

INQUIRY INTO AUSTRALIA'S FUTURE OIL SUPPLY AND ALTERNATIVE TRANSPORT FUELS

SUBMISSION TO THE

SENATE RURAL, REGIONAL AFFAIRS AND TRANSPORT COMMITTEE INQUIRY

FEBRUARY 2006

INTRODUCTION

The Natural Gas Vehicles Group welcomes this opportunity to present its submission to the Senate Rural, Regional Affairs and Transport Committee Inquiry into Australia's future oil supply and alternative transport fuels.

We hope that this contribution will help the Committee in its consideration of the Terms of Reference, especially in the development of a national policy framework for alternative fuels based on energy security and availability; costs and benefits; environmental issues; and technological issues.

THE NATURAL GAS VEHICLES GROUP PTY LTD

The Natural Gas Vehicles Group (NGV Group) is the only company in Australia whose core business is the development of Natural Gas Vehicle (NGV) technology. As such, we provide a unique voice in the clean alternative fuels market.

The company was originally structured to provide a complete range of products and services for the NGV industry in Australia, including consultancy services, component import and distribution, research and development, and refuelling services.

The Managing Director of the NGV Group, Kevin Black, was a Director of the Australasian Natural Gas Vehicles Council (ANGVC), the peak body representing the industry. The ANGVC was wound up in 2004 as a consequence of a number of policy decisions by the Federal Government. These decisions created an environment of instability where it was too risky for potential investors to build the necessary infrastructure.

As a result, all of the business of the NGV Group has been undertaken outside of Australia since mid-2004.

Nonetheless, we still believe that a vibrant Natural Gas Vehicles (NGV) industry is both possible and essential to Australia's future fuel mix.

NATURAL GAS AS A VEHICLE FUEL

Natural gas is a naturally occurring hydrocarbon that is composed primarily of methane. It is possibly the world's most abundant energy source that can be used for transport.

Briefly, some of the benefits that natural gas for vehicles (NGV) offer are:

- ⇒ Australia has vast reserves of natural gas.
- ⇒ We have an extensive and growing pipeline distribution network to all major population centres.
- ⇒ We can readily replace imported petroleum fuels with an indigenous fuel.
- ⇒ Natural Gas can reduce the impact of fuel imports on the Balance of Trade.
- ⇒ Natural Gas can insulate Australia from the worst effects of a petroleum crisis in the event of war or terrorism.
- ⇒ Natural Gas can introduce a measure of price stability into the vehicular fuels market – at about half of the current price of petrol.
- ⇒ Natural Gas can be used in any internal combustion engine.
- ⇒ As a fuel, Natural Gas has the cleanest “well-to-wheel” emissions currently available.
- ⇒ The use of NGVs could greatly reduce the health and social costs associated with transport-generated emissions.
- ⇒ Natural Gas is up to 90% safer to use than petrol, diesel and LPG.
- ⇒ The production of biogas (biomethane) from wastes sources such as garbage, animal wastes, sewage, etc., produces the most sustainable, ecologically sound fuel in the world.
- ⇒ Natural gas is the logical feedstock to provide a natural and smooth transition to the hydrogen transport economy.

NGVs are being taken up by countries around the world with comprehensive support programs. As an example, Argentina and Brazil are each putting over 20,000 NGVs on the road every month, and most Asian countries are enforcing the transition to natural gas vehicles. The United States and Europe have introduced comprehensive laws to promote the use of alternative fuels, with the European Union aiming for a target of 10% NGVs by 2020. Most Asian countries, including India, Pakistan, Bangladesh, Thailand, Malaysia, Indonesia, Myanmar, China, Korea, Iran and Japan are actively promoting or mandating the use of natural gas in every type of transport from trishaws to buses.

Natural gas can be used in vehicles in two forms – either as Compressed Natural Gas (CNG) or as Liquefied Natural Gas (LNG). In either case it is the same fuel (primarily methane - CH_4) although LNG is a more pure form of the gas due to the removal of heavier gas fractions and impurities during liquefaction.

As CNG, it is compressed to 200 bar (3000psi) and stored on the vehicle as a gas. As LNG, it is refrigerated to -161°C and stored as a cryogenic liquid.

CNG is more suitable for vehicles that use less than 50 litres of fuel per day, while LNG is ideal for larger fuel users such as buses, trucks and taxis.

Despite the fact that we have vast reserves of natural gas, and we export enormous quantities to countries that are adopting NGVs, Australia is lagging behind even third world countries in developing a suitable support program.

ALTERNATIVE FUELS IN AUSTRALIA

In the late 1990s, the Australian Government recognised that NGVs had the potential to reduce air pollution and offer a sensible and worthwhile alternative to petroleum fuels. In 1997, the Government introduced the CNG Infrastructure Program to support the development of refuelling facilities for Compressed Natural Gas (CNG). This was in response to a program initiated by one of the principals of the Natural Gas Vehicles Group while working at Liverpool City Council in Sydney.

At the same time, the government established the Australian Greenhouse Office (AGO) and placed the administration of the program under its control. In 2000, the government introduced the Alternative Fuels

Conversion Program (AFCP) as part of the negotiations for the introduction of the GST. These two programs remained under the control of the Australian Greenhouse Office. Unfortunately, due to constant Government policy changes and inappropriate AGO policy and administrative settings, the aims of the programs were never achieved. The funds allocated for the programs were gradually wound back and allocated to other programs such as ethanol and biofuels.

These inappropriate policy settings effectively killed off the industry in Australia. No sensible investor was prepared to fund the infrastructure without a secure and supportive policy environment, and since 2004, most of the infrastructure that was in place has been wound back or removed.

Our concern is that in recent years the government's policy framework for alternative fuels concentrates on ethanol and other liquid biofuels and excludes the cleanest alternative fuels. This reflects a lack of understanding of the economic, environmental and security importance of natural gas fuels, and a dangerously *ad hoc* approach to policy making.

More importantly, the events surrounding this whole process have created a public perception that the **only** clean alternative fuels in Australia's future are ethanol and biodiesel. The controversy has raised the profile of biofuels, especially ethanol, to a point where they are the Commonwealth Government's only preferred option.

The effect of the process over the past four years was to create doubt, uncertainty and confusion in the minds of vehicle owners, fleet operators and infrastructure providers about the clean fuels policy framework, especially in relation to natural gas. This destroyed the viability of the NGV industry in Australia.

