



Parliament of Tasmania

JOINT STANDING COMMITTEE

ENVIRONMENT, RESOURCES AND DEVELOPMENT

THE USE OF COMPRESSED NATURAL GAS AS A VEHICLE FUEL IN TASMANIA

Members of the Committee

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Introduction

1.1 APPOINTMENT AND TERMS OF REFERENCE

The Joint Standing Committee on Environment, Resources and Development was established for a two-year period from 6 December 2000. The Committee adopted the following terms of reference at its meeting on 26 June 2001.

To inquire into and report upon the use of natural gas in Tasmania —

(a) in the form of Compressed Natural Gas (CNG) as a vehicle fuel, with particular reference to -

- (1) the economic, employment, public health and environmental benefits to Tasmania of the use of CNG as a motor vehicle fuel;
- (2) the infrastructure requirements (including funding options), such as refuelling stations, that would be necessary to support the establishment of a CNG vehicle fleet in Tasmania for :
 - large vehicles such as buses and trucks; and
 - smaller vehicles;
- (3) the barriers to the conversion of vehicles in Tasmania to CNG;
- (4) options for funding the conversion of petrol and diesel vehicles in Tasmania to CNG;
- (5) options for encouraging owners of existing petrol and diesel fuelled vehicles, particularly buses and trucks, to convert to CNG;
- (6) options for promoting an increased public awareness of the benefits of using CNG as an alternative vehicle fuel; and¹

(b) as an alternative fuel source for residential and commercial buildings, with particular reference to —

- (1) options (including funding) for the conversion of residential and commercial buildings to natural gas; and
- (2) options for promoting increased public awareness of the benefits of using natural gas as an alternative energy source in domestic and commercial buildings; and

(c) other matters incidental thereto.

¹ Please note: This report only deals with part (a) of the Terms of Reference.

The Committee originally comprised three members of the Legislative Council – Mr Parkinson (Chairman), Mr Rattray and Mrs Silvia Smith; and three members of the House of Assembly – Mr Green, Mr Kons and Mr Smith.

The membership has changed over the last two years and now consists of four members of the Legislative Council – Mr Parkinson (Chairman), Mr Hall, Mrs Silvia Smith and Mrs Sue Smith; and four members of the House of Assembly – Ms Giddings, Mr Gutwein, Mr Kons and Mr McKim.

The Committee was disbanded on 1 February 2002 due to the prorogation of the Parliament and re-established on 12 March 2002. On 21 June 2002 the Parliament was dissolved for the State Election and the Committee was re-established on 3 October 2002.

As the Committee was to lapse as at 6 December 2002, a motion to re-establish the Committee was approved by Parliament on 27 November 2002 for a further two-year period.

The Committee has general jurisdiction over the following areas : government business enterprises; regulation of business, commercial and industrial relations; economic and finance development; environment and land use planning; natural resources – forestry, mining and fisheries; energy; tourism; transport; and primary industry.

This report arises out of the Committee's first terms of reference and follows the introduction of natural gas to Tasmania via a pipeline across Bass Strait.

1.2 PROCEEDINGS

Advertisements were placed in the three regional daily newspapers calling for submissions and evidence. In addition invitations were sent to key stakeholder organisations and individuals and are listed in Appendix 3.

Sixteen written submissions were received and are listed in Appendix 4.

Documents received into evidence are listed in Appendix 5.

As well as receiving submissions, four Committee members visited various corporations, public and private, in Victoria, The ACT, New South Wales, and Queensland. These are listed in Appendix 6. The Committee has also had the benefit of a range of information from various other sources, including the Asia-Pacific Natural Gas Vehicles Summit held in April 2001; The Australian Greenhouse Office; the CSIRO; and the National Bio-Fuels Conference in October/November 2002.

Only one submission recommended avoiding the CNG path, BP Australia Ltd. This paper was only brief and should be viewed in the context of BP's heavy investment in refinery upgrades to produce low-sulphur diesel. BP sponsored the national conference on bio-fuels, which was attended by the Committee Chairman in October/November 2002.

Whilst this report deals only with natural gas, the Committee acknowledges that whatever path is taken with CNG other alternatives will still play a role into the future (such as bio-fuels and low-sulphur diesel). This report argues that the economic, greenhouse gas and health outcomes of CNG use are verifiably superior.

The Committee is yet to investigate after market conversion technology, and plans to do so during the next few months. This will enable the Committee to be in a better position to make recommendations on the use of this technology by heavy duty vehicles.

1.3 ACKNOWLEDGEMENTS

The Committee gives special acknowledgment to the Centre for Research, Industry and Strategic Planning (CRISP), the research unit of the State Department of Economic Development. CRISP was commissioned by the Committee to conduct independent research and to advise on the options for converting to, funding of, and encouraging the use of, CNG as a vehicle fuel (ie Terms of Reference (4), (5) and (6)).

CRISP carried out its task independently of government, diligently and professionally, and reported to the Committee in October 2002. CRISP did not report to the Government and will not until this report is tabled in the Parliament. The CRISP report complements the Committee's own investigations and findings and is tabled with this report.

The Committee further acknowledges and thanks all those who contributed to this report and particularly those corporations who so warmly received the Committee and co-operated with its task.

The Committee gives special thanks to its Executive Secretary, Mrs Sue McLeod, whose dedication and ability to assist the Committee in organising its task, were invaluable.

Executive Summary

With the introduction of natural gas to Tasmania a window of opportunity exists for government to take a leading role in promoting the use of compressed natural gas (CNG) as a vehicle fuel, and the preferred use of natural gas vehicles (NGVs) generally.

The foreseeable benefits may be broadly summarised as economic, health and environmental.

Under the rapid uptake scenario proposed by this report, which will involve considerable government initiative, the potential economic benefits for the State are significant. These will occur primarily in infrastructure investment, reduced freight costs, and savings in fuel costs to the general community. Additional investment can also be expected in vehicle maintenance and skills upgrading of the applicable workforce.

The associated health benefits to the community from even a partial move into NGVs can be expected to be considerable. Any reduction in the amount of particulate matter (PM10 from diesel fuel) and carbon dioxide (CO₂ from petrol) in the atmosphere will have a beneficial effect on the general health of the community.

From the environmental viewpoint a concerted move into NGVs would contribute to the satisfaction of a number of peripheral goals.

The Tasmania *Together* process expressed the desire of Tasmanians for less air pollution, to reduce the level of greenhouse gas production, and generally to take all possible steps to improve the State's clean green image.

As part of the National Greenhouse Strategy exemptions from Commonwealth excise duty exist for users of CNG, and attractive subsidies exist towards the capital costs of government and private business initiatives in changing to NGVs.

Under the same strategy transport operators who are eligible for the Diesel Fuel Grant, are also eligible for the Alternative Fuels Grant.

These subsidies are designed to assist the national goal of greenhouse gas reduction.

Tasmania's own greenhouse statement released by the Government in 1999 seeks to:

“facilitate understanding of Tasmania's greenhouse gas emissions status and highlight the significant opportunities we have to contribute to reducing Australia's greenhouse gas emissions.”

In 1995 greenhouse gas emissions from Tasmania's transport sector accounted for 23% of the total greenhouse gas emissions in Tasmania.

A pro-active move into NGVs in Tasmania would see a significant reduction in these harmful emissions, and at the same time have a significant affect on our clean green image generally.

It is worth emphasising that detailed analysis by the CSIRO, conducted on a wide range of alternative fuels, determined that CNG is the cleanest fuel of all others available, both in terms of greenhouse gases and particulate matter.

As well as the clean air advantage, engine noise levels are considerably reduced with NGVs, which is another relevant factor in the context of our cities.

CNG as a vehicle fuel offers industry, government and the community, general immunity from the economic uncertainty, hardship, inconvenience and frustration of OPEC oil price fluctuations.

The CSIRO has estimated that Australian domestic oil reserves will become non-viable around 2025.² For Australia, with huge gas reserves, the switch to CNG is the natural alternative for motor vehicle users in the medium term; it also makes economic sense to avoid such a potential crisis in supply.

The window of opportunity for Tasmania exists because mainland States have been slow to take-up the challenge. Tasmania therefore has the opportunity to rapidly reduce the operating costs of its transport sector once sufficient infrastructure is in place to facilitate the process. With a more cost-efficient transport sector Tasmanian businesses will be in a better position to compete with those in other States, and with lower transport costs Tasmania will be a more attractive place to invest.

There are barriers to change and these are outlined in the body of this report, but there are none that cannot be overcome either in the short or longer term.

It is important to note that the level of government intervention is critical to the uptake level of CNG as a vehicle fuel. The more rapid the uptake level, the greater the economic and environmental benefits for Tasmania.

The window of opportunity also exists for Tasmania because CNG (CH₄) is seen as a pathway to fuel cell and hydrogen technology. This in turn is seen as the future energy source particularly in transport applications. The active involvement of Tasmania in CNG and NGV technology would enhance Tasmania's prospects for the establishment here of a Cooperative Research Centre for research into alternative fuel technologies. Such a centre would be worth \$20 million to the State as a start-up operation with greater economic benefits into the future.

² Centre for Research, Industry and Strategic Planning (CRISP) Report, Appendix 2, p. 24.

The thrust of this report is to advocate that government adopt the rapid uptake scenario outlined in chapter three and itself embrace CNG as its preferred vehicle fuel. The approach taken by government will have a crucial influence on the take-up of this technology by the private sector.

CNG as a vehicle fuel not only provides government with the opportunity to achieve significant additional economic growth, it also provides the opportunity to help fulfil the aspirations of the Tasmanian community with respect to our clean air and pristine environment generally.

20 March 2003
Parliament House, Hobart

Doug Parkinson MLC
Chairman

Recommendations

The Committee recommends that :

1. The Tasmanian Government take a leadership role and adopt policies that encourage a rapid uptake approach to the use of CNG as an alternative vehicle fuel by the transport sector and the motoring public.
2. The Tasmanian Government adopt CNG as the preferred fuel for all government-owned vehicles including fleet vehicles and encourage Government Businesses and local government authorities to follow suit.
3. A whole of government project team be established to make recommendations on the implementation of initiatives. This team should include representation from all relevant departments, should meet at the earliest opportunity and should consult widely with the private sector.
4. The whole of government project team be tasked with completing a cost-benefit analysis of the rapid uptake option and an analysis of the impact on the mature petroleum industry.
5. The Tasmanian Government seek at the earliest opportunity the establishment in Tasmania of a cooperative research centre (CRC) on alternative fuel technologies.
6. A communication strategy concerning alternative fuels be developed and targeted towards both the transport sector and the broader community.
7. The Tasmanian Government encourage the establishment of a construction facility in Tasmania for CNG buses.
8. At the earliest opportunity the Tasmanian Government encourage the establishment of a sufficient minimum number of CNG filler stations to achieve a minimum level of State coverage.

DISCLAIMER

As this report was prepared on the basis of submissions presented to it, no inference should be drawn or implied as to any endorsement by the Committee of any particular business, corporation, product or service referred to in the report.

Chapter 1

Economic, Employment, Public Health and Environmental Benefits to Tasmania, of the use of CNG as a motor vehicle fuel

1.1 Economic Benefits

The economic benefits to the State from CNG as a vehicle fuel will flow from a potentially lower and more stable fuel price, the infrastructure requirements necessary to sustain the transition to the new fuel, and from new and increased business activity; this all adds up to increased economic activity and additional economic growth and employment for Tasmania.

Stable/Lower Fuel Prices

Unlike petrol, diesel and LPG, the price of natural gas is not subject to world OPEC price fluctuations.

Stable fuel prices offer considerable benefits to both the public and private sectors. Indeed rapidly rising fuel prices cause budgetary problems for both public and private enterprise and can mean business failure.

The principal factor ensuring price stability of natural gas is its abundant supply. Industry estimates indicate that Australia currently has between eighty and one hundred years of available supply at current production and demand levels.

Mainland experience indicates that the pump price of CNG to the consumer will be less than half the pump price of diesel.

Improved Transport Sector Viability

Quoting Cynergy Pty Ltd as its source, Duke Energy Australia Pty Ltd submitted the following table which shows an operational fuel cost comparison between diesel and CNG in the heavy transport sector. The table shows the potential savings per vehicle (after deduction of fuel rebates and GST).

Table 1³

Vehicle Type	Annual Range (km)	% Diesel displaced by CNG	Ave. Annual Fuel Cost Saving per CNG vehicle
<5 tonne rigid truck ⁽¹⁾	60,000	100%	\$4225
5 – 16 tonne rigid truck ⁽¹⁾	60,000	100%	\$7,030
5 – 16 tonne rigid truck ⁽¹⁾	90,000	100%	\$9,450
5 – 16 tonne rigid truck ⁽²⁾	60,000	55%	\$3,880
5 – 16 tonne rigid truck ⁽²⁾	90,000	55%	\$5,200
12 – 16 tonne rigid truck ⁽²⁾	90,000	55%	\$7,050
16 – 22 tonne rigid truck ⁽²⁾	60,000	60%	\$5,600
16 – 22 tonne rigid truck ⁽²⁾	90,000	60%	\$8,400
Prime Mover ⁽²⁾	90,000	75%	\$14,130

³ Duke Energy International, *Submission to the Joint Standing Committee on Environment, Resources and Development*, November 2001, p. 3.

