Regulation Review Committee
Parliament of New South Wales

Report on the Protection of the Environment Operations (Clean Air) Regulation 2002

Report No 26/52
November 2002

New South Wales Parliamentary Library cataloguing-in-publication data:

New South Wales. Parliament. Regulation Review Committee.
Report on the Protection of the Environment Operations (Clean Air) Regulation 2002/ Regulation Review Committee, Parliament of New South Wales. [Sydney, N.S.W.] : The Committee, 2002. – 33p; 30 cm. (Report no. 26/52, November 2002)

Chair: Gerard Martin.

ISBN 0 7347 6887 7

1. New South Wales. Protection of the Environment Operations (Clean Air) Regulation 2002.
2. Air quality—New South Wales—Law and legislation.
3. Environmental Law —New South Wales.
I. Martin, Gerard.
II. Title
III. Series: New South Wales. Parliament. Regulation Review Committee. Report ; 52/26

DDC 344.944046342

Table of Contents

Regulation Review Committee

Members:

Mr Gerard Martin MP, Chairman
Hon Peter Primrose MLC*
Hon Don Harwin MLC
Mr Kerry Hickey MP
Hon Malcolm Jones MLC
Dr Elizabeth Kernohan MP
Ms Marianne Saliba MP
Mr Russell Turner MP

*Replaced the Hon J A Saffin MLC, discharged, on 30 October 2002

Secretariat:

Mr Russell Keith, Manager
Mr Greg Hogg, Project Officer
Ms Christine Lloyd, Committee Officer
Mrs Vanessa Pop, Assistant Committee Officer

Section 9 of the Regulation Review Act 1987

9 Functions

(1) The functions of the Committee are:

(a) to consider all regulations while they are subject to disallowance by resolution of either or both Houses of Parliament,

(b) to consider whether the special attention of Parliament should be drawn to any such regulation on any ground, including any of the following:

(i) that the regulation trespasses unduly on personal rights and liberties,

(ii) that the regulation may have an adverse impact on the business community,

(iii) that the regulation may not have been within the general objects of the legislation under which it was made,

(iv) that the regulation may not accord with the spirit of the legislation under which it was made, even though it may have been legally made,

(v) that the objective of the regulation could have been achieved by alternative and more effective means,

(vi) that the regulation duplicates, overlaps or conflicts with any other regulation or Act,

(vii) that the form or intention of the regulation calls for elucidation, or

(viii) that any of the requirements of sections 4, 5 and 6 of the *Subordinate Legislation Act 1989*, or of the guidelines and requirements in Schedules 1 and 2 to that Act, appear not to have been complied with, to the extent that they were applicable in relation to the regulation, and

(c) to make such reports and recommendations to each House of Parliament as it thinks desirable as a result of its consideration of any such regulations, including reports setting out its opinion that a regulation or portion of a regulation ought to be disallowed and the grounds on which it has formed that opinion.

(2) Further functions of the Committee are:

(a) to initiate a systematic review of regulations (whether or not still subject to disallowance by either or both Houses of Parliament), based on the staged repeal of regulations and to report to both Houses of Parliament in relation to the review from time to time, and

(b) to inquire into, and report to both Houses of Parliament on, any question in connection with regulations (whether or not still subject to disallowance by either or both Houses of Parliament) that is referred to it by a Minister of the Crown.

(3) The functions of the Committee do not include an examination of, inquiry into or report on a matter of Government policy, except in so far as such an examination may be necessary to ascertain whether any regulations implement Government policy or the matter has been specifically referred to the Committee under subsection (2) (b) by a Minister of the Crown.

Chairman's Foreword

This report looks at the analysis of the costs and benefits of requiring diesel vehicles over 4.5 tonnes gross vehicle mass that comply with the Australian Design Rule (ADR) 80/00 emission standard to be fitted with vertical exhausts. The requirement for vertical exhausts for heavy diesels was introduced in NSW in 1976. At that time there were no emission standards for diesel engines and diesel fuel had a very high sulphur content. With the advent of improved emission and fuel standards, the *Protection of the Environment Operations (Clean Air) Regulation 2002* has begun phasing out the vertical exhaust requirement. Vehicles which meet the ADR 80/01 standard are no longer required to have vertical exhausts. All new model vehicles in Australia will meet the ADR 80/01 emission standard from 2006 and it will apply to all new vehicles from 2007. The Environment Protection Authority has concluded that, because of the high emission standards on these vehicles, requiring them to be fitted with vertical exhaust is not justified. A number of transport industry groups have sought an exemption for vehicles meeting the ADR 80/00 emission standard. From this year, this standard has been required for all new model vehicles and from 1 January 2003 it will apply to all new trucks and buses. Diesel fuel standards are also tightening, with low sulphur diesel being mandatory from the end of this year and ultra-low sulphur diesel being required from 2006.

The purpose of diesel exhausts is to speed up the dispersal of exhaust fumes. They have no positive effect on the amount of exhaust emitted but can reduce the local concentrations of pollutants that people by the roadside are exposed to when a vehicle passes. They are therefore seen to have benefits for the health and amenity of pedestrians, cyclist and people working by the roadside. On the downside, they add expense to the transport industry in fitting, maintenance and efficiency costs. According to EPA figures, the financial cost to the industry over the next four years is likely to be at least $5 million. Industry estimates lead to figures of over $31 million. Another negative impact is that, by decreasing engine efficiency, fitting vertical exhausts can result in an increase in the total diesel emissions contributing to ambient air pollution levels.

While the evidence of the harm resulting from diesel emissions is overwhelming, there is little evidence that vertical exhausts actually have a significant positive health impact. The main study done on the subject in 1993, well before any emission or fuel standards, concluded that the significance of exhaust exposures under its tests in terms of increased risk in lung cancer were found to be small. It appears that no other jurisdiction in the developed world has ever required the fitting of vertical exhausts except Victoria.

The Committee's examination of these issues led it to the conclusion that the vertical exhaust requirement for ADR 80/00 vehicles was not justified. It has therefore strongly recommended that an exemption for ADR 80/00 from the requirement be considered.

Gerard Martin MP
Chairman

Protection of the Environment Operations (Clean Air) Regulation 2002

Background

The making of the Regulation

The *Protection of the Environment Operations (Clean Air) Regulation 2002* was published in Government Gazette No. 135, dated 30 August 2002 and tabled in this House on 4 September 2002. The Regulation replaced the *Clean Air (Domestic Solid Fuel Heaters) Regulation 1997* and the *Clean Air (Motor Vehicles and Motor Vehicle Fuels) Regulation 1997*, which were repealed on 1 September 2002 under section 10 (2) of the *Subordinate Legislation Act 1989*.

Regulatory impact statements (RISs) were prepared for a proposed "Protection of the Environment Operations (Clean Air—Motor Vehicles and Motor Vehicle Fuels) Regulation 2002" and a proposed "Protection of the Environment Operations (Clean Air—Domestic Solid Fuel Heaters) Regulation 2002" and made available for public comment. The RISs were advertised in the *Sydney Morning Herald* and *Daily Telegraph* on 11 July with comments sought by 2 August 2002 and then again on 16 July 2002 with comments sought by 7 August 2002. They were also advertised in the Government Gazette on 19 July 2002. Copies of the RISs were also sent to stakeholders and made available on the Environment Protection Authority's (EPA) website. The provisions of the proposed regulations were incorporated into the one regulation with some minor amendments. Additional consultation was also undertaken in preparation of the RISs as set out in Appendix A.

The RISs were forwarded to the Committee, together with the submissions received during the consultation period and an analysis of those submissions, on 12 September 2002.

Consideration by the Committee

Role of the Committee

The *Subordinate Legislation Act 1988* provides for the automatic repeal of all regulations every five years. It also requires a statement of the objectives of the regulation and the consideration of the alternative options for achieving those objectives and an evaluation of the costs and benefits of those options (section 4 & schedule 1). In the case of principal statutory rules such as *Protection of the Environment Operations (Clean Air) Regulation 2002*, the Act also requires that a regulatory impact statement be prepared and subject to public consultation. After a regulation is made, the RIS and any submissions received must be forwarded to the Regulation Review Committee for examination.

