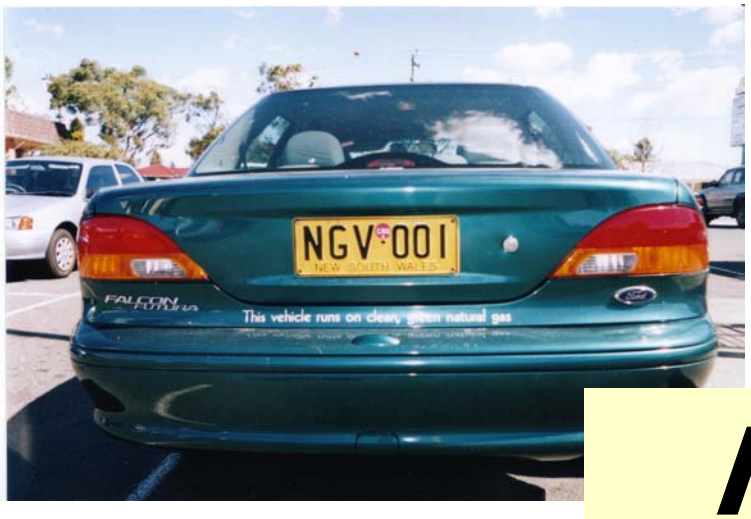
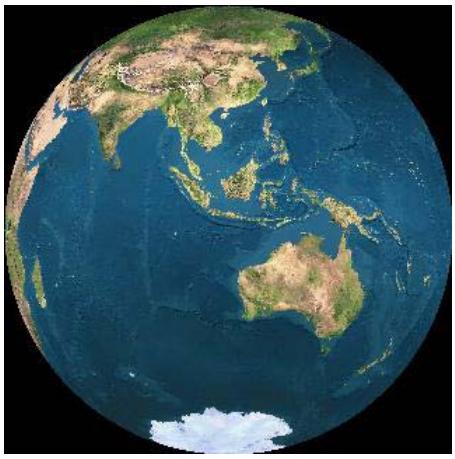


NATURAL GAS VEHICLES



THE CASE FOR AN INTEGRATED PROGRAM OF SUPPORT

SEPTEMBER 2003

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EXECUTIVE SUMMARY

This document outlines the case for a program supporting the accelerated introduction of Natural Gas Vehicles (NGVs) in Australia.

We believe that Natural Gas for vehicles offers significant long-term benefits for our nation.

These benefits include the opportunity to:

- ⇨ Insulate Australia from the worst effects of a petroleum crisis in the event of war or terrorism.
- ⇨ Reduce the Balance of Payments deficit by replacing imported fuels with a cleaner indigenous fuel.
- ⇨ Introduce a substantial measure of price stability into the vehicular fuels market.
- ⇨ Promote the fuel with the cleanest "well-to-wheel" emissions currently available.
- ⇨ Promote a fuel that is up to 90% safer to use than petrol, diesel and LPG.
- ⇨ Benefit from the reduction in health and social costs associated with transport-generated emissions.
- ⇨ Develop a framework for a sustainable Natural Gas Vehicle (NGV) industry.
- ⇨ Develop a network to provide a natural and smooth transition to the hydrogen transport economy.

This paper outlines the advantages and benefits of supporting the development of a NGV refuelling network, and for introducing programs to support the purchase of, or conversion to, Natural Gas Vehicles.

It highlights the differences between the current strategy of reliance on imported petroleum fuels, such as petrol, diesel and LPG, and a clean, environmentally responsible, indigenous fuel such as Natural Gas. It also highlights the differences between using Natural Gas, which is naturally occurring and requires little or no processing to be suitable for use in vehicles, and Bio Fuels, which are reliant on agriculture, and require significant processing.

We have proposed a program of support that could assist with the development of a responsible and viable industry at minimal cost. The total cost of the programs recommended in this paper represents less than fifty cents per year per resident of Australia, and yet offers long-term benefits to the nation that are beyond calculation.

We strongly urge all Parties to embrace the use of this fuel and to introduce the support programs outlined in this paper.

Kevin Black
Managing Director
The Natural Gas Vehicles Group Pty Ltd
September 2003

INTRODUCTION

Transport accounts for a substantial proportion of Australia's energy demand. Australia's transport needs are currently met almost exclusively by crude oil derivatives, particularly petrol, diesel and, to a lesser extent, LPG. This reliance on crude oil places transport in Australia, and the economy as a whole, in a vulnerable position.

Natural Gas for Vehicles (NGV) offers a range of benefits to vehicle operators and the community that cannot be provided by any other presently available fuel.

Natural Gas for transport can currently be utilised in 2 ways, either as Compressed Natural Gas (CNG) or as Liquefied Natural Gas (LNG). Essentially the difference between the two methods is the manner in which the fuel is stored on the vehicle. As a cryogenic fuel, it remains in its gaseous form under pressure. Liquefaction is achieved by reducing the temperature of the gas to below its boiling point of -161° C.

As the name suggests, Compressed Natural Gas is produced by compressing the gas which is usually delivered to the refuelling site by existing pipeline networks. The gas may be compressed directly into high-pressure cylinders on the vehicle or stored prior to transfer to the vehicle.

In the case of Liquefied Natural Gas, the gas is cooled and liquefied prior to transfer to the vehicle. On the vehicle it is stored in a tank similar to a thermos flask which maintains the cool temperature required to keep the gas liquefied for an extended period.

In both cases Natural Gas is combusted in the engine as a gas, meaning that the existing engine technology is used for both petroleum fuels and Natural Gas.

Applications for Natural Gas include:

- ⇨ Forklifts;
- ⇨ Cars;
- ⇨ Light commercial vehicles;
- ⇨ Medium and heavy trucks;
- ⇨ Urban buses;
- ⇨ Rail locomotives; and
- ⇨ Marine vessels.

Some of the issues that should be taken into consideration in developing a fuel strategy for Australia are covered in the following pages.

ENVIRONMENTAL BENEFITS

Reduced Life Cycle Emissions Compared With All Other Fuels

The Australian Greenhouse Office and Environment Australia in 2001/2 commissioned a consortium led by the CSIRO to undertake research into the life cycle emissions attributable to the transport sector.

In essence, the researchers concluded that the use of CNG or LNG will significantly reduce emissions of oxides of nitrogen, particulates, carbon monoxides and volatile hydrocarbons. In addition, if the appropriate engine technology is used, reductions in Greenhouse gas emissions of up to 18% compared with low sulphur diesel and up to 20% when compared with petrol may be realisable.