Prime Mover ⁽²⁾	120,000	75%	\$18,850
Prime Mover ⁽²⁾	150,000	75%	\$28,265

Note ⁽¹⁾ Dedicated CNG engine technology

⁽²⁾ Dual Fuel engine technology

Government/GBE Fleets

With Tasmania's urban bus fleet, Duke Energy research indicates the potential realisation of "significant operational cost savings".⁴ The adoption of CNG as the fleet fuel for Metro's 220 bus fleet "has the potential to produce overall operational cost reductions of the order of \$2.5 million per annum after diesel and CNG rebates and GST is deducted".⁵

Indeed Duke's optimism in this respect is supported by the Committee's own experience in visiting and viewing public bus fleet operations in Sydney and Brisbane and discussing operational cost savings with management executives.

"In 1998, after five years of operating CNG buses, State Transit assessed the fuel savings to be Aus \$0.1108 per km. With the additional service and maintenance costs associated with CNG operation being estimated at Aus \$0.0374 per km, the net cost saving due to the use of CNG was therefore Aus \$0.0734 per km. As an example, for every 100 CNG buses operated in lieu of diesel powered buses, a saving of approximately Aus \$530,000 in one year was estimated".⁶

This was before the introduction of Federal Government (Australia Greenhouse Office) assistance programs (see Chapter 2).

Following the introduction of one of those programs, namely the Diesel and Alternative Fuels Grant Scheme, and based on an average fuel consumption of 65 cubic metres per 100 km, State Transit NSW estimated a further benefit of 8 cents per km. Taking into account the then differences in price between CNG and diesel fuel State Transit NSW estimated a net saving in November, 2001 of around 31 cents per bus km using CNG as compared with the alternative cost of using diesel.

Whilst it would be overly optimistic to expect Metro Tasmania to achieve cost savings on a par with State Transit NSW (due to, for example, lower economies of scale and geographical/topography differences with associated higher average fuel consumption rates) significant cost savings would be achieved.

When the Committee visited Sydney in November, 2001, State Transit NSW was operating 306 CNG buses, had another 100 on order, and had commenced the tendering process for a further 300. State Transit's fleet total was 2,000 buses.

⁴ Duke Energy International, *op. cit.*, p. 4.

⁵ *Ibid.*

⁶ Mr Wayne Butler, Area General Manager, State Transit Authority of NSW, *CNG Buses - a Success Story*, paper presented at Asia-Pacific Natural Gas Vehicle Summit, 2001.

As a model for Tasmania, Brisbane is probably more relevant. In implementing their transition to CNG (which is still in progress) the Brisbane City Council (BCC) worked closely with State Transit NSW operatives. In this way they avoided all of the pitfalls and teething processes that New South Wales had endured before them.

BCC has 80 CNG buses on the road and will commission a further 160 over the next three years.

BCC talked of similar savings in running costs as State Transit NSW and similar payback periods for purchase price premiums.

For government owned passenger vehicles the operation of bi-fuel petrol/CNG vehicles, in the short term, and dedicated CNG vehicles in the longer term, has the potential to provide government with substantial operational cost savings.

Dedicated CNG passenger vehicles are not yet available on production-line scales in Australia, and will not be until OEM's (original equipment manufacturers) are satisfied with demand volume levels. They are available at such levels in parts of the United States, Argentina, Europe and Japan and it must only be a matter of time, before the necessary quantum leap forward is made in Australia.

The Committee is aware that NSW Police, with a vehicle fleet of 2,000 units, many of which are replaced each 9 months (after 40,000 kms) is keen to source dedicated CNG vehicles from OEM's. The Committee Chairman's recent discussions with the CEO of NSW Police Vehicles Purchasing Division indicates that to date NSW Police plans in that regard are not fulfilled, but remain on track.

Duke Energy has estimated that if 40% of the government owned passenger fleet was converted to either dedicated or bi-fuel CNG vehicles, Tasmania could achieve fuel cost savings of \$1,352,340.00 per annum, depending on individual vehicle fuel consumption rates and travel range.⁷

Table 2⁸

Number of Vehicles	Average Annual Range	Fuel cost saving per vehicle	Total fuel cost saving over petrol
308	20,000	\$1,000	\$308,000
396	30,000	\$1,655	\$655,380
176	40,000	\$2,210	\$388,960
Total Fuel cost Reduction			\$1,352,340

Note: Potential savings will vary in accordance with the fuel consumption of individual vehicles.

Estimated potential fuel cost reduction if 40% or 880 of the State-owned passenger vehicles operate on either dedicated or bi-fuel CNG; assuming petrol cost 94 cents per litre less GST and CNG cost 50 cents per litre less GST.⁹

⁷ Duke Energy International, *op. cit.*, p. 4.

⁸ *Ibid.*

⁹ *Ibid.*

Private Light Passenger Vehicles

Given adequate refuelling infrastructure (see Chapter 2) a percentage of private vehicle owners will convert to CNG. This will occur because of the price differential and the likelihood that the differential will be stable into the future.

A percentage of Tasmanians will also be attracted by the ability to make a personal contribution to Tasmania's clean air/environment image.

Once OEM's in Australia begin to provide dedicated CNG vehicles, the transition will accelerate rapidly.

Duke Energy's estimate of the transition for Tasmania's private passenger fleet, and the resultant increase in economic activity is summarised in Table 3. From its discussions with industry players on the mainland, the Committee believes that these figures are not unreasonable.

Table 3¹⁰

	Tasmanian Fleet Population	% of Fleet CNG	Total CNG Vehicle Population	Numbers of Conversions	Cost per Unit	Increase in Economic Activity (\$ Mil)
Years 1 – 3	230,472	1	2,305	1,844	\$3,550	\$6.55
Years 3 – 6	232,776	3	6,983	4,888	\$3,350	\$9.83
Years 6 – 9	235,105	5	11,755	7,053	\$3,450	\$14.50

As is pointed out later **the Committee believes that a leadership role played by government in embracing CNG as its preferred vehicle fuel and in encouraging Tasmanians to follow suit, would have a crucial influence on the take-up of this technology by the private sector.**

Light Commercial Vehicles

Duke Energy has submitted a similar table of estimated economic activity for this sector (see Table 4 below).

Table 4¹¹

	Tasmanian Fleet Population	% of Fleet CNG	Total CNG Vehicle Population	Numbers of Conversions	Cost per Unit	Increase in Economic Activity (\$ Mil)
Years 1 – 3	60,284	4	2411	1,929	\$4,100	\$7.91
Years 3 – 6	60,887	9	5480	3,836	\$4,100	\$7.43
Years 6 – 9	61,497	15	9225	5,535	\$4,100	\$14.70

The conversion uptake for light commercial operators can be expected to be more rapid than for private owners simply because the conversion costs are a tax deductible business expense. This added to the fuel cost savings will make it economically attractive, provided the re-fuelling infrastructure is in place.

¹⁰ Duke Energy International, *op. cit.*, p. 4.

¹¹ *Ibid.*

The business infrastructure for the light vehicle aftermarket conversion industry is already in place in Tasmania, as it was established during the period of conversions to LPG. This was economically attractive until the world OPEC oil pricing system determined otherwise some years ago.

The Committee received representations from two local operators who expressed an interest in expanding their businesses. Ken Vance Motors Pty Ltd stated that :

"we have performed approximately two thousand conversions on a range of vehicles - from small stationary engines to passenger cars and large buses and trucks. We have been predominantly converting passenger vehicles, light commercial and 4x4 vehicles for private, business and fleets".¹²

O'Neill's Automotive Services with 12 years experience also expressed a keen desire to be involved in the CNG vehicle fuel industry.¹³

Duke Energy has estimated the number of such businesses that will be required to carry-out the projected conversion work on the light vehicle sector as - 5 to 6 in Hobart, 3 to 4 in Launceston, 2 in Devonport and Burnie and 1 in Ulverstone.¹⁴

The Truck Sector

Whilst this sector includes everything from light commercial trucks to heavy duty vehicles (i.e. anything above 2 tonnes GVM) the comments below relate to the medium to heavy duty (4 tonnes and above).

The Committee found in discussions with various users of medium to heavy vehicles that while there was a keen desire among operators to use CNG as their preferred fuel, both because it was cheaper and because it was cleaner for the environment, they had experienced problems with after-market conversion systems.

In its submission Duke Energy points out that :

"Whilst most of the existing heavy vehicle CNG fleet has been converted to dual fuel operation using after-market converters, experience to date is that such conversions are problematic".¹⁵

The Committee visited three major local government corporations. These were Citywide in metropolitan Melbourne, Liverpool in Western Sydney and Waverley in East Sydney.

¹² Mr Ken Vance, Ken Vance Motors Pty Ltd, *Submission to the Joint Standing Committee on Environment, Resources and Development*, 7 November 2001, p. 1.

¹³ Mr Lyndon O'Neil, O'Neil's Automotive Services, *Submission to the Joint Standing Committee on Environment, Resources and Development*, 28 November 2001, p. 1.

¹⁴ Duke Energy International, *op. cit.*, p. 5.

¹⁵ *Ibid.*

Each of these corporations has a strong commitment to lowering greenhouse gas emissions and, as part of that commitment, each is in the process of converting their vehicle fleets to run on CNG . Each cited lower fuel costs as the primary economic benefit for their programs.

The Committee also visited Isuzu in Melbourne and observed a CNG demonstration vehicle. This vehicle demonstrated Isuzu’s readiness to meet the market for light and medium trucks suitable for a range of transport applications including local government waste disposal.

Duke Energy predicts that "... OEM's, e.g. Cummins, Caterpillar, Scania and Detroit via their existing Tasmanian dealer network will undertake the majority of fleet conversions"¹⁶ for heavy trucks. Duke further predicts :

"... an increase in economic activity resulting from what the engine industry term 're-birthing' and within existing truck dealer franchises and service organisations who will install OEM supplied conversion systems".¹⁷

In table 5 below Duke Energy estimates the pattern of increased economic activity in the heavy vehicle sector.

Table 5¹⁸

	Tasmanian Fleet Pop.	% increase of Fleet CNG	Total CNG Vehicle Pop.	Numbers of Conversions	Average Cost per Unit	Increase in Economic Activity (\$ Mil)
Years 1 – 3	2,400	12	288	230	\$40,000	\$9.22
Years 3 – 6	2,472	13	321	225	\$44,000	\$9.90
Years 6 – 9	2,546	10	255	153	\$41,800	\$6.39

"It is expected that the average cost of converting a heavy truck by engine-truck franchises will average at about \$40,000 of which 50% may be recouped from the Commonwealth's Alternative Fuels Conversion Program. The above heavy trucks will comprise prime movers and 10 to 20 tonne rigid trucks and are predicted to be operating as CNG by the end of year 3 commencing from CNG refuelling station network establishment".¹⁹

The Metro Urban Bus Fleet

In both Sydney (State Transit) and Brisbane (BCC) the Committee was strongly advised against converting existing diesel buses to CNG. This was to avoid associated reliability problems. **This aspect needs further investigation particularly in light of the submission to the Committee from Advanced Engine Components Limited of Western Australia (AEC).**

¹⁶ Duke Energy International, *op. cit.*, p. 5.

¹⁷ *Ibid.*

¹⁸ *Ibid.*

¹⁹ *Ibid.*

Both Western Australia and Adelaide have each converted blocks of 10 diesel buses to CNG using a conversion system designed and manufactured by AEC.

The Duke Energy submission suggests that the existing Metro Bus Scania N112 and N113 high floored buses are suitable for conversion to dedicated CNG operation. Duke suggests that this could be done using AEC's CNG engine and bus conversion system.²⁰

"This company is suitably qualified and is CNG route bus engine system and technology supplier to Renault Bus - France and RABA - Czechoslovakia, approved supplier to Daimler Chrysler and MAN buses. AEC have completed a similar project for Trans Adelaide where they provided both CNG conversion systems and project management expertise and training".²¹

The Chief Executive Officer of Trans Adelaide advised the Committee Chairman that any conversions should only occur on buses that have greater than 10 years of life left. This was to make the conversion worthwhile in terms of capital cost and payback (through the Alternative Fuels Conversion Program [chapter 2] and lower fuel costs).

Duke Energy estimates that the conversion of Metro diesel buses to CNG would add \$5.28 million to the State's economic activity over 3 years.²² This is on the assumption that

"... 55% of the Scania fleet or 88 buses would be suitable for CNG conversion in terms of age, distance travelled and capital payback period. The cost of conversion or differential between diesel and CNG new buses is about \$60,000 per vehicle. The Commonwealth's Alternate Fuels Conversion Program would pay half or \$30,000. Realistic estimates are that CNG conversion should have a payback of under three years".²³

Duke Energy therefore estimates that the conversion of fleet vehicles, public and private, would have the potential to add approximately \$29 million to the State's economic activity at the conclusion of year three following the refuelling infrastructure rollout.

Establishing CNG Refuelling Stations

The Committee received a range of advice on the estimated number and style of refuelling stations that would be needed to support CNG vehicles.

In its' submission Duke Energy estimated :

- (a) between 10 and 15 CNG refuelling stations would be required around the State;

²⁰ Duke Energy International, *op. cit.*, p. 6.