The development of a new industry is dependent on long-term investment, which in turn is dependent upon confidence in the long-term policy framework. The Government's actions over the past four years have undermined that confidence, and has brought the NGV industry to a complete standstill.

There are excellent arguments for promoting many alternative fuels, but the current debate has centred on ethanol for all of the wrong reasons. While ethanol can claim some environmental benefits when used as a fuel additive and substitute in petrol, the true debate on alternative fuels has been hijacked by political issues.

The political fallout from the controversy over ethanol has overshadowed the true reasons for considering an alternative fuels strategy for Australia, and has caused government to lose sight of the enormous national strategic, environmental and economic benefits offered by natural gas as a vehicle fuel.

The ethanol issue has hijacked the national debate on clean fuels – the debate we should be having about the direction of our overall fuels policy. There is a place in Australia's medium to long term fuel policy mix for ethanol and biodiesel (and for low sulphur petroleum fuels), but there is also a place for CNG, LNG, LPG, Hybrids and Hydrogen in that mix. The Government's position seems to be that we will get around to looking at these other fuels at some time in the future, but in the meantime, the policy vacuum is dealing a body blow to those industries.

THE IMPACT ON THE NGV INDUSTRY

The government's policies over a period of years have dealt an almost fatal body blow to the NGV industry. In the absence of a rational alternative fuels policy framework for the future, all plans to invest in NGVs or NGV

infrastructure has ceased. Indeed, AGL has announced that it has closed two of its three CNG public refuelling stations in Sydney and will be closing the other in the near future.

Our company, as a specialised NGV company, has been particularly hard hit. We established the company to participate in the growth of a new and environmentally responsible industry in Australia. All of the projects that we were supporting have been abandoned as a result of the change of policy direction and the negative signals they have given.

Unless some clear policy direction affirming support for investment in *all* alternative fuel technologies is given in the very short term, it is likely that the NGV industry, at least, will be never recover in Australia. Apart from the personal financial losses that this will involve for people like me and my partners who have invested their life savings in an effort to bring the world's most viable clean fuel technology to Australia, it will mean that this nation will fall behind the rest of the world in preparing for the transition to the hydrogen transport economy. It will also mean that we will forever remain hostage to the oil supply and pricing decisions of OPEC, and the risks associated with dependence on the Middle East as our principal fuel source.

SUSTAINABILITY

While natural gas is currently sourced from the vast gas fields under and surrounding Australia, it can also be sourced from the enormous coal seam reserves under Eastern Australia that will never be mined, and from the hundreds of landfill sites around the nation. These reserves of gas currently simply escape to the atmosphere and contribute to the greenhouse gas problem. By capturing them at source and diverting them into our domestic supply we can further improve our greenhouse performance.

More importantly, we have a wonderful opportunity to utilise our human and animal wastes to generate biogas and compost, rather than the present system of partially treating wastes and discharging them to our oceans and waterways. This process has been used in Scandinavia for some years and has had quite some success in reducing the environmental impact of the waste stream. Attached to this submission is a transcript of a story carried on the ABC Landline program on 19 February 2006.

FUEL SUPPLY SECURITY

Governments overseas are placing increased importance in diversifying transport fuel supplies and increasing energy independence. The United States implemented the Energy Protection Act (EPA) 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 international 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 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. "*

President Bush reiterated the need to develop all alternative fuels during his 2006 State of the Union Address only a few short weeks ago. Once again, the theme of that statement was the urgent need to achieve energy security from Middle Eastern Oil.

If transport energy issues are so high on the agenda of overseas governments, why are we so complacent here in Australia? We can't 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 an economy dependent on transport arguably make it more important for us to establish major fuel diversification programs.

Even though we are isolated from the current 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 considering the consequences if the supply of imported crude were restricted or even halted altogether due to changes in OPEC policy or conflict in the Persian Gulf area?

It is not a case of whether we can afford the price of supporting clean indigenous alternative fuels - we can't afford not to increase our support of them. Importantly, we can't afford to wait for serious problems to arise, but should be putting strategies in place now. A crisis could occur overnight, but putting a fuel diversification strategy in place will take some time. The time lag could be fatal to our economy.

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.

THE TRANSITION TO HYDROGEN FUEL

Natural Gas is also 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.

In his 2003 State of the Union Address, President Bush set a target for a commercially viable hydrogen vehicle by 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 2060 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. However, the corollary that there will still be more than twice as many non-hydrogen vehicles on the road as there are today, with huge fuel demands. Can we afford to continue to rely on uncertain oil supplies?

As an indicator, 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, over 20 years later, there are still about 1,500,000 pre-1985 vehicles on the road.

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 would effectively establish a refuelling network which could also be used to support hydrogen vehicles as they become available. A recent paper from the WorldWatch Institute concludes that Natural Gas is the most viable and sustainable source and path.

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 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.

CONCLUSION

We recommend that the Committee recognise the strategic, economic and environmental benefits of natural gas for vehicles and recommend the urgent introduction of an integrated alternative fuels policy framework. This leadership role would ensure that Australia will join progressive governments around the world in encouraging and ensuring the transition to clean, sustainable transport.

The future demand for transport fuels is likely to grow at an exponential rate – especially with the growth of the economies in China and India. Australia will need to use every resource at its disposal to maintain its dependence on transport. We must plan now for the inevitable crisis – it will be too late if we wait until the crisis occurs.

Natural Gas Vehicles are a mature technology throughout the world, 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 for several years. These vehicles are capable of 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.

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 Government's alternative fuels policy must be expanded **now** to ensure that all clean alternative fuels are dealt with on a fair and equitable basis. As part of this process, there needs to be a clear and unequivocal message from Government that all alternative fuels will be treated equitably and that they will have its active encouragement through effective and targeted support programs.

The current perception that the Australian Government does not support clean alternative fuels is exactly the opposite of existing world-wide best practice.

We have this last opportunity to implement policies, involving the Energy, Resource, Industry and Environment portfolios, to create an environment where Natural Gas Vehicles (and other clean technologies) can play a significant and positive role in the transport energy industry.

The attached document provides a more comprehensive overview of the benefits to Australia of an integrated program of support for NGVs. We will have other relevant documentation available at the hearing if it will assist the Committee in its consideration of the Bill.

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.

Yours faithfully

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NATURAL GAS VEHICLES: SECURING AUSTRALIA'S ENERGY AND ENVIRONMENTAL FUTURE



THE ROLE OF NATURAL GAS VEHICLES AND THE CASE FOR A RATIONAL ALTERNATIVE FUELS STRATEGY IN AUSTRALIA

FEBRUARY 2006

**THE NATURAL GAS VEHICLES GROUP PTY LTD
PO BOX 3120, LIVERPOOL, NSW 2170**

ARE YOU LOOKING FOR AN ANSWER TO SOARING FUEL PRICES?

