REGULATION IMPACT STATEMENT

New Australian Design Rules for Control of Vehicle Emissions

December 1999

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ABBREVIATIONS

AANEPM	Ambient Air National Environment Protection Measure
ADR	Australian Design Rule
AIP	Australian Institute of Petroleum
APEC	Asia Pacific Economic Cooperation
CO	Carbon Monoxide
ECE	Economic Commission for Europe
EEC	European Economic Commission
EU	European Union
Euro 1	Version of the UNECE standards which applied from 1992 in the European Union
Euro 2	Version of the UNECE standards which applied from 1996 in the European Union
Euro 3	Version of the UNECE standards which will apply from 2000 in the European Union
Euro 4	Version of the UNECE standards which will apply from 2005 in the European Union
FCAI	Federal Chamber of Automotive Industries
FORS	Federal Office of Road Safety
FTP	Federal Test Procedure
LCV	Light Commercial Vehicle
LPG	Liquefied Petroleum Gas
MOU	Memorandum of Understanding
MVEC	Motor Vehicle Environment Committee
NEPC	National Environment Protection Council
NMHVC	Non methane hydrocarbons
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NRTC	National Road Transport Commission
NSW EPA	New South Wales Environment Protection Authority
NG	Natural Gas
O_3	Ozone
PM	Particulates
PM_{10}	Particulate matter with a diameter of less than 10 μm
PULP	Premium unleaded petrol
RON	Research Octane Number
TELG	Transport Emissions Liaison Group
Tier 1	Current USEPA Tier1 light duty vehicle emission standards
TTMRA	Trans Tasman Mutual Recognition Arrangement
ULP	Unleaded Petrol
UN ECE	United Nations Economic Commission for Europe
US EPA	United States Environment Protection Agency
US94	US heavy duty emission standards introduced in 1994
US98	US heavy duty emission standards introduced in 1998

PREFACE

This Regulation Impact Statement is presented in two parts.

Part A is an analysis of new vehicle emission and fuel standards outlined in the *Measures for a Better Environment* section of the Commonwealth Government’s Tax Package Agreement announced by the Prime Minister of Australia on 28 May 1999.

PART B is an analysis of work undertaken by the National Motor Vehicle Environment Committee on the review of Australia’s motor vehicle emissions standards. The detailed analysis in PART B was undertaken prior to the Prime Minister's announcement of the Tax Package Agreement.

PART A

COMMONWEALTH GOVERNMENT'S PACKAGE ON NEW VEHICLE STANDARDS AND FUEL

PART A COMMONWEALTH GOVERNMENT'S NEW VEHICLE STANDARDS AND FUEL PACKAGE

1. INTRODUCTION

The Prime Minister announced details of amendments to "A New Tax System" on 28 May 1999, including a range of environmental proposals under the heading *'Measures for a Better Environment*'. There are three main elements of this Package which deal with new vehicle standards and transport fuel quality, *viz*:

- Staged introduction of *Euro 2* and *Euro 3* standards for petrol vehicles;
- Staged introduction of *Euro 2, Euro 3* and *Euro 4* standards for diesel vehicles; and
- The introduction of a clean diesel policy which will provide a mix of incentives and legislation to ensure that ultra low sulfur diesel is available within the timeframe for the proposed new vehicle standards.

Note: for the remainder of this PART A, the above package is referred to as the "Commonwealth Package".

2. STATEMENT OF THE PROBLEM

Motor vehicle pollution in Australia is an ongoing problem particularly in our densely urbanised cities. Vehicles are estimated to contribute up to 70% of total urban air pollution (NSW EPA, 1999). Emissions from vehicles therefore have significant effects on the quality of life for urban residents, particularly those susceptible to air pollution. High levels of air pollutants have been shown to result in a wide range of adverse health and visual impacts on society. Increasing levels of pollution can have significant environmental and economic consequences. Health effects associated with air pollution include respiratory effects, ranging in severity from coughs, chest congestion, asthma, to chronic illness and possible premature death in susceptible people. Other effects of air pollutants include damage to vegetation, buildings and materials, and reduction in visibility.

Reducing the contribution of motor vehicle emissions to air pollution is expected to have a positive impact on human health and the environment

3. OBJECTIVES

The objective of this vehicle standards package, and its diesel fuel elements, is to reduce the adverse effects of motor vehicle emissions on urban air quality and human health. The Commonwealth Government also has an objective, outlined in the Prime Minister's Statement, *Safeguarding the Future* (Prime Minister, 1997), to harmonise Australia's vehicle emission standards with international standards by 2006. A more detailed examination of the rationale for tighter vehicle standards and better fuel quality is contained in PART B. The new Commonwealth Package is consistent with this objective, and permits the acceleration of its achievement (compared to Option 2B (Modified) specified in section 7.3 of PART B). By 2006, Australian new diesel vehicle emission

Standards will be harmonised with the *Euro 4* standard and new petrol vehicles will be harmonised with the *Euro 3* standard. As the *Euro 4* standard will apply in Europe for all vehicles in 2005, Australia will be fully aligned with the diesel standards and be one step behind with petrol standards.

4. DESCRIPTION OF COMMONWEALTH PACKAGE

The Commonwealth Package involves the adoption of:

Diesel Vehicles[1],
- *Euro 2* in 2002/03 for all new diesel vehicles;
- *Euro 3* in 2002/03 for all new medium and heavy duty diesel vehicles;
- *Euro 4* in 2006/07 for all new diesel vehicles;

Petrol Vehicles[1]
- *Euro 2* in 2003/04 for all new petrol vehicles; and
- *Euro 3* in 2005/06 for all new petrol vehicles.

Table 1 highlights the key emissions differences of the *Euro 2*, *Euro 3* and *Euro 4* standards for passenger cars.

Table 1 Comparison of Passenger Car (Petrol) Emission Standards

Current & Future Standards	Date of Implementation	Limits on Emissions			
		CO (*g/km*)	HC [exhaust] (*g/km*)	NOx (*g/km*)	HC [evaporative] (*g/test*)
ADR37/01 (1)	1997-9	2.1	0.26	0.63	2
UN ECE					
Euro 2 (2)	1996	2.2	(Combined HC and NOx) 0.5		2
Euro 3 (2)	2000	2.3	0.2	0.15	2
Euro 4 (4)	2005	(3) 1.0	0.1	0.08	2

(1) The Australian standard (ADR37/01) requires the emission limits to be met for a period of 5yrs/80,000km and the test method is the same as that used in the US standard.
(2) The *Euro 2* and *Euro 3* standards require the emission limits to be met for a period of 5yrs/80,000km
(3) CO Limit for *Euro 3* is nominally higher, but *Euro 2* test excludes the first forty seconds of testing from sampling, thus making the CO limit much harder to meet
(4) The *Euro 4* standards require the emission limits to be met for a period of 5yrs/100,000km

In addition to the tighter emission limits, the *Euro 3* test, which omits the 40 second "no sampling" period at the beginning of the *Euro 2* test cycle, is a more demanding test for CO and HC emissions. *Euro 3* also has a much more stringent evaporative emissions test, compared to *Euro 2*. The *Euro 4* test is as stringent as the *Euro 3* test.

[1] The year terminology of 200X/0Y refers to the application of the new standards to new models in 200X, and the application to all models produced on or after 200Y.

Table 2 highlights the key emissions differences of the *Euro 2*, *Euro 3* and *Euro 4* standards for diesel vehicles greater than 3.5 tonnes GVM.

Table 2 Comparison of 'Heavy Duty' (Diesel) Vehicle Emission Standards

Current and Future Standard	Date of Implementation	Limits on Emission Limits (g/kWh)			
		CO	HC	NOx	PM
ADR70/00	1979	4.5	1.1	8.0	0.36
Euro 2	1996-1998	4.0	1.1	7.0	0.15 (1)
Euro 3	2000				
ESC Limit		2.1	0.66	5.0	0.10 (3)
ETC Limit		5.45	0.78 (2)	5.0	0.16 (4)
Euro 4	2005				
ESC Limit		1.5	0.46	3.5	0.02
ETC Limit		4.0	0.55(2)	3.5	0.03

(1) Original *Euro 2* limit for PM was 0.25, which was reduced to 0.15 in 1998.
(2) Non-methane hydrocarbons
(3) Smaller engines are subject to more relaxed PM limits of 0.13 (ESC)
(4) Smaller engines are subject to more relaxed PM limits of 0.21 (ETC).

The earlier introduction of tighter diesel vehicle standards is facilitated by the acceleration of the availability of low (500ppm) and ultra low (50ppm) sulfur diesel fuel announced in the Commonwealth Package. This includes:

- Voluntary introduction of 500ppm sulfur diesel in urban areas in 2000;
- 500ppm sulfur diesel as minimum standard for road transport fuel from end 2002;
- Differential pricing from 2003 and 2004 to support early introduction of 50ppm sulfur diesel; and
- Mandatory fuel standard of 50ppm sulfur diesel in 2006.

5. IMPACT ANALYSIS

5.1 Impact on Affected Parties

Vehicle manufacturers, and the road transport and bus industries, are supportive of the adoption of tighter emission standards, provided that suitable fuel is available, and they are phased in over a reasonable time. Vehicle manufacturers have requested a minimum of 2 years notice from gazettal to comply, which would allow introduction from 2002.

The *Euro 2* and *Euro 3* vehicle elements of this Package are similar, with some variation in the timing of adoption, to Option 2B (Modified) recommended in PART B. The significant differences being the acceleration of *Euro 3* for medium duty vehicles, and the adoption of *Euro 4* standards for all diesel vehicles. As such, whilst the magnitude of the impacts are likely to be greater for the industries which supply and use diesel vehicles, the nature of the impacts on key stakeholders will be similar to that outlined in Section 5.1 of PART B.

In relation to diesel vehicles, there are no local manufacturing implications, as these engines are not produced in Australia. All diesel engines/vehicles are imported from Japan, USA and Europe. Consistent with the argument in Section 4.2.1 in Part B, it is appropriate to accept the US heavy duty standards as alternatives to the UN ECE standards. In addition, as there are no emission standards in the UN ECE for heavy duty petrol engines, it is proposed to fill this gap by adopting the US emissions standards for heavy duty engines. It should be noted that there are very few of these vehicles in the Australian fleet. Parent companies are currently working towards *Euro 4* or *US 04* compliance, with *Euro 4* applying in Europe from 2005, and *US 04* being brought forward to late 2002 in the US. Companies that produce engines that comply with *Euro 4* will be able to supply these engines to a range of international markets (which are increasingly adopting ECE standards), as well as the Australian market. The one year lag from European adoption of *Euro 4* in 2005 reflects the practicality of introducing vehicle support and maintenance infrastructure.

In relation to harmonisation of petrol vehicles with *Euro 4* in 2006, there are significant local manufacturing implications, with 30% of passenger vehicles produced in Australia. It is internationally recognised that the technological demands on manufacturers in achieving compliance with Euro 4 will be very demanding. In many cases the likely technological solutions are still in the experimental stage. For these reasons it is unlikely that the local vehicle industry will be able to develop or adopt appropriate technological solutions into local vehicle production within a year of adopting Euro 4 in Europe (2005).

The Federal Chamber of Automotive Industries supports the adoption of tighter emission standards in the period 2002 to 2007. However, it proposes longer lead times for *Euro 2* and *Euro 3,* and a further evaluation of the costs and benefits of *Euro 4* before a decision is made as to its implementation. The Australian Bus and Coach Association, the Australian Trucking Association, and Transport Agencies have supported the Commonwealth Package.

The Commonwealth Package will require a major financial commitment from the Australian petroleum industry, and the AIP has not publicly responded to the Package. However some refineries (BP and Caltex) have indicated that they will be voluntarily providing 500ppm sulfur diesel in urban markets within the next few years. BP has also made a public commitment to provide 50ppm sulfur diesel, provided there are appropriate incentives.

5.2 Impact on Emissions

The Tables at Attachment A summarise the key features and emission limits of the current emission ADRs compared with *Euro 2*, *Euro 3* and *Euro 4* standards. The most significant reductions in the introduction of *Euro 3* and *Euro 4* standards are in the PM and NOx limits, and tighter evaporative HC standards for petrol vehicles. The percentage reductions for petrol vehicles are outlined in the table below.

Table 3 Percentage Reductions in Diesel Vehicle Emission Limits (rounded to the nearest 5%)

Standards	Cars % reduction		4WDs and Light Commercial Vehicles % reduction		Heavy Duty Vehicles % reduction	
	NOx	**PM**	**NOx**	**PM**	**NOx**	**PM**
From Euro 2 (1) to Euro 3	30	40	30-35 (2)	40	30	35
From Euro 3 to Euro 4	50	50	50	50	30	80

(1) For *Euro 2* standards there is a combined regulated limit for HC+NOx, EU assume a ratio of 55:45 (HC:NOx)
(2) Range reflects differing reductions depending on the mass of the vehicle

These vehicle emission reductions will provide a significant contribution to the achievement of the Ambient Air Quality National Environment Protection Measure standards in urban areas. The significant reductions in the sulfur content of diesel fuel will enhance the reductions in total particulate emissions, and will lead to emissions reductions from the total fleet, not just the vehicles meeting the new standards.

5.3 Costs and Benefits

The main costs associated with introducing the new standards relate to incorporating advanced technology and hardware in new vehicles, demonstrating compliance with the new standards and reformulation of existing fuels to meet the demands of the new technologies.

For the *Euro 2* and *Euro 3* elements of the Package, the costs and benefits over 20 years are comparable to those estimated for Option 2B (Modified) recommended in PART B. Option 2B (Modified) is estimated to provide a net benefit of over $800million (see section 5.5.2 of PART B). The main differences are the variation in timing of the introduction of *Euro 2* and *Euro 3* for petrol vehicles and the application of *Euro 3* for medium diesel vehicles in 2002 rather than 2006. It is expected that over a 20 year period, the total costs of the new standards and the low sulfur content diesel fuel, would be higher than the $1,957 million for Option 2B (Modified) in PART B, and total quantified benefits would be higher than the $2,762 for Option 2B (Modified) in PART B.

As can be seen from Table 2, *Euro 4* delivers significant reductions in NOx and PM emissions over *Euro 3*. The introduction of low sulfur diesel fuel standards will not only enable new vehicles to meet the new emission limits, but will also have a significant impact on emissions across the whole vehicle fleet. It is reasonable to conclude that the significant reductions in NOx and PM emissions from *Euro 4* and the associated fuel changes would lead to a significant reduction in health costs, as NOx and PM are the major vehicle related factors contributing to adverse health effects.

At this stage there is insufficient information available on the costs associated with the introduction of *Euro 4* standards for diesel vehicles in 2006/07 and the introduction of ultra low (50ppm) sulfur diesel, which would enable an estimate of the net benefits (ie benefits less costs) to be made. Nevertheless, in recognising the significant reductions in PM emissions which will result from the introduction of *Euro 4* emission standards for diesel vehicles, and from the introduction of ultra low sulfur diesel which will be used in all vehicles (new and in-service), it is expected that the Commonwealth Package would result in a net benefit greater than the $804 million estimated for Option 2B (Modified) recommended in PART B.

6. CONSULTATION

The Commonwealth Package was developed at the highest level of Government. The National Road Transport Commission has advised key stakeholders of the details of the Package, and as stated in Section 5.1, it is supported by the Australian Trucking Association, the Australian Bus and Coach Association and transport agencies. The Federal Chamber of Automotive Industries, whilst supporting the introduction of tighter emissions standards in the period 2003 to 2007, proposes longer lead times for *Euro 2* and *Euro 3* and a further evaluation of *Euro 4*, prior to a decision on its implementation.

7. CONCLUSION AND RECOMMENDED PACKAGE

7.1 Summary of Key Issues

The diesel vehicle elements of Option 2B (Modified) recommended in PART B were qualified because of concerns that low sulfur diesel would not be available in sufficient quantity to allow an earlier introduction date for tighter emission standards. Many medium diesel vehicles will be catalyst equipped to meet *Euro 3* and all diesel vehicles are predicted to need catalysts, or other after-treatment technology, for *Euro 4* standards. Fuel quality is more critical for these vehicles than for heavy duty vehicles which use electronic engine management systems, rather than catalysts, to achieve lower emission. The clean fuel policy outlined in the Commonwealth Package allows the introduction dates for diesel vehicles to be accelerated.
The principal difference between the vehicle emissions standards outlined in the Package and Option 2B (Modified) recommended in PART B of the RIS are as follows:

- *Euro 2* for petrol vehicles from 2003/04 rather than 2002/04;
- *Euro 3* for medium commercial vehicles (3.5 to 12 tonne) from 2002/03 rather than 2006/07;
- *Euro 3* for petrol vehicles from 2005/06 rather than 2006/07; and
- *Euro 4* for all diesel vehicles from 2006/07 (*Euro 4* was not included in the MVEC study).

A more detailed explanation of the differences between the Commonwealth Package and Option 2B (Modified) recommended in PART B are outlined in Attachment B.

This Package has significant benefits over Option 2B (Modified) analysed in PART B due to the acceleration of *Euro 3* and *Euro 4* standards for diesel vehicles, accompanied by the introduction of progressive and significant reductions in the sulfur content of diesel fuel. The increase in costs to meet *Euro 4* diesel standards and tighter diesel fuel standards, while not quantified at this stage, are expected to be offset by the health benefits, and produce a greater net benefit than that for Option 2B (Modified) recommended in PART B. A date has not been set for the adoption of *Euro 4* standards for petrol vehicles. As the adoption of Euro 4 for these vehicles will pose significant technological demand for local manufacturers, it is unlikely that Euro 4 compliant vehicles could be produced within a year of adoption of Euro 4 in Europe.

The Package[2] is supported for the following reasons:

- Early and staged implementation shows commitment to the Environmental Strategy for the Motor Vehicle Industry embodied in the Prime Minister's Statement on Climate Change *Safeguarding the Future;*
- The staged (*Euro 2* then *Euro 3*) approach for light petrol vehicles delivers significant emissions and health benefits, albeit at a lesser level than an early adoption of *Euro 3* across the board. However, attempting to apply *Euro 3* standards across the board in 2002/3 would cause severe disruption and high costs to the local vehicle manufacturing and service industry, many vehicle importers and the local fuel refining industry;
- Later adoption of *Euro 3* for petrol vehicles provides the vehicle industry sufficient lead time to meet the requirements of *Euro 3,* including the upgrading of emission test facilities necessary for local manufacturers, and the provision of a service network for the on-board diagnostic systems required in *Euro 3*;
- For petrol vehicle manufacturers, the Package is achievable at minimum cost, given the technology will be readily available and well proven by the time the standards are adopted in Australia (for the majority of vehicles, *Euro 2* and *Euro 3* would apply in Australia some 5-6 years after application in Europe);
- Early adoption of *Euro 2* for light diesel and *Euro 3* for medium and heavy duty diesel vehicles, followed by *Euro 4* four years later, will deliver significant reductions in NOx and PM emissions, which are two of the pollutants of most health concern;
- Allows latest US EPA heavy duty standards as alternatives, without compromising emission benefits;
- While the *Euro 4* standards will impose significant technological challenges, diesel buses and trucks (or at least their engines) are all imported, and the overseas suppliers will be working to deliver vehicles to this standard;
- Allows compliance with later versions of the nominated standards;
- Includes LPG and NG fuelled vehicles within the scope of the standards;
- The introduction of the clean diesel policy will ensure that low sulfur diesel is available within the timeframe for the new standards; and
- Later adoption of *Euro 3* and *Euro 4* will allow time for MVEC to review fuel requirements for petrol and other (non sulfur) aspects of diesel, in light of the Fuel Quality Review (due in 2000), so that the fuel can be delivered by 2005/6.

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2 Package includes complimentary elements of the Preferred Option in PART B, which were not addressed in the Commonwealth Package

7.2 Description of Recommended Package

Vehicle Emission Standards

Details of the new vehicle emission standards[3] are outlined in Table 4.

Fuel Requirements

The fuel elements of the Commonwealth Package are outlined below. From

2000

- Voluntary reduction of the sulfur content of diesel fuel to 500ppm in urban areas.

From end 2002

- Sulfur standard for road transport diesel set at 500ppm.

From 2005

- Changes to fuel parameters required for Euro 3, based on the outcomes of the Fuel Quality Review and discussions with stakeholders.

From 2006

- Sulfur standard for road transport diesel set at 50ppm.

[3] Table 4 includes the complimentary elements of the Preferred Option in PART B, which were not specifically addressed in the Commonwealth Package. These elements include smoke requirements, application of standards to alternative fuels (LPG and NG) and inclusion of US EPA standards as equivalents for heavy duty vehicles.

Table 4 Summary Table of New Australian Design Rules for Vehicle Emissions

ADR Categories			Equivalent ECE Category	Applicable New ADR (1),(2),(3),(4)	2002/3 (Diesel Vehicles) (5)	2003/4 (Petrol Vehicles)	2005/6 (Petrol Vehicles)	2006/7 (Diesel Vehicles)
Description	GVM (t)	Category						
Passenger Vehicles								
Cars	Not Applicable	MA	M1	Light Duty	*Euro 2*	*Euro 2 (6)*	*Euro 3 (6)*	*Euro 4*
Forward Control	Not Applicable	MB	M1	Light Duty	*Euro 2*	*Euro 2 (6)*	*Euro 3 (6)*	*Euro 4*
Off-road	Not Applicable	MC	M1	Light Duty	*Euro 2*	*Euro 2 (6)*	*Euro 3 (6)*	*Euro 4*
Buses								
Light	□□5	MD	M2 □□3.5	Light Duty	*Euro 2*	*Euro 2 (6)*	*Euro 3 (6)*	*Euro 4*
			> 3.5 □□5	Heavy Duty	*Euro 3 or US 98*	*US 96 (7)*	*US 98 (7)*	*Euro 4 (6)*
Heavy	> 5	ME	M3	Heavy Duty	*Euro 3 or US 98*	*US 96 (7)*	*US 98 (7)*	*Euro 4 or US 2004*
Goods Vehicles (Trucks)								
Light	□□3.5	NA	N1	Light Duty	*Euro 2*	*Euro 2 (6)*	*Euro 3 (6)*	*Euro 4*
Medium	> 3.5 □□12	NB	N2	Heavy Duty	*Euro 3 or US 98*	*US 96 (7)*	*US 98 (7)*	*Euro 4 or US 2004*
Heavy	> 12	NC	N3	Heavy Duty	*Euro 3 or US 98*	*US 96 (7)*	*US 98 (7)*	*Euro 4 or US 2004*

Notes (1) – (7) to Table are on the next page.

Notes to Table 4

(1) The introduction of *Euro 2* standards for light duty petrol and light duty diesel vehicles will be via a new ADR 79/00 *Emission Control for Light Vehicles*, which adopts the technical requirements of ECE R83/04.

(2) The introduction of *Euro 3* standards for light duty petrol vehicles, and *Euro 4* standards for light duty diesel vehicles, will be via a new ADR 79/01 *Emission Control for Light Vehicles*, which adopts the technical requirements of European Council Directive 98/69/EC. Directive 98/69/EC embodies the *Euro 3* and *Euro 4* requirements for light duty petrol and diesel vehicles, however the ADR will only mandate the *Euro 3* (pre 2005) provisions of 98/69/EC for petrol vehicles, but will allow petrol vehicles optional compliance with *Euro 4* standards.

(3) The introduction of *Euro 3* and *Euro 4* standards for medium-heavy duty diesel vehicles (all buses and trucks above 3.5tonnes GVM) will be via a new ADR 80/00 *Emission Control for Heavy Vehicles,* and ADR 80/01 *Emission Control for Heavy Vehicles,* respectively. These ADRs adopt the technical requirements of the proposed European Council Directive [Common Position (EC) No 35/1999 of 22 April 1999] amending European Council Directive 88/77/EEC, which was endorsed by the European Parliament on 16 November 1999.

(4) These new ADRs (ADRs79/00, 79/01, 80/00, 80/01) will replace the existing ADR37/01 and ADR70/00. The "/00" & "/01" versions represent the 2002-4 and 2005-7 groupings of the new requirements, respectively.

(5) A new smoke ADR (ADR30/01) will also apply to all categories of diesel vehicles. The smoke standard will apply from 2002/3 and will adopt UN ECE R24/03 and allow the US 94 smoke standards as an alternative. This new ADR will replace ADR30/00.

(6) Nominated standards also apply to vehicles fuelled with LPG or NG.

(7) UN ECE & EU do not have standards for medium-heavy petrol engines, hence US EPA is adopted in lieu.

8. IMPLEMENTATION AND REVIEW

8.1 Vehicle Standards

The ADRs are national standards under the Motor Vehicle Standards Act 1989 and are therefore subject to complete review on a 10 year cycle.

The Memorandum of Understanding (MOU) between the National Road Transport Commission (NRTC) and the National Environment Protection Council (NEPC) sets out the consultative arrangements governing the development of ADRs for vehicle emission and noise. Under the MOU, the Motor Vehicle Environment Committee (MVEC) has been given the responsibility of managing the work program developed under the MOU, and this review of the emission standards is the highest priority item on the current work plan.

Under the legislation establishing the NEPC, any new emissions ADRs are to be jointly developed and agreed by the NRTC and NEPC, with formal endorsement being the responsibility of the Ministers of the Australian Transport Council. In addition, as the proposed new emission ADRs will be endorsed as standards under the Trans Tasman Mutual Recognition Arrangement, the approval of the Council of Australian Governments is also required.

The new ADRs will be given force in law in Australia by making them National Standards (ADRs) under the *Motor Vehicle Standards Act 1989*. They will be implemented under the type approval arrangements for new vehicles administered by the Federal Office of Road Safety. A manufacturer will be required to ensure that vehicles supplied to the market comply with the vehicle emission requirements of this Package of ADRs. Penalties are incurred for non-compliance with the Motor Vehicle Standards Act.

The 2002/03 elements of the Package need to be gazetted by the end of 1999 to allow sufficient lead time for manufacturers to submit certification documentation. Later elements of the Package may be gazetted at a later time.

8.2 Fuel

The adoption of tighter diesel emission standards will require a reduction in the sulfur content of diesel fuel, initially to 500ppm, and then to 50ppm for the introduction of *Euro 4* in 2006. The adoption of *Euro 3* for petrol vehicles in 2005 will require changes to fuel parameters, based on the outcomes of the Fuel Quality Review and discussions with stakeholders. There is currently no mechanism for setting national fuel standards. This has been recognised by the National Environment Protection Council (NEPC) and MVEC. The Commonwealth states that a mandatory 50ppm sulfur diesel standard may be introduced through a National Environment Protection Measure, equivalent legislative device or by use of the definition in the diesel fuel credit scheme.

8.3 Other

There are a number of other issues which still need to be addressed by the Motor Vehicle Environment Committee. These include the reduction in petrol volatility and an analysis of *Euro 4* standards for petrol vehicles with a view to determining the costs and benefits of introducing these standards in the future.