²¹ *Ibid.*

²² *Ibid.*

²³ *Ibid.*

- (b) half of the capital investment on each site would be spent locally in civil engineering, planning approval etc.;
- (c) assuming an average expenditure of \$1.1 million per site and 13 stations, \$14.3 million would be spent, \$7.15 million of which would add to State economic activity.²⁴

The options for refuelling stations are considered more fully in Chapters 2 and 3.

CNG Cylinders Inspection

Duke Energy estimates that the necessary re-certification and pressure testing of approximately 8,700 CNG cylinders (based on the above estimate of CNG vehicles) will generate at least four additional jobs and would add about \$800,000 to economic activity in the first three years.²⁵

In summary Duke Energy estimates that during the first three years' operation of the refuelling network, the stimulus to State economic activity would be around \$37 million. To this must be added the effect of reduced operating costs on all CNG users.

1.2 Economic/Employment Impacts

The areas where extra jobs will be created in the CNG Industry are Education and Training, Refuelling Infrastructure, Vehicle Conversion, Cylinder Testing and Equipment Sales.

Based on its estimates of added economic activity, Duke Energy has estimated an additional 74 permanent jobs across those areas.²⁶

In Brisbane the Committee observed the creation of a spin-off industry in bus assembly. Under license to Scania, BCC has established an assembly plant where they are building their own buses. **The Committee believes that this initiative is worth investigating in the Tasmanian context, and may be worthwhile in the event that the Government decided on a rapid progression to CNG vehicles, which is recommended.**

Cooperative Research Centre (CRC)

The Committees' own research indicates the existence of a window of opportunity for the establishment in Tasmania of a Cooperative Research Centre (CRC).

The CRC program is funded by the Federal Government and could involve the CSIRO, Aurora, Industry and The University of Tasmania establishing a centre for research into alternative fuel technologies.

²⁴ Duke Energy International, *op. cit.*, pp. 6-7

²⁵ *Ibid.*, p. 6.

²⁶ *Ibid.*, pp. 7-8.

There is no such centre anywhere in Australia and it is estimated that a CRC would be worth \$20 million to the State as a start-up operation with potentially far greater benefits into the future.

The window of opportunity exists because other Australian States have been slow to embrace CNG technology, and because CNG technology is conventionally seen as a path to fuel cell and hydrogen technology, which in turn is seen as the future energy source in both transport and power generation.

In order to take advantage of this opportunity the Committee believes that the best approach for government generally would be to pursue a rapid uptake of CNG technology for Tasmania, and to lead by example in this regard. (see Chapter 3)

1.3 Health and Environmental Benefits

The health and environmental benefits to the community can be summed up in four words, clean air, reduced noise.

Whilst Tasmania is lucky, compared with other States, to have a relatively clean air environment, in more recent times there have been periodical signs of air contamination to disturbing levels in some parts of the State.

Background

Globally there is now a clear recognition of the need to reduce greenhouse gas emissions because of their effect on global warming, associated climate change, crop failures and potential world economic disaster.

The Inter-governmental Panel on Climate Change (IPCC) released its Third Assessment Report on global climate change in March 2001. The report covers the current state of scientific knowledge on climate change, its impacts on environmental and human systems, and an assessment of international attempts to mitigate climate change.

The IPCC's climate models project that average global surface temperature will increase by between 1.4 to 5.8°C in the 21st century depending on what actions are taken in mitigation by industrialised countries.

“To put the IPCC's Projections in context, global average temperatures are today only about 5°C higher than Ice Age levels. A global temperature increase even at the lower end of the IPCC's projections will, therefore, have a major global impact”.²⁷

²⁷ Dr Colin Grant, Australian Greenhouse Office, *Natural Gas Vehicles – Future Directions*, paper presented to the Asia-Pacific Natural Gas Vehicles Summit, Brisbane, 10 April 2001, p. 4.

It is not surprising then that governments throughout Australia – Federal, State and Local are taking conscious steps to reduce greenhouse gas emissions.

Vehicle Emissions

Whilst vehicle emissions Australia-wide are not the major cause of greenhouse gas emissions, their contribution in Tasmania is probably proportionately higher because here there is far less air pollution from other sources.

In Tasmania, therefore, a concerted effort at the State and Local Government levels to reduce motor vehicle greenhouse gas emissions could make a major contribution to reducing the level of greenhouse gas emissions in this State.

Greenhouse Gases as such occur naturally and a balanced level of them is necessary to sustain life on earth. It is the excess production of these gases, leading to a potentially dangerous imbalance that the Kyoto Protocol sought to address, and which most industrialised countries are now seeking to address.

Significantly CNG, being mostly methane, is a greenhouse gas but the combustion of it produces far less harmful greenhouse gas emissions than alternative fuels. This proposition has recently been supported by a scientific analysis undertaken by the CSIRO on behalf of the Australian Greenhouse Office.²⁸

The CSIRO analysis, conducted on a range of alternative fuels, determined that CNG is the cleanest fuel of all, both in terms of greenhouse gases and particulate matter.

The greenhouse gases are predominantly carbon dioxide (CO₂), methane, CFCs, nitrous oxide (N₂O) and ozone. Often nitrogenous emissions are referred to as NO_x meaning a combination of nitric acid (NO), nitrogen dioxide NO₂ and N₂O which is a greenhouse gas making up ten per cent of the total. CO₂ makes up 50% of greenhouse gas.

Particulate Matter (PM) is the term used for the smoke or fine solid particles emitted from motor vehicles and particularly from diesel powered vehicles.

PM is classified by size with PM 10 (10 microns) considered coarse and PM 2.5 or less considered fine. PM accumulates in the respiratory system and the finer the PM the more dangerous it is considered to be.

In its submission to the Committee, the Western Australian firm Advanced Engine Components Limited (AEC, previously mentioned for its advanced conversion technology) spoke of **developing international concerns about low sulphur diesel fuel due to its fine PM, and the high probability of these finer particulates causing more severe respiratory problems.**²⁹ The

²⁸ CSIRO Report, *Comparison of Transport Fuels. Life-cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles*, 2001.

²⁹ Advanced Engine Components Limited, *Submission to the Joint Standing Committee on Environment, Resources and Development*, 28 November 2001, pp. 10-11.

problems caused by standard diesel particulates (PM 10) are already well documented.

The costs to society of health problems from air pollution cannot be ignored.

“In 1996, the British Lung Foundation commissioned a cost analysis of the health effects of air pollution for the UK, which arrived at a figure of £11 billion.”³⁰

The figures for Australia would be considered to be proportionately less than the UK, but nonetheless significant.

Given the above, it is easy to calculate that there are very significant health and environmental benefits to be had from the use of CNG as an alternative vehicle fuel.

Design Rule Emission Limits

As the future Australian Design Rule Emission Limits are based on the European standards, it is useful to look at those standards and then compare the performance of diesel and CNG by reference to those standards.

Comparison of Emissions

Scania’s Gas-powered Trucks, a Current Diesel Counterpart, Euro 4 and the Euro 5 Standard.

Table 6³¹

Exhaust Gas	Euro 2 1996	Euro 3 2001	Euro 4 2005	Euro 5 2008
CO	4	2.1	1.5	0.4
HC	1.1	0.66	0.46	0.25
NO _x	7	5	3.5	2.0
PM	0.15	0.1	0.02	0.01

Note Figures are in g/kwh (grams per kilowatt hour)

Table 7³²

	Hydro Carbons HC	Carbon Monoxide CO	Nitrogen Oxides NO_x	Particulate Matter PM
Diesel Truck	0.864	1.442	7.014	0.373
LNG Scania Truck	0.180	0.017	1.532	0.013
CNG Scania Truck	0.212	0.018	0.962	0.007
Euro 4	1.100	1.500	3.500	0.020
Euro 5	0.250	0.400	1.000	0.010

³⁰ Advanced Engine Components Limited, *op.cit.*, p. 13.

³¹ State Transit NSW, *op. cit.*, p. 6., Australian Gas Journal, June 2001, p. 13., Dr Vinod Duggal, *ANGVC Paper*, ANGVC Summit, Brisbane, April 2001.

³² *Ibid.*

The above tables 6 and 7 indicate how much cleaner natural gas engines are, and in fact show that the indicated engines are meeting the Euro 5 standard not due to be introduced until 2008. A summary of the CSIRO Comparison of Transport Fuels figures is included as Appendix 1.

A further point of note made by AEC which underlines the comparative disadvantage of diesel is that :

“the **cost of exhaust gas after treatment for diesel buses, especially for Euro II and beyond compliant low sulphur diesel buses, is a continuing maintenance impost.** Particulate traps and catalytic converters are essential additional components for these diesel engines and both have a service life of 200,000 kms or just beyond 3 years for fleet route buses. This cost is about \$10,000 per bus. The annual additional component cost per bus for exhaust gas after treatment for a diesel bus will be of the order of \$45,500 per bus. It has been assessed that the Euro II low sulphur (0.05%S) diesel fuelled buses have 2½ times higher maintenance costs than their CNG counterparts”.³³

Noise Levels

A comparative discussion of the environmental and health benefits of CNG would not be complete without mentioning noise levels.

The Committee had the opportunity to assess the noise levels of CNG buses in both Sydney, and Brisbane, and was impressed at how much quieter they were both internally and externally.

Noise pollution, particularly in cities, is becoming a significant factor affecting our daily lives.

Each of the City Councils visited by the Committee (Citywide in Melbourne, Waverley and Liverpool in Sydney, and Brisbane) all indicated that reduction of noise levels was one of their priorities in choosing CNG as their preferred vehicle fuel.

Local councils are particularly attracted to the prospect of garbage collection vehicles operating at reduced noise levels in comparison to their diesel powered vehicles.

A bi-fuel Ford Falcon was on display at the Natural Gas Vehicles Forum at the Rokeby Police Academy, October 2001. It was noted just how quiet the vehicle was inside the cabin where the engine could at times not be heard at all when the vehicle was being driven.

³³ Advanced Engine Components Limited, *Submission to the Joint Standing Committee on Environment, Resources and Development*, 28 November 2001, pp. 5-6.

The Tasmanian Image – A Pristine Environment

Tasmania has an international reputation for its clean environment, including its fresh air, and the State is keen to promote that image.

The Tasmania *Together* process expressed the desire of Tasmanians for less air pollution, and to reduce the level of greenhouse gas production.

CNG as a vehicle fuel provides government with the opportunity to help fulfil the aspirations of the Tasmanian community with respect to our clean air and pristine environment generally.

Liquified Natural Gas (LNG)

After initially tendering a submission relating to CNG, NGV Solutions Pty Ltd later appeared before the Committee and recommended LNG as a more appropriate alternative for Tasmania.

While it is recognised that there may be some applications for LNG in Tasmania as time goes on, all of the evidence suggests that the appropriate path is the CNG path.

LNG is a related alternative fuel using much of the same technology, and where specific applications arose for its use these could be easily taken up.

The potential for LNG uses will no doubt be assessed by any government project team (see recommendations), and could well include remote localities.

Chapter 2

- **Infrastructure Requirements (including Funding Options)**
 - **Barriers to the Conversion to CNG**
-

Infrastructure Requirements

The first infrastructure requirement for CNG vehicles is filler stations, and in Tasmania an additional requirement is the commencement of the distribution network rollout.

The rollout of the distribution network is beyond the scope of this report, but it goes without saying that an aggressive promotion of NGV's in Tasmania would enhance the network rollout due to the effect on the demand side of the equation.

The greater the demand for gas then the greater the potential profitability of gas distribution and the greater the incentive for the network distributor to rollout the infrastructure.

Through an aggressive promotion of NGVs government can play a key role in boosting the incentive of the distributor to progress the network rollout.

The work of the Committee generated a lot of interest wherever it went in mainland States. Without exception industry players expressed the view that Tasmania had a golden opportunity to create a CNG industry for motor vehicles, and by careful planning and co-operation with industry could avoid problems experienced in other States.

It is the Committee's view that at the earliest opportunity the Government should encourage the establishment of a sufficient minimum number of CNG filler stations to achieve a minimum level of State coverage.

To achieve this, and to be seen to be encouraging the community at large to follow, the Government should lead the process by converting a percentage of its Metro bus fleet and a percentage of the rest of the government-owned fleets, including those in government owned corporations.

Further investigation is required, including cost-benefit analysis to determine the percentages involved, but anecdotal evidence offered during discussions with industry suggests that around twenty buses is considered the minimum start-off number.

Decisions will need to be made like :

- how many dedicated CNG buses to be purchased at first;
- how many existing diesel buses, if any, should be converted to CNG;
- whether it would be feasible to convert a percentage of the police fleet to CNG and what percentage; and
- whether and to what extent the rest of the government owned fleet could be converted to CNG.

The Committee's discussions with both industry and bus operators in Sydney and Brisbane indicate that in order to make a viable transition to CNG there is a minimum critical mass necessary as a starting point.

Both the major bus operators visited by the Committee, State Transit in New South Wales, and Brisbane City have implemented replacement programs that over a defined period of time will see almost their entire fleets converted to dedicated CNG operation. In each case the primary motives have been cost savings and clean air.

Tasmania has recently purchased a number of modern low floor Scania diesel buses. Because of their remaining useable lifespan they are ripe for conversion to CNG, and the Government should investigate further the viability of that course, both to reap cost savings, to commence the move to cleaner air, and to stimulate the conversion sector.

The Government should request that Metro revisit its replacement program with a view to determining the earliest possible purchase program for dedicated CNG buses.