IF YOU COULD GET:

THE CHEAPEST FUEL AVAILABLE IN AUSTRALIA

Equivalent to 47.3 cents per litre of petrol, 57.7 cents per litre of diesel or 32.5 cents per litre for LPG

THE CLEANEST FUEL AVAILABLE IN AUSTRALIA

Proven by the CSIRO to have the lowest life-cycle emissions of any fuel, with significantly lower emissions than petrol and diesel

THE SAFEST FUEL AVAILABLE IN AUSTRALIA

Up to 90% safer to use than petrol, diesel or LPG

THE MOST SECURE AND ABUNDANT LONG-TERM FUEL SUPPLY

★100% indigenous sources ★Over 100 years proven reserves

Not dependent on vulnerable world oil supplies

THE MOST STABLE PRICING

★Pricing is partially government-regulated ★Price has only increased by CPI (and GST) in past 10 years

★Not tied to world parity oil pricing ★Not dependent on fluctuating currency exchange rates

THE NATURAL PATHWAY TO THE HYDROGEN ECONOMY

Natural gas (Methane - CH₄) is already 80% Hydrogen

The natural gas refuelling infrastructure would also be used for hydrogen vehicles (When they finally arrive)

FUEL EXCISE EXEMPTION UNTIL 2011

WOULD YOU BE INTERESTED? OF COURSE YOU WOULD!! WHO WOULDN'T?

THE FUEL IS NATURAL GAS, AUSTRALIA'S MOST ABUNDANT ENERGY SOURCE AND
THE FIRST CHOICE IN ALTERNATIVE FUELS AROUND THE WORLD.

But it is still a well-kept secret in Australia. Why?

Because the Commonwealth Government has virtually abandoned all alternative fuel programs except for ethanol and biodiesel - the fuels that benefit the National Party's farmer support base.

With Government support to establish a refuelling network in our metropolitan and regional areas, Australia could reap the rewards of 100% Australian natural gas - stable pricing, secure supplies, lower balance of trade deficit, lower exhaust emissions and up to 70% fuel cost savings.

The government provided financial support to establish the first three public refuelling sites for Compressed Natural Gas (CNG) in Sydney. Then it made almost 20 changes to its alternative fuels and fuel excise policies in three years from 2001 to 2004 and effectively killed off the emerging Natural Gas Vehicle (NGV) industry. Now AGL/Agility, who operates those sites, has decided to close them down, leaving the hundreds of existing environmentally-responsible customers in NSW and the ACT who have invested in NGVs out in the cold without any refuelling services.

NGV programs throughout the world have seen the market grow dramatically over the past few years. Natural gas is the preferred alternative fuel in South America, China, South East Asia, India, Pakistan, Iran and Europe. Many of the countries embracing natural gas are importing their gas from Australia. More than 4 million natural gas vehicles are on the world's roads (more than 2 million new cars or conversions in the past five years alone).

Australia is going against the world-wide move to NGVs for short-sighted, short-term, politically-motivated reasons. And we are being locked into a petroleum-based future that is vulnerable to war, civil upheaval and terrorism.

Unless we get some enlightened leadership soon, we face an uncertain future of high fuel prices, fuel shortages and serious risks to our energy security. Australia must re-think its transport energy policies to ensure that we can insulate our nation from the inevitable fuel crises of the future. It will be too late to do anything about it when the crisis does come.

For more information on Natural Gas as a vehicle fuel, please contact Kevin Black at the Natural Gas Vehicles Group on (02) 9730 3673 or 0402 288 858 (Email: admin@naturalgasvehicles.com.au)

WE HAVE THE ANSWER. THE QUESTION IS — WHAT IS THE
GOVERNMENT GOING TO DO ABOUT IT?

THE ROLE OF NATURAL GAS VEHICLES IN AUSTRALIA'S ENERGY FUTURE

The increasing world demand for oil, the continuing risk of terrorism, and the instability of the Middle East with its potential for war, civil war and unwelcome regime change, and the impact of natural disasters has placed Australia's (and the world's) energy future at risk.

Nations around the world are actively pursuing energy diversity programs - not only for long-term energy security, but for the environmental and economic benefits that alternative fuels such as Natural Gas offer.

Australia urgently needs a fuel strategy that recognises these dangers and establishes our energy independence. We can no longer risk our energy and transport future on a blind reliance on imported oil. During the past three years, the price of crude oil has increased from \$US20 a barrel to as much as \$US70- an increase of 375%.

Natural Gas Vehicles (NGVs) *must* play a major role in our automotive energy strategy. Of all of the fuel alternatives currently available, *only* natural gas offers Australia a unique opportunity to protect our future transport industry from our continued reliance on imported petroleum fuels.

The rest of the world has recognised the major role that NGVs will play in the future. NGVs offer significant long-term benefits for our nation, including the opportunity to:

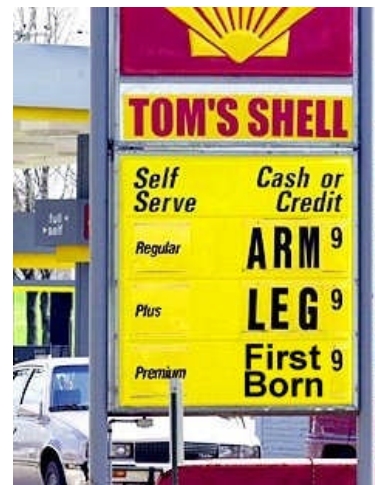
- ☐ Insulate Australia from the worst effects of a petroleum crisis in the event of war or terrorism.
- ☐ Guarantee the long-term energy security and energy independence of Australia.
- ☐ Reduce the Balance of Payments deficit by replacing imported fuels with a cleaner indigenous fuel.
- ☐ Introduce 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 network to provide a natural and smooth transition to the hydrogen transport economy.

The debate over ethanol during the past couple of years has effectively hi-jacked the alternative fuels debate in Australia, and distracted the attention of national policy-makers from the real issues that an alternative fuels strategy should be addressing.

Our national energy strategy should be based on how best to protect our transport-dependent nation from external threats to our fuel supply - not on protecting threatened rural industries. If farmers can be helped as part of a well-considered fuels policy, so much the better, but the policy must come first.