The Committee examines all regulations while they are subject to disallowance by resolution of either or both Houses of Parliament to consider whether the special

attention of Parliament should be drawn to those regulations on any ground, including:

(i) that the regulation trespasses unduly on personal rights and liberties,
(ii) that the regulation may have an adverse impact on the business community,
(iii) that the regulation may not have been within the general objects of the legislation under which it was made,
(iv) that the regulation may not accord with the spirit of the legislation under which it was made, even though it may have been legally made,
(v) that the objective of the regulation could have been achieved by alternative and more effective means,
(vi) that the regulation duplicates, overlaps or conflicts with any other regulation or Act,
(vii) that the form or intention of the regulation calls for elucidation, or
(viii) that any of the requirements of sections 4, 5 and 6 of the *Subordinate Legislation Act 1989*, or of the guidelines and requirements in Schedules 1 and 2 to that Act, appear not to have been complied with, to the extent that they were applicable in relation to the regulation,

Procedure for the Regulation

On consideration of the material forwarded to the Committee in relation to the Regulation, the Committee noted the representations in a number of the submissions regarding clause 11. That clause requires that diesel vehicles over 4.5 tonnes gross vehicle mass have vertical exhausts fitted. Clause 12 provides an exemption from that requirement for vehicles that comply with the Australian Design Rule (ADR) 80/01 emission standard. The representations sought an extension of the exemption to vehicles complying with ADR 80/00.

The Committee noted that the transport industry estimation of the costs of the vertical exhaust requirement for ADR 80/00 vehicles, both in economic and environmental terms, were significantly greater than those estimated in the RIS. At the same time, the RIS did not make sufficiently clear the extent of any benefits that would result from requiring ADR 80/00 vehicles to fit vertical exhausts. Despite these issues arising from the RIS, the Committee was pleased to note that the RIS attempted to assess the costs and benefits of the regulation as a whole and of each of its significant provisions and to quantify those costs and benefits. It also explained the objectives of the Regulation and the reasoning and assumptions by which the major provisions of the Regulation were justified.

The Committee held a public hearing on 31 October 2002. This was to enable the Environment Protection Authority to more fully justify the benefits of the vertical exhaust requirement and to better understand and to test the claims made by industry groups. The hearing was attended by a number of industry representatives and officials from the Environment Protection Authority and NSW Health, as set out in Appendix B.

As the period for disallowance of the Regulation in both Houses of Parliament was due to expire before the Committee would have sufficient opportunity to consider the evidence from the hearing and report to Parliament, the Committee requested two of its members to give notice of a motion to disallow the vertical exhaust requirement from the Regulation and to postpone moving that motion until the Committee had sufficient opportunity to report. This was agreed to prior to the hearing of evidence for the sole purpose of keeping the option of disallowance alive in both Houses in case the Committee should eventually give such a recommendation.

The Vertical Exhaust Requirement in the Regulation

Clause 11 of the regulation provides as follows:

> **11 Fitting of certain anti-pollution devices to be compulsory: sections 156 and 161 and clause 15**
>
> A motor vehicle that is propelled by a diesel engine and that has a manufacturer's gross vehicle mass of more than 4.5 tonnes must be fitted with:
>
> (a) in the case of a motor vehicle for which, as at the date of its manufacture, an Australian Design Rule prescribed requirements with respect to the exhaust pipe to be fitted to it, a vertical exhaust pipe that complies with those requirements, or
>
> (b) in any other case, an exhaust pipe:
> (i) that terminates 150 millimetres or more above the highest part of the vehicle's cab, and
> (ii) whose exhaust vent is directed upwards (within 30 degrees of the vertical) and away from the nearside of the vehicle.

Clause 12 provides a range of exemptions to clause 11, including for vehicles complying with Australian Design Rule (ADR) 80/01.

Clause 13 allows farmers to apply for exemptions for table top trucks used predominantly to transport hay or other flammable farm produce.

Justification in the RIS

The objective of the vertical exhaust requirement is "to improve dispersion of diesel vehicle exhaust high into the air..."[1] The RIS states that:

> Local impacts from diesel exhaust are intrusive to other road users and the community generally. The impacts include health concerns, odours, visual impacts and soiling. Whereas

[1] Regulatory Impact Statement, Proposed Protection of the Environment Operations (Clean Air—Motor Vehicles and Motor Vehicle Fuels) Regulation 2002, NSW Environment Protection Authority (herafter "RIS"), 3.3, p 12

vertical exhausts aid in dispersing exhaust emissions, the position of the exhaust outlet has no effect on regional air quality, as exhaust location does not change pollutant emission rates.[2]

The RIS also states that the following benefits would be anticipated from the provision:

> **Amenity.** The primary benefits of the proposed Regulation are improved dispersion of diesel exhaust emissions. The economic benefits of improved dispersion are not readily quantifiable.
>
> Although the choice of exhaust location does not affect overall pollutant emissions, it can significantly affect local concentrations of pollutants. Use of a vertical exhaust reduces the concentration of exhaust pollutants at breathing level, reducing human exposure to high local concentrations. In addition, there are significant amenity benefits in ensuring that diesel exhaust fumes and smoke from dirty vehicles operating on high-sulphur fuels are directed above and away from pedestrians, cyclists and motorists in urban streets.[3]

Reasons for not extending the exemption to ADR 80/00

The RIS, in addressing whether ADR 80/00 vehicles should be exempt states that:

> Notwithstanding the significant emission reductions expected from ADR 80/00 compliant vehicles, the need to exercise caution in moving away from a vertical exhaust requirement for diesel vehicles above 4.5 tonnes has meant that exemptions are being proposed only for ADR 80/01 compliant vehicles. This is because of:
>
> - **the significant emission reductions expected from ADR 80/01.** Whereas both ADR 80/01 and ADR 80/00 represent a much greater improvement in terms of allowable emissions when compared with standards under previous ADRs, ADR 80/01 is much more stringent. Heavy-duty vehicles complying with ADR 80/00 are required to meet a particle standard (the principal diesel pollutant), which represents a 72% reduction in the particle emission relative to similar vehicles complying with ADR 70/00 (1995/96) standards. For 80/01 the reduction is 94%.
>
> - **greater confidence that emission reductions for ADR 80/01 will be realised.** Achievement of the full benefit of the more stringent diesel vehicle emission standards is dependent on the availability of diesel fuel of an appropriate quality. In particular, diesel with low levels of sulphur is necessary, as high sulfur levels interfere with the efficient operation of emission control technology.
>
>   Diesel fuel with 350 ppm of sulfur is specified for vehicles complying with ADR 80/00. However, in Australia only diesel fuel with 500 ppm of sulfur will be available when these vehicles commence entry to the market in 2002–03. Whereas it is not clear that 500 ppm sulfur diesel will compromise the emissions performance of ADR 80/00 vehicles, a more favourable situation exists for ADR 80/01 vehicles whereby the specified 50 ppm-sulfur diesel will be available on their entry to the market in 2006–07. There is a need for a high degree of confidence that the forecast emission reductions upon which an exemption is based will be achieved. The availability of 50 ppm-diesel fuel from the time these vehicles enter the Australian fleet means that circumstances are optimal for realisation of these benefits.[4]

---

[2] RIS 3.3, p 12
[3] RIS 3.3, p 15
[4] RIS 3.3, p 13

Effects of fuel quality

The RIS notes that (at 3.3):

> The current vertical exhaust requirement ... was introduced in 1976. At that time and up until recently (1996) no emission standards – apart from smoke limits – applied to diesel vehicles. As well, diesel vehicles used fuel with a very high sulfur content, which contributed significantly to high emissions of particles, oxides of nitrogen and smoke. (In 1980 the national average level of sulfur in diesel was over 2500 ppm; in 2000 it was around 1300 ppm.) Under these circumstances the use of vertical exhausts played an important role in improving amenity for pedestrians, cyclists and motorists in urban streets by directing emissions higher into the air.[5]

From December 2002, the sulphur content of road transport diesel fuel in Australia must be no more than 500 ppm and by 2006 the maximum will be reduced to 50 ppm.

In a letter to the Committee, Bill Frilay of BP Australia Ltd said that BP's Bulwer (Brisbane) refinery was already capable of producing 50 ppm Ultra Low Sulphur Diesel (ULSD) but, because ULSD costs more to produce, there has been very little take up of the product in the market. The letter also said that the Federal Government has undertaken to introduce an excise incentive to encourage the early production of ULSD. If such an incentive were introduced, BP expects that about 40% of its Bulwer production would be ULSD in 2003, rising to 100% in 2004, and its WA refinery would commence ULSD production in early 2003. While not able to speak for other companies, BP also believed that at least two other refiners were reasonably well advance in their capacity to produce ULSD.[6]

Submissions on the Draft Regulation and Regulatory Impact Statement

The Environment Protection Authority forwarded to the Committee 28 submissions it received during consultations on the draft regulation and regulatory impact statement. Of these, nine made mention of the vertical exhaust requirement.