Assessing the feasibility of commencing a demonstration program in Launceston at an early time using 'clean fresh-air' CNG buses, would be a very attractive and worthwhile aim for government. The program could be simultaneously commenced in Hobart to reap economies of scale, and then progressively extended to the north-west of the State.

The same demonstration program possibilities exist for all government fleets, with not only the cost savings from cheap CNG, but the goodwill to be generated from the government's active involvement in programs to reduce greenhouse gas emissions, and in helping to make Tasmanian air even cleaner, for both local residents and tourists.

Any such demonstration program should be marketed as being the first stage of a committed move by government into the rapid uptake scenario. Care should be taken to avoid any suggestion that the Government is only being tentative or is unsure of the benefits of the technology. (see comments by CRISP at page 37)

The opportunity for government exists to showcase Tasmania by taking an aggressive lead in NGVs that other States have not yet taken.

Funding Options

Federal Government Programs

There is still considerable assistance available from the Federal Government under the Australian Greenhouse Office's Alternative Fuels Programs.

The Compressed Natural Gas Infrastructure Program (CNGIP)

This program was established principally to fund the development of CNG refuelling sites. The downside is that the initial funding allocation under this program has been fully subscribed.

However, as Tasmania was excluded from eligibility by circumstances outside its control it would be worth a special approach to the Commonwealth to request a grant on an equal footing basis.

A further point to note here is that the full extent of intended rollout of refuelling sites on the mainland under the program, has not been realised, and there may therefore be previously allocated funds that could be reallocated to an infrastructure rollout in Tasmania.

The Alternative Fuels Conversion Program (AFCP)

The AFCP will provide funding for the conversion, purchase, or fuel system upgrade of commercial road vehicles and buses, weighing 3.5 tonnes gross vehicle mass (GVM) or more, to operate on CNG.

The AFCP may provide funds of up to 50% of the eligible cost of either :

- the difference between the purchase price of new (OEM), CNG fuelled vehicles over their conventionally fuelled equivalents – to the extent that the price difference is due to the different fuel systems;
- converting conventionally fuelled vehicles to operate on CNG; or
- upgrading the fuel systems of vehicles already operating on LPG or CNG where improvement in greenhouse and other emissions can be demonstrated.

The Diesel and Alternative Fuels Grant Scheme (DAFGS)

The DAFGS will maintain existing price relativities between diesel and a range of alternative fuels by allowing transport operators that are eligible for the diesel fuel grant to also be eligible for the alternative fuels grant.

Fuel grants for eligible users were indexed on 1 February 2001 and are :

- CNG 12.617 cents per m³
- LPG 11.925 cents per litre
- Ethanol 20.809 cents per litre
- Diesel 18.510 cents per litre.

For refuelling sites to be eligible for CNGIP funding they must cater for cars, trucks and buses and offer full open public access 24 hours per day, 365 days per year and have a high fill rate of at least 40m³ per minute.

This latter requirement would fit in well with a plan which was designed to establish a minimum number of refuelling sites within the major population centres where Metro buses operated, in order to establish pilot programs and allow the public take-up to develop progressively.

The Committee visited sites in the ACT, Sydney and Brisbane where the refuelling infrastructure has been funded and installed by the distributor. The

State-owned energy distributor in Queensland, Energex, and equipment provider CompAir built the BCC site and BCC pays a contracted pump price per m³ to the distributor.

A similar system operates at State Transit NSW in Sydney, the ACT, the 7 Eleven site at Liverpool, and the Citywide site in Melbourne. Members of the public wishing to refuel CNG vehicles are all able to use these sites.

It is apparent that there are a number of industry players who would be keen to be involved in constructing the necessary infrastructure, and Origin Energy emphasised this point when appearing before the Committee.

Alternative Refuelling Methods

Further mention should be made at this point of CompAir (Australia) Limited. This company provided the Committee with a detailed submission and was one of the corporations that the Committee visited in Melbourne.

CompAir is an international supplier of equipment for the NGV industry and offers a total CNG solution for design, construction and installation of refuelling infrastructure.

One of CompAir's innovations is its CNG compression module system which can be built to size to suit the individual site.

This means that a refuelling site can be constructed on a relatively small scale initially and then simply added to as demand requires. Initial set-up costs can be relatively low.

In conjunction with a consulting group such as NGV Solutions Pty Ltd, CompAir has also developed the concept of a complete portable CNG refuelling station, which includes all of the components that would be found on a fixed station site.

These modular portable stations can occupy space about the size of a cargo container, but are designed in a number of sizes to suit site, capital, and demand requirements. In this way the appropriate unit can be site located to suit the demand anticipated and thereafter can be expanded until a fixed load can be justified.

The portability of these units means they can be moved to alternative sites with ease, and are suitable for trial programs.

GNC GALILEO SA – Argentina

A more recent innovation from Argentina, is the Nanobox³⁴ Refuelling Station, which can be installed for less than \$200,000 per unit.

The Nanobox is a compressor and dispensing unit package, which in its smallest configuration is capable of refuelling 30 to 250 vehicles per day (250 standard size cars). A car can be refilled in two to three minutes.

³⁴ See Appendix 2.

Its' compact size (2360 mm long, 870 mm wide, and 2040 mm high) and weight of 2090 kg make for easy installation. All it requires is a gas supply and an electricity supply, and would be ideal for a variety of dispensing sites, including existing service stations and fleet depots.

If government adopted the rapid uptake scenario for NGV's being recommended by the Committee, our research indicates that twenty refuelling sites around the State would be adequate to service the State's needs in the short term. The Nanobox system would appear to indicate that this could be achieved by a combination of public and private sector investment of less than \$4 million, or less than \$200,000 per site.

Domestic Household Refuelling

A new development recently unveiled by the FuelMaker Corporation, of California and worth noting for its potential, is a refuelling appliance that can be mounted in a home garage and connected to an existing natural gas line. Estimated to cost around \$US1,000 such a system would seem to have significant future potential, and more so in California where there are currently 19,000 NGV's with a further 600,000 expected by 2012.

This later figure is estimated following the formation of the California Natural Gas Vehicle Partnership.

“This public/private partnership includes government, air quality, transportation and energy agencies, together with vehicle and engine manufacturers, natural gas suppliers, vehicle fleet operators, and environmental organisations.”³⁵

Barriers to the Conversion of Vehicles to CNG in Tasmania

The principal barriers to the conversion of vehicles to CNG in Tasmania are :

- community complacency;
- attitude of Original Equipment Manufacturers (OEMs);
- the absence of infrastructure; and
- the absence of a market for used NGV's.

It is very much a 'chicken and egg' situation because once there is sufficient infrastructure in place and once the community at large becomes aware of the benefits of CNG as a vehicle fuel, consumer demand would be expected to increase over time.

OEMs for their part are reluctant to move into manufacturing dedicated CNG vehicles until the demand for them is evident. There has therefore, at least in Australia, been significant progress in relation to the heavy vehicle sector, but very little in relation to light passenger vehicles, due to the demand differences between the two sectors.

³⁵ The California NGV Partnership Press Release can be viewed at: www.cngvp.org/news_press_10_8.html

To some extent government complacency generally is also to blame, particularly at the mainland State level.

Whilst it cannot be said that the Federal Government has been complacent – after all its \$400 million greenhouse gas reduction campaign is a significant one – it can be said that the Federal Government could do much more.

For example its CNGIP program has been quite inadequate, and officially has expired. Pitched at higher levels this program could have a huge impact on the rollout of infrastructure Australia wide, and particularly in Tasmania.

Discussions by CRISP on behalf of the Committee with a wide range of industry players identified the following barriers:

- access to refuelling stations;
- certainty of fuel supply;
- skills development for conversion and maintenance;
- initial cost of conversion;
- length of payback period
- certainty of price
- vehicle specification (eg reduction in capacity due to tank size); and
- absence of government leadership.

Once refuelling stations are in place supply will not be an issue. All of these issues are covered generally in the body of this report and specifically in the Options Chapter 3.

Chapter 3

Options for Promoting the use of Natural Gas as a Vehicle Fuel in Tasmania

The Committee commissioned the Centre for Research, Industry and Strategic Planning (CRISP) to assist generally with the research task and to make recommendations.

The Committee has also generally accepted the recommendations as formulated by the research team.

In particular the Committee recommends the rapid uptake scenario as having the greatest employment, environmental, health and economic benefits for Tasmania.

The complete CRISP report is tabled with this Report.

Based on all the evidence obtained by the Committee, Chapter 3 and Appendix 1 of the CRISP report are in line with the Committee's view on the question of options for government, and are reproduced here in full.

“Options

3.1 Intervention scenarios

The approach used for the development of options was to consider three intervention and uptake scenarios and the benefit to industry and the community of those scenarios. The three scenarios used are a rapid uptake scenario, a medium uptake scenario and a natural uptake scenario.

Rapid uptake – Leadership in alternative fuels

A rapid uptake scenario would provide a level of uptake that would exceed world best uptake of CNG for vehicles. It would mean a very high percentage of new heavy transport vehicles (>90%) being dedicated CNG vehicles and about 50% of existing heavy transports being converted to dual fuel technology within five years.³⁶ The rapid uptake scenario would have a high proportion (relative to international experience) of new private and passenger vehicles (about 25%) being either dedicated CNG or having dual-fuel capability. This would require an aggressive approach by government.

- **Target** 25% of new vehicles CNG capable in five years.
- **Target** Tasmania publicly recognised as national alternative fuels leader in three years – leader in uptake, leader in alternative fuels technology development.
- **Target** 20 refuelling stations statewide within 3 years with servicing of areas not covered by the pipeline.

³⁶ Heavy Transport vehicles constitute only 18% of the diesel vehicle fleet (DIER Motor Vehicle Registration data). The projected uptake rate for all diesel vehicles is 40% of new vehicles within 5 years.

Medium uptake

A medium uptake scenario would have a high percentage of new heavy transport vehicles (>60%) being dedicated CNG vehicles and a moderate level of conversion of existing vehicles (about 30%) within five years.³⁷ A medium uptake scenario would have a moderate proportion of passenger and light vehicles with CNG capability, and large fleets such as government and taxis would be the main consumers. A medium uptake scenario would achieve close to world best uptake over an extended period.

This scenario would require a reduced level of commitment from government in comparison to the rapid uptake scenario.

- **Target** 10% of new vehicles CNG capable in five years.
- **Target** Conversion of 25% of government fleet to CNG capable.
- **Target** 10 refuelling stations statewide, no servicing of east and west coast.
 - Refuelling infrastructure support limited to high usage areas.

Natural uptake

This is not a 'do nothing' option. A natural uptake scenario would have only basic support from government in areas such as skills accreditation, safety legislation and planning control. These activities are baseline activities that must be completed within existing resources regardless of the intervention level by government.

The natural uptake scenario would have a slow conversion of the heavy vehicle fleet (30% of new vehicles) and some testing by the transport industry of conversion technology (10% of existing fleet). A natural uptake scenario would have virtually no uptake in light passenger vehicles in the first five years and a slow uptake beyond that time as benefits and infrastructure support builds.

No targets for uptake have been determined for this scenario and only no-cost initiatives or those that would need to be carried out regardless (for example, training and skills development) would be considered in this scenario.

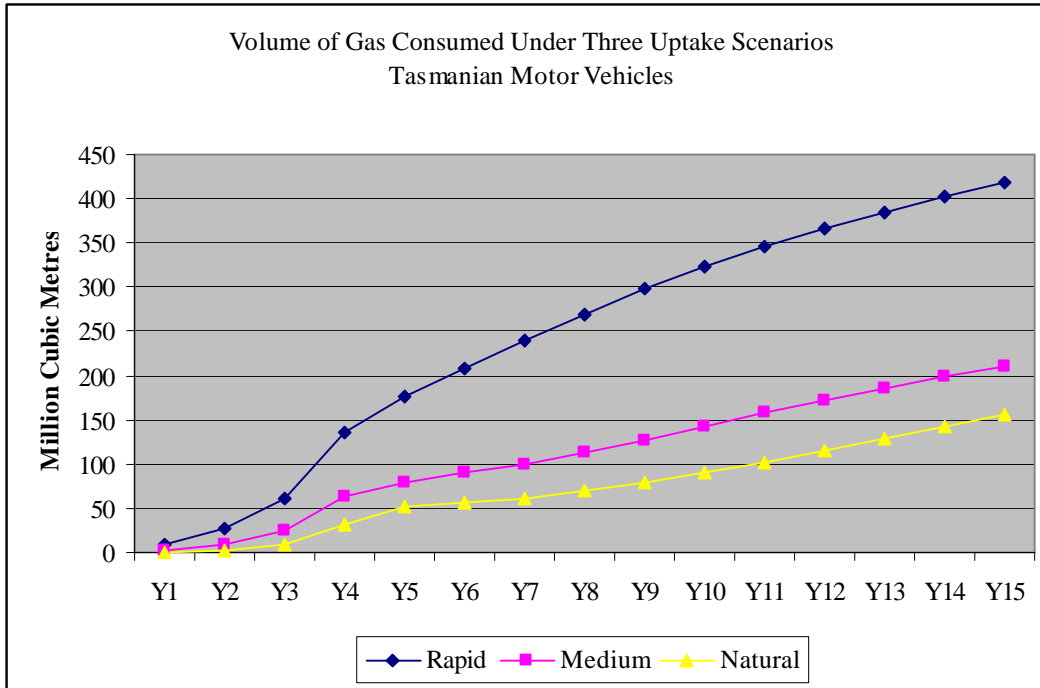
3.2 What would these scenarios mean?