The 2003 Federal Budget announcement of the imposition of fuel excise on alternative fuels seriously damaged all sectors of the alternative fuels industry by taking seven months to announce the rate of excise and a further four months to confirm the commencement date. In conjunction with almost 20 other changes in Federal Government fuel policies within two years, it effectively killed the NGV industry in Australia.

The Commonwealth Government established an Alternative Fuels Program in 1997, and extended it in 2000. However, the two programs; the Alternative Fuels Conversion Program (AFCP) and the Compressed Natural Gas Infrastructure Program (CNGIP) have been singularly unsuccessful in promoting the use of alternative fuels in Australia. The management of the programs was placed with the wrong Commonwealth Instrumentality, and was ill-directed to a very limited sector of the national transport fleet. In the 2004 Federal Budget the funding for the program was cut by over 70%.



The Australian program commenced at about the same time as Argentina embraced NGVs. Nine years on, Argentina has almost million NGVs on the road, while Australia has actually gone backwards with the exception of 600 urban buses.

Australia must embrace alternative fuels and there is an urgent need for a *successful* alternative fuels program. In the present (and future) uncertain international climate, our continued reliance on imported petroleum fuels, such as petrol, diesel and LPG, is a threat to our transport-dependent economy. Natural Gas is a clean, environmentally responsible, indigenous fuel that can guarantee our energy independence.

The Commonwealth Government has failed to recognise the serious risks that threaten Australia's energy future. We believe that it must now re-think its policies and must now actively support the only alternative fuel that can protect our transport industry from the potential danger that an oil crisis poses to our energy security, and our economic and environmental well-being.

ENVIRONMENTAL BENEFITS OF NATURAL GAS AS A VEHICLE FUEL

Reduced Life Cycle Emissions Compared With All Other Fuels

The Australian Greenhouse Office (AGO) and Environment Australia in 2001/2 commissioned a report by a consortium led by the CSIRO on the life cycle emissions attributable to transport fuels. The researchers concluded that the use of CNG or LNG in vehicles will significantly reduce emissions of oxides of nitrogen, particulates, carbon monoxide and volatile hydrocarbons. Natural gas was the **only** fuel that was significantly cleaner than Low Sulfur Diesel and Low Sulfur Petrol, the reference fuels, on every criterion. The results of that study are at page 11.

The introduction of low sulfur and ultra low sulfur fuels is also expected to produce a negative greenhouse benefit due to the more intensive energy requirements for refining, and possible decreases in engine performance efficiencies.

Air Quality and Air Toxics

Natural Gas offers up to 100% reduction in particulate matter and significantly reduced emissions of other pollutants over all existing petroleum fuels (petrol, diesel and LPG). Increased use of NGVs will contribute to a reduction in urban air pollution and an improvement in air quality.

In testing by the New South Wales RTA, the use of CNG in Ford Falcons resulted in an average emission reduction of 56% in Volatile Hydrocarbons (NMHC), 60% in CO, 21% in CO₂, and

39% in NO_x, when compared to petrol.

All Diesel Exhaust is Dangerous

A recent Stanford University Study revealed that particulate matter (PM) is also a major contributor to global warming and that reductions in particulate matter will produce more dramatic and almost immediate reductions in global warming, where CO₂ reductions aren't expected to yield benefits for between 50 and 200 years.

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 is a continuing hazard. Crude oil, diesel and petrol spillage can occur during exploration and bulk transportation via the seaways; during handling and storage at ports and depots; and during road transport and fuelling. Underground storage can leach into soils and water catchment areas and particulate emissions settle onto 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.

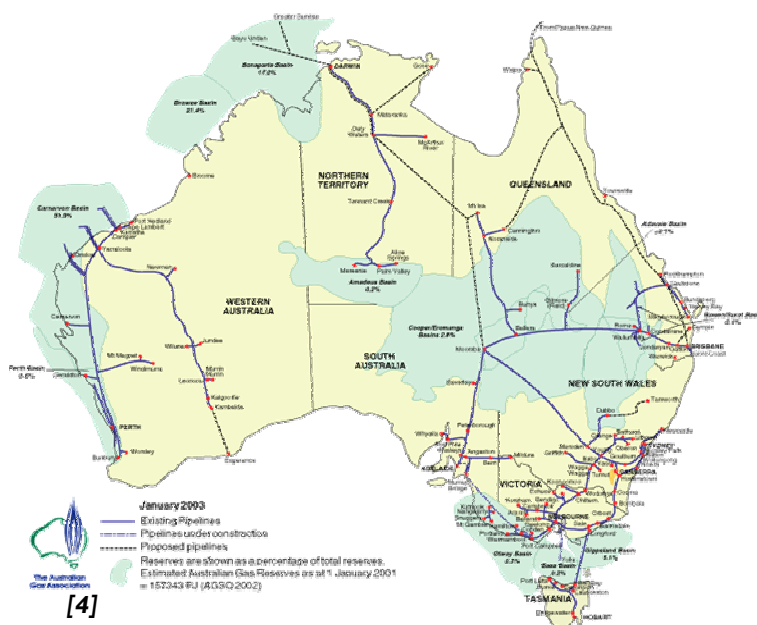
***("The control of fossil-fuel particulate black carbon and organic matter is the most effective method of slowing global warming" Mark Z. Jacobson, October 2001)**



PIPELINE DELIVERY OF NATURAL GAS

Australia's Natural Gas reserves are linked to our major metropolitan markets by over 17,000 km of existing high pressure transmission pipelines, and an extensive local distribution network in most major population centres. 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.

In addition, Australia has vast reserves of coal seam methane (CSM) that can be captured and used - especially in remote communities that are not connected to the pipeline network.



ENERGY SECURITY = NATIONAL SECURITY

The Risk to Our Oil Supplies

Australia's oil imports are expected to increase to over 200 million barrels per annum by 2009/10.

In the current uncertain international climate, Governments around the world are actively diversifying their transport fuel options and increasing energy independence. Because Australia has had reliable supplies of crude oil in the past, there is a real danger that we may become complacent about this and assume that it will always be the case. Indeed, the Commonwealth Government's energy policy "Securing Australia's Energy Future" has made the incredible claim that we have always coped in the past, so we should be able to do so in the future. The rest of the world does not share this complacency. .

"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."

European Union, Dec 2001

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**. Of the proposed alternative fuels to be used under the plan, Natural Gas will account for half, with a target level of 10% Natural Gas use. **The EU does not even share Australia's advantage of large indigenous Natural Gas reserves.**

In the United States, increasing attention is being given to diversifying fuel supplies.