ATTACHMENT A - COMPARATIVE ASSESSMENT OF CURRENT AND PROPOSED STANDARDS

Light Duty Vehicles

Comparison of Current Standards with *Euro 2*, *Euro 3* and *Euro 4* Requirements

The attached Tables summarise the differences in emission limits, test procedures and other requirements of the *Euro 2, Euro 3* and *Euro 4* standards, with the current ADR provisions for "light duty vehicles".

Currently the relevant ADRs dealing with emissions from light duty vehicles (includes cars, 4WDs and light commercials) are:

- **ADR37/01** (petrol engined vehicles 2.7 tonnes gross vehicle mass [GVM])
- **ADR36/00** (petrol engined vehicles > 2.7 t GVM, includes some vehicles treated by UN ECE system as light duty *ie* *3.5*t)
- **ADR70/00** (all diesel engined vehicles).

Table 1 - Emissions Requirements for Cars

Standard & Date of Application	Absolute Emission Limits (g/km)					Emissions Test		Other Requirements
	Cars < 2.5t [4]					Exhaust	Evaporative	
	CO	HC	NOx	PM[5]	Evap			
ADR37/01 (1997-9)	2.1	0.26	0.63	NA	2	US EPA Federal Test Procedure (FTP) from 1975	US EPA 2 hr "SHED"[6] Test from 1975	80,000km durability requirement.
Euro 2 [7] (1996)	2.2	0.28	0.22	0.08	2	Comparative testing on FTP & Euro cycles indicates mixed results on CO, E2 tougher on HC for most vehicles, and E2 much tougher on NOx for locally produced US based engines.	Equivalent to ADR37/01	80,000km durability requirement.
Euro 3 (2000)	2.3	0.2	0.15	0.05	2	E3 test more stringent than E2 as sampling starts from ignition (40s delay in E2). Comparative testing on E2 and E3 cycles indicates it makes CO and HC emission limits harder to meet, variable impact on NOx. ACEA[8] claim E3 leads to effective reduction in CO, HC and NOx emission limits of 30%, 40% & 40% respectively.	Significantly more stringent test with canister loading and conducted over 24 hrs. ACEA estimates equate to an 80% increase in stringency on the E2 limits.	80,000km durability requirement. OBD[9] requirement (initially for petrol vehicles only, phased in for diesels over 2003-2006) Separate -7°C emissions test for HC & CO emissions (from 2002)
Euro 4 *(2005)*	1.0	0.1	0.08	0.025	2	Test cycle as for *Euro 3*	Test as for *Euro 3*	As for *Euro 3* except 100,000km durability requirement

4 More relaxed limits apply for vehicles greater than 2.5t and less than 3.5t, see separate table.

5 Diesel vehicles only

6 Sealed Housing Evaporative Determination.

7 For *Euro 2* there is a combined limit for HC+NOx, split figures assume a ratio of 55:45 (HC:NOx)

8 European Automobile Manufacturers Association (ACEA)

9 On Board Diagnostics.

Table 2 – Emissions Requirements for 4WDs and Light Commercial Vehicles (LCVs)

Standard	Emission Limits (g/km - unless otherwise specified)					
	Cars > 2.5t & LCVs - up to max 3.5t (Euro & ADR70/00) 4WDsandLCVs[illegible]2.7t(ADR37/01) 4WDs & LCVs > 2.7t (ADR36/00)					
	CO	HC + NOx	HC	NOx	PM	Evap
ADR37/01 *ADR36/00* *ADR70/00**	6.2 1% by vol 58-110g/test**	NA NA 19-28g/test**	0.5 180ppm NA	1.4 NA NA	NA NA NA	2 NA 2
*Euro 2*** Petrol Diesel	 2.2 or 4.0 or 5.0 1.0 or 1.25 or 1.5	 0.5 or 0.6 or 0.7 0.7 or 1.0 or 1.2	 NA NA	 NA NA	 NA 0.08 or 0.12 or 0.17	 2 NA
*Euro 3*** Petrol Diesel	 2.3 or 4.17 or 5.2 0.64 or 0.8 or 0.95	 NA 0.56 or 0.72 or 0.86	 0.2 or 0.25 or 0.29 NA	 0.15 or 0.18 or 0.21 0.5 or 0.65 or 0.78	 NA 0.05 or 0.07 or 0.1	 2 NA
Euro 4 Petrol Diesel	 1.0 or 1.81 or 2.27 0.5 or 0.63 or 0.74	 NA 0.3 or 0.39 or 0.46	 0.1 or 0.13 or 0.16 NA	 0.08 or 0.1 or 0.11 0.25 or 0.33 or 0.39	 NA 0.025 or 0.04 or 0.06	 2 NA

* Diesel vehicles only, *Euro 1* requirements.

** Limits depend on the mass of the vehicle.

*** For *Euro 1* and *Euro 2* there is a combined regulated limit for HC+NOx, EU assume a ratio of 55:45 (HC: NOx)

Heavy Duty Vehicles

Comparison of Current Standards with Euro 2, Euro 3 and Euro 4 Requirements

The attached Table summarises the differences in emission limits, test procedures and other requirements of the *Euro 2*, *Euro 3* and *Euro 4* standards, with the current ADR provisions for "heavy duty vehicles". The comparability of the US EPA's heavy duty standards is also covered. Currently the relevant ADRs dealing with emissions from heavy duty vehicles (includes trucks and buses) are:

- **ADR36/00** (petrol engined vehicles > 2.7 tonnes gross vehicle mass [GVM])
- **ADR70/00** (all diesel engined vehicles).

Table 3 – Emission Requirements for Heavy Duty Vehicles

Standard & Date of Application	Absolute Emission Limits (g/kWh) (unless otherwise specified)				Emissions Test	Other Comments
	CO	HC	NOx	PM		
ADR36/00 (petrol) (1979) *ADR70/00 (diesel)*[10] (1995-6)	1% by vol 4.5	180ppm 1.1	NA 8.0	NA 0.36	9 mode steady state engine dynamometer test 13 mode steady state engine dynamometer test	ADR36 reflects 1974 US EPA standards for heavy duty petrol engines. US EPA 91 diesel limits at least as stringent as *Euro 1,* although US uses transient test, so not directly comparable
Euro 2 (1996-1998)	4.0	1.1	7.0	0.15[11]	13 mode steady state engine dynamometer test	ECE/EU has no standards for heavy duty petrol engines (>3.5t). US EPA 94 diesel limits at least as stringent as *Euro 2,* but derived from US transient test so not directly comparable.
Euro 3 (2000) *ESC Limit* *ETC Limit*	2.1 5.45	0.66 0.78[12]	5.0 5.0	0.10[13] 0.16[14]	Manufacturers have choice of 2 new test cycles: Euro Stationary Cycle (ESC); or Euro Transient Cycle (ETC)	US EPA 98 diesel limits similar to *Euro 3* but derived from US transient test, so not directly comparable. US expected to adopt Euro Stationary Cycle as additional requirement to the transient test sometime in 1999.
Euro 4 *(2005)* *ESC Limit* *ETC Limit*	1.5 4.0	0.46 0.55[15]	3.5 3.5	0.02 0.03	Manufacturers have to meet both test cycles: Euro Stationary Cycle (ESC); and Euro Transient Cycle (ETC)	

10 ADR70/00 allows compliance with ECE/EU standards, US EPA and Japanese Standards, the ECE (*Euro 1*) limits are used here as the basis for comparison.

11 Original *Euro 2* limit for PM was 0.25, which was reduced to 0.15 in 1998.

12 non-methane hydrocarbons

13 smaller engines are subject to more relaxed PM limits of 0.13 (ESC)

14 Smaller engines are subject to more relaxed PM limits of 0.21 (ETC).

15 non-methane hydrocarbons

ATTACHMENT B - COMPARATIVE TIMETABLE UNDER OPTION "2B (MODIFIED) RECOMMENDED IN PART B" & THE "COMMONWEALTH" PACKAGE

The attached tables summarise the differences between the preferred Option and the Commonwealth Package. The first table outlines the differences in the adoption of emissions standards and the second table difference in fuels.

Comparative Timetable For Adoption Of *Euro 2*, *Euro 3* and *Euro 4* Emission Standards Under "Option 2B (Modified) Recommended in Part B" and The "Commonwealth Package"

Vehicle Type	Option 2B (Modified) (PART B)	Commonwealth Package (PART A)
Light Passenger Vehicles (Cars & 4WDs)	• Euro2 from 2002 for all new models, and for all models from 2004. These apply to all fuels (petrol, diesel, LPG and natural gas). • Euro 3 from 2006 for new models and from 2007 for all models.	• Euro 2 from 2003 for new petrol models and 2004 for all models. • Euro 2 from 2002 for new diesel models and from 2003 for all models. *Changes –* *(1) Intro of Euro 2 for new model petrol vehicles delayed by 1 year (from 2002 to 2003);* *(2) Euro 2 for all diesel models brought forward by 1 year (from 2004 to 2003)* • Euro 3 from 2005 for new petrol models and from 2006 for all models *Changes – Intro of Euro 3 brought forward by a year for both new and existing models (from 2006 to 2005 and 2007 to 2006).* • Euro 4 from 2006 for new diesel models and from 2007 for all models. *Changes – Option 2B (Modified) did not consider Euro 4*
Heavy Buses and Trucks (buses above 5 tonne GVM and trucks above 12 tonne GVM)	• Euro 3 from 2002 for new petrol and diesel models and from 2003 for all models.	• Euro 3 from 2002 for all new diesel vehicles and from 2003 for all models *No changes* • Euro 4 from 2006 for new diesel models and from 2007 for all diesel models. *Changes – Option 2B (Modified) did not consider Euro 4*
Light – Medium Trucks and Light Buses (buses below 5 tonne GVM, light trucks below 3.5 tonne GVM, medium trucks 3.5-12 tonne GVM)	• Euro 2 from 2002 for new models and from 2003 for all models. • Euro 3 from 2005 for new models and from 2006 for all models.	• Euro 2 from 2002 for new light diesel models and from 2003 for all models. *No change* • Euro 2 from 2003 for new petrol models and from 2004 for all models. *Change - Intro of Euro 2 for new model petrol vehicles delayed by 1 year (from 2002 to 2003);* • Euro 3 from 2002 for new medium diesel models and from 2003 for all models. *Changes – Intro of Euro 3 brought forward by three for medium diesels (ie from 2005 to 2002 and 2006 to 2003)* • Euro 4 from 2006 for new diesel models and from 2007 for all diesel models *Changes – Option 2B (Modified) did not consider Euro 4*

Comparative Timetable for Adoption of Tighter Fuel Standards under "Option 2B (Modified) Recommended in Part B" and the "Commonwealth Package"

	Option 2B (Modified) (PART B)	Commonwealth Package (PART A)
Fuels	• From 2002, reduction of sulphur content of diesel to 500ppm, initially in major urban areas.	• By end 2002, 500ppm sulphur content of diesel supplied to whole Australian market. Phase in initially in urban areas. *Change – brings forward date for delivery of 500ppm diesel* • Diesel standard set at 500ppm sulphur by end 2002. • From 1 January 2003 an increase in diesel excise of 1 cent /litre for fuel above 50ppm. • From 1 January 2004 an increase in the diesel excise of 2 cents/litre for fuel above 50 ppm. *Change - Option 2B (Modified) does not deal with excise issues or other incentives*
	• From 2005, Euro 3 fuel parameters based on outcomes of Fuel Quality Review and discussions with stakeholders.	• From 2006, mandatory diesel fuel standard of maximum 50 ppm sulphur content. *Change –Option 2B (Modified) not specific on fuels beyond 500ppm diesel from 2002*

PART B

ASSESSMENT OF MVEC REVIEW OF NEW ADRs FOR THE CONTROL OF VEHICLE EMISSIONS

PART B ASSESSMENT OF MVEC REVIEW OF NEW ADRS FOR THE CONTROL OF VEHICLE EMISSIONS

1. INTRODUCTION

Motor vehicles are the single largest contributor to urban air pollution in Australia's major cities. Over the past 20 years, controls on the emissions from new vehicles through the Australian Design Rules (ADRs) have been progressively tightened. Over the last 10 years in particular, there have been improvements in a number of air quality measures, and it is generally accepted that the increasing proportion of these "cleaner" vehicles has played a major part in these improvements. Nevertheless, relatively high concentrations of pollutants are experienced on occasions in our larger cities, with exceedances of ozone goals occurring every year in some of our larger cities.

As part of his November 1997 statement on climate change, *Safeguarding the Future: Australia's Response to Climate Change*, the Prime Minister released the Environmental Strategy for the Motor Vehicle Industry. A key element of the strategy is a commitment to "harmonised noxious emission standards with international standards by 2006". This Environmental Strategy has since been embodied in the 1998 National Greenhouse Strategy (part 5.10), with the Motor Vehicle Environment Committee (MVEC) being identified as the key body responsible for progressing the implementation of the strategy.

The Australian Design Rules (ADRs) set the standards that each vehicle model is required to comply with, prior to their supply to the market. The ADRs set standards for safety and emissions, with four ADRs setting limits on exhaust and/or evaporative emissions. The relevant ADRs are ADR37/01 and ADR36/00 for petrol engined vehicles, and ADR30/00 and ADR70/00 for diesel engined vehicles.

These ADRs have been reviewed to consider:

- whether the current ADRs will deliver reductions in total emissions from the vehicle fleet at a level sufficient to ensure that improvements in urban air quality in our major cities continues over the medium to long term; and
- The most cost-effective strategies for introducing changes to the standards (if changes are warranted).

In undertaking the review, consideration has been given to ensure standards do not impose excessive requirements on business, that they are cost effective and take account of community, social, economic, environmental, health and safety concerns. The review also takes account of the provisions of the Trans-Tasman Mutual Recognition Arrangement (TTMRA) which promotes the harmonisation of Australian and New Zealand standards with the internationally recognised United Nations Economic Commission for Europe (UN ECE) Regulations.

2. STATEMENT OF THE PROBLEM

Motor vehicle pollution in Australia is an ongoing problem particularly in our densely urbanised cities. Vehicles are estimated to contribute up to 70% of total urban air pollution (NSW EPA, 1999). Emissions from vehicles therefore have significant effects on the quality of life for urban residents, particularly those susceptible to air pollution. High levels of air pollutants have been shown to result in a wide range of adverse health and visual impacts on society. Increasing levels of pollution can have significant environmental and economic consequences. Health effects associated with air pollution include respiratory effects, ranging in severity from coughs, chest congestion, asthma, to chronic illness and possible premature death in susceptible people. Other effects of air pollutants include damage to vegetation, buildings and materials, and reduction in visibility.

Reducing the contribution of motor vehicle emissions to air pollution is expected to have a positive impact on human health.

2.1 HEALTH AND OTHER ENVIRONMENTAL EFFECTS OF URBAN AIR POLLUTION

Air pollutants cause adverse effects if they are present in air at sufficient concentrations and for a sufficient length of time.

Atmospheric pollutants can cause a range of effects on human health and the environment, with the severity of effects often related to the duration of exposure and concentration of the pollutant. These include nuisance effects (eg decreased visibility, odour); acute toxic effects (eg eye irritation, increased susceptibility to infection, reduced respiratory / pulmonary function); chronic health effects (eg mutagenic and carcinogenic actions); and environmental effects (eg material soiling, vegetation damage, corrosion).

Ambient air quality standards are set at levels to protect more susceptible members of society, and significant breaches of these standards represent undesirable impacts on community health. The most common pollutants discharged to the air are oxides of nitrogen (NO_x), carbon monoxide (CO), hydrocarbons (HC), sulfur dioxide (SO_2), and airborne particles (total suspended particles and particulate matter with a diameter of less than 10 μm) including lead. These pollutants are largely produced by the combustion of fossil fuels. Another significant pollutant in major urban areas is ozone (O_3), which is a secondary pollutant formed in sunlight by chemical reactions between oxides of nitrogen and reactive hydrocarbons. The health effects of those pollutants with a strong linkage to motor vehicles are briefly discussed below (Grant *et al*, 1993; Sivak, 1993; NEPC, 1997; NSW EPA, 1996b; Vic EPA, 1994).

Carbon Monoxide (CO)
Carbon monoxide is a colourless, odourless and tasteless gas that, in high concentrations, is poisonous to humans. In sufficiently high concentrations and long exposures, CO interferes with the blood's capacity to carry oxygen. Exposure at lower levels can have adverse effects on individuals with cardiovascular disease.

Nitrogen Dioxide (NO_2)
Nitrogen dioxide is a pungent acid gas. In the atmosphere it may irritate respiratory systems, exacerbate asthma in susceptible individuals, increase susceptibility to cardiovascular disease symptoms and respiratory infections, and reduce lung function. As a precursor to photochemical smog, it also contributes to effects associated with these substances.

Ozone (O_3)

Ozone is a gas with strong oxidising properties. Health effects attributed to ozone include irritation of eyes and airways, exacerbation of asthma symptoms in susceptible people, increased susceptibility to infection, and acute respiratory symptoms such as coughing. Ozone also has adverse effects on vegetation and other materials.

Particulates (PM)

Particulates contribute to reductions in visual amenity of urban air, soiling of buildings, and can have significant impacts on human health. Respirable particles, those with a diameter of less than 10 μm (PM_{10}), are a particular health concern because they are easily inhaled and retained in the lung. Almost all of the particles in diesel exhaust are less than 1 μm in diameter (Concawe, 1998), and diesel particulates also adsorb unburnt hydrocarbons and other potentially carcinogenic organic compounds such as polycyclic aromatic hydrocarbons. The International Agency for Research on Cancer has concluded that diesel exhaust is a probable human carcinogen (California Air Resources Board 1994), and the California Air Resources board has proposed that diesel exhaust be classified as a toxic air contaminant (California Air Resources Board 1998).

Although the mechanisms are not clear, epidemiological studies in the US and elsewhere consistently show a relationship between particulates and a range of respiratory, cardiovascular and cancer related morbidity and mortality (Concawe, 1996; Ballantyne, 1995; NEPC, 1997). The NEPC reports that the research indicates that all particles, irrespective of their origin, are linked with health effects (NEPC, 1997). The US EPA concludes that the elements of particulates most consistently associated with health are fine particulates, respirable particles and sulfate (US EPA 1996, cited in NEPC, 1997). Diesel engines are sources of both fine particles and sulfate.

Visible Smoke

While visible exhaust smoke is not considered a direct health hazard, it contributes to haze and can be offensive to motorists and pedestrians because of the odour and physical irritation of airways. While there are no specific air quality goals for smoke, State regulatory authorities report that smoke is a major source of complaints from the general public.

2.2 CURRENT AIR QUALITY IN AUSTRALIA

Air pollution is an undesirable by product or waste from the use of energy in a broad range of industrial, commercial and domestic activities that underpin our modern industrial society and support the Australian lifestyle. In urban areas air pollution is produced largely by motor vehicles, domestic and commercial heating and cooking, and industrial activities.

Topography and geography, as well as meteorology, are important factors in determining the dispersion of pollutants. Most large Australian cities are located near the coast with elevated terrain in the hinterland and are subject to a daily cycle of onshore and offshore air flows, resulting in recirculation of pollutants on days of poor air dispersion. The region across which air pollutants can be transported and recirculated defined by the combination of topography and meteorology is often referred to as an airshed. Studies have now been conducted on the emissions, meteorology and photochemistry of all the large capital city airsheds in Australia, and the meteorological conditions associated with high ozone concentrations have been identified (NEPC, 1997).

The National State of the Environment Report (SoE, 1996) stated that the air quality in the cities and towns of Australia is generally acceptable, and quite good by international standards. Nevertheless, relatively high concentrations of pollutants are experienced on occasions in our larger cities. Consequently management of air pollution in urban areas is focused on dealing with those occasions when poor dispersion allows ambient concentrations to rise significantly (NEPC, 1997).

Australia is one of the most highly urbanised countries in the world, and atmospheric pollution in our cities is a significant issue for the community. Surveys of community attitudes have demonstrated that environmental issues are of major concern to the public, with air pollution a key concern. In NSW surveys, urban air pollution was cited most often (by 45-55% of respondents) as the most important environmental issue requiring action to be taken (NRMA, 1996a; NSW EPA, 1994; Clean Air 2000, 1997). Another survey conducted at the Federal level gave similar results, with respondents indicating that the Commonwealth Government's top priority should be "helping to control air and water pollution" (ANOP, 1993).

The pollutants of current concern in urban airsheds are nitrogen dioxide (NO_2), ozone (O_3), fine particles (PM_{10}), air toxics, and, to a lesser extent, carbon monoxide (CO).

Until recently, air quality goals established by the National Health and Medical Resources Council have been used to assess air quality in all jurisdictions. The Ambient Air Quality National Environment Protection Measure (AANEPM), which was made in 1998, has established a nationally uniform set of ambient air quality standards (see Table 1).

Table 1 National Ambient Air Quality Standards

Pollutant	**Averaging Period**	**Maximum Concentration**	**Goal within 10 years (Max allowable exceedances)**
Carbon monoxide	8 hours	9.0 ppm	1 day a year
Nitrogen dioxide	1 hour	0.12 ppm	1 day a year
	1 year	0.03 ppm	None
Photochemical oxidant (as ozone)	1 hour	0.10ppm	1 day a year
	4 hours	0.08ppm	1 day a year
Sulfur dioxide	1 hour 1 day 1 year	0.20ppm 0.08ppm 0.02ppm	1 day a year 1 day a year none
Lead	1 year	0.05 µg/m^3	none
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year

Source: NEPC, 1998

The pollutants identified in the table above which are significantly affected by vehicle emissions are CO, NO_2, O_3, PM_{10} and lead. Lead was formerly of concern in urban areas, but the implementation of effective management strategies has resulted in a sustained decline in ambient lead levels. The current status and trends for the remaining four pollutants are discussed below.

Carbon Monoxide (CO)

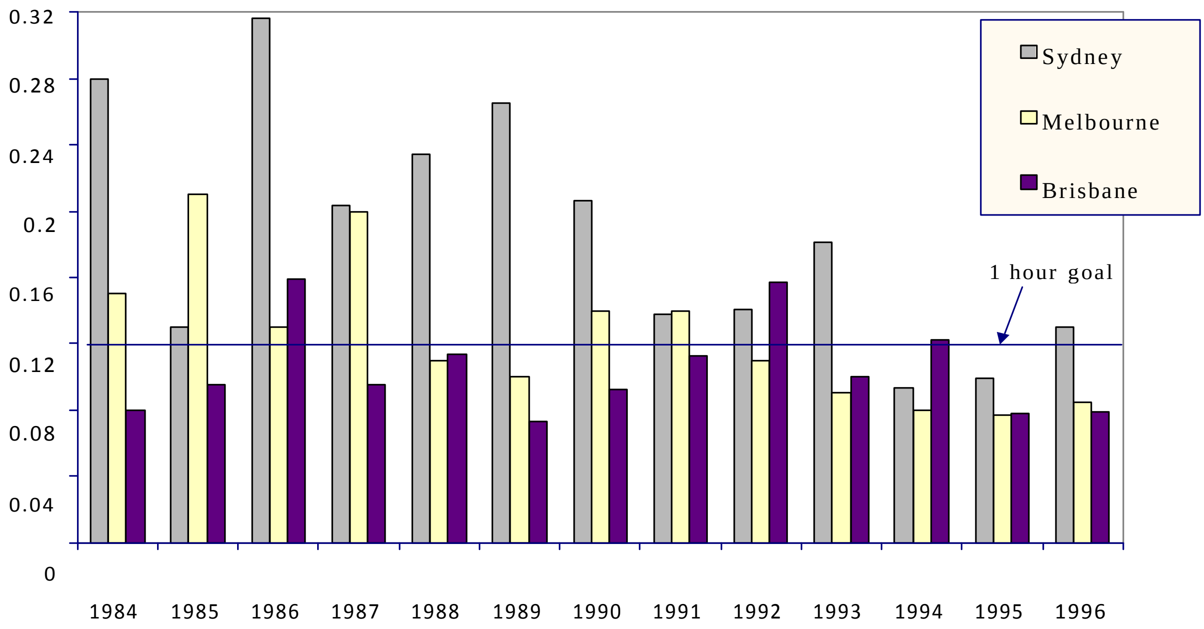
Exceedances of CO goals still occur in Australia’s larger cities, but the number of exceedances has reduced considerably over the past 10 years. Most exceedances are recorded occur in Sydney and Adelaide, but it is considered that the siting of the monitoring stations near areas of high traffic flows in those cities does not reflect exposure levels for the general population (NEPC, 1997). The general consensus of environmental protection agencies is that the current CO levels are not of concern, and will continue to decrease (SoE, 1996).

Nitrogen Dioxide (NO_2)

The number of breaches of the current NO_2 goal have been low in recent years, with only Sydney and Adelaide having any exceedances in the past 10 years. However, the formation of nitrogen dioxide in the atmosphere (from nitric oxide in vehicle exhaust) is strongly affected by seasonal weather conditions, leading a number of reports to conclude that there are no clear trends in the levels of nitrogen dioxide (NSW EPA, 1996b, Coffey Partners, 1996). While the number of exceedances are low, analysis of the peak data at the
98 percentile level (a reliable indicator of trends) concludes, for example, that a clear downward trend is not apparent in Melbourne's 1 hour average NO_X or NO_2 data (Coffey Partners, 1996).

Figure 1 indicates the trends for peak results in Sydney, Melbourne and Brisbane.

Figure 1 Nitrogen dioxide peak 1 hour values



Source: NSW EPA, Vic EPA, Qld DOE (1995-6 Melbourne Data subject to confirmation)

The New South Wales Health Department's Health and Research Program (HARP) which examined the health effects of urban air pollution (Hensley, 1996; Morgan *et al*, 1998), estimated that days of high NO_2 levels were associated with: a 7% increase in hospital admissions for cardiovascular disease; a 5% increase in childhood asthma admissions; a 3% increase in adult asthma admissions and a 5% increase in chronic obstructive pulmonary disease admissions.

Ozone (O_3)

Gaseous ozone is measured as an indicator of the level of photochemical smog in the atmosphere. It is a secondary pollutant, which is formed from the reaction of a mixture of hydrocarbons and oxides of nitrogen (principally NO_2) in the presence of sunlight.

The national 0.10ppm standard is exceeded on an annual basis in Melbourne, Sydney Brisbane and Perth. Adelaide also experiences less frequent exceedances of the standard. Until recently, breaches of the standard in most Australian cities have steadily declined, with Sydney, Brisbane and Perth showing some variability in the past few years (Figure 2).

The World Health Organisation has set a stricter goal of 0.08ppm, which is the current goal in Western Australia, and which New South Wales has indicated it intends to meet as a long term objective (NSW EPA, 1996b). Adopting this more stringent goal would indicate a significantly higher number of recorded exceedances, and a worsening upward trend (Figure 3). For example, in Sydney the number of exceedances in 1994, based on 0.12ppm, 0.10ppm and 0.08ppm goals, were 2, 12 and 25 days respectively (NSW EPA, 1996a).

