Department of the Environment and Heritage

Submission

Senate Rural and Regional Affairs and Transport References Committee

Inquiry into future oil supply and alternative transport fuels

Executive Summary

The environmental benefits of alternative fuels can include improved air quality outcomes and/or reduced greenhouse gas emissions depending on the fuel and the level of technology deployed.

While tailpipe emissions from vehicles have a primary impact on local air quality, from a greenhouse perspective the emissions produced during the lifecycle of the fuel from production to consumption are of importance. For biofuels, the dominant factors in determining its environmental impacts are the feedstock and the production method for the fuel. Lignocellulosic ethanol (ethanol from woody material) has the potential to deliver significant greenhouse benefits; however it is not yet commercially proven.

The Australian Government's Alternative Fuels Conversion Programme (AFCP), administered by the Department of the Environment and Heritage, provides assistance to industry to develop and trial gas-powered engines in heavy duty vehicles. Launched in January 2000, AFCP has demonstrated that there are no easy alternative fuel solutions for heavy vehicles that will deliver consistent greenhouse and air quality benefits. Critical barriers to the uptake of gaseous fuels have been a lack of a refuelling network and infrastructure, coupled with a lack of gas vehicle technology available and ready for adoption by the heavy vehicle industry.

The experience of the AFCP has indicated that, if improvements in air quality and greenhouse gas emissions are sought, it is preferable to set performance based outcomes that need to be met by any vehicle rather than targeting particular technologies or fuel types,

Introduction

This submission provides information that may assist the Committee on the Department's work on the promotion of alternative fuels and fuel efficiency in motor vehicles and the lessons learnt regarding the potential greenhouse benefits of particular alternative fuels and related engine technologies.

Transport fuel use in Australia

Table 1 shows that petrol (auto gasoline) represents 63% of Australia's road transport fuel use, with diesel making up most of the rest (30%). Petrol is predominately used in passenger transport while heavy freight predominately uses diesel. Light commercial vehicles, the most rapidly growing segment of road transport, uses both petrol and diesel. Liquefied petroleum

gas (LPG) has a small share of the road transport with 7% energy use. Natural gas is used in road transport as both liquefied natural gas (LNG) and compressed natural gas (CNG), primarily in heavy vehicles, but is not a major player at present with 0.1% of road transport energy use. The share of petrol used in road vehicles has declined by nearly 7% over the last decade, with diesel use growing over this time; LPG share has declined slightly in the last few years (*Australian Transport Facts 2005*). Anecdotal evidence points to a jump in LPG conversions in recent months, in line with petrol price increases.

Table 1 Australian Energy Use, transport sector, by fuel 2002-03

	Sea		Air		Road	Rail	Total	
	Domestic	International	Domestic	International				
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	
Black Coal	3.5						3.5	0.3%
Aviation gasoline			3.1				3.1	0.3%
Aviation turbine fuel			70.6	85.8			156.4	13.0%
LPG	0.0				67.1		67.1	5.6%
Automotive diesel oil	3.0	7.1			287.0	22.5	319.6	26.5%
Fuel Oil	7.2	31.3					38.5	3.2%
Natural Gas	0.1				1.2		1.3	0.1%
Electricity						7.2	7.2	0.6%
Auto gasoline					609.4		609.4	50.5%
Total	13.8	38.4	73.7	85.8	964.7	29.7	1206.1	100.0%

Source: ABARE, *Energy in Australia 2005*

Fuel Quality Standards in Australia.

The quality of fuel in Australia is regulated by the *Fuel Quality Standards Act 2000* that places an obligation on the fuel industry, including fuel suppliers, to supply fuels that meet strict environmental requirements. The Department of the Environment and Heritage is responsible for developing and enforcing a number of fuel quality standards made under the Act.

Fuel quality standards have been set for petrol, diesel, biodiesel and Autogas (LPG). Ethanol has a fuel quality information standard. Standards for biodiesel blends, diesehol and fuel grade ethanol are being considered. An Australian Standard for natural gas already exists removing the need for a duplicate standard under this Act. Monitoring is undertaken to ensure compliance with the standards. Ensuring that fuel meets appropriate standards reduces the adverse effects of motor vehicle emissions on air quality and human health, and also enables Australia to effectively adopt new vehicle engine and emission control technologies.