It should also be noted that the transition to low sulphur and ultra low sulphur diesels is expected to produce a negative greenhouse benefit. This is due to the more intensive energy requirements for refining and possible decreases in engine performance efficiencies.

A summary of the results of the study is at Table 1 on page 7.

Air Quality and Air Toxics

Transport contributes 20% of the urban emissions that contribute to photochemical smog. Natural Gas, as a cleaner burning fuel, offers up to 100% reduction in particulate matter and significantly reduced emissions of other pollutants over all existing petroleum fuels (petrol, diesel and LPG). The levels of reduction are significant, and increased use of NGVs would contribute to a reduction in urban air pollution and an improvement in air quality.

In testing by the New South Wales Roads and Traffic Authority, the use of Natural Gas in Ford Falcons resulted in an average emission reduction of:

- ⇨ 56% in Non-Methane Hydrocarbons (NMHC),
- ⇨ 60% in CO,
- ⇨ 21% in CO2, and
- ⇨ 39% in NOx,

when compared to Petrol.

A recent development in the area of greenhouse emissions is the observation that particulate matter (PM) is also a major contributor to global warming which has not been considered up until now. In fact, a recent Stanford University Study has shown that reductions in particulate matter will produce more dramatic and almost immediate reductions in global warming whereas $C0_2$ reductions aren't expected to yield benefits for between 50 and 200 years. ***("The control of fossil-fuel particulate black carbon and organic matter is the most effective method of slowing global warming"*** **Mark Z. Jacobson, October 2001)**

Though no Global Warming Potential has been assigned to PM, if it were factored into greenhouse emissions then this would extend the advantage of NGVs even further than currently accounted for, even when compared with cleaner diesels.

Pollution of Water and Soil

The potential of liquid fuels to contaminate water and soil should also to be taken into account. Crude oil, diesel and petrol spillage can occur in a number of areas.

- ⇨ During exploration and bulk transportation via the seaways.
- ⇨ During handling and storage at the ports.
- ⇨ During road transport and local storage and fuelling.
- ⇨ Underground storage can leak into soils and water catchment areas.
- ⇨ During the use of the fuel in its final application.
- ⇨ Particulate emissions settle on road surfaces and are washed into waterways through the storm water system

The potential for water and soil pollution is effectively eliminated by the use of Natural Gas and this reduced potential for pollution should be considered when establishing government policy.

CNG vs LPG

In any discussions about alternative fuels, the comparison is always made between CNG and LPG. Although they are both gases in their normal state, they could not be more different.

LPG	CNG
A mixture of Butane and Propane with some propylene	Predominantly Methane
A by-product of petroleum refining	Naturally occurring – needs no refining
Vapour heavier than air and prone to explosion	Lighter than air – readily dissipates
Lower energy value	Approximately 50% higher energy value
Subject to oil price and currency fluctuations	Stable pricing structure
Prone to contamination and variable quality	Consistent quality
No Transition to Hydrogen	Natural Transition to Hydrogen Economy
Relies on sea and road transport for delivery	Safe pipeline delivery
Marginally cleaner than petrol (if vehicle kept in tune)	Substantially cleaner that all other fuels (including LPG)

It is necessary to use approximately 1.6 litres of LPG to derive the same energy as 1 cubic metre of CNG. With comparable pump prices at the moment, LPG is therefore 60% more expensive to use.

Table 1
Summary of the results of the analysis

Fuels	GHG	PM	NOx	Toxics	Health	V&F	ESD	Future ADR
LS diesel (Aus)	Reference fuel for heavy vehicles							
ULS diesel (Aus)	=	-	-	-	√			
ULS diesel (100% hydroprocessing)	=	-	-	-	√			
Fischer-Tropsch diesel	++	-	=	-	√			
Biodiesel (canola)	=	-	+	=	=			PM>E3; NOx>E3,E4
Biodiesel (soybean)	=	-	+	=	=			PM>E3; NOx>E3,E4
Biodiesel (rape)	=	-	+	=	=			PM>E3; NOx>E3,E4
Biodiesel (tallow-expanded sys. boundary)	=	-	+	- -	√		{CH_4	PM>E3; NOx>E3,E4
Biodiesel (tallow-eco.allocat.)	=	-	+	=	=		{upstream	PM>E3; NOx>E3,E4
Biodiesel (waste oil)	=	-	+	- -	√ √			PM>E3; NOx>E3,E4
Biodiesel (waste oil 10% original oil value)	=	-	+	- -	√ √			PM>E3; NOx>E3,E4
Canola			No data			XXX		
CNG (Electric compression)	- -	- -	- -	- -	√ √			
CNG (NG compression)	- -	- -	- -	- -	√ √			
LNG (from existing pipeline)	- -	- -	- -	- -	√ √			
LNG (Shipped from north west shelf)	- -	- -	- -	- -	√ √			
LNG (Road transport to Perth)	- -	- -	- -	- -	√ √			
LPG (Autogas)	-	- -	- -	=	=			
LPG (HD5)	-	- -	- -	=	=			
LSdiesohol	=	=	=	=	=			THC>E3,E4
Ethanol azeotropic (molasses-expanded sys.bound.)	- -	-	=	-	√			THC>E3,E4
Ethanol azeotropic (molasses-economic allocation)	- -	-	-	-	√			THC>E3,E4
Ethanol azeotropic (wheat starch waste)	- -	-	-	-	√			THC>E3,E4
Ethanol azeotropic (wheat)	- -	-	=	-	√			THC>E3,E4
Ethanol azeotropic (wheat) fired with wheat straw	- -	=	=	+	X			THC>E3,E4
Ethanol azeotropic (woodwaste)	- -	-	-	+	X			THC>E3,E4
Ethanol azeotropic (ethylene)	+	-	=	+	X		fossil-fuel based	THC>E3,E4
Hydrogen (from natural gas)-upstream only	=	- -	- -	- -	√ √			
PULP	Reference fuel for light vehicles							
PULP e10 (molasses-exp.sys.bound.)	=	=	=	=	=			
PULP e10 (molasses-eco.allocat.)	=	=	=	=	=			
PULP e10 (wheat starch waste)	=	=	=	=	=			
PULP e10 (wheat)	=	=	=	=	=			
PULP e10 (wheat WS)	=	=	=	=	=			
PULP e10 (wood waste)	=	=	=	=	=			
PULP e10 (ethylene)	=	=	=	=	=			
PULP e85 (molasses-exp.sys.bound.)	- -	=	=	=	=			THC>E3,E4
PULP e85 (molasses-eco.allocat.)	- -	=	=	=	=			THC>E3,E4
PULP e85 (wheat starch waste)	- -	=	=	=	=			THC>E3,E4
PULP e85 (wheat)	- -	=	+	=	=			THC>E3,E4
PULP e85 (wheat WS)	- -	+	+	++	XX			THC>E3,E4
PULP e85 (wood waste)	- -	=	-	++	XX			THC>E3,E4
PULP e85 (ethylene)	++	=	++	++	XX		fossil-fuel based	THC>E3,E4

GHG: greenhouse gases; PM: particulate matter; NOx: oxides of nitrogen; V&F: viability and functionality; ESD: ecologically sustainable development.