Meteorological conditions have a significant impact on ozone formation. Consequently, large variations in exceedances may simply result from variations in the number of calm sunny days from year to year. Accurate assessment of ozone levels in a large urban airshed is also difficult, because the time taken for ozone formation means that levels may be highest in areas remote from concentrations of traffic, where monitoring stations have traditionally been located. For example, monitoring data from the Sydney airshed (NSW EPA, 1996c) confirmed that prevailing winds and topography were conducive to high levels of ozone formation and accumulation in the western part of the airshed (despite the fact that most primary emissions are produced in the east).

A number of reports suggest peak ozone results give a more reliable indicator of air quality trends than exceedances (Coffey Partners, 1996). On the basis of peak ozone levels in Sydney, current ozone precursors would need to be substantially reduced to achieve the 0.08ppm long term goal (NSW EPA, 1996c). In Melbourne, there is also no clear downward trend for ozone (Coffey Partners, 1996).

By international standards, the maximum 1 hour ozone concentrations recorded in Sydney and Melbourne are comparable with cities such as Toronto, San Diego, Philadelphia and Atlanta, and exceed those in London. Whilst the peak 1 hour ozone concentrations recorded in Australia's two largest cities rank as high by international standards (compared with cities of comparable or larger population), the number of days on which the 0.10ppm 1hr standard is exceeded is relatively low.

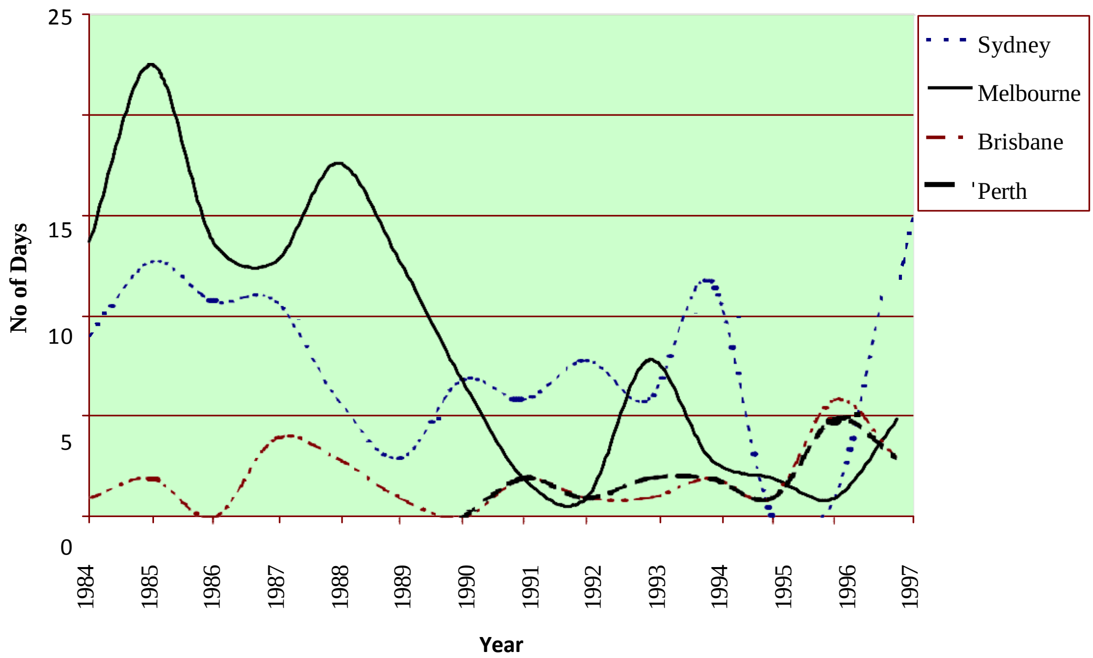
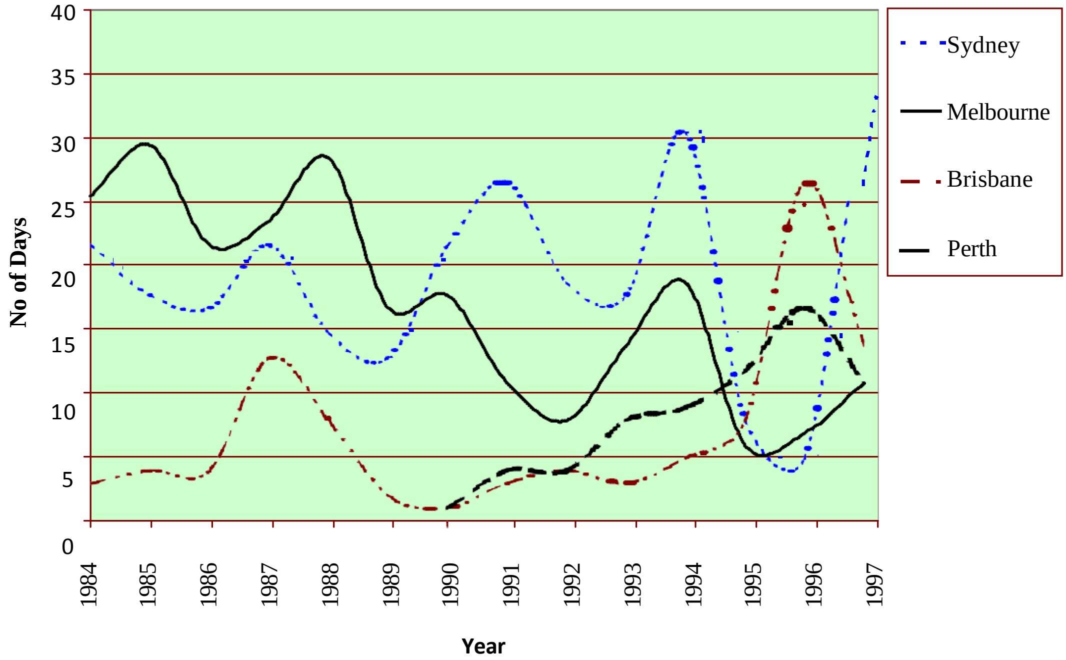


Figure 2 Ozone exceedances, 1 hour 0.10ppm

Source: NSW EPA, Vic EPA, Qld DOE, and WA DEP

Figure 3 Ozone exceedances, 1 hour 0.08ppm



Source: NSW EPA, Vic EPA, Qld DOE, and WA DEP

Particulates

Denison and Chiodo (1996) conclude that "although respirable particle levels in Australia are low, there are still strong associations with adverse health effects", and that "for mortality, at least, there does not appear to be a threshold particle level". Recent research has reported health effects at levels well below current guidelines (Pope *et al* (1995) cited in Denison and Chiodo, 1996). Other reports (NEPC, 1997; NSW EPA, 1998; WA DEP, 1996) also conclude that the research findings point to no discernible threshold below which no adverse health effects occur.

The New South Wales Health Department's Health and Research Program (HARP) which examined the health effects of urban air pollution (Hensley, 1996; Morgan *et al*, 1998), concluded that there are significant links between air pollution and health, particularly heart disease and respiratory problems. Particulate pollution was estimated to contribute to nearly 400 (2%) premature deaths in Sydney each year between 1989 and 1993. The study also estimated that days of high particulate concentrations were associated with: a 3.5% increase in hospital emissions for cardiovascular disease; a 3% increase in chronic obstructive pulmonary disease hospital admissions; and a 3% increase in heart disease admissions in the elderly.

2.3 CONTRIBUTION OF MOTOR VEHICLES TO URBAN AIR POLLUTION

Atmospheric emissions are derived from a wide variety of anthropogenic and natural sources, and have effects both on human health and on the environment. Fossil fuel combustion, particularly by motor vehicles, has been identified as the largest single contributor to the air pollutants specified in Table 2.

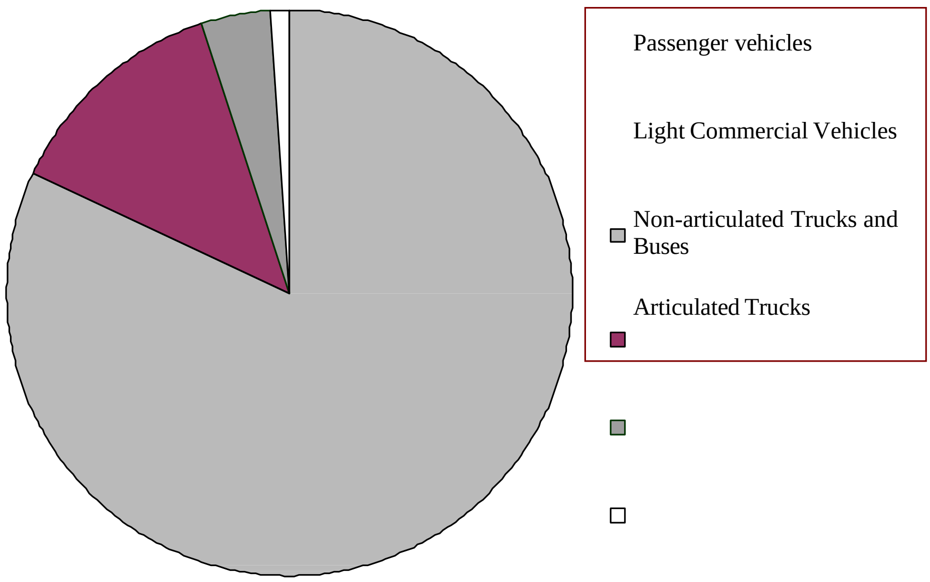
Table 2 Contribution (%) of Motor Vehicles to Air Emissions in Major Australian Cities

Carbon Monoxide (CO)	Hydrocarbons (HC)	Oxides of Nitrogen (NOx)	Particulates (PM)
70-95%	40-50%	70-80%	10-50%

Source: Coffey Partners, 1996

As indicated in Figure 4, while the larger trucks and buses may emit more pollutants per kilometre, cars are the dominant vehicles operating in the urban environment, with light commercial vehicles the next most significant group. The sheer number of cars, as well as their reliance on petrol engines, ensures that they are the major contributors to CO, HC and NOx emissions. Commercial diesel engined vehicles, while fewer in number and kilometres travelled, are nevertheless a significant source of NOx and particulate emissions, and the major vehicle offenders in terms of visible smoke. Trucks are increasingly reliant on diesel as a transport fuel, with the use of petrol by trucks (not including light commercials) falling from 18% in 1984/5 to just 3% in 1994/5 (Apelbaum, 1997).

Figure 4 Kilometres Travelled in Urban Areas, by Vehicle Type



Source: Apelbaum, 1997

Vehicle based HC emissions are a mixture of evaporative and exhaust emissions. The NSW EPA estimates that in summer, approximately 60% of light duty vehicle HC emissions are from evaporation (NSW EPA, 1998).

Data from Sydney, Melbourne and Brisbane indicate that motor vehicles are responsible for around 80% of total NOx emissions, with diesel trucks and buses contributing about 40% of these vehicle emissions (NSW EPA, 1996c; Coffey Partners, 1996; Carnovale *et al*, 1991).

In relation to particulates, a New South Wales study estimates that road transport was responsible for about 30% of particulate emissions, with commercial vehicles being the most significant vehicular emitter (NSW EPA, 1996c). The contribution of Victorian vehicles to anthropogenic particulate emissions were estimated at between 10% (in Winter) and 46% (in Summer). Diesel vehicles are estimated to be responsible for 70-80% of these vehicle PM emissions (Carnovale *et al*, 1991; WA DEP, 1996; NSW EPA, 1998; Q DOE, 1998).

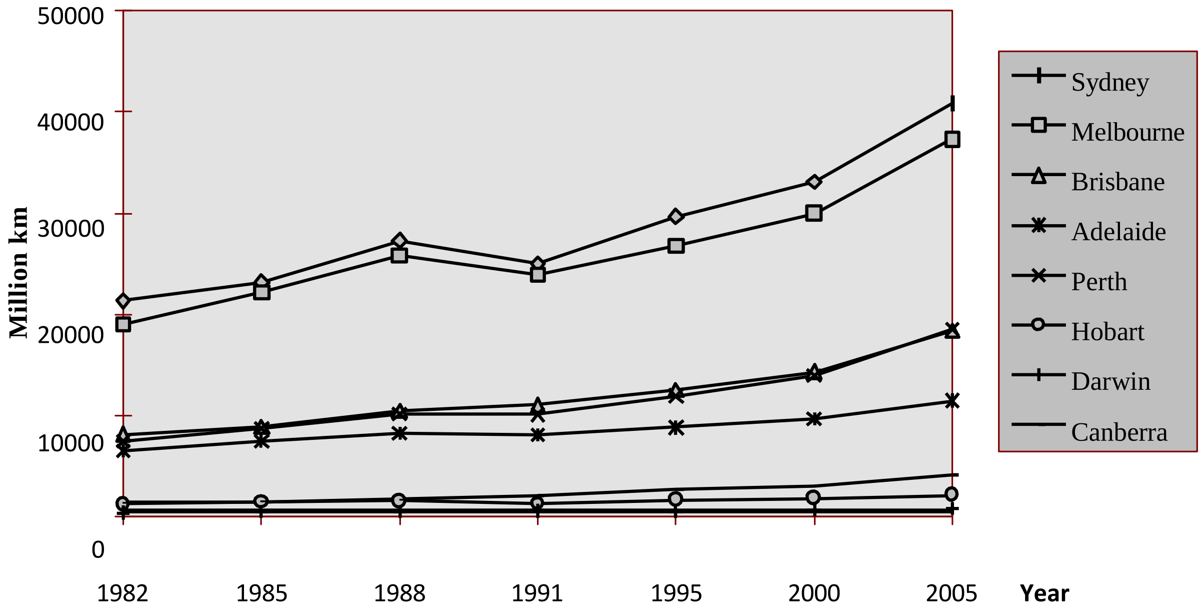
2.4 AIR QUALITY PROJECTIONS

Considerable progress has been made in improving the air quality in our cities by increasing emission controls on vehicles and industry, together with local initiatives such as controlling backyard burning. As a result of these initiatives, urban air quality has improved over the past decade and in some cases, will continue to improve in the short term (Coffey Partners, 1996).

As vehicles complying with ADR 37/00 and ADR37/01 (petrol engined) and ADR 70/00 (diesel engined) make up an increasing proportion of the fleet, the incremental effect of these controls will become less significant and any improvements will occur at a decreasing rate. Unless further action is taken, population growth, urbanisation and increased use of motor vehicles are expected to overtake improvements in the emissions performance of individual vehicles and result in declining air quality in the medium to long term (Ballantyne, 1995).

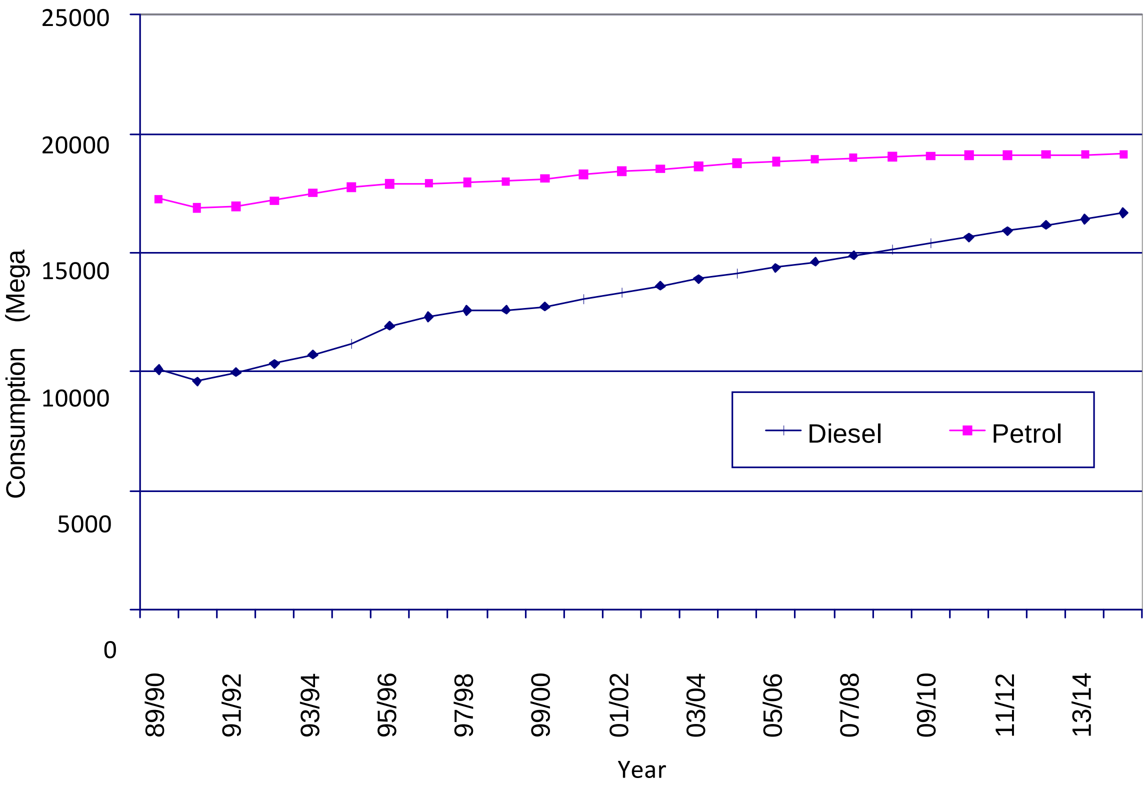
Figures 5 and 6 highlight expected increases in urban travel demand and increasing fuel consumption (particularly diesel fuel). In such an environment, vehicle emissions will increase unless action is taken to reduce emissions per kilometre.

Figure 5 Trends in vehicle kilometres travelled (VKT) in Australian capital cities



Source: Coffey Partners, 1996

Figure 6 Petrol and Automotive Diesel* Consumption (Actual & Predicted)



Source: ABARE, 1999
*diesel excludes bunkers (marine diesel)

A Melbourne airshed study (Carnovale *et al*, 1991) indicates that in the 1990-2000 period vehicle emissions of CO and HC are expected to fall, while NOx emissions are expected to remain fairly stable. The frequency of ozone breaches in Victoria, while comparatively low, are nevertheless considered a cause for concern (Vic EPA, 1993). A similar study of the Perth airshed anticipated increases in NOx emissions in the medium to long term (James, 1994).

A 1991 study of the Melbourne airshed estimates that particulate levels from motor vehicles are likely to increase over the 1990-2000 period by some 17%. Perth air quality studies conclude that PM levels are likely to increase (WA DEP, 1997), with James (1994) estimating that particulate emissions from motor vehicles will increase by some 80% over the period 1991-2011 (although no account was taken of the impact of ADR 70/00).

Recent modelling in South East Queensland, suggests that relative to 1993 levels, CO, HC, NOx and PM emissions will be lower in 2011, but the report concludes that pressures from growth in vehicle use are expected to increase emissions in the long term (Q DOE, 1998).

In the absence of further controls on vehicle emissions and with predicted increases in motor vehicle usage, air quality modelling analyses anticipate that air quality in Sydney, Melbourne, Brisbane and Perth will deteriorate in the medium to long term (NSW EPA, 1996c; RTA, 1994; Carnovale *et al*, 1991; James, 1994). To counteract the effects of increasing total vehicle kilometres, further action is required to curb the potential upward trend in air pollutant exceedances (Coffey Partners, 1996; NRMA, 1996b; Reid, 1997).

2.5 GOVERNMENT INTERVENTION

In congested urban areas, motor vehicle users often fail to take account of the health and environmental costs imposed on the wider community from vehicle emissions when deciding on the purchase or use of their vehicle. To date there has also been little incentive for Australian vehicle designers and manufacturers to take account of these external social and health costs as, unlike many safety features, emissions performance of vehicles are not an important marketable feature of motor vehicles. For example, confidential certification data held by the FORS demonstrates that many manufacturers (including importers) produce vehicles tailored to the Australian market, which meet only minimum passenger and commercial vehicle emissions standards rather than the more stringent international UN ECE standards.

Governments throughout the world, including Australia, have taken action to reduce vehicle emissions rather than relying solely on price signals. Evidence presented earlier in this RIS suggests that this significant problem will be ongoing and further government action is warranted to combat the problem."

Mandatory vehicle emission standards were first introduced in Australia in 1972 in recognition of the significant impact vehicle emissions can have on the health of people living in urban areas. These have been progressively tightened in an effort to improve urban air quality. Application of emission standards as a design requirement under the Australian Design Rules (ADRs) recognises the clear 'market failure' in dealing with motor vehicle drivers who impose adverse effects without bearing the costs. The ADRs are national standards under the *Motor Vehicle Standards Act, 1989*.

3. OBJECTIVES

An objective of government health and environment policy is to reduce the adverse effects of motor vehicle emissions on urban air quality and human health. The government also has an objective to harmonise Australian vehicle emission standards with international standards by 2006. Australian Design Rules are reviewed to ensure they are relevant, cost effective and do not provide a barrier to the importation of safe vehicles and components.

The Government's objective is outlined in the Prime Minister's Statement, *Safeguarding the Future,* (Prime Minister, 1997) as "seeking realistic, cost effective reductions in key sectors where emissions are high or growing strongly while also fairly spreading the burden of action across the economy". Vehicle based measures out lined in the statement aim to reduce air pollution and improve the health of our cities, as well as reducing greenhouse gas emissions. The statement specifically states the government objective that Australia would "harmonise noxious emission standards with international standards by 2006".

4. OPTIONS

This section outlines the potential options for reducing motor vehicle emissions including the 'do nothing' option. As the focus of the review was on the effectiveness of the current ADRs in delivering reductions in total emissions from the motor vehicle fleet at a level sufficient to ensure improvements in urban air quality, the majority of the discussion is on introducing new standards, Option 2. It is recognised, however, that there are a range of complementary strategies for addressing vehicle emissions which could be used as an adjunct to new vehicle standards.

The current standard setting limits on exhaust (CO, HC and NOx) and evaporative HC emissions from light duty petrol engined vehicles is ADR 37/01. This standard was phased in over 1997-9 and requires all new vehicles to comply with US 1993 emission limits. ADR36/00 sets limits on exhaust emissions of CO and HC from heavy duty petrol engined vehicles. This standard took effect in July 1988 and is based on US 1974 emission limits.

The two standards setting limits on exhaust emissions from all diesel engined vehicles are ADR30/00, which sets limits on visible smoke, and ADR70/00, which sets limits on emissions of CO, HC NOx and PM. ADR70/00 was introduced in 1995-6 and provides manufacturers the option of complying with one of three sets of standards. These are ECE Regulations 83/01 and 49/02 (equivalent EEC Directives 91/542 and 91/441, referred to as *Euro 1*), US EPA 1991 or 1994, and Japanese 1993/4. ADR30/00 was introduced in 1976 and sets limits on visible smoke consistent with European and US standards of the early 1970's.

4.1 DO NOTHING (OPTION 1)

As indicated in Section 2, motor vehicles are the largest single source of emissions which degrade air quality in major urban areas. Air quality improvement mechanisms therefore necessarily involve control and reduction of emissions from motor vehicles. As the bulk of the Australian vehicle fleet, petrol vehicles have conventionally been the primary focus of improvements to vehicle emission standards, while diesel vehicles have, until the introduction of ADR70/00 in 1995, received little attention. Other air quality management strategies such as the reduction of the lead content in petrol and increased regulatory controls on industrial and domestic activities have also contributed to improved air quality. Air quality projections indicate that the improvements in air quality detailed in Section 2 will be sustained in the short term, particularly as new vehicles meeting ADR37/01 and ADR70/00 penetrate the fleet and older vehicles are retired.

Maintenance of the emission ADRs in their current form would not be acceptable for a number of reasons:

- Despite improvements, exceedances of some standards, particularly Ozone still occur every year in Australia's larger cities;
- Motor vehicles are a major source of hydrocarbons and oxides of nitrogen (the precursors for photochemical smog) and particulates;
- Significant health impacts from emissions, particularly NOx and PM_{10}. Health studies suggest that current levels of air quality are having significant health effects with a strong correlation between high NO_2 and PM levels and hospital admissions for asthma and heart disease, and no safe level being determined for exposure to particulates;
- The commitment to harmonisation with international standards by 2006;
- Increases in urban population and overall vehicle travel are expected to negate the benefits from these ADRs, leading to a worsening of the air quality related to motor vehicle emissions in our major urban areas early next century. Melbourne and Sydney

are the two most densely populated cities in Australia in 1997 and collectively represented almost 40% of Australia's total population (ABS, 1999). In order to meet NEPC's ambient air quality standards (AANEPM), air quality management is being actively progressed by both of these jurisdictions. However, given their high population densities, it is likely that even with the implementation of a rigorous suite of air quality management strategies, Sydney and Melbourne will still exceed the allowable limits on some occasions. Exceedances of goals also occur to a lesser extent in Brisbane, Perth, and urban development in these cities and adjacent regions is occurring rapidly; and
- There is a high level of community concern over air quality and an expectation that steps will be taken to improve the situation.

It is unlikely that market forces alone would deliver significant reductions in vehicle emissions in the Australian fleet. Some local manufacturers are improving standards voluntarily in order to meet export standards; however, the export 'versions' of these vehicles are not necessarily supplied to the Australian market. The Federal Chamber of Automotive Industries (FCAI) has stated that vehicles can be, and are, tailored to the Australian market. These vehicles often meet the minimum standards only. Some imported vehicles (mainly European) manufactured to tighter emissions standards, are being provided to the Australian market. However, as European vehicles only represent about 6% of the Australian market, this will have little impact on total emissions. For commercial vehicles a mixture of minimum and tighter standard vehicles are supplied eg in the heavy duty sector a mix of US91, US94 and US98 standard engines are supplied (*US91* is the minimum requirement).

Despite the uncertainty inherent in air quality modelling and air quality projections, to 'do nothing', in light of available evidence, conflicts with one of the guiding principles of Ecologically Sustainable Development, that is, 'where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation' (Commonwealth of Australia, 1992). This precautionary approach is also taken by the European Parliament in dealing with air pollution problems (European Commission, 1997).

4.2 INTRODUCE NEW STANDARD(S) (OPTION 2)

Air quality improvements to date demonstrate that the implementation of more stringent new motor vehicle emission standards (largely in the absence of any other significant vehicle based measures) is a highly effective air quality management strategy (NSW EPA, 1998; Vic EPA, 1997; QDOE, 1998). The Industry Commission stated in its Automotive Industry Report (1997) that regulations such as emission standards continue to have an important role to play in addressing environmental problems, as there are substantial problems with using market mechanisms to address all the environmental impacts of vehicle use. These include the technical difficulties in measuring the cost of emissions, allocating those to certain vehicles and relating measurements to trip length and regional impact.

In assessing the need to increase the stringency of the current emissions standards, it needs to be recognised that vehicle related air pollution is essentially a problem associated with Australia's larger urban areas.

Key factors to consider in the adoption of new standards are:

- Which standards should be considered;
- The relative stringency of the candidate standards;
- The timing of the introduction of new standards;
- The impact of fuel parameters on in-service compliance with new standards; and

- The costs and benefits of adopting particular standards.

The first four factors are considered in this Section 4, with the last (costs and benefits) being considered in Section 5.

