NATIONAL ROAD TRANSPORT COMMISSION

EXTERNAL NOISE FROM MOTOR VEHICLES

Regulatory Impact Statement

October 2002

Prepared by
National Road Transport Commission &
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National Road Transport Commission

External Noise of Motor Vehicles: Regulatory Impact Statement

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REPORT OUTLINE

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Title:	External Noise from Motor Vehicles: Regulatory Impact Statement
Address:	National Road Transport Commission Level 5/326 William Street MELBOURNE VIC 3000 E-mail: nrtc@nrtc.gov.au Website: www.nrtc.gov.au
Objectives:	To present information in support of a change to external noise levels from all new motor vehicles.
NRTC Programs:	Safety and Environment
Key Milestones:	This RIS builds on the draft RIS released in January 2002 and the NRTC report *A Review of the Noise Related Australian Design Rules and Engine Brake Noise* released in April 2001. It puts forward a final policy position in support of new vehicle noise standards. It considers other options, both regulatory and non-regulatory and incorporates comments provided in response to the draft RIS. This proposal will be put to Transport Ministers following endorsement by NRTC and the Motor Vehicle Environment Committee.
Abstract:	This RIS proposes changing the Australian Design Rules relating to motor vehicle noise, such that the standards become more stringent. The proposal is to harmonise with international standards, but to allow some variation from the standards for very heavy vehicles. The report shows that the benefits are likely to outweigh the costs.
Purpose:	To assist Ministers in deciding whether to endorse the reform proposal.
Key words:	noise, ADRs, standards, harmonisation, vehicle, truck, bus, car, motorcycle, evaluation, regulation, decibels, united nations, transport, encapsulation, sound levels.

FOREWORD

Excessive vehicle noise affects millions of Australians. It has been about 15 years since the design standards for vehicle noise have been comprehensively reviewed in Australia. In developing the Third Heavy Vehicle Reform Package, the National Road Transport Commission recognised the need to review vehicle noise design standards and gained approval from industry and community stakeholders to proceed with a review.

A Review of the Noise Related Australian Design Rules and Engine Brake Noise was released by NRTC in April 2001. This report showed that Australian vehicle noise standards lagged signficantly behind international standards. Many stakeholders provided submissions to the report. All were supportive of international harmonisation, though a number of issues were raised. The release of a draft Regulatory Impact Statement in January 2002 provided the opportunity to address these issues at some length and to propose some specific alternatives to the current design rules.

Responses to the RIS were generally supportive of international harmonisation of vehicle standards, but several expressed significant concerns about timing and the need to vary from international standards because of Australia's unique circumstances.

NRTC has considered all comments in some detail. It has considered advice provided by groups including the Motor Vehicle Environment Committee, the Industry Advisory Group, the Bus Industry Advisory Group and regulatory agencies. NRTC has sought to put forward a compromise position that balances the legitimate practical concerns of manufacturers with the community demands for world's best practice in vehicle noise standards.

NRTC is required to develop noise and emissions standards jointly with the National Environment Protection Council. The joint development process culminates with both transport and environment Ministers voting on the proposal. This document, along with the proposed new ADR83/00 and an amendment to the Australian Vehicle Standards Rules will now be sent to all transport and environment Ministers for approval.

Following consideration by transport and environment Ministers, the Commonwealth Minister for Transport has the power to Gazzette the new ADR under the *Motor Vehicle Standards Act 1989*.

EXECUTIVE SUMMARY

Noise from motor vehicles is a major source of community concern and has led regulatory authorities to develop a range of strategies that aim to reduce noise. These include:

- building roadside noise barriers to prevent noise reaching homes,
- reducing demand for vehicle use;
- educational programs to encourage quieter driving practice;
- designing better road surfaces so that tyre noise is reduced;
- ensuring vehicles are well maintained so they don't emit more noise than they were designed to; and
- developing design rules to ensure new vehicles emit lower noise through better engine technologies, better muffler systems and shielding that prevents noise escaping from the vehicle.

All of these strategies contribute to reducing the overall impact of vehicle noise. It is likely that governments will continue to use each of these strategies where they are considered most appropriate. For example, roadside noise barriers are best suited to freeway areas adjacent to population centres, but are not appropriate for busy intersections where they can reduce pedestrian amenity and create an eyesore. Similarly, specialised road surfaces have little impact on vehicles travelling at low speeds. Some regulatory authorities are now exploring new approaches such as reducing registration fees for low emission vehicles. These approaches have the potential to be used to provide incentives for vehicles with lower noise levels.

The focus of this report, is not so much to determine which strategy is most effective, but to consider the extent to which new vehicle design standards should contribute to the suite of strategies that, in combination, reduce traffic noise pollution.

The release of this report represents the final stage of a two year consultation process. This report has been preceded by three earlier rounds of formal conslultation and dozens of informal meetings with a diverse range of stakeholders. Through this lengthy consultation process NRTC has had to grapple with a diverse range of views and develop a response that is balanced and acknowledges the legitimate concerns of all stakeholders. Views put to NRTC polarised around the issue of how stringent the noise levels should be. NRTC has listened to the arguments and has sought to balance the legitimate practical issues that face manufacturers, against the community desire for world's best noise standards. In doing so, NRTC has been conscious of current trends, particularly in the heavy vehicle industry, which seeks to meet strong growth in the freight task through greater access to the road network, more powerful vehicles and a preference for high productivity vehicles such as B-doubles. It is however, equally conscious of the arduous vehicle operating conditions in Australia and the problems this poses for manufacturers seeking to meet tough noise standards.

The instrument for setting new vehicle design standards is the Australian Design Rules (ADRs) which are implemented as standards under the *Motor Vehicle Standards Act 1989*. There are currently three ADRs setting noise standards for all vehicles from small motorcycles through to heavy trucks. The current noise standards have been in place since

1989 and lag well behind international best practice. It is proposed that the three ADRs be replaced with one ADR, to be called ADR83/00.

The current international standards (set by the United Nations Economic Commission for Europe – UNECE) are significantly more stringent than Australian standards. The UNECE standards have been in place internationally since 1996.

This final RIS builds on the draft RIS released in January 2002. The analysis revisits the issues put forward in the draft, makes changes where new information has arisen from the consultation process and considers the views put forward in consultation.

As well as canvassing non-regulatory options, this RIS puts forward three options for changing the existing ADRs. As Australia has signed an international agreement committing to harmonise (where appropriate) with international standards, the options focus on the extent to which Australia should harmonise with international standards. The (regulatory) options discussed are:

- full harmonisation with UNECE noise levels and test methods;
- full harmonisation with UNECE noise levels and test methods with exceptions for high-powered trucks; and
- retaining the status quo

Harmonising with US or Japanese standards has not been explored in this report, though was discussed in the Close/Apelbaum report released by NRTC in April 2000. US and Japanese standards are standards promulgated by individual countries and are not international in the same way that UNECE standards are accepted by the World Trade Organisation as technical regulations. Japan has signed the '1958 Agreement' which clearly indicates a move toward international harmonisation. The USA has ongoing communications with the UN and has assisted in the development of the 1998 Global Agreement to help ensure UN and US standards eventually harmonise. In addition, adoption of the current US or Japanese standards would not bring any benefit to the community, as they are similar to the current Australian standards.

The issues associated with the three regulatory options above are discussed at some length. Some issues are common to all three options. The issues discussed centre on whether there is a reasonable case for Australia to vary from harmonisation with international standards. The reasons stakeholders seek to vary from harmonisation often relate to climatic conditions in Australia (extreme temperatures can introduce cooling problems which are exacerbated by noise control equipment), or the unique nature of our transport industry (we move heavier loads at higher speeds than most other countries).

The key points below summarises the NRTC's final view on the arguments that have been put forward:

- The three existing ADRs relating to noise (ADR28, 39 &56) should be consolidated into a single ADR to be called ADR83/00. It should cover all vehicles from small motorbikes to heavy trucks.
    - *This is the same as the position put forward in the draft RIS*
- ADR83/00 drive by limits should be harmonised with UNECE 51/02 limits, UNECE 41/03 for motorbikes UNECE 63/01 for mopeds. However, heavy vehicles over

320kW should be permitted a further 3 dB(A) allowance on top of the UNECE 51/02 limit;

- *This is the same as the position put forward in the draft RIS, but a review of the 3dB concession has been built-in*

- ADR 83/00 should apply to trucks and buses from 1 January 2006 for new models and from 1 January 2007 for all models;

  - *This is two years later than proposed in the draft RIS*

- ADR 83/00 should apply to light vehicles from 1 January 2005 for new models and from 1 January 2007 for all models;

  - *This is one and two years later than proposed in the draft RIS*

- ADR 83/00 should apply to motorcycles and mopeds from 1 January 2005 for new models and 1 January 2006 for all models;

  - *This is one year later than proposed in the draft RIS*

- ADR83/00 should adopt the stationary test methods set out in UNECE 51/02, thereby dispensing with the specified stationary noise level for each class of vehicles, in favour of the model-specific 'signature' approach used in UNECE regulation;

  - *This is the same as the proposal put forward in the draft RIS*

- A consequential amendment should be made to the Australian Vehicle Standard Rules to reflect the shift to the 'signature' system of testing for ADR83/00 compliant vehicles. This change should permit a 5dB allowance for in-serice deterioration from the original 'signature' level.

  - *This is an increase of 3dB in the amount a vehicle is allowed to deteriorate, over that proposed in the draft RIS*

- ADR83/00 test conditions should vary from the international standard in that drive-by testing should be allowed to take place either under the test track conditions set out in the current ADR28/01, or according to ISO10844.

  - *This is the same as the position put forward in the draft RIS*

In summary, the changes in new vehicle noise levels will be:

	Standard proposed in RIS	Change from current standard	Difference between RIS position and proposed final position
Cars	74	-3dB	No change to proposed levels. Timing extended from 2004/5 to 2005/7
Buses (150-320kW)	80	-6dB	Timing extended from 2004/5 to 2006/7. Alternative approach to compliance to be introduced. Buses over 320kW also given 3dB concession (now a 3dB reduction from current standard).
Buses (>320kW)	80	-6dB	
Motorcycles (>175cc)	80	-2dB	No change to proposed levels. Timing extended to 1 year.
Trucks (150-270kW)	80	-4dB	No change to proposed levels. Timing extended from 2004/5 to 2006/7.
Trucks (270-320kW)	80	-7dB	No change to proposed levels. Timing extended from 2004/5 to 2006/7.
Trucks (> 320kW)	83	-4dB	No change to proposed levels. Timing extended from 2004/5 to 2006/7. Proposal to reassess concession at a later date.

In order to assess the economic impacts of the proposed options, a cost benefit analysis has been undertaken. On the costs side of the equation, estimates included in the draft RIS were based on European experience. Consultation has resulted in some new information on costs from Australian manufacturers. However, cost estimates are still limited, as manufacturers are sensitive about releasing cost information.

On the benefits side of the equation, a hedonic pricing approach was used in the draft RIS. Hedonic pricing links reduced noise to improvements in property prices, particularly for those properties affected by traffic noise. Given the high prices of property in Australian cities and the relatively large number of homes affected, the hedonic approach used in the draft RIS gave very high values of benefit. However, when using very conservative estimates, the benefit is small. Consultation on the draft RIS provided extensive comment on the cost/benefit analysis and figures have been revised where new information was offered.

The benefits appear to significantly outweigh the costs, even with roadside amenity and health impacts valued at zero. The consultation has led to the final NRTC view that:

- Harmonisation with UNECE standards with a 3dB concession for heavy vehcles over 320kW, is the preferred option. It is likely to provide a net benefit, but ensures manufacturing costs are significantly lower than for full harmonisation.

- Based on mid-range estimates, the net benefit to the community in the long term is likely to be in the order of $2 billion. However under very conservative assumptions, it is estimated that costs would outweigh benefits in the short term, but there would be a small long term (after about 9 years) ongoing net benefit.

- In the interests of transparency, NRTC has put forward stakeholder views arguing that the benefit should be either higher or lower. Given that the benefits appear to signficantly outweigh costs in the longer term, there would be little value in investing resources in an attempt to quantify each issue. Also, given the qualitative nature of

many of the issues raised, it may not be meaningful to reduce each of them to a dollar figure. However, they are offered for readers to form their own conclusions.

- Benefits will continue to accrue beyond the 10 year timeframe used to present estimates.

The proposed introduction of ADR83/00 will:

- ensure design standards continue to play a role in contributing to reducing traffic noise levels;
- facilitate a more rigorous approach to in-service noise control by recording stationary noise at certification and enabling enforcement officers to objectively measure deterioration in the field;
- ensure that the costs of introducing a new ADR are outweighed by the benefits and is the most appropriate response to the problem; and
- help Australia meet its international commitment to harmonise international vehicle standards and thereby enhance export opportunities.

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1. INTRODUCTION

This Regulatory Impact Statement (RIS) puts forward a proposal to reduce the noise levels that new vehicles in Australia can emit. It is being undertaken by the National Road Transport Commission (NRTC) for the Motor Vehicle Environment Committee (MVEC). MVEC was established as a mechanism to help achieve the statutory requirements of both the NRTC and the National Environment Protection Council (NEPC). These requirements relate to the establishment of new vehicle emission and noise standards.

MVEC has a work program that is updated regularly. Current items on the MVEC work program seek to reduce vehicle noise through both new vehicle design and in-service approaches. Reducing vehicle noise can result in reduced traffic noise and can have significant benefits in terms of health and amenity.

Standards for new vehicles in Australia are governed by Commonwealth instruments known as Australian Design Rules (ADRs). ADRs set standards for a range of safety and emissions characteristics relating to motor vehicles. The standards apply when the vehicle is supplied to the market. Three ADRs set noise standards for new vehicles. They are:

- ADR28/01 External Noise of Motor Vehicles. This sets stationary and drive-by noise limits for all classes of cars, trucks and buses.
- ADR39/00 External Noise of Motor Cycles. This sets stationary and drive-by noise limits for motor cycles.
- ADR 56/00 Moped Noise. This sets stationary and drive-by noise limits for mopeds (eg motor scooters with less than 50cc engine capacity).

The ADRs set requirements for noise levels when the vehicle is stationary, and when the vehicle is accelerating past microphones at a specified distance. The level specified for the stationary test is also used as the maximum in-service level that applies to the vehicle during its life (the in-service requirement is set by the *Australian Vehicle Standards Rules*). The latter test, known as a 'drive-by' or 'vehicle in motion' test is intended to replicate the noise level that might be heard at the side of the road when the vehicle is accelerating. The noise levels set by the ADRs vary according to vehicle type. In general, the heavier and more powerful the vehicle, the higher the permissible noise level. The ADRs also specify test conditions, meaurement equipment and protocols for how to take instrument readings.

