenges/deterrents to its uptake at Council?

Answer:_____

6. Would the source of feedstock be a factor in Council's choice of Biodiesel? Why?

Answer:_____

7. Would your council be opposed to sourcing Biodiesel produced from imported Palm Oil?

Yes: ☐ No: ☐

Answer:_____

8. Who was/would be responsible for planning and implementing a Biodiesel project at council?

Position/Title:_____
Department:_____

9. Would Executive and/or CEO support be crucial to the successful implementation of the project at your council, or is there some degree of departmental autonomy in project implementation? Please elaborate.

Answer:_____

10. Do you/have you worked with other councils in any way, perhaps as part of a regional group? Would this be an option for a biodiesel project?

Answer:_____

Learnings and Opportunities

11. What opportunities do you see for the Biodiesel industry in the future, in relation to local government? Are there any external and/or internal changes that you think would be either necessary or desirable in order to better realise these opportunities?

Answer:_____

12. Do you envisage biodiesel playing a significant role in council fuel usage in 2010?

Yes: ☐ No: ☐

13. Should there be a mandated level of Biodiesel usage in Australia?

Yes: ☐ No: ☐

What Level?:_____

Other Information

14. Do you have any other comments you would like to add?

Answer:_____

15. Are there any reports or documents available related to potential biodiesel projects that you would be willing to provide to ICLEI-A/NZ?

Answer:_____

16. Do you give permission for ICLEI-A/NZ to cite this material for the Department of Sustainability and Environment Biodiesel Project report "Biodiesel and Local Government" and other ICLEI-A/NZ programs?

Yes: ☐ No: ☐

17. Do you give permission for other CCP councils to acquire access to this material on request?

Yes: ☐ No: ☐

Thank you for your time.

Appendix L. Hume Specification. Supply and Delivery of B20 Biodiesel

Specification

Appendix L. Hume Specification. Supply and Delivery of B20 Biodiesel

"The statement of purposes set out in this SPECIFICATION is not intended to be an exhaustive list of the purposes required by this agreement".

1.0 - Background

Hume City Council is seeking to reduce its greenhouse gas and toxic airborne emissions, and its dependence on fossil fuels through the use of a renewable fuel with recycled content in its diesel vehicles. Council has already conducted a phase 1 trial of this renewable Biodiesel fuel and has endorsed a phase 2 trial involving the whole of its diesel fleet over a twelve month period. Recognising that sustainable Biofuels in Australia are currently a finite resource, the project seeks to assess the feasibility and promote the use of blended Biodiesel specifically as an environmentally friendly fleet fuel for local government, public transport, and diesel fleets operating in urban and ecologically sensitive environments.

2.0 - Scope

For the supply and delivery of B20 Biodiesel on an as required basis during the contract period. All deliveries shall be to the Principal's Works Depot located at 60B Maffra Street, Coolaroo. Delivery loads for B20 Biodiesel shall be a minimum of 30,000 litres. Unloading of fuels shall be directly into the Principal's storage tanks. The tanks are owned by the Principal.

3.0 - Advice to Tenderers

3.1 - Tender Prices

Tenderers to Note:

Tenderers must base the tender price for B20 Biodiesel on the diesel fuel component manufacturer's published Terminal Gate Price for ultra low sulfur diesel fuel applicable on 20/04/2007.

4.0 - Tender Assessment

The Principal shall require conformity in the evaluation of tenders to Biodiesel manufactured in Australia and produced from Australian renewable feedstock's such as vegetable oils, animal fats and waste cooking oils and fats (see clause 7.3). The Principal shall give preference in the evaluation of tenders which demonstrate the Service Providers commitment to ethical environmental practices during materials procurement, manufacture, supply, and delivery of B20 Biodiesel.

5.0 - Contract Conditions

The General Conditions of Contract AS4912 – 2002 ("General Conditions") including the Annexure Part A and C form part of this contract and shall be read in conjunction with this contract.

Appendix L. Hume Specification. Supply and Delivery of B20 Biodiesel

6.0 - Contract Period

The contract period is 12 months. The contract period is from 1 July 2007 to 3 June 2008.