"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."

President George W Bush, Oct 2001

Keeping America competitive requires affordable energy. And here we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world. The best way to break this addiction is through technology ... and we are on the threshold of incredible advances.

President George W Bush,

State of the Union Address, Feb 2006

Transport energy issues are high on the agenda of overseas governments, and Australian government should be just as concerned. Our isolated location, vulnerable shipping lanes and transport-dependent economy make it more important

and more urgent 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 already heavy and increasing further. This places most of our national commercial activities in a vulnerable position. We cannot afford **not** to increase our support of alternative fuels. We cannot afford to wait for serious problems to arise and we should be putting strategies in place now. A more diverse transport fuel supply will serve as insurance in times of strife or future oil crises.

"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".

Australian Defence Force, 2001

There is uncertainty regarding Australia's refining capacity in coming years and the threat this poses to our fuel supplies has been of concern to our Defence forces for years.

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 future oil shortages.

As an indigenous fuel, Natural Gas offers security of supply. It will never be subject to import restrictions which may arise due to either market forces, or political or military factors, or terrorism. At present Australia is very much at the mercy of overseas influences over which we have little or no control.

Using Natural Gas vehicles will insulate our economy and environment from many of these influences.



"The events of September 11 highlight the danger in continuing to turn a blind eye to our oil dependence. 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... 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 Union of Concerned Scientists—"Dangerous Addiction: Ending America's Oil Dependence." January 2002

IMPORT REPLACEMENT AND THE BALANCE OF PAYMENTS

As a result of the move towards the mandated use of low sulfur fuels, more crude oil of higher quality (and therefore higher cost) will need to be imported to produce Low Sulfur (LS) and Ultra Low Sulfur (ULS) fuels. However, it is likely that existing Australian refiners will choose to import refined fuels rather than crude oil to avoid the huge capital cost of upgrading Australian refineries to produce LS and

ULS fuels. This will effectively move refining jobs offshore.

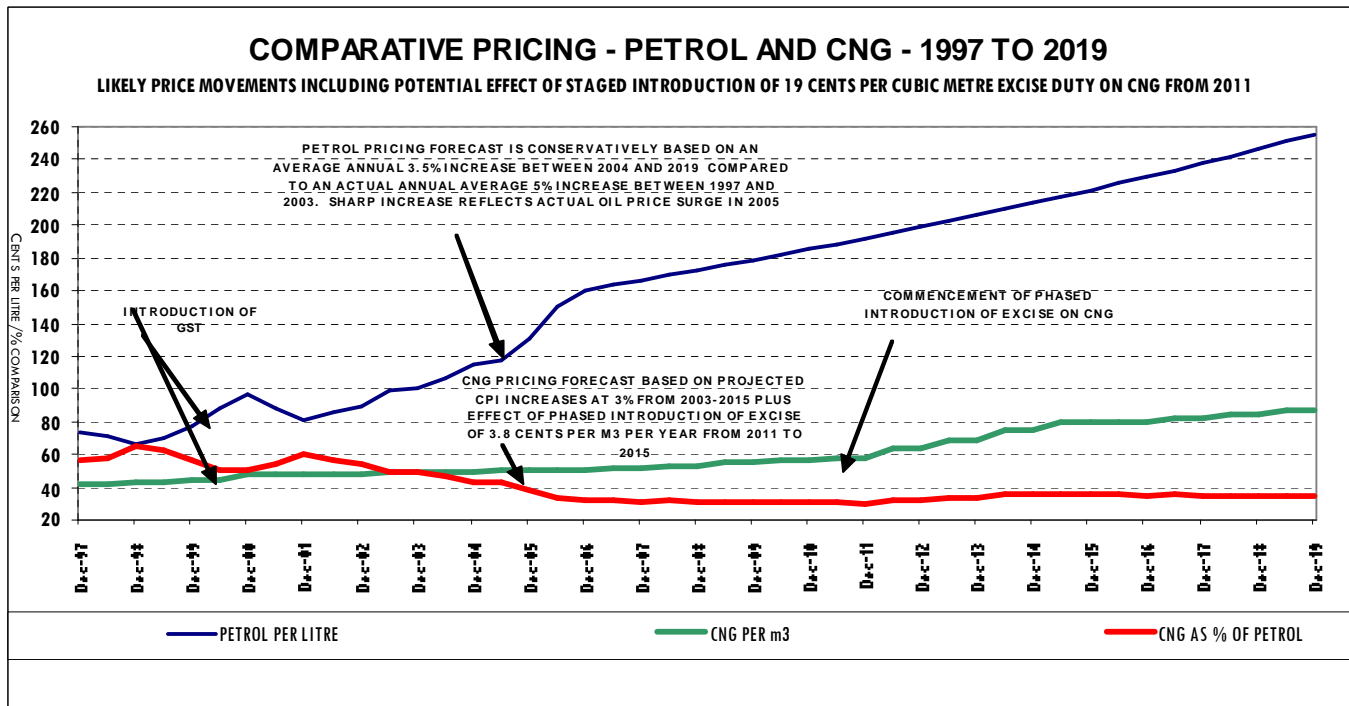
By replacing imported oil products with Australian Natural Gas, we can also reduce our Balance of Payments deficit. It is estimated that if 20% of Australian vehicles ran on Natural Gas rather than imported petroleum products, our trade deficit could be reduced by more than \$2 billion per annum.

PRICE STABILITY

The price of petroleum-based fuels (petrol, diesel and LPG) is tied to both world parity pricing and currency fluctuations. 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 China (whose demand increased by 40% between 2003 and 2004); and a host of other factors beyond our control can impact on the price Australian has to pay for crude oil. The impact of Hur-

ricane Katrina in August 2005 is expected to have serious impacts on petrol pricing around the world.

As an indigenous fuel, Natural Gas is priced in Australian currency and is therefore not subject to fluctuations in foreign exchange rates. Users of NGVs receive the benefit of price stability. Some fleet operators can negotiate prices as much as ten years in advance, which offers welcome relief from fuel price fluctuations.



FUEL SAFETY

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

- ☐ 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.

HEALTH AND SOCIAL BENEFITS

Reduction in Health Costs

Vehicle emissions contribute to a range of respiratory ailments, and 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 exhaust fumes both toxic and carcinogenic.

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. The use of a cleaner-burning and non-toxic fuel such as natural gas can contribute significantly to reductions in mortality attributable to transport emissions.