Alternative transport fuels in Australia

Potential Australian sources of alternative transport fuels for use in existing vehicles include converting our natural gas, coal or oil shale resources into petrol or diesel for use in our current vehicles, and some biofuels – primarily ethanol/petrol blends from biomass feedstocks or biodiesel from vegetable oil or animal fats. Potential alternative transport fuels requiring modified or new vehicles include using LPG, natural gas as LNG or CNG, hydrogen and some biofuels.

A number of these alternative fuels have the potential to produce environmental benefits in air quality and greenhouse gas emissions. However, a significant challenge for these fuels is that modern diesel and petrol engines are already highly fuel efficient, and as such deliver a very good greenhouse outcome relative to power output. Developments in conventional liquid fuels and exhaust gas after-treatment mean the potential air quality benefits of gaseous fuels have been reduced over time.

Excise arrangements for alternative fuels

Currently, alternative fuels (biodiesel, ethanol, LPG, LNG and CNG) do not attract any effective excise and thus have an economic advantage over petrol and diesel. However, on 16 December 2003 the Australian Government announced that excise rates for all fuels would be based on the energy content with a 50% discount for alternative fuels. These new excise rates will be introduced in five even annual steps commencing on 1 July 2011.

On 1 July 2015 the discount fuel excise rate will be 19.1 c/L for biodiesel, 12.5 c/L for LPG, LNG and ethanol and 19.0 c/m^3 for CNG.

In 2004/05, the Australian Government collected net revenue of around $9 billion in fuel excise, which represented around 7% of total revenue. Shifts in fuel consumption towards alternative fuels will thus have important budgetary impacts.

Liquefied Petroleum Gas (LPG)

LPG is the only alternative fuel with significant penetration into the Australian market. Inducements for LPG vehicles include the excise concessions on the fuel itself and a $1000 grant for LPG vehicles delivered new between 1 July 2011 and 30 June 2014.

When used in LPG-powered vehicles supplied by the original vehicle manufacturer, LPG can deliver economic and environmental benefits, including a reduction in greenhouse gas emissions.

However, these environmental benefits are dependant on the engine conversion technology used. In Australia, the majority of LPG-powered vehicles are aftermarket conversions from petrol and generally do not deliver all of the expected environmental benefits (see p 32, Australian Liquefied Petroleum Gas Association, *Liquefied Petroleum Gas as an Automotive Fuel – An Environmental and Technical Perspective 2002*, 2002, 2nd edition). There are still some significant technical advances possible with LPG engines that can improve its performance; however advances in diesel and petrol engines have reduced the potential relative environmental gains arising from the use of LPG.

Liquefied Natural Gas (LNG) and Compressed Natural Gas (CNG)

On a life cycle analysis compared to low sulfur diesel, natural gas has the potential to offer greenhouse gas emissions reductions of up to 20% and significant reductions in emissions of particulate matter, NO_x and carbon monoxide [Table 8.16, CSIRO, *Comparison of Transport Fuels EV45A/2/F3C*, 2001]. However, natural gas is primarily composed of methane, which has a global warming potential 21 times that of carbon dioxide. This means that if not managed, fugitive methane emissions may cancel out the greenhouse gas reductions from the lower carbon content of natural gas and in some cases may give rise to a negative greenhouse outcome.

To support the uptake of natural gas and LPG in heavy vehicles, in January 2000 the Australian Government launched the Alternative Fuels Conversion Programme (AFCP). However, the AFCP initially experienced significant difficulties due to a lack of gas engine technology available and ready for adoption by the heavy vehicle industry that would deliver air quality and greenhouse gas benefits over traditional diesel engines.

A change of direction for AFCP in 2003 resulted in the Australian Government working in partnership with transport operators and gas industry stakeholders on a small number of demonstration projects in an attempt to identify the conditions under which natural gas heavy vehicles could be developed to deliver greenhouse benefits to the community and economic benefits to vehicle operators.

Analysis of the demonstration projects completed over the past two years gives rise to the following specific conclusions:

1. The greenhouse benefits of natural gas vehicles vary according to the type of engine technology applied and the degree to which this technology limits tailpipe emissions of unburnt methane – either during the combustion process or via after-treatment.

2. The economic benefits of substituting natural gas for diesel for heavy vehicle operators are also highly variable, according to the specific characteristics of the fleet operator. Observed payback periods for the AFCP demonstration projects conducted to date, with a government subsidy of 50% of the additional capital cost, have varied from 14 months to over 6 years.

3. There are insufficient numbers of gas engine products in the global marketplace and some of the technologies that are available require significant investment to improve operational performance.