At the Principal's sole discretion, the Principal reserves the right to extend the Agreement period for an additional period of up to twelve (12) months.

7.0 - Product Specification

7.1 The delivered B20 Biodiesel shall be a blend comprising 80% ultra low sulfur diesel fuel and 20% Biodiesel.

7.2 The Diesel fuel component shall be ultra low sulfur (no more than 50ppm of sulfur) and comply with the Australian Fuel Quality Standards Act 2000 and the Fuel Standard (Automotive Diesel) Determination 2001 (as amended).

7.3 The Biodiesel component shall be a renewable fuel as defined by the Australian Fuel Standards Regulations 2001 and comply with the (US) ASTM D 6751 fuel quality standard for B100 Biodiesel and Biodiesel blends up to 20%. The Biodiesel component shall contain not less than 40% recycled material sourced locally. The remaining component shall be locally (south eastern quarter - Australia) sourced non GMO agricultural crop. (NOTE: Hume City Council adopted a precautionary principle policy CP2001/12/36 on the 10th of December 2001 discouraging the use of Genetically Modified Organisms until such time as the long term benefits and risks are resolved)

7.4 Recognising that the cold flow property's of Biodiesel are critical to its overall performance as an alternative fuel, the Service Provider must submit a comprehensive strategy as part of this agreement to address the cold filter plugging point (CFPP) issues associated with the storage and use of B20 Biodiesel, to ensure the operational stability of the supplied fuel during seasonal changes and the varying climatic conditions experienced under the Principals operating environment.

7.5 The Service Provider must not alter, amend or substitute the tendered Biodiesel component during the contract period without the prior written approval of the Principal.

8.0 - Blending

The Service Provider must have and maintain a license to manufacture an excisable good in accordance with the Excise Act 1901, to blend the B20 Biodiesel. If the Service Provider subcontracts the blending of the B20 Biodiesel, then its subcontractor must have and maintain a license in accordance with the Excise Act 1901 to blend the B20 Biodiesel.

The Service Provider, or its sub-contract Blender or Biodiesel manufacturer, must not exceed the current industry recommendation that Biodiesel or Biodiesel blends are to be used within six months of production.

Appendix L. Hume Specification. Supply and Delivery of B20 Biodiesel

9.0 - National Fuel Quality Standards

9.1 Current Product Standards

The Service Provider must comply with the Australian National Fuel Quality Standard for automotive diesel, and the (US) ASTM D 6751 fuel quality standard for Biodiesel and Biodiesel blends for products produced or manufactured and supplied under this contract.

9.2 Future Product Standards

In the event that amendments are made to the Australian National Fuel Quality Standard or the (US) ASTM D 6751 fuel quality standard during the contract period, then the Service Provider must comply with the relevant amended Standards for the remainder of the contract period and advise the Principal of any amendment.

10.0 - Pricing

The price for B20 Biodiesel shall be in Australian currency calculated to 4 decimal places. If necessary, the Service Provider shall round prices in accordance with the following:

If the fifth decimal place value is five (5) or greater, the fourth decimal place value is rounded up by one (1). If the fifth decimal place value is less than five (5), the fourth decimal place value is not changed.

10.1 Supply Prices

The diesel fuel component price shall be the price based on the diesel fuel supplier's published Terminal Gate Price for ultra low sulfur diesel fuel on the day the Principal orders a delivery of B20 Biodiesel.

The Principal seeks proposals for pricing which will minimise price fluctuations in the blended product. Tenderers are required to submit a proposal on how the Biodiesel, blending and delivery component prices will be structured, applied and managed during the contract period.

The Supply Price for B20 Biodiesel shall be the diesel fuel component price plus the agreed component pricing for Biodiesel, blending, delivery, unloading, business overheads and excise and taxes.

11.0 - Excise and Taxes

All prices shall be inclusive of applicable Commonwealth excises and taxes (including GST and any variants) and Victorian state taxes during the contract period.

12.0 - Usage Estimate

The usage estimate for B20 Biodiesel is approximately 600,000 litres per annum.