The National Health and Medical Research Council has estimated that if just 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.

THE BENEFITS OF NATURAL GAS OVER BIO-FUELS

Many alternative fuels, including ethanol and bio-diesel are not total substitutes for traditional petroleum fuels, but are simply additives that will reduce some of the worst of petrol and diesel's economic and environmental impacts. The table on page 9 shows that they are only marginally cleaner than petroleum fuels due to their emissions during production, regardless of the feedstock used. A recent ABARE report concludes that the long-term costs of ethanol and biofuels is hard to justify on economic grounds.

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 most recent one, the availability of crops from which to refine biofuels may well be seriously compromised.

Ethanol

The Government has secured the agreement of vehicle manufacturers and petroleum companies to introduce a 10% ethanol blend.

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. Ethanol also requires substantial processing to convert the raw feedstock to a usable fuel. In order to support the production of ethanol, which costs 1.75 times as much to produce as petrol, the government offers substantial subsidies and bounties.

Biodiesel

Biodiesel is already available in Australia in limited quantities, but 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 9). In the long run, any attempt to produce biodiesel in commercial quantities might be counter-productive. In any event, ABARE has predicted that it will have little commercial viability within 10 years.

NATURAL GAS OFFERS REAL SUSTAINABILITY

Natural Gas offers a natural pathway to sustainable fuel production. 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. It is produced from animal waste, sewage and garbage, is currently being produced in commercial quantities in Europe and America, 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. Anaerobic biogas digesters can range from small-scale (farm-based) to full-scale (sewage treatment works) units with the same positive results.

Sweden has been leading the world with the use of biogas in public transport and it is becoming more widely available for private use, either on its own or incorporated into pipeline gas.

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.

It makes logical sense to utilise waste products for gas production rather than continue to put massive pressure on landfill and traditional sewage treatment and disposal.

Coal Seam Methane

Eastern Australia is located over vast coal deposits that will never be commercially exploited. These deposits are constantly producing methane, which currently escapes to the atmosphere. The technology exists, and is being used in south-western Sydney to capture this gas. A much larger proportion of this gas could be captured to reduce its greenhouse impact. We have produced a separate paper to demonstrate the potential of this energy source, which is available upon request.



THE TRANSITION TO A HYDROGEN FUTURE

Natural Gas is the most sustainable path to the Hydrogen economy. The high hydrogen-to-carbon ratio of methane makes Natural Gas the most efficient source of hydrogen. Any infrastructure established to service NGVs 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.

The future market penetration of hydrogen vehicles will not be instantaneous. In his 2003 State of the Union Address, President Bush set a target for a commercially viable hydrogen vehicle by 2010. (Interestingly, his 2006 State of the Union address referred to alternative fuels but did not make any reference to hydrogen technology). If we assume that fuel cell vehicles are available at that time, and that there is a 30% take-up of hydrogen vehicles from then, it would still take until 2060 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. .

Australia has about 13 million vehicles today. On current growth projections that will be well over 40 million vehicles by 2060. Unfortunately, this means that 50% of the vehicles will be dependent on petroleum or other alternative fuels—and that represents twice as many vehicles than are on the roads today

As an example of this transitional lag, 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 20 years later, there are still over 1,500,000 pre-1985 vehicles on the road.

We must have a clean transitional fuel to take us from the present dependence on petroleum fuels to a realistic hydrogen future, and natural gas is the logical fuel for that role.

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 quoted a Canadian Study which found:

"... a decentralised Natural Gas reforming system poses the fewest technical challenges and is the most cost-effective hydrogen production system, reducing the life cycle greenhouse gas emissions by as much as 70 percent compared with conventional engines."

WorldWatch Institute

**"Hydrogen Futures: Towards a Sustainable Energy Future"
2003**

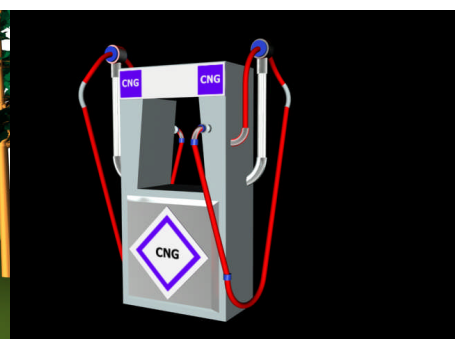
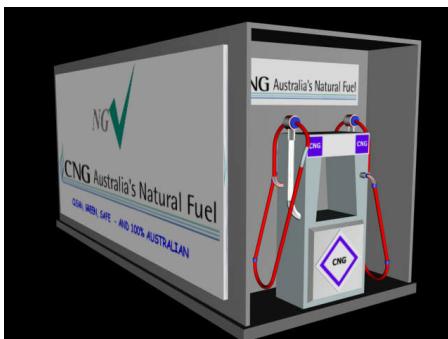
Methane reformers located on Australia's existing Natural Gas pipeline network (with compression technology similar to that used for CNG) could be used for the supply of hydrogen for transport use. Research is also being undertaken into on-board methane reformers that will increase the importance of expanding Australia's CNG refuelling infrastructure.

The use of hydrogen will also be dependent on the expertise and technology already in place to service NGVs. This adds further weight to the argument that 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 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. The only simpler fuel 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. We must have a transitional clean fuel, and Natural Gas is the natural choice.



THE PRICE OF OIL

The world price of crude oil has increased dramatically over the past five years.

The combination of many factors, including declining world reserves, limited production capacity, the threat of war and terrorism (and possible unwelcome regime change) in the Middle East, the increasing demand from countries such as

China and India, all suggest that the price of oil will remain at current prices or higher for the foreseeable future.

Australia is blessed with huge reserves of natural gas that we are exporting to other countries that have embraced natural gas vehicles, yet we have failed to recognise the benefits to our own economy and environment.

OIL SHOCKWAVE

In August 2005, an elite group of former US Cabinet members and leaders from the Security and Intelligence community looked at the likely consequences of removing 3.5 million barrels from a global market of 83 million barrels. They predicted that such a small percentage decline could result in:

- Petrol Prices of \$US5.74/gallon (\$AU2.04/litre)
- Global Oil Price of \$US161/Barrel (\$AU214)
- GDP fall in 2 consecutive quarters (the "R" word)
 - 30% loss in consumer confidence
 - CPI spike of 12.6%
- Blowout in Current Account Deficit
- 28% drop in Stock Exchange Index

The impact of Hurricane Katrina at the end of August 2005 brought these forecasts to stark reality in the short term. The damage to oil facilities in the Gulf of Mexico will take some time to repair and in the meantime, the US and the world will have to live with a production shortfall of 1.5 million barrels.