Symbols: - -, significantly lower (than the reference fuel); -, lower; =, much the same; +, higher; and ++, significantly higher. In terms of health effects, √√ indicates significant improvement (compared with the reference fuel); √, better; =, much the same; X, worse; XX, significantly worse; and XXX, poor.

TABLE 1 – SUMMARY OF LIFE-CYCLE ANALYSIS OF VEHICLE FUELS

FUEL SUPPLY SECURITY

The Risk to Our Oil Supplies

While Australia has been largely self reliant for crude oil supplies to date, this is expected to change dramatically in coming years. Australia is currently consuming oil three times faster than it is discovering it. Oil imports are expected to increase to over 150 million barrels per annum by 2004/5 and 200 million barrels per annum by 2009/10. In part this increase will be required to make up the shortfall in local supplies, and also to enable the manufacture of low sulphur fuels.

Governments overseas are placing increased importance in diversifying transport fuel supplies and increasing energy independence. The United States implemented the Energy Protection Act (EPAct) following the Gulf War with the express purpose of reducing US dependence on imported crude oil. This Act included measures aimed at increasing the use of alternative fuels, including Natural Gas.

In the current climate, the importance of this issue cannot be overstated and is in fact taking precedence in other areas around the world. Because Australia has had such reliable supplies of crude oil in the past, there is a real danger that we may be complacent about this and assume that it will always be the case. The rest of the world does not share this complacency.

In December 2001, the European Union adopted an action plan to ensure that **20% of transport fuels are supplied by alternative fuel sources by 2010.** This plan was under consideration even before the events of September 11. The EU proposal states:

"In the coming twenty to thirty years EU production is expected to decline, whereas consumption will increase as substitution possibilities will be exhausted and transport demand is likely to continue to grow. During the coming decades of increased import dependency, world oil demand is also expected to show strong growth and the global distribution of known oil reserves leaves the Middle East OPEC members as the only possible suppliers to this increased demand."

Of the proposed alternatives to be used under the plan, Natural Gas will account for half, with a target level of 10% Natural Gas use. **Interestingly, the EU does not even share the advantage that Australia has of large indigenous Natural Gas reserves.** European Commission countries are 90% dependent on imported Natural Gas supplies, unlike Australia which is 100% self-reliant and has over 100 years of supply available. In spite of this, the Commission still chose Natural Gas as the major alternative energy source for vehicles. Germany has already commenced a plan to establish 1000 CNG refuelling sites within the next five years.

In the United States, increasing attention is being given to diversifying fuel supplies. In fact, in the US, alternative fuels programs generally fall under the banner of the Department of Energy, which originally introduced legislation, not for environmental concerns but to ensure diversity of supply to the US market. For example, the EPAct was passed after the Gulf War in 1992 to improve the nation's energy security by displacing petroleum motor fuel consumption with alternative transportation fuels.

In October 2001 President Bush was quoted as saying : *"The less dependent we are on foreign sources of crude oil, the more secure we are at home ... We've spent a lot of time talking about homeland security, and an integral piece of homeland security is energy independence. "*

Senate Minority Leader Trent Lott also said *"Our energy dependence on foreign oil is dangerous for national security and economic security. "*

This view has been reinforced by the influential Union of Concerned Scientist (UCS) who released a report in January 2002 entitled "Dangerous Addiction: Ending America's Oil Dependence." The report says *"The events of September 11 highlight the danger in continuing to turn a blind eye to our oil dependence. While oil prices are down for the moment, the instability of the Middle East makes for a situation that could change at any moment. New suppliers like Russia and the Caspian region are hardly more stable. Sixty-five percent of the world's known oil reserves lie beneath the Persian Gulf."* It also points out *"Of the nearly 19 million barrels per day increase in world oil demand now forecast between 2010 and 2020, more than 85% will come from Middle East countries."*

The recent APEC Ministers Summit in October 2001 stated that a critical measure for enhancing counter-terrorism cooperation would be *"strengthening energy security in the region through the mechanism of the APEC Energy Security Initiative which examines measures to respond to temporary supply disruptions and longer term challenges facing the regions' energy supply."*

If transport energy issues are so high on the agenda of overseas governments should Australian governments be considering similar programs? Can we afford to continue relying so heavily on crude oil for our transport needs? What would be the impact on our economy and way of life if crude oil supplies became heavily restricted or unaffordable? Our isolated location, vulnerable shipping lanes and fragile economy arguably make it more important for us to establish major fuel diversification programs.

As isolated as Australia is from the geographical areas of conflict, our reliance on imported fuels is heavy already and increasing further. This places most of our national commercial activities in a vulnerable position and we should be asking ourselves: What would be the consequences if the supply of imported crude were restricted or even halted altogether? What would be the consequences of massive price hikes due to changes in OPEC policy or conflict in the Persian Gulf area?

While we often ask if we can afford the price of supporting alternative fuels, can we afford not to increase our support of them? Importantly, can we afford to wait for serious problems to arise or should we be putting strategies in place now? Wouldn't a more diverse transport fuel supply serve as a form of insurance in times of strife or oil crises?

The uncertainty regarding Australia's refining capacity in coming years and the threat to fuel supplies is already of concern to our defence forces. According to a Defence Force working paper quoted on ABC Radio (October 2001):

> *"The possible reduction in domestic refinery as a result of competitive pressure from Asian markets may have a dramatic effect on Defence's vulnerability in this area. Reliance on overseas supplies may delay ADF response or sustainment during periods of mobilisation... "A domestic refining industry ensures the*

shortest possible supply chain for the petroleum products in Australia. Supply sources outside of Australia may not attach the same priority or importance to meeting our demand, particularly if supplies are disrupted".