4.2.1 Which Standards

The preparation of a unique Australian standard is neither desirable nor necessary. The emission ADRs have always been based on overseas standards and these have delivered air quality improvements, even though the test cycles used in these standards may not be particularly representative of Australian urban driving conditions. The globalisation of the motor vehicle industry also makes the development of unique Australian standards undesirable from a manufacturer's perspective. Thus the only realistic option is for the new/revised ADR to adopt an appropriate overseas standard.

Australia's petrol vehicle emission standards have traditionally been based on the US EPA standards, while the diesel standards allow a range of standards. In the interests of facilitating trade in motor vehicles, the Australian Government strongly supports the international harmonisation of vehicle standards (Prime Minister, 1997; Sharp, 1996), and this view is also supported by the vehicle industry (FCAI, 1999a). The Inquiry into Urban Air Pollution in Australia (AATSE, 1997) concludes that harmonisation with UN ECE makes sense on the grounds of emissions reduction, trade facilitation and industry viability.

Under the World Trade Organisation (WTO) rules to which Australia is a signatory, only the Regulations developed by the UN ECE meet the definition of an "international" standard in the vehicle standards field (as opposed to national standards such as the Japanese or US). The UN ECE standards are therefore preferred for adoption in the Australian Design Rules, and the Australian Government is moving to harmonise all the ADRs with the ECE Regulations as far as is possible. The Japanese Government has also made a commitment to harmonisation with ECE vehicle standards by acceding to the UN ECE 1958 Agreement in November 1998. Many Japanese companies have an international focus in exporting to APEC economies and Europe. Most other Asian countries, and indeed the majority of countries in the world, are moving towards adopting ECE Regulations on emissions standards (FCAI, 1996). The US and ECE are also moving towards harmonisation, with some alignment of test cycles occurring in the US99 and *Euro 3* heavy duty standards (DieselNET, 1999).

Note: For brevity, the remainder of this document frequently refers to *"Euro 1", "Euro 2", "Euro 3"* and *"Euro 4"*, standards. These are the common terminology used to describe the progressively more stringent versions of the UN ECE standards which apply from 1992, 1996, 2000 and 2005 respectively. Reference is also made to *"Tier 1"* and *"US94"* and *"US98"*, which are the current US EPA Tier 1 light duty vehicle emission standards, and the US EPA heavy duty emission standards introduced in 1994 and 1998 respectively.

4.2.1.1 Petrol Vehicle Compliance with ECE Standards

Australia's petrol vehicle emission standards have for many years been based on US EPA requirements, and thus all vehicles manufactured in Australia and those imported (regardless of origin – see Table 3) have to demonstrate compliance with the US EPA emissions tests in ADR37/01 or ADR36/00.

Table 3 Australian Passenger Vehicle Market Share* by Country of Manufacture and Total Sales, 1997**

Australia	Japan	Korea	Germany	Spain	Sweden	Total No. of Cars Sold (rounded)
39%	37%	15%	4%	4%	1%	540,000

* % are rounded

** the country of manufacture is a FORS estimate, based on FCAI sales data for 1997.

A shift to adoption of UN ECE standards in these ADRs would mean that some manufacturers would have to undertake different emission test protocols. This, in itself, is not likely to cause any significant difficulties, as most manufacturers are familiar with the ECE test procedures, and have the facilities to undertake the tests (at least at the *Euro 2* level). Facilities for Australian based car manufacturers would have to be upgraded for compliance testing to *Euro 3*.

The FCAI have stated that the adoption of UN ECE for petrol vehicles may also have implications for fuel octane demand, which are discussed in Section 4.2.4.

4.2.1.2 Diesel Vehicle Compliance with ECE Standards

<u>Gaseous and Particulate emissions</u>

Under Australia's diesel vehicle emission standards (ADR70/00) vehicles can be certified to a range of standards (UN ECE, US and Japan). All diesel vehicles, (or at least their engines) in Australia are imported, with most coming from Japan, with the exception of the heavier vehicle range, most of which are imported from the US and Europe (see Table 4).

Table 4 Australian Commercial Vehicle (Petrol and Diesel*) Market Share and Total Sales, 1997

Vehicle Weight Category	Proportion by Nationality of Manufacturer (%)					Total No of Vehicles [rounded]
	Japanese	European	American	Australian	Korean	
GVM < 3.5 t	75	8	4	10	3	165,700
3.5 t ≤ GVM < 7.5 t	95	4	1	0	0	6,100
7.5 t ≤ GVM< 15.0 t	84	11	4	0	0	4,800
GVM ≥ 15.0 t	10	17	73	0	0	5,600

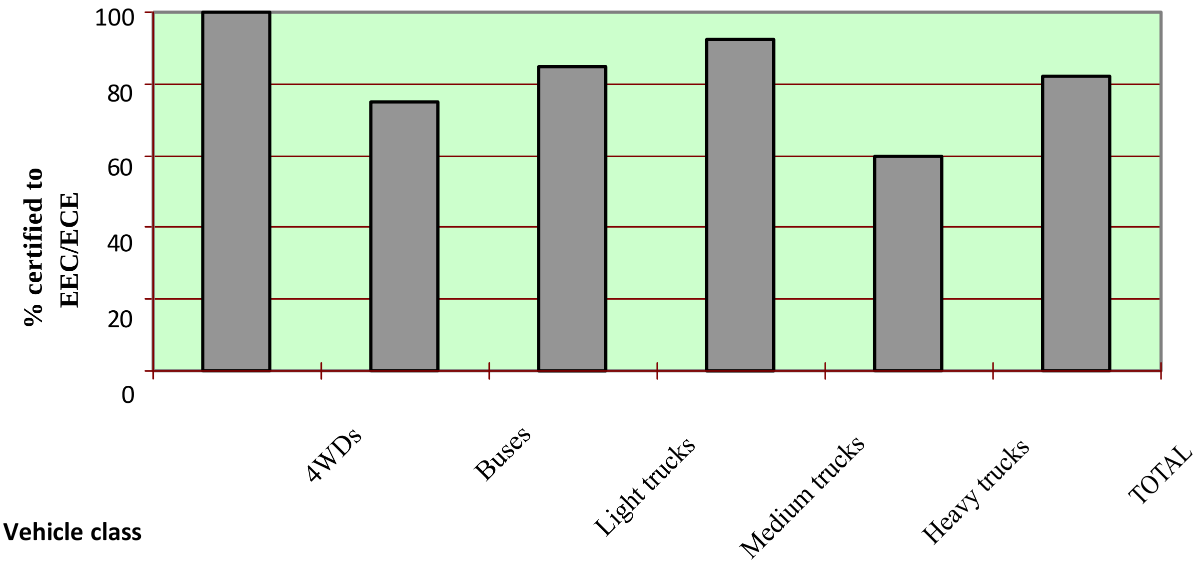
* Commercial vehicles are a mixture of petrol and diesel engined vehicles, with ABS data indicating that around 20% of light commercial vehicles (<3.5 t), 75% of rigid trucks and 100% of articulated vehicles are diesel fuelled (ABS, 1996).

Source: FCAI, 1998

For European based suppliers, harmonisation with UN ECE emission standards should pose no inconvenience since the EEC (European) directives are already technically equivalent.

Over 80% of Japanese vehicles or engines are already certified to ECE/EEC standards under the current ADR 70/00 (Figure 7). For the minority of Japanese vehicles that are currently certified under Japanese standards and do not comfortably meet ECE standards, the main impacts of compliance with ECE standards would be the re-engineering of some vehicles and some rationalisation of models.

Figure 7 Proportion of Japanese manufactured vehicles/ engines certified to EEC/ECE Standards under ADR 70/00



Source: FORS, 1996

As indicated in Table 4, a substantial proportion of heavy duty vehicles are sourced from the USA. For US based suppliers, the FCAI has stated that a revised ADR which only permitted compliance with ECE standards [ie. omitted the US EPA heavy duty standards as an alternative], would have commercial implications associated with additional certification costs. Unlike many of the Japanese vehicles, US sourced vehicles are certified to domestic US EPA standards. There are US engines going to the European market but these are not considered suitable by the industry for the demands of the Australian road freight industry (ACVEN Diesel Emissions WG, 1996). Furthermore, compliance with UN ECE standards is unlikely to improve emissions performance because it appears (albeit on limited data) that the *US94* heavy duty standards are at least as stringent as the equivalent ECE standards (*Euro 2*).

Smoke Emissions

In improving diesel vehicle emission standards, the question is raised as to whether there is still a need for a separate smoke standard (as encompassed in ADR 30/00) or whether the particulate standards alone ensure adequate control of visible smoke. Currently ADR 30/00 details a test method for visible smoke and allows the US EPA provisions and ECE R24 as alternatives.

It has been suggested that compliance with particulate standards of the stringency of US 1991 type standards (currently an option in ADR70/00) should effectively eliminate visible smoke emissions (OECD, 1993); so the question arises as to whether a smoke standard is required at all for vehicles complying with such standards. Nevertheless, the US, Europe and Japan still maintain separate limits for visible smoke in their emission regulations, and thus manufacturers undertake opacity testing as a matter of course to obtain compliance. This maintenance of a smoke test would not add to compliance costs for the Australian market. There is also an argument that for State regulatory authorities to have an effective basis for controlling smoke from in-service vehicles, it is preferable if those vehicles have passed a smoke emission requirement as part of their initial certification test.

4.2.2 Stringency of Standards

Emissions standards are complex, incorporating tests for both exhaust and evaporative[16] emission tests, durability requirements, different emission limits for different classes of vehicles, and sometimes variable applicability dates within the standard. Table 5 summarises the key features of the current ADRs (36/00, 37/01 and 70/00) compared with the *Euro 2* and *Euro 3* standards. More details on the emission limits and test provisions are outlined in the tables at Attachment A.

[16] Evaporative emission tests do not apply to diesel engined vehicles.

Table 5 - Comparison of UN ECE (*Euro 2* & *Euro 3*) standards with Current ADRs

Vehicle Type	**Key Features of the ECE Standards vs Current ADRs** (1)	
	Euro 2	***Euro 3***
Petrol		
Light Duty ([illegible]2.7 tonnes)	• No change in limits for CO & HC, 65% reduction in NOx limits (2) • Evap test same (2hrs) • Durability requirement same (80k)	• Tougher emissions test, including cold start sampling • No change in limits for CO & HC, 75% reduction in NOx limits (3) • Evap test much tougher (24hrs) • Durability requirement same (80k) • On board diagnostics (OBD) • Separate -7 ^{o}C test for CO & HC
Heavy Duty (>2.7 tonnes)	• More stringent emission requirements all round • Limits on NOx (none at the moment) • ECE does not cover petrol engines over 3.5 tonnes (4)	• Much more stringent emission requirements all round • Limits on NOx (none at the moment) • Apart from emission limits, other requirements as for light duty above • ECE does not cover petrol engines over 3.5 tonnes (5)
Diesel		
Light Duty ([illegible]3.5 tonnes)	• LCVs and 4WDs subject to more stringent emission test and limits • LCVs and 4WDs meet PM limit (none at the moment)	• LCVs and 4WDs subject to much more stringent emission test and limits • LCVs and 4WDs meet PM limit (none at the moment) • Apart from emission limits, other requirements as for light duty above, except no evap test and OBD requirements phased in over longer period
Heavy Duty (>3.5 tonnes)	• 15% reduction in NOx limits • 60% reduction in PM limits	• Changes to test procedures • 40% reduction in NOx limits • 70% reduction in PM limits

(1) % reductions rounded to nearest 5%
(2) But comparative testing on FTP and ECE indicates ECE Euro 2 test tougher on HC for most vehicles and tougher on NOx for locally produced US based engines.
(3) But comparative testing on FTP and ECE indicates ECE *Euro 3* test much tougher on CO, HC and NOx for most vehicles
(4) Propose to address this shortcoming by adoption of US Heavy duty standards for petrol engines.
(5) Propose to address this shortcoming by adoption of US Heavy duty standards for petrol engines.

As well as comparing the relative stringency of the UN ECE standards with the current ADRs, the stringency of alternative standards was also considered.

The US EPA emission standards have set the pace for international emission standards over the past 20 odd years. However, during the 1990's the UN ECE standards have been significantly strengthened to the point where it is generally accepted that the current UN ECE standards and the current US standards are "equivalent", as far as can be established, given that that the emissions tests used in the standards are different. Table 6 compares the US and UN ECE standards for petrol engined cars.

Table 6 Comparison of Passenger Car (Petrol) Emission Standards

Current & Future Standards	Date of Implementation	Limits on Emissions			
		CO (g/km)	HC [exhaust] (g/km)	NOx (g/km)	HC [evaporative] (g/test)
ADR37/01 (1)	1997-9	2.1	0.26	0.63	2
UN ECE			(Combined HC and NOx)		
Euro 2 (2)	1996	2.2	0.5		2
Euro 3 (2)	2000	2.3 (3)	0.2	0.15	2
Euro 4 (4)	2005	1.0	0.1	0.08	2
US EPA					
Tier 1 (5)	1994-6	2.1	0.25 [0.15] (6)	0.25	(7)
Tier 2	2004	1.0	0.08 (8)	0.12	

(1) The Australian standard (ADR37/01) requires the emission limits to be met for a period of 5yrs/80,000km and the test method is the same as that used in the US standard.

(4) The *Euro 2* and *Euro 3* standards require the emission limits to be met for a period of 5yrs/80,000km

(5) Limit for *Euro 3* is nominally higher, but Euro 2 test excludes the first forty seconds of testing from sampling, thus making the CO limit much harder to meet

(4) The *Euro 4* standards require the emission limits to be met for a period of 5yrs/100,000km

(5) Ti*er 1* requires the emission limits to be met for a period of 5yrs/80,000km and sets more relaxed limits to be met up until 10yr/160,000km.

(6) *Tier 1* requires total hydrocarbons 0.25g/km, with the non-methane hydrocarbons (NMHC) content being 0.15g/km.

(7) Complex evaporative emission requirements are being progressively introduced in the US between 1996-99.

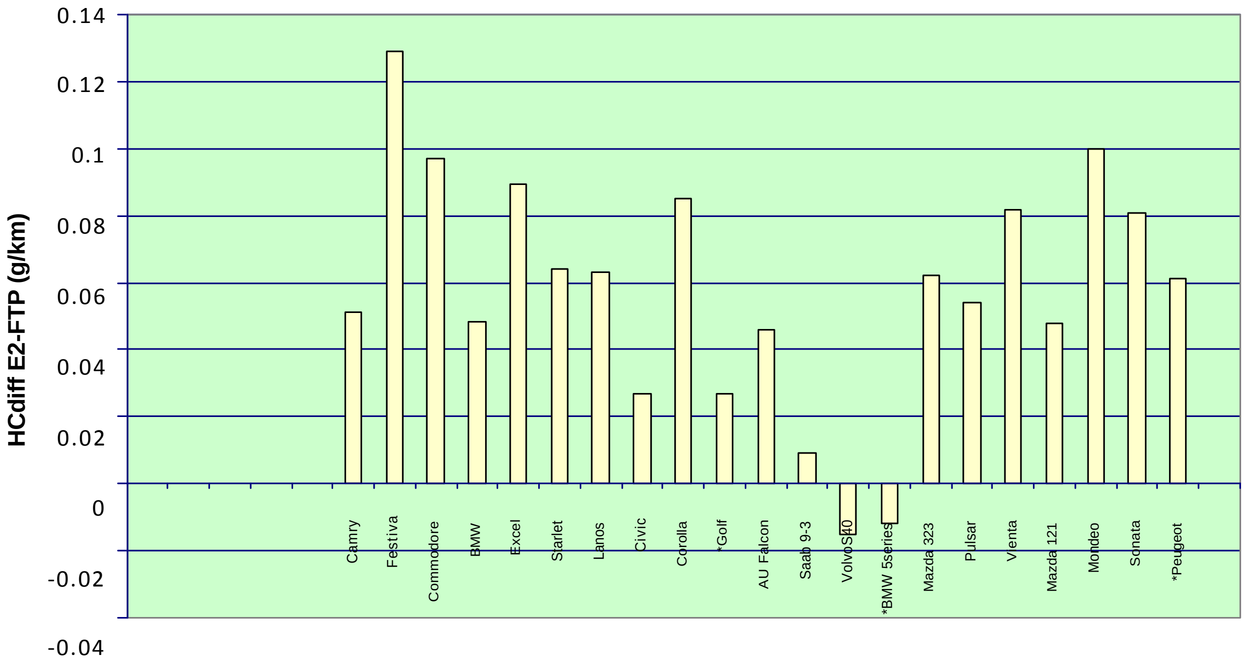
(8) Limit relates to non-methane hydrocarbons. (NSW EPA estimates NMHC 80% of total HC)

The Federal Office of Road Safety is undertaking a comparative emissions test program using current model passenger vehicles from the Australian fleet to investigate the relationships between the different standards. The key findings based on the results to date are:

- On average, current vehicles (built to meet ADR37/01) have emission rates well under the nominated ADR37/01 limit (average 30-40% of the regulated limit). While, on average, these vehicles are also under the *Euro 2* emission limits for CO and the combined HC+NOx limit, they are considerably closer to the limits (average 50% of the CO and 80% of the HC+NOx limits). When the NOx limits are considered separately (ie as ½ of the combined HC+NOx limit), the vehicles exceed the NOx limits by 20% on average. These averages for HC+NOx and NOx exclude the two high volume local models which fail the *Euro 2* NOx limits by a wide margin. These results indicates that further engine/catalyst development would be required for a number of these vehicles to enable them to meet *Euro 2* HC+NOx limits, and also for the manufacturers to be confident that the 80,000km durability requirements will be met for all 3 gases.

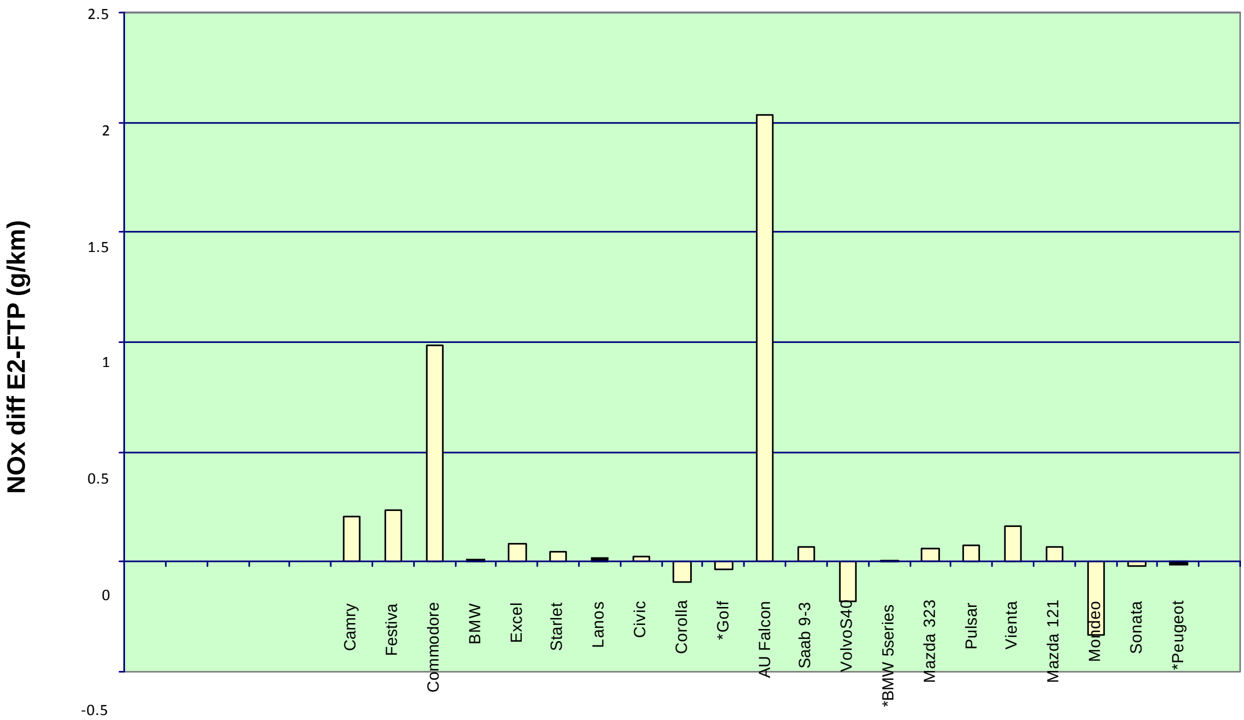
- The *Euro 2* is more demanding on HC for most vehicles (Figure 8).
- The *Euro 2* exhaust emissions test is significantly more demanding on NOx for locally built vehicles using US derived engines (Figure 9).
- The *Euro 3* exhaust emissions test is more demanding on HC and CO emissions (Figures 10 & 11).

Figure 8 **Difference[17] in HC emissions between ADR37/01 Emissions test (US FTP) and the UN ECE test (*Euro 2*) (g/km)**



[17] Positive result indicates *Euro 2* test more demanding than ADR37/01

Figure 9 Difference in NOx Emissions between ADR37/01 Emissions Test (US FTP and the UN ECE Test (*Euro 2*)



A shift to adoption of UN ECE standards in these ADRs would mean that some manufacturers would have to undertake different emission test protocols. This, in itself, is not likely to cause any significant difficulties, as most manufacturers are familiar with the ECE test procedures, and have the facilities to undertake the tests for *Euro 2*. For *Euro 3*, however, the local vehicle manufacturers would have to upgrade emissions testing facilities including variable volume 'sheds' for 24 hour evaporative testing and more sensitive emission analysers.

The FORS emissions test program also compared the performance of vehicles on the *Euro 2* and *Euro 3* versions of the UN ECE exhaust emissions test. Preliminary data indicate that the *Euro 3* test, which omits the 40 second "no sampling" period at the beginning of the *Euro 2* test cycle, is a more demanding test for almost all the tested vehicles on CO and HC emissions (see Figures 10 and 11[18]), and in a number of vehicles, it was also tougher for NOx emissions.

[18] Positive number indicates that *Euro 3* test is more demanding.

Figure 10 **Difference in CO emissions between *Euro 2* and *Euro 3* versions of the UN ECE Emissions Test g/km**

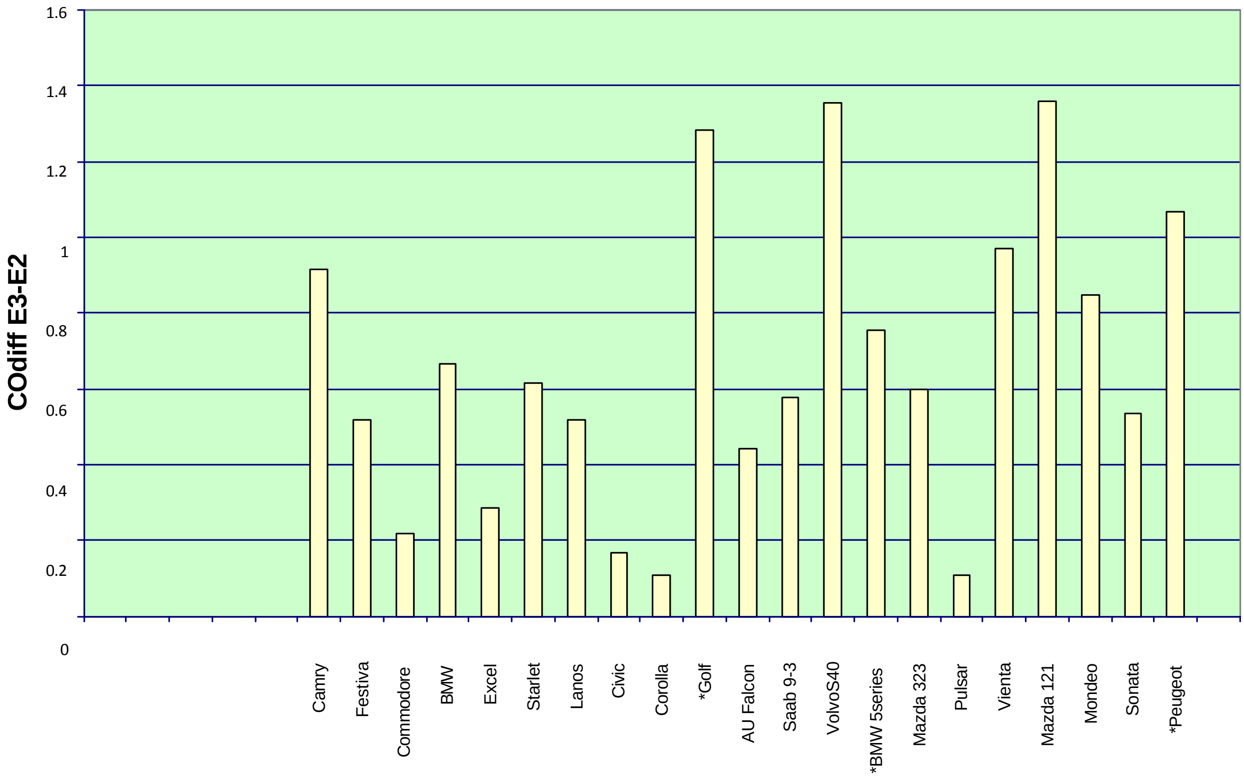
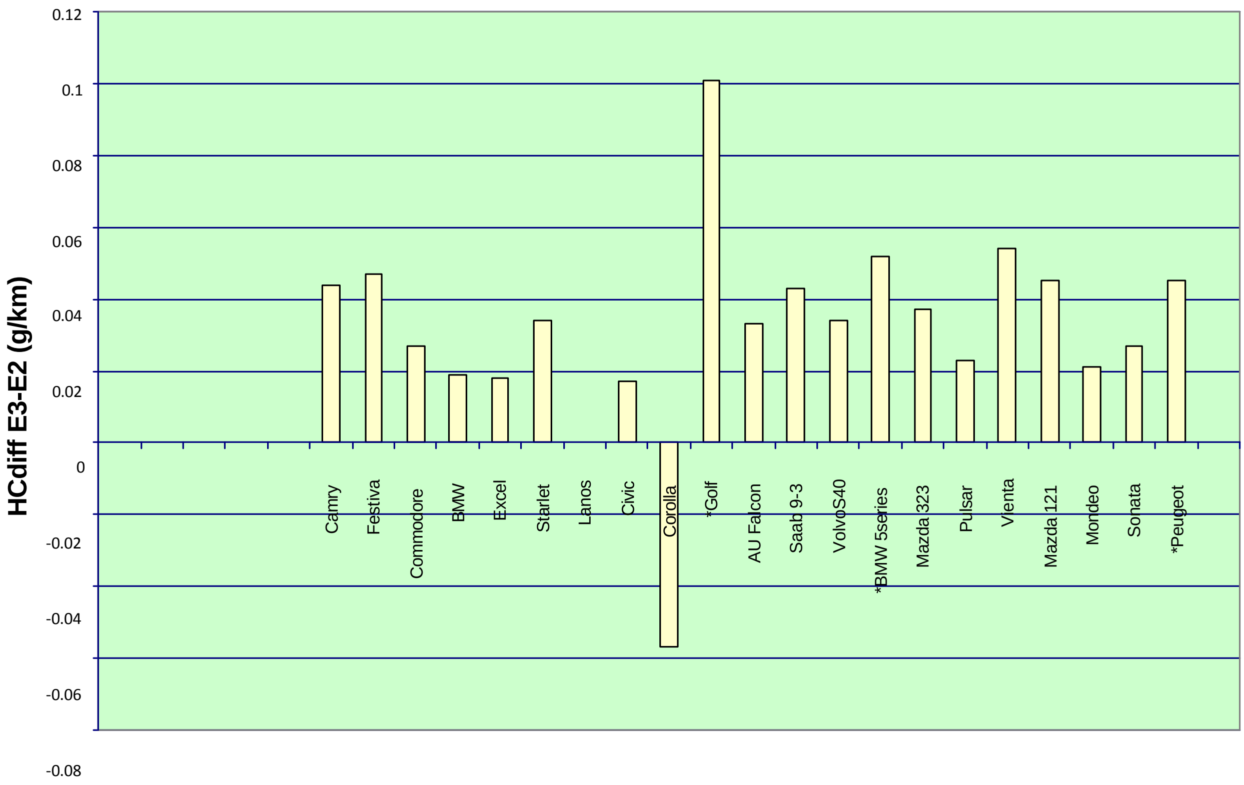


Figure 11 **Difference in HC emissions between *Euro 2* and *Euro 3* versions of the UN ECE Emissions Test g/km**



For diesel vehicles, the ECE, US and Japanese standards all set limits on HC, CO, NO_X particulates and visible smoke. Limits set by these standards are not consistent, and comparisons between the US, ECE and Japanese standards are difficult, due to differing units of measurement, test methods, and/or vehicle category definitions.