Table 1: Noise levels set by current ADRs

The table below summarises the 'drive-by' noise levels set by the current ADRs. It provides an indication of the relative differences across vehicle types.

Vehicle Type	**Maximum permissible drive-by noise level at certification**
Motorcycles with engine displacement greater that 175cc	82dB(A)
Passenger cars	77dB(A)
4WD vehicle over 2 tonnes with engine power over 150kW	79dB(A)
Buses with engine power 150-270kW	85dB(A)
Buses with engine power >270kW	86dB(A)
Small trucks 3.5-12 tonneswith engine power >150kW	86dB(A)
Large trucks with engine power >270kW	87dB(A)

ADRs are determined by the Commonwealth Minister for Transport under the *Motor Vehicle Standards Act 1989*. However, ADRs relating specifically to vehicle emissions and noise must be developed jointly by the National Road Transport Commission and the National Environment Protection Council. MVEC provides the forum for this joint development process. The current ADRs relating to vehicle noise standards are under review as part of the MVEC work program.

Australia represents only 1% of the world vehicle market, so generally adopts international standards rather than developing its own. Australia has signed an international agreement known as the '1958 Agreement'. This international agreement within the United Nations framework, provides a protocol for the reciprocal recognition of approvals certifying compliance with international standards. It means that Australian manufacturers can obtain certification approvals in Australia, which are automatically accepted by other member countries. This RIS assesses a range of proposed changes to the ADRs including harmonisation with the international standards.

The equivalent United Nations Economic Commission for Europe (UNECE) standards to the ADRs listed above are:

- UNECE 51/02 Noise
- UNECE 41/03 Noise (Motor Cycles)
- UNECE 63/01 Noise (Moped).

These standards have been in place in UNECE member states since 1996.

In April 2001, the NRTC released a consultant's report covering both new vehicle standards and in-service issues such as engine brake noise. The report, *A Review of the Noise Related Australian Design Rules and Engine Brake Noise* authored by Mr Harry Close and Mr John Apelbaum ("the Close/Apelbaum Report"), represented the first stage in this review and is an important contribution to the development of this draft RIS. The report contains a wealth of information on Australian and international noise standards and the specific issue of engine brake noise.

The Close/Apelbaum report included the views of key stakeholders that were gained from personal interviews. The report was released by NRTC for public comment over a three month period. The report, the resulting submissions, follow up interviews and the original interviews with key stakeholders have helped provide much of the information for the draft RIS.

Both the Close/Apelbaum Report and the draft RIS discussed a range of options to improve noise from both new and in-service vehicles. Improving noise from new vehicles is an effective, but long-term strategy. It will take time to have an effect on traffic noise as new vehicles will not fully penetrate the market for several years. It is therefore appropriate that MVEC also focus on short-term solutions to noisy vehicles in the community. MVEC recently gained national agreement on an in-service noise test that can be used by regulators in all jurisdictions. The current MVEC focus relating to in-service noise is in designing a strategy to address engine brake noise. A research program, building on the Close/Apelbaum report is currently underway. Any regulatory measures arising from this research will be the subject of a separate RIS.

This assessment of the impacts associated with improving new vehicle noise standards should therefore be seen as part of a package of noise reforms, which improve noise levels in both the long term and short term.

Key Points

- New vehicle noise standards are set through legal instruments known as Australian Design Rules (ADRs).
- Research shows ADRs are far less stringent than current international standards.
- There has already been extensive research and consultation on how to address vehicle noise.
- MVEC is working on both long and short-term strategies to address noise problems. Reducing new vehicle noise levels is a long-term strategy but is being complemented by projects focusing on in-service noise issues.

1.1 Statement of the problem

1.1.1 Extent of the traffic noise problem

The extent to which traffic noise is a problem throughout Australia is difficult to accurately quantify. Transport and environment agences invest significant resources into managing traffic noise through maintaining complaints databases, assessing the noise impact of new transport routes, building infrastructure to prevent noise reaching sensitive areas and developing comprehensive strategies to address traffic noise. All this, combined with extensive media coverage of community noise issues, would indicate that governments consider traffic noise a very important community issue.

We know that traffic noise adversely affects a large proportion of the population. In Sydney alone it is estimated that 1.5 million residents are exposed to traffic noise levels considered undesirable by the OECD and 350,000 residents experience unacceptable noise levels that affect behaviour and health (NSW EPA 1997). Links between excessive noise levels and human health are well documented, but difficult to quantify in financial terms. Adverse health effects include cardio-vascular and nervous system problems (Carter et al 2000), sleep loss leading to mood and psycho-social impairment (AISE 2000) and increased risk of cardio-vascular and gastro intentinal problems (INFRAS 2002). INFRAS (2002) reports also reports that that a recent study by Ising estimated that a reduction of transport noise below 65dB(A) during day times and 55dB(A) during night times would decrease cardiac fatalities in Germany by 3%. Health issues are discussed further at Appendix 2.

It is important to note that typically only 5 to 10% of residents exposed to traffic noise complain to authorities (Bergland and Lindvall, 1995). Consequently, complaints databases are unlikely to reveal the true extent of the problem. Nevertheless, most Councils, EPAs and Road Authorities have noise complaints databases that show a significant community concern. In 2001 the NSW RTA received 262 complaints, a figure that has been increasing over the last 5 years. VicRoads in Victoria receives a similar number of complaints, but notes that the volume of complaints vary as road proposals or barrier retrofitting proposals are assessed by community groups.

1.1.2 Noise levels and community annoyance

International and Australian studies (INFRAS 2001, NSW EPA 1999) identify the threshold at which traffic noise becomes annoying at about 55dB L_{Aeq} (that is, equivalent steady state sound level). This threshold of annoyance varies markedly between individuals. The proportion of the population affected by such levels is unknown, but

estimates vary from 13% to about 25%, with perhaps half the population exposed to levels over 52dB (Close and Apelbaum 2001). In Canberra, perhaps Australia's most modern and well planned city, the ACT Department of Urban Services has estimated that dwellings exposed to noise levels greater than 55dB may be as low as 5%. The NSW Government has set noise criteria for various parts of the NSW road network based on extensive research of 'annoyance' levels. The proposals range from about 35dB L_{Aeq} (near hospitals) to 60dB L_{Aeq} adjacent to freeways during daytime.

It is difficult to compare the traffic noise levels stated above with the noise levels regulated by the Australian Design Rules. For example, comparing the 55dB L_{Aeq} threshold for annoyance against the 87dB(A) regulated maximum noise level for new trucks is comparing different measures. The former figure is an equivalent steady state figure calculated over a period of time. The ADRs simply set maximum noise levels for individual vehicles measured at 7.5metres. Clearly, reducing regulated noise levels must reduce L_{Aeq} levels, but the relationship is derived from a complex statistical method. Laeq is affected not only be individual vehicle noise levels, but also by variations in traffic flows, road surfaces, weather conditions, point of measurement, etc.

1.1.3 Ways to solve the problem

There is a number of ways to reduce traffic noise including:

- reducing noise at the source through:
  - better design;
  - preventing modification or deterioration; and
  - infrastructure that limits noise (low noise road surfaces).
- prevening noise reaching sensitive areas such as homes (eg using noise barriers, building homes away from major traffic routes); and
- reducing traffic volume and traffic speed

Recent attempts to reduce traffic noise so that targets such as those set in NSW are met, has led to considerable expenditure on infrastructure. Solutions such as physical noise barriers or specialised road surfaces have been introduced, rather than solutions that reduce the noise at the source. In its Annual Environment Report (2001), the NSW RTA stated that it had undertaken measures such as noise walls, earth mounds, quieter road surfaces and architectual acoustic treatments to private dwellings. However, it noted that it had "continued to advocate to the Federal Government to introduce more stringent vehicle noise standards" (p25). Similarly, the Victorian EPA is proposing a road traffic noise strategy for Victoria. It lists three key elements of the proposed strategy including the reduction of noise from individual vehicles (EPA 2002 p2). Road agencies have begun to question the value of building infrastructure when Australia has such lax vehicle noise standards compared with its international counterparts.

1.1.4 How Australia's noise standards compare

Australia's noise standards for new vehicles are considerably less stringent than other OECD countries. In some categories, new vehicles in Australia can be nearly twice as loud as their overseas counterparts that are built to comply with international standards. Australia's noise standards have not been reviewed for about 15 years, whereas UNECE noise standards have been tightened twice in this period. The current situation is

inconsistent with the Commonwealth policy on international harmonisation of vehicle standards.

A comparison of Australian and European Union noise standards over the last 30 years is shown below.

Table 1: Noise Reduction - Buses

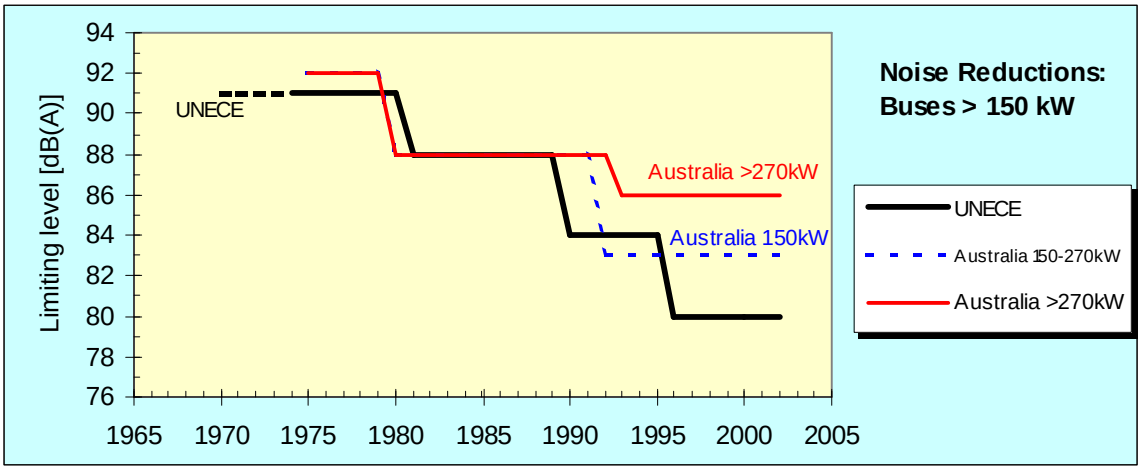


Table 2: Noise Reduction – Passenger Cars

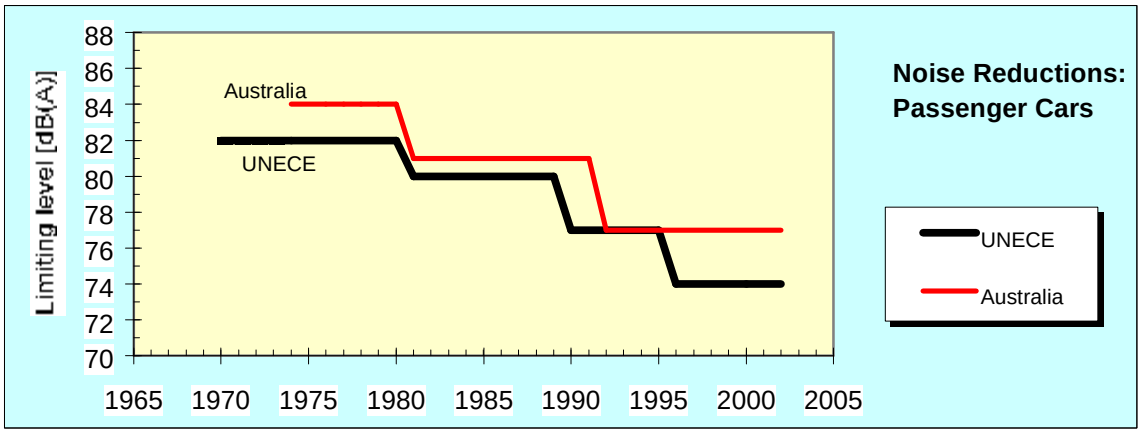
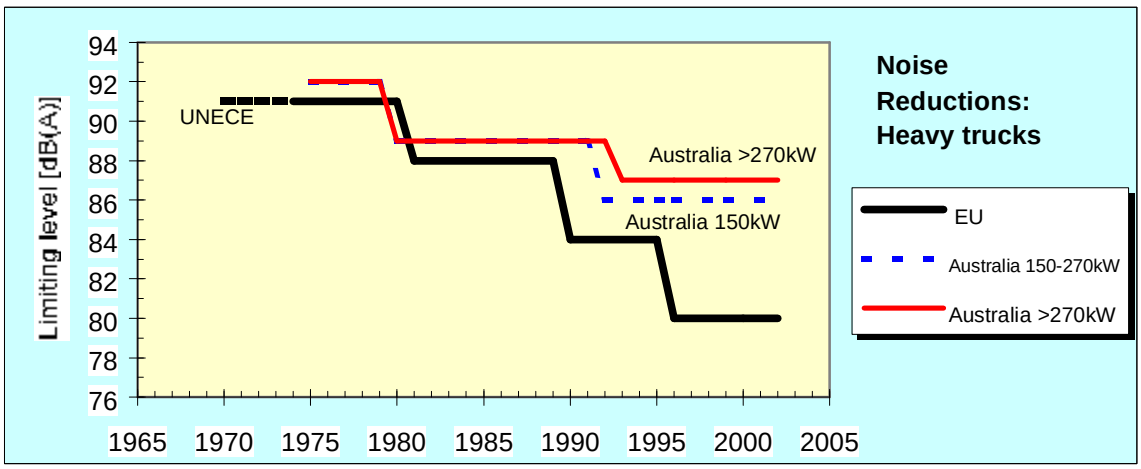


Table 3: Noise Reduction – Heavy Trucks



There is little indication that the market has ensured that noise levels from new vehicles are better than the regulated standards. Submissions on the Close/Apelbaum report and draft RIS clearly show that a majority of manufacturers will need to make a design effort to reach tighter standards.

1.1.5 The role of new vehicle standards in addressing the problem

From the discussion above, traffic noise is a significant problem, and there are a number of ways to address it. The challenge for governments is to select new vehicle noise standards that ensure vehicle manufacturers contribute to reduced traffic noise having consideration for the other approaches to reducing noise. In selecting these standards it is important to examine other methods of preventing traffic noise to ensure that the standards proposed offer a greater net benefit than the alternate approaches currently being used by road authorities. This approach will ensure that new vehicle standards play an appropriate role within a package of measures that is needed to reduce traffic noise problems in Australia.

1.2 Objective

The objective of this reform is to improve noise levels from new vehicles to an extent that shows a significant net benefit to the community, and cannot be achieved through alternative meansures that have a greater net benefit.