Submissions advocating that ADR 80/00 vehicles be exempt from the requirement included:

- Australian Trucking Association
- Truck Industry Council
- Bus Industry Confederation
- Bus and Coach Association (NSW)

The issues raised in these submissions are raised elsewhere in this report.

The Federal Chamber of Automotive Industries stopped short of expressly requesting exemption for ADR 80/00 compliant vehicles but considered that these issues were best addressed nationally through the Australian Design Rules:

---

[5] RIS 3.3, p 12

[6] Facsimile from Bill Frilay, Manager, Government Relations, BP Australia Limited to the Committee Manager dated 11 November 2002

> FCAI acknowledges the reasoning for exempting diesel vehicles from the vertical exhaust requirements where these vehicles meet the stricter standards of ADR 80/01. And while supporting this development, it must be recognised that a major driver for the adoption of UN ECE regulations is harmonisation as part fo world trade requirements. Maintaining unique requirements (as in this case vertical exhausts within State regulation, for vehicles complying with ADR 80/00) is contrary to these moves. FCAI is of the view that vehicle design requirements are best addressed through the Australian Design Rules made under the Motor Vehicle Standards Act 1989 at the federal level of government and that State regulation should provide the legislative framework to enable in-service enforcement of the ADRs or at least the intent of the ADRs.

The Australian Liquefied Petroleum Gas Association Ltd was the only body to object to any exemption to the vertical exhaust requirement. The Committee noted, however, that the vertical exhaust requirement does not apply to vehicles fueled by liquid petroleum gas and any burden placed exclusively on diesel vehicles could be assumed to assist the sale of LPG.

In its submission to the EPA, NSW Health supported the exemption for ADR 80/01 vehicles but not for ADR 80/00:

> The introduction of ADR80/01 (Euro 4) in NSW, together with the proposed exemption for vertical exhausts on vehicles that meet ADR80/01 is supported by NSW Health. NSW Health would not however support the proposition for an exemption to the vertical exhaust requirement for vehicles that meet the ADR80/00 (Euro 3) standard. A significant number of health studies have shown that health impacts from particulates can be observed even at low ambient levels.

The Total Environment Centre took a similar view:

> It is recognised that compliance with ADR 80/01 (Euro 4) standards will eliminate the need for current vertical exhaust requirements for vehicles ... over 4.5 tonnes. While significant emission reductions are also like from ADR 80/0[0] (Euro 3) compliant vehicles, TEC agrees that caution should be exercised and no exemption applied. Providing the exemption only for vehicles that comply with the more stringent ADR 80/01 emission standard will also provide an incentive for heavy vehicle users to purchase the cleanest and most modern heavy vehicles available.

In a very brief submission, the NRMA expressed support for the Regulation. The Committee's secretariat contacted the NRMA's Senior Environmental Specialist, Mr Jack Haley, who indicated that that support included limiting the vertical exhaust exemption to ADR 80/01 compliant vehicles. Mr Haley expressed the concern that the emission quality of ADR 80/00 vehicles may deteriorate significantly over time and that any fuel efficiency loss from fitting a vertical exhaust was not likely to be statistically significant.

Impacts of Exhaust Location

Dispersion

Vertical exhausts do not reduce the amount of pollutants being emitted but they do assist in the dispersal of exhaust fumes. Two American studies in 1986 gave results of increased local concentrations of pollutants in the "breathing zone" of about eight times and three to eight times greater for horizontal exhausts.

Austroads conducted a study in 1993 examining the effects of different exhaust locations in a range of scenarios. Overall, the study found that pollution concentration in the breathing zone from horizontal exhausts on the left hand side of the vehicle was 12 times worse than vertical exhausts, while horizontal exhausts on the right side of the vehicle were around 2 times that for vertical exhausts and rear exhausts 3½ times. The study found for speeds above 45 km/h, top discharge offered little benefit compared to alternative low level outlets with the rear case being only about 1.7 times worse.

NSW Health noted that emission dispersal was not only relevant for pedestrians and cyclists but could have the most significant effect on those who worked and lived near busy roads because of the prolonged exposure times. Dr Corbett from NSW Health said in evidence:

> I think even at [ADR 80/01 vehicle emission] levels there may be some concerns about pollution exposures for people living adjacent to roadways... A lot of the work that has been done in this area is on the assumption of a receptor on the roadway who is inhaling this as a passing phenomenon, but in Sydney, in a rapidly growing city, we are seeing increasing numbers of people living close to major roadways. Some of these pollution levels are not transient. We do see a rapid decline in high levels of pollution adjacent to roadways, probably about 50 metres is the distance. Some estimates put that there is a significant proportion of people in a city like Sydney, and an increasing proportion, who are living close to roadways. We cannot assume that this needs to be judged on what is the effect on the pedestrian waiting at the pedestrian crossing as the truck goes past. There are other issues here. It has been brought higher, in our estimation, by our involvement with some of these major transport developments in Sydney.[7]

The Committee was not made aware of any studies showing the relationship between the pollution exposure between those in the more general vicinity of roads and horizontal versus vertical exhausts. The Austroads study only measured exhaust concentrations 1.5 m above the ground and 2.5 m from the side of the subject vehicle. The study reports that the integration period for the emissions ranged up to 2 to 3 minutes, with exhaust concentration decay rates varying with test conditions and being quite rapid at high vehicle speeds, ie, 45 km/h. It is difficult to extrapolate from this to determine the different effects of horizontal and vertical exhausts on roadside houses and businesses. While it would seem reasonable to assume that vertical exhausts would tend to result in greater dispersal upwards than horizontal exhausts, the Committee has received no evidence to indicate if this has a significant effect away from the immediate roadside.

Health

There are vast amounts of evidence that vehicle emissions, and particularly diesel vehicle emissions, can cause severe health effects and that these effects are increased with increased exposure.

Dr Corbett from NSW Health informed the Committee that:

[7] Transcript of Committee Hearing of 31 October 2002 (hereafter, "Transcript), p 21

> The documented effects of motor vehicle emissions on health are increased death rates from heart disease and lung disease, especially lung cancer, increased admissions to hospital for heart and lung diseases, and increased rates of asthma attacks, days off work and respiratory complaints in the general population. I would like you to note that that is a mixture of acute effects that happen immediately after or soon after exposure and long term health effects, such as lung cancer which results from months and years, a life time of exposure to pollutants. That is an important issue which we might come back to. Numerous studies, including those undertaken in Sydney, have noted a dose and response relationship between fine particle pollution and many of these health outcomes. That is, quite simply, the more you are exposed to, the greater the risk.[8]

The established fact of the adverse effects of diesel exhaust does not of itself justify the vertical exhaust requirement. Vertical exhausts do not decrease the ambient levels of air pollution. To the contrary, evidence given to the Committee indicated that converting vehicles designed for horizontal exhausts reduces engine performance resulting in greater total emissions. Whether this efficiency effect is in any way significant is discussed below. The only positive effect of vertical exhausts is increased dispersion of emissions leading to reduced localised concentrations.

The 1993 Austroads study appears to be the best evidence available on the connection between the dispersal effects of vertical versus horizontal exhausts and impacts on health. In relation to the health risks from horizontal exhausts, the study concluded):

> The significance of these near field receptor exposures in terms of the increased risk of lung cancer was estimated for some arbitrary exposure histories and found to be small. This is illustrated by a scenario in which a subject on a footpath is exposed to 24 bus by-passes at 5 km/h and full load with close side discharge and shop front awnings over 5 days per week for one year. For that subject, his increased risk of lung cancer incidence was found to be 0.2% which is about 0.4 times the risk he experiences from background diesel exhaust particulate levels in Sydney.
>
> It is concluded that increased visible and odorous emissions at ground level would not be accepted by the general public if they were subjected to peak exposure events which they found to be unpleasant. The implication of this are that the incremental change in health risks that would follow from relocation of exhausts to a low level may be acceptable, but the perceived damage relating to peak short term exposures would be difficult to accept.[9]

Extrapolating from the figures in the study (see Appendix C), if the buses in the above "worse case" scenario had a vertical exhaust, the exposure would be 0.026 times as much as the worse case (giving a risk factor of 0.005%). With a bus with a right side horizontal exhaust, the exposure would be 0.007 times as much (giving a risk factor of 0.0014%). (Presumably due to the lack of turbulence to draw the exhaust back, right side exhaust performed better than vertical exhausts in the test at low speeds. At full power at 45 km/h, a right side exhaust bus would result in 0.066 times the worse case exposure.)