Some measure of comparative stringency can be gained by focussing on "heavy" vehicles (as defined in the relevant standards). For heavy vehicles, current (1996) standards are reasonably consistent on control of NOx emissions, but the Japanese standard is considerably less stringent (by a factor of 6) on particulates (see Table 7). By 2000, the NOx limits will have been tightened across the board. In 2000, the particulate limits will have also been tightened in all three standards, but the Japanese standard will still significantly more lenient (although by a factor of about 2).

Table 7 Comparison of 'Heavy Vehicle' Standards on NO_X and PM Limits

Standard *	Gross Vehicle Mass / Engine Category	Oxides of Nitrogen [g/kWh]			Particulates [g/kWh]		
		ADR70/00	1996	2000	ADR70/00	1996	2000
ECE 49/02 (*Euro 1,2,3*)	> 85 kW	8.0	7.0	5.0	0.36	0.15	0.10
US EPA (91,94,98)	> 3.9 tonnes	6.7	6.7	5.4	0.33	0.13	0.13
Japan (94,94,97-2000)	> 2.5 tonnes	7.8	6.8	4.5	0.96	0.96	0.25

* For the purposes of this table, a 1:1 relationship has been assumed for all three standards for both NOx and particulates. While caution must be exercised in comparing results from different test methods, the OECD reports that conversion factors for US transient test and the ECE 13-mode test for NOx are 1:1. For particulates the relationship is not so straightforward, however, a Norwegian analysis suggests that a 1:1 correlation is acceptable for values of 0.4-1.0 g/kWh. No correlations were available for the Japanese standard, but it also uses a 13 mode test for "heavy" vehicles (OECD, 1993).

4.2.3 Timing

The timing of introduction for any new ADR needs to consider:

- Current and proposed international standards suitable for adoption;
- The degree of lead time necessary for vehicle manufacturers to supply vehicles to the market which meet the new standards; and,
- Where necessary, for petroleum producers to supply the fuel to ensure satisfactory in-service emissions performance from the vehicles meeting the new standards.

In deciding on which standards to adopt, consideration should also be given as to how much the ADRs should lag behind UN ECE standards. The Prime Minister's statement, *Safeguarding the Future* (Prime Minister 1997), committed the Federal Government to harmonisation with international standards by 2006. By 2006, *Euro 3* emission standards will have been mandated for six years, with *Euro 2* standards having been in place for an additional four years (introduced in 1996). The European Union will also mandate *Euro 4* standards in 2005.

In terms of lead times, the current practice with ADRs is to aim for a minimum lead time of 2 years for manufacturers whenever possible. The Federal Chamber of Automotive Industries (FCAI) has stated that costs for compliance would be reduced if the timing of new standards were timed to coincide with major model changes, which on average were expected in

2002/3. This could be accommodated by requiring new models to comply by the agreed date, and allowing existing models to remain on the market for a year or more after that date. Subsequent advice from the FCAI indicates that major model changes for two locally manufactured passenger vehicle models are now scheduled a year or two later than 2002. However, the remaining local manufacturers and importers are able to accommodate a 2002/3 timeframe. It is feasible that the adoption of new standards would be phased in to allow manufacturers a transition period between phasing out existing models and introducing new models. This has been standard practice in the past, with a 1 year phase in period allowed for ADR70/00 and a two year phase in period for ADR37/01.

Although there are no local manufacturing implications for new diesel engine standards, (as they are all imported) some lead time is required for local suppliers to source suitable engines, and in some cases make modifications to enable the assembled vehicles to operate successfully under Australian climatic conditions. To comply with the *Euro 2* limits in ECE 49/02, it is expected that smaller truck models will require catalysts whilst heavy trucks generally will not (FCAI, 1996). For heavy duty diesel vehicles, industry advice is that European and US supplies can readily supply engines to the market which meet *Euro 3* or equivalent US standards in 2002. As indicated earlier, companies from these source countries dominate this sector of the heavy duty truck and bus market. Japanese diesel vehicles may not be able to readily comply with *Euro 3* by 2002.

Meeting the request for a two year lead time means that any new ADR would not take effect before 2002. With 2002 as the start date, there are a number of options which could be considered, including:

1. Adopt the version of the UN ECE standard which is in place now (*Euro 2*) in 2002; or
2. Adopt the version of the standard which will be in place by 2000 *(Euro 3)* perhaps with a later application date; or
3. A combination of both 1 and 2.

If alternative certification under US standards was recommended for heavy duty vehicles, then the *US94* standards would be the "equivalent " standards to the primary (*Euro 2*) standard. It is recognised that the US introduced even more stringent standards in 1998, but if the *Euro 2* standard is to be adopted, it would be unreasonable to require US suppliers to certify to *US98*, as this would force US suppliers to meet a standard significantly more stringent than the primary ECE standard. However, it would be appropriate to allow certification to *US98* as an alternative to the *US94*. If the *Euro 3* standards were adopted, then compliance with the *US98* standards would be appropriate.

Although the European Union will be mandating *Euro 4* in 2005, this review did not analyse the impact of *Euro 4* as the European Union are still determining the fuel and technological requirements for *Euro 4*. Hence it is difficult to assess the impact of *Euro 4* at this time.

The Australian Institute of Petroleum (AIP) has also stated that the petroleum industry would want 4-5 years lead time to install the necessary capital equipment to provide low sulfur diesel fuel across the market [see fuel discussion in Section 4.2.4].

4.2.4 Role of Fuel Parameters

If emissions standards are to be met in practice, then the relationships between fuel properties and exhaust emissions need to be recognised. Specifically, there is a need to consider the relative impacts of fuel parameters on emissions and the capacity of vehicles to meet the emission limits imposed by a new ADR in the in-service environment. There are different issues associated with petrol and diesel.

A comprehensive Fuel Quality Review has been commissioned by Environment Australia to examine the impacts of changing a broad range of fuel parameters to meet a number of environmental objectives. The results of the Review are expected to be available in early 2000.

The international vehicle manufacturers have also developed a World Wide Fuel Charter (ACEA/AAMA/JAMA/EMA, 1998) which details the manufacturers' preferred fuel standards for vehicles meeting specified emission standards applicable in those markets.

This review focused on the limited number of fuel parameters which are considered to have a direct impact on in-service compliance with the *Euro 2* and US EPA 94 (heavy duty diesel only) standards. These included petrol volatility, octane rating and the sulfur content of diesel. The fuel parameters for *Euro 3* will be considered by the Fuel Quality Review.

4.2.4.1 Petrol

Three grades of commercial petrol are marketed in Australia. Leaded petrol with a minimum research octane number (RON) of 96 currently accounts for approximately 30% of the total petrol market, and demand is steadily falling as the number of pre-1986 vehicles on the road declines. Two unleaded grades are also available; regular unleaded (ULP), with a RON of 91-93, and "premium" unleaded (PULP), with a RON of 95. Regular ULP comprises the majority of the ULP market; PULP accounts for approximately 3% of the total petrol market. This review is only concerned with the unleaded petrol grades.

The parameters of petrol which are important to consider in the context of this review of emission standards, are the octane rating and volatility. A summary of selected parameters of test and commercial fuels in Australia, Europe and the USA is contained in Table 8.

Table 8 **Comparison of Selected Parameters of Test and Commercial Petrol Fuels in Australia, Europe and the USA (based on “standard” grade of unleaded petrol)**

Fuel Properties	**Australia**			**Europe**		**USA**	
	ADR37 ULP Test Fuel	**Commercial ULP**		**ECE R83 Test Fuel**	**Commercial ULP Specifications**	**FTP Test Fuel**	**Commercial ULP (averages)**
		Average	**Range**				
Research Octane Number (RON)	91-93	91.6	90.5-96.4	95 (min)	95 (min) *	93 (min)	92.2
Volatility (RVP)	60-63.4	72.7 (Nov-Feb)	60-83 (N-F)	56-64	60 ** (summer)	63.4	variable
Benzene (% vol)	-	2.7	0-5	-	5 (1**)	-	1.6
Sulfur (% mass)	0.05 (max)	0.017	0-0.06	0.04 (max)	0.05 (0.015**)	0.1 (max)	0.035
Aromatics (% vol)	35 (max)	30	11.4-47	45 (max)	42 (max) **	35 (max)	?
Olefins (% vol)	10 (max)	10	5.5-20.7	20 (max)	18 (max) **	10 (max)	?

* Some European countries have commercial grades of ULP with lower octane ratings (90-92 RON)

** These limits to apply from 2000.

Sources:

Australian Commercial ULP figures from Australian Product Characteristics Summary 1997 – Unleaded Petrol – AIP

US Market figures for min/max from ASTM D-4814 and Motor Vehicle Emission regulations and fuel specifications – 1992 update, Concawe publication. US Average figures from Motor Gasolines, Winter 1991-1992 & Summer 1992 NIPER publication.

EEC Market figures for min/max from Motor Vehicle Emission regulations and fuel specifications – 1997 update, Concawe publication

Petrol Volatility

Petrol volatility is an indication of how fast a fuel evaporates. The fuel that evaporates from the fuel tank and system of vehicles can be discharged into the air. The discharged fuel vapours are known as evaporative emissions, and contribute to the development of photochemical smog. A number of vehicle technologies are used to limit the discharge of the fuel vapours, the principal technique being the use of a carbon canister.

As indicated in Table 8, the volatility of commercial grades of ULP in Australia are considerably higher than that of the test fuel on which the vehicle is certified under ADR37/01. Recent research conducted in Australia (FORS, 1996) indicated that many vehicles are not meeting evaporative emission standards once they are in-service. Further investigation in the Petrol Volatility Report (FORS/EA, 1997) confirmed the linkage between fuel volatility and evaporative emissions, and demonstrated that reductions in fuel volatility can significantly reduce evaporative emissions from vehicles. This later research also demonstrated that replacement of carbon canisters on vehicles can also reduce evaporative emissions, but the longevity of this benefit was uncertain.

It needs to be recognised that the issue of fuel volatility affects the in-service compliance of vehicles with the evaporative emission standards in ADR37/01 and earlier versions of the standard, so it is not an issue associated with the adoption of new standards, *per se.* Evaporative emission standards are likely to continue to be exceeded in-service with current and future standards, unless fuel volatility is reduced.

Octane Rating

Octane is a measure of the ability of a fuel to resist detonation (engine knock), with a higher number indicating greater resistance. In essence if the octane demand of a vehicle engine exceeds that of the fuel it is using, the vehicle will not be operating at optimum efficiency.

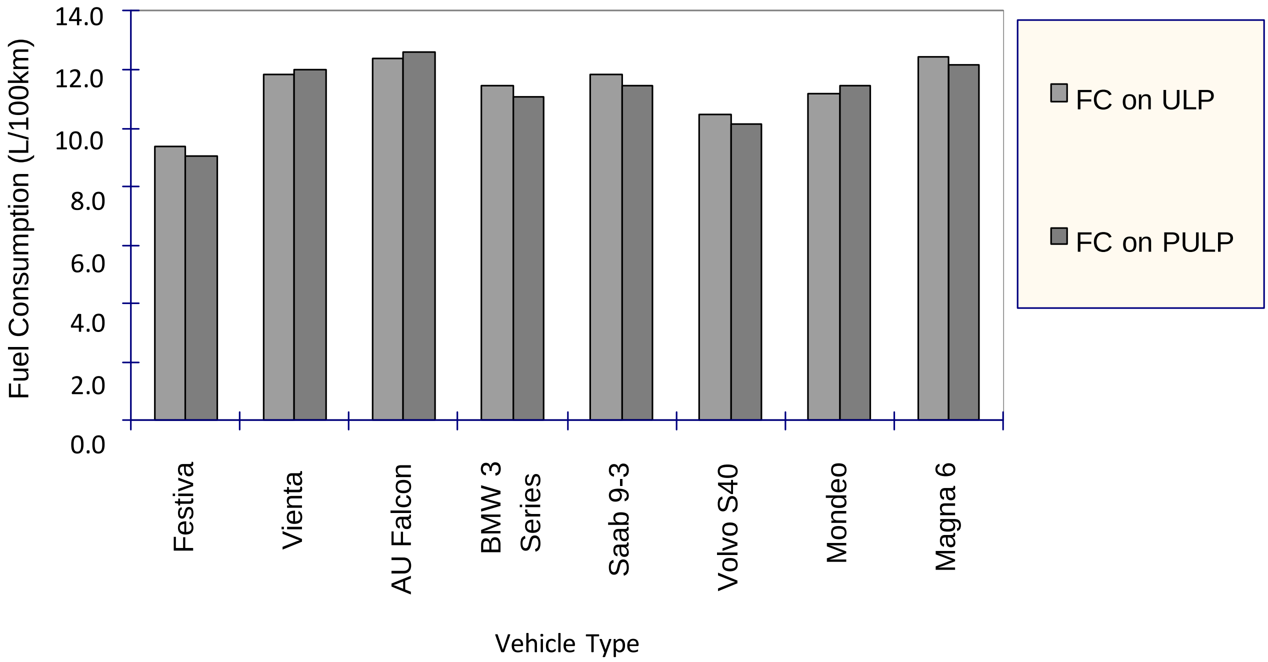
As indicated in Table 8, the average octane rating of Australian ULP is around 91 RON, in line with the ADR37/01 test fuel. In contrast, the *Euro 2* standards specify a test fuel of minimum 95 RON, with most (but not all) regular ULP in Europe also being 95 RON. Some countries in Europe have ULP with octane ratings similar to that of Australian ULP.

The FCAI have argued that if the revision of ADR 37/01 results in the adoption of the UN ECE standard, all new models certified to the new standard will need 95 RON fuel to operate efficiently (FCAI, 1999b). There was no evidence available to the review to demonstrate that a vehicle certified to UN ECE R83 (*Euro 2*) on 95 RON test fuel would have worse emissions when that vehicle is operated on a commercial fuel of less than 95 RON. This view is supported by the draft Report commissioned by Environment Australia to investigate measures for reducing vehicle consumption (ACIL, 1999) which states that no change would be required to petrol for the adoption of *Euro 2.* However, as it is likely that high compression engines will be used to comply with *Euro 3*, 95 RON may then be required for many *Euro 3* vehicles. The Federal Government is seeking to expand the supply of high octane (95 RON) petrol, as it considers it will encourage the vehicle industry to supply later technology engines which deliver improved fuel economy on 95 RON fuel (ESMVI, 1997).

Clearly there are imported vehicles on the Australian market now which are designed and tested to *Euro 2* specifications and which run satisfactorily on ULP but it is not clear whether this operation compromises their performance, fuel consumption or emission levels. Advice from one manufacturer stated that engine recalibration for driveability on 91 RON ULP, while still meeting the *Euro 2* standards on 95RON, will sacrifice optimum emissions performance, fuel consumption and engine power (Toyota, 1999).

Preliminary results from the comparative emissions test program being managed by FORS, indicate that, based on a small sample of 8 vehicles, emission rates and fuel consumption for most vehicles under the *Euro 2* test were not much different when the vehicles were tested on regular unleaded petrol (ULP - 91RON) and high octane petrol (PULP – 95RON). Emissions differences were particularly small in the 4 European vehicles which met the *Euro 2* emission limits and are presumably designed to meet the UN ECE cycle. One locally produced vehicle with very high NOx levels did show a marked difference in NOx emissions when operated on the 2 fuels. The fuel consumption results are summarised in Figure 12.

Figure 12 Fuel Consumption under UN ECE *Euro 2* Test Conducted on ULP and PULP



The vehicle industry in many countries is being required to concurrently meet both emissions and fuel consumption objectives. The review was not presented with any evidence to establish that adoption of *Euro 2* and *Euro 3* emission standards will compromise efforts to meet the Government's greenhouse gas reduction objectives for the vehicle sector.

4.2.4.2 Diesel

In terms of the key NOx and PM emissions, diesel fuel properties appear to have little bearing on NOx emissions, but some properties have significant effects on PM emissions.

Fuel Sulfur

Sulfur in diesel has been identified as a parameter closely linked to particulate emissions. PM emissions are a combination of carbon particles [the largest portion], hydrocarbons [measured as the soluble organic fraction] and sulfate particles (Bagley *et al*, 1996). The contribution of diesel fuel sulfur content to exhaust particulate emissions has been well established (McCarthy *et al*, 1992; Bertoli *et al*, 1993, OECD, 1993), with a general linear relationship between fuel sulfur levels and regulated emissions (EPEFE, 1995). Lower sulfur content in the fuel directly reduces sulfate particulate emissions and emissions of sulfur dioxide, which is converted to sulfate particulates in the atmosphere (Bagley *et al*, 1996; Den Ouden *et al*, 1994; Opris *et al* 1993 - see Table 9).

Table 9 Summary of effects of sulfur content on NO_X, PM, SO_4 and HC emissions

Fuel Property Action	Heavy Duty Vehicles		
	Effect on NO_X	Effect on Total PM *	Effect on SO_4 Proportion of PM
Reduce Sulfur (0.29�0.01wt%) @ 25% load	no significant effect	⍰⍰17%	⍰⍰98%
Reduce Sulfur (0.29�0.01wt%) @ 75% load	no significant effect	⍰⍰24%	⍰⍰96%

* PM from diesel engined vehicles is comprised of carbon [C], a soluble organic fraction [SOF] and sulfate [SO_4].

Source: Opris *et al*, 1993

Testing indicates that the relative impact on PM emissions from reductions in the sulfur content of the fuel can vary. Factors that contribute to this variation include vehicle/engine type, the emissions test cycle, the vehicle/engine technology used to meet emission standards and the level of reduction in the sulfur content of the fuel.

The FCAI has indicated that many lght duty diesel vehicles [<3.5 tonnes GVM] will require oxidation catalysts to comply with *Euro 2* type standards. This would also apply to *Euro 3* type standards. In addition the FCAI has stated that compliance with *Euro 2* standards will not be possible unless the sulfur content of commercial diesel fuel is reduced to a maximum of 0.05% (FCAI, 1999b). In light of this, the impact of sulfur content on catalyst operation also needs to be examined, particularly as light duty vehicles do most of their work in urban areas.

Oxidation catalysts lower HC, CO and PM emissions, but have no impact on NOx emissions. They have little impact on the carbonaceous component of PM emissions, but typically remove around 30% of total PM emissions through oxidation of a large proportion of the soluble organic fraction (Accurex, 1993). The sulfur content of the fuel is widely reported to have an impact on the effective operation of oxidation catalysts used on some diesel engined vehicles (OECD, 1993; Accurex, 1993; California Air Resources Board, 1994; Manufacturers of Emission Controls Association, 1996; ACEA/EC/Europia, 1995).

The conversion of sulfur in the catalyst reduces the availability of active sites on the catalyst surface. The catalyst does not appear to suffer permanent damage, and will largely recover after a period of operation on low sulfur fuel and exposure to high operating temperatures (Webster, 1997).

There is also considerable research to demonstrate that a high sulfur content in the fuel can also lead to the formation of sulfates in the converter which are then emitted as additional PM (California Air Resources Board, 1994; Hosoya and Shimoda, 1996; Ketcher and Horrocks, 1990; Ketcher and Morris, 1991; Brown, 1997).

To enable compliance with tighter PM emission standards for diesel vehicles, tighter limits on the maximum sulfur content of commercial diesel fuel have been, or are being, introduced in many countries around the world (see Table 10). Even though the sulfate proportion of the total PM emission is relatively small (around 10%), it has become more significant as the PM emission standards (which are all based on the total mass of the PM), have become more stringent. So while substantial reductions in PM emissions can be obtained without reducing sulfur levels down to the 0.05% mark, compliance with *Euro 2* type standards is not possible at higher levels, because of the relatively greater proportion of sulfates in the total mass of PM emission. Even lower sulfur limits 0.035% and 0.005% have been set in parallel with *Euro 3* and *Euro 4* standards.

Table 10 Current and Future Regulated Maximum Sulfur Limits on Diesel Fuel in Various Countries

Country/ Region	Situation at the end of 1997	Future Situation	
	Maximum Sulfur Limit	Maximum Sulfur Limit	Proposed Year of Introduction
EU	0.05%	0.035% 0.005%	2000 2005
US	0.05%	U	U
Canada	0.05%	U	U
Japan	0.05%	U	U
Hong Kong	0.05%	0.035%	2000
Singapore	0.05%	U	U
Thailand	0.2%	0.05%	1999
Australia	0.5%*	U	U

"U" means unknown;
* Sulfur content is not regulated by law in Australia, however 0.5% is the limit in the Australian Standard AS 3570, Automotive Diesel Fuel, which the industry meets on a voluntary basis.
Source: Concawe (1995), European Commission (1996b), Drummond (1997)

The lowering of the diesel fuel sulfur content to 0.05% in the US was timed to occur in conjunction with the *US94* emission standards. Similarly, the 0.05% limit in the EU was aligned with the introduction of the *Euro 2* emission standards (Concawe, 1995). In both the EU and US, all the research and development work, and subsequent certification testing of vehicles to the current standards, is conducted with low (0.05%) sulfur test fuels, in the expectation that the commercial fuel supplied will also have a low sulfur content. Apart from contributing to effective operation of catalysts and reducing PM emissions, the European move to an even lower maximum sulfur content of 0.035% by 2000 and 0.005% by 2005, is to enable tighter emission standards to be met by the use of next generation "de-NOx" catalysts, which are very sensitive to sulfur (Drummond, 1997; Council of the EU, 1998)

The average sulfur content of Australian diesel is currently 0.13% with a range of 0.0-0.5% (AIP, 1999). This average is very much dependent on the crude oil feedstock and refinery configuration.

Other Diesel Fuel Properties

Research on fuel property effects indicates that reduced fuel density, reduced polyaromatic content, increased cetane number and decreased back-end distillation temperature have beneficial but fairly weak effects in reducing emissions relative to improved engine design (EPEFE, 1995; McCarthy *et al*, 1992). Reduced fuel density is the only one of these parameters producing a significant reduction in particulates but only for light duty vehicles.

4.2.4.3 Fuels Issues Summary

In considering the findings of EPEFE (1995) and other work, the conclusions regarding the relative and absolute impacts of fuel parameters on emissions are as follows:

- Both fuel parameters and engine technologies are important determinants of emission levels;
- Relationships between fuel properties, engine technologies and emissions are complex, and, in the case of diesel fuel, changing one fuel property may have different effects on emissions from light and heavy duty vehicles;

- The fuel requirements for in-service delivery of *Euro 3* standards are likely to be more stringent than that for *Euro 2*;
- In the case of petrol:
  - reducing commercial fuel volatility would improve in-service compliance with evaporative emission standards;
  - There is no objective data to support an increase in octane rating of commercial fuel to ensure *Euro 2* standards are met in practice, but an increase in octane may be necessary for *Euro 3*;
- In the case of diesel:
  - Reducing the sulfur content, and lowering fuel density, appear to be the only measures which have a significant impact on PM emissions;
  - Fuel properties appear to have no significant impact on NOx emissions;
  - Reducing fuel sulfur content is the only change to fuel properties that can be made largely independently of other properties, and delivers significant reductions in particulate emissions. High sulfur levels also impair effective catalyst operation, but do not appear to cause permanent damage to catalysts. Current limits on maximum sulfur content in Australian diesel fuels are set at levels ten times those of the US and Europe; and
  - *Euro 2* diesel vehicles using catalysts are unlikely to meet the standards in practice unless the sulfur content is reduced to 0.05%.

4.3 TIGHTER CONTROLS ON IN-SERVICE EMISSION STANDARDS (OPTION 3)

It is recognised that achieving reductions in total emissions requires a mix of strategies including motor vehicle standards and in-service programs. For example the New South Wales, Victorian and Queensland air quality strategies recommend action on new vehicles, and in service measures (NSW EPA, 1998; QDOE, 1998; Vic EPA, 1997).

The National In-service Emissions Study (NISE Study – FORS, 1996) into in-service emissions from passenger cars demonstrated that considerable exhaust emission benefits could be obtained from regular tuning and maintenance. For cars built to ADR37/00 standards, the average reductions in emissions from tuning ranged from 9% for NOx, 21% for HC and 24% for CO. State and Territory Governments operate a range of in-service vehicle emission programs, which vary widely in their nature and level of enforcement. To date only the NSW Government has made a commitment to a regular inspection and maintenance program based on emissions testing.

The NISE Study also indicated that evaporative emissions from vehicles are on average well above the limits mandated in ADR37. The subsequent Petrol Volatility Project (FORS/EA, 1997) examined this in more detail and concluded that, from a vehicle perspective, considerable reductions in evaporative emissions could be obtained by replacing carbon canisters, although this benefit is dependent on the durability of the canisters. A program of canister replacement would be difficult to administer, and is only likely to work on a mandatory basis.

Currently, the only in-service controls on diesel vehicles are for visible smoke. There appears to be considerable technical and cost impediments to wider in-service controls on diesel vehicles. The current in-service diesel emissions studies being managed by the NEPC aim to provide some information on the emissions performance of the Australian diesel vehicle fleet, the potential benefits of maintenance, and the feasibility of establishing workable, objective in- service emission tests for diesel vehicles. Results are not expected to be available from these studies until late 1999.

The Industry Commission stated in its Automotive Industry Report (1997) that a mandatory in- service inspection scheme would be resource intensive, and if the Commonwealth Government was to administer such a scheme, it might require legislative changes as this policy area is State and Territory Government responsibility.