4. The key barrier to the establishment of natural gas refuelling infrastructure relates to the current level of demand uncertainty being too high to support the large scale commercial investment in refuelling infrastructure.

The Australian Government is continuing to work with the trucking industry, gas suppliers and engine developers under the AFCP to maximise the potential commercial and environmental benefits of gaseous fuels.

Biofuels

The Australian Government has committed to a Biofuels Target of 350 ML by 2010. To support this target at a government level, Commonwealth vehicles are encouraged to use E10 (10% ethanol blended petrol) where possible.

While use of biofuels can lead to greenhouse gas reduction, the *Report of the Biofuels Taskforce to the Prime Minister*, which was released on 22 September 2005, found that:

Greenhouse gas benefits alone would not warrant further assisting biofuels, given the availability of much cheaper carbon reduction options. [p 7, *Report of the Biofuels Taskforce to the Prime Minister*, 2005]

The *Report of the Biofuels Taskforce to the Prime Minister* found that in assessing the possible greenhouse gas reduction benefits of the 350 ML biofuels target, the emission reductions achieved would cost $204 per tonne in terms of reduced GDP or $267 per tonne in terms of direct government expenditure on assistance programs**.** In assessing possible greenhouse emission benefits of 350 ML of biofuels to arrive at these costings the taskforce assumed a split of 148 ML ethanol and 202 ML biodiesel. The taskforce noted that this scenario "favours the greenhouse benefits for the purposes of illustration".

The *Report of the Biofuels Taskforce to the Prime Minister* showed that the benefits of E-10 include greenhouse gas emission reductions and reductions in carbon monoxide, but show increases in NO_x when compared to neat petrol. The significance of this increase depends on the location of the production facility and state of the receiving airshed. NO_x leads to increases in ground level ozone formation which is known to have harmful effects on lung function. Work is progressing to confirm the air quality impacts of ethanol, especially for particulate matter (PM) from E10. The report noted that the assumption in the 2003 350 ML Target Report of negligible impact of E10 on PM needs to be revisited in light of evidence, albeit limited, of possible significant reductions in PM from E-10. The report also concluded that more smog chamber work was needed to understand properly the effect of adding ethanol to petrol on secondary organic aerosol formation. On life cycle analysis E10 delivers 1%-4% savings in greenhouse gas emissions depending on feedstock and production method.

The report found negligible benefits for 5% biodiesel (B5) but more significant benefits from B100 over extra low sulfur diesel (XLSD – due to be introduced in Australia in 2009). These include significant reductions in emissions of carbon monoxide, volatile organic compounds and particulate matter (especially with waste cooking oil as the feedstock). On a life cycle basis biodiesel delivers 23%-90% savings in greenhouse gas emissions depending on feedstock. Stacked against these benefits NO_x emissions increase by between 16 and 30%

Current petrol-based vehicle technologies will operate with up to 10% ethanol (E10) with a smaller subset of vehicle manufacturers stating that they would accept up to 5% ethanol (typically vehicles manufactured before 1986). Internationally, there are engines that can run on up to 85% ethanol (E85), but these are currently not available in Australia**.** Advice from engine manufacturers is that the maximum biodiesel blend for the current fleet should be no more than 5%. There are a number of trials of engines in Australia operating at higher rates of biodiesel.

The environmental impacts of biofuels will need to be reviewed regularly as there is the potential for improved economic and environmental outcomes from new production methods. In particular, ethanol production from lignocellulosic feedstocks such as crop waste, grasses and trees has the potential to significantly reduce both costs and greenhouse gas emissions. There is significant investment occurring internationally in research and development on lignocellulosic ethanol designed to bring forward the commercialisation of this technology.

The Australian Government recognised the potential benefits from lignocellulosic ethanol in the *Report of the Biofuels Taskforce to the Prime Minister:*

> Conclusion 1: The Taskforce notes the potential for lignocellulosic ethanol technology to impact materially on the economics of the ethanol industry in the coming decade. Policy interventions based on current industry technologies and feedstocks should be limited without further assessment of the impact of

lignocellulosic technology. [p 15, *Report of the Biofuels Taskforce to the Prime Minister*, 2005]

Hydrogen

Hydrogen is gaining prominence internationally as a fuel that might deliver both air quality and greenhouse gas benefits by displacing conventional fuels in the transport sector.

Moving to the use of hydrogen as a transport fuel presents a number of challenges. In the first instance hydrogen is not an energy source in itself; it only carries energy transferred from another source. Significant amounts of energy, whether derived from fossil or renewable fuels, are required to produce and store hydrogen. From a greenhouse perspective, how hydrogen is produced is a key factor in what impact the widespread adoption of hydrogen technologies will have. Hydrogen produced via a low carbon or renewable route offers the most benefits.