---

[8] Transcript, p 18

[9] Austroads *Review of Vertical Exhausts*, AP-105/93, 1993 (hereafter "Austroads"), pp 34-5

The percentage of increased risk quoted is not a measure of the risk itself but the proportion of change in the risk. Extrapolating from figures given in the report,[10] an increase risk of 0.2% would diminish the probability of a 40 year old white US male surviving to age 65 by around 1 in 25,000. The 0.2% figure compares with a male aged 40 to 65 who has been smoking for 20 to 30 years for whom the risk of lung cancer is increased by 1,000 to 2,000%, ie, his probability of surviving to 65 diminishes by about 1 to 2 in 5.

It should be noted that these conclusions were drawn in 1993, before the introduction of emission standards for diesel engines or the introduction of low sulphur fuel. It could therefore be assumed that the health impacts of an ADR 80/00 vehicle using fuel in 1993 would be greatly less than that indicated by the study. According to calculations in 1996 by MAN Automotive Australia,[11] the emissions of a Euro 3 (ie, ADR 80/00) vehicle would be around a fifth that of pre ADR 70 vehicles (ie, 18% of pre 1995 CO levels, 25% hydrocarbon levels, 35% NOx levels, and 14% particulate levels).

It is also important to note that in the comparisons above, all vehicles in each scenario have the same type of exhaust outlet. ADR 80/00 vehicles manufactured with horizontal exhaust will make up only a small fraction of the heavy vehicle fleet. According to figures in the RIS, the total number of new or imported vehicles manufactured with horizontal exhausts likely to be sold between 2002 and 2007 is 9,240. The heavy total heavy vehicle fleet at 31 December 2001 was 92,279 vehicles. Based on the EPA's RIS predictions, the proportion of ADR 80/00 vehicles in the fleet will peak around 10% in 2006.[12]

It should also be noted that the only health risk considered in the above conclusion is lung cancer that is only one of a number of health risks associated with exhaust pollutant inhalation. When asked whether it was possible to extrapolate the Austroads study's results across other health effects, Dr Corbett replied:

> ...most health effects, in the field of air pollution research, or any pollution research, effects are related to dose and response manner - the more exposure, the higher the outcome. We also know that with air pollutants, the same air pollutants, perhaps not exactly the same, but particle pollutants are associated with a number of outcomes, with lung cancer, with heart disease, asthma and other health problems, and they are also likely to be related to air pollution in the same dose response relationship, that is the higher the exposure, the greater the effect. There may be some mathematical differences between the magnitude of that relationship. We are not just concerned about lung cancer here, but lung cancer has been an important benchmark, I think, because the thing about lung cancer is it is much more related to chronic long-term

[10] Austroads, p 8

[11] Quoted in MVEC Strategic Plan extract attached to Truck Industry Council's Submission to the Review of the NSW Clean Air (Motor Vehicles and Motor Vehicle Fuels) Regulations 1997, submitted to the EPA on 17 January 2002

[12] The RIS estimates for future new vehicles were extrapolated from vehicles sold by year of manufacture. As the figures were taken from 31 December 2001, the figure for 2001 was a poor predictor of future new vehicles as it excluded vehicles that were manufactured in 2001 but would be registered in 2002. Examination of the total new vehicles registered from 2000 to September 2002 would suggest that the RIS projections underestimated the total number of heavy vehicles to be sold over the next four years by around 12%.

lifetime exposure. That is what is relevant in terms of lung cancer risk, rather than what you get today or the next day; it is an accumulated risk over a lifetime.[13]

The evidence from the Austroads study combined with the improved emissions from ADR 80/00 vehicles using less than 500 ppm sulphur fuel leads to the conclusion that right side horizontal exhausts on such vehicles would provide a negligible increased health risk compared to vertical exhausts. In evaluating the health risks of ADR 80/00 vehicles with horizontal exhausts, the EPA stated in correspondence to the Committee:

> The EPA recognises that given the new emission standards it is appropriate to move to phase out the vertical exhaust requirement in a responsible manner. However, the EPA has needed to exercise caution in determining the appropriate timetable for this phase-out.
>
> Diesel exhaust contains high levels of particulate emissions and oxides of nitrogen. Emerging research is indicating that while new vehicle standards will reduce these emissions, when it comes to particles there may well be an increase in those particles which are suspected of having the greatest impact on health – ie those ulta fine particles below PM2.5 microns in size. Given the findings of current research it is important that there is a precautionary approach to policy making in this area.
>
> It has been a fine balancing act for the EPA. Diesel emissions are projected to fall as new vehicles enter the market and diesel sulfur is reduced. On the other hand the EPA is increasingly aware of the health impacts of fine particles and that the situation on these may worsen in the future. Australia will soon have a national air quality standard for fine particles.
>
> It is also uncertain whether once in-service these vehicles will continue to produce lower emissions. As vehicles age, their emissions are expected to increase - even for well-maintained vehicles with properly functioning emission control systems. The percentage of vehicles that emit higher levels of pollutants increases with vehicle age. Certainly experience to date is that if diesel vehicles are not properly and regularly maintained their emissions quickly increase and often dramatically. This is a significant issue and one that was raised by Australian Liquefied Petroleum Gas Association against exempting any vehicles from vertical exhausts during the consultation period.
>
> In this situation, the EPA has erred on the side of caution in phasing out vertical exhausts – ADR80/01 vehicles will be cleaner than ADR 80/00 and the circumstances for them achieving the predicted emission reductions are better as 50ppm sulfur diesel will be available as they enter the market.[14]

Amenity

The RIS stated that "there are significant amenity benefits in ensuring that diesel exhaust fumes and smoke from dirty vehicles operating on high-sulfur fuels are directed above and away from pedestrians, cyclists and motorists in urban streets."[15]

---

[13] Transcript, p 23

[14] "EPA Responses to Suggested Questions for Hearing on Protection of the Environment Operations (Clean Air) Regulation 2002 Room 1043, 31 October 2002", emailed by Nigel Routh, EPA, to the Committee Manager on 8 November 2002 (hereafter "EPA response to written questions")

[15] RIS 3.3, page 15

In correspondence to the Committee, the EPA stated:

> Vertical exhausts divert diesel exhaust high into the air and away from pedestrians, cyclists and other motorists providing both amenity and health benefits. Vertical exhausts lift and divert the pollution to minimise its impact. Diesel exhaust can be very smoky and contains high levels of particles and oxides of nitrogens, both of which have significant health impacts.
>
> The EPA fully accepts these circumstances are changing and this means a responsible phase out of the vertical exhaust requirement can occur in a staged manner, but that point is not considered to be now.
>
> The EPA receives about 500 complaints from the public each month about smoky vehicles- that's between 23-25 each working day and that's just the people who have the time to pick up the phone and ring us. It will be interesting to see if this changes as ADR80/00 vehicles enter the market. The EPA will be keeping a close eye on any trends in this area. Clearly the community finds visible exhaust emissions to be unacceptable.
>
> Over the last 5 years EPA records show that 91% of all penalty notices issued for smoky vehicles were for diesel vehicles. Last year 2,365 penalty notices were issued for diesel vehicles (of these 65% had vertical exhausts). The proposed phase-out for vertical exhausts has been a fine balancing act that has been mindful of the strong community support for vertical exhausts and the amenity benefit they offer. However over and above this have been concerns regarding the health impacts of diesel exhaust and the need to align the phase-out to those circumstances that allow the EPA to responsibly drop the vertical exhaust requirement.
>
> The EPA has erred on the side of caution in this phase-out– ADR80/01 vehicles will be cleaner than ADR 80/00 and the circumstances for them achieving the predicted emission reductions are better as 50ppm sulfur diesel will be available as they enter the market. The Total Environment Centre and the NRMA supported the planned phase-out in their submissions on the draft Regulation and Regulatory Impact Statement. [16]

It is clear that there is general public objection to smokey vehicles. However, there is no positive correlation between vertical exhausts and the amount of smoke emitted. This is reflected in the fact that nearly all submissions on the proposed regulation expressed support for enforcement of penalties against smoky vehicles (and one industry submission called for greater penalties) while opinions regarding vertical exhausts were mixed.