Military conflict and refinery issues are not the only threats to supplies. It is widely recognised that we have now used up around half of the world's known or prospective crude oil supplies. Even though we have around 35-45 years of supply available, we can now officially say that we are 'running out'. The impact that this will have on OPEC strategies is unknown but we could safely say that those countries which establish a more diverse supply of transport fuels will be in a more secure position in the event of massive price increases.

NATURAL GAS IS VITALLY IMPORTANT TO AUSTRALIA'S LONG TERM ENERGY SECURITY

Replacement of Petroleum Imports

As an entirely indigenous fuel, Natural Gas offers the economic benefits of security of supply. It will never be subject to import supply restrictions which may arise due to either political or military factors. Australia is very much at the mercy of overseas conditions over which we have little or no control. Using Natural Gas vehicles would insulate our economy and environment from many of these influences. Increased dependence on Natural Gas will also reduce Australia's vulnerability to terrorist risks that arise in depending on imported fuels.

It is also important to take into consideration the future implications of Australia's fuel policy and related vehicular emissions standards. As a result of the move towards the mandated use of low sulphur fuels, more crude oil of higher quality (and therefore higher cost) will need to be imported to produce the Low Sulphur and Ultra Low Sulphur Diesels (LSD and ULSD). It is also likely that existing Australian refiners will choose to import refined oil rather than crude oil to avoid the huge capital cost of upgrading Australia refineries to produce LSD and ULSD. This will effectively move refining jobs offshore from Australia to overseas.

By replacing imported oil products with Australian Natural Gas, we can also reduce our Balance of Payments deficit. It was estimated in 1997 that if 15% of Australian vehicles ran on Natural Gas rather than petrol, diesel or LPG, our trade deficit could be reduced by up to $5 billion per annum.

Pipeline Delivery of Gas

Australia's Natural Gas reserves are linked to our major metropolitan markets by over 17,000 km of existing high pressure transmission pipelines. This not only reduces the risks of spillage during the delivery to service stations, but could reduce the emissions from the large fleet of petroleum delivery vehicles.

PRICE STABILITY

Natural Gas is isolated from the price fluctuations that are caused by world crude oil pricing and currency variations. This enables transport operators and governments to accurately forecast fuel prices as much as ten years in advance and removes the inflationary impact caused by crude price fluctuations.

Because the price of Natural Gas is regulated in each state and not tied to the pricing of world crude oil, users of NGVs receive the benefit of price stability. In fact, some fleet operators can negotiate prices as much as ten years in advance, which offers welcome relief from fuel price fluctuations. The introduction of 'contestability' in the gas industry also means more choice for fleet operators when choosing a gas supplier.

The price of petroleum-based fuels (petrol, diesel and LPG) is tied to world parity pricing. This ensures that the price of these products will vary as external factors (over which Australia has no influence) come into play. A decision by OPEC to limit production; a war or revolution in the Middle East; terrorism; restrictions on shipping; increased demand by larger customers, such as the USA; and a host of other factors can impact on the price Australian has to pay for crude oil.

As an indigenous fuel, Natural Gas is priced in Australian currency and is therefore not subject to fluctuations in foreign exchange rates.

HEALTH AND SOCIAL BENEFITS

"Don't kid yourself – petrol is fundamentally nasty stuff. It's a toxic cocktail of chemicals, many of which don't have to be burned to cause pollution. The gases that evaporate from petrol have been linked to cancer, multiple sclerosis and chronic fatigue syndrome ... diesel engines are naturally smoky, putting out about 20 times as many particle emissions as petrol engines ..."

The Australian
October 2001

Reduction in Environmental Disease

Reduction in Health Costs

Vehicle emissions contribute to a range of respiratory ailments, especially in urban areas such as Western Sydney, where the incidence of childhood asthma is particularly high. Air Toxics (volatile organic compounds) are believed to contribute to a range of health-related issues, including lung disease, cancer and heart disease. The California Air Resources Board has declared diesel exhausts both toxic and carcinogenic.

The National Health and Medical Research Council has estimated that if 15% of the national vehicle fleet were running on Natural Gas, we have the potential to reduce the health costs attributable to transport pollution by between $2.5 billion and $5.3 billion over the next ten years.

Reduction in Mortality

The Melbourne Mortality Study 1991-1998 showed that ambient air pollution in Melbourne attributable to transport contributed to an increase in daily mortality, and that the results were consistent with studies conducted elsewhere in Australia and overseas.

EXPORT AND EMPLOYMENT OPPORTUNITIES

Australia has the ability to develop many of the components required for the Natural Gas and hydrogen vehicles industry. A substantial opportunity exists for export of these products and services with a resulting positive impact on our economy. These opportunities are only likely to be developed if local conditions support the development of these products.

It is also likely that a manufacturing base focusing on gaseous fuels will be established in Australia if the market continues to develop. The manufactured product, ranging from tanks, valves, compression stations and conversion equipment will be sought-after products in the rapidly expanding Asian and South American NGV markets.

The relative weakness of the Australian dollar and the highly skilled workforce places Australia in a position where we could be supplying conversion kits, high pressure gas cylinders and cryogenic tanks (for NG and hydrogen), refuelling infrastructure and training to overseas clients. These mainly include potential markets in both Asia and South America as well as prospects in Europe and North America. Some suppliers have already made significant inroads into these markets but more could be achieved with a more vibrant local market.

Australian LNG producers are seeing significant export opportunities develop. Asian markets are becoming increasingly dependent on the use of imported LNG. As an example, one needs only to look to Korea where the conversion of 20,000 route buses is currently being undertaken.

The use of a low cost fuel will add to Australia's international competitiveness with the ultimate price of exported goods being lower due to lower transportation costs in absolute terms. As well as providing potential export opportunities, a number of employment opportunities will arise domestically.

These include retraining skilled conversion engineers currently experiencing unprecedented downturns in the LPG industry. A vibrant NGV industry would enable a number of businesses that would otherwise fold to continue employing staff that already have skills which can be applied to the NGV industry.

The establishment of refuelling networks, both public and depot-based will also provide opportunities for installation and maintenance engineers.

Price stability combined with lower costs of fuel, will allow manufacturers and transport operators using Natural Gas to make more accurate forecasts that are less vulnerable to the effects of currency and crude oil fluctuations.