It is important to analyse what these scenarios would mean in terms of savings for industry through cheaper freight rates, savings for the community in lower cost personal transportation, and savings for the environment through reduced emissions.

Modelling of the scenarios (Appendix 4) indicates that a rapid uptake scenario significantly increases consumption of gas when compared to the natural uptake scenario. **This means savings of around \$70m per year for industry and the community by year 10 (2013). The rapid uptake scenario also creates additional investment in the Tasmanian economy of around \$90m over a 10 year period.**

³⁷ Projected uptake for all diesel vehicles is 7% within 5 years.

Figure 1



The above Figure projects forward the consumption of CNG by motor vehicles under each of the three scenarios, indicating strong growth in consumption for a rapid uptake scenario and slow uptake for medium and natural uptake scenarios.

Economic Impacts

Savings for Industry

The freight industry is the major consumer of diesel fuel and projected changes in diesel consumption are a good indicator of the savings to industry in general. It is difficult to allocate these savings against industry sectors as some will be retained by the freight industry as profits and some will be passed on to freight customers and ultimately shareholders and consumers.

The following table summarising the diesel replacement uptake tables in Appendix 4 indicates that the savings generated are significant.

Table 1: Freight Savings using three uptake scenarios

	Savings on Freight Costs Year 10 only	Savings on Freight Costs Cumulative
Rapid Uptake Scenario	\$61m	\$324m
Medium Uptake Scenario	\$25m	\$135m
Natural Uptake Scenario	\$17m	\$97m

Savings for the Community

Personal transport is the major consumer of petrol. Savings here will be directly attributed to the general community. Table 2 summarises the petrol replacement uptake tables in Appendix 4 and indicates the expected levels of saving for the community under the three uptake scenarios.

Table 2: Personal transport savings using three uptake scenarios

	Savings on Personal Transport Costs Year 10 only	Savings on Personal Transport Costs Cumulative
Rapid Uptake Scenario	\$36m	\$197m
Medium Uptake Scenario	\$18m	\$90m
Natural Uptake Scenario	\$9m	\$35m

Investment

A rapid uptake scenario is projected to create an additional \$90m of investment for Tasmania and the three scenarios will have significantly different impacts on investment levels in Tasmania. The investments considered are investments in refuelling infrastructure, investments in vehicles and investment in research and development. The investments in vehicles have not been disaggregated into business and personal use and provide a raw figure of total change in value of vehicles purchased. A significant number of the passenger vehicles, particularly in the initial few years, are government vehicles and these also have not been disaggregated from the projections.

Under the rapid uptake scenario, Tasmania is positioned as a leader in alternative fuels technology and initiation of a CRC in Alternative Fuels is advocated. This is not advocated in the medium and natural uptake scenarios.

Investment generated by the Rapid Uptake scenario includes 20 refuelling sites around the state with an average investment of around \$0.75m per site. This equates to a total investment of around \$15m. The Rapid Uptake scenario includes the CRC with an estimated value of around \$20m. By year ten it is projected that there will be around 30,000 vehicles that are CNG-capable at an additional cost of \$3,000 per vehicle (\$90m).

The Medium Uptake scenario would only achieve about 10 refuelling sites (\$7.5m) and around 17,700 vehicles over 10 years (\$53m), while the Natural Uptake scenario would attract about 5 sites (\$3.75m) and around 10,500 vehicles (\$31.5m).

Table 3: Investment generated under three uptake scenarios

	Rapid Uptake Scenario	Medium Uptake Scenario	Natural Uptake Scenario
Infrastructure	\$15m	\$7.5m	\$3.75m
Vehicles	\$90m	\$53m	\$31.5m
Research	\$20m	-	-
TOTAL	\$125m	\$60.5m	\$35.25m
TOTAL Above Natural	\$89.75m	\$25.25m	-

The possible negative impacts of this investment have not been explored in depth. This investment may be transferred from other investments in plant and equipment and the net effect would be reduced in that case. It is also

possible that the incursion of CNG into the mature petroleum market will displace some facilities and effectively reduce the investment in this sector.

Environmental Impacts

Impact on Greenhouse Gases

A rapid uptake scenario would reduce the CO₂ contribution from Diesel vehicles by 59,100 tonnes per year within 10 years. The reduction in CO₂ from the passenger vehicle (ULP market substitution) is estimated to be 54,000 tonnes under the same scenario.³⁸ The net effect would be a reduction in CO₂ emission from motor vehicles by about 10% for Tasmania, or a reduction in the total emission of greenhouse gasses of around 2.3%.

Under a natural uptake scenario (ie no government intervention), the reduction in CO₂ from diesel vehicles would be close to 17,000 tonnes after 10 years and the passenger vehicle market would contribute 19,000 tonnes. The following table summarises the reduction in CO₂ production for each of the scenarios and indicates that an aggressive approach from government is likely to reduce CO₂ emissions by an additional 96,000 tonnes per year over a natural uptake scenario.

Table 4: Year 10 Reduction of CO₂ emission (x1000 tonnes of CO₂)

	Rapid Uptake Scenario	Medium Uptake Scenario	Natural Uptake Scenario
Diesel	59.1	24.5	17.0
Petrol	73.6	36.6	19.3
Total	132.7	61.1	36.3
Variation from Natural Uptake Scenario	96.4	14.8	-

Impact on Particulates

Diesel engines provide the greatest level of particulates of any fuel used at a highly variable rate depending on the state of repair of the fuel injection system. Emissions of particulates from petrol are very low and there would be no significant improvement resulting from a conversion to CNG.

Diesel PM10 emissions are generally around 40 mg/MJ compared to around 6 mg/MJ for CNG or a reduction of around 1300 mg for each m³ of CNG that replaces diesel. This equates to a reduction of around 283 tonnes at year 10 for the rapid uptake scenario, 117 tonnes with the medium uptake scenario, and 81 tonnes under the natural uptake scenario.

The impact of this reduction is uncertain but it will be most noticeable in high exposure localities. The following chart³⁹ maps the average air quality at an air collection and testing site in Launceston. Launceston is known to be a city with the highest rate of exceedance of particulate standards in Australia. 50

³⁸ Tables with modelling of the rapid and natural uptake scenarios are at Appendix 4 of the CRISP Report.

³⁹ Sourced from DPIWE air quality data in Launceston.

micro grams per cubic metre of particulates is considered the threshold level and the target for any one site is no more than 5 exceedances per year by 26 June 2008.⁴⁰ The chart plots the average diurnal levels and provides a 28 day rolling average.

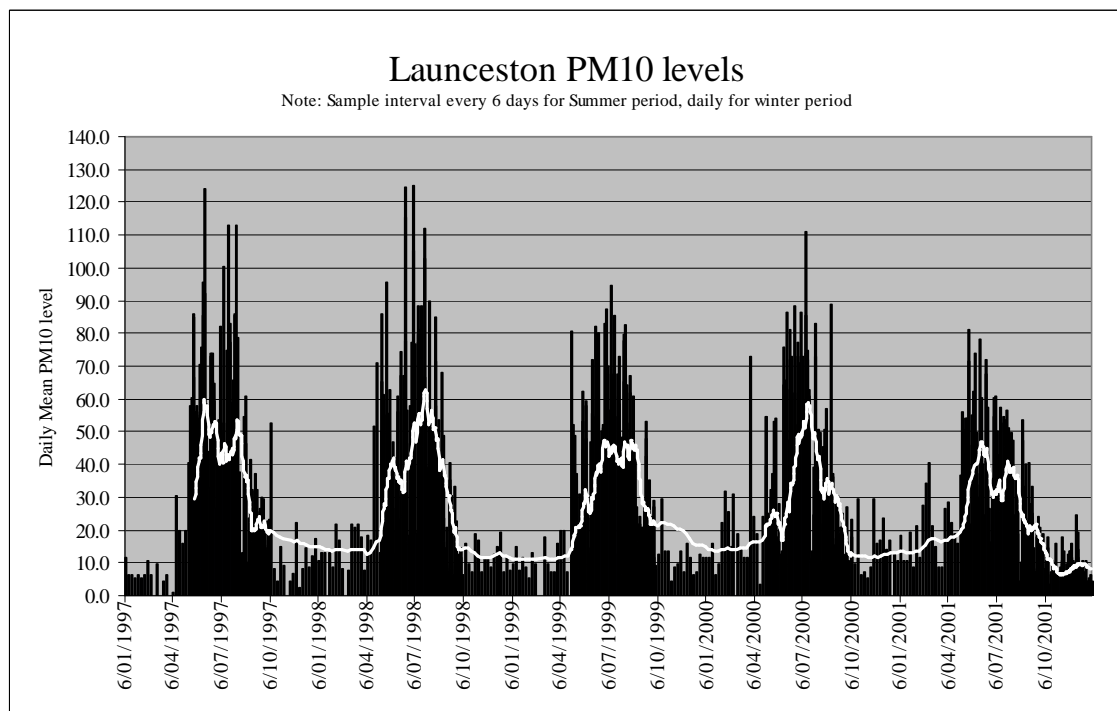
Clearly the levels are far higher in winter than in summer and a total of 27 exceedances were recorded in 2001. 14 of these (over half) exceeded by less than 5 micro grams per cubic metre.

The source of the particulates is believed to be largely wood fires for domestic heating and the microclimate of the Tamar Valley at that time of the year.

Using the base levels in summer time as an indicator of non-wood fire particulates, (rolling average of around 10 micro grams per cubic metre), and the contributions to particulates from natural sources (dust, sea spray etc), the contribution of road transport to the particulates is unlikely to be more than 5 micro grams per cubic metre. This estimate is consistent with the DPIWE estimate of around 5% of particulates from motor vehicles.

Combining the estimate of contribution by motor vehicles, the dominance of diesel engines as the contributor to particulates from motor vehicles, and the Launceston air quality data, a total conversion of diesel vehicles to CNG is likely to halve the current exceedances in Launceston.

Figure 2 Particulate Levels in Launceston from 1997 to 2001



The uptake of CNG for motor vehicles is therefore important for Launceston. However, the majority of Tasmania does not have the level of particulates that

⁴⁰ Communications with DPIWE.

Launceston has and addressing the wood heater issue will be far more productive in reducing particulate pollution in Tasmania.

3.3 Tasmania – World Best Uptake Rate for CNG

A key question to ask is, why might Tasmania achieve a 25% uptake rate (75% in heavy transport) when nowhere else in the world has achieved this level? What makes Tasmania now different from NZ ten years ago? From the USA? Why would the Tasmanian freight sector embrace the technology when the Argentine freight sector hasn't?

The answer lies in changes in technology, Tasmanian culture of “clean and green”, international pressures on full pricing for energy consumption, the size of Tasmania, the contribution of the Tasmanian Government to fleet numbers, and the efficiency drive within the heavy transport industry.

Technology Developments

Technology developments in the global automotive sector and innovation in manufacturing in recent years have introduced technology for use of CNG that didn't exist before. Purpose-built CNG engines for heavy freight vehicles are now readily available off the shelf instead of retro fitting diesel engines with hybrid technology.

Technology developments in CNG handling and storage make the fuel more manageable and less intrusive in vehicle design; and full scalability of refuelling technology increases the market scope for refuelling infrastructure.

Cars designed for CNG are now available off the shelf. Efficiencies in design and manufacture of motor vehicles and moves to the addressing of micro or niche markets means that vehicle manufacturers are able to justify investment in alternative fuels. Combined with global distribution of models (for example, the same vehicle is marketed in Europe, Asia and Australia providing economy of scale), micro-markets can be aggregated to provide the critical market mass for the development of alternative technologies. In Australia only Volvo has a production CNG vehicle, while in the USA both Honda and Ford have production CNG vehicles readily available.

Tasmanian Fleet Characteristics

The size and contribution of government to fleet numbers in Tasmania is a major contributor to the belief that Tasmania can achieve world best uptake rates for the technology. Government fleets account for around 8.5% of new vehicles in the Tasmanian passenger vehicle market. Government business enterprises (GBEs) and local government would account for a similar percentage. Total conversion of the government fleet and partial conversion of the GBEs fleets alone would bring Tasmanian uptake to close to world best. Nowhere else is this ability to influence fleet profile through a simple purchasing policy available.

Market Size

Tasmania is a relatively small island. This means that the full market can be serviced with a new technology with relatively low investment in infrastructure.

It also means that the market boundaries are clearly defined. Investment in the technology in Tasmania will not be threatened by investment in neighbouring markets. This adds certainty for investors in refuelling infrastructure and underpins uptake.

Clean and Green

The changing international emphasis on clean and green is consistent with Tasmanians' perception of themselves. Tasmania *Together* targets clearly identify a clean and green approach as being part of the Tasmanian culture and believe that Tasmania would be more likely to embrace a cleaner fuel technology than many other world regions. Political pressure for compliance on greenhouse gases adds to this debate.

Pricing of energy is moving towards whole-of-process cost allocation. This means that the costs associated with spillage risks for petroleum will be built into the price of oil. The costs of capturing carbon (carbon credit trading, scrubbing of exhausts) are beginning to be attributed to coal-fired power stations. Cleaner fuels will continue the trend to a lower cost on this basis, meaning that there will be mounting economic pressure for CNG as a cleaner fuel.