While left side horizontal exhausts have been shown to increase foot path exposure levels on average by a factor of 12 and in some scenarios may increase levels by a factor of 700,[17] right side or rear horizontal exhausts have been shown on average to increase exposure on average by a factor of 2 and 3.5 times respectively and in some scenarios result in less exposure than vertical exhausts.

---

[16] EPA response to written questions

[17] While the Austroads study results gave a worse case horizontal exhaust exposure 26,600 times worse than the best case vertical exposure, those figures result from a comparison of vehicles in different scenarios, ie a bus with left side horizontal exhaust at full power at 5 km/h by a shop front with awnings compared to a bus with vertical exhaust at cruise power at 5 km/h in an open field. The difference in exposure levels from left side horizontal and vertical exhausts for a bus at full power at 5 km/h by a shop front with awning was a factor of 682, while for a bus at cruise power at 5km/h in an open field it was a factor of 390. See Appendix C.

Impacts of Requiring Exhaust Modifications

Economic costs to industry

Representatives of the transport industry indicated that not exempting ADR 80/00 vehicles would cause significant costs in modification of new vehicles, additional ongoing maintenance, and decreased efficiency. While these costs would apply to all vehicles, it was argued both that some of these costs would be increased for ADR 80/00 vehicles arising from their higher level of engineering and that the higher emission standards of these vehicles mean that these costs are not justified.

Modification costs

The cost of adding a vertical exhaust varies significantly between vehicles. Modification can require differing levels of design and construction work to attach a new exhaust and can sometimes require significant alteration to the body of the vehicle to accommodate the pipe. The estimated cost of fitting a vertical exhaust varied from $500 to over $4,000 for some prime movers.

The EPA's RIS gave an estimated average cost per vehicle of $500 to add a vertical exhaust to a heavy vehicle. When asked how it arrived at that figure, it replied in correspondence to the Committee:

> During the development of the new regulation the EPA wrote to industry in November 2001 seeking technical information on the merits of the new standards against the retention of vertical exhausts for ADR 80/00 vehicles and ADR80/01 vehicles. As part of its response The Truck Industry Council (TIC) stated "Truck Industry Council members advise that the retail cost (to the customer) of providing a vertical exhaust for a rigid truck, which is designed for other markets with horizontal exhaust systems $550 and $750 per vehicle" (18 January 2002). Due to the lack of any detail of industry responses (apart from TIC) the EPA again requested information from all other truck and bus companies and associations in February 2002. No other cost estimates were provided in response. The TIC increased its estimate of costs to $1000 in its August submission to the Regulation review ie after finalisation and release of the Regulatory Impact Statement but during public consultation.
>
> The average $500 installation cost for a vehicle exhaust in the Regulatory Impact Statement approximated information provided by industry at that time and also reflects views of the EPA Motor Vehicle Enforcement Unit staff who are in contact with major truck exhaust repairers through the course of their work.
>
> The Victorian Environment Protection Authority recently advised that vehicle manufacturers have indicated to them that vertical exhausts represent an additional cost to imported vehicles with horizontal exhausts (generally from Europe and Japan) of between $500 and $750 on light to medium trucks.[18]

In correspondence with the Committee,[19] the Truck Industry Council estimated an average cost of fitting a vertical exhaust across all heavy vehicles would be $1,400. The TIC gave three examples:

[18] EPA response to written questions
[19] Facsimile from Terry Pennington, Truck Industry Council, date 24 October 2002

Isuzu light duty	Development	$50
	Components	$480
	Fitting	$50
	Import duty (5%)	$30
	Total ex factory	$609
	Retail	$950
medium duty	Development	$90
	Components	$600
	Fitting	$50
	Import duty (5%)	$40
	Total ex factory	$780
	Retail	$1,300
Scania heavy duty	Development	$250
	Components (incl new muffler)	$3750
	Fitting	$50
	Import duty (5%)	$200
	Total	$4,250

In evidence before the Committee, Michael Apps from the Bus Industry Confederation of Australia estimated a fitting cost for a bus of $2,400:

> ... a vertical exhaust is costing around $2400 to install because there are a range of things [body builders] have to do. Stainless steel pipes are part of it, and I think there is a sense that it is just the pipe, when in fact it has got to be hermetically sealed, it has to be insulated in the back there. There is a seat lost as a result, or it is half a seat, so you lose a seat. So there is productivity costs. On top of that replacement costs for the pipe itself are about $800...[20]

Maintenance costs

Industry representatives also informed the Committee that there were additional maintenance costs with vertical exhausts. Mr Robertson from the Australian Trucking Association told the Committee that:

> The big issue, from an operator's point of view, is the actual maintenance of a vertical exhaust system over a horizontal exhaust system. As you appreciate it gets full of moisture, leaves, all sorts of things from time to time. It is usually the furtherest point of the vehicle, so it will collect trees and things like that that might have come down. They are never above the legal limit but there is a lot of damage incurred at that point. The maintenance of a vertical exhaust is quite horrific.[21]

Michael Apps from the Bus Industry Confederation further said that,

> for example, I was speaking to Shore Link yesterday, a local operator here, they run 78 buses on the North Shore, and they lose a tip, which is the top bit, a week just because of the leafy suburbs, which is $122 per week for one, and it is often more than that. ... The underestimated

[20] Transcript p 9
[21] Transcript p 2

> aspect is the actual reduction in the performance and ultimately the life of the engine, because vertical exhausts do cause a condensation issue which rusts the pipe in itself. If you look at a car in the morning, you will see some moisture come out, which is water. Well, a vertical exhaust in a truck or a bus usually holds that in the bottom bend. That is where you will get your hole, but that also finds itself condensated into the engine, which ultimately reduces its performance and its overall life. Now, valuing that is a difficult exercise but it is actually identified and recognised as a reality...[22]

Efficiency costs

The Committee was informed that installing a vertical exhaust could affect a vehicle's efficiency in three ways: increased exhaust back pressure could reduce fuel efficiency; body modifications could increase air turbulence and drag, and the body modifications could result in a decrease in load carrying capacity.

In material forwarded to the Committee by the Bus Industry Confederation (Appendix D), Fritz Wehrmann, an automotive industry consultant and former Executive Director and Director of Engineering and Product Planning of MAN Automotive Australia and New Zealand, said that:

> According to several European engine and bus manufacturers an increased exhaust system back pressure, after adding the upright extension, will increase the energy consumption by up to 5%. The performance of the vehicle will drop, to compensate for this loss of performance the fuel consumption will increase proportionally. European manufacturers use exhaust gas re-circulation and cooling in order to achieve the NOx emission levels of Euro 3. An increased back pressure or altered exhaust system will interfere with the function of this system (AGR) and apart from the performance and energy consumption effect, the NOx emissions may well raise back to at least Euro 2 levels.[23]

The Truck Industry Council forwarded to the Committee data said to be from testing on a dynamometer by Caterpillar (Appendix E). The test compared the efficiency effect on two engines of changing the muffler from one rated at 25 inches of water backpressure to one rated at 40 inches (an additional 15 inches). Fuel efficiency was affected by a factor of around 1.2% at speed and 0.5% at load. The data sheet stated that, as a general rule of thumb, muffler manufacturers indicate that fuel economy of the truck decreases an average of 0.5% per 13.5 inches of water increase in backpressure. An accompanying note to the Committee stated that in-service testing of various trucks shows up to 3.0 psi (83 inches of water) increase in backpressure depending on the length and type of vertical exhaust fitted. According to the above rule of thumb, a 3.0 psi increase in backpressure would result in a 6% decrease in fuel efficiency.

The fuel efficiency of a vehicle could also be adversely affected by any increase in wind resistance resulting from body modifications. Adding a vertical exhaust often requires a space between the cabin and tray of 30 cm. With some body designs and loads, increasing the gap behind the cabin may increase turbulence. The Committee did not receive any evidence on how significant this effect might be.

---

[22] Michael Apps

[23] Email from Michael Apps to the Committee, 7 November 2002

The space taken by a vertical exhaust can also affect the load carrying capacity of the vehicle. The Committee was informed that this could result in the loss of a seat on the bus or the loss of up to 30 cm on the length of a truck's load carrying area. Shifting the load back could also have an impact on the possible weight distribution between axles, which could potentially affect the legal weight limit of loads. It is difficult to quantify the outcome of such impacts on carrying capacity, given that the extent of any impact would differ from vehicle to vehicle and any reduced load carrying capacity would presumably only be significant when there was the potential for a full load.