World oil experts have already predicted an oil price of \$US100 per barrel in the foreseeable future. Unless Australia takes steps to achieve energy diversification immediately, we face the potential of economic disaster within the next two or three years.

For more information on energy security and Natural Gas Vehicles, please contact:



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PHONE: 02 9730 3673 FAX: 02 9730 3796
EMAIL: admin@naturalgasvehicles.com.au**

CONCLUSION

Australia has an urgent need for a cohesive and well-considered national fuels policy. Leadership must come from the Commonwealth Government, and we also need to take some initiative at a personal, local and state level.

Our nation is heavily dependent on road transport for distribution of manufactured and consumer goods. Increasing fuel prices will have an impact on prices of all commodities, with a serious flow-on impact on inflation and interest rates. But more importantly, our reliance on fuels from the Middle East leaves us vulnerable to fuel shortages, with the potential to disrupt our distribution system, which could have dire consequences for our manufacturing and retail industries.

We must have a policy that offers independence from unreliable overseas fuels and offers a safe and secure indigenous fuel option.

To a great extent, Natural Gas can provide the fuel security we need.

Natural Gas Vehicles are a mature technology and are therefore *the* "here and now" solution to the serious energy use and environmental problems of traditional transport fuels. Vehicles operating on Natural Gas are already meeting emissions standards which aren't due to be implemented in Australia for several years. These vehicles can deliver immediate health and social 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 Australian community. They provide diversity and a secure fuel supply, energy independence and a pathway to the establishment of a hydrogen transport economy. They provide stable fuel costs, 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.

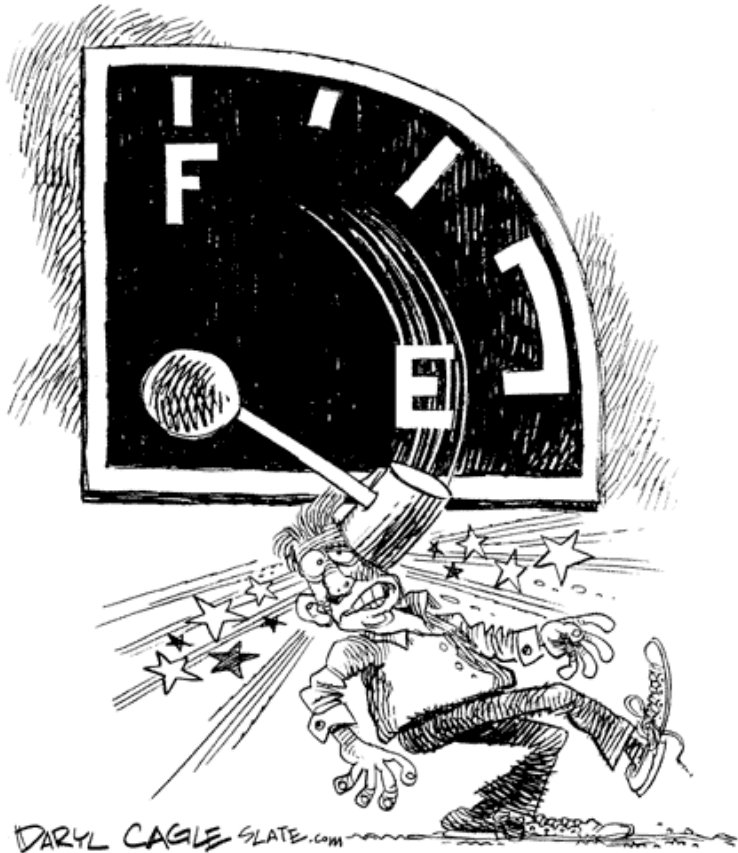
The major drawback to the establishment of a viable natural gas vehicle industry is the lack of a national refuelling strategy. With appropriate government support for the development of refuelling infrastructure for both LNG and CNG, the Australian NGV industry could become sustainable within a relatively short time. Any additional cost to the Budget would be offset by the benefits as we become less dependent on crude oil for transport fuels and increase our use of an abundant, clean, indigenous fuel.

How can we not follow the trends currently being set overseas and diversify the use of transport fuels to include Natural Gas?

Natural Gas and NGVs offer enormous benefits to Australia. No other fuel can offer these advantages:

- ☐ An abundant indigenous resource
- ☐ Energy security and independence
- ☐ Pipeline delivery

- ☐ Fuel price stability (and reduction)
- ☐ Balance of Payments reduction
- ☐ Emissions reductions
- ☐ Reductions in emissions-related health costs and mortality
- ☐ Fuel safety
- ☐ Natural transition to the hydrogen economy



We have this one last opportunity to develop effective policies, involving the Transport, Energy, Resources, Industry and Environment portfolios, to create an environment where Natural Gas vehicles can play a significant and positive role in the energy industry and underpin the development of a national fuels strategy to map the route from the oil economy to the hydrogen economy.

We urge all levels of Government to take a position of leadership and to consider the issues in this paper as the first step in development of a coherent and effective long-term energy strategy.

As individuals, we are encouraged to provide for a safe and secure future by prudently insuring against future contingencies. Responsible national governance demands that we plan for a future of secure and affordable fuel supplies.

1
2

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

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

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



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Passenger train runs on bio-gas

Reporter: Tim Franks, BBC Newsnight

First Published: 19/02/2006

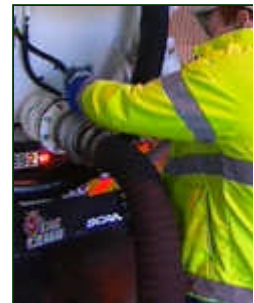
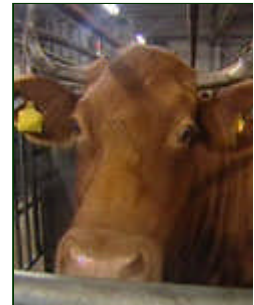
SALLY SARA: Now to the subject of biofuel and what an increasingly popular subject it's becoming. Today we're looking at what represents a dramatic leap forward in the world of cheap, sustainable and totally organic fuel. Unfortunately it's not in Australia, though for reasons which will be obvious, it very well could be. Our story checks out a passenger train in Sweden which runs entirely on biogas. The biogas comes from the parts of animals which you might only see in the wet markets of Asia. It's not a gimmick. This Swedish experiment is leaving the rest of the world far behind in the search for alternative energy. And a word of warning--early on in this report there are some abattoir images which some viewers might find disturbing.