Clearly strategies to ensure good in-service maintenance of the vehicle fleet can deliver significant emissions benefits. However, given the costs involved to administer, this option has not been pursued further.

4.4 WIDER USE OF ALTERNATIVE FUELS (OPTION 4)

There is a limited capacity to run more of the fleet which currently use petrol and diesel fuel on alternative fuels. The most significant options are liquefied petroleum gas (LPG) and natural gas (NG).

LPG is already widely used in urban areas, particularly by high mileage vehicles such as taxis, and its application to date is mainly in petrol engined vehicles. Recent testing on modern petrol engined vehicles, and equivalent vehicles running on LPG, concluded that the LPG fuelled vehicles do not offer significant environmental benefits over the petrol engined vehicles (FORS, 1997). Recent work in the UK and Europe indicates however, that heavy duty vehicles designed to run on LPG can have a very good emissions performance compared to diesel (Le Cornu and Day, 1998). The scope of LPG substitution is also claimed to be limited by its supply, with replacement of 7-8% of petrol use representing the maximum substitution (BTCE, 1994), however the current view is that LPG reserves in Australia are very substantial (Commonwealth of Australia, 1996; Le Cornu and Day, 1998).

NG has very limited use at the moment, and its greatest potential would appear to be as a diesel substitute in commercial vehicles operating out of a common refuelling point. The use of NG is becoming more common in urban bus fleets (in Perth, Adelaide, Sydney and Brisbane for example). As a substitute for diesel fuel, it offers significant benefits in reductions of PM emissions over diesel engines, but unless engine settings and emissions controls are adequate, NOx emissions from NG fuelled vehicles may be higher (BTCE, 1994). The very limited nature of the NG vehicle refuelling network is a major barrier to wider adoption. The bulkiness of NG fuel tanks and high capital cost for conversions can also limit its appeal to transport operators.

There are currently no emission standards in Australia for vehicles powered by LPG or NG. In principle, all vehicles within the scope of the ADRs should be required to meet the same emission standards, regardless of the fuel they are designed to operate on.

ECE Regulations 83/03 and 49/02 are currently undergoing amendments to incorporate emission standards for vehicles powered by NG and LPG. The limits are identical to those for equivalent vehicles running on petrol or diesel fuel. Given that these ECE Regulations will be referenced in any revised emissions ADRs it would seem appropriate to also adopt the requirements for NG and LPG engines. If the *US94* standard was adopted as an alternative, then its requirements for NG and LPG engines should also be adopted.

The inclusion of standards for LPG and NG vehicles would require changes to the scope of the ADRs, as they are presently written as petrol or diesel vehicle emission standards only.

The Federal Government currently exempts both LPG and NG from fuel excise as a means of encouraging the development of both as alternative fuels. However, there is no policy to specifically encourage their use over other fuels, but rather to allow them to compete in the transport energy market on their own merits. The Government is not able to mandate the use of specific fuels, as it would be contrary to competition principles. As indicated above, the alternative fuels network has a limited capacity to supply the fleet, and thus the use of alternative fuels, in itself, cann ot deliver significant reductions in total emissions from the vehicle fleet.

4.5 LIMITING VEHICLE TRAVEL (OPTION 5)

In order to address transport related urban air pollution, there is a ultimately a need to deal with the underlying issue of increasing vehicle travel, particularly as the emission reductions achievable from technological improvements to vehicles and fuels become progressively smaller. Mechanisms to limit vehicle use include fiscal policies (to reflect true costs of transport), transport planning and traffic management (Auto-Oil, 1995). While these mechanisms will have an important place in stabilising and reducing transport air emissions, they are beyond the scope of this review.

4.6 TAXATION STRATEGIES (OPTION 6)

The European Commission (1991) and others (Royal Commission on Environmental Pollution, 1994; Finemore, 1997) have encouraged Governments to adjust the sales tax and/or registration regimes to encourage both the scrapping of older vehicles and the purchase of newer vehicles which meet emissions standards ahead of the regulatory requirements.

An incentive based approach could be used to directly influence consumer demand for low emissions vehicles and indirectly, producer/supplier decision making. This could be achieved by lowering the purchase price of these vehicles and imposing an emissions tax on high emission vehicles. The purchase price for low emission vehicles may be lowered:

- Indirectly, through taxation and/or tariff exemptions or concessions; or
- More directly, through a rebate or subsidy to the consumer under the tax system via a direct subsidy program.

It is likely that these avenues impose a high cost on Government (from loss of revenue) for a relatively small impact on total emissions from the fleet.

Early retirement schemes for passenger vehicles are in place in some countries, and are being examined in Australia, but it is not clear whether such schemes deliver clear environmental benefits.

The taxing of emissions through a taxation regime that would allow consumers to choose between vehicles based on emissions performance, would provide a clear message to the consumer about the environmental costs associated with emissions. Low emitting vehicles would impose a lower tax, and hence be more attractive. However, taxes on emissions should be levied on the volume of pollutants from each motor vehicle. Hence, consumers should be taxed according to their level of usage and not only the design characteristics of the vehicle.

The Industry Commission stated in its Automotive Industry Report (1997) concluded that although the technology exists for measuring emissions instantaneously by analysing exhaust gases as the vehicle passes a monitoring point, there are technical limitations with this method. The level of emission varies significantly depending on the way the vehicle is being driven. Hence this type of monitoring provides an unreliable indication of the emissions performance of the vehicle.

4.7 COMPARATIVE ASSESSMENT

The focus of this review is on the effectiveness of the current new vehicle emission standards in contributing to improvements in air quality, and whether changes to those standards are warranted to ensure continuing improvements in urban air quality in Australia. This approach has been addressed in Option 2, and the following impact analysis in Section 5 examines a number of potential approaches under Option 2 in more detail.

It is widely recognised, both in Australia (eg NSW EPA 1998; QDOE 1998; Vic EPA 1997) and overseas (eg EPEFE 1995) that controlling air pollution will require a mix of strategies, and the options identified in this report are frequently identified as some of the desirable measures. However, in all cases, tighter new vehicle standards are seen as the critical measure which underpins the suite of vehicle based strategies. As an example, the South East Queensland Regional Air Quality Strategy (QDOE, 1998) states that “the most comprehensive and effective measure to reduce motor vehicle emissions is the adoption of new, tighter Australian Design Rules for motor vehicle emissions.” As stated earlier, the Industry Commission concluded that regulations such as emission standards continue to have an important role to play in addressing environmental problems, as there are substantial problems using market mechanisms to address impacts of vehicle use (Industry Commission, 1997).

New vehicle standards are considered an essential element of any strategy to address the contribution of vehicle emissions to air pollution. The other options identified above are considered *complementary*, rather than *alternative*, strategies to the introduction of new vehicle emission standards. For this reason, this Regulatory Impact Statement does not attempt to compare the relative benefits of the other options with Option 2 (except to use Option 1 as a “base case” in assessing the relative merits of the 3 “sub-options” assessed under Option 2). This is not to say that these other options do not have merit, but it is outside the scope of this report to consider them in more detail.

5. IMPACT ANALYSIS/COSTS AND BENEFITS

The only realistic option to deliver significant reductions in motor vehicle emissions, and meet the Government's objectives as outlined in the Prime Minister's Statement on Climate Change, is to revise the current emission standards (Option 2).

The impact on emissions of adopting UN ECE standards, and the relative costs and benefits of those standards have been assessed as far as practicable, noting that projections are based on limited data, and costing of items such as health effects is, at best, a very difficult exercise.

Separate analyses have been undertaken on the compliance of petrol and diesel engined vehicles with UN ECE *Euro 2* and *Euro 3* standards. Three options have been considered:

Option 2A: Adopt *Euro 2* [19] in 2002;
Option 2B: Adopt *Euro 2* in 2002, followed by *Euro 3* in 2005; and
Option 2C: Adopt *Euro 3* in 2002.

The detail of each option is outlined in Attachment B.

Whilst the principal elements of each option are the adoption of *Euro 2* or *Euro 3* standards, each option also includes:

- US heavy duty vehicle standards adopted as an alternative for heavy duty vehicles (petrol and diesel above 3.5 tonnes);
- Smoke standards in ECE 24/03 applied to diesels, with the appropriate US smoke standards accepted as an alternative for heavy duty vehicles over 3.5 tonnes;
- Emission standards applied to all vehicles operating on all fuels nominated – currently petrol, diesel, LPG and NG; and
- Later versions of the nominated standards accepted, provided they are demonstrated to be no less stringent than the version specified in the ADR.

These additional aspects are not specifically addressed in the cost benefit or cost effective analyses, as they are unlikely to have any significant impact on the conclusions.

5.1 IDENTIFICATION OF AFFECTED PARTIES

The main parties affected by the introduction of new standards are the vehicle manufacturers/importers, and the fuel industry who will incur costs and the general public who will benefit from reduced health costs and other related benefits associated with air pollution. The costs incurred by the vehicle and fuel industries are discussed in detail in sections 5.3.1 and 5.3.2. The health benefits are outlined in section 5.4.1. The impact on vehicle manufacturers, the fuel industry and consumers is also outlined in the summary of each option in Section 7.

Apart from the detailed impact analysis elsewhere (as indicated above) the impacts of introducing internationally harmonised vehicle standards at the *Euro 2* and *Euro 3* level are summarised below.

19 As reflected in the UN ECE Regulations 83 and 49.

Vehicle Manufacturers and Importers
The adoption of international standards will facilitate trade in vehicles as vehicles manufactured for world markets will be readily acceptable in Australia and those in Australia will be acceptable to a greater number of overseas markets. In addition, as it is proposed that later standards be accepted as alternatives, there will be no delays, or additional costs, in accepting vehicles complying with more stringent international standards. Harmonising with international standards provides for ready acceptance of certificates of conformance issued by international regulatory authorities. This lessens the regulatory burden on manufacturers by dispensing with the need for expensive testing programs. This will also streamline certification procedures.

Local car manufacturers will have to undertake certification test protocols which are compatible with international requirements. For *Euro 3* standards local car manufacturers will incur a cost to upgrade emission testing facilities.

Manufacturers and importers will incur investment costs to adopt the technology to meet more stringent standards and an increase in production costs.

Fuel Industry
The oil companies will incur some costs in desulfurisation capacities to reduce diesel sulfur content for *Euro 2*. For *Euro 3*, there will be significant investment costs to change additional fuel parameters (The Fuel Quality Review will assess such costs). The cost to the fuel industry may be reduced if the demand for low sulfur fuels was phased in (eg by initially requiring low sulfur diesel fuel in urban areas).

Component Manufacturers
Component manufacturers will be affected in much the same way as vehicle manufacturers and importers. A move to harmonisation with international standards means that products manufactured for world markets will be readily acceptable in Australia, and that local manufacturers will be able to produce products that are acceptable in both the local and overseas markets. There will be no delays in incorporating components and systems complying with later (more stringent) international standards.

Small Business
<u>The automotive service industry</u>
The adoption of *Euro 2* standards will have a minimal impact on the automotive service industry. The adoption of *Euro 3* standards incorporates on board diagnostics, which will require training of staff in servicing such equipment and the provision of the tools to service the equipment.

<u>Vehicle retailers</u>
It is expected that there will be minimal impact on vehicle retailers.

<u>Fuel Retailers</u>
Some of the small fuel retailers, particularly in rural and remote areas have limited or no storage and dispensing facilities for PULP. This could potentially cause some difficulties if PULP is the standard fuel (this is not expected until *Euro 3* introduction). However, it is anticipated that the storage and dispensing facilities used for leaded petrol may be replaced with PULP when leaded petrol is no longer provided to the market.

<u>Businesses with high vehicle input costs</u>
Section 5.3.1 indicates new standards will lead to increased production costs, however, the FCAI indicates that the majority of those production costs are likely to be absorbed by the vehicle

manufacturer, particularly for passenger vehicles. The Bus Industry Confederation indicates that whilst there is currently a cost difference between the *Euro 1*and *Euro 2* engine, it is envisaged that the cost difference will fall to zero during 1999 as the *Euro 2* engines will be produced in higher numbers. The cost of *Euro 3* engines will also decline as volumes increase (BIC, 1999).

Submissions to the review also indicate that some companies choose to provide latest standard vehicles to the market and have not suffered in market share.

Consumers

One of the primary impacts for consumer is improved air quality and hence reduction in health costs. In addition. harmonisation with international standards will allow consumers to have access to safer, less polluting vehicles sooner than would otherwise be the case.

It is unclear as to whether new emission standards would increase the retail costs of those vehicles currently not produced to *Euro 2* standards. Industry advice is that due to the competitive nature and price sensitivity, particularly of the passenger car market, increases in production costs may be substantially or totally absorbed by the manufacturers. Despite this, the cost benefit analysis includes estimates of costs for all vehicles under the three option. If there are increases in retail prices these will borne equally by urban and rural residents, even though the urban residents will receive the benefits of reduced emissions, air quality and hence a reduction in health costs. However, anticipated lower government outlays on health will indirectly benefit consumers in rural areas.

In relation to fuel costs, the petroleum industry will incur additional capital investment and maintenance costs for desulfurisation technology for the production of low sulfur diesel. It is unclear what proportion of these costs would be passed on to the consumer.

Regulatory Authorities

Harmonisation and the acceptance of later, more stringent international standards will allow FORS to accept certification information from other authorities which is based on the same set of regulations, thus reducing administrative load. There will be no impact on State and Territory registration authorities

Regions – Industry Viability

All sectors in both the vehicle and refining industries will be competing under the same circumstances. While some companies may be in a better position than others to meet tighter vehicle standards and fuel specifications, all parties (domestic and overseas) will be asked to meet the same standards. In the refining industry in particular, there are suggestions (Caltex, 1999a) that further rationalisation of refineries in Australia may be necessary. However, this is a commercial decision for the individual companies concerned and the tighter standards proposed in this review, are not, in themselves, likely to affect the stability of any particular operation. Such rationalisation would occur in absence of this review.

Emission standards apply the same solution to different levels of atmospheric pollution in different locations. Hence, any general tightening of emission standards impinges on vehicle users in all areas for different gains in terms of reduced local pollution (Industry Commission 1997). For this reason residents of non-urban areas may argue that it is not appropriate for emission standards to be based on the level of local pollution of one particular city, where local pollution may be relatively high. However, it is simply not financially feasible in Australia's small market for vehicle manufacturers to supply vehicles in Australia to a range of standards based on regional air quality needs. It would also be virtually impossible for regulatory authorities to prevent the use and resale of "non-urban" standard vehicles in urban areas. In addition, as global rationalisation of vehicle models increases, the development of a

single global emission standard becomes more likely. Vehicles made for export have to meet international standards in order to be sold in the greatest number of markets.

5.2 IMPACT ON EMISSIONS

In order to assess the impact on total emissions over the medium term, some cost effectiveness and cost benefit analyses have been undertaken. The following results are derived from the cost effectiveness study undertaken by the University of Melbourne and an indicative cost benefit analysis undertaken by the New South Wales Environment Protection Authority (NSW EPA). The full text of these reports is at Attachment C and Attachment D respectively. The University of Melbourne modelling covered passenger cars only, while the cost benefit work undertaken by the NSW EPA covered all vehicles except light commercial vehicles (LCVs). Table 11 indicates the predicted reductions in emissions from the 3 options outlined at the beginning of this Section 5. The wide range in projected emissions is due, in part, to differing assumptions in the modelling (particularly the deterioration rates applied) and also arises because the two models use different timelines (2015; 2021).

Table 11 Percentage Reductions in Emissions from Cars and Heavy Duty Vehicles (⍰⍰3.5 tonnes GVM) (Current standards used as the base, rounded to the nearest 5%)

	Option 2A ***Euro 2* in 2002** **%**	***Option 2B*** ***Euro 2 in 2002 and Euro 3 in 2005*** ***%***	**Option 2C** ***Euro 3* in 2002** **%**
NOx	15-50	60	30-80
HC	0-5	25-45	25-55
CO	+20-20	25-50	50-70
PM10	5	15	17

Sources: University of Melbourne 1999 (Attachment C) and NSW EPA (Attachment D)

The table indicates that the introduction (in 2002) of the UN ECE *Euro 2* standards reduces total fleet emissions of NOx and PM, but has little impact on HC emissions, and may lead to increased CO emissions (because of the omission of cold start sampling in the *Euro 2* test cycle). The introduction of *Euro 3* standards would lead to further reductions in all emissions.

As LCVs were not covered by the other analyses, the Bureau of Transport Economics (BTE) modelled changes in NOx and PM emissions from diesel LCVs, using data supplied by FORS. The modelling indicates that in the absence of any new standards to replace ADR70/00, emissions of NOx (particularly), and PM would increase over the 2000-2015 period (see Figures 13-14). This analysis indicates that *Euro 2* would deliver significant reductions in both NOx and PM emissions from diesel LCVs, with *Euro 3* increasing the magnitude of the benefit. Early introduction of *Euro 3* appears to offer only a small additional reduction in emissions in 2015 over the staged approach (option 2B). Because of the limitations in data on diesel vehicles on the Australian market (particularly prior to 1995,when ADR70/00 was introduced) Figures 13-14 should be considered as indicative of likely trends only.

Figure 13 **Estimates of NOx Emissions from LCVs under "No Change" (ADR70/00) and 3 New Standard Options**

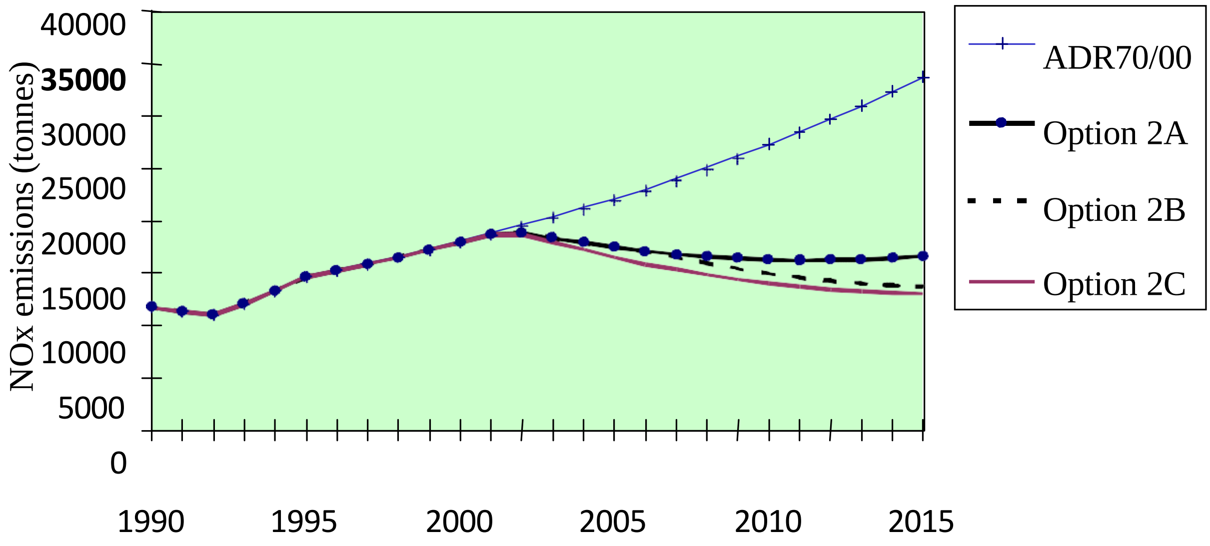
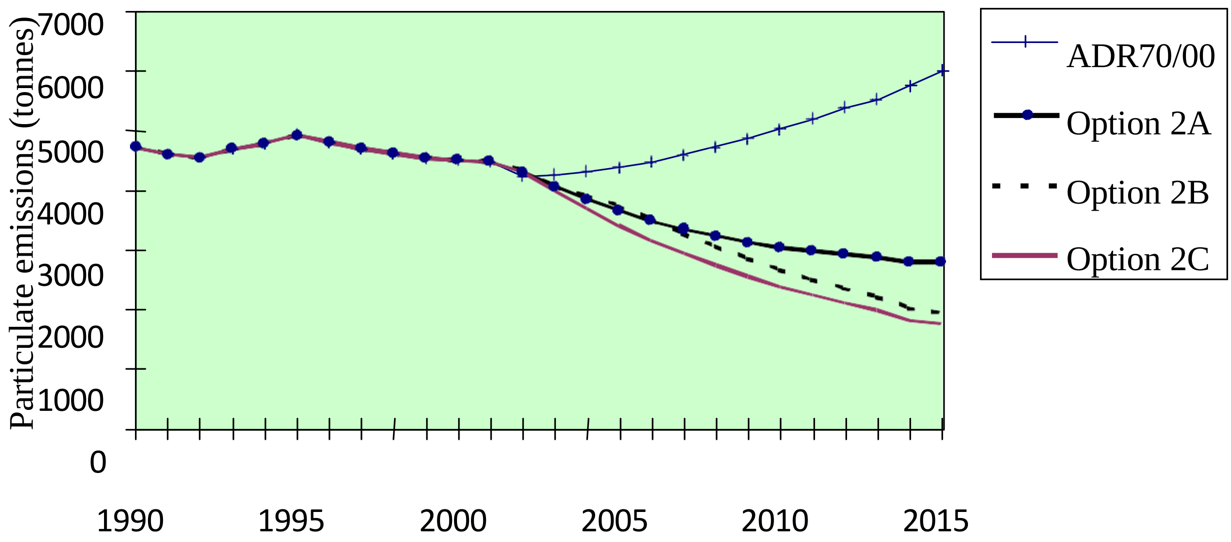


Figure 14 **Estimates of PM Emissions from LCVs under "No Change" (ADR70/00) and 3 New Standard Options**



5.3 COSTS

Estimates of vehicle and fuel costs have been drawn from a number of sources including the FCAI, the University of Melbourne study, NSW EPA analysis and overseas reports.

5.3.1 Vehicle Costs

Estimates have been made for the anticipated increase in retail costs as a consequence of adopting technology and hardware to move from the current standards to *Euro 2* and *Euro 3* standards. These are outlined in Table 12 below.

Table 12. Estimated Increase in Retail Cost

Vehicle Category	Estimated Increase in Retail Costs ($A)		
	Current to *Euro 2**	***Euro 2* to *Euro 3***	**Current to *Euro 3***
Petrol			
Small	520	350 - 600	1130
Medium	510	390 - 520	1020
Large	630	500 – 610	1210
Diesel			
Light Commercials		250 - 580	
Heavy Duty	2,000 – 3,000**	910 – 4,450	

* NSW EPA has estimated that only 25% of vehicles will need to be modified to comply with *Euro 2*

** Advice from the Bus Industry Confederation, is that during the course of 1999, the cost difference between *Euro 1 and Euro 2* engines will fall to zero.

Sources: University of Melbourne 1999 (Attachment C), European Commission (1996a), FCAI 1996, Bus Industry Confederation (BIC, 1999) and modelling undertaken by the NSW EPA (Attachment D)

These costs should be viewed as indicative only, and will vary considerably depending on the source of the vehicle. It should also be noted that only a proportion of new vehicles might need new technology to meet the standards. For example, a manufacturer of an imported European vehicle will have already met the design and development costs of *Euro 2* in supplying the vehicle to the European market, and thus there are no additional investment costs associated with supplying that vehicle to the Australian market. Similarly as Japanese and Korean, and to some extent, Australian based companies, increasingly develop vehicles for overseas markets where the UN ECE standards apply, there will be no additional investment costs associated with supplying that vehicle to Australia.

These costs are likely to be overestimates as the cost of technologies become cheaper as the components become well proven, and are produced in increased volumes. This is particularly the case for Option 2A to adopt *Euro 2* in 2002, as the necessary technology will have been on the international market for over 6 years. This will also apply to Option 2B, where *Euro 3* is introduced in 2005, as *Euro 3* will have been introduced in the European market in 2000.

In the heavy duty sector it should be noted that even now only *Euro 2* and *US94* specification engines are available for some vehicles, as the market for some *Euro 1* and *US91* standard engines falls below economic levels for the parent companies. By the end of this decade, it is likely that the availability of other than *Euro 2* and *US94* or *US98* engines will be even less. Thus although the later standard engines will cost more than those complying with the standards in the current ADR70/00, these cost increases will be largely the result of changes to standards in Europe and the US, not the introduction of tighter standards in Australia. Advice from the Bus Industry Confederation is that during the course of 1999, the cost difference between *Euro 1 and Euro 2* engines will fall to zero.

It is estimated that the total cost to the domestic passenger vehicle industry to upgrade emissions testing facilities for testing and certification to the *Euro 3* standards is approximately $4.5 million (Attachment D). These laboratory upgrade costs are assumed to be incurred for adopting *Euro 3* standards but not for *Euro 2*.

Adopting ECE standards for cars would involve additional certification costs, particularly for local vehicle manufacturers. Those imported vehicles already with EU/ECE compliance are assumed to incur no additional compliance costs. Industry estimates of certification costs to meet *Euro 2* are approximately $40 million per model. The NSW EPA analysis (Attachment D) suggests that the two local companies most affected by *Euro 2* compliance will be Ford and Holden. For these two key industry players the costs are taken to be $80 million (ie 2 models at $40 million each).

Certification costs would be incurred by all companies in adopting *Euro 3* standards. The cost for *Euro 3* compliance is considerably higher than for *Euro 2,* as it is a significantly more demanding standard than *Euro 2* - in terms of both the test procedures for exhaust and evaporative emissions, the new $-7^{o}C$ test and the lower absolute NOx emission limits (refer discussion of results from comparative emissions test program in section 4.2.2). The FCAI have indicated that there are major design implications for compliance with *Euro 3* which are not applicable to *Euro 2*. In order to comply with the standards all manufacturers will have to:

- Significantly upgrade catalyst specifications, with the likelihood of the need for “light off” and close coupled catalysts. Apart from the additional hardware costs of these items, fitting larger and multiple catalysts closer to the engine will, in many cases, lead to changes to the car floorpan and other significant structural changes to engine mountings, cross members etc. Such changes will also affect compliance with the safety ADRs which set standards for occupant protection (ADR69/00 and ADR73/00) and recertification to these ADRs is likely to be required;
- Upgrade evaporative emission control systems to meet the more demanding evaporative emissions test;
- Install on board diagnostics (OBD) systems compliant with the *Euro 3* specifications (there is no requirement for OBD systems in the *Euro 2* standards); and
- Develop new service systems and support infrastructure for servicing and maintenance of OBD systems.

The FCAI indicated at the Transport and Emissions Liaison Group Meeting on 19 April 1999, that due to the competitive nature of the passenger vehicle industry, it is likely that the costs of compliance with any revised standards would be absorbed by industry rather than passed onto the consumer as an increase in vehicle price. Estimated costs have been included in the cost benefit analysis at Attachment D.

For commercial diesel vehicles, the adoption of *Euro 2* standards is likely to incur costs associated with vehicle modifications such as the fitting of catalytic converters (for light commercial vehicles), as well as costs associated with certification itself. The FCAI claims there would be an additional hardware cost associated with fitting of catalysts to meet *Euro 2* standards of some $1,000 - $1,300 per vehicle.