Total cost estimates

The Truck Industry Council, in a letter to the Committee (Appendix F), provides costs estimates for the fitting of vertical exhausts and the consequential effects on fuel consumption. Using those figures, figures on truck numbers from the RTA, and other figures from the EPA's RIS, the net present value of not exempting ADR 80/00 vehicles is $31 million. That includes $14 million conversion costs and $17 million fuel costs. The Committee was not provided with estimates of the average maintenance costs of vertical exhausts so these have not been included. The assumptions for these calculations are set out below, together with a table showing the sensitivity of these figures to variations in assumptions regarding conversion costs and reduction in fuel efficiency.

Assumptions:

- New vehicles over 4.5 tonnes GVM in NSW pa – 4000 (RTA indicated that 4,487 new heavy buses, trucks and prime movers were register in 2000, 3,909 in 2001, and 3,034 from 1 January to 1 September 2002)
- 80% of new vehicles require new exhausts (EPA)
- In 2005, 20% of new vehicles will comply with ADR 80/01, 50% in 2006 (EPA)
- Average cost of fitting exhausts $1,400 (TIC)
- Distance per vehicle per annum – 80,000 km (TIC)
- Average fuel consumption 5km/L (TIC)
- Average diesel cost 85 cents/L (TIC)
- Increase fuel consumption from modifications 5% (TIC)
- Discount rate for calculation of net present value (NPV) 7%

Average vehicle conversion cost	NPV of total conversion costs
$500	$4.9 million
$1,400	$13.6 million

Fuel efficiency reduction	NPV of increased fuel costs
1%	$3.5 million
5%	$17.4 million

It may be concluded that, at the most conservative estimate, not exempting ADR 80/00 vehicles from the vertical exhaust requirement will have at least a $5 million cost to the transport industry and, according to data supplied by industry groups, the cost could be $31 million plus maintenance costs.

Environmental impact

Data provided to the Committee suggested that modifying ADR 80/00 vehicles to fit a vertical exhaust may decrease fuel efficiency in those vehicles by up to 5%. Any decrease in fuel efficiency will have a corresponding increase in fuel consumption and increase in the amount of exhaust emitted into the atmosphere. In addition, Fritz Wehrmann claimed that the increased backpressure from a vertical exhaust interferes with the emission control systems on Euro 3 (ie, ADR 80/00) vehicles resulting in higher concentration of pollutants in the exhaust.

The Committee has received insufficient information to estimate the actual average effect on fuel efficiency under working conditions. However, any increase in ambient air pollution levels could have adverse effects on health and the environment. Using the above assumptions on vehicles numbers, distance travelled and fuel consumption, a 1% loss in fuel efficiency from not exempting ADR 80/00 vehicles would result in an additional 23,296,000 litres of diesel being used over the next four years and a 5% efficiency loss would result in an extra 116,480,000 litres.

Obstacle to use of "maxivans"

The Australian Trucking Association raised with the Committee the use of vans up to eight tonnes currently produced in Europe and in use in Adelaide. These vans are said to have significant benefits in fuel efficiency, safety and driver comfort. Because of the van design, it is said to be not practical to fit vertical exhausts on these vehicles and consequently the vertical exhaust requirement is an obstacle to these vans being used.

In correspondence with the Committee, [24] the EPA indicated that exemption could be sought for such vehicles under clause 12(2)(h) of the Regulation. It further stated that "the retention of Clause 12(2)(h) reflects the need for a provision in the Regulation for the exercise of flexibility on the vertical exhaust requirement where a strong case for doing so is established."

Clause 12(2)(h) provides an exemption for "a motor vehicle having a diesel engine of a type certified in writing by the EPA as not requiring an exhaust pipe of the kind referred to in clause 11". The Committee notes that this allows for exemptions for engine types rather than for vehicle types. If this posed any problem to exempting these vehicles and these vehicles were not otherwise exempt, the Committee considers that the Regulation should be amended to accommodate the exemption of vehicle types.

Incentives to upgrade

One of the significant factors in diesel emission levels in NSW is the age of the heavy vehicle fleet. Vehicles prior to 1996 had no emission standards and the

[24] EPA response to written questions

subsequent 2002/03 (ADR 80/00) and 2006/07 standard (ADR 80/01) each require significantly cleaner emissions. Regardless of design standard, emission levels of vehicles also increase with age. According to the figures in the RIS, 73% of the heavy vehicle fleet in NSW was manufactured before 1996.

The Total Environment Centre argued that only ADR 80/01 vehicles should be offered an exemption to the vertical exhaust requirement as an incentive to purchase only the cleanest vehicles available. In contrast, industry representatives argued that the exemption be extended to ADR 80/00 vehicles to reduce the cost of upgrading.

The Committee did not take evidence on the possible effects on truck owners' behaviour of exemption on either ADR 80/01 or ADR 80/00 vehicles. It is therefore unable to give a comparison of the merits of these two arguments. It notes, however, that any upgrading of the fleet is likely to have significantly greater health and environmental benefits than exhaust position.

Conclusion

The benefits of the requirement of vertical exhausts for ADR 80/00 trucks and buses is that the emissions of these vehicles will be dispersed more quickly so will not have as great an impact on people within the immediate vicinity of the vehicle. The extent of this impact is unclear, although the Austroads report, which appears to be the most recent study on the effects of vertical exhausts, indicates that the health effects are relatively small even for its "worse case" scenario. It would appear from the results of that study, combined with the great emission standards of ADR 80/00 vehicles and the cleaner diesel mandated from December 2002, that the adverse health effects of right side horizontal exhausts compared with vertical exhausts must be approaching negligible. The Austroads study also indicates that, compared with a vertical exhaust a right side horizontal exhaust results on average in twice the exhaust exposure for a person on the footpath from a passing vehicle and, in the case of a rear horizontal exhaust, 3.5 times the exposure. In comparison, a pre-1996 truck in new condition would have around 5 times the content of offensive particles in its exhaust than an ADR 80/00 truck.

The cost of not exempting ADR 80/00 vehicles is at the very least an additional $5 million cost to the NSW transport industry, and more likely a cost in the order of $31 million. In addition, it is possible that up to an additional 116,480,000 litres of diesel will be converted to exhaust gases to contribute to ambient air pollution over the next four years.

A major factor in the justification for the requirement is the need for abundant caution due to the possible health impacts on people spending extended periods of time in the immediate vicinity of major roads. Although diesel exhausts pose significant known and possible health risks, the effectiveness of vertical exhausts in reducing those risks reduces from little to marginal as emission standards improve. No effects have been demonstrated on local pollution concentrations and consequent health risks away from the immediate roadside. Given that the effect at the footpath now

appears to be marginal, it is questionable whether there would be any measurable impact at all, particularly when the number of ADR 80/00 vehicles in Australia will never peak at around 10% of the heavy vehicle fleet. It is, however, not possible to draw definitive conclusions on this from the available data.

On the question of the effectiveness of vertical exhausts to improve health outcomes, it is notable that the EPA is not aware of any other jurisdiction in the developed world besides Victoria that has required the use of vertical exhausts.

In light of the remaining uncertainty regarding the health benefits of vertical exhausts, a significant factor in the EPA deferring the phase out of the vertical exhaust requirement appears to be to delay it until the compulsory introduction of ultra low sulphur diesel (ULSD), which will be mandated nationally from 2006. As noted above, it is possible that a Federal Government incentive could result in an earlier take up of ULSD from 2003.

It appears to the Committee that instead of mandating vertical exhausts for ADR 80/00 compliant vehicles, a requirement for ADR 80/00 vehicles to have an exhaust that vented away from the left side of the vehicle would have at most marginal adverse effects on health and amenity but would save significant costs to industry and have a positive, although unquantified, effect on fuel efficiency and ambient pollution levels. The requirement for vehicles over 4.5 tonnes GVM to have an exhaust which vents to the rear or right of the vehicle already exists under the national road vehicle standards and is in force in NSW under clause 155 of Schedule 4 of the Road Transport (Vehicle Registration) Regulation 1998.

Recommendations

The Committee recommends that the Minister:

1. Urgently re-examine the option of immediately exempting ADR 80/00 vehicles from the requirement for vertical exhausts under the Protection of the Environment Operations (Clean Air) Regulation 2002; and

2. If the Federal Government introduces an incentive for ultra low sulphur diesel prior to 2006, that ADR 80/00 vehicles be exempted from the vertical exhaust requirement from that time if they have not already been exempted.