TIM FRANKS, BBC NEWSNIGHT: From horsepower to cow power. These Swedish cows at an abattoir in Linköping are about to become the revolutionary fuel for a train. It will take about this many--30 of them--to power the train the 75-mile journey to Västervik. These are the bits that we don't eat and the farmer can't recycle--the fat, the blood, the guts--perfect for methane-rich biogas. These offcuts are now minced and pureed into a sludge which is ready to be taken off to the biogas factory by tanker. The smell is not quite so bad here at the biogas factory. But it's still pretty rank. Stay with us, though, it is about to become clean fuel--honest. The organic slurry then comes down this pipe into this tank, where it's cooked at a gentle 70 degrees centigrade for about an hour before it's then drawn off and allowed to sit at 38 degrees centigrade--human stomach temperature--for a further 30 days. Then out of this big silver tank, it's ready to be drawn off as biogas. And the motor behind this? Well, the boss of Svensk Biogas may be a tough chief executive officer, but underneath he is an archetypal, fresh air-loving Swede.

CARL LILLIEHOOK: I think a lot of us used to be in the forest, used to be at the countryside because we have something in Swedish where everybody can be out to nature, whenever you like. You can pick your mushrooms and you can pick your fruit and you're free to do that. And we want to save it. We want to save it as clean as it is.

TIM FRANKS, BBC NEWSNIGHT: And they don't get much cleaner than this. They call this train 'Amanda', a love theme fuelled by methane. It's that methane which is then put in here, turning the train into what its makers say is the most environmentally friendly train in the world. The other engines that run this route are all smelly, old diesel. This train, 'Amanda', emits 60 times less carbon. No wonder they painted her green. But the biggest problem for greenhouse gases is road transport which relies on dirt-spewing, climate-changing mineral oil for 99% of its fuel. Arriving right on time, another world first from the city of Linköping. 12 years ago they started powering their buses with biogas. Now it's not just their entire bus fleet, but their rubbish trucks, their taxis and some of their private cars they're filling up with biogas. And the man in charge of the project says they're flocking in from across the world to find out how Linköping does it.

GOSTAR GUSTAVSSON: A lot of people coming to Linköping nowadays. Today we have people from China, for example, and one month ago I was in Canada telling about this and people from now all around Europe visit us and



Sites

BBC

see what is going on here in Linköping so a lot of people are interesting and really to be proud of this in Linköping, of course.

TIM FRANKS, BBC NEWSNIGHT: Time perhaps for the rest of us to get on board. In order to try to get us to follow Linköping's good example, the European Commission, the bureaucrats who help run the European Union, have set targets for the amount of petrol and diesel use in transport that they want replaced by green fuel such as biogas. The idea is to hit a 2% target by the end of this year. Now, Britain is one of several member states that says that it can't do that and has set itself its own target of 0.3%, a level which the European Union has said has not been adequately explained. Sweden, meanwhile, is on course to sail past 2% and hit 3% by the end of this year. In five years' time, the European Commission wants the amount of biofuel used to be up to 5.75%, a level that this place, Linköping, has already hit. To meet that target across Europe, the real driver for change will have to come from cars, by far the biggest group of fossil fuel addicts. One answer to our filthy infatuation with these glossy beasts could be cars that run on liquid biofuel made from crops.

ORJAN ASLUND: A matter for the environment, I would say, because by driving one of these cars you can actually reduce the emissions from carbon dioxide with 80%. That's an important gain.

TIM FRANKS, BBC NEWSNIGHT: So, how do reduced emissions feel? Well, this is a ride you can't get in Britain. There the green mix on offer tends to be 95% normal petrol or diesel, just 5% biofuel. Here in Sweden, this Saab model can take 85% biofuel cocktail, as clean and as cool as Swedish jazz. So, how is this biopowered car to drive? Well, at this point I think I'm supposed to say it's zippy, it's peppy. I'm getting scent of Brazilian woman. Let me put it this way--it's nice to drive. So why is biofuel in Sweden so much more easily available and in richer variety than in Britain? Well, some experts say Sweden was just quicker off the mark. The country benefitted from unusually cheap imports, unusually advanced technology and unusually compliant oil companies. But there are comparisons that can be made in terms of subsidy. In Britain, the Government's tax break for biofuel is 20 pence per litre, and that makes the price at the pump more or less the same as normal petrol or diesel. In Sweden, the government calculates its tax break for biofuels as 36 pence a litre and the price of the pump is about a third less than normal fuel. It all sounds like another case of gilded Sweden--high income and high spending and everyone agreed on the price of the common good. Everyone? Well, not quite.

JOHNNY MUNKHAMMAR: Well, you have to remember that whenever you subsidise something, you have to take the money from somewhere else, which means that the government, which has no money, has to have high taxes on something. Normally that tax is taken from somewhere in the production--it's companies or working people or something--and that reduces growth, and it is a growing society which can afford a better environment.

TIM FRANKS, BBC NEWSNIGHT: A better environment is exactly what the Ministry of Sustainable Development is supposed to deliver, and the perspective from here is that subsidies are not just affordable, but pay for themselves.

LENA SOMMESTAD: We do not view this as a burden. We do subsidise, for example, investments in green fuels. We do have tax reliefs, for example, but at the same time we can see that this really encourage industry, that it encourage innovations. For example, I was in California the other week and we had a great interest in these techniques so we see it overall as a growth strategy.

TIM FRANKS, BBC NEWSNIGHT: But according to one calculation I've seen from the European Commission suggests that it would take the oil price to double, even from the height that it is today before something like bio-ethanol begins to pay its own way. Wouldn't it be cheaper, simpler to get people to drive less rather than try and get them to drive in a green way?

LENA SOMMESTAD: You know, I'm very suspicious of this type of calculations. When we look at ethanol, we import quite a lot from Brazil and we see that costs are getting lower when techniques are developing. I do think that this will pay off and I'm not sure that the commissioner of this calculation has really counted in all the long-time costs of climate change, which are huge.

TIM FRANKS, BBC NEWSNIGHT: The truth is it's difficult to get transport to cut its greenhouse gas emissions in the way that industry or agriculture or households have, but policy-makers also talk of a sense of fairness, though the direction has to change. So as long as the oil price is high and the demand to do more to improve the environment grows, then Sweden, on road and by rail, is likely to remain the model.

SALLY SARA: The amazing biogas train. That report from the BBC.



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