For US vehicles, the US heavy duty diesel engine manufacturers advise that there would be significant additional costs if US certified engines were required to be re-certified to comply with ECE Regulations. These costs include engine development and optimisation for the ECE test cycle. On this basis it has been proposed that for heavy duty vehicles, US EPA 94 and US EPA 98 standards be accepted as alternatives to the UN ECE *Euro 2* and *Euro 3* heavy duty diesel regulations. Progress is being made to harmonise the US EPA and UN ECE test cycles for certification purposes, and it is anticipated that in the future these standards will be fully harmonised (DieselNET, 1999).

For Japanese and Korean vehicles, implementation of the *Euro 2* and *Euro 3* standards may require further engine development work and the use of catalysts in many light and medium duty vehicles. Heavy duty vehicles are unlikely to require the use of catalysts in order to meet the *Euro 2* standard but may be necessary for *Euro 3* (Romvari, 1999). Some models may also be withdrawn from the market, as it will not be cost effective to bring them into compliance with *Euro 2.*

5.3.2 Fuel Costs

In assessing the options for new standards, there are different fuel implications for *Euro 2* and *Euro 3*. The key parameters are:

- The octane rating of petrol;
- The sulfur content of diesel fuel; and
- The sulfur content of petrol.

These are discussed below.

Fuel requirements for *Euro 3* will be clarified at the conclusion, early in 2000, of the Fuel Quality Review being undertaken by Environment Australia. The Fuel Quality Review will examine the impacts, including costs, of changing a broad range of fuel parameters to meet a number of environmental objectives.

Octane Rating of Petrol

No costings associated with possible increases in the minimum octane rating of petrol have been done at this stage, because the need for high octane (95 RON) petrol to ensure in-service compliance with *Euro 2* standards has not been convincingly established. It is generally accepted that high octane (95 RON) petrol will be required for the engines that manufacturers are likely to use to enable compliance with the *Euro 3* standards.

However, if high octane fuel was required for vehicles meeting *Euro 2* standards, the increase in demand will be gradual as the proportion of *Euro 2* standard vehicles increases. The petroleum industry will not be required to produce high octane fuel for all vehicles “overnight”, thus allowing for refineries to plan investments to meet the growing demand. The differential in maximum retail prices between regular ULP (average 91 RON) and “premium” ULP (average 96 RON) as of July 1998 was 3c/L (ACCC, 1998), but the differential in the market can be over 10c/L. These differences are unlikely to be indicative of the costs of producing 95 RON petrol in quantities larger than the current PULP production (around 4%).

Sulfur Content of Diesel

Additional costs are associated with the introduction of more stringent limits on diesel fuel sulfur content. Sulfur limits for *Euro 2* and *Euro 3* are 0.05% and 0.035%, respectively.

Removal of sulfur is a well understood procedure, which requires capital investment in desulfurisation technology and ongoing operational costs. Unlike most other parameters, fuel sulfur can be reduced without significantly affecting the other fuel properties, or the availability of fuel from a barrel of crude oil. Previous advice provided by the AIP with respect to the initial introduction of ADR 70/00, indicated that installation of diesel fuel desulfurisation capacities at all eight Australian refineries would cost in the order of $700 million (FORS, 1993), with varying cost impacts on each refinery, depending on the level of technology in place in particular refineries (ACVEN Diesel Emissions Working Group, 1996).

Based on overseas experience (eg Candido *et al,* 1997), the then Department of Primary Industries and Energy (DPIE) (Harrison, 1998) estimated that the cost of a desulfurisation unit alone to produce diesel at a 0.05% level (down from a 0.5% level) is around $30m, while noting that, because of the integrated nature of refineries, it is unlikely that investment in desulfurisation capacity will be done in isolation, and concurrent expenditure in other parts of the refinery may occur to meet other fuel requirements. DPIE also commented that the impact on each Australian refinery will be different, and the costs may be higher or lower than indicated.

Estimates for reducing the sulfur content to 0.05% in Canada were estimated at an average of $15 million per refinery [capital costs] and $1.8 million [operational costs], leading to a unit cost increase of approximately 1.3 c/L (CCME, 1996).

The AIP has indicated that even changes to sulfur alone would impose significant costs on the Australian refining industry, which is currently operating on low profitability levels.

One way of easing the early demand for commercial diesel with sulfur content of 0.05% would be to supply two grades of diesel fuel - low sulfur diesel in urban areas, and high sulfur in rural/regional areas. This would reduce the extent (and thus cost) of desulfurisation capacity required across the Australian refineries. It could also be used as an interim strategy in moving to 0.05% sulfur across the market, while meeting urban air quality objectives. BP Amoco and Caltex have publicly stated their commitment to voluntarily providing 0.05% sulfur diesel in urban markets (BP and Caterpillar, 1999; Caltex 1999b).

The Australian petroleum industry believes that having two grades of diesel may present difficulties in handling and distribution (ACVEN Diesel Emissions WG, 1996), and that effective administration of such a system may incur additional costs for Government.

The European Union estimates of fuel reformulation costs for meeting the *Euro 3* standards are $0.0035/L for diesel. However, consideration must be given to the existing sulfur levels in fuel in Australia and Europe. Australian diesel fuel has, on average, around 0.13% sulfur. In Europe, diesel is already at 0.05% and will be reduced to 0.035% (*Euro 3*) and 0.005% (*Euro 4*). In addition, Australian refineries are generally small and relatively old in comparison to world standards, therefore fuel reformulation costs may be higher. Alternatively, reformulation costs would be lower if over the period new refining facilities were constructed for Australia, or the market share of imported fuels increased. For the purposes of the cost benefit analysis, the NSW EPA has assumed that there are no costs for fuel reformulation for adoption of *Euro 2,* and that for *Euro 3,* costs for petrol are the same as Europe ($0.0035/L) and for diesel, double those estimated for European conditions (ie $0.0070/L). For Option 2B this is a total cost of $1,199 million over 20 years and for Option 2C, $1,287 million over 20 years.

Reducing the sulfur content of fuel is important for achieving the anticipated reductions in particulate matter emissions. Improving the quality of fuel by reducing sulfur content improves the operation and efficiency of the catalytic equipment to reduce particulate and other emissions. Without fuel reformulation, the performance of new emission technology would be sub-optimal, but still generate reductions as compared with current emission standards.

Sulfur Content of Petrol

Consistently low sulfur levels are necessary to ensure proper functioning of the OBD systems required by the *Euro 3* standards. Based on the European commercial fuel specifications, the maximum acceptable sulfur level for *Euro 3* vehicles is 150ppm. Currently, the average sulfur levels in Australian petrol are at that level, but there is a very wide range (0 - 6,000 ppm) (AIP, 1999). High sulfur levels will result in a number of defaults being detected by the on board diagnostics and system errors will occur. This would increase the number of occasions that consumers would need to return their vehicles for service, in a situation where service technicians may be unable to rectify the apparent problem. Industry advice indicates that presently OBD systems are disabled on *Euro 3* capable vehicles entering the Australian market.

5.3.3 Costs of Early Compliance with *Euro 3*

Section 5.3.1 identified that passenger vehicle manufacturers will incur significant costs in the design, development and hardware provision for *Euro 3* compliance. These costs can be minimised if there is adequate time to factor these processes into model planning cycles, which tend to be a long term (4-5 year) process.

The early (2002-3) introduction of *Euro 3* for passenger cars would present major planning, technical and financial difficulties for the local vehicle industry, in particular. While the impact would be less significant on imported Japanese and Korean passenger cars, 4WDs and light commercials, it may severely reduce the model choice, at least in the short term, as only a proportion of these models are exported to Europe. European model cars imported into Australia will most likely meet *Euro 3* from 2000, but they only represent about 6% of the market.

To put it in perspective, the vehicles produced by the local manufacturers represent some 30% of the market. The top ten selling models in Australia represent some 45% of the market share, five of which are locally manufactured. These five models represent 60% of the market share of the top ten selling models. The passenger motor vehicle market can be divided into four segments, small cars, medium cars, upper medium and luxury segments. The largest segment in Australia is the upper medium cars (35%). This segment is dominated by the locally produced Holden Commodore, Ford Falcon, Toyota Camry V6 and Mitsubishi Magna.
This segment has faced minimal import competition (Industry Commission, 1997).

The FCAI (FCAI, 1999c) have indicated that all of the local manufacturers would be unable to fully comply with Euro 3 by 2002. The reasons given fall into 4 main categories as follows:

1. Insufficient time for the extensive engine and vehicle development required;
2. Insufficient time to upgrade and commission emission test facilities to support engine development and certification;
3. Insufficient time to develop the expertise and network for development and maintenance of OBD systems; and
4. Lack of guaranteed supply of suitable fuel.

Items 1, 2 and 3 are largely an issue for the four local manufacturers (Ford, Holden, Mitsubishi, Toyota), but will also affect model options for Japanese and Korean importers. The fuel issue (Item 4) will affect all models, local and imported.

In relation to Item 1, advice from local manufacturers is that attempting to compress the significant research and development required for *Euro 3,* into a very short time frame which takes no account of current investment and forward business plans, would severely affect their viability. One manufacturer indicated that meeting *Euro 3* in 2002-3 would require a total reallocation of resources in an attempt to meet the requirements, thus severely curtailing other product research and development which is necessary to ensure the ongoing competitiveness of these vehicles in the market.

If local engine development over a short time frame was not possible, an alternative for local manufacturers is to cease production of engines in Australia and source engines from their parent companies overseas. This approach not only affects the engine manufacturing and component production industries in terms of viability and unemployment, it is often no less complex than local development.

Whether the engine is locally developed or imported, the requirements for *Euro 3* are likely to lead to changes to vehicle floorpans. Floorpan changes affect the structure of the vehicle which would most likely impact on its compliance with certain safety Australian Design Rules (ADR69/00, ADR73/00) relating to impact protection. In addition to the engine costs, industry would also incur costs in structural and mechanical redesign including, (but not limited to) alternations to the engine bay which would require additional sheet metal work, moving engine mounts, fitting of larger catalytic converters and heat shields. Consideration would also need to be given to the impact of any redistribution of the weight of the engine to the steering and suspension. These modifications would require further research and development, testing and certification. Thus, depending on the extent of redevelopment to accommodate the engine, this option can be as complex as local engine development.

In addition to the modifications to accommodate the engine, manufacturers need to consider the relative performance of an imported engine. As mentioned earlier, the Australian vehicles dominate the upper medium segment of the market where there is minimal import competition. One of the reasons consumers' state for purchasing these vehicle is the torque pattern of the engine. European engines are typically smaller and have less torque than those in the locally produced upper medium vehicles. The installation of the smaller engine in a heavier Australian vehicle may have a detrimental impact on the performance and fuel consumption of the vehicle, which could further erode the market share of local producers.

In relation to Item 2, to develop and test a local engine for *Euro 3* compliance, local manufacturers would need to upgrade testing facilities which includes purchasing, setting up and testing new equipment and building an evaporative test cell. Advice from industry indicates that this process would take approximately 15 months. This time is broken up intoo the following components:

- Emission sampling and analysis equipment for *Euro 3* purchased as a 'turnkey' unit. Such units take 9 months to produce from date of the order;
- 1-2 months for shipping of the unit to Australia;
- 1 month to install the unit; and
- 3 months for quality assurance testing and training of staff to operate the unit effectively.

Training of staff and quality assurance is also a significant cost and time component, given that the *Euro 3* emission test contains procedures not included in previous emission standards such as sub-zero emissions sampling, canister loading and the use of variable volume evaporative emissions enclosures.

The new standard of test facilities would be required to support engine development. If the new equipment was ordered in (say) January 2000, it would not be operational until April 2001. If *Euro 3* was introduced in 2002, this would only leave 8 months to work through the process of manufacturing, testing and redesign of a prototype engine, prior to certification and mass production. It is not practical for this process to be undertaken in such a short time frame. Advice from industry indicates that engine development typically takes 4 years, and, from an emissions perspective, *Euro 3* is the most significant change in Australia since the introduction of the first catalyst equipped vehicles in 1986.

In relation to Item 3, the introduction of on board diagnostics for *Euro 3* passenger vehicles requires both engine development and calibration and the development of service systems and support infrastructure. Local manufacturers are of the view that the introduction of *Euro 3* in 2002 would not provide sufficient time for the development and installation of dealership support infrastructure and systems, or for the training of staff.

In relation to Item 4, the discussion in 5.3.2 indicated that keeping fuel parameters within certain specifications is critical for *Euro 3* compliance and proper vehicle operation. While at least one oil refiner has made a commitment to the provision of 'cleaner fuels', the majority will not make any investment decisions on the production on '*Euro 3*' fuel until the outcomes of the Fuel Quality Review are available. The Fuel Quality Review will significantly aid the understanding of the refining industries' ability to manufacture 'cleaner' fuels and the associated cost penalties. The outcomes of the Fuel Quality Review will include a recommendation of the minimum requirements for a '*Euro 3'* fuel, and until government makes a final decision in response to those recommendations (expected to be late 2000), individual oil refineries will hold off on major investment decisions. The length of the refinery investment cycle from design to implementation can range from a few months for minor process changes to up to 4 years for major hardware commissioning.

As the new vehicle fleet (less than 1 year old) typically accounts for around 5 per cent of the market, the initial demand for '*Euro 3*' fuel would be small and steadily increase in line with the volume of *Euro 3* vehicles. If Australian refineries were unable to produce suitable fuel by 2002, it could be imported, to ensure that *Euro 3* vehicles operate effectively. However, the economics of producing and/or distributing small quantities of fuel would present a disincentive for local refiners and importers. A significant difference in retail prices between a *Euro 3* fuel and ordinary unleaded is undesirable, as it is likely to tempt owners of *Euro 3* vehicles to misfuel with unleaded petrol, with resultant OBD problems and probable decreases in the performance and fuel consumption of the vehicle. In addition, given that there are currently three grades of petrol on the market, many service stations would simply not have the storage capacity to handle another grade of petrol.

In conclusion, the available evidence suggests that the four local manufacturers would either be unable to produce *Euro 3* compliant vehicles by 2002, or would suffer serious financial penalties in attempting to do so.

5.3.4 Total Costs

The estimated "upfront" costs to Australia of adopting *Euro 2* and *Euro 3* standards are shown in the table below. The costs of adopting *Euro 2* are significantly lower as it is assumed that there would be no additional fuel reformulation costs or laboratory testing upgrades. Major fuel reformulation costs would apply in adopting *Euro 3* hence the higher cost. The time lag between the adoption of new standards and implementation may have a significant effect on the real cost of the standard. Technology, hardware and fuel reformulation costs are ongoing, whilst laboratory upgrade and certification cost are once only.

Table 13 **Total costs of Euro standards (A$/1999) for first year**

Standard	*Euro 2*	*Euro 3*
Technology and Hardware	$88 million	$107 million
Fuel reformulation	$0	$161 million
Laboratory upgrade	$0	$4.5 million
Certification costs	$80 million	$80 million
Total costs (year 1)	**$168 million**	**$352 million**

5.4 BENEFITS

5.4.1 Reduction in Health Costs

Vehicle emissions are linked to a wide range of adverse health impacts including respiratory disease and heart disease. The vehicle related pollutants with the most significant links to health are photochemical smog (measured as ozone), NO_2 and particulates.

While the findings of various researchers outlined below indicate considerable variance in estimates of health impacts, the general conclusion is that the social and economic cost of the health impacts of air pollution is considerable. Air pollution costs have been estimated at around 0.2% of GDP (BTCE 1994). With Australia's GDP at $444.6 billion in 1996-97 (ABS 1998) this equates to around $889 million pa. The Bureau of Transport and Communication Economics surveyed the international literature to broadly assess the total national costs of air pollution in other countries. Although each study used a wide range of techniques and assumptions, the estimates are in the same order of magnitude, ranging from 0.15% to 1.04% of GDP.

The Inter-State Commission made an attempt to estimate the costs of vehicle emissions in Australia in 1990 based on a similar study undertaken in the US. Using data on the rates of emissions and damage costs the Inter-State Commission estimated the annual cost of emission to be $786 m (Inter-State Commission, 1990).

The National Road Transport Commission (Segal 1995) undertook a review of health costs associated with vehicle emissions. The report concludes that health costs to Australia are "likely to fall within the range of $20 to $100 million with $50 million suggested as reasonable midpoint". The analysis is based on an arbitrary estimation of 0.1% of cancers and 0.1% of respiratory illnesses attributable to road vehicle emissions. The study produces a very low estimate of health costs because it only examines two health end-points, (cancers and respiratory disease) and does not include the impact of particulates. The report concludes that more understanding is needed on the impact of vehicle emissions on health.

Simpson and London (1995) estimated that the economic cost of current air pollution in the Brisbane City Council area is in the range $254 million and $462 million per year. Mortality effects from particulate pollution account for around 90% ($230 million to $415 million) while morbidity effects account for the remainder. Ozone impacts were estimated to account for $2.5 million in costs per year.

The impact statement released by National Environment Protection Council on air quality (NEPC, 1997) reports that health costs from ozone are estimated to be in the range of $95-$285million per annum, which compares with just $14million per annum estimated by Segal (1995).

According to the ESD Working Group on Transport (1991), the estimated health cost of emissions from heavy duty diesel engined vehicles is in excess of $150 million per annum, or $142 million if the particulate impact estimated at that time is excluded ($A 1995). Since that time, more information has become available regarding the impact of particulates on health (Ballantyne, 1995).

5.4.2 Other Benefits

Harmonisation, Trade Facilitation and Administrative Efficiency
The adoption of UN ECE standards at the *Euro 2* and *Euro 3* level is consistent with the Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Councils and Standards Setting Bodies laid down by the Council of Australian Governments (COAG). The COAG principles state that wherever possible, regulatory measures or standards should be compatible with relevant international or internationally accepted standards or practices in order to minimise impediments to trade. Industry and Government are expected to achieve improvements in trade facilitation and administrative efficiency from adopting *Euro 2* and *Euro 3* standards. If Australian manufacturers do not aspire to international standards in an increasing global market, they will limit their ability to export to a range of open world markets. (Industry Commission 1997)

Improved trade facilitation and administrative efficiency are expected to flow from further harmonisation with the UN ECE international regulations, due to increased use of UN ECE approvals for certification by FORS. The time savings occur in the preparation and scrutiny of compliance documentation by manufacturers and regulatory authorities respectively. Quantifying these savings is difficult due to other FORS initiatives in the area of electronic lodgement of compliance data, a system which is expected to be fully on stream in 1999.

Tourism
The Inquiry into Urban Air Pollution (AATSE, 1997) also points to improved air quality in Australia's large cities as not only having health benefits for the local community, but also wider benefits. Clean urban air is beneficial to a city's tourism potential, and its capacity to attract international business and major sporting and cultural events. The inquiry indicates that if just 5% of international visitors were deterred from coming to Australia because of polluted cities, then the resultant drop in tourism income would be approximately $700m per year.

Durability and Fuel Economy
Manufacturers have stated that the engines designed to the higher standards have increased durability and improved fuel economy. While these benefits for vehicle owners may not be due to compliance with tighter emission standards *per se*, they reflect the benefits of the additional design effort undertaken by vehicle and engine manufacturers.

5.5 ANALYSIS OF COSTS AND BENEFITS

As indicated in section 5.2, two independent analyses were undertaken to assess the cost and benefits associated with the introduction of *Euro 2* and for *Euro 3* emission standards. The cost benefit analysis examined costs and health benefits for passenger vehicles and heavy duty diesels, as well as costs (but not benefits) for light commercial vehicles. The cost effectiveness study did not attempt to estimate benefits, and only covered petrol engined cars. The key conclusions from these analyses are summarised below. Full details of the analyses are at Attachments C and D.

5.5.1 Cost Effectiveness Analysis

The cost effectiveness analysis conducted by the University of Melbourne estimated the reduction in total emissions from the car fleet projected to 2015, and then applied cost estimates of *Euro 2* and *Euro 3* compliance, to determine the relative cost effectiveness of *Euro 2* and *Euro 3* standards. The cost per tonne of emission reductions derived from the analysis are summarised in Table 14. It is important to recognise that this analysis is narrower than the cost benefit analysis, in that it deals with passenger cars only and does not attempt to estimate benefits. The full text of the analysis is at Attachment C.

Table 14 Estimates of the Cost per Mass of Emission reduced for Passenger Cars

Emission Type	Cost ($m - range) per ktonne by Option (rounded)		
	Option 2A *Euro 2* **in 2002**	**Option 2B** *Euro 2* **in 2002,** *Euro 3* **in 2006**	**Option 2 C** *Euro 3* **in 2002**
HC	1900-2700*	40-60	35-55
NOx	8-11	12-18	12-19
HC+NOx	8-11	9-14	9-14

* Euro 2 delivers only a small reduction on HC. If all the costs of control are attributed to HC alone, the cost per mass of HC reduced is extremely high.

The key findings of the cost effectiveness study are as follows:

- *Euro 2* alone should improve NOx emissions for cars, but will have virtually no impact on HC emissions and may lead to increases in CO emissions;
- A combination of *Euro 2* followed by *Euro 3* will lead to more significant reductions in all emissions from cars compared to *Euro 2* alone;
- Early application of *Euro 3* will further increase the reductions in all emissions from cars;
- The cost effectiveness of various options depends on the emissions reduction objectives.
  - : If the ratio of HC and NOx is not important (*Euro 2* sets a combined limit) then *Euro 2* alone (Option 2A) is the most cost effective;
  - : If only NOx control is needed, then a staged approach (Option 2B) is the most cost effective; and
  - : If reductions in both HC and NOx from cars are desired, then the staged approach of *Euro 2* followed by *Euro 3* (Option 2B), and the direct move to *Euro 3* in 2002 (Option 2C), are equally cost effective.

5.5.2 Cost Benefit Analysis

The cost benefit analysis evaluated the impact of adopting European emission standards (*Euro 2* and *Euro 3*) by assessing the marginal costs and benefits of moving to a higher standard. The analysis attempted, where possible, to quantify in dollar terms the improved health and environmental benefits of tighter emission standards in comparison with industry costs. The detail of this analysis is at Attachment D.

The primary costs from adopting UN ECE standards are the cost of new technology and hardware, fuel reformulation and vehicle compliance. The additional retail cost of upgrading vehicles with new equipment was estimated for both petrol and diesel vehicles and applied to the number of vehicles produced within Australia.

The link between air pollutants and human health was examined using dose response relationships. The health cost avoided per tonne of pollutant was then calculated for four major pollutants. These were PM, CO, HC and NO_2. The results are considered to under- estimate the health benefits, as the impacts of ozone and air toxics (such as benzene), and the personal and social costs of air pollution, were not valued. The estimated benefits from each of the 3 options are contained in Table 15.

The analysis estimates that for Options 2A, 2B and 2C, the positive net benefits would be:

- Option 2A (*Euro 2* in 2002) - $119 million
- Option 2B (*Euro 2* in 2003 and *Euro 3* in 2005) - $618 million
- Option 2C (*Euro 3* in 2002) - $1,359 million

Thus all options are estimated to provide net benefits with significantly higher benefits from the options which include the adoption of *Euro 3* standards.

Table 15. Net Benefits of UN ECE Standards ($ million 1999)

	Option 2A ***Euro 2*** **in 2002**	**Option 2B** ***Euro 2*** **in 2002,** ***Euro 3*** **in 2005**	**Option 2C** ***Euro 3*** **in 2002**
Costs*			
Technology and hardware	662	831	803
Fuel reformulation	-	1,199	1,287
Laboratory upgrades	-	3	4
Certification	70	65	70
Total costs	**732**	**2,098**	**2,164**
Benefits* (Health costs avoided from):			
Hydrocarbons	80	701	892
Nitrogen dioxide	409	1,150	1,409
Carbon monoxide	38	262	341
Particulates	324	793	882
Personal and social costs avoided, investment opportunities, visual amenity, export potential, infrastructure damage avoided and reduced greenhouse emissions	Not quantified	Not quantified	Not quantified
Total benefits	**851**	**2,716**	**3,523**
Net Quantified Benefits	**119 m**	**618m**	**1,359 m**

(* All figures in Present Values discounted at 7% over 20 years) Note: figures may not add due to rounding

As indicated in the timing discussion in section 4.2.3, heavy duty trucks and bus manufacturers are likely to be able to meet *Euro 3* standards by 2002. In an effort to assess the impacts of early adoption of *Euro 3* for these vehicles in 2002, the NSW EPA undertook further analysis of a modified version of the staged option (Option 2B) to include the adoption of *Euro 3* for heavy duty vehicles from 2002. This analysis indicated an increased net benefit of $804m, compared to the net benefit of $618m for Option 2B.

A range of other benefits, including enhanced investment opportunities, visual amenity, export potential and tourism were examined but not quantified. Reducing vehicle emissions may also provide benefits through infrastructure damage costs avoided and reduced greenhouse emissions.

These results are sensitive to assumptions in the timing and magnitude of fuel reformulation, technology and hardware costs. It has been conservatively estimated that industry costs would decline slowly over the period of the analysis, whereas typically, the costs of technology decline rapidly due to innovation and economies of scale.

Sensitivity testing was conducted in relation to the major uncertainties in the analysis (see Attachment D). Overall, the sensitivity testing demonstrated that significant changes in cost and benefit estimates for the major variables does not affect the relative net benefit of each option.

The costs associated with adopting stronger emission standards would be initially borne by the car manufacturing industry and oil refinery producers in upgrading plant and equipment to comply with the new standards. However, these costs are dynamic in the sense that a new standard may force manufacturers and producers to become more innovative as they seek to minimise costs and adopt best practice technology. Some costs would be passed on to consumers by way of higher fuel and vehicle prices. However, competition would limit the extent such costs could be passed on, particularly for passenger car manufacturers.

The benefits from avoided health costs would flow primarily to those with pre-existing health conditions such as asthma or bronchitis. Reduced health costs would also ease the burden on public health system through reduced hospital admissions and attendances and treatment costs. In addition, families would benefit through lower levels of sickness and less restricted activity days.

6. CONSULTATION

6.1 CONSULTATION PROCESS

Public Comment

In October 1998, MVEC issued a comprehensive discussion paper on the Review of Australia's Vehicle Emissions Standards for 3 months public comment. The paper considered the case for revising Australia's vehicle emission standards, taking account of:

- The status of current air quality;
- Air quality trends;
- The adequacy of existing standards;
- The options for adopting new standards;
- The timing of the implementation of new standards;
- Fuel quality; and
- Other strategies to reduce vehicle emissions.

Printed versions of the Review paper were provided to approximately 220 organisations using existing mailing lists and responses to an advertisement placed in the 10 October 1999 edition of the Weekend Australian. Mailing lists included organisations from the vehicle, fuel and transport industries, motoring organisations, environment groups, academia and government agencies. The review paper was also placed on the Department of Transport and Regional Services web site. Accompanying the Review Paper was a Public Comment Response Sheet, which encouraged comments from the public and asked a number of specific questions on the introduction of tighter emissions standards and fuel parameters.