FUEL SAFETY

Natural Gas is a safer fuel to use than Petrol, Diesel and LPG:

- ⇨ Because it is lighter than air, it rapidly dissipates into the atmosphere, where the other fuels pool, with the potential for explosion.
- ⇨ It will only ignite in a very narrow fuel/air mixture (5% - 15%).
- ⇨ It requires a much higher ignition temperature (650°C compared with 375°C for petrol and LPG).

- ⇨ It can be delivered to the refuelling point (Service Station) by pipeline, avoiding the risks of accidental pollution by sea and road transportation.

BENEFITS OVER BIO-FUELS

There will be a market for a number of alternative fuels in the future, and there will be a place for bio-fuels such as ethanol and bio-diesel. However, these fuels are, by their nature, not total substitutes for traditional petroleum fuels, but additives that will reduce some of the worst of the environmental emissions. As can be seen from the life-cycle analysis on page 7, they are only marginally cleaner than petroleum fuels due to their emissions during production, regardless of the feedstock used.

There must also be a question over the economic viability of Australian production sources, especially as they are almost totally dependent on primary production for their feedstock. In the event of a drought of a similar intensity and duration to the present one, the availability of crops from which to refine ethanol may well be seriously compromised.

Ethanol

There is already some concern about levels of ethanol above 10% causing damage to vehicle engines and fuel systems. Because of the relatively small size of the Australian vehicle market, manufacturers have stated that they have no intention to modify the specification of their products to permit higher concentrations of ethanol. Vehicle manufacturers in the United States do produce engines that will operate on 85% ethanol fuel, but at a substantially higher cost and for a much larger market. Ethanol has the same problems of transport as liquid fuels, and even if vehicles capable of higher concentrations of ethanol were available, it would require another refuelling infrastructure to be constructed. It also requires substantial processing to convert the raw feedstock to a usable fuel.

Biodiesel

Biodiesel is already available in Australia in limited quantities, and it really does not have the potential to become more than a boutique fuel. However, depending on the feedstock, it can be just as polluting as petroleum products (see page 5).

Because of the nature of the feedstock it would be necessary, not only to establish a distribution framework for a product with only limited application, but also to establish a collection transport network for the raw materials. In the long run, any attempt to produce biodiesel in commercial quantities might be counter-productive.

SUSTAINABILITY

Natural Gas offers a natural pathway to sustainable fuel production. This section outlines how we can capture existing naturally-occurring sources of Methane (Natural Gas), and utilise it in industrial, commercial, domestic and vehicular applications.

Biogas

The production of biogas is a prime example of sustainability. Biogas is produced from animal waste, sewage and compost. It is currently being produced in commercial quantities in Scandinavia, and fed into the gas distribution network, thus ensuring that these wastes are recycled. Once the feedstock is exhausted of its methane content, the residue is sold commercially as topsoil and compost.

The benefit of biogas is that digesters can range from small-scale (farm-based) to full-scale (sewage treatment works) units with the same positive results.

Land Fill Methane

Land fill methane is currently being captured at some sites for on-site electricity generation. Existing technology is currently being used overseas to produce pipeline (vehicle) quality Natural Gas.

Capturing these natural wastes from landfills ensures that the methane is diverted to productive use, rather than being dissipated into the atmosphere, as is the case at the moment. The fugitive methane emissions that currently escape from land fills are a major contributor to the greenhouse effect.

Coal Seam Methane

Eastern Australia is located over vast black and brown coal deposits that will never be commercially exploited. These deposits are constantly producing methane, which currently escapes to the atmosphere. The technology currently exists, and is being used in an experimental capacity in south-western Sydney to capture this gas. The potential exists to capture a much larger proportion of this gas and to reduce its greenhouse impact.

TRANSITION TO HYDROGEN FUEL

Natural Gas is also seen as the most sustainable path to the Hydrogen economy. This has been reinforced by recent studies from groups such as the WorldWatch Institute and the Union of Concerned Scientists. The high hydrogen to carbon ratio of methane makes Natural Gas the most efficient source of hydrogen (until such time as 'renewable' hydrogen becomes viable). Any infrastructure established to service Natural Gas vehicles can very easily be adapted to service hydrogen vehicles, either via on-board or supply side reforming.

Timeframe for the Hydrogen Economy

Hydrogen fuel cell vehicles are a reality today. The technology is available. The limiting factors to the adoption of hydrogen-powered vehicles are:

Safe and efficient storage

To store even a minimal quantity as a compressed gas, hydrogen would need to be compressed to 10,000psi (750 bar), which would require highly sophisticated storage vessels and very expensive compression equipment.

To store the fuel as a liquid, it would need to be frozen to -253°C (20°K) and held on board at that temperature. Both solutions are impractical with existing technology.

Safe transportation

Hydrogen is an essentially volatile fuel, and the bulk transportation and mass handling of the product poses significant safety risks.

Economics

The cost of a fuel cell vehicle is currently prohibitive in the commercial marketplace.

Another factor to be considered is the rate of take-off of hydrogen vehicles. In his recent State of the Union Address, President Bush set a target for a commercially viable hydrogen vehicle of 2010. If we assume that they are available at that time, and that there will be a 30% take-up of hydrogen vehicles from then, it will still take until 2050 to have 50% of the vehicles on the road operating on hydrogen. Realistically, it will take until 2070 for the majority of vehicles to be hydrogen-powered.

As an example, we only need to consider the introduction of unleaded petrol in Australia in 1985. This required no major change to vehicle production strategies, and no increase in vehicle price. Yet today, nearly 18 years later, there are still almost 2,000,000 pre-1985 vehicles on the road - enough to require every service station in Australia to continue to carry lead replacement petrol as well as unleaded.

Hydrogen Production and Distribution

While the ultimate aim would be to produce hydrogen for transport from renewable sources, fossil fuels - particularly Natural Gas - are an inevitable stepping-stone until renewable sources become viable.

The establishment of refuelling infrastructure to support NGVs effectively establishes a refuelling network which could also be used to support hydrogen vehicles as they become available. A recent paper from the WorldWatch Institute, *"Hydrogen Futures: Towards a Sustainable Energy System'* compares a number of the options available for establishing hydrogen refuelling networks and concludes that Natural Gas is the most viable and sustainable source and path.

The paper, which referenced several studies around the world, highlighted Natural Gas as being cleaner, more efficient to distribute, safer and easier to convert to hydrogen, when compared with other possible hydrogen sources, principally methanol and crude oil products.