2. PROPOSAL AND ALTERNATIVES CONSIDERED

It is recognised that there is a range of options available to reduce traffic noise. However, as identified above, the problem being addressed through this RIS is how to select new vehicle standards that ensure manufacturers contribute to reduced traffic noise. Based on the Close/Apelbaum report, the draft RIS, feedback from stakeholders and the views of MVEC, the proposed approach is:

- ***Reduce vehicle noise through full harmonisation with international standards with limited exceptions that recognise the unique Australian environment.***

The issues associated with this approach and two alternative approaches are discussed in detail below. However, there is a range of broader options that provide an alternative to regulation that warrant some discussion and evaluation.

2.1 Alternatives to Regulation

2.1.1 Rely on competition in the marketplace (consumer demand) to reduce noise levels

The exact noise performance of new vehicles entering the Australian market is known only to the manufacturers of those vehicles. Certification data is not publicly available and regarded as commercial in confidence. However there are several indications that most vehicles are performing at, or only marginally below the regulated standards. In a submission to the Close/Apelbaum report, a certification engineer estimated that, for example, 91% of manual buses certified in Australia last year would fail the current UNECE requirements. Submissions received from engine and vehicle manufacturers all claim there will be costs associated with moving to the UNECE standards due to the need for cooling measures to compensate for heat problems caused by noise reduction measures such as engine encapsulation. This view is also put by the Truck Industry Council, which claims that engines or engine bays will need to be encased in sound reduction substances.

Several manufacturers produce promotional literature that makes a virtue of low noise levels. However, this almost exclusively refers to in-vehicle noise levels. Long distance truck drivers generally prefer low in-cab noise levels to reduce fatigue. Unfortunately, the engineering requirement to reduce in-vehicle noise levels can be quite different to the engineering requirement to reduce external drive-by noise. The former focuses on insulating the vehicle interior, the latter focuses on muffler design and engine encapuslation.

Australian manufacturers claimed that some locally manufactured vehicles and most imported vehicles will comply with the UNECE standards. This is supported by publications and internet sites that list the environmental performance of vehicles supplied both overseas and in Australia.

Relying on consumer demand will therefore do little to reduce the external noise of vehicles because:

- submissions to the draft RIS indicate moderate levels of voluntary compliance with UNECE standards in Australia (ie, it's only happening to a limited degree);
- there is some cost to manufacturers in lowering external noise levels;

- consumers tend to demand low in-vehicle noise levels, not low external noise levels;

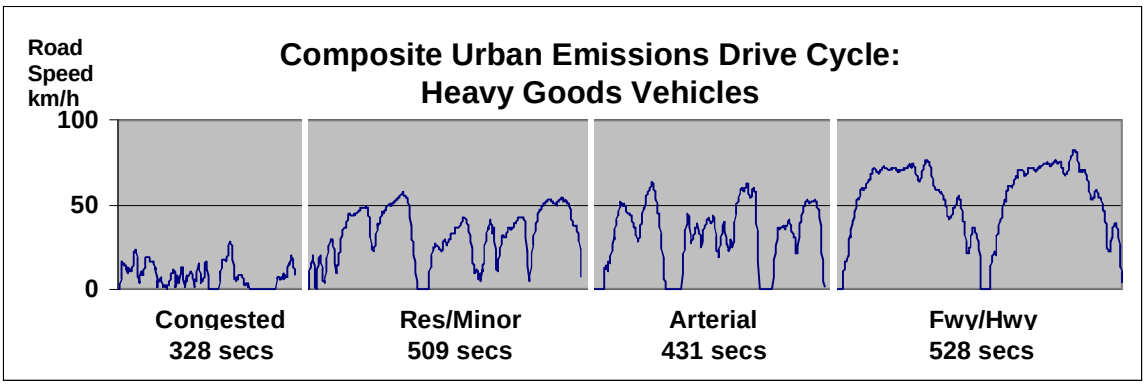
2.1.2 Prevent the noise reaching noise sensitive areas - eg noise barriers.

Noise barriers are increasingly familiar sights along urban freeways. The use of barriers as a noise abatement technology is best suited to freeway applications, where vehicles travel at relatively high speeds and there is no pedestrian access. At high speeds the noise that can be heard at roadside is primarily the noise of the tyres on the road surface. There is little vehicle manufacturers can do to engineer-out this noise (other than experimenting with tyres), so solutions such as noise barriers and improved road surfaces, are designed by construction authorities.

In non-freeway environments, noise barriers are not feasible because of the need for pedestrian access and the desire for visual amenity. Cost is also a factor as, on a typical urban freeway project, the roadside barriers can cost as much as the road itself, depending on design and materials used. Close and Apelbaum (2001) provide estimates ranging from $80 to $350 per square metre for noise barriers. In responding to the draft RIS, some stakeholders suggested alternate infrastructure approaches such as specialised road pavements. These solutions are being used by governments in noise sensitive areas where finances permit. The latest research (Dash 2002) indicates that while these special surfaces can significantly reduce noise from car tyres, the effect on truck noise is more marginal.

In non freeway environments, vehicles are moving at lower speeds and the bulk of the noise heard at roadside is engine and chassis noise. This type of noise can only be addressed through better vehicle design and maintenance.

Several stakeholders responding to the draft RIS, noted that reducing vehicle noise standards will have a limited impact on high speed noise such as freeway noise. NRTC accepts that the proposed standards will have low impact at high speeds and are therefore unlikely to significantly reduce government expenditure on freeway noise barriers. However, the standards will have their greatest impact, in an urban environment, where vehicles are constantly accelerating sharply. Research undertaken to replicate a 'typical' driving cycle for Australia (NEPC 1999) shows that vehicles in urban areas travel at low average speeds but with a great variation in speed. The graph below shows a typical drive cycle for a heavy truck:



The data shows that this class of vehicle travels at an average speed of 31.6km/h throughout this drive cycle. While the average speed of cars is likely to be higher, the typical drive cycle shows similar acceleration curves (eg: refer USEPA cycles at www.epa.gov/otaq/sftp.htm#cycles). Under these conditions, the audible noise from the fleet is primarily engine noise and it is this noise that ADRs are best placed to address.

Other noise barriers such as improved glazing will have some benefits to people living on noisy roads, but only while they remain indoors. This will clearly be a costly solution and would most likely be funded by home owners. The Close/Apelbaum report draws on research estimating that half of the population is exposed to noise levels over 52dB and that one quarter of Sydney residences are exposed to levels above 55dB. Even a conservative estimate of the cost of double glazing their homes would see a cost of several billion dollars. Given the nature of housing construction in Australia (the use of weatherboard, fibro or brick veneer is prevalent), improved glazing of certain houses may have minimal impact anyway. NRTC therefore notes that:

- preventing noise reaching sensitive areas is not a substitute for reducing engine noise through better design. Solutions such as barriers are best used to prevent high speed freeway noise reaching nearby homes, whereas better design standards will contribute to reducing noise at lower speeds in an urban environment.

2.1.3 Provide educational materials for drivers

Many road and environment authorities have provided educational material about traffic noise from time to time. Most recently Austroads developed a brochure aimed at truck drivers. That brochure has been distributed by every transport agency in Australia. Its impact is unknown, but complaint databases indicate there is still a significant noise problem.

Information and education is a useful adjunct to regulation and will continue to play a role. It does not, however, make the vehicle inherently quieter and can at best, lead to better driver behaviour. While better driving practices can reduce noise, the effect will be maximised when combined with an inherently quieter vehicle. It is therefore an approach best used in combination with other measures such as more stringent ADRs.

2.1.4 Research and Development grants for manufacturers and suppliers for new noise attenuating devices

Several devices with varying levels of sophistication are available to improve vehicle noise. These are constantly being developed by original equipment or aftermarket manufacturers to meet community demands for quieter vehicles or, in some cases, to capture energy lost when braking. Such devices are often marketed aggressively through industry media and conferences. There are a number of ways for governments to ensure this development is supported or encouraged. Providing grants is one approach, offering tax subsidies is another, but these approaches are unlikely to be as effective as setting a performance based regulation to create a market for this equipment. Offering grants may imply a need for governments to choose particular technologies rather than set performance based objectives. The setting of performance based objectives through the ADRs and in-service regulation, allows all product manufacturers to compete on a level playing field. While providing a grant or a tax break may assist in developing promising technologies, it cannot replace the need for performance standards over the medium term.

2.1.5 Provide concessional registration fees for heavy vehicles equipped with "Premium" mufflers

As discussed above, this type of approach is unlikely to take advantage of performance based indicators such as new or in-service standards. As the Close/Apelbaum report discussed, it is extremely difficult to determine what a 'premium' muffler might be, given its noise characteristics might vary depending what vehicle it is fitted to. This is

particularly the case for heavy trucks. Some submissions from manufacturers actively opposed this type of approach as there is no industry agreement on what is meant by 'premium' and no system for objective measurement because different vehicles perform differently with the same muffler.

Nevertheless, if such a system can be developed, this type of approach may have some application in future to supplement performance based standards. MVEC is currently investigating these options through its engine brake test program. This may lead to a regulatory approach whereby particular mufflers are 'certified' for particular engine families, but any such proposal will be the subject of a separate RIS.

2.1.6 Industry accreditation

As discussed above, there is little indication that manufacturers are supplying new vehicles to the market that meet international noise levels. It is therefore unlikely that an industry based approach to new vehicle noise standards would have any impact. However, it is possible that an industry based program can help stop deterioration of noise related components while vehicles are in-service. Such a program can ensure that regular checks of the engine and muffler are put in place and that regular and relevant servicing takes place. The Australian Trucking Association is developing an Emissions Management Module for its members, that includes regular checks for muffler performance. MVEC is supporting and encouraging this initiative. The Exhaust Systems Professional Association has also put forward a proposal for muffler suppliers to test vehicles when fitted with new mufflers. This is another in-service initiative that is being investigated by MVEC and may have a role in any complementary in-service measures developed.

2.1.7 Greater enforcement of existing in-service standards

Consultation on the draft RIS prompted a number of stakeholders to complain about modified or malfunctioning vehicles that were far louder than the bulk of the fleet. These vehicles are currently the target of enforcement campaigns. For example, in Victoria the EPA undertakes roadside testing, or refers excessively noisy vehicles to Authorised Noise Testers to undergo a stationary noise test. Last year the Victorian EPA served about 4000 notices requiring exhaust systems to be fixed. Stakeholders have argued that raising the level of enforcement (in all States) could have a greater net benefit than addressing the ADRs.

In-service noise levels are set by the Australian Vehicle Standards Rules. The standards set by the Rules draw on the stationary level that applied when the vehicle was new. For example, a new heavy truck (built to ADR28/01) is required to meet an in-service stationary noise level of 99dB(A), whereas a truck built before 1980 is required to meet 105dB(A). It is often the case that vehicles that only just meet the drive-by level, are often well under the required stationary level. For example, recent NRTC testing (NRTC 2002) indicates that a new truck required to meet the 99dB(A) stationary limit might actually emit around 89dB(A), while only just meeting the 87dB(A) drive-by limit. As a consequence, a new vehicle can deteriorate more than 10dB and still meet the stationary in-service standard. Sometimes this means that even obviously 'noisy' vehicles are legal. This not only provides an opportunity for people to deliberately make their vehicles louder, it acts as a disincentive to enforcement. A recent newspaper article provides an example. A story about a government noise and emissions blitz on a major route well known for noisy trucks noted that only one truck failed the test (Footscray Mail 2/4/2002). One response is to develop a regulation to wipe 5 or 10dB off the current in-service standards. However, this would retrospectively legislate a standard that some vehicles were never

designed to meet. Parliaments rarely retrospectivley legislate because of issues of fairness. Clearly it would be unfair to deprive a commercial vehicle driver of the ability to use their vehicle because it was unable to meet a retrospective standard.

An alternate response is being pursued in the current proposal. By moving to a model-specific approach to stationary noise, it is possible to introduce an in-service standard that limits all vehicles to a maximum deterioration of 5dB from its original stationary level. However, the amendment would only apply to ADR83/00 vehicles as they entered the fleet. This would provide a long-term solution to the problem.

However, removing more of the 'rogue' vehicles from the roads will have little impact on overall noise levels – it will simply remove an occasional (very annoying) 'peak'. Combining a better in-service regime with better design standards will have the greatest impact on overall noise levels.

2.1.8 Address the issue of engine brake noise

Several stakeholders identified engine brake noise as a key noise problem. Many heavy trucks are fitted with engine brakes which effectively turn the engine into a compressor to retard the movement of the vehicle. This is very effective at saving wear and tear on the service brakes, but some engine brakes can be very noisy, particularly when the vehicle condition deteriorates. NRTC is managing a project to address engine brake noise. Preliminary research indicates that the link between engine brake noise and acceleration noise is poor. A graphical representation of the noise shows it is quite different to acceleration noise. It is therefore unlikely that solving the engine brake noise will help improve overall accleration noise levels. These are best addressed through setting ADR levels.

Key Points

- There is no indication that a free market would provide significant improvement in new vehicle noise standards. Consumer demand for low noise is limited to low in-vehicle noise, not low drive-by noise.
- Many non-regulatory approaches to noise control may have some future application, particularly from an in-service point of view. However, they will be most effective when used to complement regulations setting noise levels for new vehicles.
- Solutions such as noise barriers are useful in limiting the extent that freeway noise can be heard inside nearby homes, but they are not an alternative for better vehicle design which best addressed acceleration noise in urban environments.
- Lowering new vehicle noise standards means that any deterioration will be starting from a lower base, leading to improvement in traffic noise that would be the case in the absence of new standards.
- Controlling both new vehicle standards and in-service deterioration provides the most comprehensive solution to vehicle noise control.

3. REGULATORY ALTERNATIVES

Having discussed the role of non-regulatory alternatives, it is important to examine the impacts of a range of regulatory alternatives, including the preferred option. The alternatives are:

- full harmonisation with UNECE noise levels and test methods;
- full harmonisation with UNECE noise levels and test methods with exceptions for high-powered vehicles; and
- Status Quo

There are a number of issues that are common to all three alternatives. The issues have arisen from the proposal to change from the status quo. The discussion of each issue below is based on feedback received on the Close/Apelbaum report, the draft RIS and subsequent discussions with stakeholders.

3.1 Availability of a suitable test site in Australia

Each ADR limiting noise requires a vehicle in motion or 'drive by' test. The purpose is to measure the total vehicle noise as it might be heard at the roadside. The current ADR28/01 sets out some requirements for the site where that test is undertaken. Clearly, it is necessary to have a controlled environment, so that each manufacturer has a level playing field. In reality, this means that certification tests in Australia are undertaken at deserted airfields and the like. The UNECE regulations go one step further – they require a test site that meets an international standard known as ISO 10844 which prescribes in some detail the road surface requirements including the size of aggregate to be used. Some stakeholders have put forward evidence that testing a vehicle on the ISO 10844 surface is likely to give a 2 to 4dB improvement over testing at some existing Australian sites, which don't meet the ISO standard.