Transport and Emissions Liaison Group

Following its initial consideration of the public comment, the Motor Vehicle Environment Committee provided a discussion paper on an expanded range of options to the Transport Emissions Liaison Group (TELG). TELG includes representatives from the vehicle, fuel and transport industries, motoring organisations and government agencies. A TELG meeting was held in Melbourne on 19 April 1999 to discuss the options and for TELG members to provide comments to MVEC. TELG members were also invited to make any further comments in writing to MVEC.

Meetings with Individual Stakeholders

Representatives from MVEC also had a number of meetings with the FCAI, AIP and individual vehicle manufacturers and fuel refining companies on a confidential basis, to further explore the impacts on individual companies on the different options on introducing tighter standards.

6.2 SUMMARY OF COMMENTS

Public Submissions

Approximately 50 submissions were received. Respondents were asked the following specific questions on the Review "4 Questions" Response Sheet:

- Do you agree/disagree with the paper's argument for tighter standards for vehicle emissions and fuel parameters?
- Do you agree/disagree with the proposal to
  - Adopt *Euro 2* standards?
  - Apply *Euro 2* standards from 2002/3?
  - Lower fuel volatility and reduce diesel sulfur content?
- Would you support the adoption of *Euro 3* standards?
- If you support the adoption of *Euro 3* standards should they be in lieu of *Euro 2* in 2002/3 or follow adoption of *Euro 2* (say 5 years later)?

From the submissions it was clearly evident that a number of issues were non-contentious. These included:

- Accepting the US 94 heavy duty standards as alternatives to the ECE standards;
- Allowing compliance with later versions of the nominated standards; and
- Including LPG and NG fuelled vehicles within the scope of the standards.

With regard to the remaining recommendations, respondents expressed a range of views. In relation to the four specific questions asked, the public comments are summarised below (note that each submission was counted as one response even though it may have been from a body representing a number of organisations).

Of the submissions that responded to the questions:

- 98% supported the need for tighter emission standards and fuel parameters;
- 95% supported the need for lower fuel volatility and to reduce diesel sulfur content;
- 79% supported the proposal to adopt *Euro 2* standards (the majority of stakeholders disagreeing were environmental organisations who wanted more stringent standards);
- 71% supported the proposal to apply *Euro 2* standards from 2002/3 (the majority of these being vehicle industry, motoring and government organisations);
- 64% supported the adoption of *Euro 3* standards (majority of support from government, environment and motoring organisations) 22% were unable to decide without further cost benefit analysis; and
- Of the 29 submissions that supported the adoption of *Euro 3*, 14 supported its adoption in lieu of *Euro 2* in 2002/3, while12 supported its adoption in some time after *Euro 2*.

A summary of the public comments is at <u>Attachment E</u>.

Main Stakeholder Views from the Public Submissions

The FCAI (FCAI 1999a) proposes that *Euro 2* becomes effective from 2003 for new models, and 2005 for existing models subject to:

- ensuring that suitable fuel qualities are widely available at a competitive price by that time;
- assuring a minimum of 2 years lead time from rule gazettal for new models;
- *US94* and 1998 Japan standards be allowable alternative standards for heavy duty diesel vehicles;
- EEC certificates be accepted for compliance, as the test procedure is the same as UN ECE; and
- Certification on PULP (95 RON) be allowable.

FCAI supports the adoption of *Euro 3* standards after an appropriate lead-time. *Euro 3* requires sufficient lead-time to develop supporting infrastructure for both OBD systems service and provision of a high quality fuel supply to the market place.

The Road Transport Forum (RTF) is of the view that *Euro 2* (with USEPA 94 as an acceptable alternative for heavy vehicles) should be adopted from 2002/3 with *Euro 3* standards being considered in the context of a staged approach five years later, inclusive of industry incentives to upgrade or renew equipment.

The Bus Industry Confederation (BIC) advocated the adoption of *Euro 2* standards from 2002/3. It also acknowledged that from the year 2000 *Euro 3* engines would be the industry norm. BIC recognises that the in-service emissions performance of *Euro 3* engines will be contingent on the capacity of the refineries to supply low sulfur content fuel (0.05% or lower). BIC is concerned that the adoption of *Euro 3*, five years after *Euro 2,* departs from the Prime Minister's statement to harmonise with international standards by 2006. Harmonisation implies adoption of *Euro 4* in 2006. This would require substantial investment by the oil refineries in order to supply fuel with a sulfur content that meets *Euro 4* standards.

The European Automobile Manufacturers Association (ACEA) supports the adoption of *Euro 3* standards by 2002/3. As these standards will be widely applied in Europe in 2001, the technical solutions will be available for Australian manufacturers shortly after this date. The costs should not be an obstacle due to the fact that the standards would provide a harmonised framework for the development and industrialisation of the technology.

The Australian Institute of Petroleum state that there is no current justification for *Euro 3* and that scientific work needs to be done to clarify *Euro 3* before a decision is made to adopt *Euro 2* in order to avoid short term non-optimal investment.

Transport and Emissions Liaison Group Meeting

The Transport and Emissions Liaison Group meeting was held on 19 April 1999 and was well attended. Key stakeholders were represented, including the FCAI and AIP. While the meeting did not reach a consensus on the way forward or express a preference on the options presented, some points were clear.

- There was a general acceptance of the move to tighter standards;
- There was a general recognition, of the imperatives for better air quality, and cleaner vehicles and fuel;
- Links with the Fuel Quality Review and the Petroleum Products Action Agenda were noted;
- The passenger car fleet also has to meet fuel consumption objectives by 2010;
- Significant sections of the passenger vehicle industry claim not to be ready or able to meet *Euro 3* in 2002; and
- The oil industry was not considering any changes until after the Fuel Quality Review was completed, and was seeking a long term strategy from Government.

7. CONCLUSION AND RECOMMENDED OPTION

7.1 SUMMARY OF KEY ISSUES

Australia is one of the most highly urbanised countries in the world, and atmospheric pollution in our cities has been identified as a significant community issue. Relatively high concentrations of pollutants are experienced on occasions in our larger cities, with the standards in the National Environment Protection Measure for ozone and particles being exceeded in many capital cities. It is well recognised that concentrations of pollutants cause a range of effects on human health, even concentrations below air quality standards (the World Health Organisation has recently stated that there is no safe threshold for particulates).

Vehicles are the largest single contributor to urban air pollution, and without further controls on vehicle emissions, expected increases in vehicle use will mitigate against the penetration of ADR37/01 and ADR70/00 standard vehicles, leading to predictions of worsening air quality in the long term. The need to introduce tighter emission and fuel standards was overwhelmingly supported in the public comment.

The introduction of UN ECE emission standards for petrol and diesel vehicles would be an effective strategy for reducing CO, HC, NOx and PM emissions, and is consistent with Commonwealth Government and vehicle industry objectives of harmonising with international standards. There are sound economic arguments for also including the US emissions standards for heavy duty vehicles as an alternative to the UN ECE requirements, without compromising emissions objectives. There are no equivalent arguments for US EPA standards for light duty vehicles.

Introducing the *Euro 2* standard from 2002 (Option 2A), would deliver significant emission HC and NOx benefits, particularly in light-medium duty vehicles, and should not pose any significant technological difficulties for manufacturers. The analysis by the University of Melbourne, concludes that if the objective is to reduce emissions of the combination of HC and NOx (without concern for the balance between the two), then Option 2A is the most cost effective option for passenger cars (although this analysis does not cost the implications for the fuels industry). The cost benefit analysis concludes that while *Euro 2* alone Option 2A delivers net benefits, these are much smaller than those for *Euro 3* (Option 2B or 2C). Lowering the sulfur content of diesel fuel to 0.05% would appear to be the only change to fuel required to ensure on road compliance with *Euro 2* emission limits.

Euro 3 is a more stringent standard with significantly tighter emission limits, tougher exhaust and evaporative emissions tests, and the introduction of on board diagnostics. It would be difficult for the local vehicle industry, in particular, to meet *Euro 3* in 2002 (Option 2C), and it would also be likely to have a significant impact on imported Japanese and Korean vehicles, both passenger cars and light-medium duty commercials. However, advice from industry indicates that compliance with *Euro 3* standards is readily achievable in 2002 for the heavy duty truck and bus sector. European model cars imported into Australia will most likely meet *Euro 3* from 2000, but they only represent about 6% of the market. The European manufacturers importing vehicles into Australia have made investment decisions and plans based on the supply of vehicles to the European market at the *Euro 3* standard.

As mentioned, the adoption of Option 2C would have a number of significant ramifications for local vehicle manufacturers, Japanese and Korean manufacturers of passenger cars and light-medium duty commercial vehicles. Moving from the current standards to *Euro 3* standards in 2002 would significantly increase production costs. Manufacturers have indicated that they are unlikely to pass these costs to consumers in the form of an increase in retail prices, due to the competitiveness of the industry. Consumers around the world are demanding an increase in value-for-money and in Australia it is generally agreed that passenger vehicles have become less affordable in real terms. Emissions control equipment does not add to the value of the vehicle from a consumers perspective. As such the cost of the equipment is often borne by the manufacturer, rather than impacting on the retail price of the end product. This will impact on the manufacturers investment decisions, many of which are already 'locked' into forward plans. *Euro 3* adds considerably to variable and investment cost which threatens the business equation for locally manufactured vehicles.

Local manufacturers state that Euro 3 for 2002/3 is completely unattainable, even if *Euro 3* fuels were the base market fuels, given the amount of research and development that would be required. Sourcing engines from overseas is problematical given the differences in floor plans of the Australian vehicles.

In addition, on board diagnostics systems service and support infrastructure would not be available by 2002. Without adequate support, a high level of customer complaints could be expected on OBD false alarm warnings. OBD systems are also very sensitive to fuel specification and variations.

The changes in fuel parameters needed for on road delivery of *Euro 3* standards may be significant, and cannot adequately be determined until the completion of the Fuel Quality Review, being managed by Environment Australia. It is most unlikely that the Australian refining industry could deliver, for example, the quality of fuel that the vehicle industry desires for *Euro 3* vehicles by 2002. To produce such fuel requires a significant investment over a period of time.

The analysis by the University of Melbourne concludes that if the objective is to reduce emissions of both HC and NOx, then the introduction of *Euro 3* in 2002 is a cost effective option for passenger cars (although this analysis does not cost the implications for the fuels industry). The cost benefit analysis concludes that moving directly to *Euro 3* in 2002 delivers the greatest net benefit of all three options.

A staged approach of adopting *Euro 2* now, and *Euro 3* some years later (Option 2B), would allow manufacturers sufficient lead time to re-design models and investigate new engine options for both passenger cars and commercial vehicles. It would also provide sufficient lead time to discuss fuel parameters for *Euro 3* with the vehicle and fuel industry, in light of the Fuel Quality Review findings, which will not be complete until early 2000. The cost benefit analysis indicates that the net benefit of the staged approach of adopting *Euro 2* in 2002/3 and *Euro 3* in 2005/6 delivers significantly greater net benefit than *Euro 2* alone, but not as much as the early adoption of *Euro 3* (Option 2C). The analysis by the University of Melbourne concludes that if the objective is to reduce emissions of both HC and NOx, then this staged approach is the most cost effective option for passenger cars (although as indicated earlier, this analysis does not cost the implications for the fuels industry). The Further NSW EPA analysis concluded that modifying Option 2B to require the adoption of *Euro 3* for heavy duty trucks and buses in 2002 would increase the net benefit significantly.

Based on the NSW EPA analysis Option 2C provides the greatest net benefit. However the significant cost and logistical burden of early compliance with *Euro 3* under this option, falls heavily on the local vehicle manufacturing industry. The available evidence suggests that the four local manufacturers would either be unable to produce Euro 3 compliant vehicles by 2002, or would suffer serious financial and marketing penalties in attempting to do so. There is also considerable uncertainty as to whether Australia will be able to supply sufficient quantities of low sulphur fuel for Euro 3 passenger vehicles (local and imported) in 2002-3. A fuller assessment of this risk will not be known until the completion of the Fuel Quality Review in 2000. Advice from the local vehicle manufacturing and fuel industries indicates that the early introduction of Euro 3 in 2002 (Option 2C) is neither realistic in terms of both time nor cost given the significant investment required in research, development and hardware.

Option 2B with the modification that heavy duty trucks and buses adopt Euro 3 from 2002, is considered the most appropriate option. Option 2B (Modified) delivers significant environmental benefits and begins the path towards harmonisation, without causing major disruption to the vehicle manufacturing and fuel industries or adversely affecting their financial viability. Thus Option 2B (Modified) is the most consistent with the Government's objective which is outlined in the Prime Minister's Statement, *Safeguarding the Future*, (Prime Minister, 1997) as "seeking realistic, cost effective reductions in key sectors where emissions are high or growing strongly while also fairly spreading the burden of action across our economy".

A summary assessment of each of the three options is at Table 16.

Table 16 Summary Analysis of Options

Option[20]	Impact On			Likely benefit/comment
	Vehicle Industry	Fuel Industry	Consumers/Public	
Option 2A, *Euro 2* in 2002	• Lowest cost option • Minimal impact for imported cars (*Euro 2* in place since 1996) • Minimal impact on US &Euro Diesel suppliers, *Euro 2/US94* already "standard" • Greater impact for some local car manufacturers • Estimated vehicle costs $660m (over 20 year period) • Increase in petrol vehicle costs $520- $630 • Increase in diesel vehicle costs $2,000 - $3,000	• Only fuel change required is 0.05% sulfur in diesel • Estimated costs of desulfurisation capacities at all eight refineries $350-500 million	• estimated benefits from avoided health costs $851m (over 20 year period) • criticism that this measure reflects out of date standards and on its own not sufficient • minimal impact on retail car prices (costs likely to be absorbed)	• estimated net benefit of $119 million (over 20 year period) • lowest cost option • emission benefits mostly in locally manufactured cars and light-medium duty diesels
Option 2B, *Euro 2* in 2002, *Euro 3* in 2005	• *Euro 3* test more stringent than *Euro 2*, requires on board diagnostics, tougher evaporative emission test • *Euro 3* significantly tighter NOx and PM limits • Heavy Duty manufacturers have a choice of two new test cycles, which have more stringent emission limits than *Euro 2* • Provides industry with 5 years to comply with *Euro 3* • Minimal impact for imported vehicles (*Euro 3* in place in 2000) • More significant impacts for local manufacturers • Minimal impact for US and Euro diesel engine importers (*Euro 3* and US 98 in place in 2000) • Higher technology and hardware costs than Option 2A ($831m over 20 year period, or $807m if *Euro 3* adopted by heavy duty trucks and buses in 2002)	• For *Euro 2* in 2002 only fuel change required is 0.05% sulfur in diesel • Current fuel will not meet *Euro 3* requirements, estimated fuel reformulation costs $1,199 million or $1,084 million if *Euro 3* adopted by heavy duty trucks and buses in 2002 (over 20 year period) • Adequate lead time to negotiate changes in fuel parameters for *Euro 3* (Results of Fuel Quality Review available in 2000)	• Estimated benefits from avoided health costs $2,716million or $2,762 million if *Euro 3* adopted by heavy duty trucks and buses in 2002 (over 20 year period) • Delayed adoption of *Euro 2* and *Euro 3* increases the likelihood that costs will be absorbed	• higher cost option than Option 2A, but greater estimated net benefits of $618 million or $804 million if *Euro 3* adopted by heavy duty trucks and buses in 2002 (over 20 year period) • significant emission benefits across all sectors of the fleet

[20] This is a simplified description of the options. For a detailed description see Attachment B.

	Euro 2 to *Euro 3 $350 - $600* • Costs to local car industry to significantly upgrade emissions testing facilities (estimate $4.5M)			
Option 3, *Euro 3* in 2002	• Cost as for *Euro 3* in option 2B except lead times significantly reduced • Estimated total technology and hardware costs $800m over 20 year period • Increase in petrol vehicle retail costs to *Euro 3* $1,130 - $1,210 • Significant impacts for most non-European importers and local manufacturers, very limited lead time to meet significantly more stringent standards and upgrade facilities • Minimal impact for US and European heavy duty diesel engine suppliers – costs minimal as *Euro 3/US98* will be 'standard' • Major impact on imported Japanese diesel vehicles, many export engines will not comply • Costs to local car industry to significantly upgrade emissions testing facilities (estimate $4.5M)	• Current fuel will not meet *Euro 3* requirements. • Insufficient information available at this stage to determine what changes in fuel parameters are necessary to deliver full emission benefits. Results of Fuel Quality Review not available until 2000 • Very limited lead time to negotiate and implement changes to fuel parameters. • Estimate of fuel costs for *Euro 3* $1,594 (over a 20 year period).	• Estimated benefits from avoided health costs $3,523 m (over a 20 year period)	• Highest cost option, but greatest estimated net benefit of $1,052 m (over a 20 year period) • Significant emissions benefits across the fleet, but major disruption to local manufacturers and many importers

7.2 RATIONALE FOR PREFERRED OPTION

The staged approach reflected in Option 2B (Modified) is considered, on balance to be the most effective strategy. The analysis indicated that this approach delivered significant environmental benefits while enabling the vehicle and fuel industries to reorient their marketing strategies and to plan longer term investments. Option 2B (Modified) is therefore recommended. The modifications, which reflect consultation with industry groups, are:

- Additional one year phase in period for passenger cars. Effective dates 2002 for new models, 2004 for all models;
- Extension of *Euro 3* compliance date by one year to 2006 for passenger cars; and
- Heavy duty buses and trucks to comply with *Euro 3* by 2002/3. This

modified option is preferred for the following reasons:

- Early and staged implementation shows commitment to the Environmental Strategy for the Motor Vehicle Industry embodied in the Prime Minister's Statement on Climate Change *Safeguarding the Future;*
- Achievable at minimum cost, given the technology will be readily available and well proven (this means that for the vast majority of vehicles, *Euro 2* and *Euro 3* would apply in Australia some 5-6 years after application in Europe);
- The staged (*Euro 2* then *Euro 3*) approach delivers significant emissions and health benefits, albeit at a lesser level than an early adoption of *Euro 3* across the board. However, attempting to apply *Euro 3* standards across the board in 2002/3 would cause severe disruption and high costs to the local vehicle manufacturing and service industry, many vehicle importers and the local fuel refining industry;
- Adoption of *Euro 2* will deliver early and significant reductions in NOx and PM emissions, which are two of the pollutants of most health concern;
- Allows latest US EPA heavy duty standards as alternatives, without compromising emission benefits;
- Later adoption of *Euro 3* provides the vehicle industry sufficient lead time to meet the requirements of *Euro 3,* including the upgrading of emission test facilities necessary for local manufacturers, and the provision of a service network for the on-board diagnostic systems required in *Euro 3*;
- Heavy duty diesel buses and trucks (or at least their engines) are all imported and predominantly supplied by European and US manufacturers which will already comply with *Euro 3* or *US 98* standards;
- "Locks in" next step to *Euro 3* across the fleet, which delivers significant additional benefits;
- Amends ADR37/01 as soon as possible to include UN ECE R83 (*Euro 2* and *Euro 3* levels) as an alternative standard, thus enabling manufacturers to supply vehicles meeting more stringent standards (than currently required) to the Australian market;
- Allows compliance with later versions of the nominated standards;
- Includes LPG and NG fuelled vehicles within the scope of the standards;
- Only fuel change required by 2002 is the reduction of diesel sulfur levels to 500ppm, and this could be phased in initially as a requirement for major urban centres only, to ease the volume demand on refineries. For some years there has been a widespread expectation that 500ppm sulfur would be a minimum requirement for delivering *Euro 2* emission standards and could reasonably be seen as a "base case" scenario; and
- Later adoption of *Euro 3* will allow fuel requirements for petrol and diesel to be assessed in light of the Fuel Quality Review (due in 2000) and delivered by 2005.

7.3 DESCRIPTION OF PREFERRED OPTION

The details of the Preferred Option are as follows:

Vehicles From

2000

(1) Amend ADR37/01 as soon as possible to incorporate UN ECE R83/03 (*Euro 2* and *Euro 3* levels) as an alternative standard

From 2002

(2) Introduce 3 new ADRs, one for "light duty" vehicles, one for "heavy duty" vehicles and one for smoke emissions, which align with the UN ECE emission regulations as follows[21]:
- The light duty vehicle emissions ADR will adopt UN ECE R83/03 (Euro 2 level);
- The heavy duty vehicle emissions ADR will adopt:
  - for diesel, NG and LPG vehicles, UN ECE R49/02 (*Euro 2* level) including Supplements 1 and 2, except for vehicle categories ME and NC, for which the *Euro 3* standards will apply;
  - for petrol vehicles, the US 1996 standards for heavy duty petrol engines; and
- The smoke emissions ADR will adopt UN ECE R24/03.

(3) Require the new heavy duty and smoke emissions ADRs to accept the following standards as alternatives to the principal UN ECE standards in (2):
- The heavy duty ADR - the US 1994 Heavy Duty Emission Standards (US EPA 1999 for vehicle categories ME and NC); and
- The smoke emissions ADR - the US 1994 Heavy Duty Smoke Standards

(4) Require the 3 new ADRs to allow compliance with later versions of the nominated standards, provided they are demonstrated to be no less stringent than the version specified in the ADR.

(5) Adopt the emission standards in the above nominated ECE and US standards which apply to vehicles operating on all of the fuels nominated in the standards (currently petrol, diesel, LPG and NG).

(6) Introduce the above new ADRs to take effect from 2002 for new models and 2003 for all models, except as outlined in Table 17 below.

From 2005

(7) Revise[22]:
- the new light duty vehicle ADR to adopt UN ECE R83/04 (Euro 3 level); and
- the new heavy duty ADR to adopt:
  - for diesel, NG and LPG vehicles, the replacement version of UN ECE R49, (at the Euro3 level) for all vehicle categories;
  - For petrol vehicles, the US 1998 standards for heavy duty petrol engines.

(8) Revise the new heavy duty ADRs to accept the US 1998 Heavy Duty Emission Standards as an alternative to the principal UN ECE standards in (2)

(9) Introduce the revised new ADRs to take effect from 2005 for new models and 2006 for all models, except as outlined in Table 17 below

Fuel

From 2002

(1) Reduction of the sulfur content of diesel fuel to 500ppm, initially in major urban areas.

From 2005

(2) Changes to fuel parameters required for Euro 3, based on the outcomes of the Fuel Quality Review and discussions with stakeholders.

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[21] To determine which vehicle categories fall within each of the ADRs refer to the Applicability Table on the next page.

[22] Smoke standards remain the same.

Table 17 Detailed description of new ADRs and associated implementation dates under the Preferred Option.

ADR Categories			Equivalent ECE Category	Applicable New ADR[23],[24]	Euro 2 Introduction	Euro 3 Introduction
Description	GVM (t)	Designation				
Passenger Vehicles						
Cars	Not Applicable	MA	M1	Light Duty	*Euro 2 – 2002/04*	*Euro 3 – 2006/07*
Forward Control	Not Applicable	MB	M1	Light Duty	*Euro 2 – 2002/04*	*Euro 3 – 2006/07*
Off-road	Not Applicable	MC	M1	Light Duty	*Euro 2 – 2002/04*	*Euro 3 – 2006/07*
Buses						
Light	≤ 5	MD	M2 ≤ 3.5	Light Duty	*Euro 2 – 2002/03*	*Euro 3 – 2005/06*
			> 3.5 ≤ 5	Heavy Duty	*Euro 2* (diesel, NG, LPG) & *US 96* (petrol) – 2002/03	*Euro 3* (diesel, NG, LPG) *US 98* (petrol) *– 2005/06*
Heavy	> 5	ME	M3	Heavy Duty		*Euro 3 or US 98 – 2002/03*
Goods Vehicles (Trucks)						
Light	≤ 3.5	NA	N1	Light Duty	*Euro 2 – 2002/03*	*Euro 3 – 2005/06*
Medium	> 3.5 ≤ 12	NB	N2	Heavy Duty	*Euro 2 or US 94 (diesel,* NG, LPG*) & US 96 (petrol) – 2002/03*	*Euro 3 or US 98 (diesel,* NG, LPG*) & US 98 (petrol) – 2005/06*
Heavy	> 12	NC	N3	Heavy Duty		*Euro 3 or US 98 – 2002/03*

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[23] The introduction of *Euro 2* and *Euro 3* standards will be via two new ADRs, one for light duty vehicles (adopting ECE R83) and one for heavy duty vehicles (adopting ECE R49 & US HDV standards). These new ADRs will replace ADR37/01 and ADR70/00.

[24] A new smoke standard will also apply to all categories of diesel vehicles. The smoke standard will apply from 2002/3 and will adopt UN ECE R24/03 and allow the US 94 smoke standards as an alternative. This new ADR will replace ADR30/00.

8. IMPLEMENTATION AND REVIEW

8.1 Vehicle Standards

The ADRs are national standards under the Motor Vehicle Standards Act 1989 and are therefore subject to complete review on a 10 year cycle.

The Memorandum of Understanding (MOU) between the National Road Transport Commission (NRTC) and the National Environment Protection Council (NEPC) sets out the consultative arrangements governing the development of ADRs for vehicle emission and noise. Under the MOU, the Motor Vehicle Environment Committee (MVEC) has been given the responsibility of managing the work program developed under the MOU, and this review of the emission standards is the highest priority item on the current work plan.

Under the legislation establishing the NEPC, any new emissions ADRs are to be jointly developed and agreed by the NRTC and NEPC, with formal endorsement being the responsibility of the Ministers of the Australian Transport Council. In addition, as the proposed new emission ADRs will be endorsed as standards under the Trans Tasman Mutual Recognition Arrangement, the approval of the Council of Australian Governments is also required.

The new ADRs will be given force in law in Australia by making them National Standards (ADRs) under the *Motor Vehicle Standards Act 1989*. They will be implemented under the type approval arrangements for new vehicles administered by the Federal Office of Road Safety. A manufacturer will be required to ensure that vehicles supplied to the market comply with the vehicle emission requirements of this package of ADRs. Penalties are incurred for non-compliance with the Motor Vehicle Standards Act.

The Preferred Option, if gazetted by the end of 1999, would provide sufficient lead time for manufacturers to submit certification documentation.

8.2 Fuel

The adoption of *Euro 2* standards in 2002 will require a reduction in the sulfur content of diesel fuel to 500ppm, initially in the major urban areas. The adoption of *Euro 3* in 2006 will require changes to fuel parameters, based on the outcomes of the Fuel Quality Review and discussions with stakeholders.

There is currently no mechanism for setting national fuel standards. This has been recognised by the National Environment Protection Council (NEPC) and MVEC. MVEC will need to discuss the most effective way to deliver the desired fuel with the petroleum industry. Implementation methods could include a National Environment Protection Measure or a memorandum of understanding between the petroleum industry and the Government.

8.3 Other

The review of the emissions standards raised a number of other issues which need to be addressed by the Motor Vehicle Environment Committee. These include the reduction in petrol volatility and an analysis of *Euro 4* standards with a view to determining the costs and benefits of introducing these standards in the future.

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