Heavy Transport

Finally, diesel currently dominates the heavy vehicles market. Around 86% of the total heavy freight in Tasmania is diesel powered, and 99.7% of heavy freight vehicles registered in Tasmania and manufactured in the previous ten years are diesel powered. This demonstrates that a high market penetration rate is possible. The reasons for this high market share are a fuel with clear economic advantages for the operator in terms of operating costs and reliability, a better power profile than petrol, and a highly competitive freight market that has driven an efficiency-based industry model.

A few companies that are highly focussed on efficiency dominate the heavy transport industry. This means that a new technology that offers efficiency bonuses or competitive advantage through price will gain rapid uptake. Major heavy transport fleet owners in Tasmania are enthusiastic about the potential for CNG to deliver significant cost savings⁴¹ and have said that they will convert to the fuel. Smaller fleets and owner-operator businesses are likely to follow to remain competitive, or exit the industry. This market dominance combined with the market geography (fleet limited to Tasmania – few long haul vehicles that do not need to refuel interstate) is unique to Tasmania.

3.4 Specific Options

Consultations with industry (consumers and suppliers) and government have yielded a broad range of suggested options to achieve the rapid uptake scenario. These options are grouped into the following areas of potential intervention:

⁴¹ Indicated by responses from transport companies and confirmed by personal communication with private studies on market dynamics.

- supply side (gas and technology);
- demand side (consumers);
- legislative;
- government leadership; and
- innovation and technology development.

Appendix 1 provides more detail on the options listed in the following table. Options have not been costed at this stage and will require a full cost analysis. The options are also bare frameworks that will require significant effort to work up to an implementable status.

Table 5: Summary of Possible Initiatives for Increasing Uptake of CNG

Supply Side	<ol style="list-style-type: none"> 1. Support for infrastructure development 2. Encourage investment by manufacturers 3. Skills development for conversion and maintenance 4. Negotiate with Commonwealth Government to share costs
Demand Side	<ol style="list-style-type: none"> 5. Conversion costs rebate 6. Awareness raising 7. Registration discounts
Legislative	<ol style="list-style-type: none"> 8. Price Maintenance scheme 9. Vehicle curfews 10. Weight allowances for specific vehicles 11. Tightening Emission legislation 12. Access to National Parks
Government Leadership	<ol style="list-style-type: none"> 13. Conversion of fleets 14. Purchasing Contracts by Government 15. Government vehicle supply contract 16. Tasmania <i>Together</i> linkages
Innovation and Technology Development	<ol style="list-style-type: none"> 17. Pursue partnership between University and vehicle manufacturer[s]/council 18. Application for Cooperative Research Centre (CRC) in alternative fuel technology

Details of Options

Supply Side Options

1. Support for infrastructure development

Principles

- Whole of state serviced by refuelling infrastructure to eliminate lack of refuelling access as a barrier to uptake

Actions

- Initiate an investment attraction project within Department of Economic Development to ensure investment in infrastructure.
- Provide direct financial support for the development of a network of refuelling stations in Tasmania.

- Target 20 refuelling stations with full State coverage in line with current LPG refuelling capacity supported by claims by CompAir on needs for full servicing of CNG in Tasmania.
- Develop and implement delivery options for locations without access to gas pipeline, including Strahan and east coast.
- Possible use of LNG for transport in about 2 years will reduce the ongoing cost of this approach.

Impact

- Assured investment in refuelling infrastructure.
- Up to \$15m investment.
- Access to refuelling no longer an impediment to uptake.

2. Encourage investment by manufacturers

Principles

- Ensure local manufacture of refuelling facilities and in-vehicle systems to capture value from the shift to CNG.

Action

- Investment attraction project for Department of Economic Development.
- Attract manufacturing investment and capability to Tasmania to support introduction of CNG, targeting manufacture of refuelling facilities and in-vehicle systems.
- Links to Option 1. Essential for other initiatives, particularly CRC attraction.

Impact

- Employment creation in Tasmania.
- Investment attraction – initial potential of around \$5m.
- Export potential domestic market.

3. Skills development for conversion and maintenance

Principles

- Ensure strong local capability for conversion and maintenance of CNG systems and provide consumers with confidence that CNG will be reliable.

Actions

- Skills Response Unit project to coordinate with TAFE and vehicle suppliers on skills development programs.
- Some seed funding required for course development and a dedicated staff member to coordinate the activity.
- Course delivery revenue neutral with significant in-kind contribution from industry (motor vehicle retailers and repairers).

Impact

- Capability to support fleet generated.
- Up-skilling of industry.
- Underpins market confidence

- Potential to export the development program to the rest of Australia.

4. Negotiate with Commonwealth Government to share costs

Principle

- Reduce risk for Tasmania and increase program credibility through involvement of Commonwealth Government.

Actions

- Environment Australia, Australian Greenhouse Program to be approached for contribution on basis of contribution to national agenda.

Impact

- Reduces cost for Tasmania.
- Reduces risk for Tasmania.
- Increases credibility and publicity for the program.

Demand Side Options

5. Conversion costs rebate

Principles

- Reduce the cost of conversion as an incentive for early adoption.

Actions

- Partial contribution to conversion costs of new and existing vehicles.
- 5 year sunset clause.
- Reducing level over that time, beginning with approximately 75% subsidy, scaling down to 50%, 25% and 10% over the following years (cost of conversion is currently approximately \$3000 for light passenger vehicles).
- Possible collaboration and cost sharing with Commonwealth.

Impact:

- Early uptake of technology.
- Expect 5,000 vehicles @ \$1000 over 5 years.
- Positive publicity for the technology.

6. Awareness raising

Principles

- Ensure that consumers are well informed of the benefits and incentives for conversion to CNG and ensure that lack of information is no longer an impediment to uptake.

Actions

- Communication campaign.
 - Encourage early adopters.
 - Target whole community.
 - Recognise good corporate citizens that adopt a Triple Bottom Line approach.

- School curriculum material.
- Link with industrial & domestic market development for natural gas
- Trial of technology as a demonstration project
 - This component is not recommended on the basis that:
 - There is already exceptional information on a global basis of the performance of CNG in vehicles and a demonstration project would only provide a small amount of additional information.
 - **The publicity from a demonstration project would be no better than publicity generated through advertising and would send the wrong messages to the community.** That is, it would send the message that we are uncertain about the performance of CNG in vehicles and that the global information available cannot be trusted.
 - A trial would also have the impact of slowing down uptake in the initial period of CNG implementation.

Impact

- Increased knowledge of CNG in the community.
- Informed decision making by business and the community.
- Recognition for good corporate citizens.

7. Registration discounts

Principles

- Reduce ongoing operating costs of CNG vehicles and increase operating costs of non-CNG vehicles.

Actions

- Targeting family transport
 - Acknowledging long pay back period on investment.
- Rack up existing level over 10 years
 - Effectively a tax on non-CNG vehicles (ie, still maintain differential between CNG and 'conventional vehicles)
 - NSW have announced additional tax on 'gas guzzlers' – precedent exists.
 - Danger that this may be seen as a tax on lower socio-economic demographic in that older vehicles are generally owned by these people. **That is, a tax on those that are least able to afford it. This has possible negative political impacts and tax equity implications.**
- Revenue positive by year 8.

Impact

- Publicity for the technology.
- Additional operating cost incentive for vehicle owners.
- May send wrong message – that technology does not offer enough savings to be attractive without government support.

Legislative Controls Options

8. Price Maintenance scheme

Principles

- Ensure stability and predictability of the price of CNG to reduce the risk for early adopters of the technology.

Actions

- Underwrite the percentage price differential between Diesel and CNG. This means that a gap of approximately \$0.40 per litre-m³ would be maintained allowing CNG price to move with diesel price moves.
 - Wholesale price differential is essentially controlled by Commonwealth government taxation regime.
 - ACCC a potential ally in controlling margins.
 - Contract with Duke controls underlying price.
 - Sunset of 10 years suggested to limit liability of the state.
- Expected cost is low.
- Provides certainty to consumers that the current price differentials will be maintained. The LPG experience of price rises to parity are fresh in consumers' minds.

Impact

- Investment with certainty by consumers and infrastructure developers.
- Rapid uptake by commercial operators.

9. Vehicle curfews

Principles

- Acknowledge cleaner and quieter CNG heavy vehicles through controlled access to CBD and residential streets.

Actions

- Garbage trucks
 - Extend operation time for CNG trucks on basis of reduced noise.
 - Coordination with local government.
- Heavy vehicles in city centres
 - Allow CNG heavy transport through CBD at all times.
 - Restrict non-CNG heavy vehicles on the basis of air quality control.
- No direct cost to government.

Impact

- Publicity for the technology.
- Early conversion of affected vehicles.

10. Weight allowances for specific vehicles

Principles

- Ensure comparable performance of CNG vehicles with conventional vehicles.

Actions

- Dedicated CNG trucks provided with weight allowance where payload is demonstrably reduced by weight of cylinders.
- Specifically target garbage trucks.
- **Option not recommended.** Potential impact on road maintenance in that weight allowance is on an axle basis. Increasing weight allowance would increase axle weights and have implications for road wear and tear. Possible sensitivities around road safety that would be counter productive. Other benefits from CNG (cost saving, possible extension of curfews) account for the reduced payload of vehicles.

Impact

- No disadvantage for specific vehicles.
- Early uptake in target fleets – minor advance in numbers.

11. Tighten Emission legislation

Principles

- Apply disincentives for existing high emission vehicles.

Actions

- Target health benefits through enforcement of maximum particulate emission.
 - Specific locations, city centres.
 - Lead replacement petrol (LRP) an example of this type of approach.

Impact:

- Contribution to emission targets
- Contribution to Tasmania *Together* targets.
- Raises costs for high emission vehicles through tighter maintenance regimes.

12. Access to National Parks

Principles

- Reduce the costs for tour operators as an incentive for conversion.

Actions

- Discounts for CNG buses' access to National Parks.

Impact:

- Publicity with national and international tourists.
- Minor incentive for tour operators to convert.

- Cost reduction.
- Competitive positioning advantage.

Government Leadership Options

13. Conversion of fleets

Principles

- Demonstrate government commitment by converting fleets to CNG.

Actions

- Executive car fleets converted to CNG
 - 2200 cars in the fleet
 - 100% conversion of new vehicles for rapid uptake scenario
 - 25% conversion for medium uptake scenario.
 - No targets for natural uptake.
 - Would require attitude coaching of vehicle users.
 - Training of State Government employees.
- Government Business Enterprises encouraged to convert to CNG
 - Aurora
 - Forestry Tasmania
 - Metro
- Local government fleets encouraged to convert
 - Develop incentives for local government through partnership agreements.
 - Link funding of local government activities to their progression to cleaner operations
 - Target Heavy equipment and executive fleets.
- Expected cost high in the short term. Arguably low in medium term as market for traded vehicles adjusts and volume brings efficiencies in production of vehicles.

Impact

- Major influencer of public opinion and initial market volumes.
- Instant market for refuelling investments.
- Stream of vehicles into the used car market
- Strong publicity for technology.
- Strong message (can be negative if some recipients/users are not comfortable with their role).

14. Purchasing Contracts by Government

Principles

- Use government procurement as a lever for conversion of suppliers.

Actions

- Favourable for suppliers with a commitment to CNG and good corporate citizenship.
- **Not recommended.** Difficult to implement with National Competition Policy obligations.

Impact

- Low.
- Difficult to measure.

15. Government vehicle supply contract

Principles

- Encourage vehicle suppliers to invest in CNG technology.

Actions

- Provide supplier with certainty of market to enable investment in skills and equipment.
- 2-year supply contract
- Link to Option 3 (skills development).

Impact

Investment attraction links.

Certainty for supplier will provide employment outcomes.

Commitment to skill development by vehicle suppliers.

16. Tasmania *Together* linkages

Principles

- Gain public support through linkages to Tasmania *Together*.

Actions

- Create linkages between the project and Tasmania *Together* benchmarks on environmental performance.
- Actively promote the linkages.
- Weakness that the relative impact of CNG on particulates is low compared to the impact that conversion of wood fired heating to gas fired will achieve.

Impact

- Clear Government contribution to Tasmania *Together* objectives.
- Publicity for Tasmania *Together*.

Innovation and Technology Development Options

17. Pursue partnership between University and vehicle manufacturer[s]/council

Principles

- Create a foundation in Tasmania for research in alternative fuels.

Actions

- Develop strong industry/university relationships.
- Include refuelling infrastructure manufacturers.

- Aim to develop novel and improved technology.
- Possibility of some seed money for the partnership.
- Link with investment attraction activities.

Impact

- Not directly measurable.
- Underpin positioning of Tasmania as the national leader in alternative fuels.
- Underpinning of other initiatives.

18. Application for Cooperative Research Centre (CRC) in alternative fuel technology.

Principles

- Attract investment in alternative fuel technology research to Tasmania.