Fully harmonising with the UNECE would mean introducing a requirement to test vehicles on an ISO 10844 test track. This would require a financial outlay to bring one or more test tracks up the the ISO 10844 standard. Some stakeholders, in responses to the draft RIS have argued that this outlay is unreasonable. One exhaust component manufacturer has argued that having an ISO test site in Australia is vital, as it will enhance export opportunities for muffler manufacturers, because European importers are reluctant to purchase exhaust components not proven on ISO test tracks.

The cost of a ISO compliant track is an important issue. There are essentially two costs – the cost of resurfacing an existing track and the ongong costs of seeking formal ISO accreditation. ISO 10844 specifies a test surface of about 450m^2. One estimate provided by VicRoads put the resurfacing costs about about \$10/m^2. Even allowing for the remote location of some test tracks, this would cost less than \$10,000. The costs of seeking ISO accreditation is unknown, could be significant given the narrow area of expertise.

After some discussion with stakeholders, NRTC has concluded that ADR83 should allow manufacturers to test vehicles on the existing surface described in ADR28/01. If manufacturers then wished to upgrade an existing site such that the test surface was equivalent to the ISO surface they could do-so at minimal cost. This would enable local manufacturers to take advantage of the lower noise ISO surface without incurring

accreditation costs. Some vehicle or component exporters may still wish to gain ISO accredition of a test surface. NRTC would encourage them to enter a cost sharing arrangement.

- ADR83/00 should be harmonised with UNECE test procedures but, as an alternative, allow testing to take place under the test track conditions currently set out in ADR28/01.

3.2 Cooling Issues (heavy vehicles)

Harmonising with UNECE noise levels for drive-by tests will result in a very substantial lowering in noise level limits for all vehicles from mopeds to heavy trucks. From an engineering point of view, the key difficulty in meeting these limits is the need for noise shielding using methods such as encapsulating the engine in sound resistant material. Several manufacturers, the Truck Industry Council and the Australian Trucking Association have claimed that this will affect ventilation, thereby causing increased heat, leading to cooling problems. In the worst cases, this may require the fitment of larger radiators or other cooling devices. One manufacturer claimed they may even need to de-rate engine power in some circumstances. Such changes may add to the cost of a vehicle and may require larger engine bay areas. It is recognised that there is a cost associated with the changes, particularly for heavy trucks and low volume vehicles. Estimates provided by truck manufacturers put the cost at up to $5000 per truck. This is discussed further in section 4.

The heat argument has been put forward mainly by heavy vehicle manufacturers. They claim that Australia's climate is hotter than that of Europe. While it is difficult to make accurate comparisons of climate across two continents, the draft RIS noted that temperature data suggests that parts of Europe are in fact just as hot as the hotter parts of Australia. Meteorological data shows the highest temperature in Seville, Spain is around 45^0C, whereas Darwin is 38^0C (www.washingtonpost.com/wp-srv/weather). While it may be possible to compare other cities and conclude that Australia is hotter, the point made in the draft RIS was that the engineering needed to adequately cool a vehicle is likely to be approximately the same in southern Europe and Australia. Manufacturers responded by noting that the unique feature of the Australian environment is that vehicles may need to travel for very long periods (our driving hours regulations are more lenient than Europe) at higher speeds (our speed limits are higher than Europe), in constantly hot conditions (whereas the climate may vary significantly in Europe over a long distance). While Australia is relatively flat, drivers demand high horsepower to achieve high productivity. High power enables vehicles to complete a journey more quickly, as the vehicle does not need to slow down on inclines. The manufacturers also noted that cooling is a critical issue for the introduction of the emissions rule ADR80/01 in 2006/7 and that significant cost saving could be made it the introduction of ADR83 coincided with the introduction of the emissions rule.

High power is also required for high mass vehicles such as roadtrains and B-doubles. The draft RIS noted that high mass vehicle in Australia operate under permit and have limited accesss to the road network, which limits the noise exposure to residential premises. Several stakeholders noted that B-doubles now have very few access restrictions and should not be considered any differently from standard semi-trailers.

Currently ADR 28/01 prescribes noise limits for a category of heavy vehicles of greater than 270kW engine capacity. UNECE standards have noise level limits that apply to all vehicles greater than 150kW. The over 270kW category was introduced in recognition of

the Australian operating environment and the need for high-powered vehicles to meet the transport task. However, while the 270kW figure may have been meaningful in the mid 1980s, when these standards were developed, it is no longer relevant today. An analysis of vehicles available in today's market will show that most vehicles with a GCM below 50 tonne (eg designed to operate as a standard semi-trailer, similar to the vehicles on European roads) will commonly be rated at up to (and sometimes over) 320kW. Vehicles intended to operate as vehicles unique to Australia (eg B-doubles and roadtrains up to 100 tonne GCM) will almost always be rated over 320kW. The draft RIS therefore proposed a 3dB concession vehicles over 320kW. Responses to this proposal were polarised. Some argued it was too stringent and other argued to was too lenient, particularly given the access priviliges of B-doubles.

While 320kW may represent a reasonable distinction between standard semi-trailers and B-doubles, it is not easy to separate B-doubles and roadtrains with an arbitrary power rating. An alternative approach might distinguish by gross vehicle mass, but it is common practice for a road-train prime mover to pull a B-double trailer. Alternately, it may be possible to distinguish B-doubles from roadtrains using tare mass (roadtrain prime movers tend to have higher tare mass), but the problem of one prime mover being used to pull a range of trailers still remains. Therefore, restricting the concession to roadtrains only will be difficult to achieve in practice.

NRTC therefore proposes that the 3dB concession is extended to all vehicles over 320kW regardless of their operating configuration. A review of this decision should be commenced within 3 years of Gazzettal. In order to minimise manufactuer design costs, it is proposed that the introduction be aligned with the emissions rule ADR80/01.

- ADR83 drive by limits should be aligned with UNECE 51/02 limits, but vehicles over 320kW should be permitted a further 3dB(A) on top of this limit. This allowance should be reviewed in 3 years.

3.3 Concessions for Australian configurations (Heavy Vehicles)

During earlier consultation, a heavy vehicle manufacturer and an engine supplier commented on the difference between European and Australian axle configurations. They noted that the majority of European prime movers (built to comply with UNECE 51/02) have two axles (a steer axle and a drive axle). Most Australian prime movers have three axles (a steer axle and two drive axles). Data on the exact difference in terms of market share is not available, but it is acknowledged that there is likely to be more two axle prime movers in Europe than Australia. This is a result of the mass limits in Europe and Australia. Europe generally allows a higher mass per axle than Australia, as the roads are engineered to suit heavier loads. The presence of the extra axle is likely to increase drive-by noise marginally.

The exhaust configuration required in some states of Australia is also different from that of Europe. Manufacturers argue that the vertical exhaust requirement can add marginally to the noise level a vehicle emits.

In its submission to the draft RIS, the Truck Industry Council argued that cumulative effects such as axle and exhaust configuration, gearbox and differential construction can marginally increase noise and that there should be a concession offered over the UNECE standards. The TIC proposed that the total concession including the test track concession (refer section 3.1) should be 3dB. Given that the TIC provided data showing test tracks can account for up to 4dB, it is clear that the effect of axles, etc is marginal.

The presence of some drive train noise and four extra tyres on the road is likely to contribute to overall noise. However at the relatively low speeds of the drive-by certification test, the bulk of the noise is due to the engine and drive train. It should also be noted that noise does not add numerically, so the additional noise caused by the extra axle will have little overall effect. NSW and Victoria are currently considering whether the vertical exhaust requirement has any real value for ADR80/01 compliant vehicles, as the particulate emissions on these vehicles is so low, there is little to be achieved by dispersing the pollutants upwards. Also, the additional two years proposed on the original implementation date should allow these issues to be addressed.

- Manufacturers should be required to meet any marginal improvement needed for the Australian market.

3.4 Stationary (Exhaust) Sound Level Limits

The Close/Apelbaum report discussed moving to the UNECE 'signature' approach to in-service noise levels and the draft RIS put forward a specific proposal. The current approach required in the ADRs simply requires that all vehicles in a class (eg: vehicles of a certain age and power rating) meet the same stationary noise limit. Research shows that some vehicles meet this limit very easily (by 10dB(A)), thereby calling into question how meaningful the stationary noise limit is.

The 'signature' approach is a system whereby the stationary noise level for each model is recorded and used for in-service enforcement. Under the UNECE system, new vehicles are required to meet a 'drive-by' noise level before they are allowed onto the market. The drive by test simulates operating conditions but in a controlled environment. However, it is obviously difficult to undertake a drive-by test (to detect deterioration) when a vehicle is in service. The controlled environment cannot be replicated at the roadside. Therefore, under the UNECE certification system, when a vehicle has passed the drive-by test, its 'signature' noise level is measured and recorded when the vehicle is stationary. This stationary noise test can be easily replicated at roadside when the vehicle is in-service. It can be safely assumed that any deterioration in the stationary noise level, also means a deterioration in the drive-by noise level.

The proposed approach is therefore to use this 'signature' level identified at certification testing, as the basis for the pass/fail level for in-service vehicles. However, it is recognised that each model will have its own 'signature' noise level. This imposes a difficulty in ensuring that testing authorities have access to the signature noise level for in-service testing. The practicalities of this arrangement were discussed in a separate report available from NRTC. The report shows that the technology to make the information available to enforcement officers is readily avialable and that the necessary changes to the certification system are relatively simple. Several enforcment agencies have noted that it would be desirable to establish a working group with the Department of Transport and Regional Services to agree on exactly how the system is to work. NRTC supports this initiative. Auto manufacturers have also noted that there may be a need to fine-tune their role in putting forward 'signature' data.

Vehicle manufacturers made submissions supporting the use of the signature system. The Department of Transport and Regional Services, which administers vehicle certification in Australia has made a submission which indicates that there will be few administrative problems with moving to the signature system and that critical information about each model can be made readily available.

Changing the approach to stationary noise measurement will require a consequential amendment to the Australian Vehicle Standards Rules (AVSRs), which regulate in-service stationary noise levels. The stationary noise levels required under rules 151 and 152 of the AVSRs were developed by adding a deterioration factor to the loudest stationary level of any vehicle in a class. This has led to very lenient in-service noise standards.

Under the 'signature' approach every model will only be allowed to deteriorate by a specified margin over the 'signature' level that was recorded when the vehicle was new. The draft RIS proposed to regulate stationary in-service noise levels at 2dB above the signature level recorded at certification. Respondents noted that ISO 5130 *Measurement of Noise Emitted by Stationary Road Vehicles – Survey Method* provides for a deterioration of 5dB over the signature level. ISO 1531 has been approved by 27 countries around the globe.

The Exhaust Systems Professional Association (companies that manufacture and fit exhausts) claim that its members will be adversely affected because of the proposed changes to the stationary noise measurement. It claims that small businesses that manufacture 'universal' mufflers (mufflers that can suit more than one vehicle) will suffer because the limited deterioration allowance will mean mufflers need to be designed to suit each model. However, by linking the design standard to a specified deterioration rate, the ADR is providing a mechanism to improve in-service compliance, which responses indicate, is the main source of public concern. If backed by comprehensive enforcement it has the potential to severely curtail modifications to exhaust systems which have the sole intention of making the vehicle louder. This will adversely affect the sale of 'noisy' mufflers, which are known to have good profit margins, but is likely to be offset by increased sales of good quality mufflers because of the reduced tolerance for deterioration.

The amendment to the AVSRs does not need to be finalised until the proposed new ADR is in place. However, in the interests of transparency, the NRTC has drafted the proposed amendment and has made it available for comment. Copies are available from NRTC.

It is proposed that:

- ADR83 dispenses with the specified stationary noise level for each class of vehicles in favour of the 'signature' approach used in UNECE regulation; and
- the Australian Vehicle Standards Rules be revised to accommodate vehicles built to the new standards. The in-service stationary noise level of these vehicles should be set at 5dB above the signature level recorded at certification.

3.5 Noise Levels and Timing of Introduction: Light Vehicles

In repsonse to the draft RIS, the Japan Automobile Manufactuers Association supported the proposed new light vehicle noise levels and the implementation date for new models (Jan 2004). However it proposed that all vehicles should not have to meet the standard until 2006, as there are cost savings in undertaking the necessary engineering the same time as the engineering required for the emissions rule ADR79/01, scheduled for 2006.

The Federal Chamber of Automotive Industries (FCAI), representing Australian light vehicle manufacturers and importers, orginally argued that the light vehicle noise standards be harmonised with UNECE 51/01. This would see no change in drive by noise levels for light vehicles. NRTC visited Australian light vehicle manufactuers to seek to better understand the FCAI position and assess how best to meet the UNECE 51/02 levels whilst minimising the impact on light vehicle manufactuers. FCAI later took the view that it

could meet the UNECE 51/02 noise levels from 2005 for new models and 2009 for all vehicles. It was noted that many light vehicles already comply with the proposed standard and that there would be uneccesary cost in upgrading those few models that didn't meet the standard beyond 2005. FCAI put forward information that indicates that only extending the implementation to 2009 would only affect about 26,000 cars in 2007 and 12,000 cars in 2008.

NRTC has considered this issue in consultation with MVEC members. While it is recognised that the noise impacts of allowing some cars to exceed the limit for a few extra years will be minor, experience shows that many manufacturers take advantage of implementation dates that are set with the view to accommodate only one or two models. As a result, a large proportion of models won't comply until the new noise level becomes mandatory. NRTC discussions with Australian manufacturers indicate that the 2005/7 dates will suit the circumstances of most manufacturers and most models.

FCAI supported the position put forward in the draft RIS that would see Australia harmonise with the 'signature system' of stationary noise measurement (refer section 3.4). FCAI argued was a priority as it would help target modified or malfunctioning vehicles.

Another issue raised by light vehicle manufacturers and by respondents to the draft RIS, was the requirement in UNECE 51/02 to mark mufflers with the the manufactuurer's name and part number. This requirement will not assist enforcement officers, nor is it likely to assist vehicle owners wishing to replace a worn muffler. It is therefore proposed that the marking rquirements under clause 4 of UNECE 51/02 should not apply in Australia.

- ADR83 should introduce the same noise levels for light vehicles as UNECE 51/02;
- ADR83 should apply to light vehicles from 1 January 2005 for new models, and 1 January 2007 for all models; and
- the muffler marking requirement will not be introduced in Australia.