Appendix A: Summary of EPA Transport Industry Consultation

Summary of consultation with truck and bus companies and associations[25]		
Date	**Purpose**	**Who consulted**
Oct 2001	Meeting with EPA discussing future vertical exhaust requirements	Truck Industry Council
Nov 2001	Letters from EPA requesting technical information on the merits of the new standards (ADR 80/00 and ADR80/01) as against those of continuing with a vertical exhaust provision.	Federal Chamber of Automotive Industries, Truck Industry Council, NSW Road Transport Association, Australian Trucking Association, Bus Industry Confederation and Bus and Coach Association Truck Industry Council
Feb 2002	Telephone call to TIC seeking clarification of their response to November EPA letter. Second letters to industry due to lack of detail in responses to November EPA letter.	NSW Road Transport Association, Australian Trucking Association, Bus Industry Confederation and Bus and Coach Association
July	Newspaper advertisements placed in the Sydney Morning Herald and the Daily Telegraph	Industry and wider community
July	Email summarising proposed regulation and rationale for proposed vertical exhaust exemption (provided contact details for meetings with EPA officers).	Peak industry organizations (ie the Peak Industry, Local Government meeting, which are held Quarterly with the EPA.
July	Release of draft Regulation and Regulatory Impact Statement (RIS). Copies of draft Regulation and RIS together with summary of proposed changes sent by mail.	Federal Chamber of Automotive Industries, Truck Industry Council, NSW Road Transport Association, Australian Trucking Association, Bus Industry Confederation and Bus and Coach Association Truck Industry Council, and vehicle manufactures/importers, and peak industry organisations together with additional stakeholders listed in the attached table.
July	Meetings were arranged to discuss proposed Regulation including proposed exemption for ADR80/01 vehicles. Tele-conferences were arranged for participants who could not attend these meetings.	Federal Chamber of Automotive Industries, Truck Industry Council, NSW Road Transport Association, Australian Trucking Association, Bus Industry Confederation, Bus and Coach Association, Truck Industry Council, vehicle manufactures/importers.
July/August	Summary of the proposed Regulation, together with draft Regulation and Regulatory Impact Statement provided on the EPA web site	Industry and wider community

[25] Emailed by Nigel Routh, EPA, to the Committee Manager on 8 November 2002

Appendix B: Witnesses to Committee Hearing of 31 October 2002

Industry representatives

Michael APPS	Executive Director, Bus Industry Confederation of Australia
Terence PENNINGTON	Chief Executive Officer, Truck Industry Council
Denis ROBERTSON	Managing Director, Road Master Haulage and Down Under Tours Australia, Director, Australian Trucking Association
Martin IFFLAND	Executive Director, New South Wales Road Transport Association
Neil GOW	Manager Government Relations, Australian Trucking Association

Environment Protection Authority and NSW Health officials

Christopher EISER	Director, Atmospheric Science, New South Wales Environment Protection Authority
Nigel ROUTH	Director Air Policy, New South Wales Environment Protection Authority
Stephen CORBETT	Acting Director, Health Protection Branch, New South Wales Health Department

Appendix C: Extracts from Austroads *Review of Vertical Exhaust*

Table 9 from the report, extracted below, is the raw test data for the different scenarios modelled. The figures given measure arbitrary units of undiluted exhaust x time where one unit of receptor exposure equals to the best case exposure.

Table 11 below shows the ration of receptor exposure for new exhaust discharge point compared to top emission, averaged over all speed-load conditions for each vehicle.

The vehicle-roadside geometry combinations are identified by the following codes:

O BUS = open field – bus
A BUS = shop with awnings – bus
O ART = open field – articulated vehicle
A PUD = shop front with awnings – pick-up delivery vehicle.

TABLE 9:

RANKED RECEPTOR EXPOSURE. ALL TESTS LISTED SEPARATELY

	Speed (kph)		Exposure for Discharge Point:			
Streetscape Vehicle	**Cruise Power**	**Full Power**	**Top**	**Rear**	**Far Side**	**Close Side**
(WORST)						
A BUS		5				26600
O ART		5		23200		
O BUS		5				20300
A BUS		45				17100
A PUD		5				15500
O ART	5					8800
A PUD		15				8100
O ART		15				6600
O BUS		45			4100	
A BUS	45					3900
O BUS		45		3400		
O BUS	15			3300		
A BUS	5					3200
A PUD	5					2800
O ART		45				2800
O ART		15		2750		
A PUD		45				2550
O BUS	15				2450	
A BUS		45		2240		
O ART	15					2140
O BUS		45				2130
O ART		45			2130	

Streetscape Vehicle	Cruise Power	Full Power	Top	Rear	Far Side	Close Side
O BUS	15					2120
O ART		45		2100		
O BUS	45			2030		
O ART		5				2020
O ART		45	1950			
A BUS		15		1940		
O ART	15		1920			
O BUS		15		1900		
O ART	5			1790		
A PUD	15					1790
A BUS		45			1760	
O BUS	15		1750			
O BUS		15				1720
O ART	15				1670	
O ART	15			1600		
A BUS	15					1460
A BUS		45	1400			
O BUS		45			1370	
A PUD	5				1360	
A BUS	45			1350		
A BUS	5			1350		
O BUS		15			1340	
A BUS	45		1320			
O BUS		45	1300			
O ART	45			1260		
O ART	45		1260			
A PUD	15				1240	
A BUS		15			1110	
O ART	45				1100	
A PUD	15			1080		
A BUS	45				1070	1040
A BUS		15				
A PUD	5			1020		1010
O ART	45					
A BUS	15			1000		
O ART		15			910	
A BUS	5				850	
A PUD	45			850		
O ART	5				810	
A BUS	15				750	
A BUS		5		690		
A PUD		45			590	580
A PUD	45					
A PUD		45		580		
A PUD	15		490			

Streetscape Vehicle	Cruise Power	Full Power	Top	Rear	Far Side	Close Side
A PUD		45			490	
A PUD	45		490			
O BUS	5			470		
A PUD		45	450			
A BUS	15		440			
O BUS	45		430			
O BUS	5				420	390
O BUS	5					360
O BUS	45					
O BUS	15		340			
A PUD		15		270		
O ART	5		240			
A PUD		15			220	
A BUS		5			190	
O ART		15	180			
O BUS		5		160		
A PUD		5		140		
A PUD	5		130			
O ART		5			120	
O BUS		5			110	
O BUS		5	75			
A BUS		15	70			
A PUD		5			50	
O ART		5	40			
A BUS		5	39			
A BUS	5		33			
A PUD		5	2			
A PUD		15	1			
O BUS (BEST)	5		1			

TABLE 11:

RATIO OF RECEPTOR EXPOSURE FOR NEW EXHAUST DISCHARGE POINT COMPARED TO TOP EMISSION. AVERAGED OVER ALL SPEED-LOAD CONDITIONS FOR EACH VEHICLE TYPE

Streetscape, Vehicle	Receptor Exposure Ratio for New Discharge Point at:			
	Top	Close Side	Far Side	Rear
A BUS	1	16	1.7	2.6
A PUD	1	20	2.5	2.5
O BUS	1	6.9	2.5	2.9
O ART	1	4.2	1.2	5.9
AVERAGE	1	12	2	3.5

Note: The average ratio data presented here is unweighted in terms of the absolute mass emission rate for each vehicle. The ratios therefore differ from the results of text samples where individual estimates were developed from Table 10 data.

Appendix D: Note on Vertical Exhausts

Michael Apps of the Bus Industry Confederation forwarded the following note on 8 November 2002 from Fritz Wehrmann, an automotive industry consultant and former Executive Director and Director of Engineering and Product Planning of MAN Automotive Australia and New Zealand:

Vertical Exhausts

Preamble:

A vertical exhaust on buses does not reduce emissions or visible smoke

The following analyses confirms the above and demonstrates that the exhaust emission will increase.