This usage estimate is provided as a guide only and is based on historical data. Actual quantities required throughout the contract period will be subject to the periodic requirements of the Principal. The Principal gives no guarantees as to the total quantities that it will require during the contract period.

Appendix L. Hume Specification. Supply and Delivery of B20 Biodiesel

13.0 - Orders

The Principal shall place a purchase order with the Service Provider each time a delivery is required during the contract period. The ordering procedure shall be agreed between the Principal and the Service Provider at the commencement of the contract period.

14.0 - Delivery Days and Times

All deliveries shall be to the Principal's Works Depot, 60B Maffra Street, Coolaroo. Delivery days shall be Monday to Friday excluding Public Holidays. Delivery times shall be between 7.30am and 2.30pm on the delivery days.

All deliveries shall be within 48 hours of order placement, except for orders placed on a Friday, where delivery shall be on the following Monday (Public Holidays excepted).

15.0 - Delivery and Unloading

Delivery loads for B20 Biodiesel shall be a minimum of 30,000 litres.

The Service Provider shall be responsible for the delivery and unloading of the product. (NOTE: The Principal has above ground fuel storage facilities without fuel transfer equipment) The Service Provider shall have a Safe Operating Procedure for the delivery and unloading of the product, and comply with all local statutory requirements pertaining to the handling of B20 Biodiesel.

The Principal's storage of fuels is managed by its Services Department. The Service Provider shall, for each delivery, report to the nominated Services staff member upon arrival at the Works Depot and shall liaise with the nominated Services staff member during the unloading process.

Upon delivery/unloading, the Principal may choose to take a sample of the B20 Biodiesel for the purposes of third party compliance testing (see Clause 17.2).

16.0 - Quality Assurance

The Principal's preference is to ensure the quality of the blend components rather than the delivered blended B20 Biodiesel.

The Principal will give preference to tenderers who have a quality assurance system for the manufacturing or production processes for the blend components of the B20 Biodiesel.

Tenderers are required to demonstrate in their tender submissions how they, and their sub-contractors, will manage quality assurance during the contract period including, but not be limited to;

- the manufacturer's quality system for the manufacturing or production of the Diesel fuel component.
- the manufacturer's quality system for the manufacturing or production of the Biodiesel component including conformance to product specification (See Clause 7.3).
- the blender's quality system for the B20 blending process.
- the proposed frequency for testing the component products.
- the proposed system of advising the Principal of non-conforming quality testing results.
- the proposed access to test results by the Principal.

17.0 - Testing

17.1 Testing

The cost of all quality assurance testing shall be borne by the Service Provider. The Service Provider shall be responsible for all quality assurance testing with the exception of third party testing as per Clause 17.2.

The Service Provider shall notify the Principal's Representative, within two working days of the testing information becoming available to them, of non conforming product supplied by themselves or by their sub-contractors to the Principal.

17.2 Third Party Testing

The Principal reserves the right to conduct independent third party testing of the delivered B20 Biodiesel during the contract period. Testing shall be through an accredited third party for the purpose of verifying compliance to the Australian Fuel Quality Standards and/or this specification, the (US) ASTM D 6751 fuel quality standard, and the specific biodiesel component required of this contract.

18.0 - Non-conformances

Should quality testing by either the Service Provider's testing or 3rd party testing reveal that any supplied product is nonconforming then, where relevant, the following shall apply:

- the Principal will not be required to pay for any product found to be non-conforming. If payment has already occurred then the Service Provider shall refund the payment to the Principal.
- the Service Provider shall, at its own cost, remove any non-conforming product supplied by the Service Provider from the Principal's Works Depot.
- the Service Provider accepts liabilities for any damages to the Principal that are attributed to the use of the nonconforming product.

NOTE: The Principal will require a statutory declaration from the Service Provider as part of this agreement ensuring conformance to the Biodiesel product specification, in particular the mandatory minimum recycled material content, the non GMO policy position pertaining to the use of virgin materials, and the locally sourced material requirement for the term of this agreement.

19.0 - Payment

The Service Provider shall provide the Principal with a claim for payment for deliveries in the form of a valid Tax Invoice. The payment procedure and payment terms shall be agreed between the Principal and the Service Provider at the commencement of the contract period.