3.6 Alternative Compliance (Buses)

Large buses in Australia (about 1000 per year) are mostly built up from European chassis according to the manufacturer's specification. In order for buses to meet the proposed standard, it is likely the manufacturers will offer optional 'hush kits' for their chassis which, if fitted correctly will ensure the vehicle will meet the 80dB UNECE limit. Each model, fitted with the designated hush kit, is tested to UNECE 51/02 by the manufacturer in Europe. As the same bus is built up in 'kit' form in Australia, the Australian bus builders argue that, if they can demonstrate that they have rigorously followed the original supplier's instructions, they should be permitted to utilise the European approval (rather than undergoing a separate approval in Australia).

This would enable Australian bus builders to demonstrate compliance using the original chassis builders' approval. It would mean a cost saving for the local manufacturers.

NRTC has discussed the matter with the Department of Transport and Regional Services, and both organisations support the principle of the approach put forward. The detail of exactly how the Australian bus builders will satisfactorily demonstate that they have rigorously complied with the chassis supplier's instructions will need to be resolved, perhaps using an administrative circular.

It is proposed that:

- ADR 83 should require that bus noise levels be harmonised with UNECE51/02. The implementation date should be 2006 for new models and 2007 for all models; and

- locally assembled buses that have been manufactured in accordance with the chassis supplier's instruction, should be able to use European certification data for an identical model, to demonstrate compliance.

3.7 Exhaust Configuration

The issue of exhaust position was discussed with a number of stakeholders during consultation meetings. The draft RIS noted that the Close/Apelbaum report found that on heavy vehicles (over about 4.5 tonne) the configuration of the exhaust can affect noise levels. It found that horizontal exhausts, where the pipe is underneath the vehicle, can be 1 or 2dB louder than a vehicle with a vertical exhaust, where the outlet is above the cabin of the vehicle.

During consultation on the draft RIS some stakeholders questioned the validity of the claim that horizontal is noisier than vertical. The Truck Industry Council argued that the vertical exhaust can in fact be louder than the horizontal. It is noted that there is currently no such specification for exhaust configuration anywhere, except in State regulations. The State regulations requiring vertical exhausts on heavy vehicles, were originally developed to assist dispersion of pollutants. With the introduction of the emissions rule ADR80/01 particulate matter levels will be so low, there can be little justification for a vertical exhaust requirement. State regulators are reviewing the requirement with the view to abandoning it with the introduction of ADR80/01, or earlier. As the proposed ADR83 is scheduled for implementation on the same date, exhaust configuration will not have a bearing on noise standards.

- with the extended implementation date of 2006/7, exhaust configuration will have no bearing on noise standards.

3.8 In-Service Deterioration

Several respondents to the Close/Apelbaum report argued that the traffic noise problem is primarily caused by poorly maintained vehicles, or aftermarket mufflers that are inferior to the original equipment mufflers. Enforcment agencies in Australia have varying levels of resources dedicated to this issue. The EPA in Victoria has an ongoing enforcment campaign that last year required about 4000 exhaust systems to be replaced or upgraded. In the ACT, the Department of Urban Services undertakes noise tests on all vehicles that change ownership or are re-registered.

As discussed above (refer section 2.1.2 & 2.1.7), improving new vehicle standards is only one element of the MVEC strategy to reduce traffic noise. Reducing new vehicle noise levels will mean that vehicles deteriorate from a lower noise level. Over time this must lead to an overall decrease in noise from the fleet. Short-term strategies aimed at removing very noisy vehicles from the fleet are also important and are being pursued by MVEC. The most recent has been the introduction of a nationally uniform stationary noise test for in-service use. Current developments focus on the issue of engine brake noise and the exploration of options such as better controlling the quality of aftermarket mufflers.

The move to use the signature system of noise measurement will lead to much more stringent noise standards for in-service use. The Close/Apelbaum report noted that some

heavy trucks can meet the current stationary standard by 10dB(A). Enforcement agencies are understandably reluctant to increase in-service testing while such lax limits exist. This situation can only be improved by changing the ADR stationary noise measurement system to the 'signature system' as proposed above.

3.9 Motorcycle Noise Limits (Audible Conspicuity)

The Australian Motor Cycle Council has argued that making motorcycles too quiet could have an adverse safety impact. This argument has been supported by the NSW Motorcycle Council and another stakeholder. It is claimed that very quiet motorcycles cannot be heard by car drivers, thereby increasing the chances of a crash. This issue is known as 'audible conspicuity'.

Conspicuity and safety are very important issues to motorcyclists and the community. In its response to the draft RIS, the Australian Motor Cycle Council argued that concerns about safety were trivialised and the discussion was prejudiced and not objective. NRTC has taken great care to ensure the views of motorcyclists have been aired. The issue of motorcyclist safety was singled out from dozens of equally important issues when papers were presented to transport agency chief executives and members of MVEC. The views on audible conspicuity were noted and discussed at some length. The research on conspicuity and accident rates was acknowledged, but as noted in the draft RIS, there appears to be little formal research on the specific topic of audible conspicuity and the role of vehicle noise in the small proportion of total motorcycle accidents where conspicuity may have been a factor.

There are numerous alternate ways for motorcyclists to make themselves conspicuous without having annoyingly noisy mufflers (headlights on, reflective apparel, sounding the horn, etc). Several respondents to the Close/Apelbaum report and draft RIS expressed doubt about the audible conspicuity issue.

Harmonisation with UNECE would result in a reduction of about 2dB in motorcycle noise standards. However, currently a very large proportion of motorcycles in Australia is imported without modification from Japan (around 50%). The same bikes are exported to Europe. It is therefore likely that most new motorcycles in Australia will already meet the Japanese standards and many will already meet the UNECE standard. The Close/Apelbaum report noted that negotiations are already underway between Japan and Europe to harmonise motorcycle standards, given the Japanese domination of this market. This will only increase the proportion of UNECE compliant motorcycles in Australia.

It is recognised that USA based motorcycle manufacturers have been increasing their market share in Australia. These US manufacturers are also active in the European and other international markets. It is therefore expected that the manufacturers will seek to make the bikes compliant for the much larger international market, and will thereby continue to have access to the Australian market. The Federal Chamber of Automotive Industries represents all motorcycle manufacturers and importers and it supported the introduction of the new standards. It is therefore proposed that:

- motorcycle noise limits in Australia be harmonised with UNECE 41/03; and
- the new limits be introduced from 1 January 2005 for new models and 1 January 2006 for all models.

3.10 Timing of Proposed Changes

The draft RIS proposed that:

- ADR 83/00 be introduced for new models from 1 January 2004; and
- ADR 83/00 be introduced for all models from 1 January 2005.

Given the submissions from heavy vehicle manufacturers and concerns about cooling, design costs, the impending introduction of the emissions rule ADR80/01 and the reduced burden on industry of aligning implementation of emissions and noise standards, it is now proposed that:

For vehicles which operate on diesel fuel, and vehicles with a gross vehicle mass greater than 3.5tonnes which operate on LPG or natural gas,

- ADR 83/00 should apply to new model vehicles from 1 January 2006; and
- ADR 83/00 should apply to all vehicles from 1 January 2007.

Given discussions with light vehicle manufacturers and their concerns about production cycles and the impending introduction of the emissions rule ADR79/01, it is proposed that:

For vehicles which operate on petrol fuel, and vehicles with a GVM less than or equal to 3.5tonnes which operate on LPG or natural gas,

- ADR 83/00 should apply to new model vehicles from 1 January 2005; and
- ADR 83/00 should apply to all vehicles from 1 January 2007.

3.11 Summary of Proposals

Below is a list of the key points arising for the discussion of issues above.

- The three existing ADRs relating to noise (ADR28, 39 & 56) should be consolidated into a single ADR to be called ADR83/00. It should cover all vehicles from small motorcycles to heavy trucks.
    - *This is the same as the position put forward in the draft RIS*
- ADR83/00 drive by limits should be harmonised with UNECE 51/02 limits, UNECE 41/03 for motorcycles UNECE 63/01 for mopeds. However, heavy vehicles over 320kW should be permitted a further 3dB(A) on top of the UNECE 51/02 limit. This concession should be reviewed within 3 years;
    - *This is the same as the position put forward in the draft RIS, except that a review of the 3dB concession has been built-in*
- ADR 83/00 should apply to trucks and buses from 1 January 2006 for new models and from 1 January 2007 for all models;
    - *This is two years later than proposed in the draft RIS*
- ADR 83/00 should apply to light vehicles from 1 January 2005 for new models and from 1 January 2007 for all models;
    - *This is one and two years later than proposed in the draft RIS*

- ADR 83/00 should apply to motorcycles and mopeds from 1 January 2005 for new models and from 1 January 2006 for all models;
    - *This is one year later than proposed on the draft RIS*
- ADR83/00 should adopt the stationary test methods set out in UNECE 51/02, thereby dispensing with the specified stationary noise level for each class of vehicles, in favour of the model-specific 'signature' approach used in UNECE regulation;
    - *This is the same as the proposal put forward in the draft RIS*
- A consequential amendment should be made to the Australian Vehicle Standard Rules to reflect the shift to the 'signature' system of testing for ADR83/00 compliant vehicles. This change should permit a 5dB allowance for in-service deterioration from the original 'signature' level;
    - *This is an increase of 3dB in the amount a vehicle is allowed to deteriorate, over that proposed in the draft RIS*
- ADR83/00 test conditions should vary from the international standard in that drive-by testing should be allowed to take place either under the test track conditions set out in the current ADR28/01, or according to ISO10844.
    - *This is the same as the proposal put forward in the draft RIS*

4. COSTS AND BENEFITS

Before undertaking a detailed analysis of costs and benefits it is worthwhile summarising the differences between the three options under discussion to better understand the relative strengths and weaknesses of each option. The table below provides a snapshot of the key strengths and weaknesses:

Table 4: Strengths and Weaknesses of Options Considered

Option	Costs	Benefits
Full harmonisation with UNECE standards	High. Manufacturers need to change design and build requirements for all vehicles. With some vehicles this will be very difficult, possibly leading to reduced productivity from heavy vehicles.	High. Noise reductions from all classes of vehicles will produce the maximum potential benefit of all options.
Full harmonisation with limited exceptions that recognise unique features of the Australian market	Moderate. Most vehicles will require design and build changes, but none will be very onerous as concessions would be allowed for difficult challenges like cooling for high power vehicles.	High. While noise reductions from some high powered vehicles won't be as great as for option 1, those vehicles travel vast distances in sparsely populated areas where noise is not such a sensitive issue.
Retain Status Quo	Low. No design and build changes required.	Low. The only noise reduction would be provided by market pressure to reduce noise.

Below is an attempt to quantify the costs and benefits of the 3 options. It should be noted at the outset that the assessment contains a range of assumptions, estimates and roundings. Cumulatively, these can have a significant effect on the outcome, so the figures should be treated as indicative only, and not as proof that benefits outweigh costs, or vice versa.

4.1 Costs

4.1.1 Costs to manufacturers

Options one and two will impose some cost on vehicle manufacturers. Manufacturers are likely to pass on these costs to vehicle purchasers. Those costs will primarily comprise:

- design costs associated with altering each model to comply with UNECE standards (eg design of new mufflers, engine encapsulation, etc;
- costs of noise abatement equipment (eg increased cost of muffler and cost of new encapsulation devices); and
- costs of fitting any noise abatement equipment not previously fitted.

Once the vehicle is in-service there may be some ongoing cost relating to maintaining the noise abatement equipment, or additional maintenance costs associated with removing and replacing noise encapsulation components to access the engine.

4.1.2 Costs to the aftermarket industry

In its response to the draft RIS the Exhaust Systems Professionals Association argued that there would be a cost to the aftermarket industry as a result of introducing a smaller margin for deterioration through the amendment to the Australian Vehicle Standard Rules (refer section 3.4). The ESPA did not quantify these costs. ESPA argues that the smaller margin for deterioration will mean that small muffler manufacturers will face increased design costs, making them less competitive against the original equipment manufacturer. ESPA made these comments on the basis of the draft RIS which recommended a deterioration allowance of 2dB(A). NRTC's revised position is that this should be increased to 5dB(A). This offers the aftermarket industry significantly more flexibility.

It is likely the smaller tolerence will lead to better quality aftermarket mufflers, at a slightly increased cost. This may give motorists somewhat less choice in selecting an aftermarket muffler.

A second criticism of the draft RIS raised by the aftermarket industry was that the RIS did not adequately describe the potential benefits from increased exports due to full harmonisation. This issue has been discussed in section 3. NRTC is unable to quantify such a benefit, but to improve transparency, has noted it below, in the comparison of costs and benefits.

4.1.3 Sources of cost estimates

In order to identify likely costs, the draft RIS investigated the costs overseas manufacturers incurred in meeting UNECE standards. The UNECE did not formally quantify costs and benefits in developing 1996 regulations, rather the decisions were made on a more technical basis, where manufacturers and member countries agree that the change is technically feasible. The weighing up of benefits to the community and costs to manufacturers is done by parliaments. The present UNECE noise limits have been in force since 1996. It is expected that the costs (in real terms) of the available technology to meet these standards would be lower today than they were in 1996, due to widespread availability and improved materials.

The Director General of the Enterprise Automotive Unit at the European Commission offered the following points in regard to the European approach to noise standard setting:

- technology is widely available to meet the (current UNECE) limits. It is therefore assumed that compliance costs for manufacturers would be quite limited;
- there are likely to be (trade) benefits associated with full or partial harmonisation of Australian standards with the UNECE standards;
- the European Commission is currently setting up a working group for a more integrated approach in further noise reduction measures; and
- the EC is just starting this investigation so doesn't have any results as yet and no articles or web pages specifically regarding costs.

Correspondence with Swedish National Road and Transport Research has elicited some estimates of costs for lowering the noise of trucks and cars. They were offered as indicative figures only and reflect costs in Europe. The estimates from Sweden are:

- all exterior noise abatement on a large truck represents about 1-2% of the purchase cost; and

- to reduce car noise by 1dB (below about 74dB), there is a cost of about $180 per vehicle or about 0.5% of the car price per dB.

Responses to the draft RIS drew some responses from local manufacturers, but as manufacturing costs are a sensitive, commercial in confidence issue, Australian manufacturers were reluctant to provide detail. One heavy truck manufacturer indicated that the proposed standard could add $5,300 to the cost of a heavy truck.

It should be noted that costs increase signficantly when noise limits are set below certain threshold levels. The figure used for cars is based on reductions beyond 74dB, where every extra dB reduction becomes quite expensive. As Australia is currently at 77dB, the cost figure is likely to be less than indicated above, but the above estimate is used as a worst case measure.

In the absence of any information on buses, motorcycles and mopeds it is assumed that:

- the cost to motorcycle & moped manufacturers will amount to (as for cars) about 0.5% of the value of the vehicle per dB; and

- the total noise abatement cost to bus manufacturers will amount to (as for trucks) about 1-2% of the value of the vehicle.