Data:

- Bus with Euro 3 engine, approx. 200 kW
- Exhaust system, standard horizontal outlet position
- Upright exhaust pipe with 2 x 90 degree bends plus add. 3 meter in length
- Exhaust system back pressure, standard outlet, 600 mm (max to address exhaust noise for Euro 3 engines)
- Average fuel consumption with standard exhaust approx. 40 ltr / 100 km
- Average power requirement @ 14 – 16 tonnes GVM = 150 kW

According to several European engine and bus manufacturers an increased exhaust system back pressure, after adding the upright extension, will increase the energy consumption by up to 5%.
The performance of the vehicle will drop, to compensate for this loss of performance the fuel consumption will increase proportionally.
European manufacturers use exhaust gas re-circulation and cooling in order to achieve the NOx emission levels of Euro 3.
An increased back pressure or altered exhaust system will interfere with the function of this system (AGR) and apart from the performance and energy consumption effect, the NOx emissions may well raise back to at least Euro 2 levels.

The reduction of particulate emissions from Euro 1 to Euro 2 and Euro 2 to Euro result to 50% from the fuel with lower sulpher content and the remaining 50% as result of the engine technology (injection and combustion process). These results are supported by actual measurements taken during the EEC Auto Oil Program.
This means that an Euro 3 engine in comparison to an Euro 2 (bus standard for some years), emits 22 – 28% less particulates operating on the same fuel quality.
This is based on the reduction of permissable particulates

From 0.36 = Euro 1
To 0.15 = Euro 2
To 0.10 = Euro 3

All Euro 3 complying engines have a boost pressure control, therefore the puff of black smoke, as permissable with some Euro 1 complying engine does not occur any longer.
The effect of the upright exhaust system is negative in regard to particulate emission and even more though in the greenhouse gas emissions.

Example
The average engine performance is 150 kW
The maximum particulate emission with a standard exhaust system is 0.10 g/kWh (based on Euro 3 with 300 ppm sulpher fuel). Due to the higher back pressure this increases to 0.11 g/kWh @ 150kW = 16.50 g/hr and over a 15 hr shift = 247.50 gr.
With the standard exhaust system, over 15 hours shift = 225.00 gr.
A difference of 22.5 gr per bus per day.
Average annual new buses into service = 800 – 1000 units.

The Co2 (green house gas) shows as follows:
- Average consumption = 40 ltr / 100 km
- Daily consumption approx. 120 ltr
- Daily consumption increase due to higher back pressure to 126 ltr.
- Average C02 emission = 2.6 kg per 1 ltr. diesel fuel
- Increase (6 x 2.6) 15.6 kg per bus per day
- At 280 operating day per year an increase of 3900 kg per bus
- At 800 new buses per year = 3.120000 kg per year.

This increase can be easily avoided by maintaining a standard, internationally acceptable, horizontal exhaust outlet.

I hope this is of some help.
Fritz Wehrmann

Appendix E: Extract from Truck Industry Council "Truck Engine Data Sheet"

GENERAL REQUIREMENTS

In order for an engine to produce its rated horsepower, attention should be given to exhaust gas flow restriction. Stringent legislation requirements on vehicle noise limits may require more restrictive exhaust systems.

- When checked by Caterpillar's recommended method, the exhaust backpressure must not exceed the limit given on the Truck Engine Data Sheet.
- The exhaust piping must allow for movement and thermal expansion so that undue stresses are not imposed on the turbocharger structure or exhaust manifold.
- *Never allow the turbocharger to support* more *than 201b-ft (27Nm)*

MUFFLER SECTION

The muffler or silencer is generally the single element making the largest contribution to exhaust backpressure. The factors that govern the selection of a silencer include: available space, cost, sound attenuation required, allowable backpressure, exhaust flow, and appearance. Silencer design is a highly specialised art. The silencer manufacturer must be given responsibility for the details of construction. For exhaust gas flow and temperatures, see the *Truck Engine Data Sheets.*

EXHAUST BACKPRESSURE

Backpressure has an effect on the response of an engine to load changes, exhaust temperatures, and fuel consumption. Exhaust systems should be designed for about 25in. of water to provide the best compromise between noise and backpressure. Sometimes the vehicle requirements may cause the designer to exceed 25in. of water. Caterpillar Engines are certified for smoke and gaseous emissions under Federal, California and other agency regulations with backpressure up to the values listed in the *Truck Engine Data Sheets.*

- Exhaust stack temperatures increase about 1.5°F for every 1in. of water backpressure.
- The following example shows engine performance changes from a muffler rated at 25in. of water at rated engine speed and load to one at 40in. of water at rated speed and load:

Engine 1

- 2100 rpm 425 hp
  5.0 hp decrease
  1.2% fuel consumption increase

- 1500 rpm 390 hp
  2.1hp decrease
  0.5% fuel consumption increase

Engine 2

- 1800 rpm 310 hp
  3.6 hp decrease
  1.1% fuel consumption increase

- 1500 rpm 295 hp
  2.0 hp decrease
  0.6% fuel consumption increase

As a general rule of thumb, muffler manufacturers indicate that fuel economy of the truck decreases an average of 0.5% per 13.5 in. of water increase in backpressure.

Note:
1.0 psi = 27.68 in. of water. Thus a 3.0 psi increase in backpressure is a 3.0% increase in fuel consumption.

Appendix F: Truck Industry Council
Calculation of Vertical Exhaust Costs

The following is an extract from a facsimile sent to the Committee by Terry Pennington of the Truck Industry Council on 14 October 2002.

As engines become cleaner (lower emissions) and more efficient the exhaust system plays a more important role It is no longer required to simply quieten the vehicle and provide a path for exhaust gases.

Back pressure in the exhaust system is calibrated at set levels depending on engine operating parameters. Under light throttle settings such as cruise or downhill running, a small amount of burnt gas from the exhaust comes back into the combustion chamber. Partially filling the cylinder with inert gas. The engine computer then reduces the amount of fuel required, thereby reducing the emissions. Put simply, this process effectively reduces the capacity of the engine when high power levels are not required And consequently reduces both emission levels and fuel consumption. This is the major environmental reason why modification to the exhaust by fitting vertical exhausts, is not a sound practice.

As previously advised, a fuel consumption penalty of up to 5% can result by fitting a vertical exhaust, and increased drag, the 5% becomes a conservative figure.
With respect to fuel consumption, and associated costs, a number of assumptions must be made, including

- The weight of the load being carried
- Road conditions. ie highway, suburban or urban
- Traffic conditions, particularly in suburban and urban areas

Fuel consumption for trucks above 4.5 tonnes GVM varies from 8Km/litre to 2Km/litre. The typical 10 tonne truck in the city will average about 90.000 Kms per year, whilst large prime movers in the B double application at a GVM of 60 tonnes will average 2Km/litre on the highway and travel up to 300,000 Km a year. Some examples are as follows:

Company A — Wollongong – 9 trucks, primarily general cargo, one cement truck, two tippers. Total distance travelled is approximately 800,000 Kms, mostly suburban style work. Total fuel used = 160,000 litres. An increase of 5% would result in a further 8,000 litres of fuel being used. Assume the diesel fuel rebate is available the additional cost is $6,500.

Company B — Sutherland – 11 trucks up to 2.5 tonnes GVM, general purpose cargo, mainly delivering in the local area Total distance 1,200,000 Km pa. Fuel used 300,000 litres. A 5% increase would result in a further 15,000 litres being used. Two vehicles are below 20 tonnes GVM, and therefore not eligible for the diesel rebate. Additional cost estimated to be $12,600.

Some 22,000 new vehicles are sold annually, last year 36% were registered in NSW. This year, up to 1 October, 6143 new trucks have been registered in NSW. If we assume that the average fuel consumption is 5Km/litre (very generous) and the average distance travelled is 801000 Km pa, the 5% increase in fuel consumption is as follows:

80,000 Km x 6143 = 491,440,000

Assume average diesel price is 85 cents/litre, after the diesel rebate, the total cost is $19 Mill pa.

Add to this the cost of $1 ,400 per vehicle to fit the vertical exhaust =

$1400 x 6143 = $8.6 Mill

The sub total is	$19.0 Mill –fuel
	$8.6 Mill -equipment
Total for 9 months sales	$27.6

The $1400 is an average cost. the following assumptions apply'

- Some heavy prime movers of Nor1h American origin are fitted with ver1ical exhausts by design, where space permits. Those vehicles have been excluded.
- All imported European vehicles are fitted with underslung exhausts, to change to vertical exhausts varies from $850 for a small rigid truck to over $3,000 for a large prime mover.
- In many instances, part or all of the existing exhaust system is discarded as rubbish, resulting in many tonnes of unnecessary fill.
- In addition to the costs of fitting vertical exhausts, must be added the increase in fuel consumption which has a negative impact on the environment, and is a waste of non-renewal resource.