The paper quoted a Canadian Study which found *'... that a decentralised Natural Gas reforming system posed the fewest technical challenges and was the most cost-effective hydrogen production system, reducing the life cycle greenhouse gas emissions by as much as 70 percent compared with conventional engines. '*

This view has been endorsed more recently by the Union of Concerned Scientists in a January 2002 report *"Dangerous Addiction - Ending America's Oil Dependence"*.

Methane reformers located on Australia's existing Natural Gas pipeline network (with compression technology similar to that used for CNG) could be used for the supply of hydrogen for transport use. This will increase the importance of expanding Australia's CNG refuelling infrastructure.

The use of hydrogen will also be dependent on expertise and technology already in place to service NGVs. This includes compression and cylinder/storage technology, adding further weight to the argument that the development of a vibrant NGV industry will better prepare Australia for future technologies.

Natural Gas as the Logical Transitional Fuel

Australia needs to be moving to cleaner and indigenous fuels today. We cannot wait for the availability of hydrogen vehicles to be available to begin the process. Unless we start by putting the infrastructure in place to support the first generation of clean vehicles (NGVs) now, we will not be ready for the hydrogen economy when it does come.

Natural Gas is a very simple fuel. Around 90% of Natural Gas is methane (CH4) which is just one carbon atom with four hydrogen atoms attached. The only simpler fuel available is hydrogen, but unfortunately, as yet there is no economic method of creating and distributing large quantities of hydrogen. Until this occurs, Natural Gas will remain the clean fuel of choice.

Why is a simple fuel better? It is the hydrogen that gives the power and the simpler the structure holding the hydrogen the fewer the compounds that are created during the combustion process. This is the reason that so much work has been going in to trying to clean up petrol and diesel vehicles. This work has resulted in vehicles that are much cleaner than they once were. However, Natural Gas is inherently cleaner than either of these fuels and provides significant advantages. Being rich in Hydrogen, Natural Gas will almost certainly be the major source of fuel as fuel cell technology improves.

Therefore we must look to a transitional clean fuel, and Natural Gas is the natural choice.

A VIABLE NATURAL GAS FUEL INDUSTRY IS THE PATHWAY TO FUTURE TRANSPORT TECHNOLOGIES

TARGET MARKETS

Natural Gas is suitable for use with every type of internal combustion engine, from lawnmowers to trains and ships and aircraft. The principal target market, however, is the road vehicle. In 2002, Australia had 12 million vehicles registered for use on the roads. Of these, 11.65 million were passenger and light commercial vehicles under 3.5 tonnes GVM. Only 350,000 were rated at above 3.5 tonnes.

Any program to support alternative fuels needs to address all of the market sectors, and the Commonwealth programs currently in place only address that 3% of the market over 3.5 tonnes.

Commonwealth Government Programs

Despite the considerable advantages that NGVs offer, the Commonwealth programs (the Alternative Fuels Conversion Program (AFCP) and the CNG Infrastructure Program (CNGIP) have yet to make any inroads in Australia, with the exception of urban buses. This is due to a number of factors, such as:

Limited program scope

The current programs are administered by the Australian Greenhouse Office, and therefore greenhouse benefits are the primary qualifying factor, particularly for engine approvals. Thus engines or conversion kits which, using current assessment techniques (i.e. greenhouse outcomes), but provide significant reductions in particulates, pollutants and air toxics, are excluded from the program. This is despite the fact that they reduce crude oil demands and deliver immediate reductions in emissions and noise levels. Even engines which currently meet Californian EPA air quality standards, widely regarded as the toughest in the world, are excluded from the programs because they fail to deliver significant greenhouse benefits.

Limited program availability

Current programs are restricted to vehicles over 3.5 tonnes GVM in some cases and 4.5 tonnes in others, ***effectively eliminating 97% of vehicles on Australian roads from the programs***. Establishing programs for lighter commercial vehicles (including taxis) could be done at relatively low cost, and yet would dramatically increase the number of NGVs on our roads, particularly as these vehicles enter the second hand market. This would also accelerate the demand for refuelling stations and contribute to the rapid roll-out of the refuelling infrastructure.

Lack of Government participation in programs

Almost without exception a major market driver for alternative fuels use overseas is government fleet participation in the programs. While Australian government fleets have significant uptake of LPG vehicles and some are purchasing a few petrol driven hybrid vehicles, the number of Commonwealth or State vehicles operating on Natural Gas is almost zero. As well as contributing to initial and ongoing fuel demand, Government NGVs would also filter into the second hand market, thus increasing the penetration into the wider community (as has happened with LPG vehicles)

Product availability

Due to the small size of the Australian heavy truck market, it is difficult for Original Equipment Manufacturers (OEMs) to justify the necessary investment to establish product in what is currently an uncertain market. Investments required include Australian Design Rules compliance costs, training of staff and dealer networks and establishing spare parts supplies to support Natural Gas vehicles.

The market for passenger and light commercial vehicles is altogether easier to kick-start. The CNG equipment is readily available now for after-market fitment (similar to LPG), and sophisticated CNG injection systems, suitable for OEM production, are now becoming available. A program to encourage the government and private fleet market to adopt CNG would involve relatively little cost and would kick-start the industry.

Refuelling Infrastructure

The Federal Government's CNG Infrastructure Program (CNGIP), which provided funding of $7.6 million to establish 19 public CNG refuelling sites, has been a complete failure. The concentration of its efforts at the top end of the market means that there are no vehicles to utilise the refuelling infrastructure, and therefore the infrastructure has not been built.

It will only be through the relatively low-cost and technologically simple passenger and light commercial fleet markets that there will be sufficient demand for refuelling to make it viable.

FUEL EXCISE

On 13 May 2003, as part of the Federal Budget, the Treasurer, the Hon. Peter Costello, announced that natural gas, in both the compressed and liquefied form, would become progressively subject to fuel excise tax over a five-year period commencing 1 July 2008.

In making this announcement, the Treasurer noted that this proposed imposition of fuel excise tax on previously untaxed fuels, including compressed and liquefied natural gas, would establish a "*fairer and more transparent fuel excise system, with improved competitive neutrality between fuels*".

The Treasurer further noted that the imposition of fuel excise tax on previously untaxed fuels would both "*fulfill the Government's existing commitments concerning the tax treatment of fuels*", and "*deliver on the Measures for a Better Environment commitment to encourage the production of alternative and renewable fuels*".