As discussed above, there may also be some marginal increase in maintenance costs associated with servicing noise reduction components and extra time spent removing and replacing components to access an engine.

The draft RIS provided appendices that submitted a range of assumptions and estimates about the likely increased costs given current sales figures. Some stakeholders criticised these estimates and provided alternative figures. In particular, the original estimates did not adequately distinguish between light medium and heavy vehicles, where costs and volumes vary considerably. NRTC has taken the advice of stakeholders in recalculating costs.

Appendix 1 submits a range of assumptions and estimates based on stakeholder advice, which enable the following annual costs to be calculated[1].

Costs to light truck purchasers		**$143m**
Cost to heavy truck purchasers	**Option 1**	**$68m**
	Option 2	**$34m**
Costs to bus purchasers		**$5m**
Costs to car purchasers		**$82m**
Costs to motorcycle purchasers		**$1m**
Other costs to consumers (increased cost of testing, maintenance, aftermarket mufflers, etc)		**$1m**

[1] Where one data source gives a higher estimate than another, the higher figure is used. For example, use of VFACTS figures generally gave higher cost estimates than ABS figures.

4.2 Benefits

In terms of personal amenity and health, there are clearly benefits in reducing roadside noise levels. The challenge for this assessment is to try to isolate the benefits caused solely by imposing new noise ADRs that reduce drive-by noise levels.

Imposing new ADR limits will have little effect on freeway noise, as vehicles are moving at high speed. At high speeds, most of the noise that is audible is the noise of the tyres on the road surface. The ADR drive-by test is measured using an unloaded vehicle under acceleration at relatively low speed, and therefore has the effect if forcing better acoustic design of the engine and drive train. Even if the test were undertaken at a higher speed, there is little manufacturers could do to improve noise levels other than experiment with tyre design. The benefits of new ADRs will therefore primarily be felt at speeds below about 80km/h and where a vehicle is accelerating.

International research provides us with an indication of the benefits likely to accrue from the proposed regulation. The International Institute of Noise Control Engineering recently released *Noise Emissions of Road Vehicles: Effect of Regulation. Final Report*. Importantly, this report provides an in-depth analysis of the European experience in tightening design standards. It concludes that the 1996 lowering of limits for heavy trucks resulted in 50-75% of the benefit being realised over 5 years. That is, while the noise levels were reduced by 4dB, only 2 or 3dB was realised in the traffic stream. A European Commission Green Paper (http://www.nonoise.org/library/eunoise/greenpr.htm) notes that despite significant reductions in new vehicle noise levels, road traffic noise has fallen only 1-2dB. The reasons put forward are manifold and include increases in traffic flow, slow turnover of the fleet and the lack of impact on high speed (tyre) noise.

4.2.1 Cumulative effect of noise reductions

It can be expected that the Australian experience will be similar to that of Europe. Even with quite significant reductions in vehicle noise, the 'ambient' noise levels will reduce by a lesser amount initially, but could lead to a more significant improvement over time as a greater proportion of the vehicle fleet meets the new standards. With the current proposal to reduce the ADR noise levels, it is likely the maximum benefits will be felt where:

- trucks are prevalent in the traffic stream (this proposal will siginificantly reduce truck noise, more so than light vehicle noise);
- vehicles are travelling at relatively low speed as in most urban areas or regional cities (the higher the speed, the more tyre noise will dominate); and
- vehicles are accelerating frequently (the ADR test is done under acceleration, the noise reduction at constant speed is likely to be less noticeable).

These conditions are common in urban environments (refer section 2.1.2), where the population densities are highest. Some stakeholders questioned the benefits put forward in the draft RIS because of the effect of tyre noise at high speed. NRTC notes these concerns, but it is clear the maximum benefits will be realised in the urban areas, where they will have most benefit. It should be further noted that the ADR drive-by test is undertaken with no load, at less than maximum engine speed and on a flat surface. The engine noise of loaded vehicles and vehicles on an incline is likely to be significantly more than than the proposed ADR limits, and will therefore be far more prevalent in the traffic stream than the estimates provided by truck manufacturers.

4.2.2 Quantifying Benefits

Willingness to pay (WTP) approaches to noise reduction have been used internationally (INFRAS, EC). They generally find a relationship between the proportion of GDP or per capita income that would be paid to alleviate noise levels. This data is difficult to transfer to Australia and does not focus on the benefits of improving ambient noise, as the ADR reduction would achieve. Rather the WTP studies tend to focus on problem areas such as busy intersections and consider the willingness to pay of the people affected by the problem noise.

A study by INFRAS (2000) provides us with a WTP estimate per person for each 1 dB improvement in noise levels of 5 categories. Close and Apelbaum (2001) noted a Swedish study suggesting a willingness to pay of $2000A per window for soundproofing and 1-1.3% increase in rent for a fully soundproofed building. A German study was also noted, suggesting a willingness to pay of $16A per dB(A) reduction in noise levels if noise levels exceed 43dB(A).

Another approach to estimating the costs of noise is to look at the costs of using devices such as sound barriers to alleviate noise. As discussed above, this approach is also more suited to dealing with particular problems such as freeways. The approach is not well suited to addressing broad reductions in ambient noise, such as would be achieved by introducing tighter noise limits in the ADRs.

The willingness to pay approach and the cost of noise reduction treatments have not been used to estimate benefits for this analysis.

Hedonic pricing appears to offer the most practical approach to estimating the costs of transport noise. The Resource Assessment Commission (1990) notes that hedonic pricing can be interpreted in economic terms as the utility (satisfaction) derived through an action such as consuming goods and services.

For environmental goods it is often possible for individuals to choose their level of consumption through their choice of residential location or selection of market good. For example living in a quieter area might be reflected in a willingness to pay money for a house that is not subject to traffic noise. It should be noted that hedonic pricing is often assumed to underestimate the benefit of noise reduction as assumes the purchaser of a house takes into account all market failure information.

In this case, estimates of benefits are based on the likelihood that house prices are diminished by transport noise. The extent to which dwellings are affected by transport noise can be approximated using two indicators:

- the Noise Depreciation Index (NDI), and
- any change in the average noise levels.

Once these indicators are known, an estimate of Australia-wide benefit of reducing the ADRs can be made by multiplying them by the number of houses and the average house price. A threshold level at which noise ceases to be an annoyance then needs to be factored in.

4.2.3 The Noise Depreciation Index

The noise depreciation index (NDI) simply indicates the extent to which a dwelling is devalued by noise. It gives a reduction in house prices per dB(A) noise exposure above a

certain threshold. Below the threshold it is implied noise is not disturbing. For example at a typical threshold of 50 dB(A) and a NDI of say 0.5%, exposure to a noise level of 60dB(A) would reduce house prices by (60-50) x 0.5% = 5%.

As NDI simply indicates the likely depreciation of property values due to noise, it varies little across countries and cultures. The extent to which people are sufficiently annoyed by noise to seek quiet houses is unlikely to vary a great deal. Overseas studies (Komanoff and Shaw 2000 *Drowning in Noise* Report of the Noise Pollution Clearinghouse) shows NDI values of around 3%, but a recent Australian study (Segal 1999 Review of Health Costs of Road Vehicle Emissions) draws on a range of previous studies to estimate an NDI of between 0.5 and 1%. The two values from the Australian study are considered relevant for this analysis. It should be noted recent British studies (DETR 1998) are favouring an NDI of around 0.67%, with a lower bound of 0.2%.

For the purposes of this study, an NDI of 1% was assumed. A very conservative sensitivity test at an NDI of 0.2% was also carried out (refer appendix 3).

4.2.4 The reduction in average noise levels

The extent to which noise is reduced as a direct result of regulating new Australian Design Rules is not easily estimated. The noise audible at roadside has two key components:

- the drive train noise (primarily engine noise); and
- the tyre/pavement noise (the noise caused by the tyres rolling on the pavement surface).

Given that the ADR noise levels are measured under acceleration at low speed, any reduction in ADR levels are likely to require reductions in drive train noise, rather than tyre noise. The feedback during consultation confirms this theory. Therefore, if the effect of tyre/pavement noise can be isolated, the benefits of reduced vehicle noise levels across the fleet (ie, for light, medium and heavy vehicles) can be estimated.

In order to identify the changes in noise levels resulting from different pavement (road surface) materials, a Statistical Pass-by Index (SPBI) has been developed by the International Organisation for Standardisation (ISO 11819-1). Importantly, SPBI allows a range of variables such as vehicle tyres and pavement surfaces to be taken into account during road design.

It is possible to use the approach underpinning SPBI to estimate the 'real world' noise reductions from reducing ADR noise levels, because it allows us to isolate the tyre/pavement noise contribution. The total noise of light, medium and heavy vehicles at roadside was measured during NSW RTA research. This data has been normalised for the type of road surface (refer appendix 3, attachment A, table 1). The contribution of tyre noise was then estimated from international literature (refer appendix 3, attachment A, table 2).

Knowing the contribution of tyre noise and the total measured noise, enables a calculation of the likely contribution of drive-train noise (refer appendix 3, attachment A, table 3). Reducing the ADR drive-by noise levels will primarily affect the drive-train noise. Therefore, by knowing tyre/pavement noise (fixed) and the reduction in drive train noise caused by changing the ADRs, we can calculate the total noise reduction likely to be measured at roadside.

The estimated changes (from attachment A to appendix 3) in total noise due to the proposed reduced ADR limits, for vehicles travelling at about 80km/h is:

Table 5: Estimated Noise Reductions

	Option 1 (full harmonisation) dB	**Option 2 (harmonisation with exceptions) dB**
Light Vehicles	-1.43	-1.43
Medium Vehicles	-3.57	-3.57
Heavy Vehicles	-6.0	-3.5

As pointed out by some stakeholders responding to the RIS, it is important to note that the figures in table 5 compare roadside measurement of the existing fleet with the theoretical noise from a fleet that was fully compliant with the ADRs. This would take a considerable time – at least 10 years given average vehicle life.

Other factors to note include:

- the comparison assumes that tyre noise from the current fleet would be about the same from an ADR83 fleet;
- the level of maintenance of the current fleet would be about the same from an ADR83 fleet; and
- the extent the benefit would actually be felt at roadside would vary with the vehicle types in the traffic stream, vehicle load, speed, acceleration and the surface and grade of the road.

4.2.5 Estimates for a 'typical' traffic stream

Taking a simple average of the figures in table 5 is not meaningful, as the traffic stream comprises a range of light, medium and heavy vehicles in differing proportions. Taking a typical weighting of:

- heavy vehicles (multi-axle) 5%;
- medium vehicles (dual-axle) 5%; and
- light vehicles (everything else) 90%.

Then the effect of reducing the noise ADRs by the values estimated in Table 5 would give a weighted average of:

Option 1= 1.765dB

Option 2= 1.645dB.

A key variable is the extent to which vehicles in the fleet from which the original roadside data was taken, already comply with the levels proposed in ADR83. As the measurements were taken in 2000, some proportion of the light vehicle fleet could have been compliant, though very few heavy vehicles would have complied. These figures have therefore been reduced to account for the fact that vehicles already complied. If we discount the figures above by 20% we get:

Option 1 = 1.412 dB

Option 2 = 1.316 dB

As stated above, these figures apply to a traffic stream of 90% light vehicles travelling at about 80km/h. The figures would vary significantly depending on factors such as the mix of vehicles in the traffic stream, the road surface, the speed, the load on heavy vehicles, the grade of the road and whether vehicles were accelerating, cruising or decelerating.

However, in order to make a comparison with the costs, we can use the above information to calculate a theoretical dollar figure representing the benefit to Australia of reducing the noise ADR's. The formula would be:

Average house price x NDI x reduction in average noise levels x total houses affected

The following table sets out the main results of the analysis.

Table 6: Comparison of Costs and Benefits

	Vehicle Modification Costs	**Other costs (maintenance, etc)**	**Net Community Benefits**	
			Year 1	**Year 10**
Option 1 (reduce ADRs by 7dB for Heavy Vehicles)	$299m	1m	$31m	$3,014m
Option 2 (reduce ADRs by 4dB for Heavy Vehicles)	$265m	1m	$43m	$2,823m

Sensitivity tests (refer appendices) were carried out for a change in NDI from 1% to 0.2% and for a reduction in the number of houses affected from 20% to 10%. In each case, the benefits in year 10 exceeded the vehicle modification costs. The combined effect of reducing the NDI from 1% to 0.2% and the households affected from 20% to 10% led to:

- under option 1 - negative benefits until year 10 when the benefit amounts to approximately $31m;
- under option 2 – negative benefits until year 10 when the benefit amounts to approximately $43m.

The details of the sensitivity test are set out in Appendix 3.

4.2.6 Comments on costs and benefits

Regardless of the method of analysis and assumptions used by NRTC, the valuation of socio-environmental issues such as noise, will be questioned by stakeholders. Stakeholders responding to the draft RIS provided a number of comments on the estimate of costs and benefits. Many of these comments have been reflected in the revised calculation, or where possible have been discussed in the text. Some respondents argued the costs would be lower and the benefits higher, others argued the opposite. In the interests of making the comments made by stakeholders transparent, the following summary of points raised through the consultation process are provided for information.

- The benefits do not reflect the reduction in learning and task execution effectiveness and communication difficulties. The existence of such factors, the effect of which is not quantified, makes the NDI approach likely to be conservative.

- The methodology does not consider that traffic noise can also reduce the amenity enjoyed by casual or occasional users of roadside amenities eg visitors to parks and scenic lookouts.
- Little benefit will be received by people living close to highways and freeways because tyre noise will dominate at high speed.
- The method of weighting the traffic stream is questionable – the mix of vehicles can be very different to that estimated.
- The ADR test is conducted under controlled conditions. It may not be representative of truck noise in Australia, so the benefits are overstated.
- Some heavy vehicles may need to be de-rated to meet the standard. This will adversely affect productivity and will have an associated cost.
- The potential export opportunities arising from UN harmonisation have not been estimated and would add to the benefit.
- The cost of damage to engine componentry due to increased operating temperatures should be taken into account. This would increase the costs.
- The effect of requiring higher quality mufflers will increase the cost of aftermarket mufflers and make small businesses less competitive. This will have an economic cost.
- Australia's sparse population means that the effects of improved noise levels will be minimal compared with highly populated countries. The benefits are therefore overstated.
- The report makes no attempt to value health costs, or the benefits of a quieter driving environment and its safety benefit from reduced driver fatigue. The benefits are therefore understated.
- The analysis assumes static market share. If the manufacturers of already complying vehicles increased their market share (because their competitors increase prices due to this reform), the cost to consumers could be substantially less.