Actions

- Underpin positioning of Tasmania as the national leader in alternative fuels.
 - No current CRC in alternative fuels.
 - Existing interest in University in transport technology
- Low cost but dependent on Option 17 for success
- Also requires significant investment attraction effort and success
 - Would need technology manufacturers located in Tasmania and investment attraction activity. Possible to link into technology supply incentives (Options 1 and 2).
 - Partnerships with motor vehicle manufacturers negotiated as part of vehicle supply contract for government (Option 15).
 - CSIRO involvement is critical for success of CRC bids

Impact

- Average value of CRCs is approximately \$20m with possible extensions.
- Strong positioning for Tasmania for future vehicle technology developments.
- Investment attraction over a longer period of time.
- Will take two years to achieve. The next round for CRCs is in 2004.⁴²

⁴² CRISP Report.

Appendix 1

Summary of the results of the analysis per tonne-kilometre and per passenger-kilometre⁴³

Fuels	GHG	PM	NO _x	Toxics ¹	Health	V&F	ESD	Future ADR
LS diesel (Aus)	Reference fuel for heavy vehicles							
ULS diesel (Aus)	=	~	~	~	√			
ULS diesel (100% hydroprocessing)	=	~	~	~	√			
Fischer-Tropsch diesel	+	-	=	-	√			
100% Biodiesel (canola)	--	~	+	=	=			PM>E3; NO _x >E3,E4
100% Biodiesel (soybean)	--	~	+	=	=			PM>E3; NO _x >E3,E4
100% Biodiesel (rape)	--	~	+	=	=			PM>E3; NO _x >E3,E4
100% Biodiesel (tallow-expanded sys. boundary)	--	~	+	=	=		{CH ₄ }	PM>E3; NO _x >E3,E4
100% Biodiesel (tallow-eco.allocat.)	--	~	+	--	√		{upstream}	PM>E3; NO _x >E3,E4
100% Biodiesel (waste oil)	--	~	+	--	√			PM>E3; NO _x >E3,E4
100% Biodiesel (waste oil 10% original oil value)	--	~	+	--	√			PM>E3; NO _x >E3,E4
Canola	No data					XX		
² CNG (Electric compression)	--	--	--	--	√			
² CNG (NG compression)	--	--	--	--	√			
² LNG (from existing pipeline)	--	--	--	--	√			
² LNG (Shipped from north west shelf)	--	--	--	--	√			
² LNG (Road transport to Perth)	--	--	--	--	√			
² LPG (Autogas)	-	--	--	-	√			
² 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

⁴³ Australian Greenhouse Office, *Comparison of Transport Fuels, Stage 2 study of Life-cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles, Final Report*, p. 19.

PULP e85 (wheat WS)	--	+	++	++	X			THC>E3,E4
PULP e85 (wood waste)	--	=	-	++	X			THC>E3,E4
PULP e85 (ethylene)	++	=	++	++	X		Fossil-fuel based	THC>E3,E4

GHG: greenhouse gases; PM: particulate matter; NO_x oxides of nitrogen; V&F: viability and functionality; ESD: ecologically sustainable development; E3: Euro 3; E4: Euro 4 Standard.

CNG: Compressed Natural Gas; LNG: Liquid Natural Gas; LS: low sulphur;; PULP: Premium Unleaded Petrol; ULS: Ultra-Low Sulfur Diesel.

Symbols: --, significantly lower (than the reference fuel); -, lower; ~, slightly lower; =, much the same; +, higher; and ++, significantly higher. Health effects are based on the rankings for toxics and PM. √ indicates improvement (compared with reference fuel); X, worse. The symbol XX indicates very poor.

Significantly lower/higher means two standard deviations difference; higher/lower means more than one standard deviation difference.

¹ Due to limited air toxics data THC was used as a proxy. Thus these results are only a rough guide.

² CNG, LNG, and LPG results apply only to OEM dedicated gas vehicles.

Appendix 2

Natural Gas Technologies





NANOBOX

New opportunities for CNG

NANOBOX is Galileo's new Plug-and-Play CNG compressor package, specifically designed for NGV fleets and medium sized CNG filling stations. This equipment provides a convenient and attractive solution for the needs of this market. The package integrates compression, storage and CNG dispensers in a single unit.

Available technology offers CNG-filling equipment, sized for very small fleets, or for large-capacity Service-stations. But there was no truly effective, economical solution specific to the needs of medium sized fleets, nor for CNG filling-stations in areas of limited demand.

GNC Galileo's studied all aspects of this sector's problems. NANOBOX is the answer to these requirements. Like all products of GNC Galileo, NANOBOX is an integral solution. Applying original innovations an efficient, fast refill is achieved with a compact unit of low cost of installation and operation.

Advantages of Nanobox:

- High return on investment.
- Fast, easy and low cost installation.
- Minimum space requirement.
- Fast Refill and refills turnaround.
- Simple, low cost preventive maintenance.
- Safe and reliable operation.
- Simple to operate and control.
- Refill of 30 to 250 vehicles per day.
- Register and internet transmission of Commercial, technical and audit data.

Unit Applications for Domestic systems > 100 Nm ³ /day	Public Stations or Big Fleets 3000-15.000 Nm ³ /day	Stations for less than 15.000 or more Nm ³ /day
100 - 3000 Nm ³ /day	3000 - 15.000 Nm ³ /day	15.000 or more Nm ³ /day

NANOBOX contains all the components necessary to compress natural gas, refuel NGV vehicles safely, efficiently, reliably and report all data anywhere.

Principal components of Nanobox:

- 2 to 3-stage compressor oil free: to cover a wide range of inlet pressure.
- 3/4 bar cascade storage.
- 2 High-Flow filling nozzles for fast-refill.
- Double Mass measurement system for each filling port.
- Electronic self starter.
- Automatic pressure unloaders.
- Intertube air coolers.
- Fire and explosion protection proof cabin.
- Computerized control and management.
- Automatic vehicle identification and administration of individual and total fleet consumption.
- Internet Web Server incorporated for distant data access.

Simple Installation.

Nanobox has no special installation requirements. A simple base-plate gives sufficient support. Because of the low power required and incorporated electric panel, no special electrical installation, nor power transformer, nor external panels are required.

Fast fill equal to that of large refueling stations

Nanobox regulates the refueling process with an intelligent system that permits flow-rates and ease of refill equal to that of large CNG filling stations. A daily volume of up to 3000 Nm³/day is attainable. The most advanced features of GNC Galileo's line of dispensers are incorporated in our Nanobox package. Maximum flow-rates of 20 Nm³/minute are achieved, allowing for a normal vehicle refill in as little as 2 to 3 minutes.

Connect to any gas line

Nanobox is supplied in different versions, according to the available natural gas line pressure. The wide range inlet pressures covered is from 0.02 mbar to 60 bars. The connection to high-pressure gas-lines requires no special installations. Naturally, like any other compressor, the higher the inlet pressure, the higher the refilling capacity.

Fleet Management

For the administration and control of CNG consumption, the owner, by operator or service-operator may require diverse control reports, including data on individual vehicles by date and report period.

NANOBOX is equipped with an exclusive system which automatically reads individual vehicle TAGS and registers occasion and amount of refill. The data is stored for later read via internet connection. The TAG also permits restricting refueling to previously authorized vehicles. The CPU may be programmed for three types of refueling:

- Free refueling: Refill of all vehicles. The individual records kept.
- Identified Refill: Refill of all vehicles. Individual records kept for tagged vehicles.
- Restricted Refill: Refill limited only to previously internet authorized, tagged vehicles. Individual vehicle records kept, reports and statistics produced.

Internet ready

Nanobox electronics incorporate an exclusive internet server, which permits visualization of all kinds of commercial and technical information, from any location, anywhere.

- Refueling volume and rates.
 - Fleet Management data.
 - Readout of performance and operative data of the unit.
 - Maintenance reports, records of preventive maintenance completion.
 - Fault detection and alarms.
 - Access to programs and restrictions guiding all aspects of the nanobox.
- The access and visualization of this information can be subject to pre hierarchical levels of authorization.

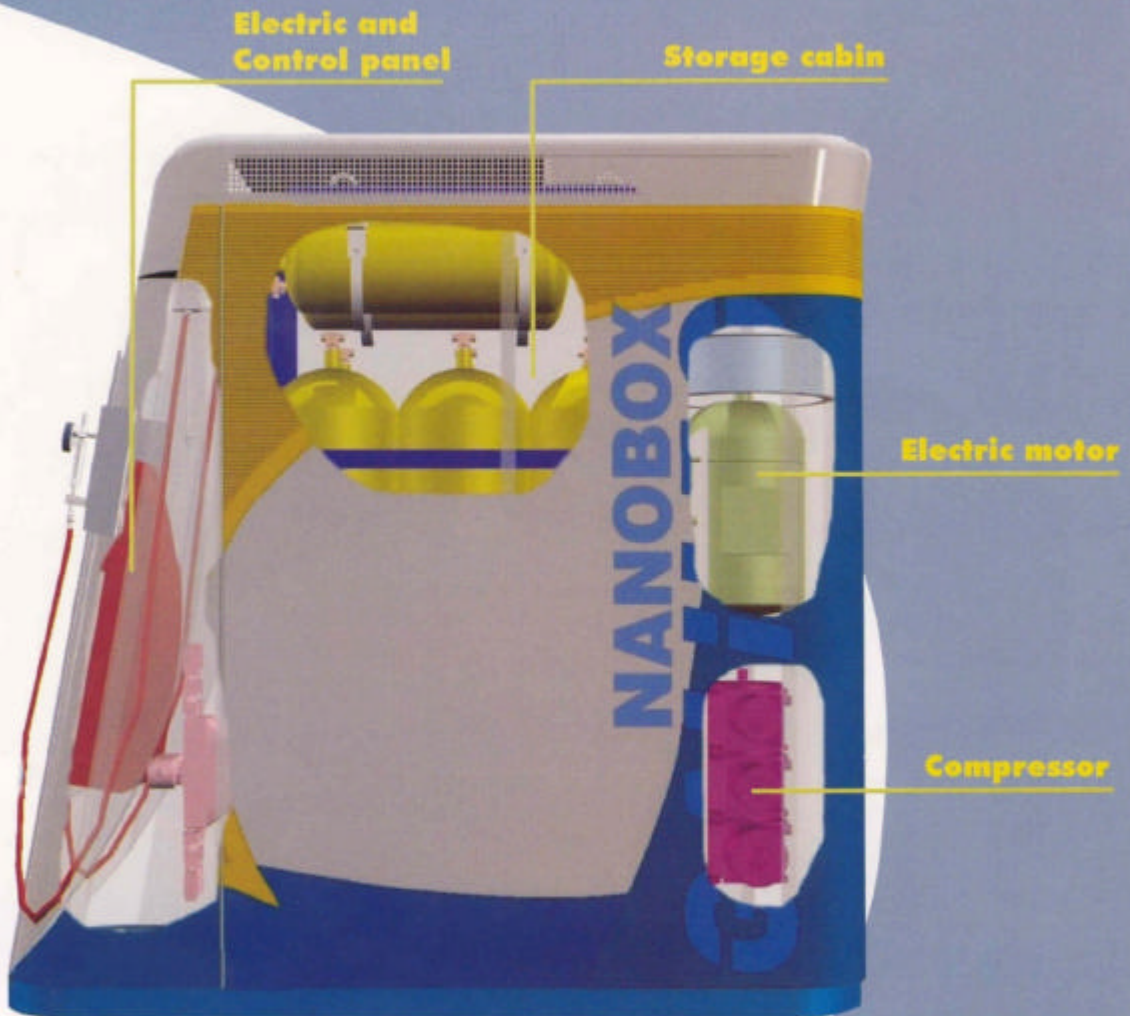
Telemaintenance

The CPU and its communications programs allow maintenance personnel to control the read-out of operating parameters on a hand-held screen, while the unit operates. Utilizing internet with the Bluetooth wireless protocol, the data can be read anywhere. Also, compliance with preventive Maintenance schedules can be checked, previous maintenance records received, and new reports filed. Assured maintenance for minimum down-time can thus be achieved.

All information about the equipment is accessible via internet, facilitating an on-site program of operation, performance and maintenance of the unit.