Consistent with the Department's experience with the AFCP, a "learning by doing" approach has been adopted to gather real world information on the potential benefits and barriers to the use of hydrogen as a transport fuel. The Australian Government has invested $2.5 million in a partnership with the Western Australian Government to trial the use of hydrogen fuel cell buses in the public transport system. This is part of a worldwide trial to gather information on the practicality of using hydrogen as a transport fuel. Nine European cities as well as Perth and Reykjavik Iceland have come together under the umbrella of the European Commission to jointly trial hydrogen fuel cell bus operations in public transport applications. The lessons learnt are disseminated to trial partners and interested parties.

A key learning to date has been the lack of market-ready refuelling infrastructure. All trial cities operating the buses have experienced good performance from the fuel cells, but all have experienced difficulties with the provision of hydrogen refuelling systems. The extension of this bus trial internationally to include hydrogen internal combustion engines and hybrid systems will extend the hydrogen knowledge base considerably. Hybrid systems, incorporating the battery storage and use of electricity produced from the on-board fuel, that can maximise the efficiency of the engine system are seen by many as a key enabling technology.

The Australian Government will complete a scoping study into the technical, financial and regulatory feasibility of an Australia-wide hydrogen bus programme before proceeding further. It should be recognised that both Toyota and Daimler Chrysler expect to be able to produce cost competitive hydrogen fuel cell vehicles in the 2015-2020 timeframe. It is yet to be seen if cost competitive hydrogen fuel production with zero-carbon emissions can be achieved in the same time frame.

Australian Government's actions on transport

The Australian Government's existing Environmental Strategy for the Motor Vehicle Industry includes the National Average Fuel Consumption (NAFC) target and consumer information programmes.

The Australian Government also regulates fuel quality standards to reduce the adverse effects of motor vehicle emissions on air quality and human health, and to enable Australia to effectively adopt new vehicle engine and emission control technologies. Fuel quality standards have been set for petrol, diesel, biodiesel and LPG. Ethanol has a fuel quality

information standard. A diesohol (blend of diesel and ethanol) standard and a standard for fuel grade ethanol are being considered. The Department of the Environment and Heritage is responsible for developing and enforcing a number of fuel quality standards made under the *Fuel Quality Standards Act 2000*.

National Average Fuel Consumption (NAFC) target

The National Average Fuel Consumption (NAFC) target is a voluntary target of 6.8L/100km for petrol passenger cars by 2010. This represents an 18% improvement in the fuel efficiency of new vehicles between 2002 and 2010. Between 1990 and 2003 there has been an improvement in the fuel consumption of Australian passenger vehicles, but this has largely been due to an increased penetration of smaller imported vehicles.

Consumer information programmes:

Current consumer information programmes include mandatory fuel consumption labelling for all new vehicles up to 3.5 tonnes gross vehicle mass at the point of sale, and the Green Vehicle Guide, which provides information about the environmental performance of new vehicles sold in Australia. This provides a combined rating of the level of air pollutant and greenhouse gas emissions per vehicle.

Council of Australian Governments (COAG) transport initiatives

On 10 February 2006 the Council of Australian Governments (COAG) agreed to a range of initiatives relating to national competition policy reform and climate change that include a number of transport initiatives.

The Productivity Commission will be asked to estimate the full economic and social costs of providing and maintaining road and rail freight infrastructure and develop proposals for efficient pricing of road and rail freight infrastructure. This will include environmental impacts of different transport modes. The Productivity Commission is to report to COAG by end of 2006.

A Commonwealth-State review will be commissioned into the main causes, trends, impacts and options for managing urban transport congestion in Australia's major cities, focussing on national freight corridors and local networks where they interact with national corridors. The review will include improved options for demand management and other travel behaviour change initiatives. The review will be oversighted by a joint Commonwealth, state and local government steering committee and will be completed by the end of 2006.

As part of the COAG plan for action on climate change, the Australian Transport Council (ATC) and Environment Protection and Heritage Council (EPHC) will report to COAG by the end of 2006 on:

- Programs and incentives to encourage the uptake of more fuel efficient and low emission passenger and freight vehicles;
- Strategies for travel demand management and increased use of public transport; and
- Opportunities for reform to regulations, codes, standards and labelling requirements to improve vehicle fuel efficiency.