Key Points

- Option 2, harmonisation with UNECE standards with a 3dB concession for trucks over 320kW, is the preferred option. It provides very substantial net benefits in the longer term, but ensures manufacturing costs are significantly lower, and net benefits are achieved more quickly, than under option 1.
- Based on mid-range estimates of benefits, the preferred approach will realise a long term (10 year) net benefit over $2 billion.
- Based on a sensitivity test of benefits, the preferred approach will realise a long term (10 year) net benefit of around $43 million.
- Benefits will continue to accrue beyond the 10 year timeframe used to estimate benefits.
- Responses to the draft RIS put forward a range of issues, some arguing the benefits should be higher, others arguing they should be lower.

5. CONSULTATION

This RIS has been preceded by three earlier rounds of formal consultation and has been the subject of ongoing discussions over two years. The first formal consultations involved meetings with key stakeholders including the Australian Motorcycle Council, the Australian Trucking Association, the Australian Automobile Association, the Bus Industry Confederation, Environment Victoria (which was representing envronment stakeholders on the Transport Emissions Liaison Group at the time) and the Federal Chamber of Automotive Industries. The meetings involved a comprehensive presentation on noise issues and ensuing discussions about the impacts on various parts of industry. These meetings were transcribed, summarised and reviewed by the participants. The summaries were then printed in the Close/Apelbaum report released in April 2001.

The initial meetings provided for a broad ranging discussion about options for reducing noise. All groups supported the principle of harmonisation, though manufacturers noted that it would need to be supported by a Regulatory Impact Statement. Manufacturers of heavy vehicles focused on the issues of cooling problems for engines if design standards were made more stringent. All manufacturers argued that in-service enforcement was equally important as new design standards. This view was also supported by the Envrionment Victoria which argued that more stringent enforcement was needed and operator accredition should be considered. The AAA also noted the need for increased enforcement in addition to new design standards. Bus manufacturers also noted that cooling is a potential issue for buses and that separate regulatory requirements for exhaust configuration (vertical exhausts) can pose problems for noise reduction. The meetings also provided for a lengthy discussion on engine brake noise, which is now being treated as a separate MVEC project.

The second round of consultation followed the release of the Close/Apelbaum report. Stakeholders were invited to respond to the report over a three-month period. Several stakeholders had difficulty with the timeline, so the period was extended on request. About 50 submissions were received, though some submissions represented a large number of individual companies. The type of individuals and organisations that responsed was diverse, ranging from small businesses affected by noise through to large manufacturing companies. Many individuals also made submissions, and there was a good balance of urban and rural views. From these submissions, the issues raised in this report were distilled. The key issues raised during the process have formed the basis for the discussion in this document.

As the draft RIS was being developed, further meetings were held with key stakeholders to clarify the process and seek views on the regulatory options being considered. This involved discussions with the FCAI, ATA, BIC, TIC and the Motor Trades Association. NRTC has also kept a broader range of industry stakeholders informed through its advisory groups such as the Transport Emissions Liaison Group, the Industry Advisory Group, the Bus Industry Advisory Group and meetings with the Australian Road Transport Suppliers Association.

The draft RIS was released in January 2002 for a two month consutlation period. Where extra time was sought, it was granted by NRTC and responses continued to be submitted until May 2002. The release of the draft RIS and accompanying press release generated extensive media coverage and radio interviews. Follow up meetings were held with all manufacturer peak bodies.

A key issues arising from the draft RIS feedback was whether to pursue option 1 or option 2. The main debate was over the proposed limit for heavy trucks: some groups arguing the proposed 3dB concession wasn't warranted, others arguing is wasn't enough given Australia's climate and operating conditions. This matter is discussed at length in section 3.2.

Consultation within government has also been extensive. The MVEC forum provides a good opportunity to reach transport and environment agencies, and where particular agencies are affected, specific meetings were held. For example, proposed changes to the system of stationary noise measurement involved extensive consultation with the Vehicle Standards Board.

6. EVALUATION

Has the need for action been demonstrated and does the preferred option represent the best way to deal with the problem?

Through feedback to consultation and complaints to authorities, the public has indicated a clear dissatisfaction with the noise levels from the Australian vehicle fleet. Several submissions advocate going beyond international noise standards to address the noise problem in Australia. Government agencies that have developed or are developing traffic noise strategies consistently identify the need to reduce noise at the source through tighter design and in-service standards. Manufacturers recognise that Australian standards are significantly less stringent than the international standards and generally support harmonisation provided there is discussion of costs and benefits and specific policy issues are addressed.

While it is not clear exactly how many vehicles are already achieving the proposed standards due to a confidentiality arrangement, every manufacturer that has commented has indicated the need to make design changes and incur costs. This shows that market demand is not leading to improved exterior noise levels.

A range of ways of dealing with the problem has been canvassed in this document. The discussion indicates that no one single measure, regulatory or non-regulatory will solve the transport noise problems in Australia. Several of the potential solutions including improving in-service regulation and encouraging industry accreditation are already being addressed by MVEC. Solutions such as freeway noise barriers and better road surfaces will continue to be used to resolve tyre noise problems at high speed, but are not legitimate alternatives to quieter engines.

The preferred option represents the best way to deal with the problem of manufacturers not taking up the design options to reduce external noise.

6.1 Do the benefits outweigh the costs?

The appendices set out the methodology used to estimate the community benefits flowing from the proposed reduction in ADR vehicle noise requirements. Appendix 1 sets out the basis for estimating the costs of vehicle modification to meet the new standards. Figures provided by manufacturers were used wherever possible. Appendix 3 seeks to factor the effect of tyre noise out of the equation so that a reasonable estimate of the noise benefits from the change can be made.

On the basis of the analysis set out in the attachments, there is a clear community gain from the introduction of the new noise requirements for vehicles. It has to be acknowledged that the analysis is based on limited information and significant assumptions and can only give approximate estimates of costs and benefits. Wherever possible, conservative assumptions have been used and a number of sensitivity tests were carried out. In all cases, benefits outweighed costs for the proposed standards over the long term.

6.2 Are there any restrictions on competition?

There are no restrictions on competition introduced by the proposed regulation. Consistency with international standards ensures no restrictive effects. The small deviations from international standards will not require overseas suppliers to re-engineer

the vehicles that already comply with the international standards (the proposed deviations are more lax, rather than more stringent). The standards are performance based and therefore do not favour any particular technology.

6.3 Consistency with international approaches

The proposed approach is entirely consistent with the international standards, except for very high powered trucks. This exception is appropriate given Australia's unique transport task and the need for vehicles with gross combination mass over 60 tonnes.

6.4 Feedback from stakeholders

Stakeholders are overwhelmingly in favour of international harmonisation. Several stakeholders argue that Australia should introduce standards more stringent that the international standards if it can be demonstrated to have a benefit, and some argue that no change should be made until a full assessment has been undertaken. This RIS and the feedback that will be received from its circulation provide that assessment.

Issues raised by stakeholders have been examined in this RIS and through numerous meetings prior to the release of this RIS. It is likely many stakeholders will be dissatisfied with the proposed outcome, some arguing it is too tough, others arguing it is too lenient. Given stakeholder feedback, NRTC has found it difficult to strike a balance between the legitimate practical issues that face manufacturers, and the demands of everyone else who want world's best practice in noise standards. While some stakeholders have argued in favour of option 1 (full harmonisation), NRTC has considered the engineering difficulties and costs associated with bringing high productivity vehicles (B-doubles and roadtrains) into line with international best practice and has proposed that the matter of the 3dB concession be reviewed within 3 years.

7. IMPLEMENTATION AND REVIEW

The proposed reductions in noise levels in ADR 28.01, 39.00 and 56.00 will be implemented through the normal process for new or amended ADRs. The changes will be determined under the provisions of the *Motor Vehicle Standards Act*, becoming national standards applicable to new vehicles sold from the date set out in the determination. Consequential amendments to the Australian Vehicle Standards Regulations will then provide the basis for in-service enforcement.

Review of the ADRs is an ongoing process, now linked to review of the UNECE regulations for road vehicles. Australia is party to the formal agreement providing the basis for the review of the UNECE regulations and participates in the review process under UNECE Working Party 29 of the Inland Transport Committee of UNECE.

As discussed above the concession of heavy vehicles above 320kW will be reviewed within 5 years to determine whether it is practical to required B-doubles to meet the 80dB level that applies to other heavy trucks.

REFERENCES

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APPENDIX 1: COSTS

Note:

Some respondents to the draft RIS argued VFACTS data should be used rather than ABS data. In the interests of transparency, both have been calculated. Though the breakdown is slightly different, the final figures are similar. The higher figure will be used in the summary table in the main document.

Calculation of Fleet Costs: VFACTS Data

Calculation of costs of noise improvement of the Australian light truck fleet using VFACTS data

Basis: all exterior noise abatement on a truck represents 1-2% of the purchase cost.

Assumptions / variables:

- This category totals about 224, 270 new vehicles per year (VFACTS Industry summary - December 2001)
- About 20% will already comply (assumption based on discussions with industry)
- Take the higher end of the estimate (2%)
- The average price of a light truck is $40,000 (CV News)

Therefore, the average increased cost will be:

$40,000 x 2% x 224,270 x 80% = $143m
(about $797 per non complying light truck)

Calculation of costs of noise improvement of the Australian heavy truck fleet using VFACTS data

Basis: all exterior noise abatement on a truck represents 1-2% of the purchase cost.

Assumptions / variables:

- This category totals about 18,959 new vehicles per year (VFACTS Full year 2001 summary)
- About 10% will already comply (assumption based on discussions with industry)
- Take the higher end of the estimate (2%) for option 1 and the lower end (1%) for option 2
- The average price of a heavy truck is $200,000 (CV News and Truck Search)

Therefore, the average increased cost will be:
For Option 1:

$200,000 x 2% x 18,959 x 90% = $68m
(about $4000 per non complying heavy truck)

For Option 2:

$200,000 x 1% x 18,959 x 90% = $34m
(about $2000 per non complying heavy truck)

Calculation of costs of noise improvement of the Australian car fleet using VFACTS data

Basis: cost of reducing noise is about 0.5% of the car purchase price per decibel

Assumptions/variables

- Passenger car registrations total about 529,452 per year (VFACTS Industry Summary December 2001)
- About 50% of these already meet international standards (based on discussion with industry)
- The average price of a passenger car is $25,000
- Improvement required is 2dB

Therefore the average increased cost for passenger cars using VFACTS data is:

50% x 529,452 x 2dB x $25,000 x 0.5% = $66m
(about $250 per non complying car)

Calculation of Fleet Costs: ABS Data

Calculation of costs of noise improvement of the Australian light commercial fleet using ABS data

Basis: all exterior noise abatement on a truck represents 1-2% of the purchase cost.

Assumptions / variables:

- This category totals about 104,523 new vehicles per year (ABS New Vehicle Registrations November 2001)
- About 20% will already comply (based on discussions with industry)
- Take the higher end of the estimate (2%)
- The average price of a light commercial vehicle is $50,000 (CV News)

Therefore, the average increased cost will be:

$50,000 x 2% x 104,523 x 80% = $83m
(about $1000 per non complying light commercial vehicle)

Calculation of costs of noise improvement of the Australian rigid truck fleet using ABS data

Basis: all exterior noise abatement on a truck represents 1-2% of the purchase cost.

Assumptions / variables:

- This category totals about 12,482 new vehicles per year (ABS New Vehicle Registrations November 2001). However, ABS has another category titled "Non Freight Carrying Trucks" which covers cranes and other special purpose vehicles (generally rigid). These total 1,580 per year. Add this figure to the rigid figure = \$14,062
- About 10% will already comply (assumption based on discussions with industry)
- Take the higher end of the estimate (2%)
- The average price of a rigid truck is \$80,000 (CV News and Truck Search)

Therefore, the average increased cost will be:

\$80,000 x 2% x 14,062x 90% = \$20m
(about \$1,580 per non complying rigid truck)

Calculation of costs of noise improvement of the Australian <u>articulated truck</u> fleet using ABS data

Basis: all exterior noise abatement on a truck represents 1-2% of the purchase cost.

Assumptions / variables:

- This category totals about 3,380 new vehicles per year (ABS New Vehicle Registrations November 2001)
- About 10% will already comply (assumption based on discussions with industry)
- Take the higher end of the estimate (2%) for option 1 and the lower end (1%) for option 2
- The average price of an articulated truck is $250,000 (CV News and Truck Search)

Therefore, the average increased cost will be:
For Option 1:

$250,000 x 2% x 3,380 x 90% = $15m
(about $5,000 per non complying heavy truck)

For Option 2:

$250,000 x 1% x 3,380 x 90% = $7m
(about $2,500 per non complying heavy truck)

NB: One heavy truck manufacturer provided an alternate estimate for this category of $5300 per non-complying truck, or $16m in total

Calculation of costs of noise improvement of the Australian car fleet using ABS data

Basis: cost of reducing noise is about 0.5% of the car purchase price per decibel

Assumptions/variables

- Passenger car registrations total about 653,000 per year (ABS New Motor Vehicle Registrations November 2001)
- 50% of these already meet international standards
- The average price of a passenger car is $25,000
- Improvement required is 2dB

Therefore the average increased cost for passenger cars using ABS data is:

50% x 653,000 x 2dB x $25,000 x 0.5% = $82m
(about $251 per non complying car)

Calculation of costs of noise improvement of the Australian heavy bus fleet.

Basis: all exterior noise abatement on a bus represents 1-2% of the purchase cost.

Assumptions / variables:

- Heavy bus registrations total about 1,000 new vehicles per year (Australian Bus and Coach 2002 Manufacturers and Suppiers Directory)
- About 75% are automatic (Australian Bus and Coach magazine) and most automatic buses already comply (submission from bus industry), so assume 50% of all buses comply.
- Option 1 will not differ from Option 2 as this only affects trucks.
- Use higher end of cost estimate (2%) to be conservative.
- The average price of a bus is estimated at $300,000 (based on a bus operator's submission to the draft RIS)

Therefore, the average increased cost will be:

$300,000 x 2% x 1000 x 50% = $3m
(about $6000 per non complying bus)

Calculation of costs of noise improvement of the Australian light bus fleet.

Basis: all exterior noise abatement on a bus represents 1-2% of the purchase cost.

Assumptions / variables:

- Light bus registrations total about 2,000 new vehicles per year (ABS publication 9301.0 but subtracting 1000 heavy buses (refer above).
- About 75% are automatic (Australian Bus and Coach magazine) and most automatic buses already comply (submission from bus industry), so assume 50% of all buses comply.
- Option 1 will not differ from Option 2 as this only affects trucks.
- Use higher end of cost estimate (2%) to be conservative.
- The average price of a bus is estimated at $100,000 (based on trade magazines and discussion with BIC)

Therefore, the average increased cost will be:

$100,000 x 2% x 2000 x 50% = $2m
(about $2000 per non complying bus)

Calculation of costs of noise improvement of the Australian motorcycle fleet.