In his announcement, the Treasurer left open for further consideration and resolution a number of important areas of implementation detail. The nature of this detail is critical to the success of the proposal. It will determine whether the potentially conflicting objectives of achieving a fairer and more transparent fuel excise system, in parallel with effective support for the production and use of alternative fuels, can be achieved.

Our core business is to promote and facilitate the development of a viable natural gas vehicle industry in Australia.

For all the undoubted benefits associated with the use of natural gas in transport applications, the development and delivery of a natural gas vehicle (NGV) industry remains a very substantial undertaking. Natural gas vehicles, given the dual realities of ongoing technical development and low initial market volume, are expensive compared to vehicles using established fuels and engine technologies. But the long-term benefits are enormous.

Very significant investment in new refueling infrastructure is required to service natural gas vehicles.

The Commonwealth, in recognising these realities, has provided a number of programs, including the Alternate Fuels Conversion Program, aimed at the resolution of these important issues. It is regrettable that the administration and delivery of these programs have failed to bring their intention to fruition.

We have no philosophical objection to the application of a fuel excise to all alternative fuels. We only seek to put the strategic and economic issues in focus during the determination process and to be included in the consultative process when the Government is considering its "*commitment to encourage the production of alternative and renewable fuels.*"

This submission has been developed in recognition that a fuel excise tax will be progressively applied to natural gas during the five-year period commencing on 1 July 2008, and we believe that a constructive and positive approach on our part will meet with a positive response from Government.

We have identified a number of options that might allow the Commonwealth to implement its fuel excise tax reforms, while retaining incentives for the use of natural gas as a transport fuel, and the continuing development of a natural gas vehicle industry in this country.

RECOMMENDATIONS

It is our recommendation that the Commonwealth Government provide national leadership by introducing an integrated policy framework to encourage the establishment and growth of the NGV market. This leadership

role would, at little cost to the Budget, ensure that Australia will join progressive governments around the world in encouraging and ensuring the transition to clean, sustainable transport.

Under this proposal, with government support, it is expected that the Natural Gas vehicle industry could become fully self sustaining by 2012.

We recommend that the support should be in the form of an integrated policy framework covering refuelling, vehicle conversions or purchase, industry training, and vehicle ownership.

Establish a New and Specific Excise Rate for Natural Gas

We propose that a product specific excise rate be determined for natural gas.

This rate should be determined in consultation with the natural gas and transport industries and other relevant stakeholders, and should include but not be limited to the following considerations:

- The basic energy content of natural gas, in relation to the unit quantum upon which the excise rate is to be based;
- An "environmental credit" to take into account the environmental benefits of natural gas, including lower carbon content;
- A "resource security credit" to take into account the quantifiable resource security benefits associated with natural gas, as an abundant and secure indigenous resource;
- An "energy futures credit" to reflect the role that natural gas and natural gas vehicles will take in the transition to the hydrogen economy.
- A "physical delivery credit" to reflect the high costs of compressing or alternatively liquefying natural gas for use in transport applications; and
- Any other relevant factors.

SET AN EXCISE RATE IN THE SHORT TERM TO ENSURE THE BENEFITS OF NATURAL GAS IN THE LONG TERM

Provide a Five Year Excise Exemption for Major Fleet "Start Ups"

We recommend that a 100% rebate on fuel excise, for a fixed five-year period, be introduced for organisations that contract to transfer a significant proportion of overall fuel use from conventional petroleum based fuels to natural gas.

The purpose of this rebate is to provide an incentive for "critical mass" in the development of a natural gas fuel and transport industry, and to assist in the delivery of the benefits outlined elsewhere in this submission.

In an environment where a fuel excise will now apply to natural gas, it is our submission that a "one off" initial incentive will be required if major fleet operators are to be convinced to make the initial capital investment necessary to convert significant vehicle numbers to natural gas.

The proposed five-year excise "honeymoon", to be delivered by way of rebate, would provide such an incentive. It would contribute to the justification and recovery of the initial investment costs involved in the transfer of significant vehicle and fuel volumes to natural gas.

PROVIDE A "ONE OFF" FIVE YEAR EXCISE EXEMPTION FOR MAJOR FLEET CONVERSIONS

Broaden the Application of the Existing Alternate Fuels Grant Program

We believe that the existing Commonwealth programs that provide subsidies for the conversion of buses and trucks to natural gas operation should be expanded to include appropriate subsidies for the similar conversion of passenger and light commercial fleet-operated vehicles, such as government and corporate fleets, taxis, and courier and delivery vehicles.

The rationale for this submission is that there will need to be an effective offset for the initial higher capital cost of all natural gas vehicles once the current fuel cost saving is negated by the imposition of fuel excise. It will also encourage the heaviest users of passenger and light commercial vehicles to move to natural gas, and provide a market that will encourage OEMs to consider local production of qualifying vehicles.

EXPAND EXISTING COMMONWEALTH CONVERSION PROGRAMS TO INCLUDE ALL FLEET-OPERATED VEHICLES

Extend the Term of the Existing Alternate Fuel Conversion Program

The existing Alternate Fuel Conversion Program (AFCP), administered by the Australian Greenhouse Office, is currently scheduled to end on 30 June 2008, concurrent with the imposition of fuel excise on natural gas and other alternate fuels.

The difficulty with this timing is apparent. It would mean that an existing incentive program would be extinguished at the same time as a new tax is imposed. This represents a huge disincentive to invest in the necessary infrastructure and vehicle acquisitions.

In our view, the combination of these two factors will represent an impossible burden for the emerging natural gas vehicle industry. We propose that the AFCP, (as extended by our recommendation above), be extended by a further five years until June 2012, and that a further extension be considered, based on the success of the program at that time.

CONTINUE THE ALTERNATE FUELS CONVERSION PROGRAM DURING THE FIVE YEAR "RAMP UP" OF FUEL EXCISE

Integrate and Centralise Commonwealth Alternate Fuel Grant Processes

We believe that the delivery of the existing Commonwealth Programs has been singularly unsuccessful under the present administration of the Australian Greenhouse Office (AGO). The benefits of all alternative fuels, and especially natural gas go far beyond Greenhouse. The strategic, economic and air quality benefits of natural gas are at least as important as the greenhouse benefits, yet the AGO has given no more than token recognition of these factors during its stewardship of the Commonwealth's programs.

We submit that the financial administration and management of all Commonwealth financial programs dealing with alternate fuels, including the various grant programs, should be integrated and centralised under one department or agency.