One solution
for all your **CNG**
needs





Nanobox Data sheet

Capacity

Peak Flow Capacity	20 Nm ³ /min
Hourly Flow Capacity	300 Nm ³ /hour
Maximum daily refilling capacity	3000 Nm ³ /day

External Dimensions

Length	2360 mm
Width	870 mm
Height	2040 mm
Total Weight	2090 Kg

Compressor

Manufacturer	Galileo
Compressor Type	Oil Free, without connecting rods.
Stages	2, 3, 4 or 5 stages, Depending of inlet pressure
Installed Power	22 Kw
Operating speed	1500/1800 RPM
Starter system	Unloaders in all stages
Cooling system	Air Cooler autooperated
Mechanical lubrication	Autolubrication with internal Oil pump
Compressor Valves	Hoerbiger head valves
Inlet Pressure	0.020 to 60 bars
Maximum Working Pressure	250 bar

Driver

Driver	Electric motor
Power	22 kW
Load Speed	1500 / 1800 RPM
Frequency	50 / 60 Hz
Voltage	380 / 440 V
Starter	Intelligent softstart system
Coupling	Direct Coupling

Gas Storage

Storage Volume	840 w liters
Usefull Storage Capacity	150 Nm ³
Operating pressure	250 bars
Loading Technology	3 to 4 Bank Cascade System

Dispenser

Hoses	1 or 2 high flow hoses
Peak refilling capacity	20 Nm ³ /hr
Refilling method	3 to 4 Bank Cascade System
Valves system	Galileo rotanting valves
Refilling nozzle	NGV 1 / Plug
Refilling hoses	3/8 ID-3.5 m long CNG Hose
Vehicle identification	Incorporated RF system

Control Unit

CPU	25.8 Mhz
Memory	8 Mb SRAM
Back up batery	yes
Display	5.6 Inch graphic display
Resolution	320 x 240 Blue/white 1/4 VGA
Input technology	High Sensitivity Touch Screen

Data Transmission

Wireless Technology	Blue Tooth
Standard Network Port	Ethernet
Internet Server	Graphic internet server , Nestcape/Explorer 6.0 compatible

Control Sensors Controlled

Pressure Transducers for :	Inlet Pressure 1st Outlet pressure 2nd Outlet pressure 3rd Outlet pressure 4th Outlet pressure 5th Outlet pressure Pressure of Cascade banks Refilling pressure
Temperature Transducers	Oil/ Frame Temperature
Level control	Oil level
Driver Control	Current Active Power Reactive Power Cos Fi
Refilling controls	Flow Volume Temperature Density

Electric Aprovals (Compliance with



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 E- mail: info@galileoar.com - www.galileoar.com

Invitations to make submissions

Appendix 3

Title	JobTitle	Unit	Company	Address1	Address2	Name
Mr David Bean	Managing Director		Short Haul Transport Pty Ltd	19 Mornington Road	MORNINGTON 7018	Mr Bean
Mr Leslie Wicks	Workshop Supervisor		Jackmans Garage Pty Ltd	94 Gormanston Road	MOONAH 7009	Mr Wicks
Mr Tony Sim	Engineering Ops Manager		Metro Tasmania Pty Ltd	PO Box 61	MOONAH 7009	Mr Sim
Mr Jim Burden	Business Operations Manager		Total Workforce	PO Box 396	LAUNCESTON 7250	Mr Burden
Mr Fred McDermott	Manager Business Services		Hydro Tasmania	GPO Box 355	HOBART 7001	Mr McDermott
Mr Malcolm Little	General Manager		Tasmanian Automobile Chamber of Commerce	PO Box 25	MOONAH 7009	Mr Little
Mr Craig Jeffery	Director	Procurement & Property Branch & Budget & Finance Division	Department of Treasury and Finance	GPO Box 1374	HOBART 7001	Mr Jeffery
Mr Roger Gillow	State Sales Manager	Commonwealth Fleet Lease Pty Ltd	Level 2	81 Elizabeth Street	HOBART 7000	Mr Gillow
Mr Greg Fannon	Group Manager		Hobart City Council	GPO Box 503	HOBART 7000	Mr Fannon
Mr Bob Hughes	The Manager		Yeoman and Hughes Autos	102 Wenvoe Street	DEVONPORT 7310	Mr Hughes
Mr Bob Mulcahy	Executive Director		Tasmanian Transport and Distribution Industry Training Board Inc	PO Box 88	KINGSTON 7051	Mr Mulchay
Mr Les Axelsen			AutoFix Services Tasmania	26 Goodford Lane	ORIELTON 7172	Mr Axelsen
Mr Matthew Atkins	Technical Services Co-ordinator		Burnie City Council	PO Box 973	BURNIE 7320	Mr Atkins
Mr Alistair Graham	Cool Communities Facilitator		Tasmanian Environment Centre	102 Bathurst Street	HOBART 7000	Mr Graham
Mr Greg Cooper	Energy Management Services Engineer		SEMF Holdings	45 Murray Street	HOBART 7000	Mr Cooper
Mr Shane Buchwald	Proprietor		Mobil East Devonport	219 Tarleton Street	EAST DEVONPORT 7310	Mr Buchwald
Mr Gary Swain	Manager - Commercial Development	Duke Energy	Level 8	85 Macquarie Street	HOBART 7000	Mr Swain
Mr Gary Woodhead	Managing Director		Compair (Australasia) Limited	PO Box 126	MOUNT WAVERLEY VIC 3149	Mr Woodhead
Mr Larry Mills	Southern Freight Manager		Redline Coaches	199 Collins Street	HOBART 7000	Mr Mills
Mr David Hazell	Plant Services Manager		Hazell Bros	PO Box 430	MOONAH 7009	Mr Hazell

Mr John Brennon	Manager - Environment & Compliance		Collex Pty Ltd	75 Mornington Road	MORNINGTON 7018	Mr Brennon
Ms Virginia Tuneritsch	Manager		City Cabs	215 Harrington Street	HOBART 7000	Ms Tuneritsch
Mr John White	Consultant			18 Clarke Avenue	BATTERY POINT 7004	Mr White
Mr Peter Lynd	Facilities Work Manager		Devonport City Council	PO Box 604	DEVONPORT 7310	Mr Lynd
Mr Darren Triffitt	Manager		Autogas and Automotive	Willis Street	LAUNCESTON 7250	Mr Triffitt
Mr Lyndon O'Neil	Manager		O'Neils Automotive Services	46B Queen Street	ULVERSTONE WEST 7315	Mr O'Neil
Mr Ken Vance	Director		Ken Vance Motors Pty Ltd	3 Cambridge Road	BELLERIVE 7018	Mr Vance
Mr Toby Green	President		Taxi Industry Association of Tasmania Limited	PO Box 247	SANDY BAY 7006	Mr Green
Mr Tim Bannerman	Director		Taxi Combined Services Pty Ltd	56 King Street	SANDY BAY 7005	Mr Bannerman
Mr Will Turvey	Manager		Coventry Mechanical Services	435 Main Road	GLENORCHY 7010	Mr Turvey
Mr Michael Doran	Project Officer		Department of Police and Public Safety	43 Liverpool Street	HOBART 7000	Mr Doran
Mr Chris McEvoy	Plant Manager		Civil Construction Corporation	3 Whitestone Drive	AUSTINS FERRY 7011	Mr McEvoy
Mr Malcolm Lazenby	Group Training		The Royal Automobile Club of Tasmania	GPO Box 1292	HOBART 7001	Mr Lazenby
Mr Kim Creak	General Manager Ops		Forestry Tasmania	PO Box 207	HOBART 7001	Mr Creak
Mr David Harries	Assistant Director	Office of Energy Planning and Conservation	Department of Infrastructure, Energy and Resources	GPO Box 936	HOBART 7001	Mr Harries
Mr John Issac	Senior Executive Officer	Scientific and Technical Environment	Department of Primary Industries, Water and Environment	GPO Box 44	HOBART 7001	Mr Issac
Ms Anne Wessing	Project Officer – Landcare	Tas Ed Leaders Institute	Department of Education	PO Box 919	HOBART 7001	Ms Wessing
Ms Debra Hill	Assistant General Manager	Manufacturing & Services – Investment Trade & Development	Department of State Development	GPO Box 646	HOBART 7001	Ms Hill

Mr Geoff Davis	Team Leader	Automotive and Electrical – South	TAFE Tasmania	GPO Box 1625	HOBART 7001	Mr Davis
Mr Roger Burdon	Proprietor		Burdon Taxis	66B Charles Street	MOONAH 7009	Mr Burdon
Mr Merv Howearth	Proprietor		M G & S J Taxi Management	6 Stratton Avenue	LENAH VALLEY 7008	Mr Howearth
Mr Robin Saward	Proprietor of Taxi Fleet		C/o City Cabs	215 Harrington Street	HOBART 7000	Mr Saward
Mr Michael Cripps	Proprietor of Taxi Fleet			4 Tullock Court	LINDISFARNE 7015	Mr Cripps
Mr Wayne Butler	Proprietor of Taxi Fleet			13 MacRobinson Terrace	CLAREMONT 7011	Mr Butler
Mr David Sajden	Proprietor of Taxi Fleet			30 Vermot Court	BERRIEDALE 7011	Mr Sajden
Mr Guy Sullivan	Proprietor of Taxi Fleet			119 Montrose Road	GLENORCHY 7010	Mr Sullivan
Mr Michael Kent	General Manager		Purity Plus Petrol	20 Lampton Avenue	DERWENT PARK 7009	Mr Kent
Mr Anton Mazar	The Manager		Air Liquidite Australia Limited	11 Windsor Street	LAUNCESTON 7250	Mr Mazar
Mr John Buis	Director of Applied Gases		BOC Gases	PO Box 288	CHATSWOOD 2057	Mr Buis
Mr Toby Meredith	The Manager		Chelsea Gas Co Pty Ltd	PO Box 698	MOONAH 7009	Mr Meredith
Mr Rodney Bean	Gas Manager		Mobil Gas	PO Box 437	DEVONPORT 7310	Mr Bean
Mr Malcolm McGregor	The Manager		Origin Energy Limited	PO Box 36	NEW TOWN 7008	Mr McGregor
Mr Justin Bock	Business Development Manager		Vitalgas	GPO 4281	SYDNEY 2001	Mr Bock
Ms Anne-Maree O'Kane	LPG Manager		BP Australia Ltd	GPO Box 5222BB	MELBOURNE 3001	Ms O'Kane
Mr Geoff Campbell	Terminal Manager		Caltex Australia Ltd	PO Box 177	MOONAH 7009	Mr Campbell
Mr Lewis Molnar	Acting General Manager		Shell Australia Ltd	PO Box 13	MOONAH 7009	Mr Molnar
Mr Norm McIlstrick	Chief Executive Officer		Aurora	GPO Box 191	HOBART 7001	Mr McIlstrick
Mr Les Doran			Wyre Forest Automotive	49 Wyre Forest Road	MOLESWORTH 7140	Mr Doran
Mr John Biggelaar			GJ Autogas Supplies	44 New Ecclestone Road	RIVERSIDE 7250	Mr Biggelaar
Mr Darren Cowen	Service Manager		JMC Automotive Group	Cnr Lower Charles & William Streets	LAUNCESTON 7250	Mr Cowen
Mr Johnny Emmanuele	Director		Norgas	Cnr Port Wakefield & Waterloo Corner Roads	BURTON 5110	Mr Emmanuele
Mr Anthony Middleton	Managing Director		Advanced Engine Components	PO Box 382	MT HAWTHORN 6016	Mr Middleton

Written submissions taken into evidence

Appendix 4

Advanced Engine Components Limited

Advanced Fuels Technology Pty Ltd

ANGVC & AGA

BP Australia Limited

Burnie City Council

Clean Air Refuelling Pty Ltd

Collex Pty Ltd

CompAir (Australasia) Ltd

Duke Energy International

Ken Vance Motors Pty Ltd

Launceston City Council

NGV Solutions Pty Ltd

Norgas

O'Neil's Automotive Services

Origin Energy

Tasmanian Government Agencies

Documents taken into Evidence

Appendix 5

Advanced Fuels Technology Pty Ltd Report

Article in Australasian Bus and Coach, "California pushes gas for buses", dated 9 November 2001

Australia's Third National Communication on Climate Change 2002 – Australian Greenhouse Office

Australian Greenhouse Office – Comparison of Transport Fuels (Index and Executive Summary)

Brisbane City – The Brisbane Air Quality Strategy – Draft October 2001

Brisbane City – The Sustainable Energy and Greenhouse Action Plan – November 2001

City of Liverpool – brochures

Citywide brochures

Comparison of Transport Fuels CD – Australian Greenhouse Office

Compressed Natural Gas for Vehicles In Tasmania Report, October 2002, Centre for Research, Industry and Strategic Planning, Department of Economic Development

CSIRO Internet Site details

Dynetek Industries Ltd brochures

International Trucks Iveco – Purpose built for Waste Collection and Recycling ACCO G Series

Isuzu Trucks brochures

Liverpool City Council – powerpoint presentation to Committee

Liverpool City Council Natural Gas Vehicle Project

NGV Solutions – Photos of filling stations (portable)

Notes of recent conversations – Doug Parkinson MLC

NSW State Transit Authority – Annual Report 1999/2000

NSW State Transit Authority – CNG Buses – A Success Story?

NSW State Transit Authority – Corporate Plan 2000/2001

NSW State Transit Authority – Wheels and Keels

Papers from the Biofuels 2002 Conference – 31st October and 1st November 2002 – Hilton Brisbane, Queensland

Reduction of emissions from commercial vehicles illustrated with reference to European emission limits

Reduction of emissions from commercial vehicles illustrated with reference to European emission limits (Part 2, only ETC – Values)

Report for the Joint Standing Committee on Environment, Resources and Development by CRISP – Presentation Overheads

Scania brochures

Supplementary Submission to the Joint Parliamentary Committee on Environment, Resources and Development – NGV

The Australian Greenhouse Office's Alternative Fuels Programs

Understanding Greenhouse Science – Australian Greenhouse Office

Waverley Council – Compressed Natural Gas powered Trucks for local Government and Short-Haul use – Executive Summary

Waverley Council – Compressed Natural Gas Powered Trucks for local Government and Short-Haul Use – Full Report July 1998

Waverley Council – Photos of truck and filling station

Interstate Visits

Appendix 6

- Advanced Fuels Technologies
- Scania Australia Pty Ltd
- Isuzu-General Motors Australia Limited
- Cummins and IVECO Trucks Australia Limited
- CompAir (Australasia) Limited and ANGVC
- Citywide
- Australian Greenhouse Office
- Cynergy Pty Ltd
- NSW Transit Authority
- NGV Solutions and Liverpool Council
- Waverley Council
- Brisbane City Council