Basis: cost of reducing noise is about 0.5% of the motorcycle purchase price per decibel.

Assumptions / variables:

- Motorcycle registrations total about 27,000 new vehicles per year (ABS Year Book 1999)
- 50 % of these are likely to be made to international standards and are likely to comply with the proposed standards (Australian motorcycles are primarily sourced from Japan)
- There is no difference between options 1 and 2 for motorcycles
- The average price of a motorcycle is $8000 (approximation from industry magazines)
- Motorcycles that don't currently comply will need to improve by about 2dB to comply with the proposed limits.

Therefore, the average increased cost for motorcycles will be:

50% x 27,000 vehicles x $8,000 x 0.5% x 2dB = $1m per year
(about $75 per non complying motorcycle)

Data Used for Benefit Calculations

Number dwellings	7,188,100
Dwellings affected (20%)	0.2
Dwellings affected (10%)	0.1
Ave dwelling price	163300
NDI (1%)	0.01
NDI (0.2%)	0.002
Option 1 noise reduction (dB)	1.412
Option 2 noise reduction (dB)	1.316

Cost Data

Option 1	300,000,000
Option 2	266,000,000

Mid range estimate of benefits (not fully realised for 10 years)

Option 1 at 1% NDI, 20% dwellings affected	3,314,858,446
Option 2 at 1% NDI, 20% dwellings affected	3,089,485,633

Sesitivity Test of Benefits (not fully realised for 10 years)

Option 1 at 0.2% NDI, 10% dwellings affected	331,485,845
Option 2 at 0.2% NDI, 10% dwellings affected	308,948,563

<u>NET</u> BENEFITS AFTER 10 YEARS:

Option 1: Net Benefit (mid range)	3,014,858,446
Option 2: Net Benefit (mid range)	2,823,485,633
Option 1: Net Benefit (sensitivity test)	31,485,845
Option 2: Net Benefit (sensitivity test)	42,948,563

Net Benefits after 1 year (mid range):

Option 1	31,485,845
Option 2	42,948,563

APPENDIX 2: OTHER EFFECTS OF NOISE

Noise has a number of effects on the community. Some of these impacts have been estimated by the use of the hedonic pricing technique (Appendix 3).

Other impacts of noise include :

- Health effects
- Amenity effects
- Work or task effects

There is little quantitative data on health effects. The issues are canvassed in a number of reports, but the data is qualitative. A range of health effects are considered, including cardiovascular effects, sleep deprivation and disturbance, mental health effects and stress effects. A draft report by enHealth Council examines the non-auditory effects of noise. It states that noise can cause changes to the learning behaviour of children, particularly in the areas of reading and motiviation. In adults it can have the effect of loss of performance and productivity and can lead to industrial accidents. It says greater research is needed into the effect of noise on stress and mental health. The Close/Apelbaum report noted there are a range of impacts on communities subject to high traffic noise. In some cases the annoyance can lead to the sale of the house and moving to a quieter area. Both the enHealth report and the Close/Apelbaum report draw on extensive literature that clearly shows that traffic noise has adverse social effects. International studies even point to a link between increased cardiac fatalities and increased noise levels (INFRAS). Responses received to the Close/Apelbaum report are overwhelmingly expressing concern about the adverse social and health effect of noise.

Amenity effects of vehicle noise relates to the enjoyment of facilities and the environment by members of the public who may not live in the area. For instance, noisy picnic spots and parks in urban areas will not be popular. Again, there is little quantitative information on this aspect.

Work or task effects relate to problems in communication between workers in noisy environments and to problems in concentration and learning.

A report for UK Department of Environment, Transport and the Regions (AEA Technology Environment 2001) suggests the following effects of high vehicle noise levels:

- Speech interference
- Annoyance
- Sleep disturbance
- Performance
- Cardiovascular
- Mental health effects

A discussion paper for the NZ Ministry of Transport suggests:

- Sleep interference
- Communication interference

- General annoyance and feeling of helplessness
- Work or task interference

The consistent theme in the literature is that there are detrimental effects of high noise levels on public health and performance. This is supported by the regular experience of complaints regarding vehicle noise.. However, it is not possible to effectively quantify these effects.

The key point to recognise is that the noise reduction benefits estimated through hedonic pricing methodology are likely to be conservative, given the acknowledged existence of other, unquantified, effects.

APPENDIX 3: BENEFITS

Estimation of the Benefits of Vehicle Noise Reduction Using Hedonic Pricing Methodology

It is difficult to value the community benefit of a program to reduce vehicle noise. This analysis relies primarily on the hedonic pricing approach. It is recognised that hedonic pricing does not capture the full range of noise effects and it it therefore considered that the estimates will be conservative.

Hedonic pricing relies on the notion that it is often possible to choose the level of environmental consumption, or degradation, through the choice of location of residence.. This appears to be particularly pertinent in regard to noise, where the impact is often location specific. A typical case would be airport noise, where it would be expected thst house prices under the flight path would be lower than prices for equivalent houses in equivalent locations, but not exposed to the aircraft noise.

Sophisticated statistical techniques are needed to separate the noise related part of the price differential. A number of studies have used the approach to identify a "noise Depreciation Index", which is the percentage price differential for a 1db change in noise exposure.

Given the complexity of the issues it is not surprising to find a range of values in different studies. Streeting 1990 identified outcomes ranging from 0.0 to 2.9 over a range of studies, with most in the range 0.2 to1.0.

More recent studies have suggested a noise depreciation index in the range 0.2-1.5 %. The report Surface Transport Costs and Charges 1998 noted that the UK Department of Environment Transport and the Regions used values of .2, 0.44 and 0.67 for low medium and high NDI estimates. The report Cost-Effectiveness of Noise Reduction Measure – Phase 1, 2001 again noted the DoTR parameters and commented that more recent studies suggested a lower value for the NDI, compared to estimates in the range 0.5-1.0%, which had been common..

Close and Apelbaum (A Review of Noise Related Australian Design Rules and Engine Brake Noise, April 2001) identified a range of NDI from different studies ranging from 0.08 to 1.5%, with "differing exposure thresholds applied to each NDI (of between 50dB(A) and 65dB(A)).

- **Ø This analysis is based on an NDI of 1%, with a sensitivity test at 0.2%.**

The formula to estimate the benefit of a reduction of N db in traffic noise is:

Community Benefit=NDI*number of affected dwellings*mean house price*noise

reduction (Ndb).

For this analysis, the mean housing price and the number of dwellings are taken from the ABS ausstats database (www.abs.gov.au/ausstats). The estimate of value applies to national owner-estimated median data for 1999-2000. The number of dwellings is taken from Table 8.1 All Households by Dwelling Structure and State/Territory (www.abs.gov.au/ausstats).

The basis for estimating the reduction in road traffic noise from the proposed reductions in ADR requirements was estimated using the procedure set out in Appendix 1 to this

attachment. The procedure uses measurements of road traffic noise and tyre noise to derive an estimate of vehicle power-train noise contribution. The procedure is then reversed to estimate the effect of the proposed ADR changes on traffic noise.

The mean effect of the reductions in ADR noise levels is estimated by applying a traffic weighting to each vehicle class. The weighted estimate of the reduction in traffic noise is then used to calculate the estimate of the benefit of the noise reduction.

The reduction in traffic noise will not be fully effective until the vehicle fleet is predominantly low noise vehicles, with the low noise vehicles dominating in the high utilisation vehicles category ie the majority of the traffic noise will be derived from low noise vehicles. Kragh 2001, derived curves suggesting that the reduction in traffic noise will be approximately linear and proportional to the rate at which the fleet is replaced – or vehicle life.

For this analysis, a mean vehicle life of ten years has been assumed to give an estimate of the increase in noise benefits as the fleet is replaced by low noise vehicles. A linear growth rate is assumed for the noise benefits. NRTC acknowledges that this assumption may not hold true for the entire fleet. In responses to the draft RIS, some stakeholders noted that heavy trucks are often 'retired' to short-haul inner city work such as container distribution in dock areas, and that this can cause a significant noise problem with local residents. These is no data on this issue, but most industry observers agree that old (noisy) trucks retire to wharf areas (where they can be a noise problem) and to farms (where they are rarely a noise problem). The key point for this analysis is that the 10 year estimate for fleet turnover may be slightly optimistic.

Results of Analysis

The first analysis used the following parameters:

Number of Dwellings (total)	7,188,100
Dwellings affected	20%
Average Dwelling price	$163,300
Noise Depreciation Index	1%
Fleet Replacement Cycle	10 years
Weighted Traffic Noise Reduction –Option1*	1.412 dB(A)
Weighted Traffic Noise Reduction –Option2*	1.316 dB(A)

* The weighted traffic noise reduction has been discounted by 20% to account for the likelihood that some vehicles from which these figures were derived, already comply with the proposed limits.

The net community noise benefit estimates for this mid-range set of parameters are:

	Year 1 Net Benefit Estimate	**Year 10 Net Benefit Estimate**
Option1: 7db Reduction for Heavy Vehicles	$47m	$3314m
Option2: 4db Reduction for Heavy Vehicles	$59m	$3089m

Sensitivity test

To indicate the sensitivity of the estimate to variations in the parameters, the following analyses were carried out:

Parameter	**Option 1** **Year 10**	**Option 2** **Year 10**
BOTH NDI reduced to 0.2% and households affected reduced to 10%	$47m	$59m

Note that the sensitivity tests show that for both Options 1&2 there is a net dis-benefit in the early years. The net benefit for option 1 becomes positive after year 9, and after year 8 for option 2..

Attachment A to Appendix 3

Estimation of the effect of reductions in the ADR noise level requirements on traffic noise

To estimate community benefits, it is necessary to estimate the effect of reductions in ADR noise performance requirements on the traffic noise levels. Traffic noise is composed of two main elements:

- Tyre noise
- Vehicle power train noise

To estimate the effects of reductions in the ADR requirements, it is necessary to estimate the current contribution of vehicle power-train noise to the passby traffic noise level This was done by splitting an estimate of traffic noise into a tyre noise component and a powertrain component. The powertrain component was then reduced by the proposed ADR reductions for each vehicle category and the tyre noise levels and powertrain component recombined to give an estimate of the effect of the ADR reductions on the passby traffic noise.

The estimates of the effect of the reductions in each category were then weighted in accordance with a estimated vehicle traffic composition of cars 90%, medium vehicles 5% and heavy vehicles 5% to give an estimate of the traffic noise reduction from the proposed ADR performance requirements. The analysis allowed for two options for heavy vehicles:

Option 1 - full 7 db reduction for heavy vehicles

Option 2 - retain 3db allowance for high powered vehicles, giving a reduction of 4db

Vehicle tyre noise is dependent on traffic speed and pavement surface. For the purpose of this analysis, a mean traffic speed of 80 Km/hour is assumed. The following table shows the passby traffic noise levels for a range of pavement types.

Table 1: Passby Noise Levels at 7.5m and 80km/h

	Open graded asphalt 1	**Open graded asphalt 2**	**Mean of 1 and 2**	**Dense graded asphalt 1**	**Portland cement concrete 1**	**Portland cement concrete 2**	**Mean of PCC 1 and 2**	**Mean vehicle noise emission level (80 km/hr)**
Car	72.9	72	72.45	77.1	80.8	79.3	80.05	**76.53**
Medium vehicle	80.6	82.8	81.7	84.7	86.5	85.1	85.8	**84.07**
Heavy vehicle	83.3	85.9	84.6	88.4	88.7	88.2	88.45	**87.15**

Source NSW RTA Report by Samuels and Parnell (Oslan Consulting) *Study of Baseline Ambient Noise Levels in Newcastle and Wollongong Areas - Vehicle Passby Noise Level Assessment* Updated Report (2001)

The mean noise level is used to allow for the effect of all types of vehicle on the range of pavements commonly in service.

It is difficult to find data on vehicle tyre noise. The following estimates are based on information in ARRB Research paper ARR314

Table 2: Estimated Pavement/Tyre Noise Contribution at 7.5m and 80km/H

	Pavement/Tyre Individual Vehicle Noise Contribution		
Speed kmph	**Range kmph**		**Mean kmph**
50	54	73	63.50
70	59	78	68.50
80	**61**	**81**	**71.00**
100	64	86	75.00

Source: McLean, J and Foley G. Road surface characteristics and condition: effects on road users ARRB Transport Research ARR 314.

The analysis uses the mean estimate of tyre noise, 71db, adjusted to reflect the different effects of cars, medium vehicles and heavy vehicles. The adjusted tyre noise figures are:

Cars 69db

Medium vehicles 71db

Heavy vehicles 74db

Using these estimates of tyre noise and the estimate of passby traffic noise, an estimate of power-train noise contribution, as shown in Table 3. It is important to recognise the logarithmic nature of the noise measurements.

Table 3: Calculation of Power-Train Noise Contribution

Vehicle Type	**Tyre Noise db**	**Total Vehicle Noise db**	**Vehicle Power-Train Contribution db**
Car	69	77	76.5
MV	71	84	84
HV	74	87	87

The next step is to adjust the power-train noise levels to reflect the proposed ADR reductions and recombine the tyre noise and adjusted power-train noise contributions to get an estimate of the impact of the reductions on the passby traffic noise.

The adjusted power train noise contributions are:

Table 4: Adjusted Power-Train Contribution Reflecting Reductions in ADR Levels

Vehicle Type	Estimated Power-train Noise Contribution db	Proposed ADR Reduction db	Adjusted Power-Train Noise contribution db
Car	76.5	3	73.5
MV	84	4	80
HV Option 1	87	7	80
HV option 2	87	4	83

The adjusted power-train noise contribution and the tyre noise were then recombined to give an estimate of the effect on pass-by noise levels.

Table 5: Estimation of Change in Passby Traffic Noise due to ADR Reduction

Vehicle Type	Tyre Pavement Noise Contribution db	Adjusted Power-Train Noise contribution db	Total Vehicle Noise db	Change in Noise Level Due to ADR Reduction db
Car	69	73.5	75.1	1.43
MV	71	80	80.5	3.57
HV Option 1	74	80	81	6
HV option 2	74	83	83.5	3.5

The estimated reductions in passby noise levels were then weighted to reflect a typical urban traffic stream of 90% cars, 5% medium vehicles and 5% heavy vehicles to give an estimate of reductions in traffic noise from the ADR reductions of:

Option1 1.77db

Option 2 1.64db

These estimates were than used to calculate the estimated community benefit using hedonic pricing approaches.