Given the central role that will be played by the foreshadowed fuel excise, it is our recommendation that these programs should become the primary responsibility of Treasury, and the Australian Tax Office, with technical and policy advice to be provided as required by other relevant departments and agencies.

INTEGRATE AND CENTRALISE ALL FINANCIAL PROGRAMS IMPACTING ON ALTERNATIVE FUELS

Establish an Alternate Fuels Task Force

The Commonwealth should establish an "Alternate Fuels Task Force", to liaise with industry stakeholders regarding the ongoing development of practical and effective alternate fuel strategies, including natural gas.

The primary purpose of the task force, which would involve appropriate industry representation, would be to develop and maintain a constructive dialogue with industry stakeholders. This process would help to ensure that the Commonwealth's objectives in managing the fair and effective generation of taxation revenues from the transport sector would relate effectively with support programs the emerging alternate fuels sector.

This process would ensure a "whole of government" approach in this increasingly important area of national policy.

ESTABLISH AN ONGOING ALTERNATE FUELS TASK FORCE, AND A "WHOLE OF GOVERNMENT" APPROACH

Support the Establishment of Public Access Natural Gas Refuelling

The previous Compressed Natural Gas Infrastructure Program (CNGIP) proved to be a total failure. The reasons for its inability to deliver the intended outcomes are now a matter of history. However, there is still a need to provide a level of support for both CNG and LNG refuelling facilities.

The re-introduction of a revised infrastructure program, developed in conjunction with industry representatives and designed to attract investment, would be an essential component of any integrated package of support.

RE-INTRODUCE A REVISED NATURAL GAS INFRASTRUCTURE PROGRAM FOR CNG AND LNG

Passenger and Light Commercial Vehicles

Passenger and light commercial vehicles constitute 97% of the national vehicle fleet and contribute 78% of the pollution and greenhouse gases generated by vehicles. At this time there are no Commonwealth or State Government programs to support this sector of the national fleet.

The opportunity exists for Government to promote the take-up of Natural Gas passenger and light commercial vehicles through a range of initiatives that complement the existing Commonwealth programs.

The following options, which individually would greatly assist the take-up of vehicles, when taken together would ensure the success of the program, and encourage even wider acceptance in the community.

Vehicle subsidy

It is recommended that the Government consider the provision of a subsidy for ***fleet*** passenger and light commercial vehicles that are purchased new as Natural Gas capable, or converted to run on Natural Gas. This program would be targeted at fleet vehicles for several reasons:

- It would be easier to administer, and would target the greatest proportion of high mileage vehicles, such as taxis, government (state and local) vehicles, courier and small delivery vehicles and company sales staff.
- It would create a market that would encourage the development of Original Equipment Manufacturer (OEM) vehicles such as Ford Falcon, Holden Commodore, and Mitsubishi and Toyota light commercial vehicles.
- These vehicles generally have a rapid turnover, and are sold into the private market, which would rapidly increase the installed base at the least possible cost.
- By increasing the installed base quickly, it would guarantee the viability and future development of the public refuelling network.

A recommended level of subsidy, with expenditure capped at $5,000,000 per year for the first three years and $10,000,000 for the final two years, would be:

$1500 per vehicle in Year One	-	3333 vehicles
$1250 per vehicle in Year Two	-	4000 vehicles
$1000 per vehicle in Year Three	-	5000 vehicles
$1000 per vehicle in Year Four	-	10000 vehicles
$1000 per vehicle in Year Five	-	10000 vehicles

This program provides a greater incentive for those who are prepared to be environmental leaders in the community by making an early commitment to natural gas, and can serve to identify them as such.

INTRODUCE A SUPPORT PROGRAM FOR FLEET-OPERATED PASSENGER AND LIGHT COMMERCIAL VEHICLES

Government Fleets

Government should lead by example. It is recommended that the Government consider a plan to mandate that an increasing proportion of Commonwealth, State and local government fleet vehicles be Natural Gas capable. This would provide environmental leadership, while again helping to underpin the long-term viability and growth of the refuelling network and supporting the concept of OEM production of vehicles.

A commitment to 10% of Government fleets being Natural Gas capable in the first year, increasing to 25% in the fifth year of the program would support the growth of the industry and would result in substantial economic and environmental benefits for Australia. These vehicles would be in addition to those identified in the subsidy scheme above, and although there will be an additional capital cost to government, the majority of these costs would be recovered at the time of disposal.

PROVIDE LEADERSHIP BY ESTABLISHING MANDATES FOR ALTERNATIVE FUELLED VEHICLES FOR GOVERNMENT FLEETS

CONCLUSION

Natural Gas vehicles are a mature technology and are therefore *the* "here and now' solution to considerable energy use and environmental problems caused by traditional transport fuels. Vehicles operating on Natural Gas are already meeting emissions standards which aren't due to be implemented in Australia until 2006-7. These vehicles are delivering immediate health benefits and the technology can be implemented not only in new vehicles but also by converting older vehicles.

Natural Gas vehicles deliver immediate, medium-term and long-term benefits to the community. The technology is available now and paves the way for diversity and security of fuel supply, energy independence and for the establishment of a hydrogen transport economy. They provide a stable cost base and do not result in a net export of wealth to oil producing and refining nations. They deliver immediate improvements to air quality, noise emissions and greenhouse emissions.

If the above recommendations were to be adopted, the Australian NGV industry could become sustainable within the time frame of the proposals. The additional cost to the Budget would be no more than 50 cents per resident per year, while the impact on Australia would be significant as we would become less dependent on crude oil for transport fuels and increase our use of an abundant, clean, indigenous fuel.

How can Australia not follow the trends currently being set overseas and diversify the use of transport fuels to include Natural Gas? Much of the debate regarding fuels has already been concluded in the public domain with the majority of informed stakeholders concluding that Natural Gas should play an important role in the Australian transport industry.

The question we need to answer is “How quickly and how widely can we adopt Natural Gas as a vehicle fuel to respond to these challenges? The answer to this question is very much dependent upon the establishment of policies to increase the use of Natural Gas vehicles.

The Commonwealth Government has this opportunity to develop policies, involving the Energy, Resource, Industry and Environment portfolios, to create an environment where Natural Gas vehicles can play a significant and positive role in the energy industry.

We urge all parties to take a position of leadership and to consider the recommendations in this paper as part of their energy strategies. We will, of course, be available to provide any other information, advice or data to assist in reaching a favorable decision.

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